

007-0355

**Platform thinking in the automotive industry – managing the
dualism between standardization of components for large scale
production and variation for market and customer**

Track title: Product Innovation and Technology Management

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POMS 18th Annual Conference

Dallas, Texas, U.S.A.

May 4 to May 7, 2007

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Abstract

Automotive industry faces two major problems. One is to develop standard platforms to reach high volumes and low cost. The other is to use platforms for enabling variation of models that suit customer needs, local market demands, and restrictions. Platform thinking embraces several industrial levels, systems integrators, global and local suppliers, and markets. How can the dualism between standardization of components and model variation be managed and which trade-offs need to be made?

In this paper we have identified and analyzed different approaches to platform concept from technical as well as organizational, production, and product development perspectives. Platform technology improves flexibility in production and product development. However, when radical changes are made, new design of platform is not

easily made, i.e. propagation of requirements and changes in models vs. platforms. When this happens, several production systems have to be entirely rebuilt causing major capital investments, redesign at suppliers etc. Hence, platform technology reduces product development flexibility.

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Key words: Platform technology, modularization, automotive industry, mass customization

1 Introduction

The success of the Japanese car manufacturers, and in particular Toyota, is due to different principles of mass production. The Toyota Production System, developed by Taiichi Ohno in the 1960s and 1970s, and lean production that was discovered in the 1980s, inverted some of the dimensions of mass production. They have some common aspects such as standardized product design, inter-changeability of parts, and continuous assembly line. But lean production uses more general resources, like multi-skilled workers and general purpose machine for flexible production, small buffers and lot sizes. It facilitates a market strategy of responding quickly to demand fluctuations with a greater variety of product designs and more decentralized authority with greater lateral communication across functional boundaries, team work, and operators' participation in quality circles and continuous improvement activities. The 'pull' system, rather than the 'push' system under mass production, leads to greater production efficiency and quality improvements. The best efficiency of lean production over mass production is also reflected in product development. A major reason for this difference lay in over-lapping product development phases and the effective use of suppliers as part of the development team.

Today, automobile industry is working according to the so-called platform thinking. Car manufacturers use a common base where they build up the entire car. This common base is known as platform. The car manufacturers share it among different models in order to reach higher volumes and to achieve economies of scale. Several brands, owned by major car manufacturers, are built on common platforms thus enabling larger volumes.

However, platform thinking not only involves this sharing of platform but also an entire philosophy of proceeding, especially when it implies groups. The main idea of that thinking is to share. They share components, tools, processes, development, workers, strategy, etc.

According to McGrath (2000) a product platform is not a product, it is a collection of the common elements, especially the underlying defining technology, implemented across a range of products. In general, the platform is the lowest common denominator of relevant technology in a set of products or a product line. These common elements are not necessarily complete in the sense that they are something that could be sold to a customer. Therefore, the corollary with platforms is “invest one, reuse over and over again” (Kuczmarski, 2000). Since a product platform is not just a physical product, it is primarily a definition for planning, decision making, and strategic thinking. In this way, the company, that uses a platform product, has to take into account how that family addresses a variety of customer needs and which markets or segments of customers are involved.

All this sharing searches a cheaper way to produce cars. However, this sharing has to be managed very carefully and to do it becomes very difficult. The companies have to coordinate a lot of different things. The use of global platforms leads to that the developing them becomes more difficult in order to fulfill all the different requirements and constraints needed for the large range of models that they have to fit. Moreover, the complexity of the product planning grows due to the large number of cars involved. At

the same time, coordination of the different production processes is really complicated. Furthermore, the fact to work with different people from different brands, even from different cultures and often in different places, makes it difficult to work together. Besides of that, too much commonality among models makes it more difficult to maintain a good level of variety in these different models based on the same platform.

Despite being used in several industries, according to Sundgren (1999) the use of product platforms has been highlighted in automotive-, consumer electronics-, and engineering industries. The challenge for those companies is to create the desired product variety economically. In the case of the automobile industry, the idea of the platform is the one represented in the figure 1.1 below, inspired from Danilovic and Börjesson (2001):

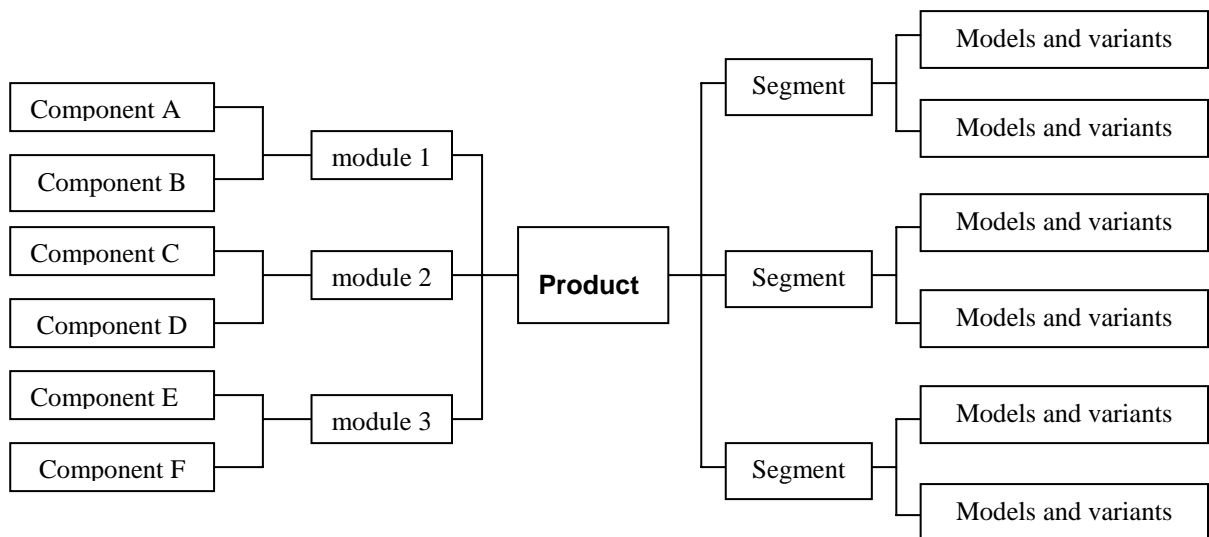


Figure 1.1. - Product platform

Source: inspired by Danilovic and Börjesson (2001)

As it can be seen there are different aspects that need to be managed carefully in order to become successful in a platform product strategy in the automotive industry, but the advantages that spring from it are really interesting.

The purpose of this paper is to highlight the different aspects and implications, both pros and cons, of technical as well as organizational, production, and product development perspectives when working in a platform environment.

