

HOW AUTOMAKERS PLAN THEIR PRODUCTS

A PRIMER FOR POLICYMAKERS ON AUTOMOTIVE INDUSTRY BUSINESS PLANNING

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The statements, findings, and conclusions herein are those of the authors alone and do not necessarily reflect the views of the project sponsors.

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The **Center for Automotive Research**, a nonprofit organization, focuses on a wide variety of important trends and changes related to the automobile industry and society at the international, federal, state and local levels. CAR conducts research, develops new methodologies, forecasts industry trends, advises on public policy, and sponsors multi-stakeholder communication forums. For further information, see www.cargroup.org.

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Executive Summary

A great deal of public discussion has focused on petroleum use and greenhouse gas emissions from automobiles. An inevitable response has been to call upon automakers to produce higher-mileage vehicles. Many policymakers have suggested regulations to spur more fuel efficient designs. But little effort has been made to explain to policymakers and the public the intricate decision-making process entailed in changing vehicle designs or adjusting product plans to meet new needs.

Understanding the process by which product planning and strategic business decisions are reached is a crucial foundation for developing sound approaches to meet the auto sector's unique challenges related to energy use and climate change. To help understand these issues, this report reviews automotive product planning practices and synthesizes insights from a set of confidential, executive-level interviews. The interviews garnered perspectives from key individuals at companies accounting for 60% of the U.S. automotive market.

In fall 2005 and again in summer 2006, the average price of gasoline in the United States crossed the \$3 per gallon mark. Some observers believe that the era of "cheap fuel" is gone forever, while others counter that there could be a return—at least temporarily—to lower prices at the pump. Whatever the uncertainty about the future oil market, high fuel prices and related issues have already impacted the new vehicle market. During 2006, sales of light trucks, including many SUVs, dropped notably. Although consumers did not rush to small cars as they did during the 1970s oil shocks, the market has shifted to models that are smaller and more fuel-efficient than in the recent past. While fuel economy has risen only slightly overall, these shifts have major competitive implications for different automakers.

How do automakers respond to a need to redesign their products, whether due to changes in consumer demand from high fuel prices and other market concerns, or due to policy changes adopted to address social concerns? That is the fundamental question addressed in this study.

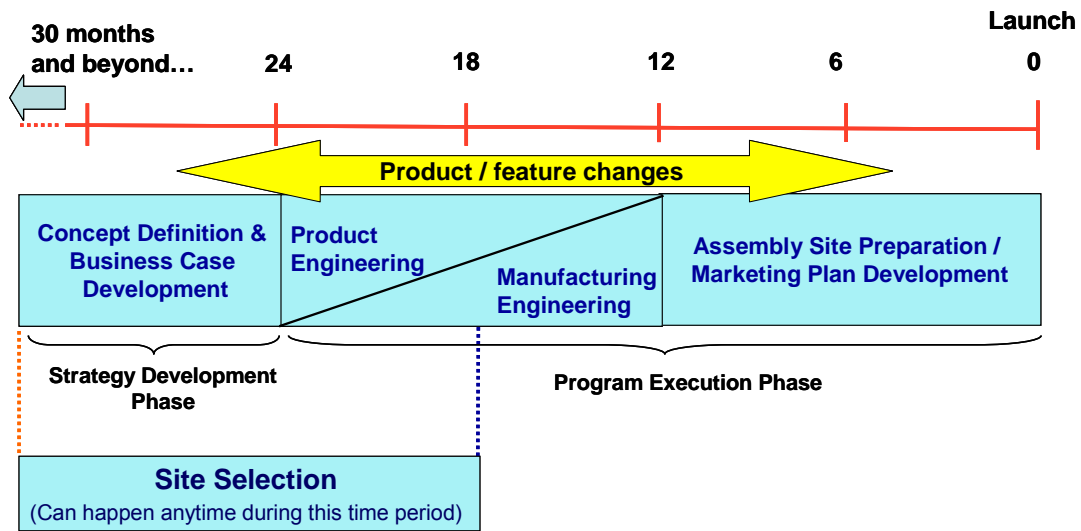
AN OVERVIEW OF THE PRODUCT PLANNING PROCESS

The process of developing automotive business plans is incredibly complex, and often as reliant on intuition as it is on hard data. Many factors must be considered, including return on investment (ROI); surveys of market trends; forecasts of market size, sales, fuel costs and future consumer preferences; as well as technology availability and cost. Additionally, a new vehicle built at an existing assembly plant must mesh with the production cycle for other vehicles at that plant, as well as with the company's overall assembly capacity.

These business plan decisions—which determine an automaker's major investments—entail many inherent uncertainties, not the least of which is the fact that market conditions can change dramatically. Given such complexity, it is indeed remarkable when a company launches a new vehicle that consumers want at the exact time they want it. And for a vehicle program to be fully profitable, consumer demand must hold up throughout the vehicle's multi-year production life prior to replacement or redesign.

Automobiles require long lead times for design, development and production planning (including tooling and supplier contracting). The process of developing a new program, whether for a new or redesigned vehicle or a powertrain, typically spans two and one-half years from concept to

Figure E-1. The Automotive Product Development Timeline



Source: Center for Automotive Research.

launch, as illustrated in Figure E-1. Speed in product development confers a competitive advantage, with the best programs completing the process in 24 months while others struggle with timelines of 36 months or longer.

The first six to twelve months is critical. During this strategy development phase—the main focus of our study—major parameters defining the program are decided and a business case is developed. Parameters set at this point include market segment and competitive positioning, expected sales volume and price, and key vehicle attributes including size, performance, drivetrain and other major technology options. The availability and utilization of production capacity also are critical elements, since poor capacity planning can be financially devastating. It is on the basis of such parameters, including capital and corporate resource needs along with profitability metrics, that a program is submitted for top management approval. This step, which typically happens about 24 months before product launch, is the point at which major funds for implementing the program are released.

Any given product program is but one element of a company's full vehicle portfolio. An automaker's *cycle plan* is the resource allocation timeline that compiles the full set of business propositions for every product in the portfolio. Auto companies address product planning activities and development decisions broadly, and increasingly globally, covering all their products and all their markets. A complete cycle plan usually spans 10-15 years, but the plan is most detailed for the immediate five years when the timing of major design efforts and capital investments are well defined.

It is in the early, concept definition phase of product development that the external business environment is factored in based on findings from ongoing company-wide studies. These studies entail forecasts of market size, segmentation and sales, social and demographic trends, economic and energy outlooks, political and regulatory trends, and consumer preferences.

EXPLORING THE DECISIONS BEHIND AUTOMOTIVE PRODUCT PROGRAMS

An ideal way to gain understanding of the process outlined is tapping the experiences of those who work through its challenges year in and year out. What follows is a synthesis summarizing what we learned from private interviews of top executives and managers involved in product planning.

Budget allocation

Budget allocation is the most important decision faced by management. At heart, it is a question of balancing supply and demand. Supply is defined by the company's capacity to deliver based on its resources in design, technology, engineering, facilities and supplier base. Demand is driven by consumer preferences, corporate image and other strategic considerations. For any vehicle program, these supply-demand fundamentals define a spending target based on expected profitability. The program's expected sales volume is a critical judgment, since sales revenues must ultimately cover the budget outlays with a profitable return.

- *Every automotive program has an internal business case that is ultimately controlled by vehicle prices and sales volumes; all aspects of a program plan must meet the resulting budget constraint.*

Budgeting is a cyclical process, laid out in a firm's cycle plan, that involves overlapping short- and long-term planning horizons linked to current product lifecycles and future product plans. New products rarely start from a "clean sheet of paper." In general, automakers start with existing segment and brand expectations on the demand side and work from existing platforms and available engineering and manufacturing capacity on the supply side. As a result, design change is almost always incremental and occurs over the course of an evolving cycle plan.

Given the product concept, the core parameters of the business case are defined based on the expected pricing and sales volumes. These parameters plus profitability targets determine a product development budget into which all aspects of the plan must fit. This budget constraint provides the framework within which the product's proposed features are evaluated in terms of their expected customer value and cost. ROI and similar financial metrics are used to evaluate programs; however, profitability targets vary by program and market segment. Finally, since every program entails elements of risk, a sound plan includes risk mitigation strategies, particularly concerning questions of expected sales volume.

The 'Voice of the Customer'

The industry uses the term "Voice of the Customer" (VOC) to represent customers' expectations, requirements and desires in a car. Automakers seek consumer input through various channels, including market research and reviewing consumer feedback through surveys and third-party sources such as J.D. Power & Associates and other market analysis firms. VOC is integral in program planning, since the ultimate arbiter of program success is how well it satisfies customers.

Nevertheless, direct VOC inputs are not always the dominant driver for program planning. For one thing, consumers are "rear-view" people, that is to say, they tend to define their wants in terms of what they know from past products. Other factors—the need to fill a known market niche, to meet the competition, or to pursue perceived new opportunities—may be more

influential than VOC in defining a product. Moreover, an increasing fraction of the automobile market is a commodity business, with basic expectations largely predefined and little opportunity to arouse strong feelings in customers.

- *While the “Voice of the Customer” is a key driver, other demand-side inputs are at least as important. Automakers must also watch the competition to determine where they need to be in the market and what features a product must have.*

VOC is important for defining and refining features amenable to consumer testing. Variations on styling, comfort and convenience items, utility attributes and electronics are examples of options that can be formally evaluated in customer clinics. On the other hand, features that are relatively intangible to consumers may be very important for a brand, and so must be included in the product—and communicated to customers—in other ways.

