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Digital marketing: A framework, review and research agenda

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ABSTRACT

We develop and describe a framework for research in digital marketing that highlights the touchpoints in the marketing process as well as in the marketing strategy process where digital technologies are having and will have a significant impact. Using the framework we organize the developments and extant research around the elements and touchpoints comprising the framework and review the research literature in the broadly defined digital marketing space. We outline the evolving issues in and around the touchpoints and associated questions for future research. Finally, we integrate these identified questions and set a research agenda for future research in digital marketing to examine the issues from the perspective of the firm.

1. Introduction

It has been nearly a quarter century since commercial use of the Internet and the World Wide Web began. During this time the business landscape has changed at a frenetic pace.Large multinational corporations such as Google, Facebook, Amazon, Alibaba, eBay and Uber, unheard of twenty years ago, have emerged as key players in our modern economy. In 2015, online sales accounted for 7.4% of overall retail spending in the U.S., the highest percentage since tracking began in 1999 (Phillips, 2015). Sales made through mobile devices have increased at a rapid rate to between 22% and 27% of all online sales (Rao, 2015; Malcolm, 2015). Corporations now highlight the importance of creating a "digital relationship" with customers (Phillips, 2015). Moreover, digital technologies and devices such as smartphones, smart products, the Internet of Things (IoT), Artificial Intelligence, and deep learning all promise significant transformations of consumers' lives in the near future.It is against this backdrop that this paper seeks to understand how the developments in digital technology are re-shaping the process and the strategy of marketing, and the implications of this transformation for research in the broad space we call "digital marketing".

Our objectives for this paper are three-fold. First, we develop and describe a framework for research in digital marketing that highlights the touchpoints in the marketing process as well as in the marketing strategy process where digital technologies are having and/or will have a significant impact. Next, we organize the developments and extant research around the elements and touchpoints comprising the framework and review the research literature in the broadly defined digital marketing space.Using the framework, we also outline the evolving issues around the touchpoints and associated questions for future research. Finally, we integrate these identified questions and set a research agenda for future research in digital marketing.

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In our discourse, we examine the research issues in digital marketing from the perspective of the firm – that is, we examine the strategic, tactical and implementation implications of the research conducted in the domain of digital marketing and focus on substantive issues of managerial relevance rather than on behavioral or methodological research per se. However, these issues could lead to fundamental questions that could be answered in the domains of consumer psychology, marketing analytics, economics, or computer science.In order to be as comprehensive as possible in covering the key substantive research developments in the area of digital marketing, and given our focus, we have narrowed down our search without compromising the representativeness. Our search for relevant literature focuses on four marketing journals: *International Journal of Research in Marketing, Marketing Science*, *Journal of Marketing Research*, and *Journal of Marketing*, focusing on articles published between 2000 to 2016.We started at Web of Science and searched for articles with the keywords "digital" or "online" as either the research topic or part of the article title, which provided us with 305 "seed articles". As we read these papers, we eliminated those that were not directly relevant and included other relevant papers cited in these seed papers. This expanded our list to other journals not covered in our initial search. For each topic discussed in our paper, we selected the earliest papers in this list, and added a few most frequently cited papers in that topic to discuss under each topic making up our review.To this list we also added the most recent papers to render the review as current as possible. Thus, the review of extant research is not meant to be exhaustive but rather representative in order to cover the issues with sufficient depth and focus on future research issues appropriately.

Our review complements recent review articles on digital marketing and related topics. The article by Yadav and Pavlou (2014) focuses on marketing in computer-mediated environments and reviews literature in both marketing and information systems. The article by Lamberton and Stephen (2016) focuses on consumer psychology, motivations, and expressions in digital environments to highlight a few.The article by Wedel and Kannan (2016) focuses on modeling and methodological issues in marketing analytics necessitated by the advent of digital, social and mobile environments. Our review cites these articles at the appropriate sections for further details on issues we do not cover.

The paper is organized as follows.In Section 2 we present the framework and identify touchpoints in processes where digital technologies play a key role. In Sections 3 through 7, we review the literature around each element and touchpoint of the framework and discuss briefly open areas of inquiry. In Section 8 we present more details on these open areas of research and present an agenda for future research and conclude in Section 9.

2. A framework for analysis

2.1. Definition and framework

The term "digital marketing" has evolved over time from a specific term describing the marketing of products and services using digital channels – to an umbrella term describing the process of using digital technologies to acquire customers and build customer preferences, promote brands, retain customers and increase sales (Financial Times, lexicon.ft.com). Following the American Marketing Association's firm centric definition (https://www.ama.org/AboutAMA/Pages/Definition-of-Marketing.aspx), digital marketing may be seen as activities, institutions, and processes facilitated by digital technologies for creating, communicating and delivering value for customers and other stake-holders. We adopt a more inclusive perspective and define digital marketing as "an adaptive, technology-enabled process by which firms collaborate with customers and partners to jointly create, communicate, deliver, and sustain value for all stakeholders".[1]

The adaptive process enabled by the digital technologies creates value in new ways in new digital environments. Institutions enabled by digital technologies build foundational capabilities to create such value jointly for their customers and for themselves. Processes enabled by digital technologies create value through new customer experiences and through interactions among customers. Digital marketing itself is enabled by a series of adaptive digital touchpoints encompassing the marketing activity, institutions, processes and customers. Significantly, the number of touchpoints is increasing by over 20% annually as more offline customers shift to digital technologies and "younger, digitally oriented consumers enter the ranks of buyers" (Bughin 2015).

In view of the above, we identify key touchpoints affected by digital technologies and propose a research framework that is inspired by the marketing process as well as by the marketing strategy process. The conventional marketing strategy process starts with an analysis of the environment including the five C's – customers, collaborators, competitors, context, and company (firm). While these elements are presented in our framework (Fig. 1), *customers* emerge as the central focus (in the left box) with other elements such as *context*, *competitors* and *collaborators* making up the environment that the company operates in. Our key objective is to understand how *digital technologies* (at the bottom in Fig. 1) interact with the five C's as well as the interface among these elements. We specifically identify the concepts, institutions and structures that emerge from these interactions – platforms and two sided markets, search engines, social media and user-generated content, emerging consumer behavior and contextual interactions. This analysis forms the input to the actions of the firm, encompassing all elements of the marketing mix – *product/service, price, promotion and place* – as well as information gathering through *marketing research* and analytics, which informs the *marketing strategy* of the firm. We focus again on how digital technologies are shaping these actions, information acquisition and analysis, and marketing strategy. Finally, as the outcome of the marketing actions and strategies, we examine the overall impact of digital technologies in value creation – creating *value for customers* (through value equity, brand equity, relationship equity and customer satisfaction), creating *customer equity* (through strategies for acquisition, retention and higher margin),

[1] We thank an anonymous reviewer for this suggestion.

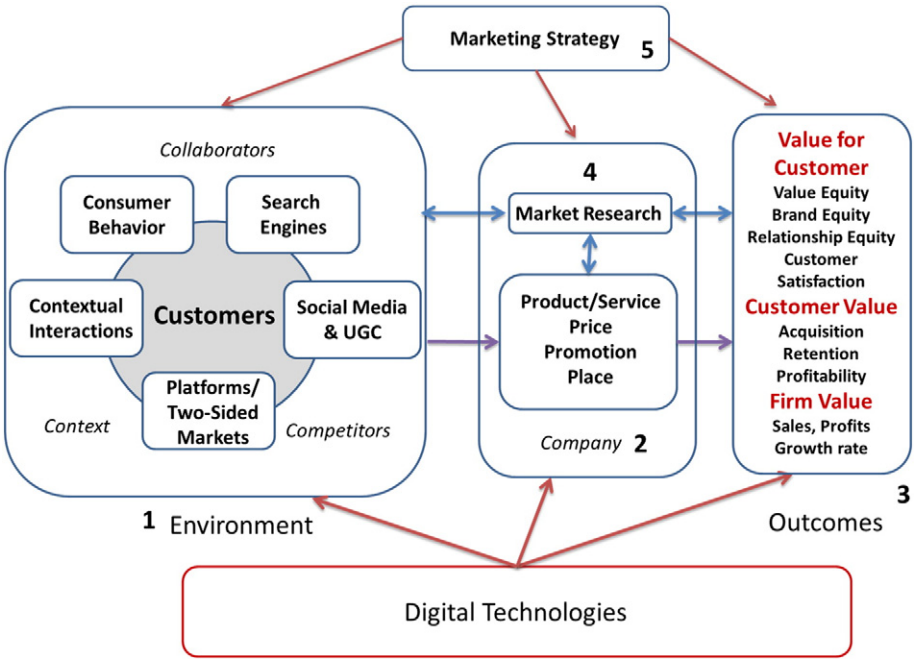

Fig. 1. The Framework for Research in Digital Marketing.

and creating *firm value* (as a functions of sales, profits and growth rate). Our framework, therefore, identifies the key touchpoints in the marketing process and strategies where digital technologies are having or likely to have significant impact. It not only encompasses the elements identified in Fig. 1, but also the interfaces among those elements, as shown by the arrows in Fig. 1. The framework also highlights our emphasis on uncovering issues in digital marketing that will impact the firm directly or indirectly. Next, we provide an overview of these concepts and elements highlighted in our framework.

2.2. Key concepts and elements

Digital technologies are rapidly changing the ***environment*** (Box 1 in Fig. 1) within which firms operate. Digital technologies are reducing information asymmetries between customers and sellers in significant ways. Analysis of interactions of digital technologies and the elements of the environment starts with the examination of how ***consumer behavior*** is changing as a result of access to a variety of technologies and devices both in the online and mobile contexts. We focus on how this affects information acquisition with regard to quality and price, the search process, customer expectations, and the resulting implication for firms. Next, we examine digital technologies' facilitation of customer-customer interactions through online media – word-of-mouth, online reviews and ratings, and social media interactions (***social media & user generated content (UGC)***). The emergence of ***platforms*** – institutions created through digital innovations which facilitate customer-to-customer interactions for ideation in new product/service development, those that connect customers and sellers in platform-based markets and those that leverage ***two-sided markets*** for their revenue generation – is also examined as collaboration enablers that connect a firm to its market using digital technologies In the same way, firms have to contend with ***search engines*** as both collaborators and platforms on which they compete with other firms in acquiring customers. Thus, we also review the research on search engines and the interactions among customers, search engines and firms. Finally, we examine the interactions of digital technologies with different contexts of geography, privacy and security, regulation and piracy, and their implications for digital marketing (***contextual interactions***).

Within the ***company*** (Box 2 in Fig. 1), digital technologies are changing the concept of ***product*** in three ways in order to provide customers new value propositions – augmenting the core product with digital services, networking of products using digital technologies to release the dormant value inherent in the products, and finally, morphing products into digital services. We examine these trends and the opportunities they create for customizing and personalizing customer offerings, by varying not only the core product/service but also the augmented digital services. The developments in digital product lines and tailored offerings to customers lead to ***pricing*** challenges for firms. The reduction in menu costs associated with digital technologies also leads to opportunities for dynamic pricing and yield management in product and service categories traditionally sold with list prices. These developments along with the use of online auctions for products/services, search keywords, display ads, and name-your-own-price strategies, have given rise to interesting research questions that we review. In addition, the interface between pricing and channels (both offline and online) is becoming an important issue as more firms adopt online and mobile channels to target and transact business with customers.

Over and above traditional means of communication such as print, radio, and television, the digital environment provides new means to reach customers and promote products and services via e-mails, display advertisements, and social media (***promotion***).There has been much focus on the effectiveness of such new media and its incremental contribution over traditional media in building brands and affecting outcome variables of interest. Newer forms of promotional tools such as location-based mobile promotions and personalized promotions are increasingly used and we explore the implications of their use for firms as well as for customers.We also focus on the rise of new ***channels*** for customer communications and promotions, not only online and mobile, but also sub-channels within each of these environments such as social channels, search engines, and e-mail that help firms to provide significant value to customers as well as acquire the right customers and increase customer value.

The impact of digital technologies on ***outcomes*** (Box 3 in Fig. 1) could span across different dimensions – in creating value for customers and in extracting the value for the firm. The outcomes are a reflection of how the firm has been able to benefit from the opportunity provided by digital technologies to create value for their customers and also create value for themselves. As Fig. 1 suggests, firms can leverage the interactions of digital technologies with the environment and with its own strategic and tactical actions in leading to the outcomes. We focus on research that models this relationship across various dimensions of outcomes – value equity, brand equity and relationship equity (Rust et al., 2004), customer satisfaction, customer value as a function of acquisition, retention and profitability of customers, and at a more aggregate level, firm value as a function of sales, profits and growth rate. Research on understanding how different channels and media contribute to these outcome measures and how this understanding affects marketing actions will also be discussed.

Marketing research (Box 4 in Fig. 1) focuses on the acquisition and processing of information generated as a result of the use of digital technologies to understand the specific elements of the environment, actions and outcomes that inform the marketing strategies of the firm. Examples include researching the browsing behavior of customers at websites and mobile sites, comparing search behavior in online environments to searches in mobile environments, and examining online reviews, social interactions, and social tags to understand how a firm/brand is being perceived by the market. While the substantive issues are discussed in the context of the environment and the company, all such research involves the development of specific methodologies and/or metrics. Within this section we highlight the managerial questions that could be answered using data within the firm and environment, however, we do not focus on the methodological aspects as these issues are well covered in extant research (see, for example, Wedel & Kannan, 2016). There are issues related to ***marketing strategy*** (Box 5 in Fig. 1) that are partly captured in one or more of the elements or interfaces, and we discuss specifically in Section 7 those issues which are not captured elsewhere. We do not track the developments in digital technologies per se, but in discussing the impact on the customer touchpoints they are implicitly taken into account. In the various sections, we also outline the descriptions and capabilities of new technologies that lead to new opportunities – for example mobile technologies, virtual reality, wearable computing and IoT, etc.

3. Digital environment

Table 1 provides an overview of the state-of-the-art research developments under each of the five main areas we focus on.

3.1. Consumer behavior

It order to understand the impact of digital technologies, it is important to understand how consumers' buying process – pre-purchase, purchase consummation and post-purchase stages – are changing as a function of new environments and devices. Consumers' information acquisition, search and information processing are also affected, and as a result, decision aids can play an

Table 1
Digital technologies and marketing environment: research issues and state-of-the art.

Area of focus	Research developments
Consumer behavior	a. Stages of buying process, purchase funnel, and impact of digital environments and digital devices
	b. Information acquisition, search, information processing and decision aids in digital environments
	c. Buyer behavior across digital and non-digital environments
	d. Customer trust and risk perceptions in digital environments
Social media and UGC	a. Electronic Word-of-Mouth (eWOM) and motivation for eWOM
	b. Dynamics in eWOM posts and their impact on sales
	c. How eWOM posts influence other posts?
	d. Social networks, identification and targeting of influencers
	e. eWOM and fake reviews
Platforms and two-sided markets	a. Network effects in online platforms, information asymmetry and impact on sales
	b. Impact of competition on two-sided content platforms
	c. Issues in crowdsourcing and using platforms for innovations
Search engines	a. How should search engines price and rank keywords?
	b. How should advertisers choose specific keywords and bid on them?
	c. Relationship between rank, click-through rate and conversion rate, and decision support for optimal bidding
	d. Synergy between organic search and paid search
Contextual interactions	a. Interaction between geography/location and digital environments
	b. Impact of regulatory environment - Privacy concerns and effectiveness of digital marketing
	c. Impact of piracy of content

important role in the new environments. Recent marketing research has provided insights into consumer behavior, customer trust and risk perceptions in these processes across digital and non-digital environments. This sub-section will review these issues.

