



A Survey of New Product Evaluation Models

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New product development is a dynamic and lengthy process ranging from idea generation through product launch. It is quite important that product managers evaluate the viability of a new product at every stage of its development. Previous literature provides a large number of models that can be used to evaluate new products at different stages of the new product development process. These models vary with respect to their objectives, applicability to different products, data requirements, suitable environments and time frames, and diagnostics. This article presents a critical review of the models with an emphasis on these factors. The article also outlines other emerging methods that companies are using today. It concludes with managerial and research implications. © 1999 Elsevier Science Inc.

Introduction

Market dynamics have been changing dramatically. Popular strategies of the 1980s, such as cost saving and quality improvement, are no longer sufficient to win the competitive battles of the 1990s [32]. These battles will be won by those companies that can create and dominate new markets by developing new products [19]. However, creating new products is a risky business. It requires substantial monetary and nonmonetary commitments. Even when an extensive commitment is made, the success of a new product is not guaranteed. Hence, previous literature provides various new product models related to different stages of the new product development process. Example studies include the multiattribute [41], conjoint [31], pretest market [69], test market [56], and diffusion models [48].

Despite the large number of available models, surveys indicate that they have been underutilized [47]. This is considered to be one of the possible reasons for

the relatively low new product success rate [86]. The surveys also reveal that managers frequently use focus groups and expect them to provide accurate forecasts even though they were never intended for such a purpose [47]. Therefore, the objective of this article is to review the widely cited new product models based on their objectives, applicability to different products, data requirements, suitable environments and time frames, and diagnostics.

The following section explains the new product evaluation process and its stages, identifies factors that distinguish different models, and presents the models relevant to different stages of the new product development process with respect to those factors. The

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article continues with a discussion of other emerging and complementary methods (e.g., environmental scanning, pattern recognition) that companies also are using today. Finally, the article concludes with managerial and research implications.

New Product Evaluation

New product evaluation is a dynamic process and generally can be conducted at five major stages including concept testing, prototype testing, pretest market, test market, and launch [46]. The concept testing stage is concerned with assessing consumers' reactions to a new product concept, identifying important attributes, and determining potential market size. In the prototype testing stage, individuals evaluate a prototype of a new product. The pretest market stage deals with the simulation of a shopping environment and measures the reactions of potential buyers to a new product. The test market stage is an evaluation with a limited product launch and is the final step before a full-scale commercialization. Finally, the launch stage involves predicting the future sales of a new product by using its early sales data.

As Figure 1 shows, one can evaluate a new product by going through the whole process. This can be an ideal practice, as previous studies suggest that using multiple methods improves forecasting accuracy. However, due to competitive pressures and increasingly shorter product life cycles, companies tend to

introduce new products as quickly as possible by skipping several stages of the process [46]. It should be noted that the process runs parallel to the new product development process and is applicable to both stage-gate and concurrent processes; thus, companies can utilize the models either sequentially or concurrently.

Previous literature and industry examples indicate that the use of a particular model largely depends on the objective, product type, data requirement, environment, time frame, and type of diagnostic information needed. These factors are explained briefly below. The next section reviews the new product models relevant to different stages of the new product development process and the emerging methods with respect to these factors. Table 1 also summarizes them.

1. Objective

New product models can be used for different purposes. For example, one objective is to predict a new product's market performance in terms of product awareness, trial, repeat purchase, total sales and profits, product life cycle, sales peak, financial worth, and market share. Another purpose is to design a new product, evaluate it, and then improve its attributes. New product models also can be used to evaluate relevant marketing attributes of a new product. Finally, a new product model also can be used to understand the overall market environment in order to determine emerging trends and lifestyles.

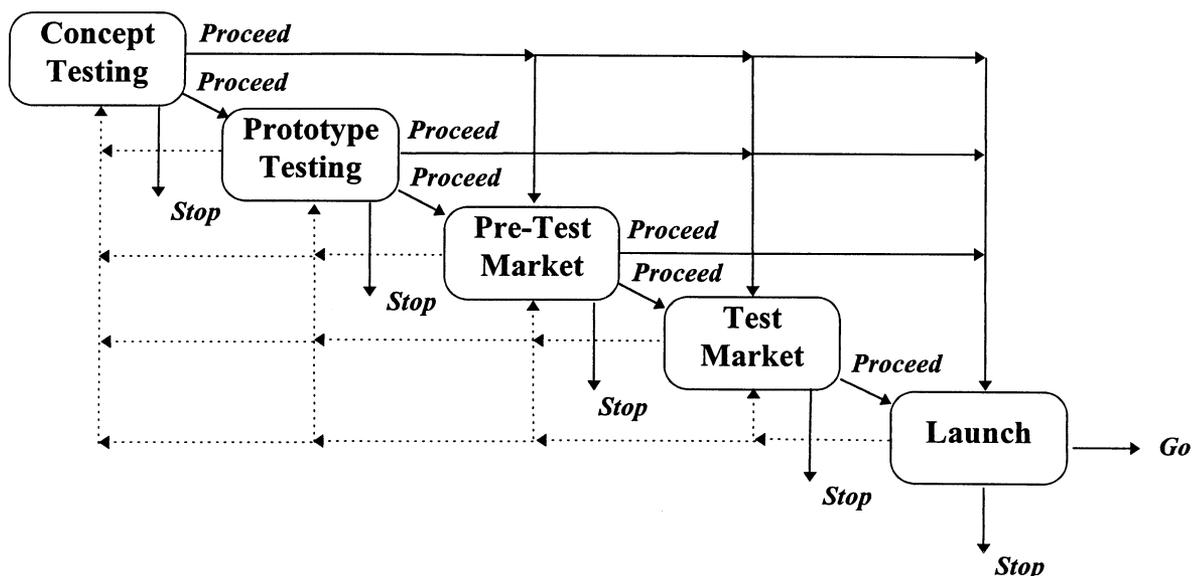


Figure 1. New product evaluation process.