- *Automakers tend not to be judgmental about what consumers demand, only about how to provide the best product to meet that demand.*

Brand values, corporate vision and corporate image

Brand distinctiveness is vital for successful products, and therefore shapes a company's portfolio. Brand values are tied to the expectations of the brand's target customers. Corporate vision can play a strong role in setting direction, especially if it has a clarity and consistency that permeates the company's planning. On the other hand, unless the brand and corporate image are closely identified, corporate image is generally secondary to brand in defining a program.

- *Brand values are paramount in shaping vehicle programs, and a brand's identity is strongly tied to its customer base. Corporate image is secondary by comparison but corporate vision can play a strong role in setting direction.*

The influence of corporate vision can be seen when firms launch new brands or product lines, or pursue special, low-volume programs ("halo cars") that tangibly express corporate strategy. Programs with strategic value can be approved even if they do not pass the customary financial tests. Examples include the Toyota Prius and Ford Escape Hybrid in their roles of spearheading their respective firm's advanced powertrain strategies. The ideal strategic process is one in which an automaker's product offerings co-evolve with a corporate vision that guides the portfolio while staying anchored in a market built on successful brands.

Robust planning: an exercise in trade-offs

Budget restrictions and other resource constraints imply that no vehicle program can accommodate all of the desired features and attributes. Product planners and management must therefore make tough choices throughout the decision-making process. For a robust business case, such issues are ideally resolved before program approval, so the product development effort stays within the budget imposed by the basic parameters of vehicle pricing, sales volume and profitability requirements.

- *Budget constraints mean that product planners must make trade-offs, ranging from whether or not programs are pursued to the selection of specific vehicle features.*

Thus, trade-off decisions are instrumental in determining how different corporate resources (engineering, facilities, etc.) are allocated across programs. Within a vehicle program, the

financial constraints may mean that if a new feature is added then something else must be dropped. Factors of great importance to a brand also get high priority during product planning and therefore may force trade-offs in features of lesser brand importance.

Regulatory requirements—safety, emissions or fuel economy—force trade-offs because they imply design changes or features that cannot pay for themselves but must be incorporated regardless of customer expectations and other considerations. In particular, fuel economy standards are viewed as incurring costs or forcing trade-offs, leading product planners at some companies to aim for only minimum compliance. On the other hand, systems-level engineering and design approaches can mitigate the need for adverse trade-offs.

- *Because fuel economy is an outcome dependent on many vehicle attributes and features, its trade-offs are ideally addressed at the whole-vehicle systems level.*

If handled holistically, it is possible for fuel economy requirements to be met while staying within budget and without incurring additional costs. Moreover, when a societal consideration has value, either for its affinity to a brand value or because of a market incentive, it will be given a greater priority in program planning than when it is merely a regulatory requirement.

The challenge of adopting new technology

A key challenge automakers confront is how to handle the adoption of new technology and its associated up-front costs. This issue is approached differently by different companies. Even within companies, exceptions to the norm may be made for specific programs.

In some cases, a new technology is developed for its initial application (typically platform-wide), and this first program bears the full development costs. Such a situation can hinder technology adoption because the first program to use the technology is essentially "taxed" for the full development costs. In other cases, the costs are spread across programs. In special cases, a new technology that is deemed important to the company may be given a discrete development budget. Automakers may also collaborate on technology (for example, the six-speed transmission jointly developed by Ford and General Motors); however, such collaborations were not explored in this study.

CONCLUSIONS

The increasingly competitive and price-constrained auto market means that manufacturers have tight product development budgets, forcing trade-offs throughout the planning process for new or redesigned vehicles. Though many challenges apply to all automakers, some, such as over-capacity and longer-than-ideal lead times for product development, impact some firms more than others.

Regulatory requirements that address social concerns are considered burdens that must be borne regardless of customer expectations and market conditions. Some firms address societal considerations holistically during product planning, enabling them to be addressed without incurring additional costs even though trade-offs are involved. Although automaking is increasingly globalized, we found little evidence that stringent regulations in Europe and Japan are influencing product planning in the United States. The industry pursues a high level of product differentiation, tailoring vehicles to meet specific market and regulatory needs.

Finally, because vehicle programs carry over a high level of components and engineering from other programs, product changes are almost always evolutionary. Moreover, intrinsic time lags—the two- to three-year lead time for product development, the even longer planning cycle for all of a company's products, as well as the evolutionary nature of product change—represent constraints that must be respected.

Any potential policy requirements must acknowledge these realities. Indeed, it is difficult for automakers to do too much too fast. They are constrained by money, human resource issues and tooling costs, to name but a few. How to apply this understanding to policy development is left as a subject for future work.

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Introduction

The automobile holds a prominent place in American society. It brings numerous benefits, not only as a means of mobility, but also as the highly valued product of an industry that employs many Americans. Policy makers have long struggled to balance societal concerns against the numerous benefits the automobile provides. Great progress has been made by the automobile industry in reducing emissions of smog-forming air pollutants—including carbon monoxide, unburned hydrocarbons, and nitrogen oxides—and controlling traffic fatalities. What loom large today are the mounting concerns regarding petroleum use and global climate change, raising the likelihood of government intervention that could impact the types of vehicles the manufacturers produce.

The American auto market—and the industry that serves it—is being buffeted by many changes, including those associated with fuel consumption. Although not as dramatic as the gas lines of the 1970s, today's energy-related issues compound other challenges associated with the now global, highly competitive and increasingly commoditized nature of automaking.

For periods in both fall 2005 and early summer 2006, the average price of gasoline in the United States crossed the significant threshold of \$3 per gallon. Some observers believe that the era of "cheap oil" is gone forever and that fuel prices are likely to rise further, sooner than had commonly been believed just a few years ago. Indeed, conflicts in oil-producing regions of the world, climbing consumption in the United States, China and India, and a diminishing supply of domestically extracted oil—even before the refining and distribution disruptions of the 2005 hurricane season—practically guaranteed that the price of gasoline would factor more heavily into the purchase decisions of U.S. new vehicle buyers. At the same time, concerns are mounting about global climate change, adding to the pressure on the auto market regarding fuel use.

As of 2006, fuel price-related impacts on the new vehicle market were manifest. Sales of light trucks (pickups, sport utility vehicles and vans) fell substantially during the year, with sales of truck-based SUVs taking the biggest hit. High fuel prices depress overall sales somewhat, but that effect is not great compared to the effect on sales mix as consumers shift their preferences to something smaller and more fuel-efficient. Statistically speaking, the aggregate fuel economy of new car and light truck purchases is up only slightly and remains 5% below its historical peak in 1987-88.¹ Thus, while major impacts on overall fuel consumption have yet to be seen, changes in the new vehicle sales mix have had significant competitive implications for different players in the auto market.

How do automakers respond to dramatic changes in consumer preferences such as has been recently seen? Outwardly, it appears some companies are responding effectively by bringing the types of vehicles to market that consumers now want, while other companies seem to be responding poorly to the new dynamic as they roll out new, but overall little changed, versions of large SUVs and pickup trucks.

¹ Heavenrich (2006), Table 1.

In reality, no company is responding to a market that seems to have changed substantially over the past two years. Due to many factors, it takes an automaker at least two years, and more typically, two and one-half to three years, to bring a new vehicle to the market. The products that were being shipped to dealer showrooms around the country for model year 2006 were vehicles that had been planned by 2003, with market conditions—and expectations—very different from those of today. When new vehicles and powertrains (engines and transmissions) are being planned, car companies develop an internal business case that depends on numerous external and internal inputs. While some were wary of oil market volatility, the prospect of U.S. gasoline prices hitting \$3 a gallon or staying near that level over a two year period was not an assumption made by product planners three or more years ago. Until very recently, the prevailing wisdom was that climbing oil prices represented another phase of transient volatility rather than a new world order in the oil market.

Complaints that car companies are not responding to consumer desires, ignoring new realities and producing vehicles that seem ill-targeted to fuel issues are numerous. Automakers have had a difficult time explaining the product development process to the general public and most policy makers, who have a poor understanding of the predicaments in which companies find themselves when they cannot get new vehicles into showrooms fast enough to respond to external forces in the market. Yet such an understanding is crucial to informed deliberations about how to respond to the challenges presented by changes in the oil market and environmental concerns such as global warming. Similarly, although advanced, "clean" technologies (available, emerging and futuristic) are widely discussed, policy makers and the public rarely appreciate the intricate decision making of product planning, which is when the choices that determine technology use are made.

The Center for Automotive Research (CAR) undertook this study to better understand the internal business case development process within today's automobile industry. The study first reviewed the current state-of-practice for automotive product development. Then, over the course of five months in the first half of 2006, the research team interviewed a total of 12 executives in several companies that sell automobiles in the United States. A formal, confidential protocol was followed, promising anonymity of both individuals and companies interviewed, and sending a set of questions to respondents in advance of the interviews (a copy of the questionnaire is found at the end of the report). Collectively, the companies responding to the questionnaire accounted for approximately 60% of the U.S. new vehicle market, or more than 10 million new vehicles sold in calendar year 2005.

This report synthesizes the findings of our investigation. To orient readers to the industry, its terminology and common practices, the report begins with an overview of auto industry product planning and budgeting processes. CAR researchers then summarize what was learned from the interviews, highlighting insights and considerations that will help policymakers and the public better understand how car companies plan new products and develop their future product strategies.

