

## A REVIEW ON VARIOUS TECHNIQUES OF RECOMMENDER ENGINE IN ONE TO ONE MARKETING

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**Abstract:** -One-to-one marketing is a customer relationship management (CRM) strategy emphasizing personalized interactions with customers. The personalization of interactions is thought to foster greater customer loyalty and better return on marketing investment. One to One marketing is one such place where we need recommender engine to do online shopping effectively. A recommender system/engine is a subclass of information filtering system that seeks to predict the "rating" or "preference" that a user would give to an item. There are two types of One-to-one marketing (individual marketing/1:1 marketing) personalization and customization. In Personalized marketing based on consumers past history, the recommendation will be provided to the customer for their purchase. One well known example is Amazon. In customization customer decides about the product and based on the customer wish recommendation will be provided. Example is Dell computers. A recommendation is a feature that filters items by predicting how a user might rate them. However, this paper presents a comprehensive review of the methods and techniques used in one to one marketing to select the best rated/recommended items by the customers using the advanced techniques.

**Keywords:** one to one marketing, CRM, Recommender, Personalization, Customization

### I. Introduction

One-to-one marketing advocates tailoring of one or more aspects of the firm’s marketing mix to the individual customer. One-to-one marketing represents an extreme form of segmentation, with a target segment of size one. There are two forms of one-to-one marketing: personalization and customization. Personalization is when the firm decides, usually based on previously collected customer data, what marketing mix is suitable for the individual. A good example is Amazon.com’s personalized book and music recommendations. The e-commerce arena is replete with other instances of personalization. Customization is when the customer proactively specifies one or more elements of his or her marketing mix. Dell computer allows customers to customize the computer they order. The MyYahoo feature at Yahoo.com allows users to specify elements of their home page such as the weather forecast, reports on their favorite stocks, or priorities given to local sports news.

The above Figure 1 illustrates these definitions. The purpose of this paper is to summarize key challenges and knowledge gaps in understanding the choices that both firms and customers make in a personalization–customization environment. We start with a summary of personalization and customization in practice and then draw on research in economics, statistical, and consumer behavior to identify what we know and do not know. We conclude with a summary of key research opportunities.

### II. Current practices

#### A. Personalization

Perhaps the most popular example of personalization is Amazon.com. Amazon uses collaborative filtering to determine what music or books to recommend to users. Indeed, the Internet has provided many opportunities for personalization. In ebay.com, the website can recognize the user and “fish” out the previous trends of the user and the searches that he or she has made. The system then introduces appropriate related links on the website as the user browses. Search engines like Google and AltaVista analyze the types of searches the user undertakes over time. When the user searches for a similar topic on

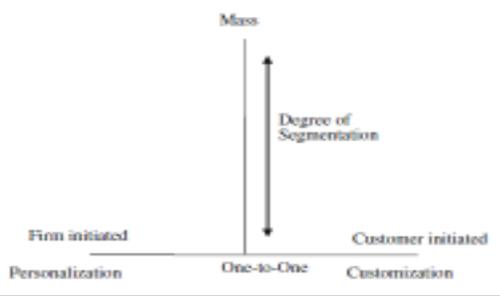


Fig 1: understanding personalization and customization

the search engine, the engine can respond faster and more efficiently.

The services industry has made ample use of personalization. For example, Sprint can analyze customer usage to determine the appropriate calling plan for the customer. During the summer, the Portola Plaza Hotel<sup>3</sup> in California relies mainly on tourism. The hotel's objectives are to increase revenue and reduce inventory. Invitations are sent to previous customers directing them to a personalized URL that gathers information about guest preferences. After detailed analysis, mails are sent to these customers offering them discounts and other promotional offers to encourage them to come to the hotel. Using this procedure, the hotel saw a significant increase in revenue and was successful in retaining its customers. Personalization is practiced by many insurance companies like ICICI-Lombard, which uses a customer survey to prepare personalized insurance plans.

Harrah's Entertainment personalizes many promotions and incentives based on what it learns from customer data.

The practical advantages of personalization lie in greater customer satisfaction and higher profits. For example, Malthouse and Elsner show in a field test that personalizing the copy used in a book offer increases response rates significantly. Notably, we are not aware of systematic study that shows personalization yields higher customer satisfaction in the long run, although the Portola Plaza Hotel example above certainly suggests so.

