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PLATFORM PRODUCT DEVELOPMENT

David Robertson

Baan Company
242 Park Lane
Concord, MA 01742
droberts@baan.com

Karl Ulrich

The Wharton School
1317 Steinberg Hall - Dietrich Hall
The University of Pennsylvania
Philadelphia, PA 19104
ulrich@wharton.upenn.edu

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Abstract

The standard for minimum acceptable product development performance is high and rising in many industries. It is no longer possible to dominate large markets by developing and mass producing one product at a time. Increasingly, good product development means developing a family, or *platform* of products, and producing them in a flexible process tailored to the needs of individual customers. We define a platform as the collection of assets that are shared by a set of products. These assets may include components, knowledge, and production processes. Effective platform planning balances the market value of product differentiation against the economies achieved through commonality. Platform planning is difficult: firms may achieve high commonality but fail to differentiate the products; firms may differentiate the products, but create products with excessive costs; or firms may create viable platform plans that are subsequently never realized. This article presents three tools for supporting platform planning: (1) the product plan, (2) the differentiation plan, and (3) the commonality plan. These tools are intended to facilitate the planning process by providing a common language for the marketing, design, and manufacturing functions of the firm.

I. INTRODUCTION

In 1987, Fuji introduced the QuickSnap 35mm single-use camera in the U.S. market. Kodak, which did not have a product of its own, was caught with its guard down in a market that was destined to grow by over 50% per year for the next 8 years, from 3 million units in 1988 to 43 million in 1994. By the time Kodak introduced its first model, almost a year later, Fuji had already developed a second model, the QuickSnap Flash. Yet, Kodak would take market share back from Fuji- by 1994, Kodak had captured over 70% of the U.S. market. The success of this response may be attributed in part to Kodak's strategy of developing many distinctively different models from a common *platform*. Between April of 1989 and July of 1990, Kodak redesigned its base model and introduced three additional models, all sharing common components and common production process steps (Clark and Wheelwright, 1996). Because Kodak designed its four products to share components and process steps, it was able to develop its products much faster and more cheaply. These different models appealed to different customer segments and gave Kodak twice as many products as Fuji, allowing it to capture precious retail space and garner substantial market share.

This platform approach to product development is a key success factor in many markets. The platform approach allows a company to quickly and efficiently develop a set of differentiated products. By sharing components and production processes across a platform of products, companies can develop products faster and more cheaply, increase the flexibility and responsiveness of their manufacturing processes, and take market share away from competitors that develop only one product at a time. For example, in the auto industry, Nobeoka and Cusumano (1994, 1995) showed that a platform approach was associated with market share gains of 5.1 percent per year, while firms pursuing a single model approach lost 2.2 percent per year.

The platform approach is also one key approach to successful *mass customization*— the ability to produce products in high volumes that are tailored to meet the needs of individual customers (Pine, 1993; Pine, Boynton, and Victor, 1993; Feitzinger and Lee, 1997). The platform approach allows highly differentiated products to be delivered to the market without consuming excessive resources.

In this article we define what we mean by a *platform*, articulate three key ideas underlying the platform approach to product development, and present a method for planning a new platform of products. We illustrate the method using as an example the design of an automotive instrument panel or "dashboard." The final section contains recommendations for managing the platform planning process.

What is a platform?

A platform is the collection of assets that are shared by a set of products. These assets can be divided into four categories:

- Components: the part designs of a product, the fixtures and tools needed to make them, the circuit designs, and the programs burned into programmable chips or stored on disks.

- Processes: the equipment used to make components or to assemble components into products, and the design of the associated production process and supply chain.

- Knowledge: design know-how, technology applications and limitations, production techniques, mathematical models, and testing methods. (See [Kim and Kogut, 1996] for an interesting discussion of the strategic role of knowledge platforms.)

- People and relationships: teams, relationships among team members, relationships between the team and the larger organization, and relations with a network of suppliers.

Taken together, these shared assets constitute the product platform. Generally platform products share a significant if not majority portion of development and production assets. In contrast, parts standardization efforts across a set of products may lead to the sharing of a modest set of components (Fisher, Ramdas, and Ulrich, 1996), but such a collection of shared components is generally not considered a product platform.

Successful platform planning offers the following potential benefits:

- Greater ability to tailor products to the needs of different market segments or customers. The incremental cost of addressing the specific needs of a market segment or of an individual customer may be reduced through the platform approach, enabling market needs to be more closely met.

- Reduced development cost and time. Parts and assembly processes developed for one model do not have to be developed and tested for the others. This benefit applies to new products developed from the platform as well as to subsequent updates.

- Reduced manufacturing cost. Economies of scale may be achieved when producing larger volumes of common parts.

- Reduced production investment. Machinery, equipment, and tooling, and the engineering time to create them, can be shared across higher production volumes.

- Reduced systemic complexity. Cutting the number of parts and processes can cut costs in materials management, logistics, distribution, inventory management, sales and service, and purchasing. (See [Ulrich et al. 1993] for an example of the magnitude of these costs.)

- Lower risk. The lower investment required for each different product developed from a platform results in decreased risk for each new product.

- Improved service. Sharing components across products allows companies to stock fewer parts in their production and service parts inventories. This translates into better service levels and/or lower service costs.

The challenge of platform planning

The central challenge of developing platform products is simultaneously meeting the needs of diverse market segments while conserving development and production resources. Developing platform products involves two sets of difficult tasks. First, a product planning and marketing activity addresses the problem of which market segments to enter, what the customers in each segment want, and what product attributes will appeal to those customers. Second, a system-level design activity addresses the problem of what product architecture should be used to simultaneously deliver the different products while also sharing many parts and production steps across the products. These two sets of tasks are challenging both because the tasks themselves are inherently complex and because their completion requires coordination among at least the marketing, design, and manufacturing functions of the firm. These functional groups may not be accustomed to working with each other, and can find such cooperation difficult due to differences in time frames, jargon, goals, and basic beliefs.

Platform planning is also difficult because of the many ways it can fail. We have observed two common dysfunctions in organizations attempting to create product platforms. First, organizational forces frequently hinder the ability to balance commonality and distinctiveness. One perspective can dominate the debate. Design or manufacturing engineers often prepare hard cost data showing how expensive it would be to create distinctive products, leading to products that are too similar from the customer's perspective. This dysfunction was illustrated graphically (if perhaps inaccurately) by a Fortune magazine cover photograph in 1983 showing "look-alike" Chevrolet, Oldsmobile, Buick, and Pontiac automobiles (Fortune, 1983). Alternatively, the marketing function may mount a convincing argument that only completely different products will appeal to the different market segments, and that commonality is penny wise and pound foolish.

Second, even when platform planning is attempted with a balanced team committed to working together, the process can get bogged down in details, resulting in either the organization giving up, or in products by committee with no character and no integrity (Clark and Fujimoto, 1990).

