EXPANDED SECOND EDITION

METHODS *for* DEVELOPING NEW FOOD PRODUCTS

An Instructional Guide

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This work is dedicated to the several people
whose immense sacrifices and inexhaustible love
made all the difference in my life:
My mother, Violet, my father, Michael, my wife, Mary,
and my two sons, Daniel and Alexander.

To my husband, Joshua, my parents,
Johnnie and Karen, and my brother, John.
Life is best spent in good company.

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Preface

FOOD product development is a continuously evolving area, which has to reflect market trends, consumer preferences, and, perhaps most importantly, current food laws and regulations. Following publication of the first edition of this book, two key pieces of Federal legislation were issued dealing with food safety and food labeling, namely, the Food Safety Modernization Act (FSMA) and the Nutrition Facts labeling requirements, of which both led to new FDA regulations that are part of the second edition. We took this opportunity to include new information as well as review all of the book's content and make corrections and additions based on recommendations of colleagues and students who used the first edition.

The second edition adds a completely new chapter devoted to the development of pet foods, which have become a major branch of the food industry. For example, in April 2017, the Bureau of Labor Statistics reported that in 2015 U.S. households increased their spending on pet foods to $230 per year from $190 the year before, suggesting this segment is a fertile area for new products. The chapter was written by Dr. Greg Aldrich of Kansas State University, a national expert on pet food processing, in coordination with his graduate student, Ms. Lydia Molnar.

Besides including information needed for the Nutrition Facts panel on packaging, we supplemented many chapters of the first edition with original material. In the area of general product development, new sections appear on how to use market research and how to reverse-engineer competitors' products, as well as descriptions of FPD software and tech-

niques for running an ideation session. The chapter on food chemistry now contains more extensive information on proteins and a case study explaining the effects of caramelization. Food processing chapters have been augmented with details on how operations are scaled up. In this edition, readers are given an account of how to develop a food safety plan that accords with FSMA requirements. Regarding documentation of food ingredients and quality, developers are now provided with samples of a Certificate of Analysis and a Letter of Guarantee.

It is our hope that the new edition will better serve the needs of instructors, students and professionals tasked with teaching, learning, and applying proven and proper techniques for developing food products that are both new and successful.

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Manhattan, Kansas
May, 2017

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CHAPTER 1

Overview of Food Product Development

Learning Objectives

- Learn the steps involved in food product development.
- Know the definitions of acid, low-acid, and acidified foods along with examples of each.
- Know the feasibility barriers to product commercialization.

FOOD product development involves more than creating the perfect recipe. Companies must plan extensively, work hard, and carry out research for an extended period of time, in order to evolve new food products. Companies engage in product development with the hopes of gaining new customers, expanding into new markets geographically, increasing profits, elevating brand excitement, and, as the foregoing imply, increasing market share. Prior to starting a new development venture, key stakeholders should create specific objectives and timetables that are integrated into the future direction of the business.

Companies large and small introduce thousands of new food products each year. The time spent developing new food products ranges from six months to five years, depending on the degree of new technology and innovation. For example, a line extension from existing items that can be made on equipment already in place at a manufacturing facility usually takes less time than a new product requiring a custom processing line. The failure rate of new products, which is defined as a product no longer on store shelves after five years, can be as high as 90 percent in some grocery categories.

Larger companies rely on multifunctional product development teams that include food scientists, food engineers, regulatory specialists, and marketing and purchasing experts, whereas smaller companies may not even have a research and development department. Smaller