An Overview of Auto Industry Business Planning

In any industry, business planning is critical for competitive success. For companies in a dynamic market, products cannot remain static if a firm is to hold onto sales, let alone gain market share. Developing new products—either brand-new offerings or freshened versions of existing products—is therefore at the core of business planning. In the introduction to their landmark study, Clark and Fujimoto write that "For senior managers around the world, developing better products faster, more efficiently and more effectively is at the top of the competitive agenda."²

Any given car model faces an unforgiving market in which it will sell well or poorly according to how it stacks up against the competition. Even though the auto industry is dominated by established firms that are behemoths among businesses, each vehicle program is in effect, an ultimate start-up. To obtain corporate resources—access to capital, engineering, production facilities and marketing muscle—a proposed product must be accepted on the merits of the profits it is expected to bring. This section provides an orientation to the planning processes by which automakers define and develop new products, thereby executing their strategies for achieving business success.

THE PRODUCT DEVELOPMENT TIMELINE

An overview of the automotive product development process can be seen in the timeline leading up to product launch. The time needed to conceive, create and deliver a new vehicle to market can be two and one-half years or more (refer back to Figure E-1). The process is complex, comprising many inter-related steps.

Three main phases are common throughout the industry. They are, in project order: concept definition and business case development; product and manufacturing engineering; and assembly site preparation and marketing plan development. While the development of a vehicle is far more involved than just these three steps, this description of the process captures the full cycle of program development from concept to launch.

Generally, the process of developing a business case starts roughly 30 months before vehicle launch, though the time can vary by company, with the best claiming 24 months. Broad aspects of design—the product "concept"—are developed early on in this stage of the process. The concept cars seen at auto shows, for example, represent various stages of thinking that feed into the process, often well before a business case has been made. Chrysler's pending decision about a new Imperial sedan (see box below) illustrates the issues considered before a program is approved.

² Clark and Fujimoto (1991), p. 1.

Making a business case: the Chrysler Imperial decision

An example of the internal deliberations entailed in deciding to introduce a new vehicle is found in a recent issue of *Ward's Automotive Reports* (July 17, 2006). An article entitled "Chrysler Imperial Decision by Year-End" details some of the many issues a company's management must address before it makes a go-ahead decision.

In January 2006, Chrysler unveiled a concept Imperial sedan at the Detroit auto show. According to *Ward's*, the company is assessing the viability of such a vehicle, with a chief factor being the potential revival of the classic "Imperial" nameplate as a way to better define the direction of the Chrysler brand. Internal company discussions are assessing where Chrysler should be in comparison to the competition. A key consideration is that the brand needs to make a "distinctive statement" and that Chrysler needs a vehicle "above the 300" in the lineup.

The internal business case now under development is slated to be presented to the board for a decision by the end of the year. The article states that the vehicle is probably positioned correctly in the Chrysler lineup; however, its features and necessary volumes are still being determined as part of the business case development.

Ward's reports that the Imperial would be built on a stretched version of the platform now used for the Chrysler 300, Dodge Charger, Magnum and the recently announced Challenger. Using an existing platform helps contain development costs.

Another critical decision is where the car would be built. Chrysler has apparently ruled out having a contract assembler, such as Magna, build the vehicle, preferring instead to assemble the vehicle in one of its plants. However, the obvious plant to produce the car—Brampton, Ontario, where the Chrysler 300 is being built—is running above capacity with a third shift making that popular vehicle. No other plant in Chrysler's system is configured to build the 300, or any of its derivatives, leaving the product team with yet another difficult decision.

Weighing brand identity, expected sales volumes, development and production costs, capacity and technology constraints, the company will make a decision based on all of the criteria—not just on a single issue. All of the pieces must come together in a robust internal business case, or a company will not make the substantial investments involved.

At the end of the business case development process, a vehicle program can be approved, rejected or delayed for reconsideration the following year. If the program is approved, the product will be assigned a platform—typically an existing platform but occasionally a new one for an all-new product.³ A similar planning process takes place for major new powertrain components, such as a new engine or transmission, which may be utilized in multiple vehicle programs.

BUSINESS CASE DEVELOPMENT

The approval of the business case for a new or redesigned vehicle defines the key constraints under which the program will proceed, including market segment and competing products against which the vehicle will be benchmarked, expected sales price and target volume, the drivetrain options and other technologies available for the product, as well as many other factors.⁴ The choices made at this stage of the process also determine the manufacturing site, which takes into consideration the physical layout of the assembly plant and capacity constraints.

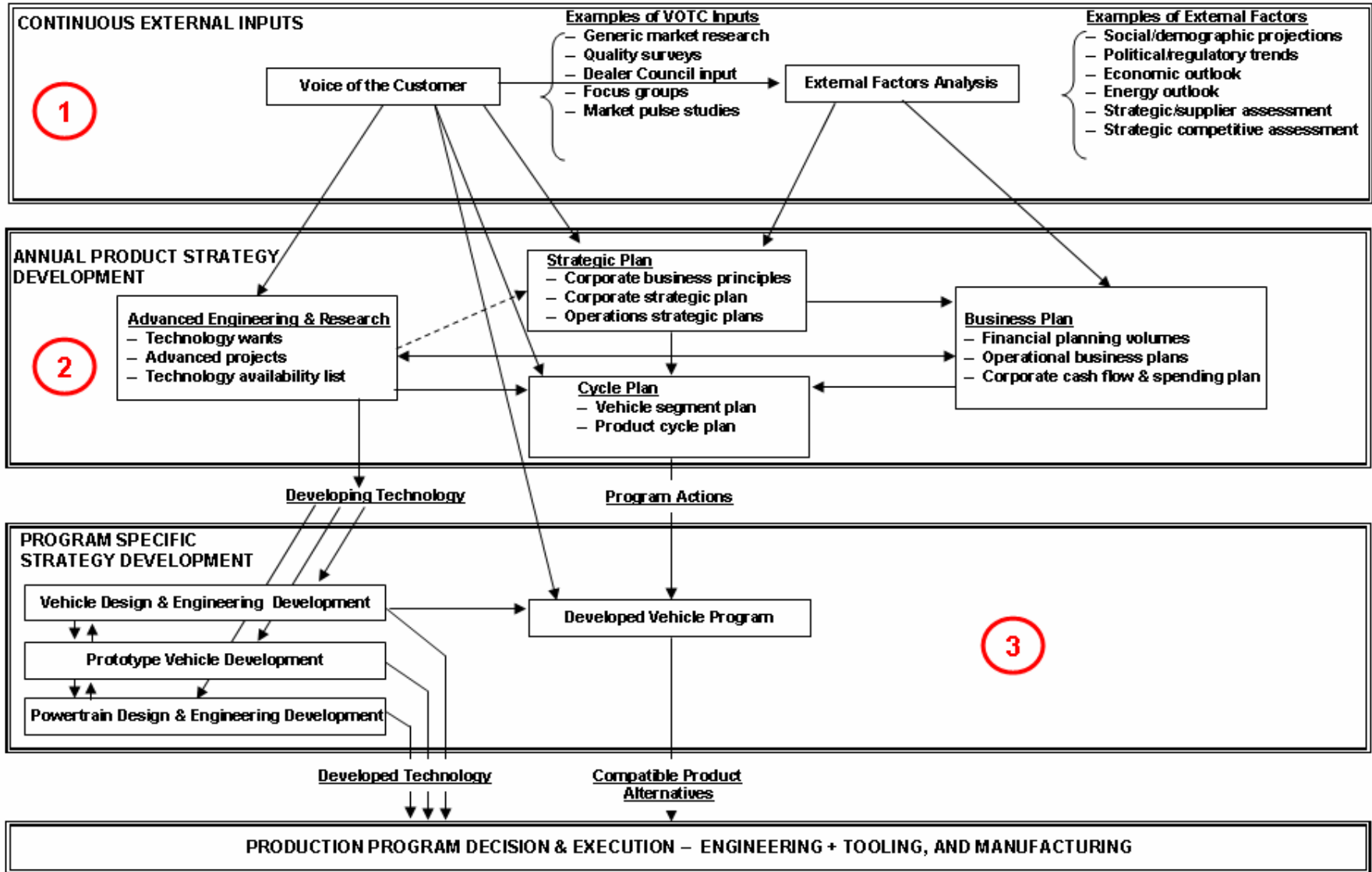
³ The term *platform* conventionally referred to "common, or partially common, structural underbodies" (Hodges 2004), or a vehicle's chassis. The term platform (or "architecture") now has a much broader meaning—one that encompasses many aspects of product development, engineering and components commonality through which firms balance the market need for product differentiation with the cost savings from economies of scale (Hodges 2004; Carney 2004).

⁴ Drivetrain refers to the engine, transmission and associated components.

Once the business case is approved, the project is assigned to a vehicle development team and product and manufacturing engineering begins in earnest. During this latter stage, the team develops the specific parts, components and manufacturing processes necessary to manufacture the vehicle.

This report focuses on the decision-making processes that occur during the business case development phase. A series of activities and decisions take place that begin with very general concepts and ideas and proceed to a narrowly defined set of executable plans for vehicles and powertrains. The decision-making steps for a specific vehicle or powertrain program draw on other key planning processes that feed specific programs and represent the evolution of a company-wide strategy.

