Modeling Market Response: Trends and Developments

by Peter Leeflang and Auke Hunneman

Market response models are useful tools that can contribute to the realization of the most important 2008–2010 Marketing Science Institute research priorities. In particular, marketing response models may improve (1) the accountability of marketing expenditures, (2) the understanding of consumer/customer behavior, and (3) approaches to generate customer insights. This article highlights trends and developments in applications and methodologies, as based on a study of papers that have been presented at Marketing Science Conferences in the past decade.

Keywords
Market response models, applications, techniques, trends and developments.

1. Introduction

The Marketing Science Institute (MSI) has provided a bridge between the academic and business communities for almost half a century. Every two years, MSI engages in a unique process in which executives from MSI member companies vote to establish the topics on which they want to encourage academic research. The top three 2008–2010 research priorities are: [1]

1. “accountability and ROI of marketing expenditures”
2. “understanding consumer/customer behavior” and
3. “new approaches to generating customer insights.”

Accountability pertains to measures and comprehension of the returns on marketing investments, such as those devoted to advertising, sales promotions, and sales force efforts, as well as money spent on digital communications. The accountability of the marketing department is one of the most important determinants of this department’s influence in modern firms (Verhoef/Leeflang 2009). An international study, with more than 2000 firms in seven countries, confirms this result (Verhoef et al. 2010).

Understanding customers represents a basic activity for marketing managers. It involves the decision-making processes adopted by individual customers and groups of customers. In the modern digital environment, understanding word-of-mouth effects and the role of social media (e.g., Facebook, Hyves, Twitter, LinkedIn) may be particularly important, as confirmed by Sullivan (2008), who cites the development and use of social media (i.e., social marketing) as one of top three marketing breakthroughs for 2008. Existing research methodologies often are not able to generate new insights from individual customers and about the peer-to-peer relations between (potential) customers. Hence, we note the profound need to develop new approaches to model such business-to-consumer and consumer-to-consumer interactions.

Market response models are numerically specified relations between a relevant (demand) measure and variables that may explain fluctuations in this measure. The most frequently used measures include brand and category sales, market shares, and, at the individual customer level, brand choice probabilities. The explanatory variables typically are (marketing) variables thought to produce changes in the response variable, such as advertising, price, and sales promotions. Market response models are useful tools (or approaches) that can be used to determine the accountability of marketing expenditures on metrics. They also are used to contribute to the realization of more and better customer insights.

We discuss various developments and trends in market response models and specify the necessary transformations that may enable existing models and methods to provide the required customer insights. We start with a brief review of developments in these models, with particular consideration of developments in the past decade. We base this analysis on the applications and techniques presented during the past ten Marketing Science Conferences. We then elaborate on some of the trends and specify future modeling needs.

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2. Review

The past 50 years have witnessed enormous productivity in model building by marketing scholars. Models advance marketing knowledge (understanding customer/consumer behavior) and aid management decision making (measuring accountability of marketing expenditures). The increased marketing knowledge also is reflected in (1) specific knowledge about marketing problems, methods, and techniques and (2) generalizations. Leeflang/Wittink (2000a) define five eras of model building in marketing:

1. The direct application of existing operations research (OR) and management science (MS) methods to marketing problems during 1950–1965, which represents the beginning or the transposition of OR/MS methods.

2. Adaption of models to fit marketing problems. These larger and more complete models from 1965–1970 capture marketplace reality better, but they lack simplicity.

3. In the implementable models era, 1970–1985, there was an increased emphasis on models that provided acceptable representations of reality and were easy to use.

4. Model implementation, with a concomitant interest in marketing decision support systems, as well as increasingly routinized model applications that result in meta-analyses and studies of the generalizability of results, was the focus during 1985–2000. Wierenga (2008, p. 5) calls this era the marketing information revolution. We observe an emphasis on scanner-based models and standardized models (see Hanssens/Leeflang/Wittink 2005).