Table 1. Summary of New Product Evaluation Models

| Stage (Method) | Primary Objective | Product Type | Required Data | Environment | Time | Diagnostic Information | Limitations |
|---|--|--|--|---|--|--|---|
| Concept Testing: Analogies | Predicting performance (awareness, trial, repeat purchase, total sales, total profits, financial worth, and market share). | Products that have a suitable analogy with a similar market environment, marketing strategy, and company background. | Historical sales data of similar products. | The analogy should have a comparable environment, marketing effort, and consumer perception. Effective in stable environments. | Effective for short term predictions. Can be conducted very quickly. | Insights for product positioning and information about the required marketing budget. | Difficult to find suitable analogies. Unclear which similarity base (i.e., functional, conceptual, perceptual) to use. |
| Concept Testing: Expert Opinions | Predicting performance and identifying likely and unlikely events in the market. | Any new product as long as experts are not biased. | Opinions of different experts. | Effective in stable environment. | Effective for short term predictions. Can be conducted very quickly. | Insights for product design and positioning. | Subject to such biases as optimism, conservatism, anchoring, and supply orientation. |
| Concept Testing: Purchase Intentions | Predicting performance. | Every type of new product as long as people are familiar with it. Less accurate with "new-to-the-world" products. | Consumer survey data. | Effective with stable concept, environment, and marketing plans. | Reliable when the time between the test and actual purchase is very short. Can be conducted very quickly. | Information about product design and positioning. | Unreliable when the time interval is long. Insensitive to the changes in environment, consumers, and concept. |
| Concept Testing: Multiattribute models | Predicting a new product's relative market position and designing its features. | Products with clearly definable attributes. Less accurate with "new-to-the-world" products. | Consumer survey data. | Effective when the environment and consumer perceptions are relatively stable. | Reliable in short term analyses. Can be conducted quickly. | Information about product attributes, relative position of the new product in the market, and new opportunities in the category. | Based on the assumptions that products have a finite set of attributes, and people base their opinions on them. |
| Concept Testing: Focus Groups | Understanding a new product's usage and relevant purchase processes. Designing new products. | Any new product with which participants are familiar. | Opinions of consumers and/or experts. | Can be used in a stable environment. | The relevance of the focus group results may be short term. Can be conducted quickly. | Information about product design and positioning. | The group may not be representative. The group discussions might be influenced by more talkative people. |

continued

Table 1. Summary of New Product Evaluation Models

| Stage (Method) | Primary Objective | Product Type | Required Data | Environment | Time | Diagnostic Information | Limitations |
|--|---|---|--|--|--|--|--|
| Concept Testing: Scenario Analysis and Information Acceleration | Understanding future market conditions. Designing new products and predicting their performance. | Expensive, risky, and/or future products. It also can be used with "new-to-the-world" products. | Consumer data, historical sales data of similar products, managerial input, and data for production constraints. | Requires a stable environment. | Can be used to simulate long term market conditions, but the process takes time. | Market simulation generates insights for product positioning and marketing planning. | The quality of the results depends on that of the scenario, simulation, and future conditioning. |
| Prototype Testing | Identifying and correcting potential problems of a new product. Designing new products. | Any new product as long as a prototype can be developed at a reasonable cost/time. | Opinions of potential buyers and/or experts about product usage. | Reliable when the environment is stable. | Can be used for long-term product development. The test takes time, but it can be reduced by using the Internet. | Information about a product's problems and ways to correct them. | Small sample may not represent the population. Good for diagnosis but not for prediction. |
| Pre-Test Market | Predicting performance. Evaluating marketing variables. | Low-cost/risk packaged goods that are not seasonal and do not have long purchase cycles and irregular usage patterns. | Consumer, product, and marketing data. Store audit. | Requires a stable environment. Effective to eliminate potential competitive reactions to a test-market study. | Effective for short-term results. Can be substitute for a test-market study under time pressure as it can be conducted relatively faster. | Information about marketing variables and market positioning. | The laboratory simulation may not represent the true market conditions. |
| Test Market | Predicting performance. Evaluating marketing variables. | High-cost/risk consumer products. | Consumer, product, and marketing data. Store audit. | Requires a stable environment. Can be affected by competitive reaction and sabotage. | Effective for short-term results. It takes time, and this can delay a new product's introduction. | Information about marketing variables and market positioning. | Subject to competitive reaction. The test is highly controlled so that it may not represent the true market conditions. |
| Launch: Diffusion | Predicting performance. | Any new product that has historical sales data and/or has analogies with historical sales data. | Historical sales data of the new product considered and/or its analogies. | Requires a stable environment. | Can be used for long-term forecasting in stable environments. Can be conducted relatively quickly. | Information about marketing variables and market positioning. | Unstable when there is a limited amount of early sales data. |

continued

Table 1. Summary of New Product Evaluation Models

| Stage (Method) | Primary Objective | Product Type | Required Data | Environment | Time | Diagnostic Information | Limitations |
|------------------------------------|---|---|--|--|--|---|--|
| Brand Equity Analysis | Evaluating a brand and market extension. | Brand/line extensions. | Historical data of an existing brand. Consumer survey data about a brand and its extension. | Requires a stable environment. | Reliable for medium-term focus. Can be conducted relatively quickly. | Insights for product development and positioning. | Assumes that the existing brand has a specific and well-understood image, and buyers base their decisions on it. |
| Need/Usage Context Analysis | Understanding unfilled needs and/or a product's usage situations and the type of problems it can solve. | Can be used with every new product. | Opinions of lead users. Consumer survey data. | Can be helpful in unstable environments. | Can have a long-term focus. Can be conducted relatively quickly. | Insights for product design and positioning. | More specific product and marketing attributes need to be tested by other methods. |
| Environmental Scanning | Understanding the overall environment of a company to develop, position, and monitor new products. | Relevant to every type of new product. | Primary and secondary data about the environment including consumers, competitors, dealers, and suppliers. | Can be used in any environment. Can be useful in unstable environments. | Can have both short- and long-term focus. Can be conducted quickly with today's technology. | Insights for new product development and positioning. | More specific product and marketing attributes need to be tested by other methods. |
| Portfolio Approach | Developing, monitoring, and positioning a portfolio as opposed to a single product. | Can be used with every type of new product. | Primary and secondary data relevant to a portfolio. | Can be used in any environment. Can reduce new product risks in unstable environment. | Can have both short- and long-term focus. Can be conducted quickly with today's technology. | Insights for new product development and positioning. | More specific product and marketing attributes need to be tested by other methods. |
| Pattern Recognition | Understanding consumer lifestyles and consumption patterns to develop and position new products. | Can be used with every type of new product. | Primary and secondary data from the environment. | Can be used in any environment. Can reduce new product risks in unstable environment. | Can have both short- and long-term focus. Can be conducted quickly with today's technology. | Insights for new product development and positioning. | More specific product and marketing attributes need to be tested by other methods. Can be unstructured. |