Platform planning in the auto industry

While we believe that the platform planning method we describe below is broadly applicable across many types of products, we illustrate the method using an example from the auto industry. Throughout the paper, we use the example of the design of an instrument panel (i.e., the "dashboard") to illustrate the key ideas. An instrument panel is a critical part of new car's design and plays several important functional roles. It provides structural support for heating, ventilation, and air conditioning (HVAC) ducts, components, switches, gauges, audio components, storage areas (such as the glove box), airbags, and a great deal of tubing and wiring. The instrument panel also must help absorb the shock of a front or side collision, and help prevent the car body from twisting during normal driving (which improves handling). The instrument panel has a strong role in the aesthetics of a new car: the look, feel, and even smell of an instrument panel can effect the appeal of the car. The look and feel of the instrument panel can also do a great deal to distinguish one car from another.

The instrument panel example is drawn from our experience with a major automobile manufacturer, however many of the details have been stylized for clarity of exposition.

II. BALANCING COMMONALITY AND DISTINCTIVENESS

At a fundamental level, product variety is valuable in the marketplace, yet variety is generally also costly to deliver (Lancaster, 1990). The platform approach is one way to skirt this basic tradeoff through the sharing of substantial assets across products. Platform planning balances the need for *distinctiveness* with the need for *commonality*. Three key ideas underlie the platform planning process.

1. Customers care about distinctiveness; costs are driven by commonality.

Customers care whether the firm offers a product that closely meets their needs; they do not care directly about the level of parts commonality among a collection of products. Closely meeting the needs of different market segments requires distinctive products. Conversely, the costliness of the internal operations of a firm is substantially driven by the level of parts commonality among a collection of products, and is not directly related to how distinctive those products are in the marketplace.

We use the term *differentiating attribute* or *DA* to denote an attribute that customers view as important in a product. Products are distinctive if the values of the DAs that characterize the product are distinctive. For example, interior noise level is a DA that contributes to the distinctiveness of a vehicle. Customers generally expect audible cues from the engine in sporty vehicles, while they expect near silence in luxury vehicles.

We use the term *chunk* to refer to the major physical elements of a product, its key components and subassemblies. (This usage is increasingly common in industrial practice and is consistent with that in [Ulrich and Eppinger, 1995]). A set of products exhibits high levels of commonality if many of its chunks are shared. For example, at many car companies the engine compartment is treated as a chunk which may potentially be shared across several vehicles.

Note that while DAs and chunks are related (interior noise is influenced by insulation) they are two very different ways of describing a product. DAs reflect the level of distinctiveness as perceived by the external customer, while chunks reflect the level of commonality as experienced by the internal operations of the firm.

2. Given a particular product architecture, there is a trade-off between distinctiveness and commonality.

Consider a pair of products. If these products shared 100 percent of their parts they would be completely common, but would have no distinctiveness. If these products shared no parts, they would have no commonality, but could have an arbitrarily high level of distinctiveness. As the number of common parts is increased from zero percent to 100 percent, the distinctiveness of the two products will decline to zero. For example, the instrument panels for two different automobile models could be arbitrarily distinctive if they shared no parts. A firm might share several parts of the instrument panel, say mounting screws and small brackets with very little loss of distinctiveness. As more and more parts are shared, say gauges, environmental controls, and audio system, the two instrument panels lose more and more distinctiveness. Of course if every part were common, the two panels would be indistinguishable. This trade-off between distinctiveness and commonality can be represented schematically by Exhibit 1. Two products that are very distinctive, yet share few parts correspond to Scenario A, while two products that are less distinctive, yet share many parts correspond to Scenario B. For a given product architecture, product designers face a trade-off between distinctiveness and commonality. Conceptually, this trade-off can be thought of as constraining the distinctiveness and commonality of a pair of products to fall along the curve labeled Architecture 1 in Exhibit 1.

3. Product architecture dictates the nature of the trade-off between distinctiveness and commonality.

While there is a trade-off between distinctiveness and commonality, the nature of the trade-off can be influenced by changing the product architecture. Architecture 2 in Exhibit 1 results in a trade-off in which slight efforts at commonization will result in drastic reductions in distinctiveness (Scenario C). It is also possible, as illustrated by Architecture 2, that even with no parts in common, two products may not be viewed as completely distinct. In the ideal case, the product architecture presents the firm with a trade-off in which a relatively high level of commonality can be achieved without much sacrifice in distinctiveness, and distinctiveness declines slowly as commonality is increased. This situation is represented by Architecture 3 and Scenario D.

For example, consider the two different instrument panel architectures shown schematically in Exhibit 2. One architecture consists of a tubular metal structure over which a contoured plastic skin is assembled; the other consists of a curved plastic panel with metal reinforcements integrally molded as part of the structure. In the first case, the underlying metal structure could be common across Instrument Panels A and B, while the plastic skin could be different. This commonization would result in relatively little loss of distinctiveness. In the second case, an attempt at commonizing one of the integral metal-plastic panels will leave the two vehicles with similar exterior appearances for the dashboard, a large decrease in distinctiveness. Architectures like the first example are called *modular*, while architectures like the second are called *integral*. (Ulrich, 1995).

Although not the focus of this article, another type of architecture that may be important to consider in platform planning is the production architecture. The production architecture defines the range of products that can be produced. For example, if the different models of a new platform of cars are to be assembled and painted on the same production line, then the structure of the production line will determine the range of possible heights and widths, the allowable sizes of the different systems in the car (e.g., how big or small the dashboard, seats, and other systems can be), and the assembly sequence of the car. This production architecture is not a fixed constraint, but the cost of revising it may be significant.

III. THE PLATFORM PLANNING PROCESS

Platform planning is a cross-functional activity involving at least the product planning, marketing, design, and manufacturing functions of the firm. In most cases platform planning is best carried out by a core team made up of representatives from each of these functions. For large development projects, each of these representatives is in turn supported by an experienced staff.

We advocate a loosely structured process for platform planning focused around three information management tools:

- The product plan.
- The differentiation plan.
- The commonization plan.

These three plans are shown schematically in Exhibit 3. The three plans are top-level summaries of deeper analyses by members of the extended platform planning team, but they explicitly display the degree to which coherence has been achieved between product strategy, market positioning, and product design. The goal of the platform planning process is to achieve coherence across these three plans.

The process of platform planning is likely to be iterative. The team begins by constructing the three plans and then works iteratively to achieve coherence among them. We devote a section to each of the three planning tools and to the process of iterative refinement.

Establish a product plan

The product plan for the collection of products encompassed by the platform specifies what the distinct market offerings will be over time, and is usually taken from the company's overall product plan. Exhibit 4 contains a product plan for a new platform showing a sporty coupe, a family sedan, and a family station wagon. The two axes of the chart correspond to the segments of the marketplace and to time. The timing and segment of each planned product are indicated by location on the chart. The genealogy of the products is indicated by the links on the chart.

The product plan is supported by a top-level description of each product. This description contains the customer profile (key needs, psychographics, and demographics), and a basic business plan (expected sales volumes and selling price range). The product plan indicates major models, but does not show every variant and option of the product.

The product plan is linked to several other key issues and pieces of information, including:

- Availability of development resources.
- Life cycles of current products.
- Expected life cycles of competitive offerings.
- Timing of major production system changes.
- Availability of key product technologies.

The product plan is reflective of the firm's product strategy. Some firms will choose to simultaneously issue several products, while others will choose to launch products in succession.