It is well known that consumers move through different stages in the buying process starting with awareness, familiarity, consideration, evaluation and purchase. If consumers receive value consistently by purchasing a brand, they are more likely to become loyal customers. In conventional offline environments the consumer journey is fairly extended, especially in the consideration and evaluation stages, whereas in the digital environment these stages can be quite compressed or even eliminated (Edelman & Singer, 2015). Customers can gather information from focused research at search engines and read other customers' reviews on retailers' sites or third-party forums not controlled by the seller, and the initial demand to purchase could be created just by seeing a post on social network. Thus, in the digital environment, customers can move through their decision journey in fundamentally new ways.

Our key research focus is to understand how buyer behavior is affected by the digital environment, specifically through interactions with search engines, online reviews, recommendations, and other similar information not produced or controlled by the firm or brand. In addition, even as the environment itself changes depending on the device that customers use – personal computers (PCs), smart phones, tablets, or wearable devices – how do these devices and environment affect buyer behavior? Such research issues focus on the elements unique to the devices or environment and examine their impact on consumer decision making and buying behavior. A good example of an early paper focusing on such research is by Haubl and Trifts (2000) who investigated the nature of the effects that interactive decision aids may have on consumer decision making in online shopping environments. Another example is by Shi, Wedel, and Pieters (2013) who used eye-tracking data to examine how customers acquire and process information in their online decision making. Shankar et al. (2010) developed propositions on how the characteristics of mobile devices may influence consumer behavior, and Xu, Chan, Ghose, and Han (2016) examined the impact of tablets on consumer behavior in digital environments.Focusing on the role of decision aids in evolving consumer behavior, Shi and Zhang (2014) found that consumers evolve through distinct behavioral states over time, and the evolution is attributable to their prior usage experience with various decision aids. Decision aids can be constrained by device features, and thus the optimal design of decision aids could vary across devices.

Research in the practitioner's realm offers a new perspective of the digital buying journey wherein interactive social media and easy access to information may expand rather than narrow customer choices. Furthermore, customers can influence other potential buyers through online reviews, social media, and so forth, during both the pre-purchase and post-purchase stages (Court et al., 2009).

The customer decision journey, more often than not, spans across digital as well as traditional offline environments.This buyer behavior *across* environments has been the subject of several papers. For example, do customers who shop across the two environments spend more money than those who use just one channel? Kushwaha and Shankar (2013) addressed this question with a compiled database of around one million customers shopping across 22 product categories over 4 years. In their analysis, a print catalog was the only offline channel and its customers were compared with customers who use the online channel, or both. They developed a conceptual framework where the monetary value of a customer relies on two features of the product category - whether the product is utilitarian or hedonic and whether the product is of low or high perceived risk. They found that the multichannel customers are not necessarily more valuable than single channel users. For example, the offline-only customers have a higher monetary value than multichannel customers on low-risk utilitarian product categories, and the online-only customers spend more on high-risk utilitarian products than multichannel shoppers. Neslin et al. (2006) provided a comprehensive review on the customer behavior in the search, purchase and after-sale stages of multichannel shoppers. They identified five key challenges for future research, including data integration, understanding customer behavior, channel evaluation, resource allocation, and channel coordination. In addition, the large volume of individual-level touch point data adds more complexity to these challenges.

Information search plays an important role in the customer's decision journey. Early research by Ratchford, Lee, and Talukdar (2003) examined how the digital environment affects automobile purchases and revealed that the Internet shortens the consideration and evaluation stages of the customer journey, and customers would have searched even longer if the Internet was absent. A later study by Ratchford et al. (2007) in the same automobile context, found that the Internet substitutes for time spent at the dealer, for print content from third-party sources in pre-purchase stage, and for time spent in negotiating prices in the purchase consummation stage. These results highlight the importance of the reduced search costs and thus more efficient purchase processes in digital environments.

The specific manner in which the consumers' digital search unfolds and how the process is affected and moderated by search- and decision-aids in an ever-changing digital environment is, in and of itself, an important topic. Many of the research findings in the general area of search can be applied to specific digital settings. For example, Seiler (2013) developed a structural model in which the search decision is jointly modeled with the purchase decision. The customers decide on how much information they need to gather by trading off the perceived purchase utility with search cost. Using customers' shopping data in traditional brick-and-mortar stores, Seiler (2013) showed that customers do not search in around 70% of their shopping trips due to high search costs. If the search cost is reduced in half, as in his counterfactual analysis, the elasticity of demand can be more than tripled.In the online setting, when search cost is significantly reduced, researchers found higher demand elasticity in various product categories (Degeratu, Rangaswamy, & Wu, 2000; Granados, Gupta, & Kauffman, 2012).

Kim, Albuquerque, and Bronnenberg (2010) integrated the sequential search process into a choice model. They used web-crawled data of viewing and ranking for all camcorder products at Amazon.com for a one and a half-year data window and assumed these data are aggregations of individual-level optimal search sequences. Their results showed that consumers usually

search among ten to fifteen product alternatives. While the ranking and filter tools offered by the retailer can help customers reduce search costs, these tools also concentrate demand on the bestselling products. Bronnenberg, Kim, and Mela (2016) examined customer online search behavior for multi-attribute, differentiated durable goods such as cameras, and found that on average a customer conducts 14 searches online across multiple brands, models, and online retailers over a 2-week period. However, the extensive search is confined to a small set of attributes and 70% of the customers search and purchase within the same online retailer. They also found that customers first search with generic keywords and narrow down to specific keywords, echoing the research findings by Rutz and Bucklin (2011).

Trust is an important element that influences customers' selective information gathering and search behavior in the digital environment. Shankar, Urban, and Sultan (2002) introduced a conceptual framework for online trust building using stakeholder theory, which approached the trust building from the perspective of different stakeholders such as customers, suppliers, and distributors. From customers' perspectives, they want retail sites to be trustworthy and their transaction information and personal information to be protected. However, such customer needs may not quite align with supplier's efficiency perspective. In one of the earliest empirical studies on customer privacy concerns in online shopping, Goldfarb and Tucker (2011a) conducted a field experiment and found that targeting can undermine the effectiveness of a display ad. According to their research, an ad that is both obtrusive and content-based targeted has less impact on a purchase than an ad that is only obtrusive or targeted, possibly due to customers' privacy concerns.

Understanding how emerging digital technologies affect consumer behavior is an important research area. It is the key to understanding the role of various touchpoints in determining customers' purchase journey, extending the work of Court et al. (2009). Do these touchpoints always compress and shorten the purchase journey as described by Edelman and Singer (2015) or is there a tipping point where the journey gets extended? How are these findings change across devices? Does switching across channels and devices increase or decrease the search cost? Theory-driven research focusing on the impact of devices on consumer behavior is critically needed.

3.2. Social media and user-generated content

An important characteristic that sets the digital environment apart from the traditional marketing environment is the ease with which customers can share word-of-mouth information, not only with a few close friends but also with strangers on an extended social network. In the digital environment, customers can post reviews on products, services, brands and firms at firms' websites as well as third-party websites and social networks, and these reviews reach a much larger number of potential customers.

Toubia and Stephen (2013) focused on the important motivation question: why do people contribute on social media? Their research distinguished between two types of utility that a contributor derives from social media: (1) intrinsic utility, the direct utility of posting content and (2) image-related utility derived from the perception of others. These two types of utility can be empirically distinguished because the former depends on posting behavior whereas the latter only relates to the number of followers a person has on the social network. In their field experiment, Toubia and Stephan randomly selected 100 active non-commercial users on Twitter and added 100 synthetic followers to each user over a 50-day period. They found the intrinsic utility outweighed image-related utility when the Twitter users had fewer followers, whereas image-related utility became more dominant as the Twitter users gathered more followers. Moreover, the image-related utility was larger than intrinsic utility for most users.

It is important to identify the influential individuals in a social network. In their seminal paper, Watts and Dodds (2007) proposed a hypothesis that there is a small group of influencers, the impact from whom can cascade to others. Trusov, Bodapati, and Bucklin (2010) developed a latent measure of influence and empirically examined the influence on individual log-in behavior with social network data. Katona, Zubcsek, and Sarvary (2011) studied the diffusion of influence and found that an individual's position in the network together with specific demographic information can be good predictors of adoptions. An individual is more likely to adopt if she is connected to more adopters or if the density of adopter connections is higher in her group.

One form of online customer interactions that has been studied extensively is the online review (e.g., user generated content and electronic word-of-mouth, or eWOM). Just as with traditional offline word of mouth, eWOM encompasses customers' knowledge about the products, their usage, experience, recommendations, and complaints, and is generally perceived as trustworthy and reliable. Moreover, eWOM may have richer content and larger volume than offline word of mouth, and it is much more accessible and can be shared widely in the digital environment. Given the importance of eWOM, it has been the subject of extensive research over the last decade, addressing issues such as: the motivation for eWOM posts; the impact of eWOM posts on sales and the dynamics of such posts; how eWOM posts influence other posts and reviews; and the identification of the most influential people in the network, known as "influencers". More recently, research has also focused on deceptive reviews and their motivations.

Godes and Mayzlin (2004) were the first researchers to investigate the impact of the online review. They examined the volume and dispersion of the online review and found that the dispersion is a good predictor of the ratings of a TV program. Chevalier and Mayzlin (2006) studied the important relationship between online reviews and sales using online book reviews. They found that online reviews are generally positive and that these reviews can increase a book's sales rank, but that negative reviews have a stronger impact than positive ones. Moe and Trusov (2011) identified two dimensions of online reviews – product evaluations and social dynamics – and found both influence sales. Apart from the relationship between eWOM and sales rank, researchers are also developing tangible metrics to measure the return on investment (ROI) of social media. Kumar et al. (2013) introduced a metric to measure the viral impact of eWOM and its associated monetary value. Wu, Che, Chan, and Lu (2015) developed a learning model to evaluate the monetary value of a review and found more value is derived from contextual comments than numerical ratings. In addition to the organic eWOM created by customers, can firms drive sales by generating their own eWOM?

According to Godes and Mayzlin's (2009), the answer is yes. In a large-scale field experiment, in which they collected data from customers as well as non-customers, they found less loyal customers are likely to have a greater impact on eWOM campaigns.

Chen, Wang, and Xie (2011) compared the impact of eWOM and observational learning at Amazon.com, where eWOM is created by customers and the observational information is provided by an Amazon feature that shows the customer what other customers purchased (as an aggregate metric in percentage) after viewing the same product. This observational learning feature was discontinued by Amazon in late 2005 and resumed in late 2006. The researchers collected one and a half years of data covering these two feature changes at Amazon and used a first difference model to measure the impact of eWOM, observational learning, and their interactions. The results showed that negative eWOM is more influential than positive eWOM, whereas the reverse is true for observational learning. These findings imply that it is profitable for retailers to provide observational information and the impact of such information can be strengthened by eWOM volume.

One selection issue that needs to be taken into account is that not every customer contributes to online reviews and a customer's decision to write a review needs to be modeled. Ying, Feinberg, and Wedel (2006) developed a selection model to capture this decision process and also examined the valence, volume and variance of ratings. They found that more active reviewers post lower ratings than less active reviewers and that over time these active reviewers become the majority of the reviewer population, which explains the declining trend of the proportion of favorable ratings over time. Another explanation of the declining trend in positive online reviews is offered by Li and Hitt (2008). They identified a selection process where the customers who purchased later and thus reviewed later had lower utility from the product and the lower rating over time represented the lower valuation by these later customers. In addition, Godes and Silva (2012) contributed to the research of the dynamics of eWOM by explaining the temporal dynamics. Moe and Schweidel (2012) focused on why consumers post ratings and modeled the individual's decision to provide a product rating and the factors which influenced that decision. The researchers showed that there were significant individual differences in how consumers responded to previously posted ratings, with less frequent posters exhibiting bandwagon behavior while more frequent posters tended to differentiate themselves from other posters. These dynamics affect the evolution of online product opinions over time.

The past decade has witnessed a surge in research on online reviews. Based on 51 studies, You, Vadakkepatt, and Joshi (2015) conducted a meta-analysis on the elasticity of the volume and valence of online reviews. They found that the valence elasticity (0.417) is higher than the volume elasticity (0.236) and these elasticities are higher for private and low-trialability products. In an interesting study on online deception, Anderson and Simester (2014) found that approximately five-percent of the online reviews at a large retailer's website were for products never purchased by the reviewers. These tended to be more negative than the average review and the authors conclude that it is unlikely that all were written by competitors or their agents as these reviewers seem to have purchased a number of other products at the retailer.In a recent meta-analysis, Rosario et al. (2016) found that eWOM had a stronger effect on sales for tangible goods new to the market, but not for services. They also found that eWOM volume had a stronger impact on sales than eWOM valence and negative eWOM did not always jeopardize sales, but high variability in reviews did.

Lamberton and Stephen (2016) provided a detailed survey of recent research developments encompassing substantive domains of digital, social media, and mobile marketing topics from 2000 to 2015. They focused on digital technologies as a facilitator of individual expression, as a decision support tool, and as a market intelligence source, which complements our above treatment by providing more details about social media and UGC research.

Current research on UGC mainly centers on the study of structured data – the number of stars or likes and their statistics such as mean and variance. However, the content of the reviews and posts themselves contain valuable and direct information expressed by the customer. While sentiment analysis has been used to capture valence information, only a few empirical papers have tapped into the unstructured textual content of online reviews (for example, Tirunillai & Tellis, 2014; Büschken & Allenby, 2016). Future research needs to focus more on the semantic analysis of UGC.

3.3. Platforms and two-sided markets

Several platforms and platform markets have emerged in the digital environment, including those that connect individual customers with other individual sellers (eBay), those that connect customers with a multitude of firms/sellers (Alibaba, Amazon, media sites, and various advertising exchange networks), firms with firms (business-to-business platforms) and firms with the crowd (crowdsourcing and innovation platforms like Kickstarter). In all the above examples, platforms are independent third-party entities that connect buyers, sellers, firms, the crowd, and so on. To this list, we also add customer communities that firms organize so that they can observe and interact with the crowd (firm-sponsored platforms). Innovation platforms (for example, Dell Ideastorm, Cisco's open innovation platform) and other social communities are good examples. The revenues for the independent two-sided platforms come from one or a combination of commissions, performance-based charges (for example, Google charges advertisers by cost per click), and impression-based charges (for example, the cost per thousand impressions charged by the ad networks). Two-sided markets are well-studied in traditional network markets and much of the research is readily applicable to online platforms too (see, for example, Parker & Van Alstyne, 2005). In this section we will specifically focus on studies that draw upon the unique characteristics of the digital environment in examining the relevant research issues.

Extant research in online platform markets has empirically examined the existence of network effects, that is, more users/buyers will increase the number of advertisers/sellers of the two-sided marketplace (Parker & Van Alstyne, 2005). Tucker and Zhang (2010) conducted field experiments and investigated the influence of disclosing information on the user base and seller base of an exchange network. Their results suggested that a seller prefers an exchange network with more sellers due to its

attractiveness to more buyers. Fang et al. (2015) applied a vector autoregressive models analysis to investigate the direct effects of buyers and sellers on the platform's advertising revenue, as well as the indirect effects of click-through rate and cost-per-click (CPC). Their results demonstrated strong network effects – more buyers boost the CPC for the sellers and more sellers increase the buyers' click-through rates. The two-sided platform in their study launched a search advertising service within their data window, which allowed them to capture the different effects during the launch and the mature stages of search advertising services. Interestingly, they found the ROI at the mature stage is twice of the ROI at the launch stage. In the launch stage, they found the existing sellers bid higher than new sellers and have a stronger impact on click-through rates. The reverse is true during the mature stage. As for buyers, the new buyers have a greater impact on the click-through rates and price during the launch stage and this impact is even more prominent during the mature stage. Additionally, the impact of new buyers lasts three times longer than that of existing buyers.