FIGURE 1. A detailed look at automotive business case development



The overall process, which is organized differently by company, is illustrated in Figure 1. The three major elements are:

- **Continuous external inputs.** Ongoing studies of the broad demographic, economic and social factors influencing the auto market, as well as consumer research. These studies are typically summarized for high-level management review on an annual basis.
- **Annual cycle plan update.** Annual strategy development studies embrace a corporate strategic plan, a technology plan and a business plan. These inputs are reflected in a cycle plan that lays out all of a company's vehicle programs on a time scale that maps product development and production to competitive positioning in the marketplace.
- **Program-specific strategy development.** Consistent with an approved cycle plan, the given vehicle program is developed, with inputs from vehicle and powertrain design and engineering, as well as prototype development activities.

Auto companies approach these activities and decisions broadly—and increasingly—on a global basis, covering all their products in all markets.

Because the time from first concept to production launch can span 30 months or more and resources are not available to work on all vehicles at once, an all-inclusive plan covering all of a company's products can span a 10-15 year horizon, with the immediate five years receiving the most detailed attention. Automakers typically renew their plans annually, reviewing what has changed over the past year, modeling and analyzing these new factors, building another layer of specificity on top of the previous year's plan, and adding another year at the end. The working collection of such plans comprises the *cycle plan* (see box and discussion below).

Continuous external inputs

An overarching activity that informs all of an automaker's decisions is an ongoing, company-wide study of the external business environment. These studies (listed in Box 1 of Figure 1) are undertaken by a variety of internal departments.

Marketing staff define target markets and segments in which the company expects to participate in over the 10-15 year horizon, updating their brand strategies as needed. Corporate economists forecast long-term social and demographic trends as well as the near-term economic outlook. Together these departments project industry-wide sales volumes by region or country and by market segment within countries. They also project shares of market that can be attained, both by the company and its competitors. A variety of analysts examine political and regulatory issues, the energy price outlook, supplier capabilities and availability, and labor issues.

"The Voice of the Customer" (VOC) is a key input, and many sources of data are used to characterize this critical factor, both for specific programs and for overall brand and corporate strategies. In defining VOC, for example, market researchers evaluate customer feedback from new vehicle buyer studies, new vehicle quality studies, assessments of competing vehicles, focus group panels and sales trends.

A corporate committee or department charged with external factors analysis presents the findings from these studies to various levels of vehicle program and corporate management.

"Gap analysis"—identifying gaps or disconnects in the company's plans relative to customer expectations and competitors' plans—is an important aspect of this annual review.

Annual cycle plan update

The manifestation of all of an automobile company's program plans is contained in the *cycle plan* (see box). The activities surrounding the definition of a cycle plan are shown in Box 2 of Figure 1. The process is informed by external inputs, but the firm's overall strategic plan is a key starting point. Automakers lay out their core principles and business strategy considerations to obtain buy-in across departments prior to cycle plan development. They also identify contingency strategies to address possible alternative scenarios. Strategic plans generally are developed for large regional areas: North America, Europe, Asia-Pacific and South America, and these regional strategies are integrated into a formal global plan.

The Cycle Plan

In automotive parlance, a *cycle plan* is the layout, along a multi-year time axis, of a company's plans for the design, engineering, tooling, launch and production life of all of its various vehicle lines and models.

The life of a product line spans many years, and so does the cycle plan. For a given vehicle line, the time from conception to first production may span two and one-half to five years. The time from first production ("Job #1") to the last vehicle off the line ("Balance Out") may span from four to five years to eight to ten years or more, depending on the dynamics of the market segment.

At the point of final production of the current vehicle line, a new model with the same badge and similar characteristics may be ready to take its place, continuing the cycle, or the old model may be dropped in favor of a different product. In any case, the cycle plan—covering all of the company's products—keeps rolling.

For practical planning purposes, the cycle plan usually spans 10-15 years. It is reviewed and renewed at least annually, with another year added at the end of the time span covered.

From a marketing viewpoint, the cycle plan ideally parallels a market segmentation plan on the same time axis. The segmentation plan indicates what vehicle models the company needs to offer to respond competitively to forecasted vehicle demand by segment.

A key function of the cycle plan is to lay out a forward view of the company's resource allocation requirements. This includes the time phasing of workload in design, engineering, testing, purchasing (i.e., suppliers) and marketing, so that workload can be contained within available resources across an automotive company's entire vehicle lineup. The cycle plan also defines the time-phased requirements for capital investments in facilities and tooling.

Business plans are developed by each operating unit to translate strategic direction into guidance for their specific programs. The set of sales volumes assumed for financial planning purposes is a critical factor. These planning volumes are often set at the corporate level, based in part on studies of the external environment described earlier, and approved for consistent use across all of the company's operations. The corporate business plan summarizes the operations' business plans, with competing objectives and resource sharing, or constraints, identified, prioritized and resolved. It also defines the corporate spending plan, cash requirements and borrowing needs.

The technology plan reflects another major planning activity, designated Advanced Engineering & Research in Figure 1. Automakers track the status of technological advances, including basic and applied research underway internally, of suppliers and to the extent known, of competitors, as well as advances in other industries and institutions, universities and government laboratories.

Technology is construed very broadly by automakers (far beyond, say, powertrain technologies affecting fuel use). In fact, much automotive technology work focuses on an ever-expanding range of features that can appeal to customers: from comfort and convenience items to entertainment, navigation, communications and other information technology applications. The technology plan addresses "want lists" from program planners; R&D and engineering work needed to bring concepts to production readiness or adapt them for automotive application; basic research on innovative approaches to meet product needs; technology-related resource requirements; and subjective estimates of the potential payoffs. Technology projects are prioritized within a five to ten year technology spending budget. The resulting plan defines the availability of technologies for incorporation into specific vehicle programs.

Cycle plan example

A concrete example illustrates the cycle plan concept, as shown here in this simplified version of Chevrolet's cycle plans for years 2006-2009 as reported in *Automotive News*:

2006	2007	2008	2009
Malibu – freshen		Malibu – restyle & re-engineer	
Impala – restyle & re-engineer			
		Aveo – redesign	
Monte Carlo – reskin			
		Cobalt – freshen	
	Equinox – freshen		Small sport wagon – debut
	Tahoe – restyle & re-engineer		
	Suburban – restyle & re-engineer		
	Silverado – restyle & re-engineer		
	Avalanche – restyle & re-engineer		
		Trail Blazer – restyle, re-engineer	
			Colorado – restyle & re-engineer
			Uplander – redesign
Corvette Z06 – return			

Source: *Automotive News*. Future Products – General Motors: GM's high expectations. August 22, 2005.

The corporate strategy, business planning and technology planning activities all feed into the updated cycle plan, which defines the market segments in which the company expects to compete and the specific product plans for each segment. An excerpt from a cycle plan summary is shown above, illustrating the staggered timing of product programs, including major

redesigns, all-new vehicle introductions, additions of derivative models, restyling and re-skinning of existing models, freshening of a vehicle's styling and powertrain upgrades.

Program-specific strategy development

The third box in Figure 1 represents the process of defining the strategy for implementing a specific vehicle program. Program-specific decision making occurs in parallel to the ongoing analysis of external inputs and annual updating of the cycle plan, with different programs receiving attention in different years. Automakers have various forums and mechanisms for sharing the myriad internal plans and other aspects of information needed to define a program. The procedure can be highly company-specific, but generally entails frequent, high-level review of plans as they develop in order to facilitate information exchange and move the decision process forward.

Ultimately, the decision about whether to pursue a program and what specific features it will include are made on the basis of expected financial performance (some common metrics are described below). The decision process inevitably involves making a series of trade-offs as the program and its elements progress through various stages of approval. As noted earlier, these stages involve successively greater degrees of specificity about all aspects of the design, engineering and manufacturing of the product. The resulting program strategy will then include plans and budgets for vehicle design and engineering, prototyping and powertrain development, as noted in Box 3 of Figure 1, as well as other aspects of program execution.

About six months into the process of developing ideas and concepts—and about six months before approval—the strategic intent of a program is reviewed by senior management and (perhaps) by the Board of Directors. This approval gate usually includes the authorization of a relatively small expenditure for further development work. Six months later, when top executives (including the Board) review the program for final approval, major capital funds for facilities and tooling are released and the requisite resources of the engineering and manufacturing operations are committed.

A well-executed business plan reduces the time to program implementation and improves the quality of execution by achieving management consensus on the business case before the decision to commit funds. A less-than-ideal process can result in a poorly defined business case, a lack of coordination among the competing resource needs, a possible neglect of some key decisions or their deferral into the program execution phase—all serving to raise the risk of a poorly executed, and potentially unprofitable, program.

FINANCIAL METRICS

With rare exceptions—such as special "halo" or "the right thing to do" programs pursued for strategic reasons—every automotive program plan must establish that it will meet internally-defined profitability targets. These financial evaluations are a determining factor in the program approval process. Automakers measure the return on program investments in a variety of ways, including incremental time-adjusted return on investment and fully accounted return on assets. Payback periods and returns on sales may also be used in some instances.

Incremental time-adjusted return reflects the difference between a given proposal and an alternative course of action (which may be the *status quo*). It considers only changes in revenues, costs and assets related to the specific proposal, discounting these factors to reflect

the time value of money. If its time-adjusted return exceeds the firm's cost of capital, then the cash flow from the program will recover the initial investment and provide a return greater than the cost of funds.

