Expert Feature:
Designing Better Products by Coordinating Marketing Research and Engineering

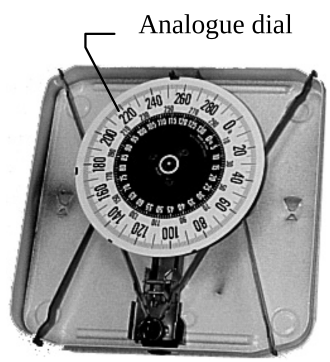
Jeremy J. Michalek

Prior to the Industrial Revolution it was common for a single person or a small group to be responsible for the design, manufacturing and marketing of a new product. As industries and markets have grown, the scale, scope and complexity of these tasks has led to a division of labor: Marketing, design and manufacturing are typically handled in different departments, both in industry and in educational and research institutions. This compartmentalization has made the mass creation of complex products and processes possible; however, it has also created new challenges in communication between the areas. Marketing researchers, product designers, artists and engineers often seem to speak different languages: distinct scopes, terminology, goals, representations, assumptions, and incentive structures all contribute to difficulties in maintaining a 'holistic' perspective when making product decisions.

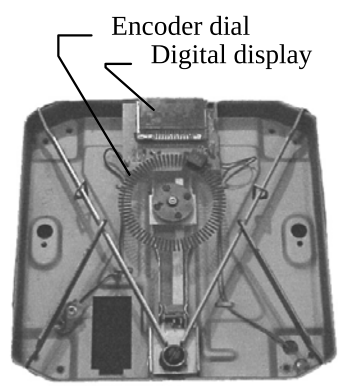
A number of practical tools have been developed to help structure the process of coordinating the unique perspectives of market research, design, and manufacturing in product development. For example, a method called Quality Function Deployment examines the relationships between customer "needs" and technical product specifications; similarly, Design for Manufacturing Analysis encourages early consideration of downstream impact of design decisions on manufacturing cost. While these methods are widely used in industry, they do not explicitly coordinate the many powerful quantitative decision models developed in each discipline, such as the conjoint analysis methods described in this book. For example, marketing researchers may use conjoint to determine appropriate product attributes and levels. However, if these attribute levels are chosen without input from design and manufacturing, it is as if the decisions are "thrown over the wall" to the engineering department, with the assumption that engineering will somehow deliver products with the specified attribute levels. While this assumption may be reasonable for well-established products with few engineering tradeoffs – for example, frequently-purchased supermarket goods, or even small durables – it can be problematic for products with even moderate engineering complexity. For example, automotive engineers may be able to design cars with high fuel efficiency or high performance, but providing both in the same vehicle may be prohibited by physical and technical tradeoffs; a big, powerful engine will not squeeze the most mileage from a gallon of gasoline.

Clearly, it is important for marketing researchers to bear these tradeoffs in mind when making positioning recommendations and to actively communicate with design and manufacturing representatives throughout the product development process. Years of experience with such "concurrent engineering" and "concurrent design" approaches have helped many product development efforts evolve from the "throw it over the wall" approach toward an iterative, integrated process of give-and-take. In the future, it will be possible for engineers and marketers (and other groups) to each 'post' their best-performing and most relevant models – like conjoint for marketing researchers – to a common computer platform,allowing them to intercommunicate and reach decisions that are optimal for the firm. Iterative coordination of such models, as a supplement to today's costly human iterations, also has the potential to speed up the product development process and to assist communication through well-defined interfaces and objective metrics, resulting in better decisions.

The conjoint examples in this book deal with data on dial-readout bathroom scales, and one might have thought that there was little else to say about that market. However, the humble bathroom scale example provides a compelling story of the potential advantages of interdisciplinary coordination. The figure below shows an analogue scale and a digital scale. We have only so far considered the first, but both designs work on the same principles: transmitting force and measuring displacement. Let's see how this actually works in more detail: The force applied to the cover is transmitted to the X-shaped levers, which transfer the force to a linear coil spring at the base of the scale; the spring resists displacement proportionally to the force applied, and a pivot arm transfers the vertical motion of the spring to the horizontal motion of a rack, which lies along the center of the scale; the rack then turns a pinion gear attached to the dial so that the output is a dial turn proportional to the force applied. In the dial-readout scale, the dial is then printed with numbers, which can be read through a window in the cover; in the digital scale, the dial is instead printed with encoder markings, and a photo-interrupter measures the number of markings that pass, which is processed and then presented on the digital display.



