BMW's 3-Series: Managing Platform Design and Development Costs

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BMW's philosophy is to build driving machines that respond faithfully and enjoyably to their driver's commands while also providing the safety, practicality, style, quality, reliability, and durability that help make long-term ownership a rewarding experience. It was BMW's policy to develop new platforms for its series of cars every 7 to 8 years. New platforms were not simply modifications, but completely new structures. According to Friedrich Nitschke, manager for the BMW 3 series development project, there were three goals for the new 3 series platform that came to market in the 1999 model year. First, it was to generate the highest level of customer satisfaction in its class. Second, it was to utilize the best processes available within BMW. Third, it was to generate the most profit of any BMW series.

Developing the successor to the third-generation of 3 series was a real challenge, since it had been an extremely successful series. BMW's chief designer Chris Bangle explains,

> *There are two ways of doing car design. Either it's a personality cult, where the designer runs the show and the car is just an ego toy, or the stylist is more the curator of a heritage and tradition. Then, the challenge lies in understanding a marque so well you become part of it. It's quite clear my job here is to perpetuate a set of icons.*

Bangle's latest platform introduction had been the redesign of its 5-Series, as shown here.

The BMW 528l

The overall styling of the 3-series was especially important, and was a limiting factor in its design. Models built on the new platform had to look like a BMW and be recognizable on the highway. Focus groups were used to identify the basic design features that made a BMW recognizable, and those traits were maintained in its design. For example, the BMW logo and "double kidney" grill were key recognition factors. The 3 series position in BMW's product line set many of the basic characteristics for the new platform, and would determine the basic characteristics of the models using the new platform. For example, the dimensions, engines and transmissions became part of its target definition.

Building on Tradition

The Bayerische Motoren Werke (Bavarian Motor Works) was created in 1916 through the merger of an aircraft maker and a manufacturer of aircraft engines. BMW's first notable success was the 6-cylinder BMW IIIa engine, which in 1918 powered a biplane to 5000 meters altitude (16,405 feet) in just 29 minutes. Its impressive performance led to strong demand for BMW engines. In 1919, a BMW-powered biplane set a world altitude record of 9,760 meters.

In 1922, BMW produced a small engine for the Victoria motorcycle, and a big truck engine with an advanced overhead camshaft. BMW introduced the BMW R32 motorcycle in 1923 using the BMW Boxer engine [a horizontally opposed twin-cylinder engine], rear-wheel drive, and a double-tube frame. Its pioneering technology was still used in the four R1100 series models introduced in 1993.

In late 1928, BMW acquired the Eisenach Vehicle Factory, which produced a single licensed model of England's little Austin Seven. As BMW's first automobile, it was known as the 3/15 or "Dixi." In 1932, a new, larger model called the BMW 3/20 was introduced. A year later, BMW introduced its first sports sedan, a 6-cylinder model called the 303. In 1934, the 303's engine was enlarged from 1.2 to 1.5 liters, and the model-naming system was instituted with the 315/1 sports roadster. BMW's 6-cylinder engine was progressively enlarged, to 1.9 and then to 2.0 liters, and finally to 3.5 liters.

After World War II ended in 1945, BMW's Eisenach plant, where all BMW cars had been produced, was in East Germany. BMW rebuilt its bombed-out Munich plant and began production of motorcycles, then tiny hybrid cars, called the Isetta, powered by motorcycle engines. Within a decade, BMW introduced sedans and roadsters with V-8 engines, including the 507, one of the Europe's most coveted postwar collector cars.

BMW introduced the 1500 family car in 1962, with responsive overhead-camshaft 4-cylinder engine, front disc brakes and 4-wheel independent suspension. Germany's unlimited driving speeds encouraged BMW to introduce a performance model as well, thereby beginning BMW's modern sports-sedan tradition. The BMW 1500 spawned a smaller 2-door version and the 2002, which introduced Americans to BMW's sports-sedan concept. A new 6-cylinder version, like the Bavaria sedan and 3.0 CS coupe, were introduced.

Since 1975, BMW has referred to its smallest line of cars as the 3-Series. The first 3 series achieved higher performance with its 6-cylinder engine. The second generation provided more choices, including 4-doors, convertible and touring models. The most successful third generation raised driving performance to an even higher level, while providing quality comparable to Mercedes-Benz. The

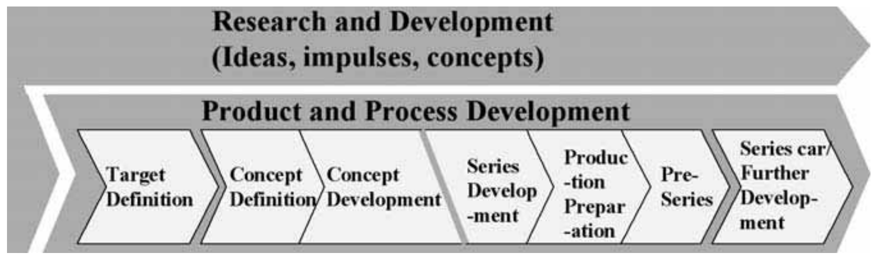


Figure 1: BMW's Product Development Process

fourth generation would again undergo a redesign of the various models in the series. The first models to change were the sedans, next the coupe, then the convertible and hatchback, and finally the wicked M3 sports cars. This sequence of introductions allowed BMW to extend the life of the design by stretching out introductions over the life of the series. The current 3 series design had been in production since 1990. The styling of the new 3-series would be similar to the larger 5 and 7 series cousins.

BMW's Forth-generation 3-Series Platform Development

As one journalist said of the third generation models, "BMW's beautifully proportioned 3-series cars are still the design pacesetters in this realm" of small sport sedans. Friedrich Nitschke's challenge was to develop the fourth-generation of BMW's pacesetting tradition. In addition, Nitschke was assigned the task of implementing a new planning system for BMW's 3 series replacement platform. He explained:

I was given responsibility for developing the new 3-series BMW in 1993. This development process (Figure 1) was introduced in BMW for use in the new 3 series. The target definition gives the basic characteristics of the new platform for the series.

Separate teams designed the saloon (sedan), coupé, compact, touring, convertible, and M3 sports models to be introduced on the new platform. Models included two or four door versions of family and sporty cars. For example, the existing lineup included:

- Saloon (316i, 318i, 323i, 328i, 318tds, 325tds, M3)
- Coupé (316i, 318is, 323i, 328i, 328i Sports, M3)
- Compact (316i, 318tds, 318ti)
- Touring (318i, 323i, 328i, 318tds, 325tds)
- Convertible (318i, 323i, 328i, M3)

The first model on the new platform, the four-door sedan, was to be introduced in 1998, using a more powerful 166 horsepower 2.5-liter inline-six engine (323i models) or the 190 horsepower 2.8-liter inline six (328i models). The less powerful in-line four-cylinder engine was being dropped from use in the sedans. Over the new platform's life, existing models would be replaced by the new platform, and then beefed up as an M-type model.

Setting the budget.

The top-down target cost budget for the project was set as shown in Figures 2 and 3. BMW's marketing department set the price range for the 3 series between DM 40,000 and DM 60,000, pricing the compact 316i at around DM 42,000, and the 328i sports sedan at around DM 60,000. At these prices, marketing estimated sales between 2 million and 3 million cars over the platform life. Management then set the target revenue and profit level required for the series at 3 million units. Mr. Nitschke explained:

This strict product development process was introduced with the 3 series in 1994. We would not start the development of the 3 series until we were sure that we could make money with this car. That means that the plan's cost and target cost needs to be nearly equal. In the past, we might have some difference, but we would start the R&D process in hopes of finding ideas to reduce costs. Therefore, we wouldn't meet target profits and would have to implement cost reduction projects as soon as we introduced the new car.

Market Inputs

The concept definition phase of development relied on market inputs. Market inputs included data on appeal, customer satisfaction measures, product benchmarks, product reverse engineering, customer call center inputs, market studies, product tests, patents, conjoint analysis, and SWOT analysis of the competition. The third generation 3-Series models were compacts, but offered minimal passenger comfort. Some customers had complained about its cramped rear seat and sub-par interior. The hard plastic interior was heavily criticized. New competition from Lexus, Infiniti and Mercedes caused customers to question spending upwards of $40,000 on a car that had a second-rate interior.