Fully accounted return on assets indicates fully accounted financial results in contrast to comparative results. It includes all revenues, costs and assets related to the business that contains the proposed action, not just those that change because of the action. This metric is useful in gauging the relative attractiveness of a specific program to the business, indicating whether the program can earn a reasonable return while carrying its share of corporate overhead. Typically, fully accounted results are calculated for the complete business unit (or product line) that contains the proposed program.

Both of these measures (among others) are used to evaluate vehicle program business cases. Together, they can provide a complete view of a program's profitability, evaluating whether the return on incremental expenditures exceeds the cost of capital and whether the investment is being made in a profitable line of business. There is much more to automotive financial evaluation, of course, and the planning process acknowledges that some factors are difficult to quantify (e.g., benefits associated with improved quality or manufacturing flexibility) and so cannot be fully reflected through financial analysis.

COMPREHENSIVE BUSINESS PLAN

The ultimate test of a company's program plans is their synthesis into an annual comprehensive business plan, which typically covers a five-year horizon. It is based on financial planning volumes approved by top management and incorporates the operational business plans from all parts of the company. The investment requirements of the individual programs are reconciled with corporate cash and borrowing plans. The first year of the comprehensive business plan is the foundation for the following year's operational budget, and the overall plan ideally represents the achievable business structure that guides all of the company's actions.

As noted earlier, the business plan is reflected in Box 2 of Figure 1 as an aspect of the annual cycle plan process, illustrating the inherently iterative and interlocking nature of business planning in the automotive industry.

Interview Findings

CAR conducted a series of confidential, executive-level interviews focused on understanding the internal budgeting and business case development process prior to the approval of a new automotive program. Through the interviews, the researchers sought to shed light on the process and the various decision factors that go into forming a capital budget for a major automotive program (e.g., a new vehicle or drivetrain). Understanding the role that external factors—such as regulations, consumer preferences and market forces—play in the decision-making process and how these factors are integrated into the internal business case is also important.

The interviews were conducted in confidentiality and the interviewees were assured that findings would be aggregated and discussed generally, rather than reveal information specific to any one company. This protocol enabled candor and openness in discussing the questions. The inquiry (stating the purpose of the study and the interview protocol) sent to automakers to solicit their participation and the questionnaire (used for the interviews and circulated to the respondents in advance) are provided in the Appendix.

Though the process was not designed as a scientific survey—the number of interviews conducted was not large—we believe it fairly represents how the auto industry develops its products. The interviews garnered first-person descriptions of different firms' approaches and gleaned the thoughts, revelations and opinions of executive-level decision makers in companies that had a collective 60% of the U.S. light vehicle market, or 10.1 million vehicle sales out of a market of almost 17 million sales in 2005.

Among the specific goals of the research was understanding how decisions are made in approving a major new program. For instance, what data are needed, what departments play a major role, and what external factors are considered? The interviews identified a number of themes concerning the nature of the budget allocation process, including the many considerations and constraints the companies and individual departments must address before a new program is approved. Major themes around which this narrative is organized include: steps in the formation of a capital budget; how the VOC is incorporated; the roles of corporate vision, image and brands; and how trade-offs are made among competing requirements. As might be expected, there was substantial commonality among the responses from the interviewees, along with areas of divergent views and philosophies.

THE CAPITAL BUDGET ALLOCATION PROCESS

Automotive capital budget allocation is rooted in economics and cash flow, but it is also driven by corporate vision and brand considerations. At the level of corporate strategy, considerations include economic, demographic and psychographic trends in various markets; the implications for the size of major segments and vehicle mix; and expectations regarding what share a company's brands can capture. The process is one of balancing demand and supply. Demand is driven by VOC, corporate image and other strategic considerations. Supply represents the company's ability to deliver based on design and engineering resources and production capacity.

The budget allocation strategy and process can be described in a number of ways. It addresses basic business economics and cash flow evaluated in light of a company's overall corporate

Table 1. Major factors that go into defining an automotive product	
External	Internal
broad market trends that define segment needs	a company's strategic vision
expectations from past products and the competition	brand identity
Voice of the Customer ("VOC")	corporate culture and expectations
projected market shares and volumes	availability of capital and capacity to deliver
regulatory and other social pressures	technology, manufacturing and supplier capabilities

strategy and brand image. Ideally, business, product and branding considerations are co-optimized. Because a firm must account for its available production capacity and issues of needs for capacity expansion, contraction or reallocation, program budgets are also evaluated within the firm's global planning framework.

In general, the capital budget ultimately covers the conceptual phase of program development, vehicle design and engineering, and production. The budget includes spending on "hard" capital (facilities, tooling) as well as personnel (engineering, manufacturing and marketing). It is on the basis of defined programs that capital is allocated in bringing a product to fruition. Table 1 summarizes the external and internal factors that are used to define an automotive product program.

For a given program, budget planning occurs in two major phases. First is the concept phase ("intent"), which establishes a spending objective based on expected profitability for a product concept. Approval at this phase results in a limited release of funds that enables the project to define the concept and develop a business plan to execute the program. The next phase is program approval, at which point major funds for implementing the program are released, typically around three years before product launch. Within a company, such program plans are synchronized through the cycle plan, as defined in Section 3 and elaborated on below in the capital allocation context.

A large part of the content of the new product is decided in the annual review process—not features and functionality, but the broad scope of the program. Feature and functionality are decisions are made during the product engineering phase and are subject to trade-offs in order to remain within the budget and other defined parameters of the program. During such reviews, elements of evaluation include a competitive assessment, risk analysis, discussion of the program's role in the corporate product portfolio, analysis of impacts on operations, and how well the program is optimized in terms of both market needs and corporate capacity. During annual reviews, management asks questions such as: Where are we? Where did we say we'd be? What's gotten better and what's gotten worse? How do we stand compared to our competitors?

The approval phases for a program are often described as "gates" through which the program plans must pass before funds are released. The major gate at which approval is sought for the

broad scope of the program typically occurs about three years before the start of production. Sometimes called the "intent" gate, it represents the key decision to take program planning to the next level of detail as part of the company's defined cycle plan. Depending on the company, after program intent gets approved, funds are released for detailed business planning which then takes place within roughly six months. This process yields a detailed plan presented for a full approval gate, at which point the major capital for implementing the program is released. It is then that a program passes from a business planning phase to an implementation phase, including "hard" design, development, engineering, sourcing and manufacturing plans. In a well-managed situation, major changes to the capital budget are rare once the implementation process has begun.

During the capital allocation process, automakers seek to make the best use of available resources, optimizing what for them is the "supply" side of the equation—the engineering resources, technology assets, plant capacity and other corporate resources at their disposal. Thus, in terms of technology deployment decisions, it is within the capital budget process (for particular programs) that determinations are made regarding which technologies will move from basic to applied research, based on cost and market competitiveness. More broadly, the introduction of new products coincides with the availability of a platform to match the needs of the program and the availability of manufacturing, engineering and technological capacity within the company.

Production volumes at various plants can be impacted by a decision to build a new product. Most companies initially look for excess manufacturing capacity on a platform, seldom starting with a "clean sheet of paper." Thus, the application of technology and design change is generally incremental. However, the availability of a new technology can drive the inception of a new program in the sense that, once it reaches a state of readiness, it is considered part of the supply of deployable resources a company has at its disposal.

Short- and long-term plans

Each of the automakers meet annually to finalize a one-year business plan and a multi-year strategic plan. These multi-year plans look forward anywhere from four to eight years, with one automaker suggesting they look out as far as 15 years. The advance planning for a program four to eight years off is generally tied to the replacement (or major upgrade) of a current program, or introduction of a new program.

As noted earlier, this planning process is built around a *cycle plan* that aggregates the set of rigorously defined business case propositions for every product in the firm's portfolio. In general, planning doesn't start from scratch, with the previous year's plan serving as the base for a new plan. A sound plan is also cost-constrained and includes a risk mitigation strategy, which in some circles is called a "SWOT" (Strengths, Weaknesses, Opportunities, Threats) analysis. The planners examine what might go wrong (including both internal and external factors) and specify how to address such risks while staying in budget.

At the corporate level, capital is allocated to brands based on their projected profitability. Hard costs (facilities, tooling, etc.) are allocated across programs early in each phase of the cycle plan. In some approaches, soft costs (engineering) are backed out of the business plan, resulting in an allowance for how much can be spent within the budget for a given program. Alternatively, under a more centralized planning structure, soft costs are also allocated across programs, involving a negotiation across their respective competing needs. In some of the

companies, the process involves a combination of planning that is both "top down," from the corporate resources level, and "bottom up," from the program needs level.

However, interviewees noted that a rigorous planning process sometimes breaks down, to the detriment of a company. In such circumstances—perhaps in spite of efforts to the contrary—management operates in a reactive mode. Internal pressures and constraints (e.g., financial issues and technological challenges) then result in the planning process being manipulated in such a way that a clear vision is never attained, or the original vision is lost; extraneous factors unrelated to creating a strong program can sometimes end up in the approved plan.

Role of corporate departments

In general, the budget allocation decision process entails three main phases, all involving multiple departments. The early, concept definition phase of the process is somewhat similar among companies, in that many individuals from many departments are involved in the planning. It is the interaction—or lack thereof—of these individuals and departments that differentiate companies. Some companies work internally at all levels to bring the numbers and people together. Everyone is in line with the corporate strategy and the information flows through all levels of the operation. Conversely, in other companies, departments work independently with final decisions resting with the upper-level executives, and executive management can adjust capital budget at any time during the approval process.