Godes, Ofek, and Sarvary (2009) examined the impact of competition on two-sided platforms in both duopoly and monopoly settings with analytical models. They found in a duopoly setting the media firms tend to charge more for their content than what they would charge in a monopoly case where no competition exists. This contradicts the common belief in the negative relationship between competition and price that the price is lower when competition is more intense. As a result of the network effects of a two-sided market, the profits from advertising may decrease at a higher level of competition, but the content profits could still increase. Jiang, Jerath, and Srinivasan (2011) examined the role of Amazon as a platform provider in linking small sellers with customers and the strategies it adopts in observing the demand for sellers' products and offering the high-demand products themselves and examined, in a game-setting, the firm strategies. Chakravarty, Kumar, and Grewal (2014) focused on business-to-business platforms and examined their total customer orientation as a function of buyer-side versus seller-side concentration on the platforms and found that total customer orientation increased with buyer-side concentration.

Crowdsourcing platforms are another type of platform that connect firms to their customers (the crowd) and help generate ideas for new products and services. Such innovation platforms allow firms to repeatedly collect ideas from a dispersed crowd of customers and choose the best ideas to develop further. Bayus (2013) researching Dell's Ideastorm platform found that customers who repeatedly submitted ideas were more likely to provide good ideas but once they won their success rate dropped. Luo and Toubia (2015) focusing on online idea generation platforms suggested that the platforms should customize the task structure of the idea contests on the basis of each customer's (those who submit ideas) domain-specific knowledge in order to increase the idea quality. As innovation platforms become increasingly popular, there is more research attention on how to increase ideation quality in such platforms. In the context of firm-sponsored community platforms, Manchanda, Packard, and Pattabhiramaiah (2015) focused on "social dollars" (the economic benefit to a firm generated from customers being engaged members of the community) and found stronger social than informational source of economic benefits accrued for the firm from customers in the platform, highlighting the benefits of running such communities for the firm. A more detailed treatment of platforms can be found in Sriram et al. (2015), where the authors identified opportunities to advance the empirical literature in platform research.

There is still a significant gap in our understanding of the processes within the platforms that can lead to more efficient and effective interactions and outcomes (for both firms and customers/crowd). For example, how can platforms maintain the engagement of customers/crowd in e-commerce interactions or in new product/service development ideation processes? How can social processes and commercial processes co-exist and complement each other on platforms? As the social networks facilitate commerce on their platforms – Facebook runs a virtual Marketplace to let users trade within a local community and Chat apps like WeChat and Line can be used to order groceries delivered to the door, the research on the relationship between social and commercial features of a platform assumes greater importance.

3.4. Search engines

Search engines allow customers to acquire free information on products and services and identify firms and brands that fit their search criteria. Search engines provide organic (natural) listings of websites as well as paid search listings in response to the keywords that users type in. In this sub-section, we first review research examining the impact of search engines on outcome variables of interest. Then, we focus on search engine decisions as a platform, and decisions by advertisers as the clients of the platform.We examine the ecosystem as a whole and center our discussion on the relationships among the decisions of various players. Finally, we highlight the research on the synergy between organic and paid search.

The effectiveness of search engines is supported by several empirical studies. Chan, Wu, and Xie (2011) found that the customers acquired through paid searches purchase more and generate higher customer lifetime value than customers acquired from other online or offline channels, indicating that search engines are an effective selection mechanism to identify high-value customers.In addition, Dinner, Van Heerde, and Neslin (2014) found that paid search advertising is more effective than offline advertising, and Wiesel, Pauwels, and Arts (2011) also found the impact of a paid search is more enduring than that of e-mail.

There are three players involved in search engine marketing: the search engine, the advertiser/firm, and the customer. We have already discussed the role of search engines in a customer's decision journey. In this sub-section, we focus on specific issues from the perspective of the search engines and the advertisers: (1) how should search engines price and rank keywords, and (2) how should advertisers choose specific keywords and bid for those keywords for the most efficient and effective customer acquisition.

The generalized second price auction is widely adopted by search engines to determine the prices and rankings of listings for each keyword. It is well-known in economics that the generalized second price auction outperforms the first-price auction, but its implementation at search engines may not always be optimal. Amaldoss, Desai, and Shin (2015) compared the generalized second price bidding and the first-page bid estimate mechanism implemented at Google (the estimate offers the minimum bids to appear

on the first page of search results for specific keyword and advertiser combinations). Their results emphasized the latter's advantage in dealing with advertisers' hidden valuation and budget constraints, resulting in higher revenues for search engines that do not necessarily come at the expense of the advertising clients. Chen, Liu, and Whinston (2009) developed an analytical model of optimal share structure to assign shares of impressions to the bidders and help search engines achieve maximal revenues. Later, Zhu and Wilbur (2011) further discussed a hybrid bidding scheme in which advertisers can bid on a pay-per-impression basis or on a pay-for-performance basis (i.e. the number of clicks). They suggested that search engines should provide different bidding options to advertisers.

The auction-based market at search engines, by definition, can create intense competition among advertisers. Many firms hire an advertising agency to manage their search engine marketing and award the agency based on conversions. Abou Nabout et al. (2012) found such compensation plan can lower the agency's profit by up to 30%. Skiera and Abou Nabout (2013) proposed an automated bidding decision support system to maximize the advertiser's profit. The proposed algorithm is shown to improve ROI by 21% in field experiment and increase both advertiser's and firm's revenue. Desai, Shin, and Staelin (2014) investigated the tradeoff of purchasing a firm's own brand name versus its competitor's brand name. Such a purchase is affected by the quality of brand owner and its competitor. When the brand owner expects its competitor to purchase its brand keyword, the optimal action is to buy its own brand name to preclude the competitor. Additionally, they found that bidding on competitors' brand names increases search engine's profits, but could lead both brand owner and its competitor to the prisoner's dilemma wherein both lose profits.

Search engines provide the firm with keyword performance reports to help the firm understand the effectiveness of their paid search advertising. For example, Google provides daily statistics including the number of impressions, number of clicks, click-through rate (CTR), conversion rate, average CPC, total costs, average position, and quality scores, etc. Among these metrics, position, CTR and conversion rate exert the most impact on acquisition costs. In one of the earliest empirical studies on search engines, Ghose and Yang (2009) simultaneously modeled the customer's click-through and conversion, the CPC and the position of search ads. They found that as the search ad moves to the top of the result page, the CTR is higher. Their results showed that the inclusion of the retailer name in the search keywords generates higher CTR, while the inclusion of the brand name or longer search phrases leads to lower CTR. Following this research, Agarwal, Hosanagar, and Smith (2011) showed that the CTR decreases as the ad position moves down, but the conversion rate is not monotonically associated with the ad position. Rutz, Bucklin, and Sonnier (2012) extended this stream of research by showing that the conversion rate of keyword ads is affected by the presence of brand name and location information. Some research focuses more on the ad position. For example, Yao and Mela (2011) examined the competition for ad position and modeled advertisers' strategic behavior. Narayanan and Kalyanam (2015) used a regression discontinuity approach to investigate the impact of position on the effectiveness of search ads. They showed position is more important for smaller advertisers, and they also found the presence of brand name or specific product information can undermine the ad effectiveness. Li, Kannan, Viswanathan, and Pani (2016) centered on the role of attribution strategies in search campaigns. They modeled the firm's keyword bidding and its ROI, the search engines' ranking decision and the customers' click-through and conversion, and showed that attribution strategies can have a significant impact on targeting customers using keywords. Berman and Katona (2013) examined the impact of search engine optimization (SEO) on the competition between advertisers for organic and sponsored search results, and identified conditions under which SEO improves customer satisfaction with search engine results.

Apart from the research on the relationship among the performance metrics of search campaigns, Yang and Ghose (2010) also examined the synergy between organic search and sponsored search ads. Rutz and Bucklin (2011) developed a dynamic linear model to capture the spillover from generic to branded paid search ads. The spillover effect from traditional marketing channels such as TV advertising is studied by Joo et al. (2013) and Joo, Wilbur, and Zhu (2015), and the spillover from search engine marketing to other online marketing channels is also studied in multi-channel multi-touch attribution literature (Li & Kannan, 2014; Xu, Duan, & Whinston, 2014).

Future research in the area of search engines will be fueled by new developments – both in business modes as well as in technology. For example, Google has been embedding prices of searched products directly in its organic search results, which provides customers the option of bypassing websites with higher prices. Currently, businesses can opt-in to the program of displaying their prices directly in the organic search results. A question of importance for these firms is whether they should opt-in or not. From the customers' viewpoint, do these options cut their search time and the number of website visits? These are interesting questions to examine. From a technological development viewpoint, new search engines like Memex from US DARPA that search the "dark" web and search engines that use images and audio to conduct searches are likely to keep research in this area at the forefront.

3.5. Contextual interactions

In this sub-section, we examine the interaction between digital technologies and the contextual elements of a firm's environment. Specifically, we focus on three contextual elements that have received significant interest in extant marketing literature given they could have significant impact on the effectiveness of digital marketing – (a) geography and location, (2) regulations on privacy and (3) regulations against the piracy of content.

While the digital environment cuts across geographical boundaries, online customer preferences and choices are still very much a function of geography. Using online field experiments and a spatial model formulation, Jank and Kannan (2005) showed that a customer's choices between different book formats offered by a publisher exhibited geographical variation possibly capturing the unobserved effects due to locational differences and price sensitivities. Bell and Song (2007) examined customer trials at Netgrocer.com and found that customers' adoption decisions influenced the adoption decisions of geographically proximate

residents who had yet to try the service. The estimated neighborhood effect was found to be significantly positive and economically significant. More recently, location effects in the mobile environment have found to be very significant. Danaher et al. (2015) studying the effectiveness of mobile coupons found that the effectiveness was a function of where and when the mobile coupons were delivered, with the location and time of delivery significantly influencing the redemption. Andrews, Luo, Fang, and Ghose (2015) examined the targeting effectiveness of mobile ads in the context of crowds and found that commuters in crowded subway trains are about twice as likely to respond to a mobile offer by making a purchase vis-à-vis those in non-crowded trains. They suggested that as increased crowdedness invaded one's physical space, people adaptively turned inwards and became more susceptible to mobile ads. As digital technologies become more personal, the impact of geography and location could be important predictors of consumer behavior.

There is an increasing effort by online firms to leverage the valuable individual-level information on customers' search behaviors, online reviews, social media activities, and anything else that customers interact with online. In the US, customers' personal information can be shared among companies as long as the companies state their intentions in their privacy policy. The granular data collected by the companies helps marketers better understand when, where and how to fulfill a customer's needs. However, customers' concern for their privacy is rising. A recent report by J.D. Power (Pingitore et al., 2013) showed that consumers' privacy concerns remain at a high level while their mistrust of online data collectors continues to grow. Most surveyed customers do not believe firms should access their personal data by tracking cookies or social media activities. However, 81% consumers feel they do not have control over how their personal information is being collected and used. In the European Union (EU), the privacy laws are much stricter, which can have a significant impact on targeting customers. Using a large scale survey of customers exposed to display ads, Goldfarb and Tucker (2011a) found that, on average, "display advertising became far less effective at changing stated purchase intent after the EU laws were enacted, relative to display advertising in other countries". The reduction in effectiveness was particularly pronounced for display ads of smaller sizes with no interactive elements and for websites that had general content such as news.

Rust, Kannan, and Peng (2002) developed an analytical model to examine the equilibrium level of privacy in a simplified setting with a monopoly firm and a representative customer, assuming the market of privacy is free of government regulation or intervention. Their findings were in line with the well-held belief that overall privacy would decline over time and maintaining privacy would be more costly for consumers. They expected a market for privacy to emerge wherein consumers could purchase a certain level of privacy in that market.

Finally, turning to the issue of piracy and digital rights management (DRM), there have been a number of studies, both analytical and empirical, focusing on the impact of piracy and DRM on sales and profits of information goods. Some researchers have shown that piracy can be beneficial to firms when there are strong network effects and copying expands the market. Jain (2008) showed that even when there is no network effect, piracy could increase a firm's profit as weaker copyright protection could enable firms to reduce price competition by allowing price-sensitive consumers to copy. Thus, weaker copyright protection could serve as a coordination device to reduce price competition. Likewise even when there is a presence of strong network effects, stronger copyright enforcement by one firm could serve as a coordinating device to reduce price competition.

Vernik et al. (2011) examined the impact of the presence and absence of DRM. By endogenizing the level of piracy, they found that download piracy might actually decrease when the firm allows legal DRM-free downloads and that copyright owners would not always benefit from making it harder to pirate content. In an empirical support, Sinha, Machado, and Sellman (2010) conducted two large empirical studies and a validation exercise, and found that the music industry can benefit from removing DRM because such a strategy had the potential to convert some pirates into paying consumers. A DRM-free environment also enhanced both consumer and producer welfare by increasing the demand for legitimate products as well as consumers' willingness to pay for these products. In a related study, Danaher et al. (2010) found in a natural experiment that piracy increased when content, which was previously available for download legitimately online, was made unavailable for distribution online. When the distribution was restored, piracy levels dropped.

The impact of geography and location on consumer behavior – especially with respect to search and purchase behavior – is an important topic to research with digital technology becoming more personal and wearable. With the advent of virtual reality (VR) and augmented reality (AR), contextual interactions become significant. Is the impact of these technologies different in digital environment vis-à-vis a brick-and-mortar environment? Would they be different for products versus services? How can firms selling customer experiences online (travel, hospitality, vacation packages) benefit from such technology and how can they incorporate the technology in their online decision aids?

With privacy issues becoming more salient for customers, firms may be forced to limit data collection at a very granular level (either by government regulations or by self-regulation). In such a case, the development of personalization and customization techniques that use more aggregate level data or partial data will become critical. Wedel and Kannan (2016) provide some possible ways to handle such anonymized and/or aggregate data.

4. Marketing actions

4.1. Product

The concept of product is undergoing a rapid transformation in the digital age. First, the augmentation of the core product with services is becoming increasingly digital, wherein the core value of the product is increased with value derived from digital enhancements (e.g., automobiles with GPS systems, sensor-based self-driving technologies). Second, the networking of products

using online and mobile technologies is spawning a rental economy wherein the dormant value of owned-products (e.g., housing and automobiles) is released through digital networking for rental options (e.g., Airbnb and Uber).Such networking technologies are also fueling developments in Internet of Things (IoT), where products are infused with smart technologies enabling communication with each other and the users. Third, products/services themselves are morphing into digital services, especially in the domain of information products such as software, and content such as music, video and text, with online and mobile technologies playing a key role in fulfillment. This has provided opportunities to create product lines of various digital and traditional non-digital formats with interesting implications for pricing and marketing. Product lines of digital services also allow models such as "freemium," where the basic version is offered free of charge and the enhanced version is offered for a fee (e.g., digital storage and online content). All these developments also provide opportunities for customizing and personalizing customer offerings, by varying not only the core product/service but also the augmented digital services.