Conjoint analysis, shown in Appendix 1, revealed that safety and road behavior were the two most important factors in purchasing a new vehicle. Since the early 1990s, BMW had invested heavily, producing the safest and best driving machine on the market. For example, by 1997, BMW planned to have a *head protection system* above the front doors and within the A-pillar of its 7-series, which inflates an airbag diagonally across the side window. *Rear side airbags*, and *driver and passenger side airbags* were planned for 1996. *Dual threshold deployment* was an "intelligent" safety system that kept airbags from deploying at a lower crash severity if seat belts were worn. *Passenger seat occupancy sensor* recognizes if a seat was occupied or not. *Interlocking door anchoring system* anchors a diagonal aluminum reinforcement bar to the body pillar in the event of a serious side impact. The newest systems were typically offered on the 7- and 5-series first. Benchmarking the existing 3 Series, the Mercedes C series, the Audi 90, and, for noise, the more expensive Lexus was the basis for setting feature standards for the new platform. Mr. Nitschke explained:

A goal for the new 3 series is to be one of the quietest cars in its class. As of 1994, Lexus didn't have a direct competitive model, so we looked at the large Lexus for its noise control. Our target was to reach that level of quiet in the new series. The existing 3 series is also a benchmark model, since we want to improve on it. It is good to drive, but the space is restricted and *the cockpit isn't great. It is nice, but we will improve the value to the customer. These were the inputs from the market.*

Mr. Nitschke reviewed the importance and age of each component.

More interior space was a target that resulted from prior owner responses, as was the need for a more luxurious interior. The suspension is an important item in determining the interior space. Changes in rear and front suspension provide more interior space. Since we have a rear wheel drive, we can push the front suspension closer to the front of the car. This is one of the reasons that the interior space can be expanded. We can also bring the engine behind the front suspension to give the car a more balanced weight ratio between the front and the rear. We also decided to add two centimeters to the length and three centimeters to the width to give additional interior space. Many of the characteristics that the customer does not see, like the basic structure, can be carried over from the previous model.

The resulting technology analysis provides the characteristics of the new model (Figure 4). Nitschke continued:

We look at the competitors' noise levels, aerodynamics, etc., and create in our head what is needed for the new car to be better than the old one. We consider quality, transportation, safety, comfort, and environmental features. We then compare each feature against the old car and competitors' cars to determine what we need to do in each category. In quality, we need to be best in class. In space, we just want to be marginally better. Everybody knows what the key points are for improvement in the new car. Our customer inputs made that clear.

The target definition included more interior size and higher quality appointments. According to Dr. Anton Heiss, team leader for manufacturing,

The old 3 series had a problem getting feet under the rear seat. It also felt cramped, so we needed more space between the front seats. We decided to add space to the rear and between the passengers. We also decided that the styling of the dash needed to give a more open feeling.

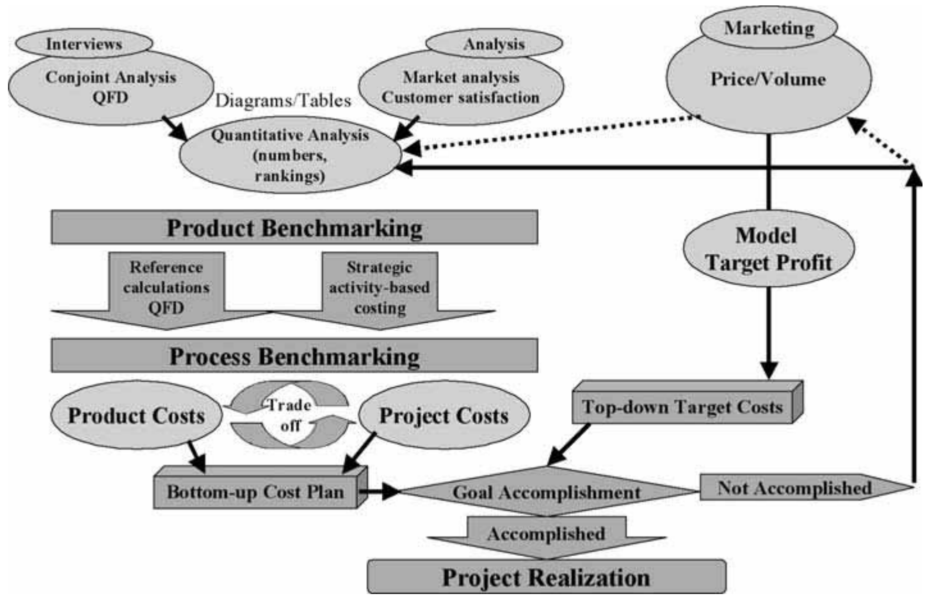


Figure 2: Integrated Market-oriented Top-down Target Cost Management

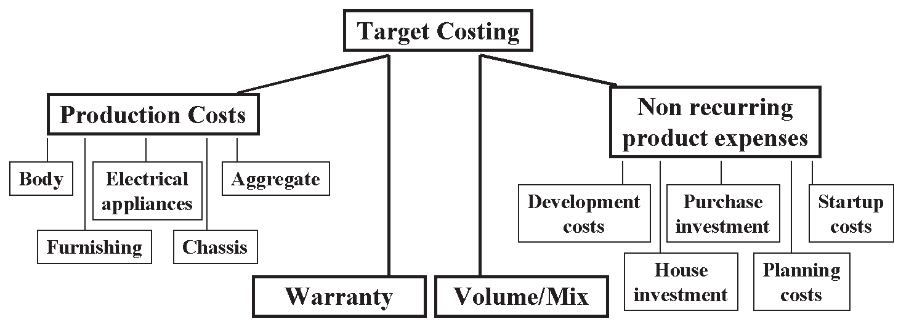


Figure 3: Target Cost Budgeting Model

Discussions included leather trim and optional leather upholstery, power seats and windows, an on-board driving computer, alloy road wheels, ABS brakes, dual airbags, and air-conditioning. The team also wanted it to achieve the USA's highest safety rating. Each module and component was analyzed. Nitschke continued:

We evaluate each component to determine what is good enough, and what must be improved. We created a summary of each area. We know that the body must be new. The customer can see that it is new, and not a face lift. All parts for the skin must be new. There are about 80 such parts that will be new. In the structure, we know that the new safety laws and crash tests require some new parts. The old structure will not pass these new tests. The impact tests and roll over tests will be more stringent in the future. In California, these tests are required. We then determine what parts of the structure must be new, and what can be used from the old model, or taken from the 5 or 7 series. To improve quality, a determination has to be made on what parts must be new and what is good enough, so that there is no real quality problem.

The cost of the proposed design improvements then had to be determined. Table 1 shows how the parts' costs are determined in terms of planning, R&D and investment costs. A vehicle includes about 4000 different part numbers, or 13,000 total parts. An engine, for example, uses the same parts for each cylinder. Each of the 4000 parts are classified into modules and related compo-