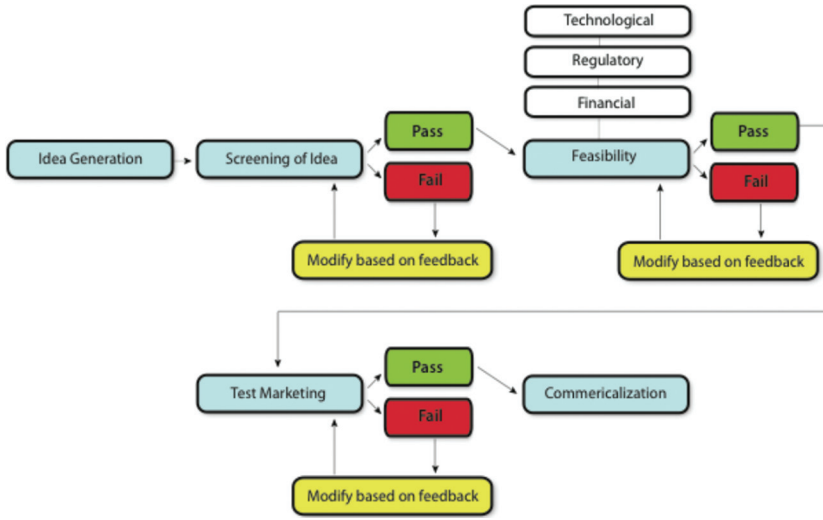

FIGURE 1.1. The Process of Product Development.

companies must rely on outside resources, such as universities, independent laboratories, third-party development firms, or in-house development teams at co-manufacturing facilities, in order to create successful products.

WHY DEVELOP NEW FOOD PRODUCTS?

In recent times, economic progress has been linked to innovation and application of new technologies in many fields, including food. This would not have been possible without spending money on product research and development to drive these new technologies. The development of food products certainly follows this model. Companies develop new food products for financial reasons, with the main driving force being to increase profitability over the long range, despite the initial costs associated with research and development. New product development is mostly market driven, meaning that products are developed in response to consumer trends. Other factors may affect a company's desire to introduce new food products into the market. Chief among these are the following:

a. *Technological advances*, such as improvements in ingredients or packaging. Examples would be the discovery of a new artificial sweetener or of a self-heating food package.

b. *Regulatory/legal rationales*, such as changes in laws, labeling requirements, or agricultural policies. Examples would be banning a certain food additive or allowing a new health claim or nutrient content claim.

IDEA GENERATION

Companies use varying techniques to generate ideas for new products. Marketing teams may be charged with the central development of ideas, with supplementation from researchers. Ideas may also come from consumers. Some companies may not need this step, especially if they thrive on regenerating competitors' products. An example is creating a store-brand product that is very similar to name-brand products already on the market. Ideation sessions using participants from all departments can also be a part of corporate idea generation. After idea generation, the major steps in developing a new food product may be divided into four phases: screening, feasibility, test marketing, and commercialization. Idea generation should be completed by gathering information about trending ingredients and consumer desires, attending trade shows, keeping up to date on new product releases from other companies, scanning research articles and trade publications, and monitoring grocery shelves.

Developing marketable concepts can also be accomplished through the hiring of market research companies or the purchasing of periodical market surveys that large firms publish regarding particular product categories or consumer trends. If this does not fit your budget, your company could do its own research to build a customer database to help you understand which market segments your existing customers fall into and what you could do to increase your market share. Additionally, there is a wealth of free information on websites from government agencies, commodity groups, and trade associations, where companies can tap into data on consumer and product trends. One reliable source of information is the USDA Economic Research Service (ERS) reports on Food Consumption and Demand that cover topics such as Commodity Consumption by Population Characteristics, Food Consumption and Nutrient Intakes, Food Availability (Per Capita) Data System, Food Environment Atlas, and Eating and Health Module (ATUS). Economic Research Service research on food consumption examines: the effects of food consumption choices on agriculture; the behavioral and economic determinants of food and nutrient consumption; interrelation-

ships between spending on food and non-food items; consumer valuation of quality, safety, and nutritional characteristics; and the role of information in determining food choices.