In order to understand digital marketing and its impact, it is essential to focus on how digital technologies are augmenting and transforming the core product. At the heart of this augmentation and transformation is an effort to provide new values to consumers that foster the creation of new business models (Fig. 2).

An early trend in the digitization of the core product with augmented service is the transformation of products and the associated service into digital services in the domain of information products – software, music, video, text, video games, etc. This transformation was easy as the nature of the product was digital and the innovation was in simply shedding the physical form to become entirely digital – books became e-books, music/video distribution changed from CD/DVD to streaming, video games migrated online, and so on. This transformation significantly reduced the marginal cost of producing and distributing digital content. Bakos and Brynjolfsson (2000) showed that it could lead to large-scale bundling of content through what they called "economies of aggregation". Specifically, given the low marginal cost of content, bundling becomes a product strategy even without network externalities or economies of scale or scope. If there is no disutility for irrelevant information then bundling of content becomes an optimal strategy. On the other hand, a transformation to digital version has also made unbundling of content (music singles, book chapters) possible. Elberse (2010) found that unbundling and digital downloading decreased revenues significantly by displacing bundled content. However, if the items in the bundle were of equal appeal and/or if the artist had a high reputation, there was less of an impact on revenues.

Overall, the availability of a digitized product/service along with the product in its traditional form – specifically, a product line with same product in different formats, has led to some interesting research. While the products in a product line tend to be substitutes, conventional formats and digital formats can complement one another depending on the usage occasions for the formats and they could be bundled.

Koukova, Kannan, and Ratchford (2008) showed that when advertising emphasized common usage situations across formats, consumers perceived the formats as substitutes, but when advertising emphasized unique usage situations for each format, consumers perceived the formats as more complementary. Koukova, Kannan, and Kirmani (2012) used this idea to show how the formats can be designed to be more complementary and thereby encourage consumers to purchase a bundle of formats.

A related research question is the issue of designing digital samples of products such as movies, songs and books that enable consumers to learn more about the products with the goal of encouraging sales. Halbheer et al. (2014) examined the issue of sample quantity, i.e., how much of a sample should be provided to maximize sales. Li, Jain, and Kannan (2016) examined how the quality of the sample affects sales using both analytical and empirical models. The objective in both studies is to determine the optimal level of sampling under different conditions. The sampling problem is similar to the above product line problem – for some consumers the sample is a substitute for the digital product. The firm's objective, however, is to make the sample and product as complementary so that more consumers will buy the product after sampling. The idea is the same in freemium models where consumers use the free access or free sample for a period of time before upgrading to the premium product for a price. It can also be viewed as a product line problem where the products are temporal complements (Berry et al., 2014).

A significant impact of the digital environment on product strategy is the facilitation of mass customization. The digital interface makes it easy for customers to choose options and configure the product according their specifications. One of the key research issues is the design of the "choiceboard" (or a menu of choices) of various features and options for configuring their own products and services. Wind and Rangaswamy (2001) coined the term "customerization" to describe a firm's product strategy that combines mass customization with customized marketing employing online menus to customize modularized products. Early research by Liechty, Ramaswamy, and Cohen (2001) examined the use of experimental choice menus for assessing customers'

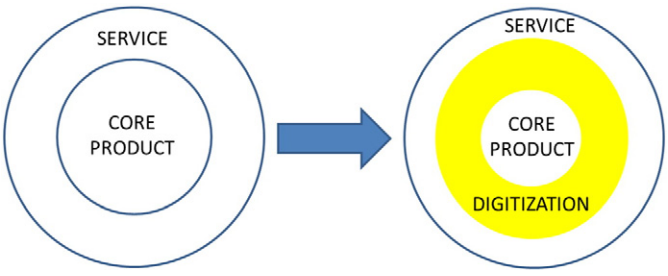

Fig. 2. Digital augmentation and transformation of product.

preferences and price sensitivities for products and services with different features and options. Dellaert and Stremersch (2005) examined the tradeoff between mass customization utility and complexity in the design of menus, and found that mass customization configurations have higher utility for customers with expertise than for customers with low product expertise and complexity had lower negative impact on the product utility for the experts. Hildebrand, Haubl, and Herrmann (2014) focused on reducing the complexity of mass customization by providing starting solutions for customers while at the same time maintaining all of the advantages of customization. The research on decision aids (discussed under Consumer Behavior) is also relevant in this context.

While the concept of product has undergone a complete transformation in the case of digital formats, there are recent business models in which the core product remains the same but the augmentation is achieved through digital services. Examples of such business models include Airbnb, Uber, and Lyft, which release the inherent value in products for rentals using digital technologies and networks (see, for example, Sundararajan, 2016). While these business models can also be seen as platforms, from the perspective of product design the fact that they are shared or rented may have special significance. Other examples of augmentation of core products through digital services include innovations such as self-driving automobiles, networked automobiles providing complementary services using apps, etc. This comprises the realm of IoT where physical products such as homes, appliances, instruments and equipment are augmented with sensor, GPS, electronics, software and network connectivity so that they can exchange data to derive improved efficiencies, effectiveness and economic benefits. An interesting problem in such a realm is how the products should be designed to optimize the eco-system's complementary products so that customers will derive increased value and thus adopt them.

With products being increasingly integrated and networked with digital technologies, it is important to understand the usage and connectivity contexts of products and the impact these contexts have on the utility derived from products. Such an understanding can provide the basis for personalizing the products using the digital services augmenting the product. For example, automobile manufacturers such as Ford are increasingly focusing on designing products for customer experience. In the sharing economy customers may increasingly focus on the features that affect their driving experience rather than the features that are salient in owning a car. New research should also address questions such as (1) identifying the customer's role in product design given the interactive digital environment, and (2) how mobile devices can change the transaction and delivery of products and services.

4.2. Price

Digital products and services have very low or zero marginal cost for production and distribution. This has important implications for pricing and revenue models, especially in the context of product lines consisting of traditional formats as well as digital formats. Venkatesh and Chatterjee (2006) examined optimal pricing of online and offline content (magazines and journals) and showed that the online format can lead to higher profits acting as a device for price discrimination. While they assumed consumers buy one or the other format, Kannan, Pope, and Jain (2009) showed that consumers are heterogeneous in their perception of substitutability and complementarity of formats and that higher profits can be achieved by bundling formats. Pauwels and Weiss (2007) focused on freemium models in the context of newspapers and magazines in the presence of advertising revenue. Kanuri et al. (2016) constructed a menu of content subscription bundles that maximizes total profit from both consumers and advertisers in the context of a similar newspaper platform and provided insights into profit maximizing menus under various business model and format strategies. Focusing on content platforms, Lambrecht and Misra (2016) examined the question of how much content should be free and when firms should charge a fee. They found that firms can increase revenue by flexibly adjusting the amount of content they offer against a fee instead of setting a static paywall as many content providers do. The flexibility depends on the heterogeneity in consumer demand and therefore can be dynamic.

Lee, Kumar, and Gupta (2013) focused on ad-free freemium products like Dropbox and developed optimal pricing strategies using structural models. As firms create new types of digital goods and formats, academic research has followed and provided generalizable understanding and recommendations. Other examples of recent research involve innovations in digital goods such as online music (Chung, Rust, & Wedel, 2009), video games (Liu, 2010), and cloud computing (Liu, Singh, & Srinivasan, 2015). Lambrecht et al. (2014) provided a review on content-based, information-based, and advertising-based revenue models for digital goods. In the content-based revenue model, the firm can sell content and services. The information-based model applies when revenue is generated by a firm selling its customers' information, such as browsing behavior at the cookie level. The advertising-based revenue model is suited for websites that hold inventory for display ads. The space allocated for advertising can be an important driver of the firm's revenue.

The pricing for products and services online is more dynamic than in brick-and-mortar businesses for a number of reasons: (1) search costs for consumers are low, (2) menu costs for retailers are low, (3) changes in the shopping environment are rapid, and (4) retailers can respond to customers' searches more quickly. Additionally, the increasing use of auctions to acquire customers (through search engines, re-targeting, etc.) brings in more selective customers to the retailers' site. On the one hand, the customers are doing more price comparisons due to lower search costs. Degeratu et al. (2000) found that online shoppers are more price sensitive than offline shoppers. Using the data from air travel industry, Granados, Gupta, and Kauffman (2012) similarly showed that online demand is more elastic, partially due to the self-selection issue that more leisure travelers than business travelers reserve their air travel online. On the other hand, online retailers are able to measure demand, track competitors' prices and adjust prices faster due to lower menu costs. Kannan and Kopalle (2001) distinguished the information-based virtual value chain from

the product-based physical value chain and discussed a few new pricing strategies emerging on the Internet, including the auction model, demand aggregation, dynamic posted prices, Priceline's reverse auction model, and others.

A number of studies have focused on new models of pricing enabled by the digital environment and on the characteristics of pricing in the online market – name-your-own-price-channels (Hann & Terwiesch, 2003; Spann & Tellis, 2006; Fay, 2004; Amaldoss & Jain 2008), online auctions (Popkowski Leszczyc & Häubl, 2010; Haruvy & Popkowski Leszczyc, 2010), and price dispersion in online markets (see Pan, Ratchford and Shankar, 2004).

With IoT poised to take off, pricing of products augmented with digital services would be an important area of research. Prior research in online information pricing and access pricing is a useful starting point. Jain and Kannan (2002) examined the various ways online servers providing access to databases charge consumers – connect-time pricing, flat-rate pricing for information downloaded, or subscription-based pricing for unlimited downloading. Essegaier, Gupta, and Zhang (2002) and Iyengar, Jedidi, and Kohli (2008) have examined similar issues in the context of access-based pricing and a pricing structure for telecommunication services that would be useful for IoT applications. In a similar vein, Iyengar, Jedidi, Essegaier, and Danaher (2011) built a conjoint analysis model to study consumer choices between contracts with three-part pricing (base fee, free usage allowance, and per-unit charge for usage exceeding the free allowance), as is common for telephone, mobile data, and car rental agreements. Their model simultaneously incorporated price and consumption levels into the conjoint analysis and captured the mutual dependence between price and consumption. They took into account consumer uncertainty about actual consumption levels, and found that ignoring such uncertainty would underestimate a consumer's consumption level. Such pricing structures will become increasingly relevant in the future.

Pricing in the context of mobile and personal technologies is an area ripe for future research. These technologies along with voice and image based search may render search costs to be infinitesimally small.What are the implications of this for pricing and price matching? What are implications for price competition? Many firms are resorting to dynamic pricing on the Internet where the prices change depending on the time of day, the day of the week and other contextual situations. How will customers' expectations be affected by such pricing formats? How can personal technologies enable firms to build customer loyalty and increase their pricing power?

4.3. Promotion

Many online retailers recommend products to their customers using collaborative filtering or adaptive personalization. These can be viewed as augmented services around the core product (like Netflix's recommendation system) or as personalized promotion.Focusing on such systems, Ansari, Essegaier, and Kohli (2000) developed a Bayesian preference model which considers the customer's preference heterogeneity and product heterogeneity. In their research, the unobserved attributes can be imputed with data augmentation from the observed rating data. Ying, Feinberg, and Wedel (2006) account for the endogenous selection in online recommendation ratings. They found that jointly examining the selection to rate a product and the corresponding ratings can improve recommendation quality. Bodapati (2008) made a distinction between the self-initiated purchase and the recommendation response and modeled the influence of a firm's recommendation on customers' purchase behaviors.He found that the model based on the expected response of the customer to a recommendation performs better than the traditional recommendation methods that merely recommend an item that a customer is highly likely to buy based on past preferences. Chung et al. (2009) have proposed an adaptive personalization system for online music (digital audio players) to adaptively personalize the service, fine-tuning the service over time for each individual customer, based on observation of that customer's behavior. Such closed-loop feedback systems render the systems to be highly effective. Wedel and Kannan (2016) have provided a detailed review of such systems.

Email and display are two firm-initiated tools used to reach customers. Ansari and Mela (2003) showed that emails with customized design and content can increase website traffic. With their proposed content-targeting method, the CTR of the emails was shown to increase by 62%. However, firms should not overuse email communication. Ansari, Mela, and Neslin (2008) found the overuse of email targeting could have a negative impact.

With ever-increasing spending on display ads, there has been extensive research on determining the effectiveness of the display ad. Winer and Ilfeld (2002) found that online advertising leads to more website traffic, but may not increase brand awareness, whereas Drèze and Hussherr (2003) found display ads increase brand awareness and ad recall. A key metric of display ads' effectiveness is the CTR. Chatterjee, Hoffman, and Novak (2003) found the customers' responses to banner ads depend on the frequency, cumulative exposure, and elapsed time since the last click. They modeled a customer's propensity to click through a banner ad and found a non-linear decreasing relationship. As the same banner ad is repeatedly shown to the customer, the customer is less likely to click on the ad. Customers who revisit after a longer timeframe are more likely to click on banner ads than those with a shorter revisit interval. That is, customers who are new to a display ad or less frequently exposed to the ad are more likely to click. Beyond CTR, the impact of display exposure on purchase rate has also been studied. Manchanda et al. (2006) showed the number of exposures to a banner ad accelerates a purchase. As the visitors browse across more sites, this impact is stronger. In addition, they found that increased number of exposures and increased number of sites on which the display ads are shown increases the likelihood of repeat purchases.

In terms of path to purchase and browsing behavior, Rutz, Trusov, and Bucklin (2011) found that banner ads influence subsequent browsing behavior for certain customers. More recently, Hoban and Bucklin (2015) conducted an experiment that investigated the impact of display ads at different stages of the purchase funnel. They found a positive impact of display ad exposure on subsequent visits to the firm's website. A study by Bleier and Eisenbeiss (2015), using experiments both in the field and in the lab,

showed that the customer perceptions of informativeness and obtrusiveness of ads have an impact on their effectiveness. Specifically, although personalization can substantially enhance banner ad effectiveness, its impact hinges on its interplay with timing and placement factors.

A recent trend in display advertising is the re-targeting technique in which the customer is exposed to the impression of previously viewed products. Goldfarb and Tucker (2011a) found that the ad that is both obtrusive and targeted has less impact on purchase than ads that are only one or the other. This impact is also contingent on the product category. In more private categories, such as financial or health products, this effect is most prominent. In another study, Goldfarb and Tucker (2011b) found that when behavioral targeting is restricted by regulation, the ad effectiveness is undermined. Lambrecht and Tucker (2013) investigated retargeting display ads in which the ad shows the exact product a customer previously saw. They found the re-targeted display ads are less effective than generic ads, unless the customers refined their preference, for example, by visiting review websites.

In one of the early research on online promotions, Zhang and Krishnamurthi (2004) showed that customized promotion methods at the individual customer level better leverage the power of the digital environment than methods traditionally practiced offline. Zhang and Wedel (2009) formally compared effectiveness of customized promotions at three levels of granularity-mass market, segment specific, and individual specific – in both online and offline stores. One of their key findings was that loyalty promotions were more profitable in online stores than in offline stores, while the opposite was true for competitive promotions. They also found that, in the online environment, for categories that were promotion sensitive, individual-level customized promotions led to significant profit increase over segment- and mass market-level customized promotions. These results are important starting points for any future effort in online promotion – especially for display advertisements and couponing.