5. Leeflang/Wittink (2000a) only outline the contours of the current era, during which they anticipated that changes in technology would stimulate the growth of new exchange systems, creating a corresponding need for new modeling approaches. Recently, Wierenga (2008) has named it the customer-centric approach era, which focuses on the following prominent modeling approaches:
   - Customer relationship management (CRM) models.
   - Customer lifetime value (CLV) models.
   - Electronic commerce models.

In what follows, we also clarify other characteristics that effectively can identify this most recent decade (2000–2010).


3.1. Applications

In 2000, Leeflang/Wittink (2000a; 2000b) specified several propositions for models of the future. In other words: they define their expectations for the future. This ‘future’ refers to the present decade, 2000–2010. We discuss these developments in market response modeling by contrasting their propositions with developments that have taken place in the past decade. These developments comprise not only a paradigm shift but also new applications and shifts in focus. In addition, we consider developments in methodologies in Section 3.2.

Leeflang/Wittink (2000a; 2000b) offer the following predictions for the fifth era, i.e. this decade (2000–2010):

1. Future modeling approaches will reflect a new paradigm, in which a firm selects those customers for or with whom it can offer products and services better than can other firms, and with whom it can develop long-term relationships that ensure each customer directly or indirectly contributes to the firm’s expected profits (Leeflang/Wittink 2000a, p. 117).

2. They expect growth in model building applications in new contexts, including
   - Services marketing
   - Retailing
   - Business-to-business (B2B) marketing
   - Electronic marketing

3. They also expect shifts from:
   - Models that cover metropolitan areas, regions, and countries to models of international marketing activities.
   - Single brand models to models of multiple owned and other-brand items.
   - Horizontal competition to horizontal and vertical competition (and interdependencies between channel partners).
   - Models specified at the retail chain to models at the individual store level (micro marketing).
   - Models for tactical decisions to models for strategic decisions.

In what follows, we validate these predicted characteristics of the fifth era (i.e., the customer-centric approach). We note the following developments:

Ad 1: Cooperation Between Suppliers and Customers.

One type of such cooperation has gained an official designation, as customer engagement, which refers to a behavioral manifestation, other than purchase, of the relationship between a customer and a brand/firm. In this context, models attempt to represent several concerns, such as name your own price (Kim/Natter/Spann 2009; Spann/Tellis 2006; Wang/Gal-Or/Chatterjee 2009) and the determination of which informational advertising messages should go to which persons (Baye/Morgan 2009). However, significant room remains for new models and new approaches, as a forthcoming special issue of the Journal of Service Research (Vol. 13, No. 2, 2010) exemplifies.

Other topics pertaining to the cooperation between suppliers and customers appear in models that study cus-
tener metrics such as satisfaction, behavioral metrics (e.g., customer retention, customer lifetime value [CLV]), and financial performance, as well as their interactions (Gupta/Zeithaml 2006). We observe enormous growth in this area, Blattberg/Kim/Neslin (2008) give an excellent overview of models used for what they call “database marketing.” They discuss CLV models, predictive modeling (statistical methods to predict individual customer behavior), and customer management (acquiring customers, cross-up-selling, frequency rewards, customer tiers, churn, multichannel, acquisition and retention) extensively; see also Verhoef/Van Doorn/Dorotic (2007). Recently, Becker/Greve/Albers (2009) studied the impact of technological and organizational implementation of CRM on customer acquisition, maintenance, and retention.


The availability of panel data, about financial services in particular, has prompted tremendous growth in modeling of services (see, for example, Iyengar/Ansari/Gupta 2007; Prins/Verhoef 2007; Rust/Chung 2006).

The same claim holds true for retailing. A multitude of articles discuss modeling the effects of the retail mix, many of which appear in a special issue of the Journal of Retailing (Vol. 85, No. 1, 2009). Other models pertain to competition between retailers (Gielen et al. 2008; Van Heerde/Gijsbrechts/Pauwels 2008).