Specify the differentiating attributes of each product

DAs are the dimensions along which the differentiation of the product is meaningful to customers. The differentiation plan indicates what the target values of the DAs are for each of the products in the product plan. Exhibit 5 is an example of a differentiation plan. The rows of the matrix correspond to the critical DAs. The columns correspond to each product in the product plan, with the final column containing an approximate assessment of the relative importance of each DA. A common pitfall in platform planning is to become bogged down in detail. We generally find that the best level of abstraction for platform planning results in no more than 10 to 20 DAs. In the beginning of the process, these DAs will focus on the overall properties of the product. As the planning process evolves, the work will shift to the system level, and the DAs will become more and more detailed.

The DAs that differentiate one car from another and that affect the instrument panel are:

- Curvature of the window glass. A sporty model with more highly curved glass requires wider doors (as the glass will take up more room inside the door when the window is rolled down).

- Styling of the instrument panel. The look and feel of the instrument panel are important differentiating characteristics. Sports car drivers will not accept any instrument panel that looks like it belongs in a family sedan.

- Relationship between the instrument panel and the driver. Drivers of sports cars like to sit lower to the road, which increases the sensation of speed. Sports car drivers also like to sit further away from the steering wheel, with their arms straighter, and with the seat back more reclined.

- Front end styling. A shorter front end on the coupe changes the stance of the vehicle, making the car seem more ready to "attack" the road. A shorter front end, however, will change the specifications for the instrument panel, as more of a front impact would have to be absorbed by the instrument panel.

- Colors and textures. Cars can be differentiated by the materials used to cover the surfaces the owner sees and touches. This company has chosen to use a mixture of leather and textiles on the instrument panel to evoke the feel of an English roadster.

- Suspension stiffness. A stiffer suspension can improve vehicle handling, but may also cause a higher level of squeaks and rattles in the instrument panel.

- Interior noise. Sports car drivers do not want wind or road noise, but like hearing the sound of the engine.

On the first pass, the differentiation plan represents the ideal case of how each product would be differentiated for maximum appeal to customers in the target segment. On subsequent iterations, this ideal case will be adjusted to respond to the need for commonality.

The values of the DAs for the competitive products serve as a useful benchmark for the differentiation activity, and can be entered in additional columns of the matrix. However, care must be taken to avoid focusing on existing competitive products at the expense of anticipating where the market is going in the future.

Objective metrics are particularly useful for representing the target values of the DAs when such metrics are widely accepted as meaningful in the marketplace (e.g., miles per gallon for automobiles). When such metrics are not available, direct comparisons may be useful (e.g. like Lexus ES300).

Quantify the commonality across products

The commonality plan describes the extent to which the products in the product plan share physical elements. The plan is an explicit accounting of the costs associated with developing and producing each product in the product plan.

Exhibit 6 is an example of a commonality plan. The rows of the matrix are the critical chunks in the product. To manage complexity, the team should limit the number of chunks to roughly the number of DAs, and to no more than 10 or 20. The columns are the products in the product plan, in order of the temporal sequence of their development. We use four metrics in the commonality plan:

- Incremental number of unique parts.

- Incremental development cost.

- Incremental tooling cost.

- Unit manufacturing cost.

For example, consider the first row of the commonality plan shown in Exhibit 6 and corresponding to the HVAC system. The Sporty Coupe will require 45 unique parts, $4 million in development cost, $9 million in tooling cost and will have a unit manufacturing cost of $202. To then produce the HVAC system for the sedan and wagon will require an additional 35 unique parts, $3.8 million in development cost, and $7.5 million in tooling cost. The unit manufacturing cost of the HVAC system for the sedan and wagon will be $200.

For different product contexts, the relative importance of these metrics may vary. For example, in some settings, tooling cost may not be significant and may be dropped from the plan. In other settings, other metrics may be important. For example, development time may be the most important metric for a product due to the potential loss of market share from being late to market. In this case, a time metric could be added to the commonality plan.

The values of these metrics are estimated, because actual values can not be determined until the products have been designed and produced. Note that, with the exception of unit manufacturing cost, the values in the commonality plan are the incremental values assuming the preceding products will be developed and produced. If the sequence of products in the product plan changes, the incremental values may also change. The commonality plan in the example considers the incremental parts and costs associated with producing the sedan and station wagon after the sporty coupe.

Underlying the commonality plan are the basic engineering design concepts for the product. In most cases, engineering layouts of each product would be created to support the estimation process. Once the values of the metrics are estimated, the total values for each product and for each chunk can be summed.

Iteratively refine the plans to achieve coherence

Given the objective of maximizing market presence, the firm would most likely wish to enter many segments with many products, and replace them all regularly. Given the objective of capturing a large fraction of each segment, the firm would attempt to ideally position the product with respect to the values of the DAs. Given the objective of minimizing development cost, tooling investment, and complexity, a substantial fraction of all the products in the product plan would be identical. Typically, these three objectives are in conflict. For most product contexts an unconstrained product plan and an unconstrained differentiation plan will lead to high costs. For this reason, iterative problem solving is required to balance the need for differentiation with the need for commonization. After completing the commonization plan, the team may return to the differentiation plan and modify the target level of differentiation on DAs that are particularly critical drivers of product costs. After reviewing the costs of effectively differentiating a product for a particular segment, the team may decide that it is simply infeasible to consider that product part of the platform.

Conceptually, this iterative activity involves both moving along the distinctiveness-commonality curve and exploring alternative product architectures with different associated trade-off characteristics (Exhibit 1).

We offer several guidelines for achieving coherence across the three plans:

1. Focus on the critical few DAs and chunks.

The relationship between the DAs and the chunks can be represented by the matrix in Exhibit 7. The rows of the matrix are the DAs and the columns of the matrix are the chunks. A cell of the matrix is filled when the DA and the chunk associated with that cell are interrelated (i.e., when variation in the DA is likely to require variation in the chunk). We denote a strong interdependency with a solid circle and a weaker interdependency with an outlined circle. Because the exact relationships between chunks and DAs depends on the final product architecture, the matrix should be viewed as approximate and representative of the team's best estimates.

The matrix is most useful when the DAs are arranged in order of decreasing value to the customer of variation, and when the chunks are arranged in order of the decreasing costliness of variation. When organized this way, the DAs and chunks in the upper left portion of the matrix whose corresponding cells are filled have special significance. These are the important DAs and costly chunks that are interrelated. These elements are the critical few on which platform planning is focused.

Note that chunks that are not related to important DAs should be rigorously standardized and incorporated into the platform. Variation in these chunks does not offer value in the marketplace. Also note that valuable DAs that are not related to costly chunks can be varied arbitrarily without incurring high cost, and so should be varied directly in accordance with market demands.

2. Search for architectural solutions to apparent conflicts

In this example, the initial architecture of the instrument panel involved reusing only a few HVAC components, gauges, switches, wiring, brackets, fasteners, and other components. The initial commonality plan (Exhibit 6) shows that the development and tooling costs for the sedan/wagon would be $5.2 million less than for the couple, reflecting some savings from commonality in the initial design approach. However, the engineering team set out to develop an alternative architecture that would allow greater re-use of components

The first area the team examined was the most expensive: the HVAC system. Team members realized that, by designing the duct system using a modular architecture, they could re-use many HVAC components. They designed a system where the ends of the ducts varied across models, while the main ducts and the mixing box that connects them could be re-used (Exhibit 8). They also realized that with some careful packaging they could re-use the support structure for the entire instrument panel. This resulted in $10.4 million of additional savings in development and tooling cost compared to the initial plan (Exhibit 9).