2 Research Approach and Methodology

This paper is based on research, the theoretical knowledge written in articles, papers, conferences, books, etc. about multi-project and more accurately platforms, above all in the automotive industry. Almost all these articles and papers were written during the last eight years, and the number of published articles grows every year, which means that it is an issue that is drawing more and more attention.

The table 2.1 shows the number of specific papers categorized after how they address different aspects of platform approach.

POINTS	NUMBER OF PAPERS USED
Approaches to platform concept	19
Advantages and disadvantages of platforms	12
Influences of platforms on strategy and structure	26
Influences of platforms on the production	7
Dynamics of life cycle approach	

• Development new platform	13
• Dynamics of the platform	8
• The life cycle approach	5

Table 2.1. – Resources consulted

During the second phase of our research on empirical investigations, interviews were conducted with representatives for car manufacturing companies as well as some major suppliers.

This paper is based on literature reviews and case studies in the automotive sector.

3 Platforms in automotive industry

Many car manufacturers use common platforms for their different models. Although the concept of the platform is really accepted and used in the automotive sector, the components of the platform are not always the same. Depending on the brand, they work with more or fewer components in their platforms. Some brands have a more basic platform formed by few components, while other brands make their platform with more components included.

These variations in the components used are caused by several reasons. One of these is that for one company it could be better to add one piece to the platform and, therefore, share it among the different models and, on the other hand, another company could prefer to have this piece different for each model based on the same platform, so they do not put this piece in their platform. Another reason is the different possibilities of the manufacturing technology that each company has. Each car manufacturer uses different processes in the production and, obviously, these affect the choice of parts that he builds

the platform on. For these technological reasons, there are some components that sometimes one of these manufacturers would like to have in the platform but he can not put on it because of his production process.

However, the difference among the parts that belong to the platform is not the only one. The strategy to work with platforms is not always the same in each brand either. There are companies that have totally integrated in their structure the platform meaning and, on the other hand, there are some brands that use the platform to save money but they did not adapt their strategy completely to it. The group does not only need the thinking of the platform to be changed, it needs the money to pay all these changes too. To adopt a platform strategy the group needs to change your factories as well, which is a really expensive process.

A review of the concept of platform, that the different brands of the market have, shows really clearly the idea explained above; the components of the platform are not fixed. For example, regarding Volkswagen, the platform consists on front axles, rear axles, front ends, rear ends, exhaust systems, brake systems, and numerous other elements (Sudjianto and Otto, 2001). On the other hand, General Motors considers its platform as the union of the steering, suspension, brakes, engine and exhaust. It is necessary to say that the engines are also produced by platform, so when GM design the car platform, several engines can be used on it (Scott, 1995).

Due to this variety of concepts shown by car companies, the literature of this field does not always define the platform in the same way either. So, there are components that some authors think that they belong to the platform and others do not. In this way, in the

literature there are from really general and simple definitions with few components to ones more detailed and complex with more parts.

Basically, the platform means the core framework of cars that includes the floorpan, drive train, and axles (Ghosh and Morita, 2002). But, the literature has deeper definitions of the platform as a physical product. The platform is usually defined as the sum of suspensions, underbody, axles, and power train (Muffatto and Roveda, 1999). Finally, there are some definitions that include different kind of platforms depending on the strategy that the company is applying. The basic definition of a platform includes the underbody and suspensions. Underbody is made up of the front floor, underfloor, engine compartment and frame. From this basic definition of the platform three other different forms may be distinguished in the case of Japanese companies: narrow, broad and flexible (Muffatto, 1999).

For this author, in a narrow definition a platform is the front floor and underfloor, engine compartment and suspensions; the steering equipment can be added to the basic narrow definition. On the other hand, in a broad definition, a platform is defined as front floor, underfloor, engine compartment, suspensions, engine, transmission, fuel tank and exhaust system. A broad definition indicates a more “aggressive” approach or a more developed platform strategy, which has a significant impact on both product development performances and on the organizational structure.

Finally, in a flexible definition a platform is defined as: floor panels (divided into core, front and end ones), suspensions, powertrain and engine. A single platform may have different lengths (depending on the wheelbase). It is important to use the same stamping

dies or with very few modifications, to produce the same platform. The other important factor is whether the platform enables the same production line to be used without major modifications or not. Within these constraints a platform could use a combination of parts such as core under-floor B, front suspension A, rear suspension B, etc. However, this flexibility also brings some trade-offs. For example, if the same platform is to be combined with different engines, the weight of the chassis and the size of the engine must be considered together, as a larger engine needs a heavier structure and vice versa.

Different brands on the same platform and with small differences in technology, experienced quality, and features make it difficult to convince customers that the specific car provides unique experience. Why pay for an Audi or VW when a Skoda is equal in terms of features, performance, and comfort? The platform technology will be optimized for the car model with the largest volumes.

Even so, it can be said that in average the development of a platform is around 24 months, whereas the model development is situated around 18 months.

Another important point of the concept of the platform is the number of models that shares the same platform. This number of models per platform used to be less in the past, and the tendency nowadays, and for the future, is making as much models as it is possible with the same platform. This tendency has an easy explanation: the higher the number of models spreading out from a unique platform, the heavier is the exploitation of the platform itself and the higher its effectiveness (Muffatto, Roveda, 1999). At the same time, the car manufacturers try to reduce the number of platforms that are working with,

so the number of models based on one platform will increase more and more over the years.

Table 3.1 shows, for several groups of the automobile sector, the relationship between some platforms that they were using in 2000 and some models produced in the same year or planned for the future. It is important to remark that there are shown neither all the models nor all the platforms of these groups.

GROUP	PLATFORM	MODEL	PRODUCTION 2000
PSA Peugeot-Citröen	M49	Citröen Berlingo	185 400
		Peugeot Partner	85 400
	106	Peugeot 106	103 287
		Citröen Saxo	243 200
	306	Peugeot 306	237 700
		Citröen Xsara	222 100
		Citröen Xsara Picasso	138 800
	PF1	Citröen C3	Start production on 2001
		Peugeot 107	Start production on 2002
		Citröen Pluriel	Start production on 2003
PF2	Peugeot 307	Start production on 2001	
	Citröen C4	Start production on 2004	
PF3	Citröen C5	Start production on 2001	
	Citröen C6	Start production on 2004	
	Peugeot 407	Start production on 2003	
U40	Peugeot 806/Expert	46 700	
	Citröen Evasion /Jumpy	39 300	
U3	Citröen Jumper	22 250	
	Peugeot Boxer	34 200	
V2	Citröen Evasión	Start production on 2002	
	Peugeot 806	Start production on 2002	
FORD	BE91	Ford Ka	150 000
		Ford Fiesta	274 250
		Ford Puma	22 000
	CDW162	Jaguar Xtype	Start production on 2001
		Ford Cougar	52 200
Ford Mondeo		186 700	
CW170	Ford Focus	Unknown	
V2	Ford Galaxi	Start production on 2002	