The number of applications for B2B marketing remain relatively low though. We observe some growth in B2B model building applications in specific areas, such as pharmaceutical marketing (e.g., Kremer et al. 2008; Manchanda et al. 2005; Stremersch/Van Dyck 2009; special issue of International Journal of Research in Marketing, Vol. 25, No. 4, 2008), partner selection (Wuys/Geyskens 2005; Wuys/Verhoef/Prins 2009), and networks between firms (Wuys et al. 2004).

Finally, we observe growth in the number of market response models that are developed in the area of electronic marketing (see, for example, Bucklin 2008).

Ad 3: Shifts.

In the past 10 years we indeed have experienced the shifts predicted by Leeflang/Wittink (2000a). In response to calls for greater internationalization (Burgess/Steenkamp 2006), many studies now cover at least several countries. For example, Deleersnyder et al. (2009) investigate advertising’s sensitivity to business cycles using data from 37 countries, representing all continents, that cover up to 25 years. Other studies that offer international comparisons investigate growth in private-label shares (Laney et al. 2007) and the international launch of new products (Tellis/Stremersch/Yin 2003). However, studies that model international marketing strategies remain scarce.

Much research activity works to determine cross-brand and cross-category effects, such as studies by Ailawadi et al. (2006), Boztag/Hildebrandt (2008), Hildebrandt/Klapper (2001), Leeflang et al. (2008), Seetharaman et al. (2005), Song/Chintagunta (2006), and Wedel/Zhang (2004). Most of the cross-category/cross-brand studies deal with cross-promotional effects. A general conclusion from these studies is that the number of significant cross-promotional effects is small. Within-category promotional effects are much larger than between-category promotional effects.

A special issue of Marketing Science (2005) focused on competition (Vol. 25, No. 1) contains articles in which the authors study vertical and horizontal competition simultaneously (e.g., Ailawadi/Kopalle/Neslin 2005).

The past decade also features market response models specified at the individual store level, such as those presented by Cleeren/Dekimpe/Verboven (2006); Daun/Mela (2009) and Van Dijk et al. (2004). Modeling the performance of individual stores is a topic which has received attention for already a long time. However, in the past the models were (too) simple and did not account for all kinds of variables which are now measured longitudinally and cross-sectionally such as promotional prices, regular prices, non-price promotions, shelf space, and similar variables at competitive stores.

In contrast, not many market response models support strategic decision making, which may be due partly to the declining role of marketing in firms (Verhoef/Leeflang 2009; Verhoef et al. 2010). Another explanation, recently articulated by Reibstein/Day/Wind (2009), suggests marketing academics have little to say about strategic marketing issues or emerging issues, such as the impact of networked organizations, the impact and marketing of emerging technologies, and so on. Models that address the marketing-finance interface may alter this picture though; these models use the value of the firm, instead of sales or market share, as the response measure. They also demonstrate the effects of marketing investments on firm value.

An excellent example is the recent study by Srinivasan et al. (2009), and Srinivasan/Hanssens (2009) provide a survey. Another recipient of recent attention deals with the relations between the Net Promoter Score and the value of the firm (Cook et al. 2007; Keiningham et al. 2008).

We use Table 1 to summarize the trends that we have discussed briefly. If the models have been developed in accordance with the expected trend in Leeflang/Wittink (2000a; 2000b), we indicate this by a ‘yes’. If the number of models in a particular area is still low, we indicate this by ‘limited’ or ‘still to be developed’.

3.2. Empirical Evidence

We illustrate trends in the applications of market response models using an empirical analysis of papers presented at the ten Marketing Science Conferences organized during this millennium.
1. New paradigm: From B2C to C2B
   - CRM models: yes
   - CLV models: yes
   - Customer engagement: still to be developed

2. Growth areas
   - Marketing of services: yes
   - Retailing: yes
   - B2B marketing: only developments in some areas:
     - Pharmaceutical marketing: yes
     - Partner selection: yes
     - Networks: yes
   - Electronic Marketing: yes