The second area they examined was the cross-car beam. They found that, even though the coupe's instrument panel was narrower than the others on the platform, they could standardize the attachment points of the dashboard cover and structure and re-use most of the cross-car beam components. The only change that was required was a main beam that was 6 cm shorter. This resulted in another $3.8 million of development and tooling savings (Exhibit 9).

Finally, the team examined the electrical equipment and steering system. Team members found that while the airbag itself had to be tuned differently for the different models, the housing, sensors, and control module could be re-used. The expensive combination switch (which controls the turn signal, wiper washer, and headlight switches) could be re-used if the dashboard cover was styled correctly and if different covers were used for the switch arms. Between the electrical equipment and steering system, these actions saved an additional $4.7 million over the initial plan.

In addition to savings in fixed costs, the variable costs of producing components also falls in this example because the volume of the components increases. Suppliers offered an average 5% price discount in return for standardizing components. This resulted in an annual savings of $9 million.

The team could have achieved further savings by using a common dashboard cover. However, the dashboard cover is absolutely critical in differentiating the two products. Therefore, the team chose to sacrifice commonality, even at substantial cost, because of the market value of the resulting distinctiveness.

3. Attempt to express costs and benefits in terms of profits

To keep the problem-solving discussions that occur during platform planning productive, they should be anchored in a common language. We suggest that the best way to let all groups communicate is to focus the discussion on the impact of choices on platform profitability.

The group iteratively refining the differentiation plan must focus on the impacts of decisions on market share, and link share points to profitability. The group refining the product architecture should similarly focus on product costs. Only when both groups are working from the same profitability model can they begin discussing the bottom-line tradeoffs between commonality and distinctiveness.

In an ideal world, we would want to explicitly optimize the platform to achieve maximum profits. While some current research efforts are directed at this objective (Krishnan et. al, 1996), explicit profit maximization is hard for at least three reasons. First, the data are scarce, especially related to the value of a particular choice of a DA. Second, decomposing the value of a product into the value of individual DAs is difficult. Third, much of the problem solving activity in platform planning involves creative design problem solving around the choice of product architecture, for which there are no structured optimization techniques. For this reason, our underlying assumptions are that a correct answer is unlikely, that providing a clear way of displaying information will help, and that the team should work for a solution that is good enough. The key to making the process a success is to avoid "analysis paralysis," but to get data that supports quick, creative problem solving iterations.

4. Become as sophisticated as possible in describing DAs

The ability to describe DAs well is vital to platform planning. Understanding how customers view products, and what distinguishes one product from the next is a difficult task. By describing DAs clearly and in a detailed manner, the linkage to the chunks of the vehicle will be easier to understand. Developing an understanding of DA s that are holistic (i.e., that arise from the entire product as a system) is especially critical (Ulrich and Ellison, 1997).

One good example of careful DA definition comes from Lotus Engineering (Lees, 1992). To describe the handling characteristics of their cars, Lotus uses very sophisticated terms for the characteristics of its vehicles. These terms, which are vividly descriptive of the feel of the car in many different situations, help Lotus better connect a car's handling characteristics to the components that determine them. For example, three of Lotus' attributes are:

- Umbrella is the feel that a car is descending after coming over the crest of a hill. A car has motions that make a driver feel that it is flying off the road and motions that bring it closer to the road, and a car with good umbrella will have twice as many motions closer to the road than motions off the road.
- Nibbling is the series of quick back-and-forth movements that happen when a car goes over a series of bumps.
- Standing up is the feeling that the rear end of the vehicle is rising. The back end of a car that stands up feels like it rises more than it falls as it goes over bumps and hill.

These DAs allow the different groups at Lotus to better work together to understand what has to be differentiated and how. By describing very carefully how these should be different, the specifications for the chunks of a car can be more exactly determined.

IV. MANAGING PLATFORM PLANNING

Top management should play a strong role in the platform planning process for three reasons: (1) platform decisions are among the most important made by a company, (2) platform decisions may cut across several product lines or divisional boundaries, and (3) platform decisions frequently require the resolution of cross-functional conflict.

Platform planning will determine the products that will be introduced by a company into the market over the next 5-10 years or longer, the types and levels of capital investment, and the research and development agendas for both the company and its key suppliers. Because of the impact of platform decisions, they warrant significant top management involvement.

Top management's participation is needed because making good platform decisions requires making complex tradeoffs across different areas of the business. For example, making an instrument panel slightly less stylish could hurt the appeal to certain target segments, yet improve commonality and manufacturability. Or a product plan that requires spinning five products off a common platform may turn out to not be realistic, and have to be revised.

Different functions within the firm have different perspectives during product development. Some functions, such as sales, market research, marketing, and styling, concentrate on those characteristics of the product that the customer experiences while using the product. Other functions, such as engineering, production, and after-sales service, may be more focused on the cost of the product. When designing a new platform, the functions of the firm that focus on the customer features of the product often are in conflict with groups that care about the parts and production processes of the product. Top managers should recognize that the organization may be in fundamental disagreement about the goals of the platform and that a top-management perspective may be required to achieve the best overall solutions.

The following guidelines are intended to facilitate the initial organization of a platform planning project:

- <u>Put someone in charge of each plan</u> (the product plan, the differentiation plan, and the commonality plan), and someone else in charge of driving the whole process

- <u>Make sure all key functions are involved</u>: engineering, market research, manufacturing engineering, industrial design, etc.

- <u>Set up two support teams</u>. One team estimates the value of differentiation or the cost of a lack of differentiation. The other team estimates the costs associated with a given level of commonality.

- <u>Spend time building a high-performing team</u>. The planning process is a difficult one, involving many different functions that are not used to working together. Time spent in the early phases clarifying objectives, building consensus, and creating a true team can pay off handsomely in the later phases of the process.

- <u>Set targets for the total cost of the platform</u>, based on past performance, or on benchmarked results. These cost targets will help prevent the activity from resulting in too little commonality

Once the project is organized, several managerial guidelines can be used to facilitate the process:

- Help all understand that, while there is a tradeoff between commonality and variety, it is not a zero sum game. It may take all functions quite a while to learn that choosing the right architecture can do much to improve commonality and distinctiveness. Working together can help improve the platform products from everyone's perspective.

- Drive for quick, approximate results, not for slow, perfect answers. Challenge the organization to quickly experiment with different architectures, evaluating them for their ability to achieve commonality and distinctiveness. The secret to platform planning is not deep detailed analysis, but fast, creative problem solving.

- Push for facts, not someone's "gut feel" of the answer. Management should ask for and get the best possible data on customer needs, size of segments, and cost of differentiation before making decisions. This is not to suggest that analyses should be detailed, bulletproof research papers. Rather the analyses, however approximate, should be based on the best facts available, and not on personal hunches.

- Don't insist on total agreement and perfect resolution of all issues, but rather ask for design solutions that everyone believes are good enough on all dimensions, and very good relative to the few critical competitive dimensions.

- Start as high in the structure as possible, and iteratively refine the plan in greater and greater detail. For example, in the development of a new car, the first step might be to examine the production process to maximize its flexibility. Then, planning would focus on the complete vehicle, followed by systems, subsystems, then individual parts. The planning process we describe would continue at some level through the entire design process.