Reverse Engineering Competitors' Products

Reverse engineering is widely used in the food industry, especially to launch generic versions of proven, successful products introduced by national brands. The purpose is to develop a product as close as possible to the one being imitated, but at a lower cost. In general, this means that the two products, original and imitation, must be extremely similar in terms of sensory properties. The ideal process flow to achieve this result is as follows:

- Characterize applicable physical and chemical properties of the original product: shape, size, thickness, weight, density, color, texture, pH, water activity, viscosity, and proximate analysis (moisture, protein, fat, ash, fiber, carbohydrates). This can be done using a variety of analytical instruments and methodologies.
- Characterize the sensory properties of the original product using a trained sensory panel. This procedure does not address likes and dislikes, but rather seeks to produce a descriptive analysis of selected product attributes such as sweetness level, saltiness, intensity of certain flavors, mouthfeel, after-taste, and order of appearance of flavors.
- Identify processing methods and parameters for the product, based on knowledge of unit operations and working closely with engineers. For operations such as extrusion, thermal processing, baking, or dehydration, make sure to provide the engineers with moisture levels of both raw and processed products. Achieving a certain moisture level is a critical metric for many processes and ensures that desired physical and chemical properties can be achieved.
- Starting from the list of ingredients listed on the original product's label and based on the proximate analysis, work with a nutrition labeling software to formulate several products that fit the data provided. One of the biggest challenges at this step is to duplicate the balance of spices in the original product, since names of spices do not have to be listed on the ingredient legend, except for a few that also provide color (e.g., paprika, turmeric, saffron). We have achieved good success with this challenge in our laboratory by simple microscopy:

observing samples of the original product under the microscope at a 10× magnification and comparing the sample's spice particles to the wide stock of individual spices we maintain. By counting the number of specific particles in a field, we obtain a rough estimate of the amount of a certain spice, and then we proceed with numerous sensory tests until we match the spice profile.

- Use your sensory panel to test the formulations you have developed and determine which one has an attributes profile closest to your target product.
- Keep manipulating that formulation and consulting your trained panel until results from the imitation closely match the original product.
- Run a test batch of your product and use it with the control to perform a sensory "triangle test" or a "duo-trio" test to find out if consumers can pick the "different" sample. These tests are explained in Chapter 5. In case these tests prove that consumers can detect the different sample, some finetuning of the formulation may be necessary.
- Finally, perform a statistically significant consumer preference test between your new product and the original product. Make sure your test ballot also has a comment section to get any input on the products. Hopefully your product will be as much, if not more, preferred (it has happened!) than the one you are trying to match. Otherwise, data and comments from the consumer study will guide you to make further changes to your product before you re-test it.

SCREENING

After an idea has been agreed upon, the steps of product development begin. Screening is the most critical step in a product development project. Thorough testing of product concepts can assist a firm in deciding whether to invest time and money in a venture, or to abandon the effort completely. Project ideas, now more carefully refined, must be judged to be congruent with organizational goals. Project managers should repeatedly screen an idea throughout development of the project in order to gauge whether the concept remains acceptable in the target market, ingredients are still readily available, and regulations impacting the product have not changed. Smaller companies may call on outside firms to assist in market screening.

Collaboration of departments during the screening step helps to evaluate individual areas involved in product development, including financial and legal considerations, process and equipment availability,

Questions for Screening Concepts

Companies can begin by asking a series of questions such as:

- Who will use the product?
- How will it be used?
- What preparation is necessary for the consumer?
- How will the consumer benefit from it?
- Does it have any other uses?
- Who is the competition? How is the product different?
- Where will the product be available?
- How will people find out about the product?
- What will the price be?

purchasing power and ingredient accessibility, shifts in the marketplace, and consumer perceptions. Examining markets and conducting consumer research are vital to product screening.

Consumer testing is essential when screening products. Without consumer testing, companies have no way of knowing consumer needs, desires, and willingness to purchase. Initial screening may also reveal useful information for subsequent marketing strategies.

FEASIBILITY

Feasibility considerations for a business include regulations, technology, and finances. By setting up an interdepartmental team, the tools will be available to answer questions of attainability, which may be introduced at any stage during the development process.