continued

Table 1. Summary of New Product Evaluation Models

| Stage (Method) | Primary Objective | Product Type | Required Data | Environment | Time | Diagnostic Information | Limitations |
|--|---|--|---|--|--|---|--|
| The Internet | Understanding the environment of a company. Testing new products, prototypes, and market strategies. | Relevant to almost all types of new product. | Online primary and secondary data. | Can reduce new product risks in unstable environments when used with other methods. | Can have both short- and long-term focus. Can be conducted quickly with today's technology. | Insights for new product development and positioning. | Currently, the Internet can be accessed by a limited number of people who may not be representative. |
| Alliances | Gaining access to additional resources to design and market new products. | Relevant to almost all types of new product. | Information about the potential candidates for an alliance as well as consumer survey data. | Can be used in any environment. Can reduce new product risks in unstable environment. | Can have both short- and long-term focus. It might take some time to find a partner. | Insights for new product development and positioning. | Heavily depends on the success of the alliance. |
| Value-Chain Approach | Developing, evaluating, and positioning new products. | Relevant to every type of new product. | Opinions of the members of the value chain of a new product. | Can be used in any environment. Can reduce new product risks in unstable environment. | Can have both short- and long-term focus. Can be conducted quickly with today's technology. | Insights for new product development and positioning. | The new product needs to be equally important to different people in the value chain. |
| Straight Judgment-Vicarious Input | Predicting performance. Developing new products and related strategies. | Relevant to every type of new product. | Opinions of top management. | Can be used in any environment. | Can have both short- and long-term focus. Can be conducted quickly. | Insights for new product development and positioning. | Subject to such biases as optimism, conservatism, anchoring, and supply orientation. |

2. Product Type

The use of a particular model also can depend on the type of new product considered. For example, some models are applicable to line extensions, whereas others are more suitable for "new-to-the-world" new products. Some models can be used with almost every type of new product when certain qualifiers are satisfied. For example, analogies can be used with any new product as long as a suitable analogy can be identified. Also, some models can suffice for low-cost/risk consumer products, whereas others are better utilized for high cost/risk consumer products.

3. Required Data

Different types of data required by the models include historical sales data, opinions of experts, consumers, lead users, and top managers, consumer survey data, store audit, and primary and secondary data about the environment. For instance, the analogies method uses the historical sales data of similar products, whereas prototype testing uses the opinions of consumers and/or product experts. Because data collection involves time and cost, managers also should consider the type of data required by a model before using it.

4. Environment

The effectiveness of a model depends on the stability of the environment. For example, the reliability of the results of the multiattribute models diminishes when changes are expected in the environment. However, environmental scanning can complement these models in unstable environments. The competition in an environment also can influence the results of a particular model. For instance, test market models are subject to competitive reactions. Thus, pretest market models can be an effective way of avoiding that reaction.

5. Time

The models also differ with respect to their time horizons. Those models that are related to assessing specific product and marketing attributes may have a short-term focus. On the other hand, those models that pertain to understanding the market environment and consumption patterns tend to have a long-term focus. Models also vary with respect to the amount of time required to complete them. For example, it usually takes 9 to 12 months to complete a test market study, whereas a pretest market study can be completed in a matter of weeks. Therefore, managers also need to

consider the amount of time they have before selecting a model.

6. Diagnostic Information

New product models also provide relevant diagnostic information to managers. For instance, a model can generate product-related diagnostics for improving a product. In addition, it can provide marketing-related diagnostics for enhancing various marketing variables. Finally, it can give insights about new opportunities in the market so that new products can be developed to capture those opportunities.

Concept Testing Stage

Previous research has concluded that predevelopment activities, including concept testing, are particularly effective in separating successful and unsuccessful new products [20]. As a result, concept testing can be considered as one of the most critical steps in the new product development process. Consistent with this importance, there are quite a few concept testing methods. Among the most widely used methods are analogies, expert opinions, intentions, multiattribute models, focus groups, and scenario analysis/information acceleration.

Analogies. This method uses the historical data of similar products to assess the success of a new product. Assuming that the environment stays stable, analogies can answer two important questions once they are identified. First, they can be used to predict the performance of a new product in terms of awareness, trial, repeat purchase, and market share. Second, analogies can help companies determine the approximate marketing effort required to achieve a similar level of performance. This, in turn, helps companies position their new products [87].

Analogies can be very effective when they are used to model the relationship between two contingent products. Contingent products can be both consumer goods (computer and software) [8] and business-to-business products (supermarket scanners and UPC symbols) [13]. Analogies also can be useful to estimate the diffusion of new products that have no historical sales data [75]. However, a suitable analogy may not exist for some type of products such as "new-to-the-world" products. In addition, it is unclear which similarity base (i.e., functional, perceptual, and conceptual similarities [76]) to use. For example, a Lexus and Toyota Celica are similar in a functional

sense, but are perceptually very different. Finally, the environment, marketing effort, company backgrounds, and consumer perceptions may not be comparable. For example, using a name-brand radio as an analogy for an unknown radio brand can be misleading, because the famous brand's image might be a driving force in its sales performance in addition to its functional characteristics. Moreover, larger companies are likely to have more sophisticated distribution systems that can enhance sales performance.

Expert opinions. Both in-house and industry experts can provide opinions about the prospects of a new product. They can predict whether various events are likely or unlikely to affect its demand. In addition, they can generate valuable insights for product design and positioning, particularly when there are no historical data. Expert opinions have been used widely by such companies as RCA [43], L'eggs Products, Inc. [51], Lenox Industries, Inc. [16], and the Nabisco Foods Group [29]. They also have been used to determine likely competitive events in the telecommunications industry [68].