- Make the process a living process. The way in which platform planning is implemented will (and should) be different in every company. One key to successful platform planning is a continuing evaluation and improvement of the process. A static, regulated implementation of the planning process is doomed for failure.

- Evolve the planning process into the next phase. As planning nears completion, more and more members of the team that will execute the next phase of the project should be involved, to make sure they understand and agree with the major decisions that have been made.

- Use the results to drive the improvement agenda for the company. What should research work on? Where does production need to be more flexible? What other customer segments are out there? What dimensions of the product do the customers really care about? How can the product technology be made more robust so that it can be used in many platforms?

V. SUMMARY

The standard for minimum acceptable product development performance is high and rising fast in many industries. It is no longer possible to dominate large markets by developing one product at a time. Increasingly, good product development means good platform development.

To do platform development well, a company must carefully align its product plan, its differentiation plan, and its commonality plan through an iterative planning process. No longer can the product planning group throw its plan over the wall to other groups; the planning must be a cooperative process involving all groups and guided by top management. Just as good product engineering involves up-front consideration of manufacturing issues, good platform planning requires up-front consideration of design and manufacturing issues.

Much academic and industrial attention has been concentrated on product strategy and on product development project execution, but very little emphasis has been placed on coordinating the development of the set of products that realize a product plan. Platform planning forms this missing link. Yet platform planning is difficult: teams may achieve high commonality but fail to differentiate the products; teams may differentiate the products, but create products with excessive costs; or teams may create viable platform plans that are subsequently never realized.

The planning tools in this article are intended to be a common language that the marketing, design, and manufacturing functions of the firm can all understand. The platform planning process we present is intended to apply these tools in a way that no critical elements of the process are forgotten and that coherence among the plans is achieved.

REFERENCES

"Will Success Spoil General Motors," *Fortune*, August 22, 1983, (cover).

Clark, K. B. and S. Wheelwright, *Leading Product Development*, The Free Press, 1996.

Clark, K. B. and T. Fujimoto, "The Power of Product Integrity," *Harvard Business Review*, Vol. 68, No. 6, 1990.

Feitzinger, Edward and Hau L. Lee, "Mass Customization at Hewlett-Packard: The Power of Postponement," *Harvard Business Review*, January-February 1997.

Fisher, M.L., K. Ramdas, and K. Ulrich, "Component Sharing: A Study of Automotive Brakes," Working Paper, The Wharton School, Department of Operations and Information Management, 1996.

Kim, Jong-Jae and Bruce Kogut, "Technological Platforms and Diversification," *Organization Science,* Vol. 7, No. 3, May-June 1996.

Krishnan, V. et. al, "A Model-Based Approach for Planning and Developing a Family of Technology-Based Products," Working Paper, University of Texas, Austin, 1996.

Lancaster, K., "The Economics of Product Variety," *Marketing Science*, Vol. 9, No. 3, p. 189-206, 1990.

Lees, Howard, "Word Perfect: How do you accurately describe what a car feels like to drive?" *Car Design & Technology*, August 1992.

Nobeoka, K. and M. A. Cusumano, "Multi-Project Strategy and Market Share Growth: The Benefits of Rapid Design Transfer in New Product Development," International Center for Research on the Management of Technology Working Paper #105-94, 1994.

Nobeoka, K. and M. A. Cusumano, "Multiproject strategy, design transfer, and project performance: A survey of automobile development projects in the US and Japan," *IEEE Transactions on Engineering Management*, Vol. 42, No. 4, p. 397-409, 1995.

Pine, B. Joseph II, *Mass Customization: The New Frontier in Business Competition*, Harvard Business School Press, Boston, 1993.

Pine, B. Joseph II, Bart Victor, and Andrew C. Boynton, "Making Mass Customization Work," *Harvard Business Review*, Vol. 71, No. 5, p. 108-111, Sept/Oct 1993.

Ulrich, K. and D. Ellison, "Customer Requirements and the Design-Select Decision," Working Paper, The Wharton School, Department of Operations and Information Management, 1997.

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

Ulrich, K., “The Role of Product Architecture in the Manufacturing Firm,” *Research Policy*, Vol. 24, p. 419-440, 1995.

Ulrich, K., “Including the Value of Time in Design for Manufacturing Decision Making,” *Management Science*, Vol. 39, No. 4, p. 429-447, April 1993.

Exhibit 1: The trade-off between distinctiveness and commonality between two products for a given product architecture.

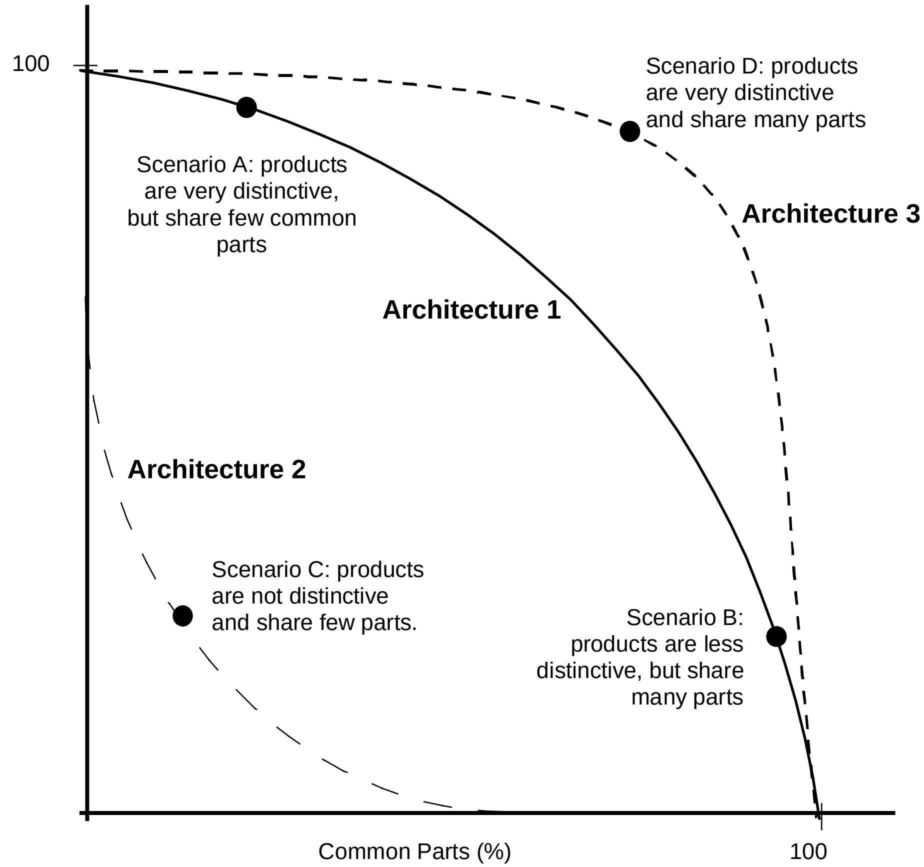
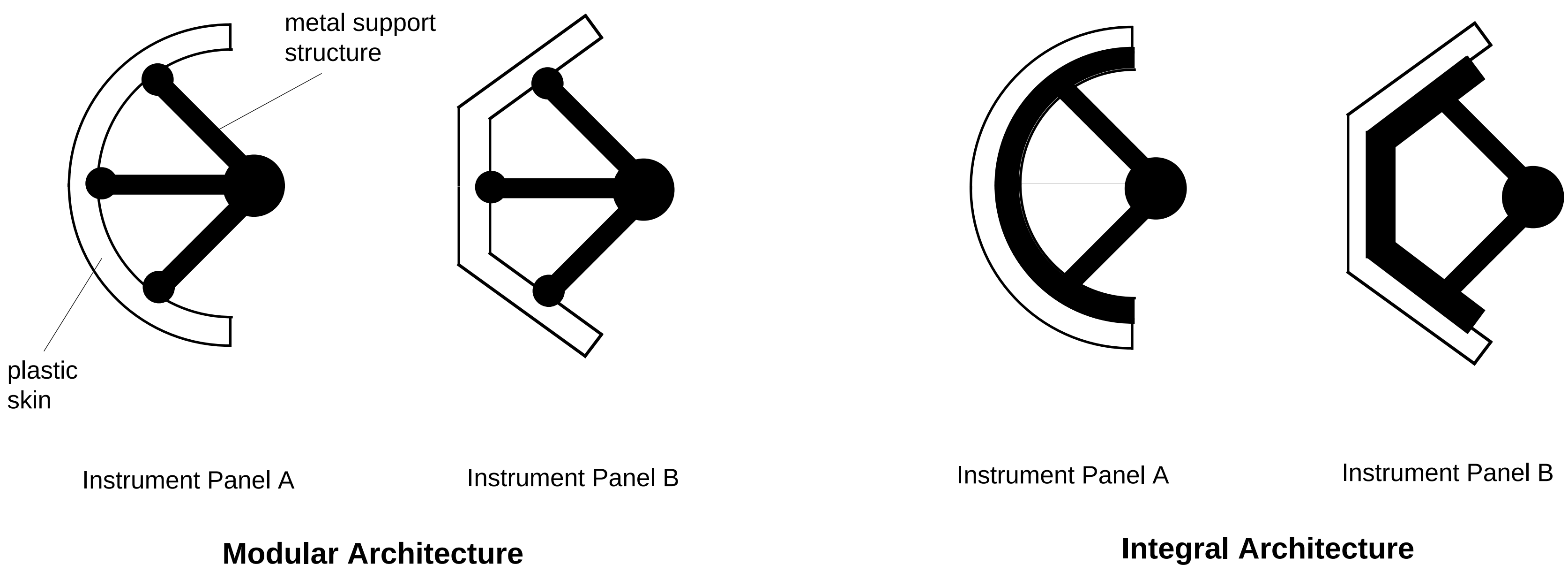