There are many third-party promotion and coupon sites online (e.g., Groupon, LivingSocial) that assist firms in acquiring customers through coupons and deal-of-the-day promotions. Eisenbeiss et al. (2015) examined the deal-of-the-day promotions and found that depending on the type of a promoted product (utilitarian vs. hedonic), promotional effectiveness varied. Additionally, they found differences in the attention that consumers pay to the discount level relative to the deal-of-the-day time constraint. Wu, Shi, and Hu (2015) found empirical evidence of two threshold effects in such group buying contexts – a significant increase of new sign-ups around the time when the thresholds of group-buying deals are reached, and a stronger positive relationship between the number of new sign-ups and the cumulative number of sign-ups before the thresholds are reached. There is a critical need for studying the impact on a firm's acquisition costs and the likelihood of retaining customers acquired through such promotions.

Building on our current knowledge of personalization and the promotion in a multi-channel environment, more research is needed to identify the causal relationship between promotion and conversion to enable accurate evaluation of the impact of promotion. One primary challenge faced by many firms is how to extract relevant and useful information from the large volumes of data, so-called "big data". Another challenge would be the "real-time" execution, which requires making use of large data sets with the aid of automation. Scalable modeling methods would be needed for future marketing research.

4.4. Place

There has been extensive research on consumer behavior in online channels, the effectiveness of online channels and forms of interactions on online channels, which has been subsumed in the discussion on Digital Environment as well as in the section on Marketing Research. We focus on the newer channels in this sub-section as well as multi-channel, omni-channel issues.

With the advent of new mobile devices such as smart phones and tablets, device attributes and the consumers' usage of these devices have significant implications for marketing. Using the data of microblogging users, Ghose, Goldfarb, and Han (2012) compared users' Internet browsing behaviors on mobile phones versus their browsing behaviors on personal computers. The research found that ranking effects were stronger for mobile phones: when a post moved up by one position, the click-through rates increased by 37%, which was 12% higher than the increase due to a one position movement upward on PCs. They attributed such differences to the smaller screen size and correspondingly higher search costs on mobile phones. In addition, they found the click-through rates are higher for geographically proximate brand posts - a 23% increase in click-through rates for brand posts one mile closer in distance on mobile phones and a 12% increase for posts on PC. Both of these findings highlight how browsing behaviors differ significantly on mobile phones and PCs.

Luo et al. (2013) analyzed the effectiveness of mobile targeting strategies - temporal targeting and geographical targeting, in a large-scale field experiment. The temporal targeting in this research comprised three manipulations (same-day, one day prior, or two days prior), and the geographical targeting also consisted of three (near, medium, or far). They found both temporal targeting and geo-targeting can increase sales separately. However, jointly using these two strategies did not show a synergistic boost on the sales. For example, for consumers with farther geo-targeted locations, the relationship between temporal targeting and sales showed an inverted-U shape.

Mobile devices provide a new platform for existing digital marketing channels such as email, display advertising (in mobile apps), search, etc. The ubiquitous usage of mobile devices extends the reach of advertisers. As the customer develops a lifestyle that relies more on mobile devices, the shift offers more opportunities for advertisers. Researchers have examined coupon redemption on mobile phones (Danaher et al., 2015) and geo-targeting (Fong, Fang, and Luo, 2015).Large scale field experiments were done to examine the mobile shopping behaviors and the synergy between mobile advertising and offline shopping (Fong et al., 2015).

With mobile devices becoming more important to a customer's path to purchase, there is a growing stream of research projects focused on all aspects of mobile devices as a channel. Research to understand the contribution of mobile devices to marketing

outcomes and to design media to optimize their effectiveness will be an active area of focus in the coming years.Specifically, with use of mobile apps becoming popular, the impact of apps on customer usage of the mobile channels, spending and customer loyalty are emerging as important areas of inquiry.

Multiple-channel issues in the context of the digital environment can be viewed from two perspectives. One is from the perspective of how online channels interact with traditional offline channels and create synergies. The other perspective is to view "channels" within the online environment such as display, search, e-mail, affiliates, etc., and how they interact to create value for customers, acquire customers, and increase customer loyalty. A large volume of literature focuses on multi-channel issues from the first perspective, which can provide useful insights into how online channels play a role in creating and extracting value for customers. For example, Verhoef, Neslin, and Vroomen (2007) studied how customers choose a channel for search or purchase with survey data. They identified three reasons to explain the research shopping phenomenon in which shoppers use the Internet to gather information, but ultimately make the purchase from a brick-and-mortar store. They found attribute-based decision-making, lack of channel lock-in, and cross-channel synergy as three mechanisms that lead to the popularity of research shopping. Rather than discuss all other research in this area in detail, we refer to Neslin et al. (2006), Neslin, Scott, and Shankar (2009) and Verhoef et al. (2015) for an excellent review of the developments in this area.

One of the advantages of the digital environment from a firm's viewpoint is that it is much easier to get data on the specific customer touchpoints with the firm. This data is very useful to measure the efficiency and effectiveness of various online marketing actions, and thereby optimize the marketing spend on various marketing instruments. Not only can firms measure the costs in acquiring customer online more accurately, costs of retention and other marketing actions can be apportioned to individual customers and segment levels. When customers interact with many marketing instruments/channels on their path to purchase, the question of how each individual channel is evaluated in terms of its contribution to sales becomes important. This "attribution" problem of attributing conversions, acquisitions and retentions to individual channels, as well as the measurement of the carryover and spillovers effects of individual channels/marketing touchpoints have been a focus of active research.

Focusing on the attribution problem, Li and Kannan (2014) developed a hierarchical model to examine the customer's consideration of using a marketing channel, their visit and purchase at the channel in an online multichannel environment. Using individual-level impression, visit and purchase data, they attributed the conversion credit to individual marketing channels, such as search, display, email, referral and direct site visits. Based on their proposed attribution method, the often used last click attribution or linear weighted attribution over-estimates the search channel and under-estimates the referral, email and display channel. Xu, Duan, and Whinston (2014) and Todri and Ghose (2016) made similar contributions in the research space. An overview of attribution research is discussed in Kannan, Reinartz, and Verhoef (2016).

Research has shown spillover effects among the online marketing channels and between online and offline channels. For example, Rutz et al. (2011) found a spillover effect from paid searches to subsequent direct visits. Li and Kannan (2014) also found strong spillover effects across channels when examining six online marketing channels. Joo et al. (2013) found TV ads can promote the volume of Google searches, especially searches on brand keywords. Danaher and Dagger (2013) investigated ten advertising channels and found single-medium elasticity decreased in the order of catalog, then direct mails, television, email, and online searches. Dinner et al. (2014) found the cross channel effects were as strong as its own channel effects. In particular, the cross effects are strong for display and paid search advertising. However, the impact of offline advertising on paid search click-through rate is negative. Batra and Keller (2016) have provided an excellent review of such spillover effects which complements this discussion.

As customers are taking more control of their information search, how can firms identify the most appropriate place to contact the customers and motivate them to search for more information and make a purchase in an omni-channel world? Do customers consider and use different sets of channels when using different devices? Future research can also focus more on the shopping behaviors of various segments, regarding when, where and how to reach them.

5. Marketing outcomes

Outcomes of firms' actions as a function of the environment that they operate in can be classified into value for customers encompassing the dimensions of value equity (the objective value they derive), brand equity, and relationship equity (Rust, Lemon, and Narayandas, 2004) and customer satisfaction, customer value and its elements, and firm value and its elements (Fig. 1). Much of the extant research discussed in this paper affects one or more of the above dimensions and we do not repeat all of it here. Instead we will provide a few exemplars below.

On the dimension of value for customers, Steenkamp and Geyskens (2006) examined how country characteristics systematically moderate the effects of individual-level drivers of the perceived value that consumers derive in visiting a brand's website, based on a large scale data from 23 countries. One of their main findings was that customers living in more individualistic countries gave more weight to pleasure, to privacy/security protection, and to customization in their perceived value judgments than customers from collectivistic countries, a finding that has implications for web site design. Shankar, Smith, and Rangaswamy (2003), focusing on the impact of digital environment on outcome, examined whether the levels of customer satisfaction and loyalty for the same service are different when customers choose the service online versus offline. They found that the levels of customer satisfaction for a service chosen online were the same as when the service is chosen offline, but the loyalty to the service provider was higher when the service is chosen online. In a related study, Danaher, Wilson, and Davis (2003) compared consumer brand loyalty in online and traditional shopping environments for over 100 brands in 19 grocery product categories. They found that observed brand loyalty for high market share brands bought online was significantly greater than expected, with the reverse result for small share

brands, where there was no such difference in the offline environment. It would be interesting to examine the mechanism that led to this effect and understand why consumers would exhibit such behavior.

An illustration of the research that relates an element of the environment directly to an outcome variable is by Sonnier, McAlister, and Rutz (2011) who focused on the sales effect of the volume of positive, negative and neutral online customer interactions. They modeled daily measures of online word-of-mouth about the firm and its products as contributions to a latent demand-generating stock variable and found significant effect of positive, negative, and neutral eWOM on daily sales performance. Later McAlister, Sonnier, and Shively (2012) extended this analysis to firm value and found that online chatter had a significant impact on firm value and rule out all possible alternative explanations for this result. Stephen and Toubia (2010) examined the economic value implications of social commerce in online social networks where sellers are individuals. They found that allowing sellers to connect to customers can generate considerable economic value in terms of sales with the value from the network emanating primarily from the access customers have to the marketplace, thus highlighting the value inherent in networks for both customers and sellers. Finally, Kumar et al. (2016) studied the impact of firm-generated content in social media sites on individual customer purchases in and across product categories and found that firm-generated content complemented and strengthened the impact of TV and email marketing on sales. One of the important aspects of the above research linking digital environment and firm actions is the rigor in ensuring that alternative explanations are ruled out.

6. Marketing research

The digital environment produces a vast array of data ranging from clickstream data, customer reviews and ratings, blogs, tags, and social interaction data, to customer responses to marketing actions and information on collaborators and competitors. This data is very informative for a firm to understand online customer behavior, develop marketing strategies, and measure the effectiveness of its actions and tactics on marketing outcomes. In this section, we focus on empirical research that is centered on understanding the digital environment and relating the digital environment to the outcomes of marketing actions.

Early research on digital environment by Hoffman and Novak (1996) proposed a structural model of consumer navigation behavior in the digital environment that incorporated the notion of flow. Later, the model was formalized with a quantitative analysis to relate the model to specific consumer behaviors online (Novak, Hoffman, & Yung, 2000). Based on the actual behavioral data customer clickstream analysis became popular. Bucklin and Sismeiro (2003) modeled visitors' browsing behaviors at a website and examined visitors' decisions to continue browsing more pages (or exit) and the length of time spent at websites. The dynamics of browsing are consistent with lock-in and stickiness of the website and a visitor's learning over repeated visits. Using similar data, Sismeiro and Bucklin (2004) modeled online buying behavior of customers. Key findings included that the number of repeat visits is not indicative of purchase propensity and the availability of sophisticated decision aids does not guarantee conversion. Moe (2003) used clickstream data to empirically test a typology of store visits which varied with shoppers' underlying objectives – buying, browsing, searching or knowledge-building – and was able to categorize visits using the behavioral data. Such categorization helps to identify and target prospective buyers and design more effective and customized promotional message. Clickstream analysis is widely used for market research purposes (e.g., Moe & Fader, 2004) and Bucklin and Sismeiro (2009) have provided a review of advantages and limitations of such data for research purposes and how best to leverage them.

Another rich source of data is from social interactions in social networks. Trusov, Bodapati, and Bucklin (2010) focused on identifying the influential members in a social network – the influencers – who could then be the target for a firm hoping to propagate their message. The authors developed an approach to determine the specific users who have significant effects on the activities of others using the longitudinal records of members' log-in activity (see also Shriver, Nair, & Hostetter, 2013). Katona, Zubcsek, and Sarvary (2011) studied how the adoption of a product/service is influenced by network effects and personal influences. Using the metrics of network structure, their model focused on predicting the next set of adopters given a set of previous adopters. Such methodologies have practical implications for viral marketing by revealing the network connections among potential customers. Moe and Trusov (2011) examined consumer product ratings and developed a model to tease apart the variation in ratings due to personal product experience from variation due to social influences, which allowed them to quantify the impact of social dynamics on sales.

There is an evolving stream of research that uses the data generated in the digital environment to create metrics related to firm performance. Tirunillai and Tellis (2012) showed that UGC is related to the stock market performance of a firm. Specifically, they found that the volume of UGC chatter has a strong positive impact on abnormal returns and trading volume, with the effect of negative and positive valence of UGC being asymmetric. They also found that an increase in off-line advertising significantly increases the volume of chatter and decreases negative chatter. Tirunillai and Tellis (2014) showed that UGC data can be mined for marketing purposes to create dynamic mapping of competitive brand positions on dimensions deemed important through the analysis of data over time. Nam and Kannan (2014) used social tagging data and developed tag-based metrics that worked as proxy measures for customer-based brand equity and explained abnormal returns. This stream of research shows that digital environment data can contain very useful information for tracking a firm's performance. There is still much to be explored using such data (see for example, Lee & Bradlow, 2011) and our agenda for future research in Section 8 will outline some opportunities that exist in that space. From a methodological perspective the paper by Wedel and Kannan (2016) provides the specifics that are relevant from a marketing research and analytics viewpoint and complements this section.

7. Marketing strategy

Two core marketing elements that a firm focuses on to maintain a sustainable competitive advantage are its brand and its customers.In this section, we focus on recent research related to these elements of marketing strategy that are not specifically captured in the other sections – and address how a firm should strategically manage its brand and customers in the ever-changing digital landscape. The introduction of new channels, new shopping devices, and new customer interactions calls for an updated understanding of the customer management and brand management and requires the firms to re-define their marketing mix metrics and CRM metrics. For example, Haenlein (2013) examined the impact of social interactions on customer churning and reported that the churning rate is higher for a customer who is connected with previously churned individuals. Malthouse et al. (2013) discussed how social media would re-shape the "social CRM" strategies and emphasized that customer value includes not only the purchase-based value, but also the value of their social influence. Given that some elements of customer value are impacted significantly by the digital technologies, such research calls for a more inclusive definition of customer value. In this content, Lemon and Verhoef (2016) and Kumar and Reinartz (2016) have provided useful frameworks to understand the role of customer experience and customer engagement afforded by digital technologies in creating value for customers as well as increasing customer lifetime value.

The focus with regard to brand management is on understanding how the brand is created, modified and strengthened in and by the digital landscape. Hewett et al. (2016) described how social media sites have created a reverberating "echoverse" for brand communication, forming complex feedback loops between firm communications, news media, and user-generated social media. They found that while firms benefit from using social media for personalized customer responses and online brand communications, traditional brand communications still have a key role to play in shaping the brand. Batra and Keller (2016) have provided an overview of these synergies in the context of brand communications.A firm's brand positioning strategy can be impacted by their search engine marketing (SEM) and search engine optimization (SEO) strategies (Dou et al. 2010). As SEM and SEO are adapted and applied for mobile, voice search, in-app search and chat room commerce, more factors and metrics need to be considered when developing a branding strategy. Hanssens and Pauwels (2016) have provided an extensive discussion of the metrics and measures needed to monitor the implementation of strategies and also define the value of marketing to the firm.

As new digital devices and technologies evolve, future research needs to focus on how firms can use these developments to create sustainable competitive advantage, gain market share, and increase customer equity and brand equity. We highlight some of these research issues in the next section.