One concern is invasion of privacy. Personalization thrives on data, driving companies to stretch the envelope on what data they collect. The customer wonders, "How do they know I want that book?" This may be why Amazon now explains its recommendations. Second, personalization is expensive. It requires data and expensive software for implementation. Whether personalization pays out ultimately depends on the accuracy of the personalization—did we recommend the right book to the right person? This cannot be taken for granted.

### **B. Customization**

Whereas Amazon serves as the prototypical example of personalization, Dell Computer plays that role for customization in the computer industry. The customer can order a computer from Dell according to his or her needs and likes. Thus, the computer is custom-made for the user. The long-term payoff of this strategy is difficult to determine and confounded with Dell's reliance on the Internet channel and its recent woes. However, it certainly appears that customization was part of the value proposition that propelled Dell into being a major player.

Customization has been applied in a variety of other industries. Many restaurants allow customers to suggest alterations to the stated menu. A recent study found that 81% of motorcyclists would like to have the motorcycle seats made-to-order. Sporting goods giant Adidas-Salomon has utilized customization. Faced with intense competition to launch the right new products, Adidas has begun

production of shoes which are "codesigned" by the customer. Companies like "Spreadshirt" and "Levis"<sup>6</sup> also customize apparel. In consumer durables, "IKEA" and "Benz Furniture"<sup>7</sup> have started a joint venture to provide custom-made furniture. The "BMW-Mini" is a very common car in Germany and, now, it comes with a customized roof design too. One can design the roof of the car online and then the car is custom-made. Marelli Motors, responding to competition from new entrants, has decided to produce only custom-made electric motors.

Other examples abound. Banks such as Garanti Ban<sup>8</sup>, Turkey and Deutsche Bank have begun to offer checkbooks and credit cards in any design that suits the customer. In the pharmaceutical industry, "VURU" is a pill box used to carry nutritional supplements in customized daily packs. The customer is given the freedom to choose how he or she wants his box to look like and what it should contain. This product is already on the market and comes with all the details that are considered pertinent for the medicines inside.

An obvious potential advantage of customization is greater customer satisfaction. While the proliferation of examples cited above implicitly bears testimony to this, the long-term impact and profitability of customization has not to our knowledge been analyzed systematically. Another potential advantage suggested by the above examples is strategic—we often see customization emerging in highly competitive industries—restaurants, banking, apparel, computers—where product differentiation is crucial but difficult to achieve. Customization itself is a point of differentiation (Dell) and moreover ensures the product itself is unique.

A potential disadvantage of course is cost. For example, the customized Adidas shoes are about 30% more costly than the standard line. Again, the question is whether the incremental volume and strategic advantages overcome this cost. Customization could also make the purchase decision difficult by making the choice task very complex. Huffman and Kahn and Dellaert and Stremersch demonstrate the psychological difficulty of trading off the higher utility derived from customized products with the complexity of making the choice. Another potential problem is the Pandora's box of raising customer expectations. For example, the BMW mini customer may decide that he or she wants everything customized—from the interior to the hub caps. How does the customer react when BMW says, "Sorry, we can't allow you to customize everything?"

2.3 Forces shaping the evolution of personalization and customization The challenges in implementing personalization and customization will have to be met by future advances in three steps of delivering one-to-one marketing (1) collecting the data, (2) transforming the data into insights, and (3) operationalizing the results.

The key issue in collecting data is customer data integration—the collection of customer data at all "touches

points.” There are two dimensions to this issue. First is the extent of integration. Second is for how many customers the firm has the integrated data. A company may be able to obtain a 360° view easily for 40% of its customers because they are members of the company’s loyalty program. Obtaining such data for the next 60% may be prohibitively expensive. Perhaps the company can leverage the insights from the 40% sample to the 60%, although they are obviously not randomly generated samples.

This leads us to the second challenge—developing insights. Companies that perform the most sophisticated personalization and customization have strong capabilities in statistical modeling. Some of the sophisticated techniques that are used to analyze customer behavior are being standardized into computing packages like SAS and BUGS, and this software will have to become more accessible in the future. In addition, companies will have to learn how to analyze text data (Coussement and Van den Poel 2007) generated by customer emails, blogs, news groups, chat forums, and virtual communities. Coca Cola, Harley Davidson, and Disney have invested in learning from brand communities.