	418	Ford Galaxy	18 500
	B256	Ford Fiesta	Start production on 2002
GM	T3000	Opel/Vauxhall Astra Opel Zafira Astra Coupe y Cabrio	568 000 201 500 50 000
	J2900	Opel /Vauxhall Vectra Saab 9-3 Saab 9-5 Saturn L-Series	230 000 44 800 35 700 94 000
	S4200	Opel/Vauxhall Corsa Opel Tigra	414 200 17 100
	V	Opel Omega Cadillac Catera	50 300 18 000
RENAULT	P1	Renault Kangoo Renault Clio Renault Twingo	361 900 470 200 Start production on 2003
	P3	Renault Megane Renault Scenic	300 100 329 100
	P5	Renault Espace Renault Vel Satis Renault Laguna II Renault Avantime	62 000 Start production on 2001 168 600 Start production on 2001
VW	A00	VW Lupo Seat Arosa	88 100 30 100
	A0	Seat Cordoba Seat Ibiza Skoda Fabia VW Polo	84 600 175 200 72 100 358 100
	A	VW Golf VW N. Beetle Audi A3 Audi TT Skoda Octavia VW Bora / Jetta Seat Toledo Seat León	670 000 122 750 117 700 38 400 100 800 92 400 52 600 71 700
	B	VW Passat Audi A4 Audi A6	272 600 17 700 112 800
	D1	VW D1	Start production on 2002
	PQ24	Seat Cordoba Seat Ibiza VW Polo	Start production on 2002 Start production on 2002 358 100
	PQ35	Seat Toledo	Start production on 2003

	418	VW Sharan	44 100
		Seat Alhambra	45 300
	MAC	VW Colorado	Start production on 2002
FIAT	178	Fiat Palio Hatchback	Unknown
		Fiat Siena	Unknown
		Fiat Palio Weekend	Unknown
		Fiat Strada	Unknown
	B	Fiat Punto	569 000
		Fiat Punto Cabriolet	5 000
		Fiat Barchetta	5 500
		Lancia Ypsilon	110 100
	-	Fiat Stilo	Start production on 2001/2002
	C	Fiat Bravo /Brava	136 300
		Fiat Marea / Weekend	56 350
	D	Alfa Romeo 156	98 000
		Alfa 156 Wagon	15 650
	Lancia Lybra	57 200	
	Alfa Romeo 147	7 500	
GTV Coupe	Maserati Spyder	Start production on 2001	
E	Alfa Romeo 166	19 300	
U40	Lancia Z	2 200	
	Fiat Ulysse /Scudo	49 100	
V2	Lancia Z	Start production on 2002	
	Fiat Ulysse /Scudo	Start production on 2002	
U3	Fiat Ducato	275 200	

Source: www.autoindustria.com

Table 3.1. - Production of platforms 2000

The reason to work with platforms is really clear for the *Car manufacturer*:

The main reason of the platform thinking is that you can share components, reduce costs and made more cars(Car manufacturer).

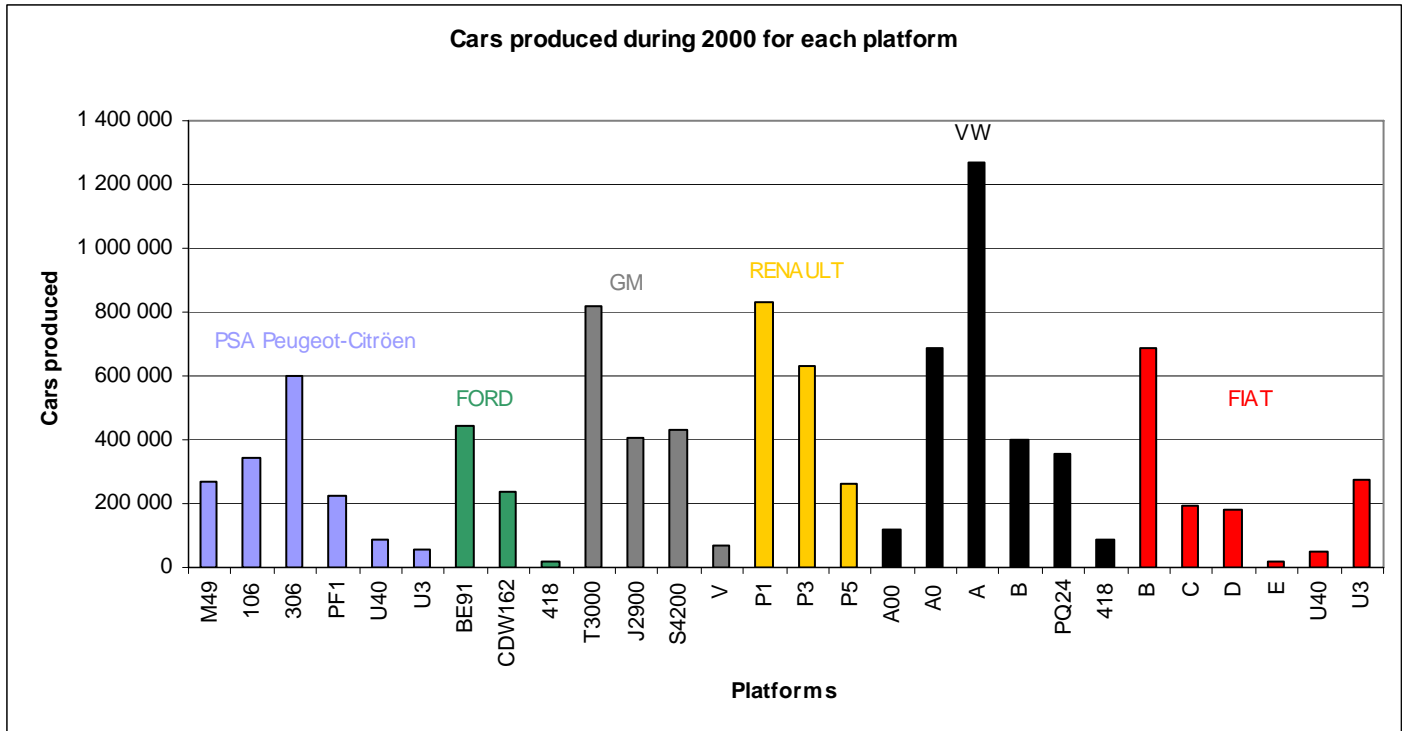
4 Market aspects vs. production

Geographic location of market

An important thing to avoid with the use of the platform is the inflexibility of the product because it goes head-on against the permanently changing world of the automobile. In this way, maybe the scale of economy theory cannot explain a so complicated and diversified changing market and its movements of the demand across different regions and time without synchronizing such changes by regions (Shimokawa, 1999).