3. Shifts
   - Internationalization:
     - Comparisons: yes
     - International strategies: limited
   - Multiple brands: yes
   - Horizontal and vertical competition: yes
   - Store-level models: yes
   - Strategic decisions: limited
     - Marketing–finance interface: yes
     - NPS versus value of the firm: yes

Table 1: Trends in the Applications of Market Response Models

![Graph](https://example.com/graph.png)

Fig. 1 illustrates the growth in the number of papers presented – from approximately 300 in 2000 to more than 600 manuscripts in 2008. These numbers stand in sharp contrast to the number of papers presented in 1979 at the first Marketing Science Conference in Stanford. The conference was attended by only 120 participants, who presented 40 papers, only 11 of which included practitioners (Wittink 2001).

By counting the number of articles pertaining to topics that reappear in almost every year, we determine the most relevant topics. In turn, we classify these papers according to the following trend designations:

A: Positive trend over the decade (with one or two exceptions), named positive (++).

B: Positive trend in the past few years, called new stars (+-).

C: Fluctuating pattern, designated as stable (+/-).

D: Negative trend over the decade, which we refer to as stable but negative trend (-).

E: Negative trend in the past few years, named recent losers (+-).

Table 2 summarizes the trends we observe for each topic.

We observe (absolute) growth in research attention to the following topics:

- Brand management
- CRM
- Diffusion (including WoM)
- Pricing

More recently, we also observe growth in

- Consumer behavior (customer insights)
- Marketing metrics
- Pharmaceutical marketing
- Modeling of marketing of services (services)

The attention paid to consumer behavior is revealing and particularly noticeable in recent issues of *Journal of Marketing Research* (December 2008, February 2009).

We have determined the relative growth for each topic through the calibration of a market share model in which the fluctuations in market shares are explained by linear and quadratic trends. Here we find a confirmation of the (relative and absolute) growth of the following topics:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Average Number of Papers</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertising</td>
<td>17</td>
<td>+/-</td>
</tr>
<tr>
<td>Brand management</td>
<td>16</td>
<td>++</td>
</tr>
<tr>
<td>Competition</td>
<td>22</td>
<td>-/-</td>
</tr>
<tr>
<td>Consumer behavior</td>
<td>17</td>
<td>-/+</td>
</tr>
<tr>
<td>Consumer choice</td>
<td>31</td>
<td>+/-</td>
</tr>
<tr>
<td>Customer relationship management (CRM)</td>
<td>34</td>
<td>++</td>
</tr>
<tr>
<td>Diffusion (WoM)</td>
<td>24</td>
<td>++</td>
</tr>
<tr>
<td>E-commerce</td>
<td>31</td>
<td>+/-</td>
</tr>
<tr>
<td>Marketing metrics</td>
<td>8</td>
<td>-/+</td>
</tr>
<tr>
<td>Marketing strategy</td>
<td>10</td>
<td>+/-</td>
</tr>
<tr>
<td>(Multi-)Channel management</td>
<td>22</td>
<td>+/-</td>
</tr>
<tr>
<td>New product development</td>
<td>23</td>
<td>+/-</td>
</tr>
<tr>
<td>Pharmaceutical marketing</td>
<td>6</td>
<td>-/+</td>
</tr>
<tr>
<td>Pricing</td>
<td>36</td>
<td>++</td>
</tr>
<tr>
<td>Retailing</td>
<td>17</td>
<td>+/-</td>
</tr>
<tr>
<td>Sales promotions</td>
<td>11</td>
<td>+/-</td>
</tr>
<tr>
<td>Services</td>
<td>7</td>
<td>-/+</td>
</tr>
</tbody>
</table>

Table 2: Summary Trends in Topics in Which Market Response Models are Used, Based on Presentations at Marketing Science Conferences (2000–2009)
brand management, CRM, services, and consumer behavior.

It seems remarkable that there have been virtually no papers on B2B marketing and just a few articles pertaining to marketing strategy. However, this trend matches our discussion in the previous section. Of course, not all papers presented at Marketing Science Conferences deal with market response models, so for example, the number of market response models related to consumer behavior is limited. In this application area, the emphasis has fallen more on experimentation than on modeling.