The final step, operationalization, requires close coordination among marketing, information technology, and production. The challenges can exceed the organization’s capabilities. This suggests more “partnering” to bring about personalization and customization. One such example is “Land’s End,” a catalog retailer. The data for customizing jeans or shirts are collected at the Land’s End website. But Land’s End relies on externally provided software to translate customer specifications for jeans and shirts into final patterns that are then used to produce the clothing.

### III. Empirical challenges in personalization

#### A. The issues

A distinguishing feature of personalization versus customization is its reliance on statistical analysis of customer data to predict customer response to prices, promotions, or communications. There are two key issues. First, how accurate are these predictions? Personalization relies on assigning the right marketing effort to the right customer. But, if the cost of misclassification is large, the firm may be better off not personalizing. For example, distracting and annoying the customer by recommending a series of books in which he or she has no interest may be worse than making no recommendation at all. The second issue is how far the firm should go toward the ultimate goal of one-to-one marketing? Figure 2 depicts the choices available to the firm. It may be that the loss in “precision” in going one-to-n may be worth avoiding the errors of misclassification in going one-to-one.

#### B. What we know

The research on these issues can be classified into two categories: supportive and doubtful. Among the supportive

research, Rossi first quantified the benefits of adopting one-to-one pricing by utilizing household purchase history data and empirically found that individual personalization improves 7.6% over mass optimization. Later, Ansari and Mela found that the content-targeting approach can potentially increase the expected number of click through by 62%.



Fig. 2. Firms choice on level of personalization

Furthermore, Arora and Henderson (2007) showed customization at individual level can enhance the efficiency of embedded premium. Among the doubtful stream of research, Zhang and Wedel (2007) investigate the profit potential of various promotion programs customized at different levels in online and offline stores. The three levels of customization are (1) mass market (one to all)—each customer receives the same coupon, (2) segment (one-to-n)—each member of the same customer segment receives the same coupon, and (3) individual (one-to-one)—each customer receives an individualized coupon. They found that the incremental benefits of one-to-one promotions over segment- and market-level customized promotions were small in general, especially in offline stores. Note that it is possible that one-to-one promotions may significantly increase response rates, perhaps due to steeper discounts, but that may not translate into significant profit increases.

#### C. What we need to know—future research

It is not resolved whether traditional consumer choice models can be used successfully to personalize the marketing mix. We need to know what methods predict most accurately. There are two directions to go here—more complex or simpler. On one hand, complex machine learning algorithms (e.g., see Blattberg et al. 2008) might be required. Or, given the data limitations and specification issues that can wreak havoc with complex models, simple models such as RFM may be the best way to go. RFM stands for Recency–Frequency–Monetary Value and uses information about a customer’s most recent purchase, her frequency of purchase, and the dollar value of her past purchase to predict her likelihood of purchasing a product in the future. This can be done on an individual customer basis and can therefore be used to provide personalized recommendations of future product purchases. Regarding level of personalization, Malthouse and Elsnerv provide encouraging support for one-to-n personalization (using relatively simple statistical analysis). This support is in the form of a field test, which should be the litmus test for research in this area. More broadly speaking, we need decision support systems for

weighing the costs of incorrect personalization and helping managers decide when to personalize and to whom.

#### **IV. Economic models of firm choice related to personalized pricing**

##### **A. Key results in literature**

From an economic standpoint, the promise of personalization is to enable firms to estimate their customers' valuations and, hence, implement finer price discrimination. A number of theoretical papers have shown that, among equally matched firms, offering personalized pricing, while being optimal for each practicing firm, makes all firms worse off. Choudhary et al. examine a vertically differentiated duopoly and show that the higher-quality firm can be worse off with personalized pricing.

Of course, in reality, competing firms are rarely equally matched. For instance, firms may differ in terms of how many loyal customers they each may have and hence their targeting strategies may differ in terms of offering discounts to own vs. the rival's customers. In that case, Shaffer and Zhang show that personalized pricing can alleviate price competition and benefit firms. In a more general model, Shaffer and Zhang consider both horizontal and vertical differentiation, with a positive cost of targeting customers.