Typically, the product segment is identified in the early stage, along with the accompanying powertrain. In addition to defining the actual product, the target consumer demographic group is defined, as is an estimate of expected annual sales. Finally, once the parameters are generally determined, the overall budget is estimated. Departmental groups participating in this stage of the process and their general level of input include (in relative order of importance to this stage): corporate strategy, product strategy, business strategy, operations controller, finance, product planning, marketing and sales, vehicle engineering, purchasing, accounting and manufacturing.

The second phase of the process can be called the program stage. It is during this stage that the program is defined, including features and styling. It is here that marketing plays a much more prominent role, providing input from focus groups, and competitive pressures and constraints are assessed.

The final phase (which was not addressed in our interviews) is the actual product and manufacturing engineering, which gets underway only when the program has been approved and funded.

Return on Investment (ROI)

The industry uses a variety of metrics for evaluating program business propositions, including ROI, internal rate of return (IRR), after-tax return on sales (ATROS) and contribution margin. The requisite levels for ROI or other metrics depend on the segment and product. One cannot expect the same level of return for commodity vehicles as for premium vehicles. There are different thresholds for different products. In some companies, each program has its own profit margin targets.

Ultimately, business cases are constrained by anticipated vehicle prices and expected sales volumes. The resulting financial metrics for expected program performance are therefore

fundamental to decision making. Automakers perform the equivalent of "textbook" assessments based on business theory, striving to ensure that the business case for a program reflects a disciplined, realistic evaluation of prices and volumes.

Thus, all aspects of plans must fit into the resulting cost constraints. If more money is needed for one part of a plan, it must be made up somewhere else. Within the budget for a given product, that means making trade-offs (as shown in Section 4.4). For example, holding the top competitive rating in one aspect of a product will mean benchmarking other attributes to a number two or three position to meet affordability constraints.

Financial analysis also affects decisions about adding a new feature to a vehicle. The feature may be evaluated in terms of its expected pricing (consumer willingness to pay) and contribution to program cost. If the feature's incremental change to the program is positive, it will get the go-ahead; if not, it is either rejected or, if the feature must be included for other reasons, offsets must be found to stay within budget. In some situations, incorporation of a new technology into the business plan requires meeting very stringent metrics; for example, it might be necessary for the company to break even on a technology's development costs within one and one-half years.

For a brand that is part of a larger company, building a strong business case can entail accessing corporate resources, which means having a solid proposition for what the rest of the company gets back in return. For example, a division might request additional corporate resources for vehicle development by offering a plan for sharing assembly capacity that will in turn reduce costs in other divisions.

With a good plan, if things go well, profits can be outstanding. If a plan is weak, not risk-mitigated or tightly managed, the results can be disastrous if the product does not perform as well as planned (i.e., fails to achieve the sales target). During the interviews, we heard some "horror stories" of the types of things that can go wrong and the severe financial repercussions when the business case for a program is not sufficiently robust and risk-mitigated.

ROI or other evaluation metrics are not necessarily binding if a program has strategic value for the brand or for furthering the corporate vision. Such programs require a "leap of faith," reflecting the basic need to take risks in the hope of achieving a significant advance in the marketplace.

The approach to addressing strategic considerations varies by company, however. Some firms generally assess program budgets according to strict product cycle ("short term") profitability objectives; they may then allow for exceptions ("flyers" or "got-to-do" programs) in special circumstances that are still within overall corporate risk limits. In other firms, project-specific targets for ROI are commonly evaluated in terms of long-term margins and profits; there is little need to "take a flyer" in the sense of exceptional planning, when the projects fit into the overall corporate vision.

If a new vehicle program incorporates a new technology which was developed separately (such as a drivetrain), some of the development costs of the technology will be passed on to the program costs. This could make the ROI target more difficult to achieve and may preclude the decision to include the new technology in the program, thus leaving the technology "on the shelf." On the other hand, automakers can work with suppliers to offload some technology development costs, or they may find ways to allow the associated costs to be spread across other programs and platforms.

INCORPORATING THE VOICE OF THE CUSTOMER

"VOC" is the industry's term of art that embodies consumer-articulated requirements, expectations and desires in a car. All respondents emphasized that VOC is integral to the decision to proceed with a program and how to define it.

A variety of formal techniques including market research are used to capture VOC. However, respondents noted that VOC is elusive and as one put it, customers are "rear-view" people. In other words, when asked about what they want, consumers tend to define it in terms of what they know from past products (either positive or negative). For this reason, VOC inputs are mainly applied to defining specific vehicle features, such as horsepower (performance), safety, electronics, size and cost. VOC is rarely used in the early stages of making the business case for a new program, as the companies are more concerned with filling a known market segment need and matching the competition, or carving out a new niche where there is a perceived opportunity.

Some respondents spoke of VOC in very fundamental terms, conveying that catering to consumers was such an ingrained element of the firm's culture that it permeated the entire product planning and budget allocation process. This makes the role of VOC, along with input from the automakers sales offices and dealerships, a key aspect of defining the demand side of the supply-demand equation of a product's business case. In other cases, assessments of what competitors are doing in a segment may be just as important as VOC.

Formal methods

The formal processes used to assess VOC occur in stages. In general, the earliest stage obtains feedback on broad product concepts; a later phase evaluates the defined concept's features and pricing; and a final phase tests and refines the communications strategy for the product. A variety of approaches are involved in assessing VOC. Marketing teams conduct surveys; they may solicit driver journals, hold customer clinics and visit dealers. Feedback and input are also obtained from outside firms such as J.D. Power and Associates. Automakers constantly look for new features and technologies that can grab customer interest enough to make them select that vehicle over the competition. A shorthand expression is calling such a feature a *Why Buy?*—something that gives a compelling answer to the consumer's question, "Why should I buy this vehicle?"

Given the elusive nature of VOC, automakers need ways to translate what might be called "the soft points of customer preferences" into specific financial criteria for use in program evaluation. Examples of how this translation occurs include product attribute profiling techniques (as described in the context of how planners make trade-offs, in Section 4.4 below).

Intangibles can be important

An interesting finding on VOC pertains to the need to address features that are in some way important for the customer (or for the brand or corporate strategy considerations), but at the same time intangible to consumers. This might be the case for certain technologies or aspects of design that are hidden from direct customer view or feel, or relate to some overall attribute of the vehicle as opposed to a specific, customer-definable feature. Incorporating such product attributes can be very important to a brand.

Examples of this situation might include detail-level design changes or technologies needed to provide the right performance and handling for BMW, a fuel economy edge for Honda, or safety leadership for Volvo. Marketing can be used to communicate the value to the customer and such communication considerations can yield design choices not strictly needed for performance but useful because they are tangible to the customer.

Limitations of VOC

Several respondents noted that, while VOC is very important, it has its weaknesses for guiding the planning process. Therefore, other approaches are used to understand the future from the perspective of the firm's target customers and VOC techniques might play only an indirect role in developing the longer term sense of direction that leads to new product concepts. A non-automotive example is the iPod, a product that met—and even created—a new and unexpected customer need but which could not have been initially conceived based on market research findings alone. When evaluating new designs, planners often look for what might be called "bipolar" responses in market research. Something that elicits a strong response—both positive and negative—may make for a better design than one that elicits acceptable but more neutral responses.

Customer preferences are also very diverse and attempting to explicitly address all of the demands that might come out of consumer research can conflict with the severe cost constraints that arise from the "commoditization of the car." This phenomenon—that a decreasing number of customers respond emotionally, with excitement and enthusiasm for a car—presents an increasing challenge for automotive product development. Some assessments place as much as two-thirds of the car market in the commodity buyer category.

Thus, not all product decisions are based strictly on market demand as articulated through customer input. For example, automakers will need to have product in a commodity segment, and many of the parameters for such programs are dictated by what the competition is doing, brand legacy and other factors. VOC is involved, of course, but may not provide guidance that is robust enough to define a clearly winning product.

ROLE OF CORPORATE VISION, BRAND AND IMAGE

Corporate vision—the long-term strategy and direction sought by the automaker's top management—at least indirectly shapes the product development process at all companies. How it is integrated into the decision making varies, however. The role of corporate vision (as revealed by the interviews) depended on the vantage points of the particular respondents as well as on the relative importance of corporate vision among different companies. As noted earlier, an ideal process combines "top down" guidance based on corporate vision (and resources) with "bottom up" program needs based on market factors defined for particular products.

The preeminence of brand

The role of brand (and brand image, as distinct from corporate image), on the other hand, is much better defined. The importance of brand was particularly apparent in the replies of respondents who had direct involvement in managing product development for a brand, either currently or at some point in their careers. Brand, of course, is intimately coupled to customer views and expectations. Strong customer satisfaction leads to a virtuous circle of success, as

product sales deliver a steady stream of revenue enabling the automaker to invest in upgrading the brand's products to ensure ongoing customer satisfaction.

Some respondents related how brands can strongly influence an automaker's larger vision, since corporate strategy is embodied in the firm's product portfolio, and it is the brands that in turn shape that portfolio. Conversely, other respondents emphasized how the larger corporate vision drove product strategy, noting that carrying such a vision forward requires a concerted constancy of purpose on the part of management. This degree of commitment can be implemented by having, and closely following, a well-defined internal corporate strategic plan. Such a plan is not static, but evolves as consumer demands and other external factors are absorbed into a high-level planning process that maintains coherence throughout the company, from the corporate board down to vehicle program staff.