Regulations

At the start of a project, firms must be cognizant of the state and/or federal agencies that regulate a product. In general, products sold locally (i.e., do not cross state lines) are regulated by state agencies. A product crossing state lines comes under the United States Food and Drug Administration (FDA) or the United States Department of Agriculture (USDA) jurisdiction, depending on the type of food. Some states allow small food processing businesses to be conducted out of a person's home, but the processing area must be separated from the living quarters by solid walls, and there should be no direct entrance from the living quarters to the food processing area. Other local governments

prohibit in-home commercial food processing, so awareness of zoning laws is of utmost importance.

The term "food"—as defined in 21 CFR 321 (f)—signifies the following: (1) articles used for food or drink for man or other animals, (2) chewing gum, and (3) articles used for components of any such article. Legally binding "standards of identity" stipulate the requirements for individual food products as defined in the Code of Federal Regulations (CFR). Individual products must meet certain guidelines in order to be called by a specific name. Applesauce, for example, has strict guidelines on ingredient inclusion for it to be labeled as such (21 CFR 145.110). Applesauce can legally name a product only with a soluble solids content (measured by a refractometer) of at least 9 percent if unsweetened, and 16.5 percent if sweeteners are added. Apples must be the primary ingredient of the product, but optional ingredients such as water, salt, apple juice, organic acids, nutritive carbohydrate sweeteners, spices, natural flavorings, and a color additive/color preserving agent may be added in limited quantities. The FDA and USDA release publications that give the guiding principles of labeling products under their jurisdiction. These are titled "*Food Labeling Guide*" and "*The Food Policy and Labeling Guide*," for the FDA and USDA, respectively. In 2015, USDA FDIS stated that they will no longer update their guide and instead will issue compliance policy guides as needed but this document still provides valuable insight into general labeling laws.

Meat and poultry products containing more than three percent fresh meat or at least two percent cooked poultry and intended for sale in interstate commerce are regulated by the USDA Food Safety Inspection Service (FSIS). The FDA regulates all other food products except for seafood, which is regulated by the Department of Commerce and the FDA.

Because of the hazard of botulism, special regulations apply to heat-processed, low-acid canned foods and acidified foods in hermetically sealed containers (CFR 108, 113, and 114.). Acid foods are those that naturally have a pH below 4.6 and/or a water activity (a_w) below 0.85. These regulations are based on the microbiological activity of *Clostridium botulinum* and *Staphylococcus aureus*. Low-acid canned foods are defined as processed foods with a pH greater than 4.6 and an a_w greater than 0.85, except for alcoholic beverages. Water activity is a measure of the water available for microbial growth in a food. Acidified foods are low-acid foods to which acid(s) or acid food(s) are added to reduce the pH to 4.6 or below with an $a_w > 0.85$. All processors of these foods must take an FDA-approved course of study, often referred to as

the Better Process Control School. In addition, companies must provide site-specific processing information for FDA approval. Products such as jams and jellies usually have pH values low enough that they do not fall under these regulations. Most canned vegetables and pickled products are subject to low-acid food regulations.

Other regulated areas that require attention fall under two general categories: health safeguards and economic safeguards. Health safeguards protect against adulteration, natural toxicants, unapproved food additives, residues, and unsanitary processing or holding practices. Economic safeguards focus on issues of labeling, especially misleading or false statements, and net contents. More information on these subjects will be covered in Chapter 10—Regulatory Considerations.

It is imperative for the product developer to keep abreast of new approved ingredients and emerging regulations to ensure compliance of the new product with federal and state regulations. The FDA has recently enacted final rules regarding compliance with the Food Safety Modernization Act (FSMA) for development of food safety plans by processors, as well as mandated new formats for the Nutrition Facts panels on food products. Both issues are discussed in more detail in other chapters.