They show that the firm with more loyal customers can earn higher profits in equilibrium when both firms engage in one-to-one promotions. Ghose and Huang allow symmetric firms to offer a continuum of qualities and show firms can avoid a Prisoner's dilemma and are better off when they engage in one-to-one pricing. This happens because a firm can provide higher qualities to each consumer without the fear of intrafirm product cannibalization.

When we look at personalization in the presence of strategic consumers, the results once again paint a complex picture. Villas-Boas shows that a monopolist is worse off by offering one-to-one promotions because "strategic consumers" can sacrifice their purchase in the first period so that they are not identified as existing customers in the next period. However, Chen and Zhang show that targeted pricing is profitable, in the presence of strategic customers, only in a competitive setting.

Allowing consumers to haggle is another mechanism by which firms can personalize pricing. When costs of haggling are heterogeneous, Desai and Purohit show that firms may find it profitable to allow consumers to haggle than follow fixed-price policy.

Another important issue associated with personalized pricing is whether firms should engage in first-degree or second-degree price discrimination when customizing their products. Ulph and Vulkan use the Hotelling framework to study this relationship in a duopoly and show that a firm is

always better off using first-degree price discrimination if it also mass customizes and vice versa.

A critical issue is that the cost of personalization also plays an important role in the decisions being made by firms. Dewan et al show that as the cost of personalization decreases, firms provide more and more personalized products compared to standardized products when they can employ second-degree price discrimination whereas Chen and Iyerson show that firms will invest in personalization if customers are sufficiently heterogeneous and the cost of personalization is high which again requires understanding of context where one prediction is more robust than the other one and vice versa.

##### **B. Future research**

While we have generated important theoretical insights regarding personalized pricing, there still are a number of unanswered questions. How does the growth rate of any market impact firms' personalization strategies? Are there synergies between personalization and branding? Currently, firms have a lot of information about their existing customers but not about competitor's customers. There needs to be further research on conditions under which sharing information with competitors can be profitable. Although a few empirical papers have examined the role of personalized communication in reducing information overload and aiding customer decisions, this also remains a fruitful area for future theoretical research. Further research is also needed to understand firm strategies when firms have different cost functions arising due to operational efficiencies enjoyed by a firm. Another area is the role of personalization when firms adopt nonlinear pricing schedules.

#### **V. Firm choices in product customization**

##### **A. Product proliferation vs. product customization**

A familiar presumption in marketing is that a consumer realizes higher utility when the product better matches her ideal preference. Therefore, when costs to achieve this match are sufficiently low, firms with some monopolistic power may reap higher profits by providing better-matching products. Product customization and product proliferation are two popular strategies for improving the preference-product match, with some firms actively pursuing both. A firm pursuing product customization first invites each individual consumer to reveal her preference and then produces and delivers a product with the closest match possible. A firm pursuing product proliferation does not hold such one-to-one dialogs with consumers. Instead, it offers many variants and the customer chooses the most appealing product. Product proliferation is observed in many markets such as breakfast cereal, yogurt, toys, apparel, books, and consumer electronics.

##### **B. Customization, competition, and firm profitability**

Although customized products increase consumer utility, firms do not always gain from adopting mass customization, frequently because customization reduces product differentiation in a competitive context. In fact, if two or more firms offer a consumer the product that perfectly addresses her taste, then Bertrand competition will drive prices down to the second-highest marginal cost. Nevertheless, if a firm does not pursue customization but its competitors do, then the former would probably become worse off. In many product categories today, the technological ingredients underlying product customization are relatively mature and readily accessible to all firms. This implies that adopting customization cannot ensure competitive advantage and, indeed, studies have shown that pursuing customization may lead to a prisoner's dilemma. So, will customizing firms ever be able to escape the curse of prisoner's dilemma? The answer is yes. As Dewan et al. further show, when firms differ in the timing of adopting customization, the early adopter may achieve a first-mover advantage. Such first-mover advantage can be sustained if there is salient learning curve effects and/or scale economies. It is mainly for such reasons that Dell Computers, the first to offer customized PCs on the Internet, maintains its industry leadership today. Amazon.com invented the book recommendation system based on collaborative filtering. Due to the inherent scale economies in collaborative filtering, Amazon is widely believed to provide more relevant recommendations than its competitors.