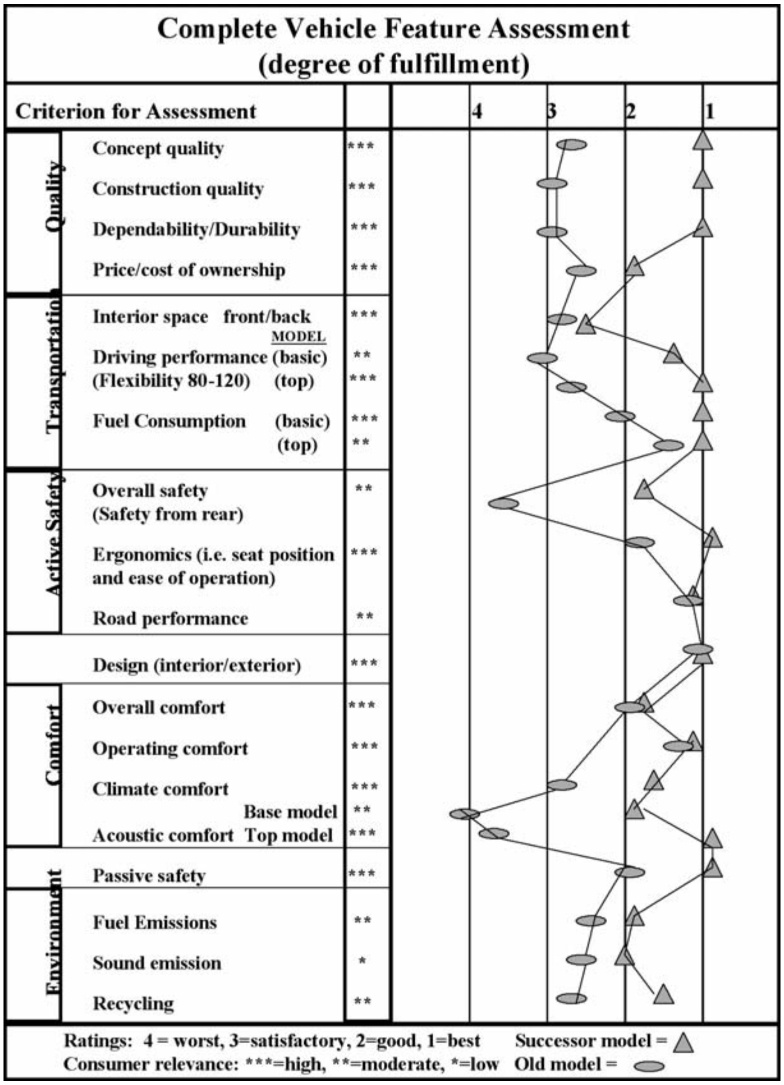


Figure 4: Next Generation 3 Series Profile

nents. For example, the interior area includes the cockpit and seats. The seat is one module, and the frame for the seat is one component. Each component includes a number of parts. Each part ID number was identified.

For example, Nitschke's team had to decide if the back seats from the 3 or 5 series could be used in the new platform. Each part was either used from the prior 3 series, incorporated from the 5 or 7 series, acquired from a supplier, or developed new. Nitschke explained:

We identify the ID for each part, and then decide what action is needed. The inside hood, for example, can be used for the new series, but the hinge must be new. Of the 335 parts in Table 1, we will create 212 new parts. The airbag generator can be used from the 5 series, so that saves planning, R&D, and investment costs. This analysis lets us determine at an early stage the cost required for development, R&D, and investment in each technology area.

We haven't pre-determined how much technology will be transferred from the 5 or 7 series. When we tried to do that in the past, it didn't work. The market moves too quickly to determine what parts might be used in a later series. We had developed a new seat for the 5 series that can be used in the new 3 series. The marketing analysis tells us what features we need.

The budgets specified the basic vehicle and its standard features. The budget provided DM15,000 for the basic vehicle and DM5,000 for the standard features. A small budget of DM 2000 remained for features that may be included later, but were not specified. Since the concept definition phase occurred 36 to 40 months before launch, some flexibility was needed in deciding on innovations. Nitschke noted:

If we think the car is good enough, we don't need any innovation expense. However, the research department has lots of ideas for new features. The only problem is that they must be able to bring them to high quality within the time needed for launch. If we need two years for development, then we may be able to include those features in the new car. If the quality is not good enough, we don't want it.

BMW's goal for the basic model is to have the best quality and crash performance in its class. That is part of the basic cost. We want the highest safety ratings in this class of car in crash and roll over tests. The basic safety in terms of brakes, steering, frame, etc. is built into the basic car. Some of the innovation money can be spent for safety, and not just gimmicks. Additional side impact airbags can come out of the innovation cost.

It is difficult to determine what is a good feature, and what is a gimmick. The rain detector, for example, was originally developed for the 7 series, but the marketing department said it wasn't a feature that customers wanted. They said that customers would consider it a gimmick or a toy. Then Mercedes Benz introduced a rain detector, so marketing said we had to have it. In the third generation 3 series, customers loved the automatic dimming of the interior lights after you close the door. So that feature will be in the fourth generation 3 series. We usually have more ideas for innovations than we have budget. How do you decide what is right for this car?

BMW's research and development center (RDC) employed nearly 5,000 engineers, designer, technicians and support personnel in one of the world's largest advanced automobile development facilities. Since studies have shown that engineers develop 80% of their ideas in private conversations with their colleagues, the individual offices and workstations for each department are no more than 50 meters away from each other. The idea of streamlining communication has been applied to the management structure, too,

Module	Code	Supplier	Name	Technical Description	Part count	Same part	New part	Change factor	Plan cost	R&D cost	Invest-ment
10	1234		Outer sidewall	New development	100	2	98	0.5	200	300	3000
20	1235		Front hood	Develop new hinge	50	10	40	1	100	20	100
			"	Use from predecessor							
30	1236	Webasto	Sliding roof	New development	50	0	50	0.8	50	10	1500
40	1237		Airbag generator	Use from 5 series	20	20	0	0	0	5	0
40	1238		Battery w/holder	Use from predecessor							
			"	Develop new holder	5	1	4	0.2	20	10	200
40	1239		Inner lighting	Use from 7 series	10	10	0	0	0	50	0
50	1240		Heating	Use from predecessor,	100	80	20	0.5	200	300	2000
			"	Modify (some change)							
Summary:					335	123	212		570	695	6800

Table 1: Technical Scoring Framework

thereby reducing the length of decision-making paths. The five buildings and 90,000m^2-floor space that comprise the RDC are completely linked in a massive data communications network. At the heart of this is a CRAY X-MP/28 supercomputer and 800-plus CAD/CAM and CAE terminals for development of new designs and technologies of tomorrow.

The development teams also consider the additional options for the new series. For example, other BMW series offered such options as a sonar distance device (for crunch-free parking), automatic traction control, a limited slip differential, metallic paint, sunroof, an anti-theft device, powered front seats with settings memory, and CD players.

Cost Control

With 70% of the cost of a new series being determined during the planning phase, BMW's new planning process had high visibility. The model profitability is determined after all direct and indirect costs are estimated. Direct costs include the project costs from planning, development, investment, and start-up. Income, variable production costs, and warranty costs are also direct costs. Indirect costs include overhead costs for facilities, operations, and unit operations. These bottom-up planning costs are then compared against the top-down target costs and model profitability levels established by top management. Nitschke continued:

After we complete the technical analysis, we total the planning costs, the R&D costs, and the investment costs. We then have a matching process against the target goal. We had a difference of between 15 to 20%. We had budgeted DM 2000 for innovation, but we don't know what that will be at the planning stage.

We have some cost drivers that we can change. One is technology. For example, to develop a new suspension system required investment costs of some DM 200 million; but, if we carry over some of the old parts, the investment costs are only DM 80 million. We look at what we can carry over to lower our total costs. On one hand, we need no R&D and investment for old parts. On the other hand, the seat of the 5 series costs DM1000, but we have a budget of DM 800 for the 3 series. You have to develop a new seat to realize the DM 200 difference. We look for ways to save investment and R&D, but the cost of an existing part may actually be higher.

During 1994, the matching process between top-down targets and bottom-up costs took 3 months.

The actual model profitability was determined through a complex computer analysis. This sensitivity analysis (Figure 5) was used for the matching process. For example, the model profitability figure is the overall profitability of the car. Top management had set a goal to generate a 26% profitability level. As is usual in product planning, the initial bottom-up cost plan exceeded the top-down target by nearly 20%. Nitschke's team had to find ways of improving profitability.

We first asked marketing if they could charge a higher price or sell more cars because of our technical improvements. Of course, marketing said this was impossible, so we had to deal with the planned cost factors. In our sensitivity analysis, an increase of 1% in price (say to DM 40,400) can increase the model profitability by 2%. When we have lower project costs of about 1%, we can increase the model profit-

ability by nearly 1%. With this analysis, we can determine if it is better to change the part cost, or the investment cost. For example, when we have a low volume car like the 8 series, it is better to reduce investment and R&D costs, rather than reducing part costs. A model like the 3 series, with estimated sales of 3 million units over its life, it is better to reduce the parts costs. Therefore, this sensitivity changes with each model.

This matching process was central to the new planning process, and required serious reevaluation of the planned costs. Nitschke explained:

Until we actually start the development process, the car is simply in our heads. We must complete the planning phase within six months, or we delay the actual development.

Since the first matching had higher costs, we looked again at parts that could be carried over. We wanted to develop a new suspension, but the old suspension was very good. Instead of developing a new suspension, we decided to reduce the weight of the old one. We decided to change the material of some parts, by using aluminum and magnesium rather than steel. That saved some investment and R&D costs.