A more recent topic of interest in Marketing Science Conference involves entertainment marketing, with a primary focus on the motion picture industry (Eliashberg/Elberse/Leenders 2006; Eliashberg et al. 2009). Modeling entertainment has been on the Marketing Science agenda only in the last two years.

Models that deal with marketing metrics and models that determine the effects of marketing expenditures on firm value (for an overview, see Srinivasan/Hanssens 2009) refer to marketing and accountability. Most other applications deal with the creation of knowledge to understand customers. In the next section, we discuss ‘new approaches’ to gain customer insights.

4. Methods/Techniques

Some important developments pertain to the use of “new” techniques to specify, parameterize, and validate market response models. Although many of these seemingly new techniques have been developed previously, their application to marketing problems is very recent. For example, we note the use of spatial models for marketing (Bradlow et al. 2005; Bronnenberg 2005); spatial econometric models first emerged in the 1980s (Anselin 1988), but only in the 2000s were they applied to marketing (Bronnenberg/Mahajan 2001).

Table 3 includes a schematic overview of the methodologies that have received most of the attention in the first decade of this century.

Important breakthroughs appear particularly in the areas of time-series modeling and state-space modeling, as indicated by not only the wealth of publications but also the creation of a series of conferences, called Marketing Dynamics (Leefflang et al. 2009; Pauwels et al. 2004). For a detailed and recent survey of time-series models in marketing, we refer to Dekimpe et al. (2008).

Both dynamic linear models (DLM) and Kalman filtering offer promising and comprehensive methods that help account for varying parameters over time. With
roots in state-space modeling, DLM relates closely to variance autoregressive (VAR) models.

Although choice models have a relatively long history in marketing, they face many challenges in terms of both developments and applications. The increasing availability of reliable and relevant individual customer data has stimulated their application. In the past ten years, we have observed an enormous productivity in developing brand choice models. Although many developments took place in the seventies, we observe many applications and modifications in the years thereafter. These models are developed at the aggregate as well as the individual household level, the examples of which are discussed in Van Heerde/Neslin (2008). Brand choice models are also used in combination with neural networks (Hruschka 2008). A possible future research avenue is to apply these models to describe word-of-mouth (WoM) processes (probably in combination with social simulation models).

In the past decade, spatial econometrics has penetrated marketing thought, providing excellent tools to model the interactions among customers, retailers, firms, and other entities (for an overview of marketing applications, see Bronnenberg 2005). The same development holds for agent-based models, which can be used to model word-of-mouth (WoM) interactions. However, other methodologies such as VAR modeling (Trusov/Bucklin/Pauwels 2009) remain useful tools for studying the effects of WoM.

Hierarchical models offer excellent opportunities to increase the number of parameter estimates in a model and thereby account for heterogeneity (Andrews et al. 2008). These models often appear in combination with Bayesian modeling. Rossi/Allenby/McCulloch (2005, section 5.8) provide an overview of findings derived from Bayesian hierarchical models and their influence on marketing practice and marketing theory.

Matching methods serve to distinguish treatment from selection effects, a distinction that is highly relevant, for example, for determining the effects of the use of multiple channels on customer profitability. Many managers seem to believe that customer profitability improves when customers use online channels, in addition to traditional distribution channels, but this effect actually appears due generally to a selection effect, instead of a treatment effect (i.e., the use of the online channel). Matching methods can disentangle these effects (Gensler et al. 2009; Hitt/Frei 2002).

Structural models rely on economic and/or marketing theories of consumer and/or firm behavior to derive the econometric specification to apply to the data (Chintagunta et al. 2006, p. 604). In many of these models, a structural demand equation connected to a structural supply equation provides the means to derive and test competitive interactions between firms. In many cases, the development of structural models, including their specification, estimation, and validation, does not always correspond with their applicability in marketing practice, and their usefulness for normative as well as descriptive purposes (Chintagunta et al. 2006).