Technology

Before launching a food product, companies must vet all equipment, facilities, and processes needed to manufacture the product. Technological feasibility can be accelerated when companies utilize co-manufacturing facilities in which expertise in specific technologies is established. Co-manufacturing and the utilization of third-party laboratories and consultants are efficient ways to expand a company's capabilities without large investments. If a potential product is found to be not technologically feasible, the project should be terminated.

Formulation

Experimentation with varying ingredients, processing parameters, and packaging options will be carried out to find the best combination to create the desired product. Sound statistical analysis and adequate record-keeping are critical at this step to ascertain which combinations contribute to the best product. After initial trials, an experimental design will cut down on the number of prototypes to be developed, which saves time

and money. All formulas and experiments should be fully recorded in a laboratory notebook or equivalent. Each entry should include detailed information, so colleagues can understand the experiments and results. This is beneficial when projects are temporarily delayed, last for long periods of time, or are passed to other developers in the organization.

Ingredients

Ingredient specifications and quality can directly change the properties of a food product's sensory characteristics and ability to machine. Considerations when choosing ingredients include whether the commodity will be available for purchase year-round or only seasonally. Product developers will generally consider more than one supplier of the same product to test quality, cost effectiveness, and ensure consistent supply. Larger companies may need to find more than one supplier of the same product to fulfill needs. Certain applications require more rigid ingredient specifications than others. If more than one supplier is used, tight deadlines and exacting product specifications must be followed by all suppliers.

Processing

If a new product will be made in an existing facility, you must ask what relevant equipment do you already have? Companies usually try to produce newly developed products on equipment already in place, since adding machinery is a major capital expense. Thus, new product development projects are often based on expanding product lines through the use of existing facilities and equipment. For this reason, product developers should be aware of what equipment is available at the location where the product will ultimately be produced. If the product will be produced in more than one manufacturing location, consideration needs to be given to differences between facilities and how they can be reconciled to produce commercially similar products.

Processing capabilities can be expanded through the use of a co-manufacturing model. Even large multi-national companies may enter into a contract manufacturing agreement to gain access to manufacturing techniques without making significant investments. Quality and food safety personnel review new facilities by auditing their capacities to meet internal company standards and governmental food safety requirements, while at the same time assessing all processes. Auditing of

facilities gauges the levels of overall food safety, quality, and environmental practices.

Facilities

Facility capabilities and design are a focal point of multi-functional research and development teams. Teams should consider the capacity of the current equipment to meet the expected product demand, the geographical proximity to raw material, finished good warehouses and retail destinations, the climate in given locations, and predicted capital investment. The qualification of the manufacturing locations should take into account the entirety of process flow: from raw material storage to processing/packaging capabilities to holding/warehousing of the finished product.

The facility's surroundings should be assessed for interior and exterior design. Exterior design (and location) considerations include the risk of environmental contamination and pest issues. Trees and shrubs should be maintained to cut down on pests. The location of the facility should be assessed in terms of temperature, relative humidity, potential for natural disaster, and surrounding businesses and terrain. Will your facility face potential contamination from a nearby sewage treatment facility or insect infestation from a body of water? Exterior placement of security features, such as lighting and openings to the building, are important as well. Loading docks and receiving areas should be separated by enclosures to allow for assessment prior to acceptance of materials. All doors and windows should be sealed and secured.

Safety and quality personnel will also evaluate interior design features. Crosscontamination and allergen control must be limited by operational flow, air conditioning, and employee access to sanitation stations and break rooms. All interior features should be constructed for durability and cleanability, using materials designed to withstand the chemical and physical wear of manufacturing. The conditions inside the plant, such as temperature and relative humidity, should be taken into account. Facilities in areas with high humidity and heat need to modify ambient conditions to produce efficiently throughout the entire year. Additionally, water supply and sewage systems require inspection.

Packaging

Packaging is a critical part of a product's appeal to consumers, espe-

cially with first-time purchasers. The aesthetics of a package affect how consumers view what it contains, including the discernment of whether it is a high-quality premium product or a generic grade. Marketing specialists, product developers, and packaging engineers need to examine the types of packaging materials used in competitors' products and decide how to set theirs apart. Additionally, packaging is an important factor in determining a finished product's quality and shelf-life.