If the product has multiple attributes of keen interest to consumers, then the firms may relax price rivalry by judiciously choosing which attribute(s) to customize. In a two-dimensional spatial model, a surprising insight of Syam et al. is that the competing firms may choose to customize an identical attribute but not both attributes, achieving "matched partial customization." In a model of both horizontal and vertical differentiation, Ghose and Huang investigate a duopoly where one or both firms tailor both its prices and product qualities based on consumers' willingness to pay. They also show that a prisoner's dilemma situation does not arise even when the firms are ex ante symmetric.

### **C. Constraints and challenges in mass customization**

Generally, it is economically viable for firms to tailor those attributes most valued by consumers and yet not too costly to customize. Currently, firms in many industries customize only a fraction of the product attributes and allow limited options for each of these attributes. However, technological advances may lower these costs. We might then be left with the prisoner's dilemma of all firms customizing on "all" attributes. For instance, many apparel makers are very happy to accommodate customers' request regarding size, color, or fabric but are reluctant to alter their basic styles due to concerns of compromising their brands. Customization can even prove

harmful for status goods because an objective of such goods is to project an image of exclusivity. Syam and Kumar show that, in competing exclusively with customized products, firms may lose all differentiation advantages, and they may therefore not want to eliminate their standard products. Branding may become more important in a customization environment.

## **VI. Consumer perspectives**

### **A. Preference formation**

Substantial research shows that consumers often construct their preferences "on-the-fly" as a function of task and contextual characteristics—including the ease with which Collaborative which attributes can be evaluated, information format, response mode, the particular attributes used to recommend products and the particular alternatives available for consideration at a given time. In other words, instead of being exogenous, preferences are in fact endogenous to the particular task and information environment facing the consumer.

These findings question two important assumptions of product personalization and customization. The first assumption is that consumer preferences are stable or evolve in a predictable fashion. Preference stability is critical for personalization because previous choices are used to predict future choices. Preferences are likely to be more stable when the information environment itself does not change and when consumers have made repeated choices in a product category. To the extent that the Internet allows consumers to learn from the product experiences and social information of other similar consumers, this should also enhance preference stability, allowing personalization.

The second assumption is that preferences revealed by consumer choices truly maximize utility. Suppose a customer heavily weighs price in her product choices. The typical inference is that the customer has high price sensitivity. Another possibility, however, is that product information was presented in a way that made price comparisons easy and this accentuated the importance of price. Similar effects may occur from using Internet-based shop bots that facilitate price comparisons. Thus, if prior choices are to be used to personalize product offers, care must be taken in designing the offer to mirror the environment under which the data driving the personalization were obtained.

The danger for product customization is that customers may realize after designing their "ideal" product that their actual preferences correspond more closely to standardized products. Customer uncertainty about their preferences is less likely to be an issue in business-to-business settings, where buyers have greater experience and expertise. To the extent that a market is characterized by dramatic changes in market offerings, however, even experienced buyers may not know—or may be overconfident in—their

preferences. One way to reduce preference uncertainty is to provide buyers with interactive tools that allow them to visualize and experience customized products prior to purchase or to learn from the experiences of others. Additional research is needed to examine the extent to which such Internet-based tools reduce uncertainty.

### **B. Information search and processing**

One of the greatest challenges to implementing customization is the extent to which consumers are willing and able to process and act on all the attribute options (Huffman and Kahn 1998). Information overload may lead to poor-quality choices or a failure to purchase (Huffman and Kahn 1998; Iyengar and Lepper 2000; Lurie 2004). As the number of potential alternatives can be the factorial product of the number of attributes, having consumers choose among menus of attributes can reduce perceived choice complexity and increase satisfaction with choice processes and outcomes (Huffman and Kahn 1998). Other research suggests that menu-based choice can allow firms to assess consumer preferences for a larger number of potential products than traditional conjoint approaches (Liechty et al. 2001). Moreover, menus of product attributes can be personalized (i.e., firms can offer different menus of attribute levels to different customers). This suggests a promising personalization–customization hybrid model. Whether for economic, technological, or information overload reasons, product customization will typically only be available for a subset of attributes. As a result, consumers will be presented with a default product that can be modified. Research suggests in such cases that consumers are likely to stick with the default. If the default is chosen with the consumer's interest in mind, for example, automatically setting aside money for retirement unless the consumer opts out, there can be significant welfare advantages. Also, Hsee and Leclerc suggest it may be more profitable to offer consumers a single product because offering multiple options may lead to perceived losses in consumers' minds. Finally, research on cognitive lock in suggests that there may be advantages to engaging the consumer in customization. Getting consumers to provide attribute importance weights which are used to create customized recommendations can reduce consumer effort and therefore increase loyalty.