In parametric regression models, the model builder approximates reality with a mathematical function. Therefore, the parametric models have a functional form and a parametric distribution of the error term. With a nonparametric regression approach, the modeler instead relates the criterion variable to predictor variables, without reference to a specific form. The advantage of a nonparametric regression model therefore is its flexible form. Because the estimation of the parameters occurs over a (large) number of rounds, this method belongs to the category of machine learning techniques, along with boosting and bagging methods. Lemmens/Croux (2006) undertake bagging and boosting of binary logit models to predict churn in a wireless telecommunications company.

Finally, we observe the intense use of structural equation modeling (SEM). The two most frequently applied SEM methods are covariance-based structural equation modeling (CVSEM) and partial least squares (PLS). Recently Buckler/Hennig-Thurau (2008) introduced universal structure modeling (USM) as an exploratory complement to CVSEM and PLS. For critical evaluations of SEM in marketing, see Baumgartner/Homburg (1996), Leeflang/Wittink (2000a, 2000b), and Steenkamp/Baumgartner (2000).

Counting the number of papers presented at a Marketing Science Conference over the past decade that use a particular method or technique confirms some anticipated trends, such as the penetration of spatial models into marketing in 2000 and the recent revival of SEM. We also observe methods that have only recently been applied to marketing problems, including Bayesian, structural, and agent-based models. Other techniques, such as models that capture marketing dynamics (i.e., time-series and dynamic models), have been popular among marketers for quite some time, but the number of papers using these techniques fluctuates heavily from year to year.

5. Response Models for the Future

Research already has identified the decision support needs of marketing managers (Hanssens/Leeflang/Wittink 2005). We also find that the successful implementation of market response models depends on data availability and the methodology. Sophistication in the model specification and estimation may not be conducive to acceptance; instead, marketing managers appreciate:

- Outcomes of empirical generalizations.
- Standardized models (one or more relations in which the mathematical form and the relevant variables are fixed).
- Models of the firm that are connected to market response models.
Most decision making is repetitive or tactical in nature, so standardized models are particularly useful to support these decisions. Yet in some situations, idiosyncratic models may be preferable to standardized ones, such as modeling in support of litigation. Idiosyncratic market response models may also contribute to the resolution of policy issues.

Other modeling needs, classified according to MSI's 2008 – 2010 top priorities are as follows:

1. Define appropriate metrics and relate these metrics through formalized and subjective estimation methods. Measuring scores through metrics (Farris et al. 2006), is a necessary but not sufficient condition to support marketing decisions. We also need to calibrate models between these metrics. In many firms, data collection is still in its infancy, and there are no historical data about relevant metrics. The development and application of subjective estimation methods would be very useful in these cases (e.g., Leeflang et al. 2000, section 16.9).

2. Generate generalizations to support a better understanding of customer behavior.

3. Uncover new approaches to generate customer insights in a number of specific application areas, such as:
   - Customer engagement
   - B2B marketing
   - International marketing

Furthermore, there is a need to develop and implement market response models that are appropriate to support strategic decision making in marketing.

The development of these new approaches faces several challenges, including but not limited to the following:


- How do we deal with endogeneity issues? (Shugan 2004). There are now many approaches that deal with endogeneity, including instrumental variables (IV approach, e.g., Card 2001; Nevo 2001; Villas-Boas/Winter 1999), the specification and estimation of simultaneous equation systems, (similarity-based) spatial econometrics (Van Dijk et al. 2004), and control functions (Park/Gupta 2009; Petrin/Train 2010). For some comparisons of these alternative methods, we refer to Andrews/Ebbes (2009) and Van Dijk et al. (2004).

- How to specify structural models of demand and firm behavior that enhance their applicability in marketing practice and their usefulness for normative as well as descriptive purposes? (Chintagunta et al. 2006).

We realize that these points constitute only a portion of the “to-do” list for marketing model builders. Thus, we conclude that much, and challenging, work remains for the near future.

**Notes**

[1] This text is based on MSI (2008).

**References**