Exhibit 2: Modular and integral architectures for an instrument panel.

(Illustrative instrument panel designs shown in cross section.)



The modular architecture allows the same support structure to be used in two different instrument panel designs.

Exhibit 3: The platform planning challenge is to achieve consistency among the product plan, the differentiation plan, and the commonality plan.

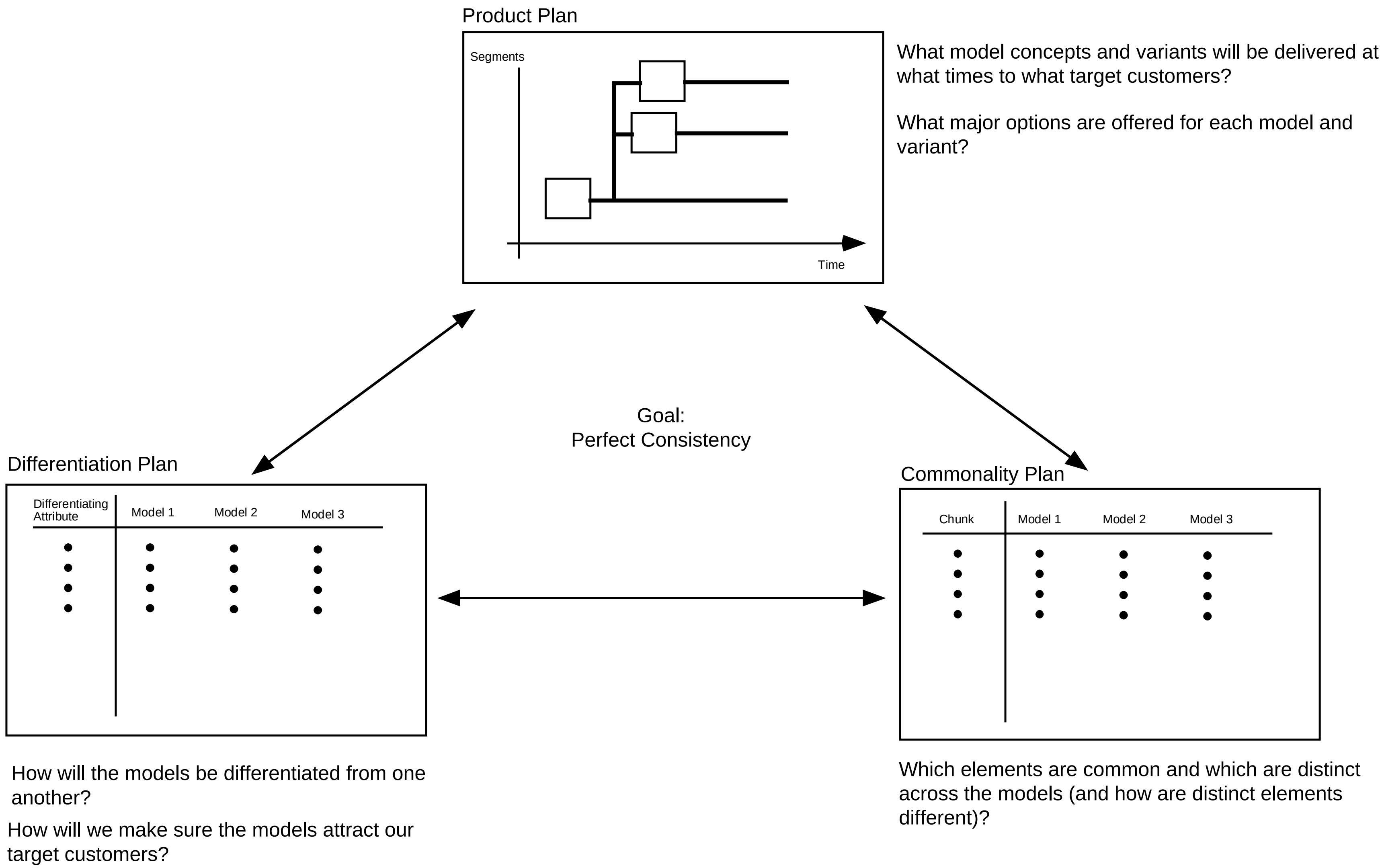


Exhibit 4: The product plan.