Distribution

Distribution must be considered to determine the profitability and feasibility of a product. Products requiring special distribution include frozen and refrigerated foods. Organizations must calculate the costs of higher-level distribution. Other distribution considerations include the radius in which the product will be available and climate effects on the product. The distribution radius will also influence packaging needs.

Shelf-life

Shelf-life is the determination of how long a product will maintain quality as perceived by customers. The shelf-life of a product is important when considering distribution channels. Shelf-life can be calculated through the use of accelerated or realtime testing. Product degradation occurs as a result of factors such as exposure to varying temperatures, light, and product chemistry and property changes over time. The most important determination to be made about a new food product with regard to shelf-life is the expected Mode of Failure, which points to the one quality-related property affecting acceptability that will fail first. Depending on the product properties, the Mode of Failure could be staling, rancidity, mold growth, color fading, flavor changes, or loss of a certain nutrient. Quantitative methods need to be developed to measure these properties. More information about shelf life and its testing will be given in a later chapter.

Safety

In an age of multiple and well-publicized foodborne disease outbreaks, new product developers must carefully investigate the safety risks of their products. History of contamination of similar products and published safety risks of product categories provide clues to risk fac-

tors. For example, peanut butter producers must use controls to test for *Salmonella* contamination, a concern heightened by a large outbreak in early 2009, which sickened 400 people and led to at least 5 deaths. Some products are more susceptible to spoilage and the growth of pathogenic microorganisms. Physical contaminants, such as metal shavings from processing equipment, can pose safety threats to consumers as well. Allergens in the facility and the processes used to restrict exposure of products to these allergens are a major consideration that should never be overlooked.

Finances

Before a food product is created for sale, an understanding of all development, production, and marketing costs is required. A detailed cost analysis should be carried out prior to manufacture. The two types of costs are annual fixed and variable. Annual fixed costs are those that will not change in any one year, regardless of the level of production. These costs include the values of equipment, buildings, property taxes, and other items that do not fluctuate due to changes in production. Variable costs are expenditures that vary with the volume of production, such as labor, raw ingredients, packaging materials, fuel, electricity, utilities, and other items required to manufacture a specific product. Variable costs need to be carefully examined prior to test marketing and commercialization, in order to set a unit price in line with profit calculations.

TEST MARKETING

Should screening and feasibility tests indicate that a product has potential for launch, the next logical step is actual development and test marketing. Purchasing equipment at this stage is not advisable. The chief costs should be for test packaging materials, test marketing, third-party development (if applicable), and ingredients. Large companies rely on pilot plants to manufacture smaller batches of new food products for test marketing. For start-up companies, pilot plants at regional universities or community centers can be used at minimal charge. Third-party development firms or comanufacturers with small-batch capabilities can also be utilized at this stage. Alternatively, the test product could be manufactured at an approved food processing facility in your area with the proper equipment. Consumer tests at this stage are sometimes

conducted as in-home use tests. Consumers should provide assessments of the product prior to the food manufacturer engaging in capital investments and launching a larger marketing scheme.

Market testing is most effective when planned well in advance with the help of an expert. Ask for assistance from marketing and consumer testing specialists who can devise a plan and interpret the results of your test, if the in-house cross-functional team does not include a professional trained in this area.

Test marketing should address formulation, processing, and packaging. At the time of test marketing, a final formula is no longer a "recipe," and ingredients should be expressed on a weight/percent basis. Multiple sources for all ingredients should be located. These should be of high quality with very little variability between shipments.

Processing techniques and ideal product qualities should be defined at this juncture. The process must be adequate to routinely deliver a high-quality, safe product. Check for state or federal regulations on processing parameters, such as final internal temperature requirements, for specific products. Packaging must be designed to appeal to the consumer, while providing protection from contamination. Codes on packaging can be helpful in keeping track of shelf-life and distribution.