8. Agenda for future research

By design, our review of extant work in digital marketing has focused only on marketing journals, primarily to keep the review tractable as well as to uncover the gaps that exist in the marketing literature and suggest new topics for exploration. Any new research effort has to be cognizant of the theories and models developed in marketing as well as in consumer psychology, sociology, economics, computer science and operations research in taking on new lines of inquiry. From this perspective, we provide below specific research issues and questions as digital technologies interact with each of the broad areas identified in Fig. 1 – environment (Box 1), company (Box 2 and Box 4), outcomes (Box 3), and marketing strategy (Box 5).

While new digital technologies are emerging constantly, we only highlight below the broad categories of technologies and methodologies that are likely to impact marketing in the near future.

1. Personal computing devices and technologies including mobile devices, wearable technologies (e.g., smart watches, smart glasses), virtual reality (VR) and augmented reality (AR) technologies, mobile apps, etc.;
2. Computing technologies and analytical methodologies including cloud computing, AI, cognitive computing and deep learning, machine learning techniques, and big data analytics;
3. Search technologies for images, videos, voice-recognition based search, eye-tracking technologies, and search technologies for the "dark" web;
4. Connectivity technologies including sensors, Internet of Things (IoT), chat technologies, new forms of platforms such as Uber, Airbnb, etc.

We focus on these technologies and their interactions with the elements of Fig. 1.

8.1. Environment

In evaluating the impact of digital technologies on the elements of the environment, understanding the attributes and characteristics of the technology and/or device is critical.These have important implications for the adoption of technology and usage by customers – specifically, the situational factors of adoption and usage (when, how, and where) and the extent of adoption and usage.The attributes that are unique to the technology and device will especially be important in the above analysis (e.g., location for mobile devices).

1.1. There is a critical need for consumer behavioral theories to explain the psychological motivations for adopting devices such as mobile and wearable computing (e.g., Belk, 2013, Hoffman, & Novak, 2015). How do consumers' cognitive capabilities and experiences change in the context of using the new devices?

1.2. What are the implications of adopting mobile and/or wearable technologies on customers purchase journey?The specific questions with regard to consumer behavior in usage of these devices will cover the pre-purchase, purchase consummation and post-purchase stages and could include:how do consumers use these devices for searches as compared to searches using desktops and laptops? How does the composition and size of the consideration set in using the devices vary from those in other contexts? How is consumer choice affected? How do the answers to the previous questions vary across product/service categories?
1.3. In the context of customer decision journeys, it is necessary to understand the specific roles that each digital touchpoint plays in consumers' overall decision making (search, display ads, recommendations, e-mails). Both theoretical and empirical research is needed to characterize how the touchpoints interact and impact the length of the decision journey (see also Lemon & Verhoef, 2016). How are they impacted by the specific device used?
1.4. As technology becomes more individual focused, small and wearable, would ubiquitous access reduce consumers' search costs? Or would search costs rise for consumers using increasingly smaller devices? How would the impact of search cost affect the competition in product categories? What conceptual and behavioral research can provide insights into these questions?
1.5. Would customers focus on only the most trusted firms when using their personal devices?Given the personalized nature of devices and interactions, it could be argued that customers may become less price-sensitive. Could they also become more loyal to a brand/firm as they increasingly use personal devices to interact with that brand/firm? Will they spend more money as a result?
1.6. What will be the new nature of user-generated content such as reviews and ratings when new device/technology becomes more popular? Would they be less frequent, less detailed, and more focused on fewer products? Will there be a systematic differences in the reviews provided on different devices – more extreme reviews in the context of mobile versus more varied in the context of PC or stationary devices? If so, how can explain such differences?
1.7. How can platforms maintain the engagement of customers/crowds in e-commerce interactions or in new product/service development ideation processes? How can the social process and commercial process of a platform co-exist and complement each other in chat apps such as Line and in virtual marketplaces offered by Facebook?
1.8. There are exciting developments in the area of visual marketing (Wedel & Pieters, 2007), cognitive computing, anticipatory computing, and deep learning, that are based on data capture of eye movements, bio rhythms, textual information, which are likely to lead to high degree of personalization that anticipates customer needs in digital space.These developments along with the advances in IoT can provide customers of tomorrow values that cannot be easily imagined at this point. However, these also come with risks.Firms may benefit, at the expense of customers, from inferred preference and usage data of customers.For example, firms can dynamically use price discrimination and extract more value out of customers using such data. An auto insurance firm can benefit from data about a customer's driving behavior and set insurance rates.If giving access to customer data means adding additional risks, will customers be willing to share data?How can firms engender consumer trust in such contexts?How do these risks trade-off with the additional value that customers derive through personalized service? What kinds of mechanisms can be designed to benefit both firms and customers while safeguarding their privacy and security?It is important that marketing as a discipline focus on such issues proactively by putting such research on the forefront.

8.2. Company

Digital technologies enable firms to wrap their core products and services with digital services. They also allow versioning of products and services, especially for information products. They provide opportunities for networked products as in the case of IoT.The research questions in this context include:

2.1 To what extent can firms benefit from such new technology wraps – for example, branded apps or virtual reality technology? How do they affect customer engagement, revenues and margins across multiple channels and overall customer retention and customer value?
2.2 How should the freemium product line be designed – for information, entertainment and video games, and cloud services – so as to maximize overall customer value? Field experiments can be very useful in answering such questions.
2.3 What are the opportunities for real-time pricing based on demand and provide value to customers? How would consumers respond to such pricing schemes?
2.4 As much interest as IoT has generated, initial indications are that the customer adoption of smart home technology is not high (Schneier, 2015). Apart from the cost concerns, the low adoption rate could result from privacy concerns surrounding the data capture by firms or because of the fear of lock-in and limited choices when a single firm supplies all the components and networks. So the critical question is: how should firms design IoT products/networks for modularity and compatibility and price it accordingly? There is a need for new design options and pricing options to boost the adoption.

One of the most important thrusts of future research in digital marketing will be in the area of cross-device and cross-channel marketing. With the increased fragmentation of media and the increased number of device options for consumers to choose from, it is the cross-device consumer behavior that will dictate who the winners and losers will be in the digital space. This calls for focused theoretical, descriptive and prescriptive research covering the following issues:

2.5 Why are consumers motivated to use different devices? What are the psychological factors that drive the usage? What situational factors dictate when, where and how customers use different devices? Are the device usages substitutes or complements? What factors moderate the usage and substitutability and complementarity?

2.6 Why and how do customers' paths to purchase vary across devices and how do their device choices affect their search and purchase behaviors? How do these vary across product/service categories? More specifically, how is the purchase of information products affected by cross-device behavior?

2.7 What are the implications of cross device usage for product design? For example, children's TV programming has evolved into an entire ecosystem consisting of TV-content plus online interactive content, games, and videos – all of which are complementary and fulfill consumer needs across different types of devices. Such designs are needed to keep the competition from stealing customers whenever customers switch devices. What is the dynamic product strategy that will ensure this?

2.8 How does cross-device usage impact pricing, especially in the marketing of content? Do customers derive differential value in using different devices?For example, when the Wall Street Journal (WSJ) introduced its online version, it implemented two differential pricing schemes for the online version and the print version. When mobile devices became more popular, WSJ adopted a third pricing scheme just for mobile devices. The question is whether the derived value is the same across all formats and whether WSJ should charge for the option value.

2.9 Should firms use price discrimination strategy based on the devices selected by the customers? If so, how should they do it? Will customers be less price-sensitive or more price-sensitive as they move across devices?

2.10 How can a firm coordinate across devices and channels to provide the best digital experience for its customers? How should they promote across devices as the customers' paths of purchase cross device boundaries? What will be the role of decision aids in linking different devices and in coordinating paths to purchase across devices? The proliferation of new technologies and online channels and the spread of marketing investments across these entities has hindered the ability of firms to measure the impact of their marketing investments accurately.

2.11 The multi-device, multi-screen environment may fragment and distract customers' attention. When and how should the firm insert their ads on customers' journey in this environment and engage the customers amid the distractions?

2.12 Improved attribution methodologies and appropriate data are needed for understanding the individual impact of channels and touchpoints – across offline (e.g., TV, print) and online boundaries, and across various devices and online channels. While there has been some effort in this area, it is necessary to develop generalizable results on carryover and spillover effects across devices and channels so that firms can get a better understanding of the directions of these effects and can more accurately measure the impact of their investments in specific contexts (as an example see the meta-analysis of marketing communication carryover effects by Kohler et al. (2016)).

2.13 Personalization for customer targeting (with display ads, retargeting and promotions) across different channels and devices will be the greatest challenge faced by firms as they seek greater efficiency in their marketing spending.Research in methodologies that provide real-time, accurate targeting across platforms and the development of intermediaries who can help in such personalization will be of significant importance in the digital space.

2.14 Development of media mix model to optimally allocate marketing investments across devices and online channels is crucial for improved marketing ROIs.Given that the planning cycles for such investments vary in time, it is important to develop hierarchical marketing investment models taking into account the individual channel/device effectiveness.

Significant research has been done in the area of online ratings, reviews, social media interactions, and online chatter. The data have been related to sales, brand performance, and stock market returns, and further used to understand customers' motivations to post and the impact of social influence versus experience on ratings and reviews, etc. However, there are still many opportunities to harvest such data for gaining insights into many important marketing issues.

2.15 How can the data on social interactions, reviews and ratings be used for designing new products, services and new pricing plans?How can a firm use such data to tease apart customers' own preferences from social influence? What can the data reveal about consumers' preference formation?

2.16 How can firms measure the impact of mass media on social media and the subsequent viral nature of the posts? How can firms actively monitor and manage social media to ensure positive brand images? How can firms use firm-generated content in social media to influence brand images and promote sales online as well as in offline channels?

2.17 How can social media data be used for enhancing customer service? How can sentiment analysis be used as an indicator of how well the actions of the firms are viewed? How should the benchmarking be done on these to avoid overreaction to social posts? How should firms organize customer service teams to better use the data from social media for superior service outcomes?

8.3. Marketing outcomes

Implementing marketing strategies and managing the process has been complicated by the fragmentation of media and proliferation of devices and channels, as marketing investments and measurement of returns are spread across many entities.The design and the implementation of marketing operations and related processes is becoming a key differentiator between success and failure. In this context, the key research questions are:

3.1 How can dashboards be designed to provide indicators and feedback to management on their actions? What are the key metrics that significantly influence returns and need close scrutiny? Given the increasing velocity of day-to-day commerce, what is the optimal frequency of the updates provided?
3.2 How should the marketing operations be structured and organized? How can the principles of operations management and hierarchical planning be applied to marketing operations?
3.3 How should the firm design its real-time testing and acquire feedback on marketing tactics? How can bucket testing and real-time testing be automated?
3.4 As firms introduce mobile apps what impact would they have on increasing customer equity and firm value? Similarly, can VR and AR technologies increase customer equity?

8.4. Marketing strategy

4.1 From a strategic perspective, it is important to understand how the competitive landscape may change as a result of technological advances. For example, Amazon has emerged as a behemoth in the retail domain, completely altering the competitive landscape using the online channel.This happened in conjunction with consumer behavior changing as the online technology matured.Can mobile technology disrupt markets in a similar way? There are recent examples of travel intermediaries benefiting from the introduction of mobile apps in the travel and hospitality industries and strengthening their competitive position in the market vis-à-vis hotel chains.Rather than creating disintermediation, technology has made the intermediaries stronger. Could this repeat in other verticals? These are important research issues to consider as technological developments emerge.
4.2 If the firm/product category is significantly affected on the basis of the above analysis, how can the firm take advantage of the technology/device better than its competition? How can the firm adapt the design and price of the product according to the additional value that is created for the customers? How can the firm use the technology to better promote their product/service (cf., geo-targeting and coupons in the case of mobile devices)?How can the firm adapt its current marketing mix to influence customer behavior in a direction that benefits the firm?How can the firm design a digital experience that increases customer satisfaction, revenue and customer loyalty (e.g., can mobile apps create greater customer loyalty?) Answering these questions will necessarily involve theoretical models and frameworks from consumer psychology, sociology and economics.
4.3 Just as ubiquitous connectivity enabled by mobile devices and platforms contributes to the emergence of category-dominant companies such as Uber and Facebook, it is important to research how providing value to customer using connectivity can alter competitive boundaries. This will be an increasingly important topic of inquiry in the future.
4.4 Finally, it is tacitly assumed that firms should adopt new digital technologies as they emerge to provide more value to customers. However, the value delivered to customers depends on the provision of reliable and superior service using the technology. What are the first-mover advantages in adopting new digital technologies? Would a firm be better off waiting for its competitors to adopt the technology first? Are there late-mover advantages? The answers to these questions depend on the specific technology, firm and customer base characteristics and competitive market factors. Both normative and empirical research is needed in this area.

9. Conclusion

Our key objective in this paper is to set an agenda for research in digital marketing.We have defined digital marketing in the broadest sense and we have developed and proposed a framework that highlights the touchpoints in the marketing process as well as in the marketing strategy process where digital technologies play a key role.Using this framework we have organized and reviewed the extant research around these touchpoints. The unresolved questions in each area we have identified above can benefit from future research, so we have integrated all these questions into a broad agenda in Section 8. We have purposely synthesized the research issues at a high level to stimulate more detailed and specific research aided by our framework. We leave it for other researchers to delve into these issues.The extant survey papers we identified should complement this paper well. To keep our analysis tractable we have focused only on papers in the marketing domain. However, there are several important contributions in the area of information systems, operations management and economics which could complement our work.

Finally, we have some observations regarding the research process that will lead to useful knowledge. It is imperative that academic- and practitioner- communities work together in order to tackle these research issues (For examples, see Lilien & Rangaswamy, 2000; Roberts, Kayande, & Stremersch, 2014). For one, the pace of digital technology development has increased tremendously. Owing to the need to gain competitive advantage, implementations of technological developments by firms is often rapid and without thorough deliberation of the pros and cons or ROI. There is a need for researchers to take a critical look at the research issues we outlined with appropriate data from observational studies and field experiments.Practitioners can provide the raw material and academics can provide the rigor, and together they can extend our knowledge of the ever-changing digital environment. The good news is that digital marketing is already seeing such collaborations and this augurs well for the future.

References

Abou Nabout, N., Skiera, B., Stepanchuk, T., & Gerstmeier, E. (2012). An analysis of the profitability of fee-based compensation plans for search engine marketing. *International Journal of Research in Marketing*, *29*(1), 68–80.

Agarwal, A., Hosanagar, K., & Smith, M. D. (2011). Location, location, location: An analysis of profitability of position in online advertising markets. *Journal of Marketing Research*, *48*(6), 1057–1073.

Amaldoss, W., & Jain, S. (2008). Research note-trading up: A strategic analysis of reference group effects. *Marketing Science*, *27*(5), 932–942.

Amaldoss, W., Desai, P. S., & Shin, W. (2015). Keyword search advertising and first-page bid estimates: A strategic analysis. *Management Science*, *61*(3), 507–519.

Anderson, E. T., & Simester, D. I. (2014). Reviews without a purchase: Low ratings, loyal customers, and deception. *Journal of Marketing Research*, *51*(3), 249–269.

Andrews, M., Luo, X., Fang, Z., & Ghose, A. (2015). Mobile ad effectiveness: Hyper-contextual targeting with crowdedness. *Marketing Science*, *35*(2), 218–233.

Ansari, A., & Mela, C. F. (2003). *E*-customization. *Journal of Marketing Research*, *40*(2), 131–145.