Furthermore, the tendency to reduce the number of platforms and the merge of different brands could drive to standard products without their charm and weakening their attraction. Too much standardization could bring cars towards the path of personal computers. And for the consumers, it may decrease the expectations or the perceived value of the product when the component sharing is visible, easily perceived or known to the user. In that sense, even the best-camouflaged common components will lower perceived valuation, particularly when attributes that consumers value are involved. For instance, General Motors offered several models of cars based on a common platform and it was roundly criticized for its look-alike car line-up (Desai, Kekre, Radhakrishnan, Srinivasan, 2001). So, at the same time that companies diminish the manufacturing costs with the use of shared designs and common parts, the company's overall profits could go down for the effect of the declining differentiation. And it has to be watched carefully.

With table 3.1 shown before, it is possible to make a graph showing how many cars were built basing on each platform during the year 2000, see figure 4.1.



source: www.autoindustria.com

Figure 4.1. - Cars produced during 2000 for each platform

We can see from table 3.1 that manufacturers use a number of different platforms for car models in different segments of the market and with different production volumes. This implies that manufacturers are using production facilities in different plants, regions and countries in order to ensure requirements of scale of economy and customization.

Those aspects are to be elaborated and investigated in this paper.

5 Market strategy vs. platform thinking

Frequent releases of new models is enabled through platform technology.

When a primary product platform enters in decline, the entire business is threatened if the company does not react in time (McGrath, 2000). Deciding when and how to react against this decline is a critical judgment and, more often than not, the delay proves fatal.

This idea can be seen in the table 3.1, for instance, looking to the GM models, it is easy to see that Opel Tigra is built on the platform S4200 used by Opel Corsa, too. The volume of Opel Tigra it is really lower than Opel Corsa one (17.100 units versus 414.200 units respectively). So probably, Opel Tigra, without using the S4200 platform, could not have enough market to cover the cost to develop it starting from 0. In this way, it is easy to see more examples illustrating this issue, like Ford Puma with the BE91 platform or Fiat Barchetta with the B platform.

This also implies that platforms diversify the company's risk. That means that, if some area of the market fails, it can be covered by success in other areas (Kuczmarski, 2000). Thus, platforms increase market variety but at the same time allow reducing the internal variety as it was seen before.

The times of introducing each different model in the same platform are different. When the use of a new platform starts, the car manufacturers begin to produce only a few models with it. Later on, more models will be added to this platform. For instance, this is what happened with the platform PF1 of the PSA Peugeot-Citröen group. PF1 is the same platform for Citroën C3 starting in year 2001 and Peugeot 107 starting in year 2002 followed by Citroën Pluriel in 2003 that should use the same platform. This is a good example that shows the difficulties to coordinate the different models, as well as it also happens with the cases of the PF2 and PF3 platforms of the same group. In this case

Citröen C3 and Peugeot 107 are similar car models, from a marketing point of view, aiming the same market segment. The similar situation is visible for PF3 platform. PF3 platform is expected to be used for Citröen C5 and Peugeot 407. Also in this situation the car models are of similar size and aiming at the same market segment.

However, we can see in Table 3.1 some interesting issues. Ford is using the same platform, CDW162 for three car models, the family car model Mondeo, the more prestigious and premium market targeting Jaguar model and the sport model Cougar. We can also see that production volumes are very different. From a market perspective the Jaguar has not been that success. One possible reason is that Mondeo and Jaguar are perceived by customers as too alike car models and that Jaguar X-type car adds little value while the price is 50% higher. Here we can see one major problem with platform approach. How to find the balance between brand differentiation for market and customer adaptation and standardization of components, systems and platforms for achieving high volumes in manufacturing and low manufacturing cost. The similar situation goes for Jaguar S-type that is build on the same platform as Ford Lincoln. None of Jaguar cars has been a market success and major renewal of the Jaguar model range has been announced. One interpretation is that Ford has been focusing too much on standardization and cost and not on differentiation and customization of brands.

Looking at the figure 4.1, it is easy to see which platforms were used to produce more units and, for every group, what was the use of his platforms during the year 2000. A perfect model of platform that takes benefit of this way of working was one platform of the group Volkswagen again. Their A platform was the base for eight models: VW Golf,

VW New Beetle, Audi A3, Audi TT, Skoda Octavia, VW Bora (or Jetta), Seat Toledo and Seat Leon. This example is also useful to show how they try to share platforms among different brands of the same group, since that platform was shared by four different brands: VW, Audi, Skoda and Seat.

An example of platform sharing among several models in one brand is the large platform, as it is named, that Volvo is using in the present to produce his models S60, S80, V70, and the cross-country cars XC70 and XC90. All of these models do not share only the platform but also a lot of components. Moreover, all of them have the same fixing points, so they can be made on the same line in the factory. So, for this brand the platform is not only one part of the car, it is a concept really related to the strategy that involves all the processes from development to production.

It is difficult to make very cheap cars and very luxury cars from the same platform because people will realize of that (Car manufacturer).

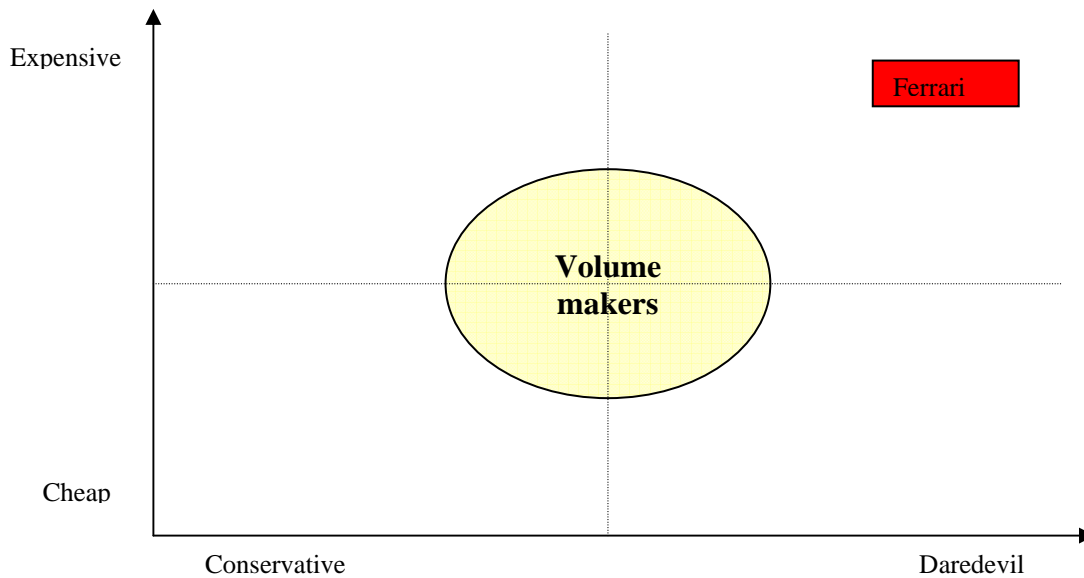


Figure 5.1. - Perception map. Ferrari case

The people do not want to pay the same price for a Ferrari manufactured in e.g. a Golf platform, see figure 5.1. A company that manufactures luxurious cars is looking for the differentiation and it assumes the disadvantage of the cost. They do not need the platforms; they need special cars with special features. So, the necessity of platforms depends on which place in the market the company is. Thus, the diversification of the market has limits.