Research has shown that expert opinions are less accurate when the environment is unstable [4]. For example, experts tend to be inaccurate in predicting a competitor's price retaliation. In addition, they are subject to such biases as optimism, conservatism, anchoring, and an emphasis on easily available data, any of which can generate a forecasting error [5]. Finally, they tend to be supply oriented and to overlook consumers' needs and concerns. For example, several expert forecasts for home video technologies had paid too much attention to technical factors and too little to user needs, resulting in either an over- or underprediction [43].

Intentions. This method asks potential buyers to evaluate a new product concept and to state their intentions to purchase it. Intentions can be used to predict trial and/or repeat purchase of a new product. However, they tend to be more reliable for predicting trial than repeat purchase because the latter requires a longer time horizon and involves other factors such as satisfaction with a trial [72]. The intention results can be helpful in assessing a new concept's financial worth and provide insights for improving and positioning it [21]. Previous studies have shown a positive but low association between purchase intentions and actual purchase. However, recent attempts to improve predictions based on stated intentions have shown some promising results, most notably grouping potential

buyers into segments and evaluating intentions within each segment [54].

The intention measures have been widely used. For example, they were used for durable and nondurable goods [38] and for service products [37]. As an application in a nonprofit setting, they also were used to investigate the role of such antecedents as donor knowledge and perceived risk in intention to donate blood [2]. However, the reliability of intentions depends on the assumptions that there are no changes in (1) concept, (2) environment, and (3) positioning between the first exposure and product introduction [55]. Moreover, asking about intentions causes increased polarization of attitudes, use of simulated heuristics, and an increased attitude accessibility that may not exist in an actual purchase situation, thereby resulting in a biased estimation [55]. Finally, the effectiveness of intention measures is reduced when used with "new-to-the-world" products, because the respondents may lack *knowledge* and/or a *suitable frame of reference* to make reliable judgments, and/or they might have a *functional fixedness* with respect to current attributes being offered and resist accepting a new product [69,84].

Multiattribute models. These models use consumers' evaluations of a product's overall description and its attributes to generate a graphical and/or mathematical representation of the product. Then, the models determine the relative importance of product attributes and the effects of different attributes on the overall product judgment [31]. In addition, they can enable managers to understand a product category and recognize opportunities by providing a succinct representation of how customers view and evaluate products in that category. Finally, they can help managers test a product's ability to fill those opportunities [78].

Multiattribute models have been used widely. For instance, a study compared a new health maintenance organization concept to other competitive plans in the Boston area and identified four key dimensions, namely, quality, personalness, value, and convenience [78]. Another study evaluated three museum exhibits compared to an ideal exhibit and showed that, all other factors being equal, exhibits sharing many characteristics with a notional ideal concept achieved a larger market share [3]. As an application in the consumer durable products category, Sunbeam Appliance Co. also successfully used this method to test its new product concepts in a simple, less costly, and realistic way [59-61].

These models make several assumptions, the viola-

tion of which seriously undermines the effectiveness of the models. The assumptions are as follows: (1) concepts have a finite and stable set of attributes that influence choice and differ for at least some of the concepts; (2) people evaluate concepts based on the attributes; (3) the attributes are correlated to the extent that a reduced space representation is possible; (4) people have a preferred level for concepts along each attribute; and (5) the attributes jointly determine an individual's preference for each concept [85]. In addition, there are several intangible attributes that are difficult to account for in a multiattribute model. Finally, especially for "new-to-the-world" products, respondents can be (1) uncertain about whether the product will possess each feature at the time of purchase, (2) uncertain about what sign should be applied to the part-worth (i.e., whether it is desirable or undesirable to have each feature), or (3) uncertain about the absolute magnitude of each feature [41].

Focus groups. Focus group interviews involve 6 to 10 consumers or product experts engaged in an open and in-depth discussion about a new product with which they are familiar. The interviews are led by a moderator whose role is to facilitate a nondirective and free-flowing discussion. A typical focus group study usually consists of an orientation, exposure, product and price evaluation, and discussions about possible feature additions and product modifications [49]. Many focus group sessions are videotaped, and a complete transcription of the sessions also is prepared. The results are used in understanding consumers' opinions about the new product, its usage situations, and relevant purchase processes. This information then can be used for product design and positioning as long as the environment and consumer perceptions remain stable [78].

Focus group interviews are useful for incorporating the voice of consumers into the design of a new product. In addition, they usually are conducted more quickly and at less cost than other techniques [21]. Despite these advantages, the quality of the focus group interviews depends on the skill and articulation of the moderator. In addition, the groups may not represent a target population. Finally, the group discussions may be unduly influenced by certain group members who are forceful and articulate [53].

Scenario analysis and information acceleration. Often times, companies try to understand future needs so that they can develop new products to satisfy them. With a scenario analysis, companies first paint a scenario (e.g., driving 25 years from now); then they

study it for unique needs; and finally, they evaluate them and try to come up with new products that can fulfill the most important ones [21]. A scenario analysis can be a good way of identifying future needs and generating new product concepts before competition. However, specific concepts still need to be evaluated. In addition, because of a lack of necessary knowledge, people may not visualize the future and cannot assess related new product concepts.

As a special case of scenario analysis, "information acceleration" tries to reduce individuals' lack of knowledge and help companies evaluate new product concepts. It first conditions respondents to think about a future environment by providing them some infrastructure, context, and economic or regulatory aspects of the future. Then, they receive information about the product tested (e.g., an electric car) through a multimedia computer simulation. They can get the information from an online TV commercial, newspaper advertisement/article, and/or a video showing other people's opinions about the product. Finally, they make a discrete choice among several alternatives. The dynamic model utilizes an extensive amount of input from the multimedia exercise (e.g., online search by consumers, dealer visits, word-of-mouth communication, magazine reviews), historical data of similar products, industry sales, managerial judgments, and production constraints. All these inputs are used to forecast and simulate the market environment [79].