Ansari, A., Essegaier, S., & Kohli, R. (2000). Internet recommendation systems. *Journal of Marketing Research*, *37*(3), 363–375.

Ansari, A., Mela, C. F., & Neslin, S. A. (2008). Customer channel migration. *Journal of Marketing Research*, *45*(1), 60–76.

Bakos, Y., & Brynjolfsson, E. (2000). Bundling and competition on the internet. *Marketing Science*, *19*(1), 63–82.

Batra, R., & Keller, K. L. (2016). Integrating marketing communications: New findings, new lessons, and new ideas. *Journal of Marketing*, *80*(6), 122–145.

Bayus, B. L. (2013). Crowdsourcing new product ideas over time: An analysis of the Dell IdeaStorm community. *Management Science*, *59*(1), 226–244.

Belk, R. W. (2013). Extended self in a digital world. *Journal of Consumer Research*, *40*(3), 477–500.

Bell, D., & Song, S. (2007). Neighborhood effects and trial on the internet: Evidence from online grocery retailing. *Quantitative Marketing and Economics*, *5*(4), 361–400.

Berman, R., & Katona, Z. (2013). The role of search engine optimization in search marketing. *Marketing Science*, *32*(4), 644–651.

Berry, S., Khwaja, A., Kumar, V., Musalem, A., Wilbur, K. C., Allenby, G., ... Mele, A. (2014). Structural models of complementary choices. *Marketing Letters*, *25*, 245–256.

Bleier, A., & Eisenbeiss, M. (2015). Personalized online advertising effectiveness: The interplay of what, when, and where. *Marketing Science*, *34*(5), 669–688.

Bodapati, A. V. (2008). Recommendation systems with purchase data. *Journal of Marketing Research*, *45*(1), 77–93.

Bronnenberg, B. J., Kim, B. J., & Mela, C. F. (2016). Zooming in on choice: How do consumers search for cameras online? *Marketing Science*, *35*(5), 693–712.

Bucklin, R. E., & Sismeiro, C. (2003). A model of web site browsing behavior estimated on clickstream data. *Journal of Marketing Research*, *40*(3), 249–267.

Bucklin, R. E., & Sismeiro, C. (2009). Click here for internet insight: Advances in clickstream data analysis in marketing. *Journal of Interactive Marketing*, *23*(1), 35–48.

Bughin, J. (2015). *Brand success in an era of digital Darwinism.* February: Mckinsey Quarterly.

Büschken, J., & Allenby, G. M. (2016). Sentence-based text analysis for customer reviews. *Marketing Science*, *35*(6), 953–975.

Chakravarty, A., Kumar, A., & Grewal, R. (2014). Customer orientation structure for internet-based business-to-business platform firms. *Journal of Marketing*, *78*(5), 1–23.

Chan, T. Y., Wu, C., & Xie, Y. (2011). Measuring the lifetime value of customers acquired from google search advertising. *Marketing Science*, *30*(5), 837–850.

Chatterjee, P., Hoffman, D. L., & Novak, T. P. (2003). Modeling the clickstream: Implications for web-based advertising efforts. *Marketing Science*, *22*(4), 520–541.

Chen, J., Liu, D., & Whinston, A. B. (2009). Auctioning keywords in online search. *Journal of Marketing*, *73*(4), 125–141.

Chen, Y., Wang, Q., & Xie, J. (2011). Online social interactions: A natural experiment on word of mouth versus observational learning. *Journal of Marketing Research*, *48*(2), 238–254.

Chevalier, J. A., & Mayzlin, D. (2006). The effect of word of mouth on sales: Online book reviews. *Journal of Marketing Research*, *43*(3), 345–354.

Chung, T. S., Rust, R. T., & Wedel, M. (2009). My mobile music: An adaptive personalization system for digital audio players. *Marketing Science*, *28*(1), 52–68.

Court, D., Elzinga, D., Mulder, S., & Vetvik, O. J. (2009). The consumer decision journey. *The McKinsey Quarterly* (June). (accessed November 27, 2015). available at http://www.mckinsey.com/insights/marketing_sales/the_consumer_decision_journey

Danaher, P. J., & Dagger, T. S. (2013). Comparing the relative effectiveness of advertising channels: A case study of a multimedia blitz campaign. *Journal of Marketing Research*, *50*(4), 517–534.

Danaher, B., Dhanasobhon, S., Smith, M. D., & Telang, R. (2010). Converting pirates without cannibalizing purchasers: The impact of digital distribution on physical sales and internet piracy. *Marketing Science*, *29*(6), 1138–1151.

Danaher, P. J., Wilson, I. W., & Davis, R. A. (2003). A comparison of online and offline consumer brand loyalty. *Marketing Science*, *22*(4), 461–476.

Danaher, P. J., Smith, M. S., Ranasinghe, K., & Danaher, T. S. (2015). Where, when and how long: Factors that influence the redemption of mobile phone coupons. *Journal of Marketing Research*, *52*(5), 710–725.

Degeratu, A. M., Rangaswamy, A., & Wu, J. (2000). Consumer choice behavior in online and traditional supermarkets: The effects of brand name, price, and other search attributes. *International Journal of Research in Marketing*, *17*(1), 55–78.

Dellaert, B. G. C., & Stremersch, S. (2005). Marketing mass-customized products: Striking a balance between utility and complexity. *Journal of Marketing Research*, *42*(2), 219–227.

Desai, P. S., Shin, W., & Staelin, R. (2014). The company that you keep: When to buy a competitor's keyword. *Marketing Science*, *33*(4), 485–508.

Dinner, I. M., Van Heerde, H. J., & Neslin, S. A. (2014). Driving online and offline sales: The cross-channel effects of traditional, online display, and paid search advertising. *Journal of Marketing Research*, *51*(5), 527–545.

Dou, W., Lim, K. H., Su, C., Zhou, N., & Cui, N. (2010). Brand positioning strategy using search engine marketing. *MIS Quarterly*, 261–279.

Drèze, X., & Hussherr, F. X. (2003). Internet advertising: Is anybody watching? *Journal of Interactive Marketing*, *17*(4), 8–23.

Edelman, D. C., & Singer, M. (2015). Competing on customer journeys. *Harvard Business Review*(November 2015).

Eisenbeiss, M., Wilken, R., Skiera, B., & Cornelissen, M. (2015). What makes deal-of-the-day promotions really effective? The interplay of discount and time constraint with product type. *International Journal of Research in Marketing*, *32*(4), 387–397.

Elberse, A. (2010). Bye-bye bundles: The unbundling of music in digital channels. *Journal of Marketing*, *74*(3), 107–123.

Essegaier, S., Gupta, S., & Zhang, Z. J. (2002). Pricing access services. *Marketing Science*, *21*(2), 139–159.

Fang, E., Li, X., Huang, M., & Palmatier, R. W. (2015). Direct and indirect effects of buyers and sellers on search advertising revenues in business-to-business electronic platforms. *Journal of Marketing Research*, *52*(3), 407–422.

Fay, S. (2004). Partial-repeat-bidding in the name-your-own-price channel. *Marketing Science*, *23*(3), 207–418.

Fong, N. M., Fang, Z., & Luo, X. (2015). Geo-conquesting: Competitive locational targeting of mobile promotions. *Journal of Marketing Research*, *52*(5), 726–735.

Ghose, A., & Yang, S. (2009). An empirical analysis of search engine advertising: Sponsored search in electronic markets. *Management Science*, *55*(10), 1605–1622.

Ghose, A., Goldfarb, A., & Han, S. P. (2012). How is the mobile Internet different? Search costs and local activities. *Information Systems Research*, *24*(3), 613–631.

Godes, D., & Mayzlin, D. (2004). Using online conversations to study word-of-mouth communication. *Marketing Science*, *23*(4), 545–560.

Godes, D., & Mayzlin, D. (2009). Firm-created word-of-mouth communication: Evidence from a field test. *Marketing Science*, *28*(4), 721–739.

Godes, D., & Silva, J. C. (2012). Sequential and temporal dynamics of online opinion. *Marketing Science*, *31*(3), 448–473.

Godes, D., Ofek, E., & Sarvary, M. (2009). Content vs. advertising: The impact of competition on media firm strategy. *Marketing Science*, *28*(1), 20–35.

Goldfarb, A., & Tucker, C. (2011a). Online display advertising: Targeting and obtrusiveness. *Marketing Science*, *30*(3), 389–404.

Goldfarb, A., & Tucker, C. (2011b). Privacy regulation and online advertising. *Management Science*, *57*(1), 57–71.

Granados, N., Gupta, A., & Kauffman, R. J. (2012). Online and offline demand and price elasticities: Evidence from the air travel industry. *Information Systems Research*, *23*(1), 164–181.

Haenlein, M. (2013). Social interactions in customer churn decisions: The impact of relationship directionality. *International Journal of Research in Marketing*, *30*(3), 236–248.

Halbheer, D., Stahl, F., Koenigsberg, & Lehmann, D. R. (2014). Choosing a digital content strategy: How much should be free? *International Journal of Research in Marketing*, *31*(2), 192–206.

Hann, I., & Terwiesch, C. (2003). Measuring the frictional costs of online transactions: The case of a name-your-own-price channel. *Management Science*, *49*(11), 1563–1579.

Hanssens, D. M., & Pauwels, K. H. (2016). Demonstrating the value of marketing. *Journal of Marketing*, *80*(6), 173–190.
Haruvy, E., & Popkowski Leszczyc, P. T. (2010). Search and choice in online consumer auctions. *Marketing Science*, *29*(6), 1152–1164.
Haubl, G., & Trifts, V. (2000). *Consumer decision making in online shopping environments: The effects of interactive decision aids.* February: Marketing Science, 4–21.
Hewett, K., Rand, W., Rust, R. T., & van Heerde, H. J. (2016). Brand Buzz in Echoverse. *Journal of Marketing*, *80*(3), 1–24.
Hildebrand, C., Haubl, G. and Herrmann, A (2014), Product customization via starting solutions, Journal of Marketing Research, Vol. 51, Is. 6, p. 707–725.
Hoban, P. R., & Bucklin, R. E. (2015). Effects of internet display advertising in the purchase funnel: Model-based insights from a randomized field experiment. *Journal of Marketing Research*, *52*(3), 375–393.
Hoffman, D. L., & Novak, T. P. (1996). Marketing in hypermedia computer-mediated environments: Conceptual foundations. *Journal of Marketing*, *60*(3), 50–68.
Hoffman, D. L. and Novak, T. P. (2015), "Emergent experience and the connected consumer in the smart home assemblage and the internet of things" Available at SSRN: http://ssrn.com/abstract=2648786
Iyengar, R., Jedidi, K., & Kohli, R. (2008). A conjoint approach to multipart pricing. *Journal of Marketing Research*, *45*(2), 195–210.
Iyengar, R., Jedidi, K., Essegaier, S., & Danaher, P. (2011). The impact of tariff structure on customer retention, usage, and profitability of access services. *Marketing Science*, *30*(5), 820–836.
Jain, S. (2008). Digital piracy: A competitive analysis. *Marketing Science*, *27*(4), 610–626.
Jain, S., & Kannan, P. K. (2002). Pricing of information products on online servers: Issues, models, and analysis. *Management Science*, *48*(9), 1123–1143.
Jank, W., & Kannan, P. K. (2005). Understanding geographical markets of online firms using spatial models of customer choice. *Marketing Science*, *24*(4), 623–634.
Jiang, B. J., Jerath, K., & Srinivasan, K. (2011). Firm strategies in the "mid tail" of platform-based retailing. *Marketing Science*, *30*(5), 757–775.
Joo, M., Wilbur, K. C., Cowgill, B., & Zhu, Y. (2013). Television advertising and online search. *Management Science*, *60*(1), 56–73.
Joo, M., Wilbur, K. C., & Zhu, Y. (2015). Effects of TV advertising on keyword search. *International Journal of Research in Marketing*, *33*(3), 508–523.
Kannan, P. K., & Kopalle, P. K. (2001). Dynamic pricing on the internet: Importance and implications for consumer behavior. *International Journal of Electronic Commerce*, *5*(3), 63–83.
Kannan, P. K., Pope, B. K., & Jain, S. (2009). Practice prize winner-pricing digital content product lines: A model and application for the National Academies Press. *Marketing Science*, *28*(4), 620–636.
Kannan, P. K., Reinartz, W., & Verhoef, P. C. (2016). The path to purchase and attribution modeling: Introduction to special section. *International Journal of Research in Marketing*, *33*(3), 449–456.
Kanuri, V. K., Mantrala, M. K., & Thorson, E. (2016). Optimizing a menu of multi-format subscription plans for ad-supported media platforms. *Journal of Marketing*. http://dx.doi.org/10.1509/jm.15.0372 (forthcoming).
Katona, Z., Zubcsek, P. P., & Sarvary, M. (2011). Network effects and personal influences: The diffusion of an online social network. *Journal of Marketing Research*, *48*(3), 425–443.
Kim, J. B., Albuquerque, P., & Bronnenberg, B. J. (2010). Online demand under limited consumer search. *Marketing Science*, *29*(6), 1001–1023.
Kohler, C., Mantrala, M. K., Albers, S., & Kanuri, V. K. (2016). A meta-analysis of marketing communication carryover effects. *Journal of Marketing Research* (forthcoming).
Koukova, N. T., Kannan, P. K., & Ratchford, B. T. (2008). Product form bundling: Implications for marketing digital products. *Journal of Retailing*, *84*(2), 181–194.
Koukova, N. T., Kannan, P. K., & Kirmani, A. (2012). Multi-format digital products: How design attributes interact with usage situations to determine choice. *Journal of Marketing Research*, *49*(1), 100–114.
Kumar, V., & Reinartz, W. (2016). Creating enduring customer value. *Journal of Marketing*, *80*(6), 36–68.
Kumar, V., Bhaskaran, V., Mirchandani, R., & Shah, M. (2013). Practice prize winner-creating a measurable social media marketing strategy: increasing the value and ROI of intangibles and tangibles for hokey pokey. *Marketing Science*, *32*(2), 194–212.
Kumar, A., Bezawada, R., Rishika, R., Janakiraman, R., & Kannan, P. K. (2016). From social to sale: The effects of firm generated content in social media on customer behavior. *Journal of Marketing*, *80*(1), 7–25 (2016).
Kushwaha, T., & Shankar, V. (2013). Are multichannel customers really more valuable? The moderating role of product category characteristics. *Journal of Marketing*, *77*(4), 67–85.
Lamberton, C., & Stephen, A. T. (2016). A thematic exploration of digital, social media, and mobile marketing Research's evolution from 2000 to 2015 and an agenda for future research. *Journal of Marketing*, *80*(6), 146–172.
Lambrecht, A., & Misra, K. (2016). Fee or free: When should firms charge for online content? *Management Science*. http://dx.doi.org/10.1287/mnsc.2015.2383 (forthcoming).
Lambrecht, A., & Tucker, C. (2013). When does retargeting work? Information specificity in online advertising. *Journal of Marketing Research*, *50*(5), 561–576.
Lambrecht, A., Goldfarb, A., Bonatti, A., Ghose, A., Goldstein, D. G., Lewis, R., ... Yao, S. (2014). How do firms make money selling digital goods online? *Marketing Letters*, *25*(3), 331–341.
Lee, T. Y., & Bradlow, E. T. (2011). Automated marketing research using online customer reviews. *Journal of Marketing Research*, *48*(5), 881–894.
Lee, C., Kumar, V., & Gupta, S. (2013). *Designing freemium: A model of consumer usage, upgrade, and referral dynamics.* (Working Paper).
Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. *Journal of Marketing*, *80*(6), 69–96.
Li, X., & Hitt, L. M. (2008). Self-selection and information role of online product reviews. *Information Systems Research*, *19*(4), 456–474.
Li, H., & Kannan, P. K. (2014). Attributing conversions in a multichannel online marketing environment: An empirical model and a field experiment. *Journal of Marketing Research*, *51*(1), 40–56.
Li, H., Jain, S., & Kannan, P. K. (2016). *Optimal design of content samples for digital products and services.* (Working Paper).
Li, H., Kannan, P. K., Viswanathan, V., & Pani, A. (2016). Attribution strategies and return on keyword investment in paid search advertising. *Marketing Science*, *35*(6), 831–848.
Liechty, J., Ramaswamy, V., and Cohen, S.H. (2001), Choice menus for mass customization: An experimental approach for analyzing customer demand with an application to a web-based information service, Journal of Marketing Research, Vol. 38, Is. 2, 183–196.
Lilien, G. L., & Rangaswamy, A. (2000). Modeled to bits: Decision models for the digital, networked economy. *International Journal of Research in Marketing*, *17*(2-3), 227–235.
Liu, H. (2010). Dynamics of pricing in the video game console market: Skimming or penetration? *Journal of Marketing Research*, *47*(3), 428–443.
Liu, X., Singh, P., & Srinivasan, K. (2015). *A structural analysis of unstructured big data leveraging cloud computing.* (Working Paper).
Luo, L., & Toubia, O. (2015). Improving online idea generation platforms and customizing the task structure on the basis of consumers' domain-specific knowledge. *Journal of Marketing*, *79*(5), 100–114.
Luo, X., Andrews, M., Fang, Z., & Phang, C. W. (2013). Mobile targeting. *Management Science*, *60*(7), 1738–1756.
Malcolm, H. (2015). Cyber Monday clocks record sales as mobile sales surge. *USA Today* Dec 2. Accessed from http://www.usatoday.com/story/money/2015/12/01/cyber-monday-sales-results/76602534/
Malthouse, E. C., Haenlein, M., Skiera, B., Wege, E., & Zhang, M. (2013). Managing customer relationships in the social media era: Introducing the social CRM house. *Journal of Interactive Marketing*, *27*(4), 270–280.
Manchanda, P., Dubé, J. P., Goh, K. Y., & Chintagunta, P. K. (2006). The effect of banner advertising on internet purchasing. *Journal of Marketing Research*, *43*(1), 98–108.
Manchanda, P, Packard, G and Pattabhiramaiah, A, (2015), Social dollars: The economic impact of customer participation in a firm-sponsored online customer community, Marketing Science, Vol. 34, Is. 3, 367–387
McAlister, L. M., Sonnier, G. P., & Shively, T. S. (2012). The relationship between online communications and firm value. *Marketing Letters*, *23*(1), 1–12.
Moe, W. W. (2003). Buying, searching, or browsing: Differentiating between online shoppers using in-store navigational clickstream. *Journal of Consumer Psychology*, *13*(1–2), 29–39.
Moe, W., & Fader, P. (2004). Dynamic conversion behavior at *e*-commerce sites. *Management Science*, *50*(3), 326–335.
Moe, W. W., & Schweidel, D. A. (2012). Online product opinions: Incidence, evaluation, and evolution. *Marketing Science*, *31*(3), 372–386.
Moe, W. W., & Trusov, M. (2011). The value of social dynamics in online product ratings forums. *Journal of Marketing Research*, *48*(3), 444–456.