Nowadays, companies such as Toyota or Ford have decreased the life cycle of their models to four years. This decrease is explained by Chris Theodore, Ford’s vice president of Advanced Product Creation who says the industry is responding to consumers who continue to demand lots of change in product, faster. Theodore says, “Life cycles are now about four years but platforms will stretch out over a decade.”

The platform is not just the frame of the floor as a lot of people think, the platform is a way of working that tries to share as much pieces as possible among different models as well as work with big volumes to achieve the scale of economies.

Anyway, there is generally a part of the car that it is known as the platform. These parts of the car is a concept called with different names inside the automotive sector, sometimes it is talked about architecture and sometimes it is talked about platform but, even then, the concept is almost the same.

Another problem that appears with the platform strategy applied by groups with different brands, as VW Group or General Motors, is related to the overlap of the markets among models of the same group. They start to fight among them for the same segment of the market. The brands of the same group are competing instead unifying forces. Furthermore, as they share the same critical dimensions (length, width, height) and many key components because of the use of the same platform, a growing number of customers have begun choosing the lower-priced products instead of more upscale division products. So, the initial target of saving money becomes later in a way to loose it. In the table 3.1 it can be seen that in this way, the Volkswagen Group had in the year 2000, up to 8 different models sharing the same platform, the A one, and some of these models are in the same segment, with similar look likes, facilities, quality, etc.

That means that the cars based on the same platform sharing the technology, the components, the production system have the same level of quality, and they can achieve

the same performance. However, people do not buy only for the performance of the car as a product; they see more things in a car. An example can explain it better. Technically, an Opel is as good car as a Saab looked as a product. They share the technology, the platform, etc. However Opel customer is more general public. Saab has to make a huge effort of marketing to try to focus their product to a certain part of the market, and to move it in the perception map to the left and up. In this way, another example to try to solve this problem could be seen in Volkswagen group. They try to focus each brand of the group to a certain market, Skoda to the economical segment, Seat more sportive, Audi more exclusive, etc., to avoid these brands fight among them. Even then, it is not easy to achieve it, because nobody wants to make the cheapest and simplest cars if they think that they are able to do as well as the other ones.

However, different groups have already started to fight against this factor. In this way, VW Group is trying to focus each of his brands to a special segment. For example this group, in the past, had the Seat Ibiza and the Skoda Fabia competing in the same segment. However, while Seat is trying to adopt a more sportive image, Skoda is developing models for the segment of low-prices cars. So, they try to assign to each brand a segment of the market trying to diversify their market and at the same time avoid the problem of the overlap.

Another attempt to solve it could be seen in Toyota that, trying to avoid the effect of similarities among different models, is starting to work with architectures rather than platforms. That allows working in a more flexible way making more structural changes

(widths, longer or shorter wheelbases, different packaging configuration, power trains and similar) to differentiate more the different models and brands (Eisenstein, 2002)

In this way, another problem that will be seen widely in the chapter called *Dynamics of the platform* is the loss of differentiation among products that could appear with the use of common parts and designs. While manufacturing cost always decrease with the use of commonality, the company's overall profits may decline because of reduced differentiation (Desai, Kekre, Radhakrishnan and Srinivasan, 2001).

Also there can be a partial problem related with the use of the platforms. This one is the fact that developing the initial platform requires more investments and development time than developing a single product. It also brings a delaying on the time to market of the first product and it affects the return on investment time. However, it is only a partial problem because it is only in the first product development, and the advantages of the use of the platform thinking rise quickly with next products based on the platform. The margin of profit grows and the lead time decreases as it was told before.

That we can see here is a struggle between two logics. One is focusing on scale of economy, lowering the cost of product development and manufacturing while the other logic is to differentiate car models according to customer demands and expectations. When one platform is used for different segments the differentiation is difficult to achieve and much effort has to be put in identifying what package of a platform is common, non-visible for customers, and what is visible and perceived as creating value, what customers are willing to pay and expect to get in return. When shortening of lead

time is becoming important the issue is to make platforms more sustainable while car models are changed more frequently.

6 Manufacturing perspective vs. platform thinking

The use of platforms brings the chance of sharing the same materials, the same components, etc. So it allows taking advantage of scale economies. This is what is known as “bill of components”. At the same time, the use of platforms in the production brings the so-called “bill of process”, which is referring to the way of manufacturing. This means that in the factory the car manufacturers, as well as all the suppliers, have the same fixing points, the same size of the product etc. Therefore, the same robot could take them and put clinches in different models from different brands based in the same platform. The companies can have different cars coming on the line where they maintain the same robots that can fit either a model from one brand or the other. It does not matter the look of the car or the size. As car manufacturer said:

The factory is the same even if there are different cars coming on it (Car manufacturer).

Thus, with the platforms, it is easier to combine different models in the assembly line of one factory. At present, every line of the factory is made for cars from one platform and then, as each factory uses to have some lines, in each factory the carmakers have a lot of different materials, flows, etc. Moreover, with the use of platforms, they reduce the

number of suppliers, the space of stores, the number of machines, etc. achieving scale in production.

If we take into account the increasingly way of working as unified groups, that the brands are adopting, these advantages grow up and they become a strategic issue to keep in mind in order to achieve bigger economies of scale and to have a flexible production capacity. In this way, the fact of using the same assembly line among different models, based on the same platform, together with the use of common platforms among models of different brands drive to the use of the same kind of factories for the different brands of the group. In this way, the groups try to build the plants in the same way around the world, with the same layouts, task organization, etc. With this, they gain flexibility in their group production capacity. They can, as it was commented before for the case of one single company, combine the different production model volume through the several brand plants in order to have a higher adaptation capacity to the market fluctuations. Then, they can increase the productivity of some brand model just assembling a high volume in other factories from other brands of the group. Then, the production planning becomes a group issue and if the group can manage it successfully they can get a strong leadership. From our point of view the groups should take advantage of this possibility as much as it can since it can represent a huge difference to their competitors, especially if we are referring to volume makers.