We began the actual development phase with 5 to 6% higher planned costs than target, but decided to develop some new process that would hopefully recover those costs in production and purchasing. For example, we brought some suppliers into the development team as model life suppliers. Five years ago, we had suppliers compete for contracts, so they never knew who was the model life supplier. As a result, we couldn't bring them onto the development team. Now we asked suppliers to compete on concepts, and the supplier with the best concept is chosen as the model life supplier. Now our supplier actually develops the seat. Some of the purchasing people don't like this approach, since they prefer to push the price down with competitive bidding. When Lopez (Opel's ex-purchasing manager) moved to VW, he started a process that VW still uses to push its suppliers to reduce prices. We hope that our new approach will save money in the long run. For example, since our suppliers are on the development team, we ask them to make changes without adding additional costs, and they usually agree. Before, any change provided opportunity for the suppliers to raise their prices. By launch, we hoped to meet the 26% model profitability goal.

The New 3 Series Platform

The current 3 series models had little commonality in parts, except for the engines, transmissions and floor structure. The development team wanted more commonality between the new 3 series models in order to reduce costs of manufacturing and improve overall quality. Although transmissions and engines were largely carried over from existing models, the chassis was totally new. According to Dr. Anton Heiss:

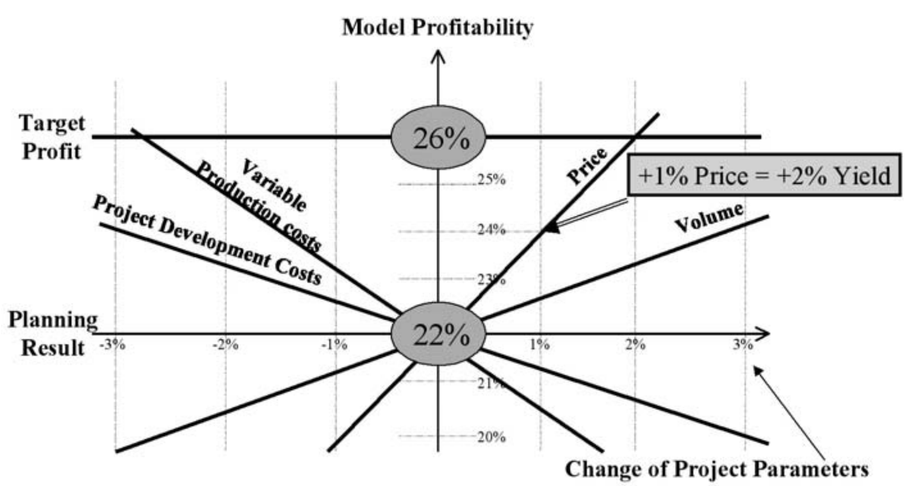


Figure 5: Sensitivity Analysis for Model Profitability

For the new 3 series, we decided to have more common parts. Everything up to the instrument panel will be the same for the sedan, coupe, and touring models. Also, the sunroof is the same. The doors for the convertible will be the same as on the coupe. That is more than in the past. All the skins are totally different between the models.

All of the discussion about what will be carried over and what will be new are styling issues. We decided that we had to have different styling for each model. On one hand, nobody wants to have totally different cars. Every car has to be almost the same shape. But it is impossible to have the same front with the same windscreen, and have a body with a new shape. You have to change the windscreen angles and curves to fit the coupe or convertible styling. That requires a totally new greenhouse (cabin) for each model. We didn't want to make compromises in keeping the look of a BMW, so we must produce a new skin and give it a proper shape. We want each model to look like a BMW, and not like a Toyota.

To increase rear-seat passenger room, the all-steel body was about 4 cm (1.6 inches) longer. In addition, new front seats were being developed to give more space beneath them for rear seat passengers to put their feet. The added weight of the larger frame was being held down to 27 kg (60 lbs.) through the use of aluminum, particularly in the suspension and front sub-frame assembly. The planned rollout of the new sedan models was scheduled for the second quarter of 1998. The coupe model was planned for 1999. A touring wagon and 3.4-liter M3 was to follow in 2000, with the compact and convertible models in 2001. M-tuned editions would then supplement models to keep the cars exciting through the seven-year life of the new platform.

The new 3 series platform added advanced safe driving technologies to meet future safety requirements. First, it was one of the most balanced cars on the road with a near 50/50 ratio between front and rear weight distribution. Second, while it was a rear wheel drive, it also included all-season traction and an antilock braking system (ABS). BMW's cornering brake control (CBC) was a further development and expansion of the antilock braking system for braking maneuvers on curves. CBC regulates the pressure in the different wheel brake cylinders for optimal breaking. BMW's advanced ABS system included a recirculating pump in the hydraulic unit that activates in emergency braking situations. This dynamic brake control (DBC) assured maximum deceleration and the shortest stopping distance. A new rear axle drive system architecture and suspension improved driving performance and body reinforcement. About 20 percent of the axle and suspension parts were remade of aluminum to save weight and improve driving comfort.

Cost Reduction Strategy

As the new 3 series entered the development phase, Dr. Anton Heiss was given the task of bringing the new model to market within the cost targets. Since the initial design phase had not met the target cost levels, the factory had to make significant improvements. Heiss explained:

> *This was the first series where we brought manufacturing people into the process at the beginning of the planning process. This was very helpful. At the beginning, we started with a 5 or 6-person team one year before the platform team was founded. We had one from marketing, one from finance, one from styling, one from general car integration, one from interior and ergonomics, and one from driving characteristics.*
>
> *At the beginning of the project, I did all the feasibility studies for manufacturing. What can we do, and what is feasible to manufacture? Second, I studied the manufacturing problems of the old 3 series to find solutions from the manufacturing point of view. We wanted to avoid all the old problems. The third job was to calculate the investment for the new manufacturing line. At the beginning, it was a rough estimate, determining what new tools were needed in comparison to the existing line. Once we decided on the new version of the 3 series, we made more detailed studies. We came up with all the manufacturing requirements, what is in the new car, and then began with styling the new model. For body-in-white, we set targets for the number of welding points. The number of parts used for body construction affected that.*

After studying the old assembly line, Heiss found over 950 items or processes that needed to be changed or fixed. In planning assembly of the first prototype, about 600 were addressed. About 200 were not worth the cost or investment of the improvement. The new production philosophy was to handle parts or assemblies only once, or complete them in a single line. While assembly only accounted for about 10% of the total cost, Heiss and his team had cut those costs by over 10%.

Changing Competition

As BMW's new 3 series prototype was about to be completed, a major competitor, Audi, introduced its new benchmark model for 1996, the Audi A4. *Car and Driver* magazine named the A4 one of the Ten Best 1996 cars. In fact, *Car and Driver* gave the new A4 a one-point higher rating than BMW's 1996 328i. The A4 was central to Audi's strategy of directly attacking BMW's product line. Having hired away several of BMW's marketing executives, Audi was now introducing series with numbering systems similar to BMW but always symbolically one number higher. The Audi A4 was targeting the BMW 3 series. The Audi A6, introduced in 1995, was targeting BMW's 5 series.

The Audi A4's design was very competitive with the BMW 3 series. The A4's standard items included cruise control, anti-theft system, automatic climate control system, AM/FM/cassette and rear defogger. It included power windows and locks and dual power outside mirrors—along with a power driver's seat and tilt/telescopic steering wheel to make drivers of various sizes comfortable. The wheel was even leather-wrapped. Enhanced safety items included dual air bags, anti-lock brakes and side-impact protection that met 1997 federal standards. It also included 5-m.p.h. bumpers, rear headrests and a headlight-washer system. Audi gave a three-year, 50,000 mile warranty that includes everything, even scheduled maintenance. Reviews praised the styling and roominess of the A4, along with its luxurious interior. According to one reviewer, "Walnut inlays in the dashboard, center console and doors convey a feeling of opulence not generally found in a car that costs less than $30,000." An optional Bose music system was available. The primary complaints of reviewers came from the limited legroom in the rear seats, the poor cup holder design, and the difficulty in putting the stick shift into reverse.

1996 Audi A4

Overall, the A4's styling was considered more attractive than anything being offered by Lexus or Acura, the luxury was equal to big American cars such as the Cadillac Seville or Oldsmobile Aurora, performance was on par with top sedans from BMW and Mercedes, and safety was close to Volvo standards. The biggest concern to Nitschke was the A4's price tag, about $4900 less that BMW's 328i (see Appendix 2). Nitschke's team felt added pressure, since supplier prices had increased as technical improvements were added during the development phase. While the new 3 series was only 24 months from launch, Nitschke saw Audi's A4, Mercedes C-class, and the new Lexus CS300 as the new benchmarks for the 3 series.