### **C. Consumer acceptance of product customization**

Although one-to-one marketing should increase satisfaction, there are situations in which consumers may prefer standardized products. Consumers with collectivist, as opposed to individualist, orientation react more positively to products that meet group, as opposed to individual, preferences. Because preferences are labile, customers may be as satisfied with products that seem customized even if differences from standardized products are minimal. There is evidence that, although

recommendations for superior options increase choice satisfaction and confidence, recommendations that go against consumers' initial preferences can have the reverse effect. Research also suggests that consumer acceptance of personalized offers depends on the ease with which consumers can see how recommendations were developed.

Although personalized products may be appreciated by consumers, personalized prices may not be, particularly if such prices are seen as unfair. Prices are most likely to be viewed as unfair when consumers can see that they are paying a premium relative to others for a similar product. For example, Anderson and Simester find that charging more for large-sized clothing in a catalog leads to significant declines in sales and profits. To the extent that personalized pricing is unlikely to reveal price premiums, since each customer only sees one offer, such approaches may be successful. However, there is risk here, as Amazon learned when it suffered a severe backlash for charging different prices for the same DVD different customers. If price offers are based on purchase history, then other aspects of the offer should also be personalized to minimize comparisons on the basis of price alone. Other research suggests that price customization (e.g., through negotiation) is less likely to be seen as unfair since consumers participate in price setting. On the other hand, personalized pricing through the distribution of coupons or customized emails are becoming increasingly common.

### **D. Translating attributes into benefits**

The benefits provided by a collection of attributes are often in the interaction of these attributes. This increases the information-processing burden for customers. Novice consumers may be less able to customize their own products. For such consumers, specifying the relative importance of product benefits, rather than selecting preferred product features. At the same time, as expertise increases, greater benefits are perceived from interfaces that allow the buyer to specify product features. Internet based opinion sites and review forums can go a long way in helping consumers translate attributes into benefits.

### **E. Future research**

The customer is central to one-on-one marketing much more than is the case in traditional mass marketing. Therefore, it is important to understand the different aspects of consumer behaviors as they pertain to customization. While some research has addressed these questions, much more remains to be done. To what extent will the need for uniqueness help the movement towards customized products? Will the consumers' desire to seek comfort in familiar products detract from the widespread adoption of customized products? Clearly, this will depend on the product category and the way consumers make

decisions for different types of products. How do consumers deal with the risk that manufacturers will not be able to precisely customize according to their specifications? More research should address these and other questions.

### VII. Summary and conclusions

This paper has reviewed two major forms of one-to-one marketing—personalization and customization—and identified areas for future research. We started with an overview of one-to-one marketing in practice and structured our discussion from the perspectives of empirical work, economic analysis, and psychology. Each of these perspectives yields its own “wish list” for future research.

We conclude by synthesizing a few issues that draw on all three disciplines:

#### **When should the firm engage in one-to-one marketing?**

Traditional concepts in economics, such as price discrimination, and in psychology, such as information processing, have long supported tailoring the marketing mix to each consumer. But why is one-to-one such a recent phenomenon? It may be that advances in the data analysis and technology opened the door. But undoubtedly there are other conditions under which one-to-one marketing is advisable.

#### **When should the firm embrace personalization as opposed to customization?**

Clearly, data play a key role, as personalization is only possible if reliable and projectable customer data are available. However, economic and psychological analyses that pit customization versus personalization are needed.

#### **Which elements of the marketing mix should be personalized or customized?**

It may be that price should be personalized and product should be customized, but what conditions favor one form over the other? Consumer response—choice—plays a key role here.

#### **To what degree should the firm personalize?**

Should personalization be at the individual level, the segment level, or somewhere in between? This surely is a statistical issue in terms of how accurately we can predict consumer choice, but undoubtedly there are economic and psychological factors as well.

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