Regarding this fact, we want to show an example where it can be seen how this sharing of factories among brands can be carried out. Looking at the table 4.1, we can see the current model-line-up of the different plants of the PSA group, and the future planning

line-up for the year 2004. In this table the tendency to platform oriented production becomes clearer. We can see, that at present the plant production is more brand focused and we can find models from the same brand in each plant. Only in the Aulnay plant and the Sevel Nord-Valenciennes one they share the factory for models from different brands. But if we look at the future line-up planning, we can find that their production planning goes towards a more platform orientation, meshing the production of the different brands in the plants, only take into account the platform which the models are based on. Thus, we can see that the PSA group is planning for instance the production of the Citroën Xsara, the Peugeot 307, the Peugeot 206 and the Peugeot 206CC, all based in the PF2 platform in the Mulhouse plant. Also, in the Rennes plant we can see, that they are planning to produce the different models based in the PF3 platform, Citroën C5, Citroën C6, Peugeot 406 and Peugeot 607.

PSA Manufacturing Plants in Europe - The New Manufacturing Footprint			
Country	Plant Name	Current Model Line-Up	Future Platform Focus and Model Line-Up (2004)
France	Aulnay	Saxo, 106, C3	PF1: Saxo replacement (C2), Pluriel (C3 variant), C3, 107 (the 106 replacement), 206 replacement.
	Poissy	206, 306	PF1: same models as Aulnay in the long run, although there may be some specialisation yet to be confirmed. Aulnay and Poissy will be reconfigured to produce all models to be made off the PF1 platform, with output switching according to demand for different models.
	Mulhouse	206, 206CC	PF2: Xsara, 307; 206 will continue until end of current model. The replacement will switch to Poissy and Aulnay.

	Sochaux	406, 607	PF2: Xsara, 307; some large car production will remain in 2004, but will all switch to Rennes by 2006. Mulhouse and Sochaux will also ultimately be reconfigured to produce all models to be made off the PF2 platform, with output switching according to demand for different models.
	Rennes	Xsara, C5	PF3: will add 406 and 607 replacements and C6 (eventual replacement for the Citroën XM) in 2003. Will be sole European site for PSA's large cars. Xsara production transferred to Mulhouse/Sochaux.
	Sevel Nord - Valenciennes	MPVs and LCVs - Evasion/806, Partner/Expert. Parallel Fiat models also made here: larger LCVs are made at Fiat's Sevel Sud plant in Italy	Will continue as now for two more model cycles, i.e., until 2017, according to agreement with Fiat.
Spain	Vigo	Xsara, Picasso, C15, Berlingo/Partner	Picasso, Berlingo/Partner
	Vilaverde, Madrid	Xsara, C3	Models off PF1 platform, but which ones are still to be confirmed.
Portugal	Mangualde	Saxo, Berlingo/Partner	To be confirmed, but likely to be the PF1 models and possibly some Berlingo/Partner vehicles to help Vigo.
UK	Ryton, Coventry	206, and new 206SW (estate)	PF1 models. Will be the sole source for 206SW.

http://www.worldmarketsanalysis.com/wma_sample_pages/site_pages/WMASampLightVeh.html

Table 6.1- PSA – The new manufacturing footprint

Following with this issue, this way of producing drives to a better knowledge sharing among the different brands of the group as well as a higher possibility of people rotation through the brands or, at least, through the different brand plants. Thus, when a factory has to be adapted to some new model or process, it is easy to run it just allocating people from other factories, which are using this new performance, during a certain period of time in order to make easier this transition and to help in the training of the staff. Also, the introduction of a new model based in an existing platform in one assembly line, becomes easier and the time to do it decreases widely than it was before without the use of common platform. In the past, introducing the production of a model to another in a plant, could take several months and it represented an important increment of costs. With the use of platforms, this process could take only one or two weeks in order to adapt some tools and to change some tooling parameters, but they are very little changes. Here, the carmakers can gain a worth time and production capacity. The transition to incorporate a new platform in a factory takes more time, as it was seen in the Theoretical Framework, but these transitions are less frequent in time and they do not represents too much loss of productivity than in the past. The carmakers only change the platform once each eight or ten years. The model changes are more frequent.

Platform technology makes it easy to make small changes and simple to move production between sites. Technology changes require new platforms which is very difficult and costly. Platform technology is manufacturing driven, with demands for high productivity and mass production. The market on the other hand would like more flexibility in terms of frequent changes and customized products. The paradox mass customization combines these two demands, but up to a certain limit, the limits of what can be achieved using a

certain platform.

In spite of all the profit that carmakers can achieve with this way of working, we can find few drawbacks. The fact of having the same typology of factories around the world, also involve loosing the possibility to incorporate the different thinking, the different know-how, the different capacities of the different regions where the group has his plants and centers. With this uniformity in the production plants, becomes very difficult to try to introduce different thinking or possible improvements from the different people of different brands and regions. In our opinion the carmakers should have a sort of system to take into account the contributions that the assembly line workers, and the different people from the staff could do to the production process in order to benefit the global production process from the different philosophies, the know-how of the different brands, etc. It is important to remark that these changes should be done in all the group factories, since doing them individually would make differences among factories and then the capability to share the production lines among models would be lost. We know it is a difficult task to carry out because of the enormous quantity of people involved and the different mentalities, but the profits of that could be huge too.

In a similar way, we can find another possible disadvantage in the fact of this sharing of production process makes difficult the introduction of changes in this production process because of the huge amount of changes that the carmakers should do around all the plants. With the introduction of a new solution or new technology, there are a lot of plants that needs the same changes and it represents a huge amount of money. Moreover, if the carmakers decide to use some kind of technology for all the plants, and later on

they realize that this is not the best way to produce, or that there are some problems in this way of producing, the money to solve it becomes enormous. A mistake here could bring big problems to the company.

Referring to the production plants dedicated to produce the different components of the car, we think that the ideal case will be that the different plants dedicated to produce the components of a certain car should be close to the assembly plant where this car is assembled. This allows reducing the transport costs, makes easy the coordination of the different parts with the global production plan and, moreover, reduce the communication problems. If the group has the plants distributed in several countries, there are a lot of problems that appear. The group has to have a really good mean of communication along the different plants to coordinate the production of the different parts. And building up and maintaining in the correct way this mean of communication costs money. Another problem that appear is the difficulties to understand correctly the information given. Often, the location of the different plants is in different countries, with different thinking, different languages and relations. So, the communication among them could be difficult in some cases. On the other hand, if the group has to locate the plants closely to the other production plants, it does not have the possibility to find the right place regarding to the production costs, for example. Sometimes the carmakers prefer to locate a plant in a country where the salaries are lower where they can achieve lower production costs. The decision has to be taken carefully and looking all the advantages and disadvantages.