Besides the price, team members were surprised with the A4's driving characteristics. It handled better than expected for a front-wheel drive car. Nitschke explained:

> *The old Audi 80 had been our original benchmark, but the A4 quality is much better, and the interior appointments and suspension system are much better. The Audi 80 had been a conservative car that was considered the choice of civil servants. The A4 is a serious competitor and is a well-developed car. We need to reevaluate our budget for innovations to determine how we can respond to the A4. The budget has between DM 500-1000 still available for innovations.*

The team considered redesigning the new 3 series for more significant cost reductions, but was concerned that a redesign would significantly delay the plat-

Main activities	Cost Driver	Technologies: Driving	Chassis	Body	Furnishings	Electricals/ Electronics
1. New series	First release	300	200	300	100	400
2. Model revision	First release	300	200	300	100	400
3. Alterations prior to series start.	Alterations	70	50	60	30	70
4. Alterations after series start.	Alterations	70	50	60	30	70

Figure 6: Cost Drivers in Developing the New 3 Series (million DM)

form launch and negatively affect the final quality of the new model. Furthermore, revisions and major alterations to the development prototype could significantly affect the model's profitability since development costs were included in the targeted costs (Figure 6). Significant alterations could easily add an additional 25% to the overall development costs. However, new competitive entries raised questions about the new 3-series competitiveness for the coming decade, since the series would be in the market from 1998 to 2005.

The team wanted to make sure that the new 3 series would surpass the A4 and compete head-on with the Mercedes C-class in buyer satisfaction. They decided to review existing technology and innovations that could be included in the new model. Given the A4's lower price, they had to review what features to include in the base model to justify the higher price of the BMW, and decide what options consumers would pay extra for. R&D had developed a remote keyless entry with 2 stage unlocking power door locks. Drivers could press the button once to open the driver's door, or twice to open the other doors and the fuel filler flap. BMW's new remote locking system could also include a power remote trunk release. Cadillac had recently introduced a similar system. The 5 and 7 series power driver's and front passenger's seats had 3 memory settings that could be included. A smart key system could be programmed to remember the seat settings for each driver.

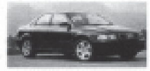
Nitschke also considered raising the safety level of the new 3 series by adding the HPS (head protection system) airbag for about 150 DM. The highly accredited American Insurance Institute for Highway Safety (AIIHS) crashed two 5 series BMW's sideways against an obstacle at 20 mph. In the car without the HPS airbag, the collision would have been fatal. Using the HPS airbag, the injury rates were one-fifth those of cars without the system, ensuring the driver's survival. According to Brian O'Neill, president of AIIHS, "This first of its kind head protection system from BMW demonstrates what can be done to protect people in serious side impacts."

The cost parameters would be affected by changes to the new 3 series in light of the Audi A4's introduction. Of course, the 1996 benchmark models had now been introduced, and could be used to assess the new design. The question now was, "How far should the team go in altering the 3 series model to be competitive?"

Product Components		Body			Furnishings				Electricals				Chassis					
Product Qualities	Meaning	Body skeleton	Body skin	Doors/Hood/Trunk	Outter design	Inner design	Cockpit	Seats	Heating/Climate control	Instruments	Network	Electro-mechanical	Front axle	Rear axle	Springs/shock absorption	Wheels	Brakes	Engine
Exterior design	7.3		2.2	1.5	1.8							0.4		1.5				
Interior design	4.7			0.7		0.7	1.2	1.2	0.2	0.5						0.2		
Seating comfort	4							4										
Operating comfort/ergonomics	2.7			0.4			0.4	0.4	0.3	0.1	0.3	0.1	0.1			0.4	0.1	
Inner acoustics	3.3	0.3		0.2	0.2	0.3	0.2						0.3	0.7				0
Heating/Air comfort	2.6					0.1		0.4	1.8									0
Gear shifting comfort	2.8																	
Air flow/circulation	10.3		0.5		0.5									0.5				7
Acceleration	4.3		0.2		0.2									0.2			0.2	
Speed limit	2.6		0.1		0.3									0.4			0.1	1
Gas consumption	8.6		0.4		0.4									0.4	0.4			
Maintenance	7.7		0.4	0.4	1.2				0.4		0.4	0.4	0.4	0.4	0.4			2
Safety	20.5	5.1	1	3.1			3.1	3.1			2.1					3.1		
Road behavior	14.6	0.7									0.7		2.9	5.1	2.9	1.5		0
Non-polluting	3.9	0.2	0.4	0.2	0.2	0.2	0.2	0.2			0.2							1
Sum	100	6.3	5.3	6.4	4.8	1.4	5	9.2	2.7	0.6	3.6	0.9	3.8	9.2	3.7	5.2	0.5	23

Appendix 1: Conjoint Analysis of Critical Product Qualities and Components

Appendix 2: Comparisons of Benchmark Vehicles




	1996 Audi A4 QUATTRO 4-Door Sedan All-Wheel Drive	1996 BMW 3-SERIES 328I 4-Door Sedan	1996 Mercedes-Benz C-CLASS C280 4-Door Sedan	1996 Lexus ES 300 4-Door Sedan
General Information				
Model Year	1996	1996	1996	1996
Car Type	Sedan	Sedan	Sedan	Sedan
Number of Doors	4-Door	4-Door	4-Door	4-Door
Seating Capacity	5	5	5	5
Manufacturer	Audi	BMW	Mercedes-Benz	Lexus
Price				
Original Price	$28,050	$32,900	$35,250	$32,400
Fuel Economy				
City Mileage	18 mpg	20 mpg	19 mpg	20 mpg
Highway Mileage	27 mpg	27 mpg	26 mpg	29 mpg
Fuel Tank Capacity	16.4 gallons	16.4 gallons	16.4 gallons	18.5 gallons
Safety				
Safety Rating	Excellent	Very Good	Excellent	Very Good
Reliability				
Reliability Rating	Excellent	Excellent	Excellent	Excellent
Size				
Interior				
Cargo Capacity	14 cubic ft	10 cubic ft	12 cubic ft	14 cubic ft
Front Head Room	38 inches	37 inches	37 inches	38 inches
Rear Head Room	37 inches	37 inches	37 inches	37 inches
Front Leg Room	41 inches	41 inches	42 inches	44 inches
Rear Leg Room	33 inches	34 inches	33 inches	33 inches
Exterior				
Length	178 inches	175 inches	177 inches	188 inches
Width	68 inches	67 inches	68 inches	70 inches
Height	56 inches	55 inches	56 inches	54 inches
Curb Weight	3,228 lbs	3,120 lbs	3,350 lbs	3,374 lbs
Wheelbase	103 inches	106 inches	106 inches	103 inches
Technical Specifications				
Horsepower	172	190	194	188
Number of Cylinders	6 cylinders	6 cylinders	6 cylinders	6 cylinders
Displacement	2.8 liters	2.8 liters	2.8 liters	3.0 liters
Engine Type	Gasoline	Gasoline	Gasoline	Gasoline
Drive Train	All-Wheel Drive	Rear-Wheel Drive	Rear-Wheel Drive	Front-Wheel Drive
Most passenger cars have front-wheel drive, while most trucks and high performance have rear-wheel drive. Four-wheel drive is available for most trucks, sport utilities, and some cars.°°				
Transmission	Manual, Automatic	Manual, Automatic	Automatic	Automatic
Most manufacturers offer both automatic and manual options for each model. Almost all cars are available in automatic, while about 300 models are not available in manual.°°				
Brakes	All Disc	All Disc	All Disc	All Disc
Available Features				
Anti-Lock Brakes	Yes	Yes	Yes	Yes
Driver-Side Airbag	Yes	Yes	Yes	Yes
Passenger-Side Airbag	Yes	Yes	Yes	Yes
Air Conditioning	Yes	Yes	Yes	Yes
Cassette Player	Yes	Yes	Yes	Yes
Cruise Control	Yes	Yes	Yes	Yes
Power Brakes	Yes	Yes	Yes	Yes
Power Door Locks	Yes	Yes	Yes	Yes
Power Steering	Yes	Yes	Yes	Yes
Power Windows	Yes	Yes	Yes	Yes
Sunroof/Moonroof	Yes	Yes	Yes	Yes

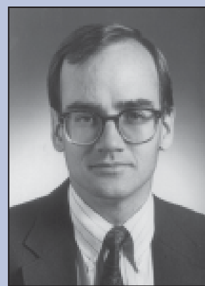
Appendix 2: Comparisons of Benchmark Vehicles

About the Authors

Dr. William Boulton is the *C.G. Mills Professor of Strategic Management* in the College of Business at Auburn University since 1990.