The information acceleration has been used for a few products such as an electric car, blood cell count analyzer, and camera [82]. Evidence so far shows that it has a strong internal and a reasonable predictive validity [82]. Extension studies have incorporated categorization, elimination, and consideration aspects of consumer behavior into the original model to provide more managerial insights for positioning and marketing planning [80]. Despite its usefulness, the average cost ranges from \$100,000 to \$750,000 [82]. Thus, the tested product initiatives should be important enough (such as an electric car) to justify this cost. In addition, the results heavily depend on the quality of the simulation. Finally, the results also are dependent upon the accuracy and stability of the future conditioning of the respondents [81].

Prototype Testing Stage

After designing a new product, a company usually manufactures its prototype and tests it to determine (1) whether the product lives up to its promises; (2) how

the product compares with the other brands in the market; (3) how the product can be improved; and (4) how consumers' preferences change after usage [53]. Hence, a prototype test enables a company to detect and correct potential product problems before proceeding further in the new product development.

There are three types of prototype testing. The first is alpha testing, in which the prototype is tested under laboratory conditions within a firm to see whether it delivers the intended performance. The second is beta testing, where people use it for a specified time period within their own usage environment and report their experiences. Finally, in gamma testing, people use it indefinitely and report any problem they might have with the product [21]. Both novices and experts can evaluate a prototype [78].

Prototype testing is feasible only when a prototype can be developed and tested in a reasonable time with a reasonable cost. It has been used with almost every product type ranging from dog food to automobiles, from detergents to electric microscopes [78]. It can detect potential technical problems with a new product before its mass production. However, it may not be appropriate for assessing the market potential of a new product. In addition, because it is conducted with a small sample, they cannot assure market success [53]. Furthermore, timing plays a crucial role for new products. If prototype testing is conducted too late in the new product development process, it may have little value in preventing big financial losses [24]. Moreover, it may be impossible to wait for the results when there is a time pressure to enter the market and/or when changes in the environment are expected [25]. However, some software companies have speeded up the way they conduct prototype testing by using the Internet [86]. Finally, for industrial products, these tests require a big commitment from customers [24].

Pretest Market Stage

Pretest market studies are conducted before a test market or before a full-scale launch and can be in the form of in-home use tests, laboratory simulation tests, minitest markets, regional rollouts, and/or an adoptive experiment [87]. A typical pretest market model uses product, marketing, and consumer data as well as store audit. It gives a sales forecast and marketing diagnostics that can be used for corrective actions before going into a more expensive test market or a national launch [78]. Hence, a pretest market study increases the chances of eliminating potentially unsuccessful

products early in the process. Finally, competitors can see the results of a test market study and subsequently develop a competing brand in a short period of time without going through a lengthy and costly product evaluation process. Thus, a pretest market study also can be a good way of limiting competitors' ability to learn from the results and/or their ability to sabotage a test market [69].

These models can be used either independently or in addition to a test market. A test market may not be needed in addition to a pretest market study when (1) there is a need to reach the market early; (2) market entry costs are low; (3) a small market is to be entered, and potential gains/losses are small; or (4) the pretest market sample size is large, accurate awareness and distribution estimates can be made, and there is no change in the firm's marketing plan [77].

Pretest market models have been used mainly with low-cost/risk packaged goods. The products included laundry products, household products, deodorants, over-the-counter drugs, and vitamin supplements [69]. They may not be suitable for products with long purchase cycles (luggage), irregular usage patterns (barbecue sauce), or with highly seasonal patterns (Easter egg dye) [69]. Also, they perform well when people make purchase decisions after a single advertising exposure and when the environment is stable [53]. In addition, in a laboratory situation, many respondents may recognize the tested brand because it is the "unfamiliar one" and/or may think that they are participating in a research study. Besides, the test may not represent real market conditions, thereby limiting external validity [69]. Moreover, they assume 100% distribution and awareness [53]. Finally, the predictions of the models or the data on which they are calibrated usually must be adjusted by judgmental parameters that may be biased, because the desire often is to develop high enough forecasts to allow the product to proceed to a test market [69].

Test Market Stage

A test market is a controlled experiment conducted in a limited, but carefully selected, part(s) of the target market. This stage is generally the first opportunity for a company in the new product development process to test all the relevant marketing variables together. It can give forecasts for total sales and market share and can provide important diagnostic information about marketing variables. Furthermore, it helps companies re-

hearse marketing strategies under realistic market conditions before they commit to a national launch [21].

The decision to conduct a test market depends on several factors. If the risk (i.e., failure, investment size, and firm reputation) is high, a test market can reduce it. Also, if the opportunity cost (i.e., the time delay caused by the test, and the effort and enthusiasm of the sales force that can be used in other projects) is high, firms can avoid it. Finally, if a competitive reaction (i.e., sabotaging and/or learning from it) is likely, a test market can be skipped [53].

Among the most widely used test market models are TRACKER [9] and NEWS/MARKET [63]. These models consider the major stages of consumers' new product adoption process (awareness, trial, and repeat purchase); use store audit and consumer, product and marketing data; provide diagnostic information; enjoy a high degree of commercial acceptance; and are not very complex [56]. However, the purpose of a test market should be how to best execute a marketing plan rather than to learn if people will try a product; the latter question should have been answered earlier [21]. Also, a test market takes place in a controlled setting where firms pay extra attention to the project and upgrade the quality of the product and marketing due to a desire to be successful in the test. Thus, the results can be biased [53]. In addition, a typical test market study can cost up to \$500,000 [21] and take 9 to 12 months [78], thereby increasing its opportunity cost. Because it takes a long time to conduct the test, the market environment needs to be relatively stable. Finally, a test market enables competitors to affect the results and gives them a chance to develop a competing brand without going through a lengthy and costly testing process themselves [87].

Launch Stage

Here, the purpose is to assess the diffusion of a recently launched new product by using its early sales data and/or the historical sales data of its analogies. Models at this stage can provide forecasts about a new product's life cycle, sales peak, and the number of adopters. They also give diagnostic information in the early stages of a new product introduction. A diffusion model is "*characterized by the probability $P(t)$ that an initial purchase will be made at time t given that no purchase has yet been made is a linear function of the number of previous buyers*" [6]. Since its introduction in the 1960s, researchers have advanced the original model by redefining innovators and imitators, intro-

ducing better parameter estimation procedures, and relaxing its assumptions [48].