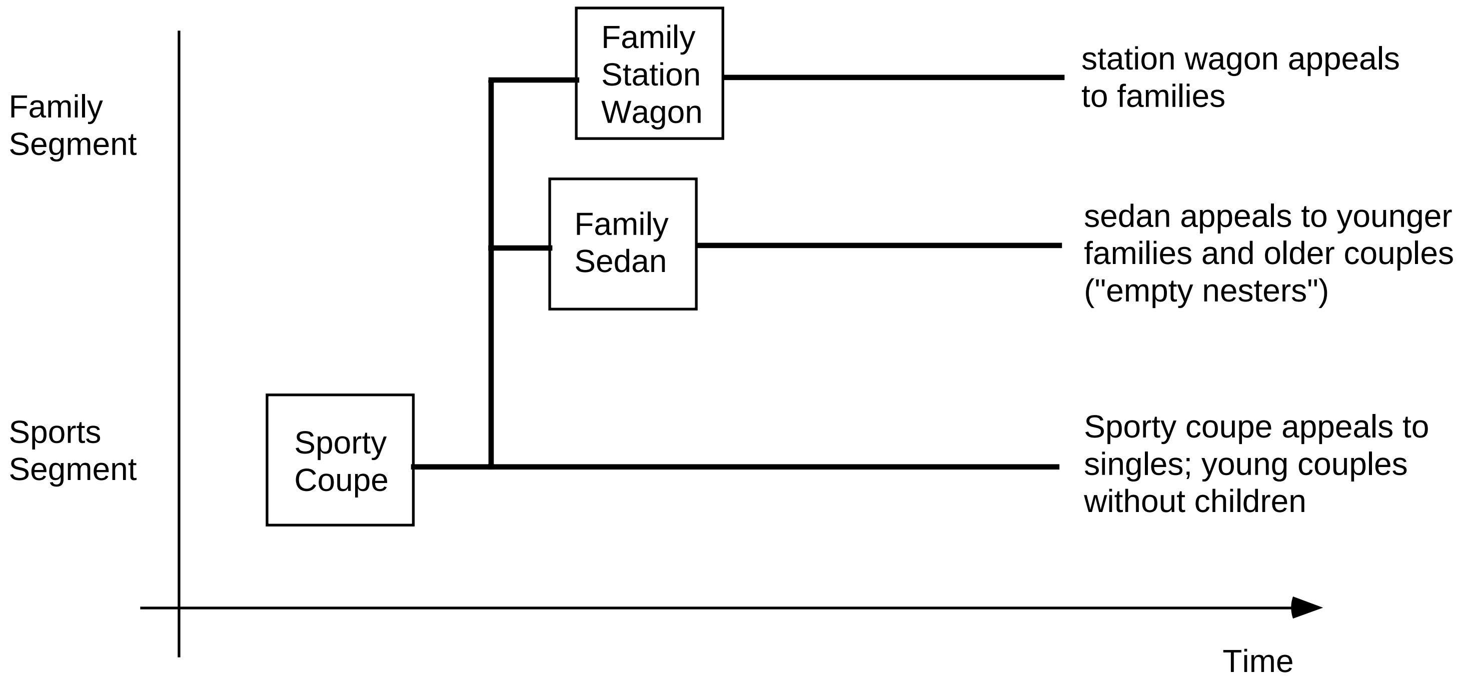


Exhibit 5: The differentiation plan.

Differentiating Attributes	Sporty Coupe	Family Sedan/Station Wagon	Importance to Customer
Curvature of window glass	More curvature.	Straight, vertical.	•••
Styling of instrument panel	Evocative of English roadster.	Highly functional.	•••
Relationship between driver and instrument panel	Driver sits low to ground, distant from steering wheel, with seat reclined.	Driver sits higher, closer, more upright.	•••
Front-end styling	Shorter nose; vehicle appears to attack the road.	Longer nose, more substantial look.	•••
Colors and textures	Darker colors and mix of leather and textiles.	Practical surfaces and colors.	••
Suspension stiffness	Stiff, for improved handling.	Softer, for improved comfort.	••
Interior noise	Some engine noise desirable, 70dB.	Noise minimized, 60 dB.	•

Exhibit 6: The initial commonality plan.

Instrument Panel Chunks	Sporty Coupe				Family Sedan/Station Wagon				
	No. of unique parts	Devel. cost ($ millions)	Tooling cost ($ millions)	Mfg. Cost ($)	No. of unique parts	Devel. cost ($ millions)	Tooling cost ($ millions)	Mfg. Cost ($)	comments
HVAC system	45	4	9	202	35	3.8	7.5	200	Duct work and support structure different; Share motors and other components.
Dash cover and structure	52	4	7	123	48	3.8	6.5	120	Share some brackets and components.
Electrical equipment	115	4	2.2	420	65	2	2.1	430	Share switches, wiring, and central module.
Cross car beam	12	2	2	35	12	2	2	35	Cross-car beam entirely different.
Steering system and airbags	26	2	0.1	200	26	2	0.1	195	All components different.
Instruments and gauges	16	1	0.2	22	13	0.8	0.2	20	Can share some instruments.
Molding and trim	10	0.4	0.2	11	10	0.4	0.2	10	All molding and trim different.
Insulation	3	0.2	0.2	8	1	0.1	0	10	Change insulation in coupe to let in more engine noise.
Audio and radio	8	0.2	0	300	0	0	0	300	Same radio option in all vehicles.

Total	287	17.8	20.8	1321	210	14.9	18.5	1320

Exhibit 7: The relationship between Differentiating Attributes and Chunks.