His research is focused on *Global, Technology-based Competition*. He was Visiting Professor at the Universitat Seminar der Wirshaft (USW) in Germany in 1999 and The Keio Business School in Japan during the Fall Semesters of 1992 and 1993. He was a Fulbright research scholar in Japan in 1986 and was a visiting scholar at Japan's prestigious *Institute for Fiscal and Financial Policy* in 1993.□ He had completed numerous research reports for U.S. government agencies on electronic manufacturing technologies and industrial development policies of Asian countries that include **Electronic Manufacturing and Packaging in Japan** (1995), **Semiconductor and Electronic Manufacturing in the Pacific Rim** (1997), **Information Technologies in the Development Strategies of Asia** (1999), and **Electronic Manufacturing in Hong Kong and China** (2000).□ He is author of numerous articles and cases covering topics of competitive strategy, strategic planning, boards of directors, and technology and innovation management. He also co-authored **The Japanese Electronics Industry** (1999), and authored **The Resource Guide for the Management of Innovation and Technology** for the AACSB (1993), and **Business Policy: The Art of Strategic Management** (1984).

Prof. Dr. Michael Dowling was named to the professorship for Innovation and Technology Management at the University of Regensburg



effective July 1, 1996. Previously he had been an Assistant Professor and Associate Professor with tenure at the University of Georgia. Prof. Dowling was born in 1958 in New York, USA. He studied at the University of Texas in Austin (Bachelor of Arts with High Honors), Harvard University (Master of Science) and University of Texas at Austin (Doctor of Philosophy in Business Administration). As an exchange student he also spent two years at the Ludwigs-Maximilians Universität München. He has worked as a Research Scholar at the International Institute for Applied Systems Analysis in Laxenburg, Austria and as a Research Analyst with McKinsey & Company in Düsseldorf Germany.

His research interests include the strategic management of technology in the private sector, especially in the information technology industry, and the relationships between technology, public policy and economic development. He has published articles in Strategic Management Journal, Management Science, California Management Review, Research Policy, Business Horizons, Columbia Journal of World Business, and Telecommunications Policy.

He has received academic honors including Phi Beta Kappa, a Rotary International Fellowship, a Fulbright Scholarship, a Sarah Moss Fellowship and a SEL Foundation Fellowship.

He has also consulted with various companies and organizations including Bell South Corporation, Southwestern Bell, and UBM Consulting.

Teacher's Note[1]

BMW's 3-Series: Managing Platform Design and Development Costs

This case is about the development of BMW's new 3-series platform, which was initiated in 1994 for introduction in 1998. It is based on interviews with the project leader and key team members. The case describes the key tools used in the concept design and target costing processes of product development. It summarizes many of the tools being used for product design and development by leading edge firms, such as BMW, including target costing, market analysis, product assessment, module evaluation, and technology assessment. It also raises the problems of dynamic competition during the development process. Key management questions include:

1. What are the critical inputs to product design and development? How do you integrate product design with and development with cost management?
2. What happens when competitive products are introduced during the product development process? What is the impact of design changes on your costs?
3. How do you maintain strategic flexibility and manage product costs in a dynamic world?

Intended Audience

This case was designed for use in executive development programs and in advanced courses in product development, technology and innovation management, and strategic management. It provides a comprehensive view of the concept design process, which makes it a good introductory or summary case. The case provides the instructor with an opportunity to stress the dynamics of the competitive conditions under which products are being developed. For the BMW 3-series, Audi introduced its new A4 model in 1996 to compete directly with BMW 3-series. The case also compares new benchmarked vehicles, including Mercedes and Lexus models.

1 Funding was provided by the Peter Curtius Foundation for USW.

Teaching Objectives

This case is set in the dynamic world of automotive design. The teaching objectives are related to the interactions between product design and cost management during the product development process. There are several directions that you can take. One is to focus on the product design and development process itself. For example, you can put the class into teams and have them begin planning for the next platform, since it is now time to start the process again. You can then add the competitive challenge of shortening the total development cycle to and industry goal of 24 months. Two is to focus on the basic characteristics of the case itself. Either approach would address the following questions.

1. What do you consider the important characteristics of a BMW? If you were to appoint BMW's next generation 3-series project team leader, what basic guidelines would you set for the team? Why are they important?
2. How would you evaluate BMW's project management tools? How does the top-down target costing system work? Is it effective? How do you handle the gap between top down and bottom up cost assessments?
3. How can you determine a new model profile? How do you determine what level of satisfaction it will generate?
4. How do the marketing inputs help define the project targets? What are the criteria?
5. How effective is the technology and module analysis? How does it help in defining the new model? What happens if the bottom-up costs do not meet the top-down target? How do you bring the budget into financial balance?
6. What do you do about new competitive introduction during development? Do you modify the model? Do you protect the budget?

Discussion of Teaching Questions

1. What do you consider the important characteristics of a BMW? If you were to appoint BMW's next generation 3-series project team leader, what basic guidelines would you set for the team? Why are they important?

QFD (quality function deployment) is directed at meeting customer requirements. There is a basic difference between developing new models, and continuing a classic design or icon. The basic 3, 5 and 7 series of BMW are well know styles in the marketplace, and must continue their heritage if they wish to keep their customers coming back. For example, if the Jeep was radically changed in style, it would no longer be a Jeep. Many of the 1950s British sports cars have lost their heritage, as did Ford's Thunderbird and Mustang, and Nissan's 280Z. Maintaining a classic design allows for an extended life cycle that may go well beyond normal products. BMW is attempting to build classic designs that will live for at least seven years. In such a case, what are the design parameters?

A picture of the BMW 528i is placed on page 1 of the case to show BMW's latest series design. The question posed to students should be, how similar or different should the new 3 series look? How much similarity should there be across the series 3, 5 and 7. In what ways should they differ? This should lead to a discussion of the basic characteristics that the design team must use? For example:

- What characteristics make it a BMW? The "double kidney" grill is key. The BMW logo is very distinctive. The styling is sleek and the raised body over the wheels is distinctive for BMW.
- What should be the differences between a 3, 5 and 7 series? They primarily differ according to size, weight, and features. The 5 series is heavier and larger, making for more comfortable driving at high speeds (in Ger-

many, it is the car for company sales people). The 7 series is much larger and more expensive. There is about a $15,000 price difference between each model.

- There can be open discussion about what car gets the latest technology. Since each series lasts for 7 years, the latest model generally gets the latest technologies. However, that closes the gap between model features that can be used for marketing. The latest series tends to pull sales from older series, unless new "sporty" or "special" features can be added to existing models.
- Finally, response to competition and customer complaints is critical with new models, since you will live with them for seven years. The old 3 series was too small in the rear seat and between seats, and lacked an elegant interior suitable for its high price and image.

2. How would you evaluate BMW's project management tools? How does the top-down target costing system work? Is it effective?

BMW's new project management process is systematic and is intended to increase the discipline of the project team. The easiest way to understand it is by viewing Figure 2 in the case.

The first step is to understand the market. Interviews provide input for Conjoint Analysis. A good example of Conjoint Analysis for consumer use is available by accessing http://www.autotrader.com/ on the Internet and following their *Decision Guide* through the decision-making process. You can then identify many of the elements that go into the decision-making for car buyers. AutoConnect will help you find the car(s) that best fits your decision criteria.

3. How do the marketing inputs help define the project targets? What are the criteria?

Market analysis and customer satisfaction inputs provide the criteria for improving on the existing product. Competitive benchmarks give a minimum requirement for a new series, plus specific customer inputs that come from customer surveys and satisfaction reports. This sets the minimum standards for improvement of a new series. From this, the vehicle feature assessment provides the specific targets for design and technical improvements. You can see from Figure 4 in the case that overall safety and acoustic comforts were especially poor in the old 3 series.

You can also see that little effort was planned to improve design and road performance characteristics.

Finally, the market volume and price must be decided to provide a forecast for determining the overall revenue target for the new series. Without this number, it is impossible to generate a total cost target.