Diffusion models have been used in a wide range of product categories. For example, a meta-analysis [71] compared 213 applications with respect to the nature of innovation, country under study, model specification, and estimation procedure. A dummy variable regression model showed that (1) industrial and medical innovations had higher coefficients of imitation than other innovations; (2) data from European countries produced higher coefficients of innovation than that from the U.S.; (3) the presence of the coefficient of innovation was associated with a higher coefficient of imitation; (4) when the marketing mix variables were included in the models, the coefficient of imitation became smaller; and (5) the ordinary least square (OLS) estimation procedure produced slightly higher estimates compared to the maximum likelihood estimation (MLE) and other nonlinear estimation procedures.

The purpose of these models is to represent the level of diffusion in a population as a function of time that has elapsed since the introduction of a product [48]. As a result, these models require early sales data. However, by the time these data become available, it may be too late for a company to recover any losses from the early investments in the project. Also, because of possible changes in the environment, the data can be no longer applicable. For example, an early study showed that a diffusion model for consumer durables required at least 6 years of annual sales data to provide useful forecasts of the sales peak [34]. Alternatively, historical sales data of similar products can be used (i.e., analogous forecasting). However, this approach also can have the limitations associated with using analogies discussed earlier.

Emerging and Complementary Methods

The models reviewed so far can help companies evaluate new products and improve related product and marketing attributes. They are not necessarily exhaustive and mutually exclusive. There are also other new product evaluation methods that companies are using in today's complex market environment. A review of the recent business and other publications suggests that companies are also using the following new product evaluation methods: (1) brand equity analysis, (2) need/usage context analysis, (3) environmental scanning, (4) portfolio approach, (5) pattern recognition,

(6) the Internet, (7) alliances, (8) value-chain approach, and (9) straight judgment/vicarious input.

Brand Equity Analysis

Previous literature provides an extensive amount of evidence about the effectiveness of brand/line extensions on new product success and relevant cost savings [1]. Increasingly, companies are studying their brands and using their findings to evaluate new product initiatives and to make related marketing decisions. For example, Hard Rock Café analyzes its brand regularly and evaluates new market opportunities based on the fit between its brand image and potential markets. As a result, its restaurants are expanding fairly rapidly in the Asian market. Similarly, the brand name of Hard Rock Café is associated with traveling (its typical customer is a traveler and comes from 900 miles away); consequently, a brand extension to Hard Rock Café Resorts has been quite successful [18].

A brand equity analysis can be helpful in evaluating a brand/line extension and obtaining insights for product development and positioning. It uses the historical data of an existing brand and consumer surveys about it and its new extension. It assumes that an existing brand represents a specific and well-understood image, and customers base their decisions on that image. The reliability of the results depends on the assumption that the brand image and consumer perceptions remain relatively stable over a reasonable period of time. It can be used in assessing the overall viability of a new product/market opportunity at the concept stage where a specific forecast is not possible. However, it should be used in conjunction with the other methods to fine-tune marketing strategies for the new extension.

Need/Usage Context Analysis

Many successful new products are intended to solve a problem rather than to create a technological appeal (e.g., the Walkman, Express Mail, and cellular phone). New products can also be assessed based on the types of problems they solve and the situations in which they can be used. Traditional consumer and survey-based methods may not be enough to understand the problems that a product can solve and to determine its possible usage situations, but asking the opinions of lead users can be helpful [86]. For example, when a team of astrophysicists wanted to simulate a moderate-size star cluster to investigate the galactic dynamics,

they realized that it would take too long for the supercomputers of the 1980s to complete it: 3,000 years to be exact [73]. Instead of waiting for IBM or Intel or Cray to develop a fast enough computer for them, they designed their own computer, GRAPE, which has become the fastest computer in the world. The latest version can do over a trillion calculations per second and can complete the simulation in a few months. It is expected to perform a quadrillion operations per second by the turn of the century. The usage situations for this type computer are enormous, ranging from airplane design to medical diagnosis. Many government agencies and major corporations have already shown interest in acquiring the technology [73].

A need/usage context analysis can provide valuable information about new product opportunities so that new products can be designed and developed to capture those opportunities. It also can provide ideas on how to position a new product so that its offerings are understood clearly by the target market. This information can be valuable in unstable and competitive environments for long-term strategic planning. It can be used with every type of new product. Because it emphasizes the need and usage aspects of a new product, its effectiveness can be enhanced if it is used in conjunction with other models that capture more specific product and marketing attributes.

Environmental Scanning

New product development and evaluation takes place in a dynamic environment. Those companies that collect information from this environment, disseminate it across their functional units, and respond to it accordingly are more likely to be successful than others [40]. Relevant information can be collected from economic, social, cultural, legal, political, competitive, and technological environments. This information can be used to supplement new product decisions. It also can be used to conduct a gap analysis [21] to see where a company, in general, and its new product concept, in particular, stand in the marketplace. The results of such a gap analysis can provide information about unfilled needs and indicate the extent to which a new product concept can take advantages of the unfilled opportunities. In addition, environmental scanning also can look at possible future events (scenarios) and determine the nature of the future environment.

Environmental scanning has been used widely. For example, Nokia of Finland has built a research and development team of 8,000 researchers, scientists, and

managers to understand challenges in wireless communications. Considering the collected information, they have been able to introduce successful new products and maintain a strong market growth [36]. Similarly, after observing that people need a companion that is compatible with their busy lifestyles, Bandai Co. of Japan has introduced the successful Tamagotchi, a pocket-sized game featuring a digital pet that needs virtual care to survive [17].

Environmental scanning provides a broader and long-term perspective to a company's operations. Hence, it is relevant to every type of product at every stage of the product life cycle. It can be particularly valuable in an unstable environment, because it reduces the uncertainties about it. It can be used for new product development, positioning, and monitoring purposes. Current developments in computer technologies can speed up the process of information gathering and dissemination. Because it gives a broader perspective, companies still need to use other models to make more specific new product evaluations.

Portfolio Approach

Many new product models focus on a single product. However, when companies develop new products, they usually consider a number of products or multi-generation product lines that they can develop and manufacture with the same technology. This allows them to manage better their new product development programs and plan the scheduling of sequential new product introductions [86]. Whereas many new products apparently disappear from the market, they, in fact, evolve into other better products (e.g., consumer electronics). Certainly, this kind of phenomenon cannot be captured by a model focused on a single product. A better way might be not to focus on a single product, but rather to create a portfolio and excel in that area. For example, Charles Schwab has become a leading contender in financial services, whereas Nokia has excelled in wireless telecommunications.