Nam, H., & Kannan, P. K. (2014). Informational value of social tagging networks. *Journal of Marketing, 78*(4), 21–40.
Narayanan, S., & Kalyanam, K. (2015). Position effects in search advertising and their moderators: A regression discontinuity approach. *Marketing Science*, *34*(3), 388–407.
Neslin, S. A., Grewal, D., Leghorn, R., Shankar, V., Teerling, M. L., Thomas, J. S., & Verhoef, P. C. (2006). Challenges and opportunities in multichannel customer management. *Journal of Service Research*, *9*(2), 95–112.
Neslin, Scott, A., & Shankar, V. (2009). Key issues in multichannel customer management: current knowledge and future directions. *Journal of Interactive Marketing, 23*(1), 70–81.
Novak, T. P., Hoffman, D. L., & Yung, Y. F. (2000). Measuring the customer experience in online environments: A structural modeling approach. *Marketing Science*, *19*(1), 22–42.
Pan, X., Ratchford, B. T., & Shankar, V. (2004). Price dispersion on the internet: A review and directions for future research. *Journal of Interactive Marketing*, *18*(4), 116–135.
Parker, G., & Van Alstyne, M. W. (2005). Two-sided network effects: A theory of information product design. *Management Science*, *51*(10), 1494–1504.
Pauwels, K., & Weiss, A. (2007). Moving from free to fee: How online firms market to change their business model successfully. *Journal of Marketing, 72*(3), 14–31.
Phillips, E. (2015). Retailers scale up online sales distribution networks. *The Wall Street Journal* November 17, 2015. Accessed from http://www.wsj.com/articles/retailers-scale-up-online-sales-distribution-networks-1447792869
Pingitore, G., Meyers, J., Clancy, M., & Cavallaro, K. (2013). Consumer concerns about data privacy rising: what can business do? *J.D. Power report.*
Popkowski Leszczyc, P. T., & Häubl, G. (2010). To bundle or not to bundle: Determinants of the profitability of multi-item auctions. *Journal of Marketing*, *74*(4), 110–124.
Rao, L. (2015). Online shoppers spent a record $4.45 billion on Black Friday and Thanksgiving. *Fortune* Nov 28, accessed from http://fortune.cm/2015/11/28/black-friday-sales-2/
Ratchford, B. T., Lee, M. S., & Talukdar, D. (2003). The impact of the internet on information search for automobiles. *Journal of Marketing Research*, *40*(2), 193–209.
Ratchford, B. T., Talukdar, D., & Lee, M. S. (2007). The impact of the internet on consumers' use of information sources for automobiles: A re-inquiry. *Journal of Consumer Research*, *34*(1), 111–119 June.
Roberts, J. H., Kayande, U., & Stremersch, S. (2014). From academic research to marketing practice: Exploring the marketing science value chain. *International Journal of Research in Marketing*, *31*(2), 127–140.
Rosario, A. B., Sotgiu, F., De Valck, K., & Bijmolt, T. H. A. (2016). The effect of electronic word of mouth on sales: A meta-analytic review of platform, product, and metric factors. *Journal of Marketing Research*, *53*(3), 297–318 June.
Rust, R. T., Kannan, P. K., & Peng, N. (2002). The customer economics of internet privacy. *Journal of the Academy of Marketing Science*, *30*(4), 455–464.
Rust, R., Lemon, K., & Narayandas, D. (2004). *Customer equity management.* December: Prentice Hall.
Rutz, O. J., & Bucklin, R. E. (2011). From generic to branded: A model of spillover in paid search advertising. *Journal of Marketing Research*, *48*(1), 87–102.
Rutz, O. J., Trusov, M., & Bucklin, R. E. (2011). Modeling indirect effects of paid search advertising: Which keywords lead to more future visits? *Marketing Science*, *30*(4), 646–665.
Rutz, O. J., Bucklin, R. E., & Sonnier, G. P. (2012). A latent instrumental variables approach to modeling keyword conversion in paid search advertising. *Journal of Marketing Research*, *49*(3), 306–319.
Schneier, B. (2015). How the internet of things limits consumer choice. *The Atlantic* Dec 24. Accessed from https://www.schneier.com/essays/archives/2015/12/how_the_internet_of_.html
Seiler, S. (2013). The impact of search costs on consumer behavior: A dynamic approach. *Quantitative Marketing and Economics*, *11*(2), 155–203.
Shankar, V., Urban, G. L., & Sultan, F. (2002). Online trust: A stakeholder perspective, concepts, implications, and future directions. *The Journal of Strategic Information Systems*, *11*(3), 325–344.
Shankar, V, Smith, A.K., Rangaswamy, A (2003), Customer satisfaction and loyalty in online and offline environments, International Journal of Research in Marketing, Vol. 20, Is. 2, p. 153–175.
Shankar, V., Venkatesh, A., Hofacker, C., & Naik, P. (2010). Mobile marketing in the retailing environment: Current insights and future research avenues. *Journal of Interactive Marketing, 24*(2), 111–120.
Shi, S. W., & Zhang, J. (2014). Usage experience with decision aids and evolution of online purchase behavior. *Marketing Science*, *33*(6), 871–882.
Shi, S. W., Wedel, M., & Pieters, R. (2013). Information acquisition during online decision making: A model-based exploration using eye-tracking data. *Management Science*, *59*(5), 1009–1026 2013.
Shriver, S., Nair, H., & Hofstetter (2013). Social ties and user-generated content: Evidence from an online social network. *Management Science*, *59*(6), 1425–1443 (June).
Sinha, R. K., Machado, F. S., & Sellman, C. (2010). Don't think twice, it's all right: Music piracy and pricing in a DRM-free environment. *Journal of Marketing*, *74*(2), 40–54.
Sismeiro, C., & Bucklin, R. E. (2004). Modeling purchase behavior at an *E*-commerce web site: A task-completion approach. *Journal of Marketing Research*, *41*(3), 306–323.
Skiera, B., & Abou Nabout, N. (2013). Practice prize paper-PROSAD: A bidding decision support system for profit optimizing search engine advertising. *Marketing Science, 32*(2), 213–220.
Sonnier, G. P., McAlister, L. M., & Rutz, O. (2011). A dynamic model of the effect of online communications on firm sales. *Marketing Science*, *30*(4), 702–716.
Spann, M., & Tellis, G. J. (2006). Does the internet promote better consumer decisions? The case of name-your-own-price auctions. *Journal of Marketing, 70*(1), 65–78.
Sriram, S., Manchanda, P., Bravo, M. E., Chu, J. H., Ma, L. Y., Song, M. J., ... Subramanian, U. (2015). Platforms: A multiplicity of research opportunities. *Marketing Letters*, *26*(2), 141–152.
Steenkamp, J.B.E.M. and Geyskens, I. (2006), How country characteristics affect the perceived value of web sites, Journal of Marketing, Vol. 70, Is. 3, p. 136–150.
Stephen, A. T., & Toubia, O. (2010). Deriving value from social commerce networks. *Journal of Marketing Research*, *47*(2), 215–228.
Sundararajan, A. (2016). *The sharing economy: The end of employment and the rise of crowd-based capitalism.* Cambridge, MA: MIT Press.
Tirunillai, S., & Tellis, G. J. (2012). Does chatter really matter? Dynamics of user-generated content and stock performance. *Marketing Science*, *31*(2), 198–215.
Tirunillai, S., & Tellis, G. J. (2014). Mining marketing meaning from online chatter: Strategic brand analysis of big data using latent Dirichlet allocation. *Journal of Marketing Research*, *51*(4), 463–479.
Todri, V., & Ghose, A. (2016). Towards a digital attribution model: Measuring display advertising effects on online consumer behavior. *MIS Quarterly* (forthcoming).
Toubia, O., & Stephen, A. T. (2013). Intrinsic vs. image-related utility in social media: Why do people contribute content to twitter? *Marketing Science*, *32*(3), 368–392.
Trusov, M., Bodapati, A. V., & Bucklin, R. E. (2010). Determining influential users in internet social networks. *Journal of Marketing Research*, *47*(4), 643–658.
Tucker, C., & Zhang, J. (2010). Growing two-sided networks by advertising the user base: A field experiment. *Marketing Science*, *29*(5), 805–814.
Venkatesh, R., & Chatterjee, R. (2006). Bundling, unbundling and pricing of multiform products: The case of magazine content. *Journal of Interactive Marketing*, *20*(2), 21–40.
Verhoef, P. C., Neslin, S. A., & Vroomen, B. (2007). Multichannel customer management: Understanding the research-shopper phenomenon. *International Journal of Research in Marketing, 24*(2), 129–148.
Verhoef, P., Kannan, P. K., & Inman, J. (2015). From multi-channel retailing to omni-channel retailing: Introduction to the special issue on multi-channel retailing. *Journal of Retailing, 91*(2), 174–181.
Vernik, D. A., Purohit, D., & Desai, P. S. (2011). Music downloads and the flip side of digital rights management. *Marketing Science*, *30*(6), 1011–1027.
Watts, D. J., & Dodds, P. S. (2007). Influentials, networks, and public opinion formation. *Journal of Consumer Research*, *34*(4), 441–458.
Wedel, M., & Kannan, P. K. (2016). Marketing analytics for data-rich environments. *Journal of Marketing.*, *80*(6), 97–121.
Wedel, M., & Pieters, F. G. M. (2007). In C. P. Haugtvedt (Ed.), *Visual marketing.* New York: Lawrence Erlbaum Associates, Marketing and Consumer Psychology Series.
Wiesel, T., Pauwels, K., & Arts, J. (2011). Practice prize paper-Marketing's profit impact: Quantifying online and off-line funnel progression. *Marketing Science*, *30*(4), 604–611.
Wind, J., & Rangaswamy, A. (2001). Customerization: The next revolution in mass customization. *Journal of Interactive Marketing, 15*(1), 13–32.

Winer, R. S., & Ilfeld, J. S. (2002). Generating website traffic. *Journal of Advertising Research*, *42*(5), 49–61.
Wu, C., Che, H., Chan, T. Y., & Lu, X. (2015a). The economic value of online reviews. *Marketing Science*, *34*(5), 739–754.
Wu, J. H., Shi, M., & Hu, M. (2015b). Threshold effects in online group buying. *Management Science*, *61*(9), 2025–2040.
Xu, L., Duan, J. A., & Whinston, A. (2014). Path to purchase: A mutually exciting point process model for online advertising and conversion. *Management Science*, *60*(6), 1392–1412.
Xu, K., Chan, J., Ghose, A., & Han, S. (2016). Battle of the channels: The impact of tablets on digital commerce. *Management Science*. http://dx.doi.org/10.1287/mnsc.2015.2406 (forthcoming).
Yadav, M. S., & Pavlou, P. A. (2014). Marketing in computer-mediated environments: Research synthesis and new directions. *Journal of Marketing*, *78*(1), 20–40.
Yang, S., & Ghose, A. (2010). Analyzing the relationship between organic and sponsored search advertising: Positive, negative, or zero interdependence? *Marketing Science*, *29*(4), 602–623.
Yao, S., & Mela, C. F. (2011). A dynamic model of sponsored search advertising. *Marketing Science*, *30*(3), 447–468.
Ying, Y., Feinberg, F., & Wedel, M. (2006). Leveraging missing ratings to improve online recommendation systems. *Journal of Marketing Research*, *43*(3), 355–365.
You, Y., Vadakkepatt, G. G., & Joshi, A. M. (2015). A meta-analysis of electronic word-of-mouth elasticity. *Journal of Marketing*, *79*(2), 19–39.
Zhang, J., & Krishnamurthi, L. (2004). Customizing promotions in online stores. *Marketing Science*, *23*(4), 561–578.
Zhang, J., & Wedel, M. (2009). The effectiveness of customized promotions in online and offline stores. *Journal of Marketing Research*, *46*(April), 190–206.
Zhu, Y., & Wilbur, K. C. (2011). Hybrid advertising auctions. *Marketing Science*, *30*(2), 249–273.