Corporate image considerations

As for corporate image, its ties to product development generally seemed less distinct. While all respondents said that it was important, some suggested that when corporate vision was seamlessly integrated into product strategy, corporate image is taken care of as a matter of course. Its role is more clear when corporate image is closely aligned to brand images, which in turn reflect a company's core values. In that case, an alignment between corporate image and the image achieved through its products is maintained because of the high priority given to brand values during product planning.

The extent to which environmental image can be addressed in product planning appears to depend on how well environmental expectations and performance align with brand image. This alignment, in turn, is tied to customer expectations of the brand and therefore (by extension) of the company. It can be challenging to determine how to infuse a new long-term vision into "day-to-day operations" and in some situations the corporate vision may be too far ahead of customer expectations. Regarding this conundrum, one respondent remarked: "Ultimately, our products have to reflect customer reality." Thus, automakers can face a challenge if brand images need to change in order to implement the corporate vision, and corporate image can be at risk when these two drivers of product strategy are out of alignment.

On the other hand, although it requires steadfast management focus, concern for corporate environmental image can be a driver of strategy. A company that relates the sustainability of its business to a broader view of global sustainability will have a strategic plan that integrates its growth strategies, corporate image and contribution to community. Pursuing such a course requires a major commitment by management.

We heard some descriptions of how corporate vision and image (environmental or otherwise) can become central to making the internal business case for a particular product. Examples of such cases might include recent hybrid-electric vehicles (such as Toyota Prius and Ford Escape Hybrid) as well as projects such as GM's Hummer brand, the Pontiac Solstice and the revived Ford Mustang. A program that has high strategic value for furthering the corporate vision may not be strictly bound by ROI and other financial metrics that otherwise screen program plans. Thus, the corporate vision can bolster a case for funding and push product strategy in a direction that leads rather than merely following past brand image and customer expectations.

Some respondents suggested that their companies would exceed regulatory requirements (e.g., for safety or environment) because it is the "right thing" to do. In this way, corporate vision can include a responsibility to community, reflected in a company's desire to plan its actions so as to

sustain both itself and the society of which it is a part. The role of corporate vision in shaping products also pertains to non-social factors, for example, in shaping products for premium segments where market leadership in certain vehicle attributes is a core part of the company's self-image.

HOW TRADE-OFFS ARE MADE

Budget and other resource constraints imply that it is impossible to accommodate all of the features and attributes that might be desirable for a given product. Thus, product planners are faced with trade-off decisions. Ideally, these often difficult judgments are resolved before a plan goes forward. Management is always seeking ways to fit plans within the cost constraints of the internal business case. Evaluations are made to determine whether the costs of all of the proposed vehicle features can be contained within the limit imposed by profit and investment targets. If costs exceed this limit, management must make trade-offs about which features to include and which to drop.

Product plans generally work from an extensive set of "givens"—attributes that are carried over from a prior version of the product. These attributes are crucial for being competitive against other firms' products in the target segment, required by regulation, or are otherwise essential for customer expectations and corporate image. Something has to give when new requirements arise but not all requirements can be accommodated while staying within budget. Several respondents noted that in luxury classes, there is generally more customer "willingness to pay" for new features, so new technology can often be introduced first on a luxury product. On the other hand, as once-new features become commonplace, they become a "given"—a matter of customer expectation for which there is no incremental willingness to pay. Ways must be found to include the features without adding to vehicle price. One respondent said that such situations may spur a search for lower priority features that can be dropped to save cost.

Budget discipline

The need to make tough choices often emerges when considering new features or other significant changes in product design. A feature is evaluated against its expected impact on business case metrics, with a goal of ensuring that profitability is enhanced, or at least held harmless, if the feature is included in the product for whatever reason. Making such decisions requires discipline, ensuring that if additional spending is needed in one area, it is offset by reduced spending in others.

A breakdown of discipline (failing to clearly resolve essential trade-offs as the program goes forward) can mean that a business case will not be solid and the results can be financially disastrous. Given the realities of fixed capital availability, trade-off decisions are made at multiple levels—from the design options of a particular product to broader issues of company-wide resource allocation.

One way a design option can be evaluated is to ask whether it can be priced—whether market research indicates a customer payoff (willingness to pay) for the feature. Another way to evaluate a feature is in terms of its contribution to brand equity, either for a particular product's distinctiveness or for the brand image of the company. In such cases, the payoff may be intangible. For example, a brand image that is very dependent on best-in-class performance and handling will require giving top priority to the design options (technologies, features, re-engineering) needed to achieve a Number 1 ranking on those attributes when benchmarking

against competitors. Doing so will command a certain share of resources. To remain within budget, less can be spent on other attributes (e.g., plushness of the interior, various comfort and convenience features). Thus, staying within budget while being Number 1 (best-in-class) on a given attribute forces trade-offs that entail settling for a Number 2 or 3 position when ranked along other attributes.

Dealing with regulations

Regulatory requirements force trade-offs. Regulations represent things that have to be done—for safety, emissions, and fuel economy—regardless of how they are valued by customers. Given all of the other attributes desired in a vehicle based on brand and customer expectations, competitive assessments and other market considerations, the imposition of requirements not valued by customers results in the need to make additional trade-offs. In short, product requirements that are not valued by customers force trade-offs in features that would otherwise be designed or included on the basis of customer value.

Some such requirements can be handled at a systems level while fitting within budget constraints. Such a systems-level strategy is the ideal way to address fuel economy, for example. Because it affects nearly every vehicle system, a holistic approach is needed; if this is done well, fuel economy can be handled without incurring additional costs and while staying within budget.

Feature prioritization

Although judgment is ultimately involved, automotive product planners use various formal methods to evaluate trade-offs among vehicle attributes. Such approaches can entail metrics that executives review as consensus is sought on which options are to be added or deleted from the product.

For example, a "product profile" might be defined using a set of ratings in terms of key vehicle attributes. These attributes can include characteristics such as driving and handling, performance, various measures of capability (seating, towing, etc.), safety, cost of ownership, and so on, depending on the brand and market segment. Primary attributes may be further broken down into sub-attributes that are benchmarked against competing products and otherwise evaluated based on customer inputs and marketing considerations. For example, the driving and handling attribute will entail its own set of metrics that might include throttle responsiveness, steering feel, braking, road grip and body sway—covering the specific characteristics that will go into customers' and car reviewers' evaluations of the product.

To assist in the decision process, a product's attributes and sub-attributes are typically evaluated against a defined set of competing products. Automakers closely track what the competition is doing to have a good idea of likely competing product profiles several years down the road to determine where their product's profile needs to be in order to meet or exceed its sales volume goals. Such assessments may take the form of a "gap analysis," in which a company's products and product plans are compared with those of other automakers, leading to a detailed plan for closing the gaps to have a competitive product. Pareto analysis is another approach used. Features and technologies under consideration for a given program are evaluated according to cost effectiveness and used to determine the best feature set that fits within the program's profit and investment targets.

OTHER FACTORS AND CONSIDERATIONS

Although we framed our questions in general terms (not specifically seeking responses about how environmental considerations are handled in product planning), the subject came up in a number of the interview conversations. As noted above, environmental requirements, like other societal requirements (such as safety), generally are handled as a matter of course in the product planning process. They are most often treated as things that have to be done regardless of customer value and therefore often force trade-offs. However, when a social factor is important to the brand, it will have value (even if intangible) and will be given priority. The case of Volvo and safety is an excellent example.

The fuel economy challenge

In terms of how automakers are grappling with environmental issues, it was clear that the challenge associated with fuel economy is very much on the industry's mind. In general, social factors—such as regulations regarding Corporate Average Fuel Economy (CAFE), safety and emissions—are not dealt with in a vacuum but rather are evaluated in the context of other things needed for the product. Handling social factors can be viewed in terms of a need to balance "care and feeding" of the customer. Care represents things done for customers as part of society, often taking the form of regulatory requirements. Feeding represents things that excite customers as individuals, namely, features, performance and other product attributes that customers directly value.

While some viewed CAFE as a particularly "bad system," there was some acknowledgment that the recent Federal rule providing a size-adjusted basis for light truck CAFE standards may have improved the system. A weakness of regulation is that it only motivates automakers to barely meet the requirements, which are themselves subject to lobbying and are therefore of uncertain effectiveness. Thus, attention is focused on becoming compliant by any means possible, whether or not it is effective or efficient, and there is no motivation to find ways of exceeding minimum compliance levels that might offer competitive advantage. Similar views were expressed regarding the European Union's CO₂ emissions targets for cars.

In contrast, incentive approaches to policy can drive product change in a beneficial direction. One example mentioned was Japan's Green Tax, a consumer incentive program that reduces the tax on vehicles that achieve lower-than-required tailpipe emissions and exceed the fuel economy standard for their class. This program is viewed as effective because it taps customer concerns, and therefore automaker image, about emissions and motivates the production of lower-emitting cars.

Technology adoption

Another topic discussed in the interviews was the process for new technology adoption. Regarding the extent to which it is driven from the supply side (R&D progress) or by the demand side (required for customer or other needs), neither factor clearly dominates.

New technology is commonly put into production at the platform level, that is designed for use in a group of vehicles sharing a common architecture and there are different ways of handling the up-front costs of new technology development. In some cases, the cost is borne by the first program that uses the technology. This approach can inhibit the adoption of new technologies because it effectively taxes the first users of the technology even though it eventually may be

used more widely. In other cases, new technology development costs are spread over multiple programs.