7 The Dynamics of platforms

There are different reasons to modify a platform. The changes that can be done can be

divided in three main types. Firstly, the changes caused for the adaptation of the platform to the different local markets. Not only to adapt to the different needs, likes and demands of each region but also to fulfill the different regulations or standards in each different local market. Secondly, the changes referring to adapt the platform to the different models that use this platform. The way to differentiate each model based on the same platform even from different brands or the problems to fit several different models in one platform. Finally, another type of change is the changes over the years. How the companies change the platform along the years, how they adapt it to the new technologies. Below, these main types of changes will be seen more widely.

In the first case, referring to the local adaptation of the platform there are different aspects to consider. Firstly, every local market has its own consumers and it is well known that the likes and dislikes of the people from different places vary widely. Besides, the uses that people give to the cars and the expectations that the people have for it also vary. For example, there are a lot of differences between the American market and the European one are many, and with the Asian market too. Table 7.1 summarizes the major general tendencies that serve as barriers to global automotive products that meet the preferences of both Americans and Europeans.

		Europeans	Americans
Engine	Diesel	X	
	Gasoline		X
	Small Displacement	X	
	Large Displacement		X
Transmission	Manual	X	
	Automatic		X
Left or Right Hand Drive	RHD	X	
	LHD	X	X
Regulations	EECS	X	

	FMVSS		X
Vehicle Size	Small	X	
	Large		X

Source: “Opel Corsa: The accidental World car”

Table 7.1. – Preferences of the European and American market

So, it is not easy to have a platform that can fit well in these different markets at the same time with these large concept differences.

Secondly, the needs for the car change along different territories and the requests can be really different depending on the places that the car will be driven on. To show this point clearly, there is an example that can be useful. Focusing on the Indian market, as well as the Brazilian one, there are different motoring conditions from the Europeans ones. A car that will be used in India requires stronger suspensions for rough roads, clutches and steering systems that are more resistant to the wear per kilometer traveled (Humphrey, 1999).

Thirdly, the products that are going to be sold in a determinate country or region must fulfill all the regulation, and normally not only the regulations but also the standards used in this industry, regarding to this kind of product. If the company wants to sell in different regions it has to fulfill all the regulations of the different places that the car will be sold. And normally these regulations vary along the different markets. Some examples of these regulations could be the laws and standards referring to the security systems (like NCAP, EuroNCAP...), the environmental laws, the quality standards, and so on.

For all these reasons regarding local market differences, there are some changes that might be done. The way to deal with this issue changes depending on the group and its development strategy, but the most common way is having local development teams that work close to the global development teams to adapt the platform to the local necessities. The company wants to know the demands from the local consumers, the necessities and the regulations of local markets, but it wants to control the re-design process from the main development centre, especially for the key components.

To work in a market the carmakers have to fulfill all the legislations of this market, thus as much markets they want to sell, much legislation to fulfill. Also, they have to adapt to the different customers, tastes, necessities, etc. as it was commented in the *Strategy* section.

However, they have to try to build up a platform as global as they can in order to have high volumes and to take more advantage of the platform. So, they have to share as much as they can, avoiding the changes as much as possible to achieve high volumes. In *Strategy* were pointed out some way to try to adapt better to the different markets like the regional platforms, but only in certain cases.

It happens something similar with the suppliers. When they design a component they try to make it for all the markets where the car that fit it will be sold. Then, they choose the strong constraints. About it, the *Supplier* told us:

We are only used to one demanding requirements for whole different markets that our product it's supposed to be. We choose the worst condition (Supplier).

Thus, they try to make as common as possible the design to achieve scale economies, too.

Another important thing for the carmakers is that they have to be very close to the evolution of the market to identify which will be the main markets in an early future and then try to adapt their products to it. Sometimes, there is a market that grows up more than the carmaker thought. Then they have to make more changes on the platform than they thought in the beginning, just to take part of this market. They have to be there, they have to sell. Therefore, the carmakers has to follow the market, they do not only have to think in their platforms. About it, *Car manufacturer* said:

You have to be costumer driven, you cannot be production driven. Platform is to make the production works well, but it has no sense to work to make product because of the production, you have to make products because of the costumer. You should be market driven (Car manufacturer).

That means that the carmakers have to produce for the market. They do not have to produce a sort of cars just because they have a platform. They have to pull from the market, not push. Otherwise, the carmakers will not sell the cars.

Another issue regarding the dynamics of the platform is how they evolve during the time. To adapt the platform to the new technologies is really complicated. Always is difficult to

introduce new thinking, new technologies. In the *New platform development* this last point will be more explained.

For example, it is possible that inside one group, there is a brand very market driven, with very fighting spirit, which wants to use new technologies. However, if this brand wants to introduce something new, they always have to discuss all these things with the board of the entire group, the platform people, etc. who are more product oriented. And, generally, it is not easy to find a solution that fits well in both minds.

8 Conclusions

The automotive market is in constant evolution. The steering forces of this evolution come from different ways. Firstly, and the most important because the auto industry must be market driven, it is the customer. This one demands more different cars, for new different uses than in the past, and at lower price. Moreover, he wants new models more often. Secondly, the increasingly worry about aspects like the environment or the safety is leading to new constraints that provoke the search and use of new materials, technologies and solutions. Finally, due to the hard competence of the sector, the brands have to innovate constantly as well as reduce their costs to have competitive prices in the market.

Because of the previous reasons, the automobile industry has to evolve constantly. In this way, the platform concept known as nowadays appeared. The main idea of it is the sharing of both components and processes among several products in order to achieve bigger volumes that allow the use of scale economy. The reason why they do that is clear:

the higher volume, the higher profit. The need of achieving these volumes, as well as the platform concept itself, has favoured in the present the companies work together as world groups.

The sharing of components involves basically the base of the car where the car is building up, but also is applied in all the pieces possible. In this way, the platform thinking should try to share as many pieces the customer does not see as possible. This sharing of components, as well as the sharing of processes, makes that the carmakers can afford release of several models in shorter periods of time and at lower cost. Thus, the car manufacturer reduces the costs as well as responds quickly to the changes of the demand.

However, to achieve all the advantages of this concept is not enough with trying to share, the carmaker has to think also in platform during its strategy, as well as adapt its structure in an efficient way. Since the moment that the automakers are working more in big groups, those groups establish the guidelines that the different brands must follow. These decisions of the group can be from the development of a global platform for several group brands to the definition of their production planning. Referring to the structure, the car producer forms cross-functional teams dedicated to each project. In the case of a global platform, this team is composed by people from the different brands of the group.