Because the portfolio approach considers all related products as a whole, the relative success and failure of a new product gains a new meaning. It uses primary and secondary data relevant to a portfolio and provides a broader perspective to profitability, resource allocation, risk, market share, market size, and market growth aspects of a new product [22,83]. Due to this broader perspective, it can be helpful to eliminate new product risks in unstable environments. It has been used in a wide range of areas, such as hygiene [57],

beverages [50], and chemical [14] industries. Recently, for instance, Sanrio Co. of Japan has successfully introduced 40 new "Hello Kitty" products ranging from cellular phone cases to rucksacks. Hello Kitty is a white kitten cartoon character and is quite popular in Japan [58].

As the above examples indicate, the portfolio approach can be used with every new product as long as there is a similarity among the products in the portfolio. It can be used throughout a product's life cycle for its development, evaluation, and positioning decisions. If it is a line extension in an existing market, the focus will be more on the fit of the new product with the other products. On the other hand, if it is a "new-to-the-company" and/or "new-to-the-world" product, the focus will be more on the fit between the new product and the company's resources. When there is a need for product-specific analyses, other methods should be used.

Pattern Recognition

Recent developments in computer technologies enable companies to collect an enormous amount of primary and secondary data about consumer lifestyles and consumption patterns. Advanced "neural network" algorithms and supercomputers can process the massive consumer data effectively and identify common consumer/consumption patterns in the market. This information can be quite valuable in an unstable environment to reduce new product risks and to develop long-term strategies. It can be used for developing, evaluating, and positioning new products. For instance, Brylcreem, a catalogue company, can group 21 million customers in its database 75 different ways and adjust its catalogues to appeal to different groups accordingly: pink dresses on the cover for one group, blue trousers for another, free credit for frequent buyers, express delivery for the impatient, and so on [26]. It also maintains another database for 20 million non-buyers that it analyzes regularly to create/test new opportunities [26]. In addition, when Land Rover launched its new luxury Range Rover in Britain, it correctly identified/targeted 11,000 potential buyers of whom 85% visited showrooms to see the new model, compared to a 1% to 2% response rate for a normal advertisement [26]. Moreover, the fashion industry also utilizes this concept in conjunction with the traditional forecasting techniques to set and forecast fashion [11].

Pattern recognition, also referred to as data mining,

can be used with every new product throughout its life cycle. In the early stages, it can be used for product development and evaluation, whereas in the later stages it can be used for positioning and maintaining the product in the marketplace. Compared to other methods, pattern recognition is relatively less structured, and its size and contents depend on the product type and the number of buyers. It can be product specific for new products in relatively established product categories. On the other hand, it can focus on broader trends for relatively “new-to-the-world” products. For industrial products, it can look at the trends in related off-spring products/services. Because it can be quite nonstructured, a systematic process should be used in deciding when, how, and what type of data to collect. Besides, it should be used in conjunction with other models for evaluating more specific product and marketing attributes.

The Internet

The Internet provides immense opportunities for new product development and evaluation. It can be helpful in getting corporate intelligence, identifying market trends, and testing new products and/or their prototypes in a shorter period of time than it would take with a traditional method [86]. For example, Microsoft tests its new software prototypes through the Internet. Also, firms such as Firefly on the Internet use people’s own descriptions of their likes and dislikes to suggest new films, books, and music to them [26]. In addition, it can be used to promote a new product and educate customers. For instance, Motorola uses the Internet to educate people about its complex new products [27].

The Internet can be used for product development, information gathering, and prototype testing in the earlier stages of a new product and for positioning in the later stages; consequently, the focus can be both short and long term. The Internet provides online primary and secondary data and can increase the reliability of the results of the other techniques in unstable environments. It should be used in conjunction with other models when more specific product and positioning information is needed. Because only a small portion of the population has access to the Internet, its representativeness is limited. Also, many of the web sites are developed by computer programmers who often overlook the users’ concerns; thus, the web pages may consist of layers and layers of images that can be annoyingly time consuming to download for those who are interested in solving a problem. Com-

panies interested in using the Internet for new product testing should evaluate their web sites first because it can be an important factor in attracting people to visit/revisit their web sites.

Alliances

Companies are forming alliances to gain access to the complementary resources required to develop and market new products. This can be very helpful in unstable environments to reduce new product risks and establish long-term market positions. A particular product concept might not be viable for a single company, but when it allies with another company, the whole concept becomes much stronger. Alliances can be formed at any stage of the value chain including supply, development, and distribution stages. For example, NCR allied with its computer processor supplier, Intel, to produce a scaleable data warehousing and high availability transaction processing device [23], and AST Co. allied with Samsung to shorten the supply chain [35]. In addition, four major European telecommunications manufacturers—Ericsson, Nokia, Siemens, and Alcatel—are uniting to promote a standard technology for the new generation of cellular phones [15]. Companies also are forming alliances to gain access to a foreign market. For example, Maytag Corp. [64], Whirlpool [39], and Motorola [67] are among the companies forming alliances to gain access to the Chinese market.

In a new product development and evaluation context, alliances are relevant if there is a need for additional resources at any stage of a product’s life cycle. Thus, it is applicable to every type of new product. Generally, a new product should be evaluated with other models before proceeding with forming an alliance. New alliance concepts also can be tested with those methods. One should also consider the following problems associated with alliances: (1) a partner might shut down or form other alliances [70]; (2) partners may get access to intellectual property [30]; (3) resources may not be as compatible as expected [74]; and (4) the effectiveness of an alliance can be affected by different cultural and managerial styles [66].

Value-Chain Approach

Because every firm is a collection of activities that are performed to design, produce, market, deliver, and support its products, Porter [62] has proposed the concept of “value chain” as a tool for identifying

potential sources of value enhancement. Opinions of people in a value chain, such as suppliers and distributors, also can be incorporated into the new product development and evaluation process, as they play a crucial role in creating value for potential buyers in the long run. Suppliers can provide input on whether the new product can be produced and/or whether there are better ways to produce it, whereas distributors can be helpful in assessing various distribution options. For example, the value created by such mail order companies as Gateway 2000 and Dell computers heavily relies on the effectiveness of overnight delivery services. People in the distribution system can be instrumental in creating and maintaining such a value.