4. How do the marketing inputs help define the project targets? What are the criteria?

Since there are planning, development, and other **Non Recurring Costs** that must be determined in addition to **Production Costs**, the **Targeting Costing** parameters must be determined by the project development team (Figure 3 in the case). Warranty and volume mixes are also important in determining total costs. Because of the variations in volume and cost allocations, historical market data is useful. BMW has a long history selling its 3, 5 and 7 series and can determine relative volume based on past sales numbers.

In the final analysis, tradeoffs between various scenarios can be produced using Sensitivity Analysis shown in Figure 5 of the case.

5. How effective is the technology and module analysis? How does it help in defining the new model? What happens if the bottom-up costs do not

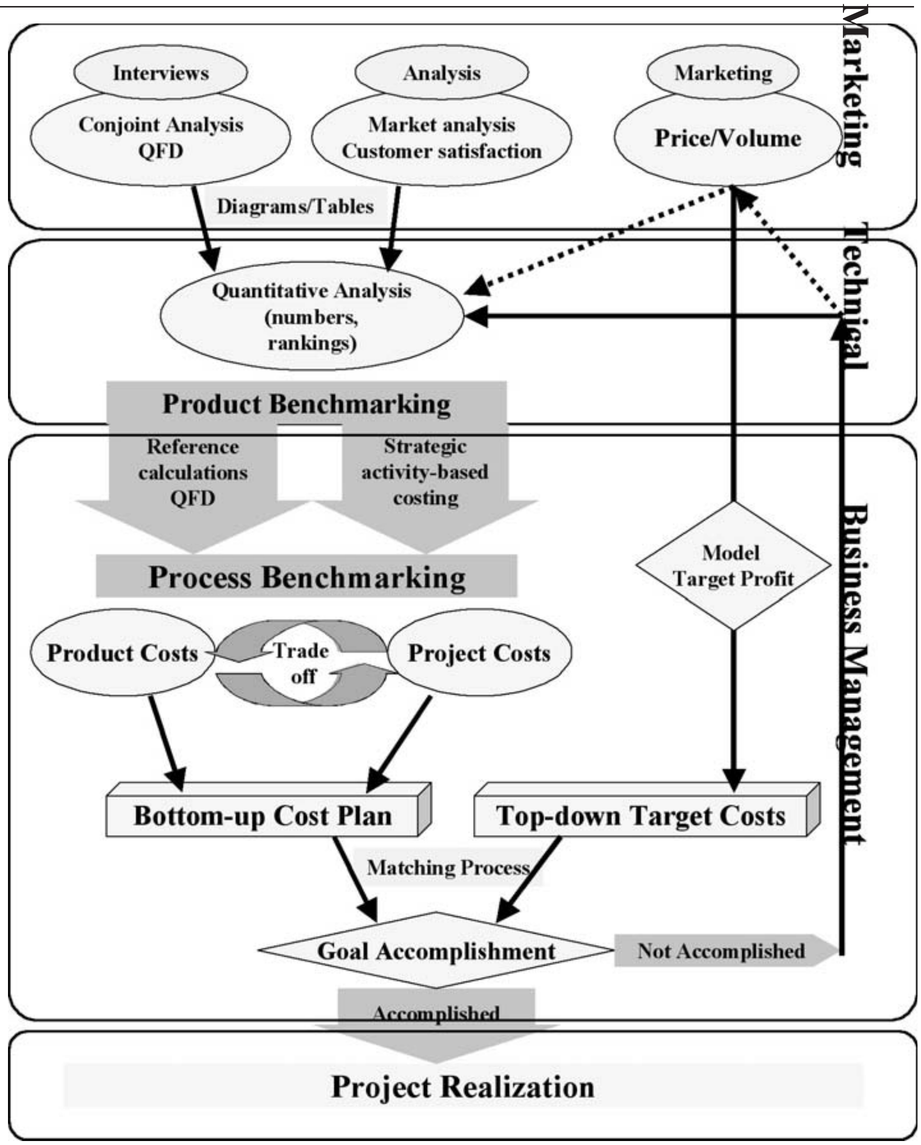


Figure 2: Integrated Market-oriented Top-down Target Cost Management

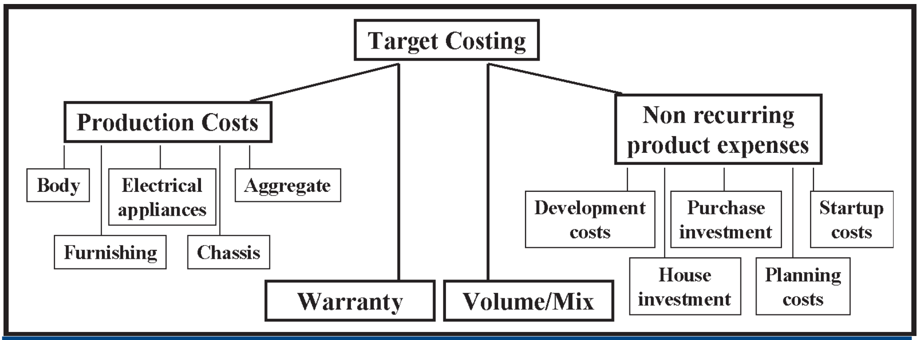


Figure 3: Target Cost Budgeting Model

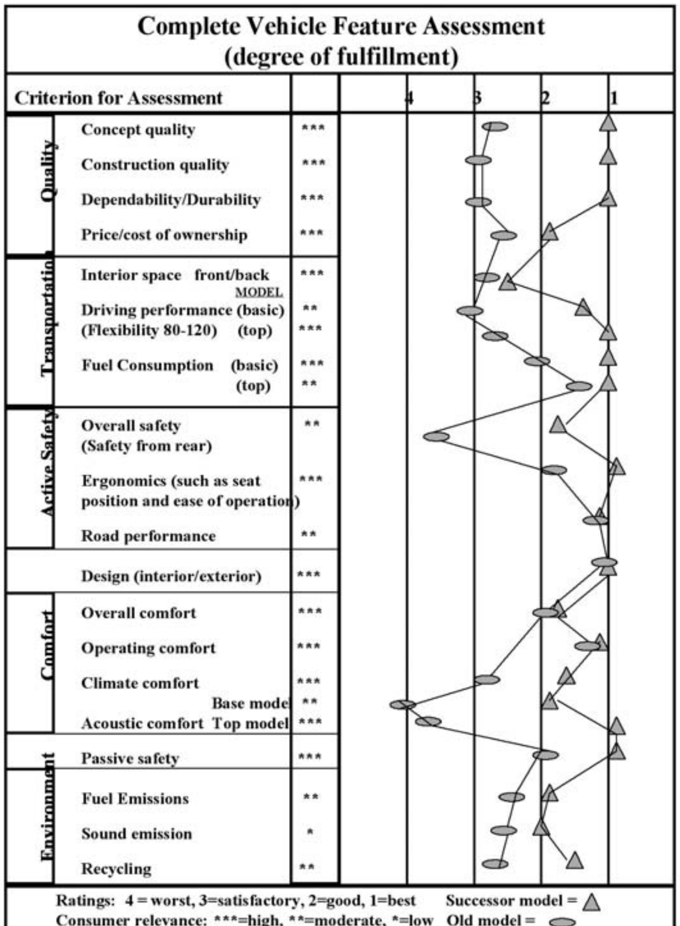


Figure 4: Next Generation 3 Series Profile

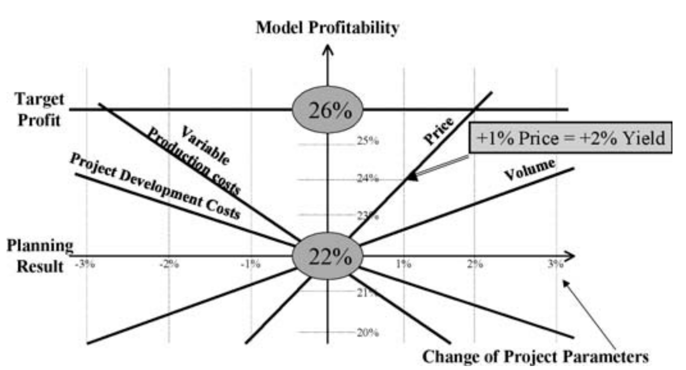


Figure 5: Sensitivity Analysis for Model Profitability

meet the top-down target? How do you bring the budget into financial balance?