The process that has benefited more from the platforms is the production process. With the use of common platforms, the assembly lines of different models based on the same platform are the same in the different factories of the group, since these models have the same assembly parameters. This fact allows producing any of these models in any of these factories adapting then easily the production to the demand fluctuations. At the

same time, being the same assembly lines the different brands use the same tools, so they can get them cheaper reducing then the highest investment of the car's bringing out.

Despite all of that, the platform thinking could not be put into practice if it was not for the advances of the CAD systems, which represent the crossover between the suppliers and the carmakers, as well as among the different brands of the same group.

However, the platforms also involve some difficulties. The main one is the complexity in the management, from the handling of big teams composed by people of different brands to the coordination of all the processes of all the models. Moreover, the fact of designing commonly for different models makes that each model does not achieve as good performance as it could be if the platform were designed specially for it. In this way, the group can make the mistake of develop platforms too standard. Furthermore, due to sharing the same solutions and technology, sometimes it is difficult to maintain the specific characteristics of each brand. Another disadvantage is that the first model that uses the global platform increases its lead time due to all the requirements of the several brands the design has to comply, although the following models that are developed once the platform is done get this lead time shorter. Finally, the volume of units that the platform is used for is so big that the car manufacturer can not risk a lot introducing big changes with new technologies, since they could not afford the failing of a platform. Despite all of that, the advantages of platform technology outweigh the disadvantages.

Finally, the present trends seem to take two different ways. On the one hand, there is the tendency of trying to achieve more volumes. The reduction of the platform number and then, the increase of the number of models per platform, go in this way. This reduction

provokes that the global platform becomes more and more used allowing thus, the chance of covering with only one platform several regions as well as several market segments. However, there will be a moment when the carmakers will not be able to reduce more the number of platforms without losing the variety necessary to cover the market demands. Then, the carmakers will have to use another way to achieve higher volumes. The cooperation among different groups, as it has already happened in certain market segments, or even mergers of these groups, seems to be the path to follow.

On the other hand, the market demands for more variety. Then, the car manufacturers need a flexible production process as well as more flexible products in a cheaper way. In this way, they are developing a more modular system, with more complex parts, that allows producing a big variety of cars just combining different modules as well as achieving a lower cost because of the cheaper tools needed to this easy assembly system. The idea of this trend is transferring the cost from the process to the components that are, transferring the costs from the fixed to the floating ones.

9 Managerial implications

In this section, we have gathered the advices that we give to the car manufacturers about the platform concept that the thesis has dealt with. We had divided them in two categories: strategy and production.

Strategic implications

- Share as much as possible all the pieces that the user can not see and, at the same time, be flexible in the visible components for each model. Although, it must have

- a limit because not only the image of the cars should be different but also the performance.
- The carmakers have to be market driven. They have to produce the cars that complies the needs and likes of the people, not the cars that they can produce easier.
 - Volume makers should use the platform thinking.
 - The members of the platform team should be easy to work with, since a problem of non-understanding among them can fail whole the project. In the same way, the platform manager not only has to know about technology and markets, he also has to know how to manage teams.
 - On the one hand, during the platform development, the new technologies should be used more in order to avoid travels. On the other hand, this should not mean that the team stop meeting. It is necessary to sit the people in the same place.
 - The car manufacturers must have a lot of concept thinking in the beginning of the project. In this way, they have to take into account the legislation coming as well as the possible new technology.
 - In the development of a platform it should be brought out the best option thinking on the entire group.
 - The platform team could benefit from the background of the group, so the group should have an efficient system to allow this. This system could be a data base where all the steps of the past processes could be consulted and that favours the getting in touch with the people that were involved in similar project.

- The carmaker should follow the present product accurately to know in which position of the cycle is and, thus, start the development of the new product to bring it out before the end of the old one.
- To work with as much volumes as possible, it is important to finish the production of all the models of one platform at the same moment and, then, starting the production of the new models based on a new platform. Besides working with more volume, doing that they avoid to have factories with low production.
- The carmaker should not try to run away from developing a new platform. Sometimes the fact of have been adapting the old one and then building one new is more expensive than developing the new one the first time.
- The carmaker has to be extremely sure of the advantages of the new technology to introduce it in the platform.
- The group should try to make platforms that cover as much market as possible as well as reduce the number of platforms used. However, always knowing that there is a minimum of platforms necessities to cover all complying the requirements as well as keeping variety. Covering as much volume as they can with the same platform makes the platform really profitable and allows them to compete against their competitors.
- If the company has so volume that needs several tools to make its platforms, maybe it should be better to have these tools little bit different in order to be able to produce little bit different platforms, each one adapted to each regional need.
- The group should try to instill the idea of unity among the different brands.
- The group should promote the cooperation among brands to avoid the double development work, as well as to benefit from the knowledge of the different

brands, forming flexible and diversified networks. To achieve it the group should develop a system where the companies could consult what all the brands of the group have done and also find help getting in contact with people of another brand. At the same time the group should invent anything to motivate the use of the system.

- The group has to separate the image of each brand. The group should allow that each brand keeps some level of distinctiveness, some different way of solutions, promoting the cooperation but not the uniformity. In the same way, the group has to spend more money in marketing campaigns trying to focus their companies to different sectors of the market to avoid this overlap.
- The group should not make the mistake of make a single uniform company, because then it will be losing market.
- The group should do a huge effort of negotiation between all the brands involved and be able to mark clearly the main lines.
- Producing in the same way as nowadays, it would bring a lot of profits if the supplier works inside the company, starting in earlier stages than now. To achieve the best results the carmaker should coach its suppliers and then, keep more them to improve and to take profit of the mutual understanding. Although if the modularity arrives, it seems not to be so necessary.
- In the coming years, the group should take into account the possibility of share platforms with others groups even before that when the group has arrived to the minimum number of platform possible.

- It has to be avoided the too much standardization of the products that the modularization could bring. The modularity has to drive to more variety not cut it.

Production implications

- The group should search adopting flexible production systems in order to be able to adapt to the fast changes of the automobile technologies.
- The production process has to allow introducing diversity in the final products, and producing a number of different models in the same factories.
- The carmaker should find a way to produce with cheaper tools to reduce the investment.
- The carmaker should buy the tools as later as possible to have more information. Once they are bought, the production has to be done with them.
- The fact of having the same factories in different places standardizes all the processes forgetting the different ways of working of the different places. The carmakers should have a sort of system to take into account the contributions that the assembly line workers could do to the production process in order to benefit the global production process. It is important to remark that these changes should be done in all the group factories, since doing them individually would make differences among factories and then the capability to share the production lines among models would be lost.

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