Inputs from the parties in a value chain can be used at any stage of a new product's life cycle. For example, Owens-Corning Corporate Library tapped into the knowledge and strategic direction of its suppliers to reengineer its services [45]. On the other hand, inputs from the value-chain members have been used to form partnerships and to maintain market positions in the insurance industry [33]. With the help of today's computer technologies, inputs from the members of a value chain can be obtained in real time wherever they might be and immediately incorporated into the new product development and assessment process. As the uncertainties associated with a "new-to-the-world" product are higher, the relative importance of the input from the value-chain members is higher for these products compared to line extensions. Furthermore, this approach can reduce new product risks in unstable environments and can be helpful in developing long-term relationships with the people in the value chain. However, the success of this method depends on the assumption that a new product is equally important to the different people in the value chain. Finally, when there is a need for a more specific assessment of product and/or marketing attributes, inputs from consumers also can be used in conjunction with the opinions of the value-chain members.

Straight Judgment/Vicarious Input

Models and managerial judgments have complementary strengths. For example, models are unbiased, immune to social pressure for consensus, do not get tired, bored, and emotional, whereas managers diagnose and predict, are proficient at attribute valuation, can adapt to changing conditions, and may be able to recognize and then interpret abnormal cases containing "broken leg" cues in a situation [10]. Given this, previous

research has called for a balanced approach (i.e., a mix of managers and models [10] and a mix of inputs from executives and lead users [86]).

Straight judgment can be used at any stage of a new product's life cycle and is applicable to every product. It can be used in developing new product ideas, predicting market performance of a new product, and designing related marketing strategies. It can have both short- and long-term focus and be used in every environment. For example, VTech, an educational toy manufacturer, evaluates new products based on executive judgments [88]. Nevertheless, they can be subject to such biases as optimism, conservatism, relying on readily available data, and supply orientation. If the judgments are based on relevant data obtained through an environmental scanning, and brand equity, need, usage context, and pattern analyses, the effectiveness can be enhanced. This implies that companies need to focus more on consumer and market needs. For instance, Vickers Inc., a leading hydraulics maker, changed its corporate culture from the one driven by products and engineering to an organization centered on customer and market needs and improved its manufacturing efficiency by 40% [44].

Conclusion and Implications

Over the years, we have witnessed several new product evaluation models relevant to different stages of the new product development process. Managers can assess the viability of their new products at any stage of the new product development process and know which method to use and why. The use of a particular method depends on the objective, product type, data requirement, environment, time frame, and the type of diagnostic information needed. Depending on their unique situations, managers can select an appropriate method by taking into account these considerations.

As Figure 1 shows, managers can drop or launch a new product, modify its features, or speed up its introduction by skipping one or more stages of the new product evaluation process. However, deciding which action to take is an important and challenging issue for managers. At any stage of the new product development process, they can decide what to do based on the expected return of a new product. The expected return is affected, in part, by the uncertainties in a new product's cost, profit margin, market size and share, and competition [7]. It also depends on a company's investment policy, attitude towards risk, knowledge of the awareness it can generate, ability to achieve the

targeted distribution, and its competitive practices [77].

The models presented in this article can help managers assign probabilities to the uncertain elements of the expected return and compare it with previously established examples. For instance, if no new product in a given class has ever achieved more than 40% trial, and if more than 50% of the triers have never repeated the purchase, it is unlikely that a new product in that category will ever outperform this historical trend [87]. In addition, past research showed that of those who stated that they would definitely or probably buy a nondurable (durable) product, only 36% (10%) actually bought it [38]. Past research also showed that 63% of the products that were tested passed the pretest screening, and 66% of those were subsequently successful in the test market [69]. Also, if a new consumer durable does not take off within the 6 years of its introduction, it is unlikely that it will ever take off after that [28].

Unfortunately, these numbers cannot be generalized to every company and product, because different companies would face different environments and follow different marketing and new product strategies. Managers can, however, reduce the new product uncertainties by using a combination of methods, as different methods tend to provide different perspectives (e.g., product versus marketing attributes, product versus market characteristics, consumers versus lead users versus executives). Besides, they can increase their efforts at the “fuzzy-front-end” of the new product development, because evidence shows that new product evaluation at the “fuzzy-front-end” improves the success of a new product [65]. In addition to improving product success, activities at the “fuzzy-front-end” also can prevent companies from overcommitting themselves to a failing new product idea early in the process, because past research indicates that managers’ increased commitment to a new product makes it difficult to drop it once it passes the concept stage [12].

A new product can be dropped from further consideration if its expected return is negative, or if it can neither be improved nor be effectively positioned. Managers can conduct a prototype testing if they would like to see whether the new product can function, and if it is feasible to develop/test a prototype at a reasonable time and cost. If one wants to test marketing variables fairly quickly without worrying about a competitive reaction, a pretest market study can be conducted as long as the new product is from a well-

defined, low-risk/cost packaged goods category. Otherwise, if the new product is a high-risk consumer product and there is a low opportunity cost and/or a competitive reaction is unlikely, a test market study can be used to measure the effectiveness of marketing variables. Finally, if there is no need to test a prototype and/or marketing variables and/or there is a time pressure to enter the market, the new product can be launched. However, companies still need to continue evaluating a new product throughout its life.

In terms of research implications, there are quite a few avenues that researchers can pursue. First, we need to know how to identify suitable analogies. Second, future studies can look at ways of selecting appropriate experts to reduce the biases associated with expert opinions. Third, there is a need to determine the factors affecting the relationship between purchase intentions and actual behavior. In addition, the literature has provided several ways of converting purchase intentions into predictions. Hence, a future study can compare them and outline specific conditions that make one preferable over another. Fourth, the methods presented here are independent. Future studies can address the possibilities for, and the issues involved in, combining them. Also, future research can develop related mechanisms for combining and updating different data sets across different time periods.

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