Documentation is critical to assess the success or failure of your market test. Records should be kept for all processing steps and controls, including quality and temperature of raw ingredients, final cooking temperature, weight of every ingredient used in the batch, chemical and physical tests performed, net content of containers, and the number of defective units. Assessment of each step can identify product and processing flaws that can be devastating to product launches.

For test marketing, it is best to limit the distribution area. The target market should be defined by this point. Questionnaires should be provided for consumers, so they can evaluate the quality of the product. Keep in touch with store managers selling your product, and take frequent trips to determine who is buying and where and how the product is displayed at the retail level. Keep a detailed record of the market test and ask for help in analyzing the data to determine whether you should take the next step—commercialization.

COMMERCIALIZATION

Should your market test prove successful, the product will be ready to commercialize. The product can still be produced at an existing food

processing plant; otherwise, the main concern at this stage is to find a location to manufacture larger quantities of the product. To set up a processing facility, a firm must address issues that include finding a location, building, equipment, utilities, and personnel. Consumer concerns remaining from test marketing need to be addressed, and a second round of testing may be conducted if deemed necessary.

Product promotion will be an integral part of commercialization. Companies with the leverage to fund national marketing schemes use many avenues to get their products noticed. Common methods of advertising new products include savings coupons, national television, internet, and product placement strategies.

Finally, product maintenance must be covered in commercialization. Maintenance should concentrate on quality and profit improvements, including sustaining the initial quality and, where feasible, enhancing it. Quality factors are maintained by noting potential defects in the product as it is handled in processing, distribution, and display. Cutting costs rather than raising the price can achieve profit improvement without deterring potential consumers. Investigating ways to improve process efficiency, save on labor costs, and find alternate suppliers of ingredients is essential to boost profits. While the product is new, solicit consumer reactions, to help identify alternative flavors and packaging.

INNOVATION MANAGEMENT SYSTEMS

Streamlining the innovation process and creating set steps for each milestone increase efficiency in product innovations. Often, organizations will subscribe to a specific innovation management system, such as the Stage-Gate® International "Idea-to-Launch model" or internally developed procedures. Innovation management systems guide organizations to make systematic decisions throughout the process, requiring one set of tasks to be finished before moving to the next.

Innovation systems should include the basic development steps outlined in this chapter, coupled with deliverables at each step. Once all mandatory tasks at a certain level are completed, the project team can move to the next step. Generally, innovation management systems begin with the idea-generation phase and end when the product is launched. Each step should be accompanied by a checklist that must be completed before going to the next step. Some systems allow for conditional passing to the next step, with an explicit acknowledgment of risks and sign-off by management.

The idea-generation phase should begin widely and end narrowly, with the output of a well-defined concept. This phase should include defining the basic parameters in terms of which product concept is to be developed. From the outset, the company should understand how the product concept will fit into a portfolio, have potential buyers in mind, and comprehend the general feel and appeal of the product, including details such as concept flavors and desired claims. At the end of this initial phase, the product should be easily explainable to the research and development team. Once the concept is well defined, the product goes to the screening phase.

Screening of products includes major steps to ensure the product hits the mark with consumers and can provide a path to profitable production. Product screening is calibrated by the basic standards set by the company. What percentage of consumer acceptance in a screening test should be accepted? This is dependent on the degree of risk a company is willing to accept and the business case for the product. As a part of a system, if a consumer concept test shows that potential consumers have little interest in the product or the concept is not well accepted, the project should either be redefined in the idea-generation phase or dropped from the innovation pipeline. Likewise, if the business case for the product cannot be realized or does not look like a promising road to profit, the concept should be discarded. Screening will differ based on product complexity. That is, a line extension may take less time in the screening process, if the original product has been wildly successful.