The ultimate cost structure will be driven by the degree of changes made in the new series. Every component and part that is changed has some additional cost element. Any components that can be migrated from an existing series reduces the cost of change. The more desirable the new series, the higher the sales volume and ultimate profitability. A 1.0% increase in price will generate a 2.0% increase in profitability. A 1.0% increase in volume will generate a 0.5% increase in profitability. A 1.0% reduction in development costs will increase profitability by about 0.5%. A 1.0% reduction in production costs will improve profitability by over 1.0%.

Over 70% of costs are determined in the design process. Depending on what trade-offs are made in design, 30% of the remaining costs can be controlled by production. At the end of the design process, the deficits in achieving the target costing goals are put on the shoulders of manufacturing. This is what was done with the 3 series.

6. How effective is the technology and module analysis? How does it help in defining the new model? What happens if the bottom-up costs do not meet the top-down target? How do you bring the budget into financial balance?

The real cost analysis of the new series must come from the technology assessment. This begins with an assessment of the key spaces/modules (Figure 6) of the car, and then moves into the individual discussion of all 4000 unique parts (Table 1).

The degree of change, planning cost, R&D requirement, and investment associated with each part change is assessed to provide the **bottom-up cost** factor. It is also here that ultimate cost control will be made. When the initial matching process begins, the design team must move from the "ideal" to the "reasonable" design. For example, the engine used in the 528i was used in the new 3 series. The suspension system, which was quite adequate in the old 3 series, was only modified, rather than made new. You can lower overall development costs by using more parts from existing series. This requires

Module	Code	Supplier	Name	Technical Description	Part count	Same part	New part	Change factor	Plan cost	R&D cost	Invest-ment
10	1234		Outer sidewall	New development	100	2	98	0.5	200	300	3000
20	1235		Front hood	Develop new hinge	50	10	40	1	100	20	100
			"	Use from predecessor							
30	1236	Webasto	Sliding roof	New development	50	0	50	0.8	50	10	1500
40	1237		Airbag generator	Use from 5 series	20	20	0	0	0	5	0
40	1238		Battery w/holder	Use from predecessor,							
			"	Develop new holder	5	1	4	0.2	20	10	200
40	1239		Inner lighting	Use from 7 series	10	10	0	0	0	50	0
50	1240		Heating	Use from predecessor,							
			"	Modify (some change)	100	80	20	0.5	200	300	2000
Summary:					335	123	212		570	695	6800

Table 1: Technical Scoring Framework

continuous trade-offs, and continued review of the conjoint and competitive analysis to determine the impact.

7. What do you do about new competitive introduction during development? Do you modify the model? Do you protect the budget?

Flexibility in design is critical in a dynamic industry like automobiles. While freezing the design is always critical for cost control, having a strategy for responding to market changes is essential for long term competitiveness. The introduction of the Audi A4 and the Mercedes modified C-class required some reassessment. BMW engineers are familiar with most new designs, but have not experienced the revised driving characteristics of competitor's cars. It is critical for the new 3 series maintain its reputation as the "Ultimate Driving Machine". Team members were surprised at Audi's drivability. For a front-wheel drive car, it was better than they expected. Its price and features were also better than the team expected, forcing team members to reconsider what options to make standard for the added price. Mercedes' new C-class had quad front lamps, which caused BMW's design team to change the front lamp design slightly, giving it a slightly sculpted look to its headlamps.

From a teaching perspective, the question is how many changes you can afford to make at such a late date. The cost of new releases can increase the cost by 25%. A new design costs as much as the first. Each decision impacts the ultimate profit sensitivity. But a better competitor design could also reduce expected sales, and thus profitability. Ask the students what risks they want to accept? Lower sales, or higher cost?

You can see the added cost of alterations to an established model in Figure 6.

The figure shows how closely the new 3 series looks like the current 5 series displayed in the case. The latest development of the new 7 series also follows this design theme, as Bangler continues to develop a set of BMW icons. The new BMW X5 SUV also has the same front end design. There is no mistaking the BMW for a Toyota.

Main activities	Cost Driver	Technologies: Driving	Chassis	Body	Furnishings	Electricals/ Electronics
1. New series	First release	300	200	300	100	400
2. Model revision	First release	300	200	300	100	400
3. Alterations prior to series start.	Alterations	70	50	60	30	70
4. Alterations after series start.	Alterations	70	50	60	30	70

Figure 6: Cost Drivers in Developing the New 3 Series (million DM)

Other Readings

Dr. Friedrich Nitschke, Market and Process Oriented Cost Management for Product Design in Automobile Manufacturing. (Hamburg, Germany: Verlag Dr. Kovac) 1998. Dr. Nitschke used the 3-series project for his Ph.D. dissertation at Rostock University.

The New BMW 328i: Good Things Come in Threes

I've always been a big fan of BMW's best-selling 3 Series—the M3 is still the vehicle I'd buy tomorrow—for the cars' performance, usability, and quality (not to mention manual gearbox). In fact, the only things I'd fault the current generation entry-level Bimmers on is conservative lines, lackluster interior styling, and

a compact back seat. But hey, with this kind of nimble handling and racer-boy mentality camouflaged in a well-built everyday driver, who's complaining? Not me, since I drove the next-generation 3 Series last week in Chicago. With the new 328i, BMW has fixed those problems. Polished them, in fact, to a high gloss.

On hand to articulate the understated yet handsome changes was BMW's head of design, Chris Bangle. An American with the energy of a mad scientist and the demeanor of a stand-up comic, Bangle pointed to two features—the sweeping vertical cut lines that accent the rear portion of the passenger compartment and the scalloped, eyelike headlight casings—as the keys to the redesign. The first was largely aesthetic, while the second was the result of a 30% increase in headlight power. "We raised the hood and dipped down low under the lights to create an eye effect," explained Bangle, magic marker dancing over his sketch pad. "The competition, however, does cartoon eyes," he continued, drawing a wide-eyed Mickey-Mouse-Mercedes pair.

The other looks-enhancing change is the car's wider stance, which gives it a crouched, ready-for-action look—and even more stability. And ready it is: For several hours, I got to push the new 3 through Wisconsin's rambling, empty back roads. The second I sat down, the new interior styling wrapped around me, beckoning me to speed with its simple, elegant, driver-friendly controls, and an interactive feel. All the buttons are at just the right spot to hit without groping while driving, and the orange cascade panel lighting gives you, as Bangle puts it, "a whole surface to relate to, not just a swarm of fireflies." Exactly.

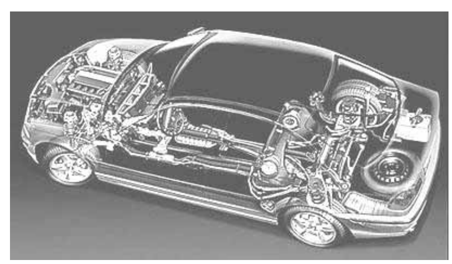
My favorite features were the exceptionally sweet, easy-to-use five-speed gearbox and the four-wheel ventilated disc brakes (the largest in class, up against the likes of the Mercedes C-Class and the Audi A4). The BMW also expanded its interior space from 86 to 91 cubic feet—more than the Mercedes and the Audi. The 328i has a new system, CBC (cornering brake control) that continues where ABS leaves off. Here's how it works—and I speak from experience: Say, for example, you're screaming around a blind curve in the middle of farm country, and suddenly you realize you're going too fast, as evidenced by the rear end of your car starting to swing around alongside you. When you brake, the CBC kicks in, automatically calculating the curve's degree of sharpness, and then distributes brake force to the outside wheels to stabilize the car.

Shall I go on? BMW increased body stiffness by 50% and the front end's energy absorption by 80%. There are eight airbags, a programmable key that controls 40 driver preferences, more low-end torque, and a trunk rug that reverses to rubber to accommodate muddy gear or help groceries stay in place while testing the aforementioned braking system. Has BMW messed with its best-selling car line? You bet. And the results are fabulous. It's good-looking, safe—and most important, it offers up as much fast yet unintimidating driving fun as I've had in a while.

Price: Base: $33,400 Loaded: $38,200

Highlights: 0 to 60: 6.6 sec. Engine 190 hp 2.8-liter inline six cylinder engine, multi-programmable ignition key, increased interior space, more extensive options packages.

Who'd Buy It: Anyone serious about a car's performance, quality, ability to handle real-world loads—and good looks. See the BMW website at www.bmw.com.



Review by Sue Zesiger, senior editor of **Fortune Magazine,** July 31 - August 6, 1998.