In special cases, when a new technology is deemed very important to the company as a whole and can't be hampered by attaching it to a single program budget, it is given its own development budget and not held to ROI constraints. This approach allows for the technology to be developed on its own schedule. A distinction is also made for long-term R&D, as for fuel cell technologies, for which automakers set aside a portion of company-wide resources. However, the bulk of R&D budgeting is focused on developing features and technologies that will be ready for implementation in the next program cycle (i.e., in three to four years).

Addressing change

In discussing the challenge presented by the climate problem, a respondent said that addressing it would involve a "generational effect" and that public education on global warming and energy conservation would be crucial. This remark evoked other respondents' comments on how product *strategy* is developed, in contrast to how a given product is developed.

Product development happens quickly, driven by competitive and cost factors with a typical timetable being three years or less. Automakers can be very agile in getting new product quickly to market when the need is there and once the concept is well-defined. By contrast, product strategy evolves only slowly, and requires a process of consensus building throughout the company as it takes in new but often uncertain information about the business environment it will face in the years ahead. A time frame as long as 15 years was mentioned by more than one respondent in the context of strategic direction for where the product portfolio needs to be in the future.

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Conclusions

The U.S. auto market has become increasingly competitive, price-constrained and globally linked. Moreover, the car is becoming more of a commodity, with many vehicle attributes taken for granted by consumers who are often unwilling to pay more for features that once commanded a premium. These factors can severely constrain product development budgets, forcing trade-offs throughout the planning process. Automakers must make tough choices when deciding which programs to pursue or drop company-wide as well as when selecting the vehicle features to prioritize within a program budget. While many challenges apply to all automakers, some, such as over-capacity and long product development lead times, impact some firms more than others.

This study's review of automotive product planning practice and executive-level interviews offer insights that can help policymakers and the public better understand the challenges the industry faces when redesigning its products—whether to address market needs both foreseen and unforeseen or to address societal expectations. The following is a summarization of the key points taken from this study:

- Every automotive program has a business case which is ultimately controlled by vehicle prices and sales volumes; all aspects of a plan must meet the resulting budget constraints.
- Budgeting is a cyclical process involving overlapping short- and long-term planning horizons linked to current product lifecycles and future product plans.
- Individual programs are primarily evaluated using return on investment (ROI) and similar financial performance metrics, although profitability targets vary by program and market segment.
- Every program entails elements of risk, particularly for achieved sales volumes; having risk-managed plans is critical for financial health.
- The Voice of the Customer (VOC)—customer needs and wants as gauged through market research—is a key driver for all programs but, not always the dominant driver.
- Because consumers typically express their desires only in terms of what they already know (they are "rear view" people), other factors become important in developing competitive products.
- Primarily, automakers continually watch the competition to determine where they need to be in the market and what features a product must have.
- Brand values are paramount in shaping a vehicle program, and brand identity is strongly tied to its customer base. Corporate image is secondary by comparison, but corporate vision can play a strong role-setting direction.
- The trend toward global operations is playing out in several ways as firms balance the value of spreading costs and risks against the market benefits of regional and brand autonomy.
- The ideal approach appears to be one where a firm's product portfolio co-evolves with a corporate vision that guides the product strategy, while remaining anchored in a market built around successful brands and the brand's relationships to its customers.

- A variety of approaches are involved in the adoption of new technology. It may be developed for its initial application (typically platform-wide) which must then bear the full development costs; in other cases, the costs are spread across programs; and in special cases a new technology may be given a discrete development budget.
- To better utilize resources and control costs, programs carry over a high level of components and engineering. Product changes are therefore almost always evolutionary.
- Budget constraints mean that planners must make trade-offs which occur at multiple levels, ranging from whether or not major programs are pursued or deferred, to the selection or rejection of specific features for a vehicle.
- Regulatory requirements can force trade-offs, since they must be adhered to regardless of brand requirements, customer expectations or other market considerations.
- Regarding fuel economy in particular, the requisite trade-offs must be evaluated using a systems-level approach, best done holistically. If done well, it enables fuel economy to be addressed without incurring additional costs.
- When a societal consideration has value, either for its affinity to a brand value or because of a market incentive, it will be given greater priority in program planning than if it is merely a requirement that incurs costs or forces trade-offs.

Although operations are increasingly globalized, we found little evidence that higher fuel prices or CO₂ regulations in Europe and Japan are influencing product planning in the United States. Today's auto industry is successful in pursuing a high level of product differentiation, tailoring its products to meet specific market and regulatory needs.

Finally, it is important to keep in mind that automotive product planning and marketing is characterized by intrinsic time lags. These time lags include the two to three year lead time for product development, the even longer cycle plan that allocates resources for all of a company's products, and the inherent inertia in the system due to the evolutionary nature of product change. When considering policies intended to influence automobile design, such time lags must be respected to avoid disruptive impacts on the industry. Any potential car climate policy must acknowledge and address such product planning realities and the budget-constrained nature of automotive product development. It is difficult for the automakers to do too much too fast. They are constrained by money, human resource issues and tooling costs, to name just a few. Applying this understanding holistically in the development of policy is left as a subject for future studies.

Appendix

Questionnaire used for automaker interviews

INQUIRY SENT TO SOLICIT PARTICIPATION

The following inquiry was sent to automakers to solicit their participation in the interviews and describing the purpose of the study and the protocol being followed:

The Center for Automotive Research (CAR) has begun a research study in partnership with Environmental Defense. This study is focused on helping understand the budget process prior to vehicle development. Specifically, we would like to explore the decision factors implicit in forming a capital budget for a major program, such as a new vehicle or drivetrain. Additionally, we would like to understand the role that external factors (e.g., regulations, consumer preferences, market forces) play in the decision process and how these are integrated with the internal business case.

Through this research, we hope to gain an understanding of the entire range of decision factors (e.g., financial, marketing, technological, and cost) that impact product development. With CAR and Environmental Defense partnering on this project, there is an opportunity to educate a broad constituency on some of the barriers, opportunities and considerations the automotive industry faces in this decision process as it might be impacted by public policy.

We would like to conduct an interview with you and any other of your colleagues you deem appropriate. Specifically, we would like to interview executives from the areas of finance, product planning, and corporate strategy. This interview should take about one hour. Prior to the actual interview, we will e-mail you a short list of questions.

This research is intended to explore commonalities in the product development budgeting process generic to the automotive industry. The identity and specifics of individual interviews will not be cited in the final research report. This research study is not intended to be a surrogate policy discussion; we will only be making general inquiries, as opposed to seeking your views on public policy. Details of the interviews will remain confidential and a report will be released on general findings only.

QUESTIONNAIRE SENT IN ADVANCE OF INTERVIEWS

This study seeks to understand the budget process prior to vehicle development. Specifically, we would like to explore the decision factors implicit in forming a capital budget for a major program, such as a new vehicle or drivetrain. Additionally, we would like to understand the role that external factors (e.g., regulations, consumer preferences, market forces) play in the decision process and how these are integrated into the internal business case. Through this research, we hope to gain an understanding of the entire range of decision factors (e.g., financial, marketing, technological, and cost) that impact product development.

(If you would prefer to discuss a particular program when answering the following questions, that would be fine.)

1. What are the steps in the formation and approval of a major capital budget?
2. What role (and to what extent) do the following departments have in the product review/development process (you need address only those you are comfortable with):
 - a. Financial
 - b. Environmental
 - c. Marketing
 - d. Corporate strategy
 - e. Legal
 - f. Vehicle Engineering
 - g. Product Planning
 - h. Manufacturing
3. What information is requested from you? (follow-up to any of a-h above)
 - a. Please name some examples
4. We understand there may be a matrix of programs and program needs such as assembly plants, or drivetrains which may cut across programs. How are these factored into the budget process?
5. Is ROI a factor in the budget allocation process?
 - a. If NO: what metric(s) are important?
 - b. If YES: How is ROI factored into the decision?
[at what level?]

6. What are the trade-offs involved in evaluating major design options, and how are they handled? For example, how would accommodating a significant new interior feature (e.g., fold-in-floor third-row seat) affect other aspects of vehicle design that might impact packaging requirements and mass targets?
 - a. How do requirements for new features interact with the budget for the rest of the vehicle?
 - b. In this context, how does your company evaluate investment in new technology? At what level do technology tradeoffs occur? For instance, are tradeoff decisions made at the component level (4-speed (old/standard) vs. 5-speed (new)), or is it a tradeoff between systems (new trans. vs. ABS)?
 - c. [optional] How about the role of R & D -- is it active (i.e., significantly driving the product development budget), or passive (R & D driven largely by product development needs)?
7. How do corporate vision and image influence the type of new product development?
 - a. How is a product's potential future value estimated?
 - b. How are corporate image and social benefits valued?
8. How are consumers represented in the capital budget formation decision process?
 - a. How are customer evaluations of new features and their desires represented in the decision process?
 - b. How are tradeoffs handled for consumer preferences vs. other product requirements?
9. Are there any other factors that drive the decision process we haven't asked you about?
 - a. Do you consider information from third parties? If so, who are they, how is it introduced, etc.?
 - b. How are these other factors introduced into the process?
10. Who or what department (in your opinion) makes the final go-ahead decision?
11. Is there anything else you'd like to add?

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