The adherence to innovation management systems continues in a similar fashion—assigning specific tasks and benchmarks in order to continue to the next step, until the final step, the launch. Initially, certain concepts may not be ready to introduce to market. However, these concepts should be filed and revisited. As markets change and mature, an older idea may become the perfect product concept. Innovation management systems allow organizations to make educated, logical decisions about development, while limiting verdicts based mainly on emotion. (Emotion should not be discounted, but rather heeded with caution.)

The Stage-Gate® Process (http://www.stage-gate.com/)

Stage-Gate® International is a private entity that created a system for developing all kinds of new products from idea to launch. The system sets a number of serial activities (stages) monitored by management

decisions (gates). Teams must successfully complete a prescribed set of activities at each stage, which are reviewed by management for approval prior to proceeding to the next stage.

The Stage-Gate® Process has five stages (Stages 1 to 5) besides Idea Discovery (Stage 0): Idea Discovery, Scoping, Building a Business Case, Development, Testing and Validation, and Launch. The structure of each stage is similar in that each requires Activities, Integrated Analysis, and Deliverables. "Gates" separating each of these stages are structured into Review of Deliverables and Criteria for Decision making, which often are supplemented by scorecards. Criteria for decision making are what the project is judged against in order to make the go/kill and prioritization decisions. These criteria are usually organized into a scorecard and include both financial and qualitative standards. Outputs are results of the "gate" review. Gates must have clearly articulated outputs, including a decision (go/kill/hold/recycle) and a path forward (approved project plan, date, and deliverables for the next gate agreed upon).

PRODUCT LIFECYCLES

Are products from your childhood still for sale and others no longer on store shelves? The product lifecycle registers the various points throughout a product's time on the shelf, until a point in which it is no longer sold. Products go through cycles during their period of sales. When a product is first launched, companies heavily promote it. products. In-store demonstrations are sometimes used to lure customers who might not try the product otherwise. Discounts and coupons can help spike sales of a new product as well. Initial advertising costs are high, and the returns are minimal directly after launch.

The next phase in the cycle is a strong growth period. At this time, repeat buyers may decide to purchase the product on a regular basis. Word of mouth may begin to attract new customers. Expansion to new markets can also assist in generating sales. Costs continue to be high, but profits are improving.

The next phase is a decline in the growth rate. Repeat buyers decline, new markets have been tapped out, the competition begins to grow, and added costs associated with trying to attract attention to the product start to rise. Nonetheless, profits are still good in this phase.

This stage is followed by a stability period that experiences no growth in sales, as a result of consumer fatigue. There is little excitement about

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About the Authors

Dr. Fadi Aramouni was born and raised in Beirut, Lebanon. He received his BS in Biochemistry in 1977 and his MS in Food Technology in 1980 from the American University of Beirut. Dr. Aramouni earned his PhD in Food Science in 1986 from Louisiana State University. He joined the Kansas State University Department of Foods and Nutrition in 1989, then the Department of Animal Science and Industry in 1995. Since July 1999, his responsibilities have been primarily in extension; however he also teaches course such as Research and Development of Food Products, Principles of HACCP, Advanced HACCP Principles, and Fundamentals of Food Processing. His honors from the College of Agriculture include the Outstanding Faculty Award, graduate teaching award, and faculty member of the semester.

Kathryn Goddard Deschenes is from Ellsworth, Kansas. She received her BA in Food Science in 2011 and received her MS in Food Science in 2012 from Kansas State University. She has won several national awards in Food Product Development competitions, including first prize in the 2008 Almonds Board of California "Game Day Snacks for Men" and the grand prize at Disney's Healthy Snack for Children in 2009. Kathryn has managed activities at the Kansas Value Added Foods Lab from 2009 to 2013 as well as provided technical assistance to food companies in product development, ingredients and packaging, regulatory compliance, and packaging technologies. Kathryn also did an internship at Kellogg's in Battle Creek, Michigan, for 6 months. She is currently a regulatory compliance manager for a food company in Idaho where she resides with her husband, Joshua.