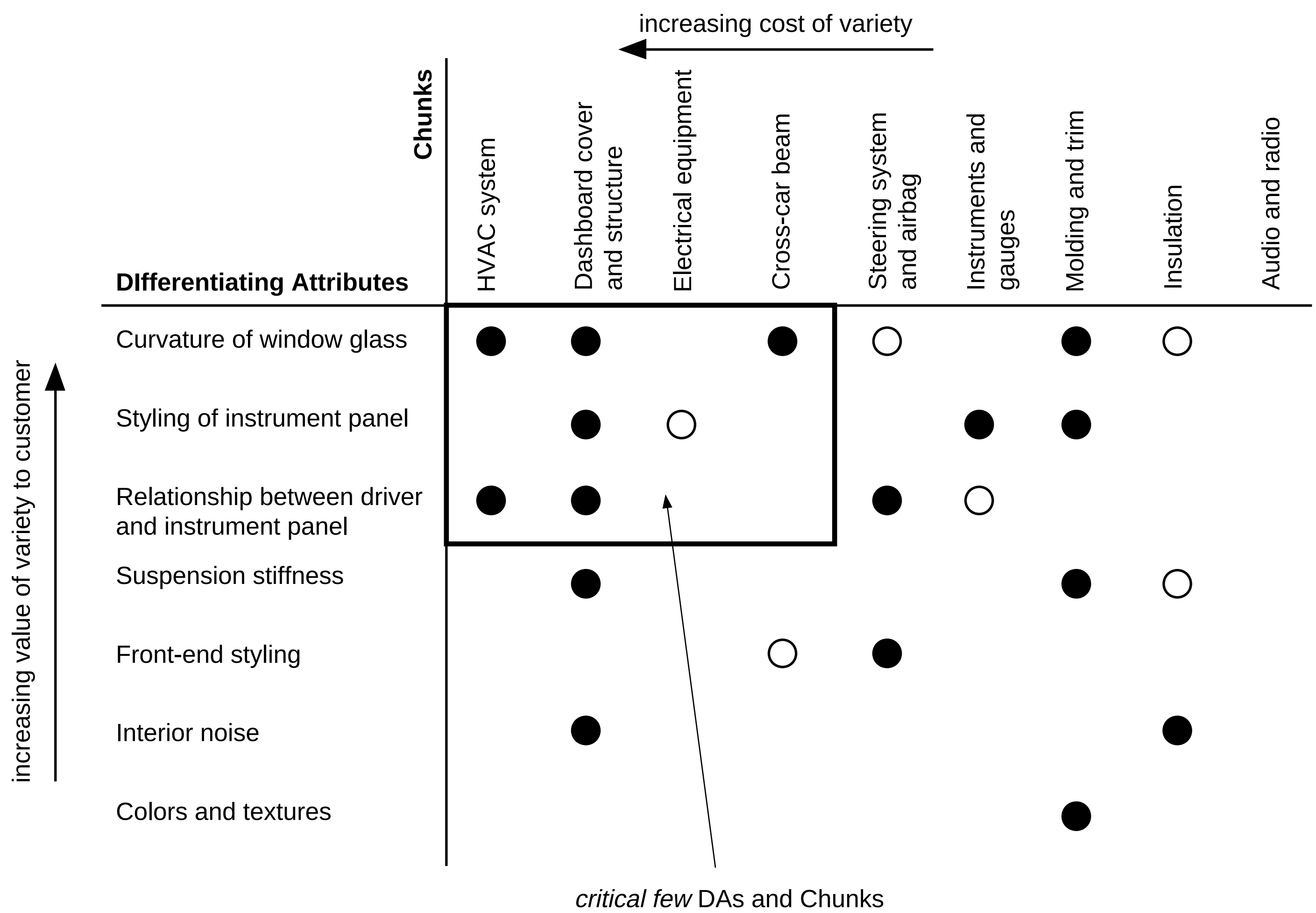


Exhibit 8: The resulting design for the dashboard cover and structure and HVAC components. (Common components are shaded.) Components highly visible to the customer are differentiated; invisible components are common.

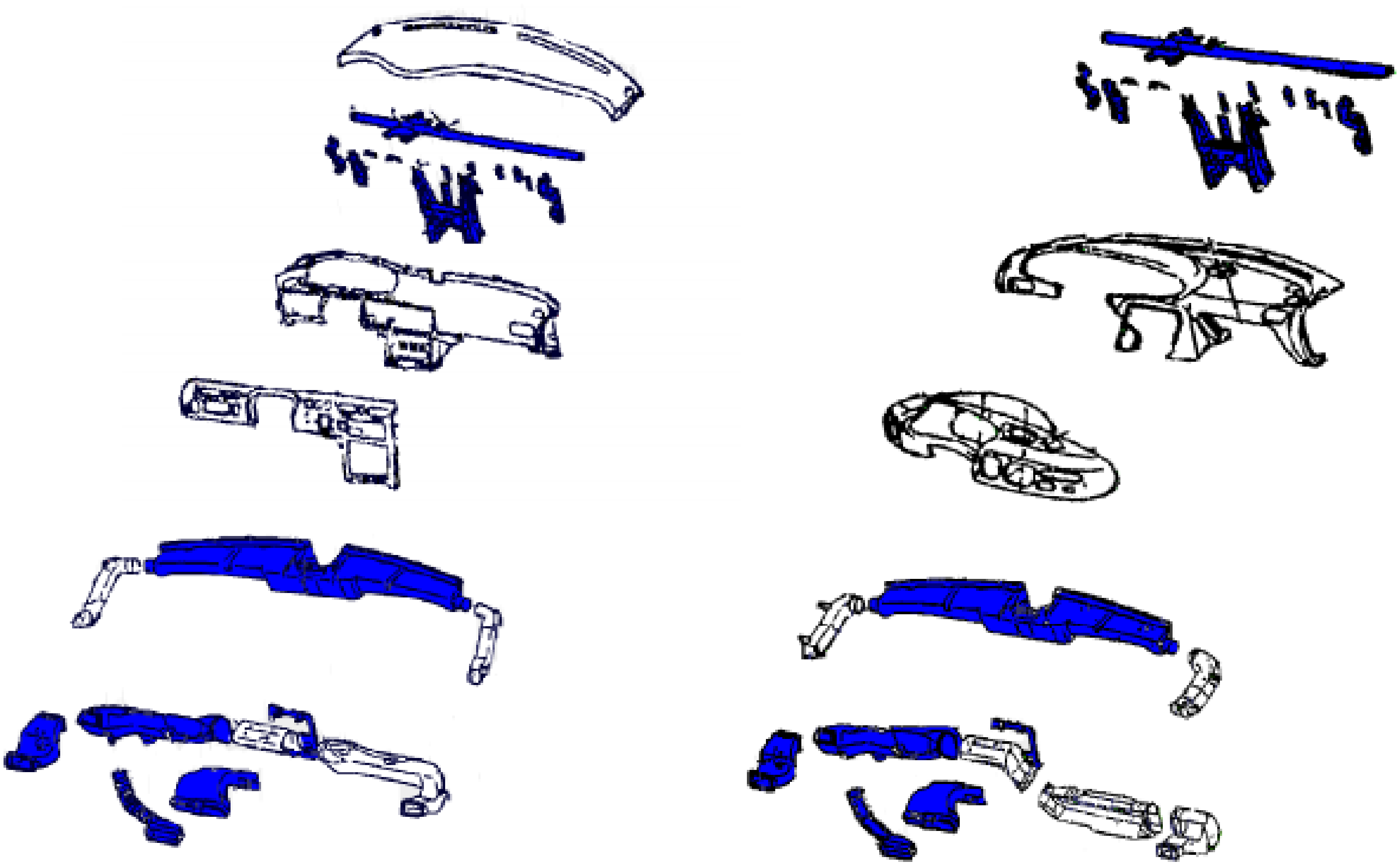


Exhibit 9: The revised Commonality Plan.

Instrument Panel Chunks	Sporty Coupe				Family Sedan/Station Wagon				comments
	No. of unique parts	Devel. cost ($ millions)	Tooling cost ($ millions)	Mfg. Cost ($)	No. of unique parts	Devel. cost ($ millions)	Tooling cost ($ millions)	Mfg. Cost ($)	
HVAC system	45	4	9	196	8	0.4	0.5	195	Share all but ends of ducts.
Dash cover and structure	52	4	7	123	48	3.8	6.5	120	All new shape and structure for coupe.
Electrical equipment	115	4	2.2	412	30	0.5	0	415	Share wiring, control module, and combination switch.
Cross car beam	12	2	2	33	1	0.2	0	33	Change horizontal beam length.
Steering system and airbags	26	2	0.1	196	21	1.0	0	192	Change only steering wheel and cover.
Instruments and gauges	16	1	0.2	22	13	0.8	0.2	20	Share gauge mechanisms.
Molding and trim	10	0.4	0.2	11	10	0.4	0.2	10	All molding and trim must be different.
Insulation	3	0.2	0.1	8	1	0.1	0	10	Change insulation in coupe to let in more engine noise.
Audio and radio	8	0.2	0	300	0	0	0	300	Same radio option in all vehicles.
Total	287	17.8	20.8	1301	132	7.2	7.4	1295	