Dial-readout scale with top cover removed (Note analogue indicator wheel)



Digital scale with top cover removed (Note encoder wheel and display)

Reading this for the first time, most users of scales are at least somewhat surprised that two designs that seem so different *to consumers* can be so similar in terms of *engineering design*, that is, "what's inside the black box". Commonality at the engineering level saves cost – fewer designs, fewer parts, fewer production lines, etc. – while differentiation at the consumer level allows marketers to target a variety of market segments and deter competitors. Achieving just the right balance between the two is important, and would be impossible without substantial communication between the various disciplines involved. If conjoint and other quantitative marketing methods can be coordinated with their counterpart models in engineering design and manufacturing, this optimal balance in product variety and differentiation can be determined ever more accurately, saving both time and money for the firm, while providing a superior array of products for consumers.

Coordination of interdisciplinary perspectives can be particularly important when working with products that have significant environmental impact. With growing attention on the environment in government and among producers and consumers, the set of ‘environmentally relevant’ products is steadily increasing. Economists have long understood that the market forces guiding production of consumer goods work differently for products that impact the environment: because benefits of the product are enjoyed privately by the consumer who purchases it while environmental costs are shared publicly by all people, the market does not automatically provide sufficient incentives to reduce environmental impact. Instead, government regulatory policies are often introduced to limit impact or alter incentives. Because such policies have complex effects on consumer preferences, cost structures, business incentives and the space of available design alternatives, some companies devote entire departments to determining the most profitable way to satisfy policy requirements. This can be a complex undertaking, requiring extensive coordination of engineering and market knowledge. For example, in the automotive industry, separate corporate average fuel economy standards for cars and light trucks provide incentives for automakers to guide consumers away from large cars (e.g., station wagons) toward small trucks (e.g., SUVs), a practice that improves corporate averages in *both* categories; however, the net impact to society is an overall increase in fuel consumption and consequently greenhouse gas emissions. Similarly, California’s attempt to achieve 10% sales in “zero-emission vehicles” did not succeed as planned, due to lack of consumer appeal for high-cost, poor-range electric vehicles. In order to anticipate unintended consequences and avoid policy failures, it is necessary to coordinate knowledge of consumer preferences, producer incentives, cost structures, competitive interactions, technical knowledge of the design, and regulatory policy.

Finally, one caveat: Quantitative approaches in all of these disciplines are only as good as the models themselves and the appropriateness of applying them in any particular scenario. Thus the newer and more innovative a product is, the more risk it caries in interpretation of conjoint results for attributes with which respondents may not be familiar – think about the very first time you bought a computer, digital camera or MP3 player – as well as accuracy and validation of engineering analysis models and simulations that predict attributes of the product. Thus, marketing researchers and other modelers need sufficient knowledge of underlying assumptions and sufficient experience to determine applicability of appropriate models to the problems they hope to solve.

Quantitative models, including the many introduced in this book, offer valuable predictions, recommendations, and ability to clearly define and capture knowledge. With the exponential increase in computing power, the rise of networks, and cross-disciplinary information technology, we will see ever more coordination of these modeling approaches, as well as their increasing growth across disciplinary boundaries.

Further Reading:

Krishnan, V. and K.T. Ulrich (2001) “Product Development Decisions: A Review of the Literature,” *Management Science*, 47(1): 1-21.

Kusiak, A. (1993) *Concurrent Engineering: Automation, Tools, and Techniques*, John Wiley & Sons, New York.

Ulrich, K.T. and S.D. Eppinger (1995) *Product Design and Development*, McGraw-Hill, New York.

Bio:

Jeremy J. Michalek is Assistant Professor of Mechanical Engineering at Carnegie Mellon University and Director of the Design Decisions Laboratory, where he studies optimization methods and the influence of market forces and policy on design decision-making. He received his B.S. from Carnegie Mellon and his M.S. and Ph.D. from the University of Michigan, Ann Arbor.