Study

The Next Wave: Emerging Market Innovation, Threats and Opportunities

How low-cost vehicles impact the automotive industry

Roland Berger
Strategy Consultants

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Table of contents

Preamble

Dear Reader,

In winter 2006, Roland Berger Strategy Consultants published a study entitled "The early bird catches the worm". It showed the increasing yet somewhat unmet demand for affordable cars and directed the attention of automotive top managers to low-cost cars. The surprise success of the Logan and the debut of the Tata Nano show that low-cost cars will be a key topic for the automotive industry in the upcoming years and not just in emerging markets.

While the study provided useful insights on market trends (the "Why"), it barely skimmed the surface regarding the "How". We therefore decided a year ago to set up an international project team to research the approaches of global Western and Asian OEMs to creating low-cost cars. Wolfgang Bernhart and Norbert Dressler led the project team of approx. 20 colleagues from our offices in the US, Europe and China, and from our Indian partner Edica-Intrim in Delhi. The team conducted around 80 in-depth interviews with industry experts around the globe and evaluated a vast amount of material to identify the underlying concepts and business model elements.

We would especially like to extend our gratitude to Marc E. Kalton and Rajan Chhibba from Edica-Intrim for their insights on the Indian market, and to Karl Hirtreiter, who supported and challenged the team as they extracted the major findings and drew the right conclusions.

We hope you find the study useful and wish you insightful reading.

Sincerely,

Wolfgang Bernhart
Partner
Global study coordinator

Ralf Kalmbach
Partner
Head of Global Automotive
Competence Center

1. Background and objective of study

The automotive industry faces considerable challenges: The global market place is becoming more competitive, environmental and safety regulations are becoming more stringent, and consumers increasingly expect better quality at lower cost or "more car for less money". This not only forces manufacturers to seek new ways to better manufacture automobiles more cheaply, but is driving a paradigm shift in how cars will be manufactured in the future. The opportunity and threat to the industry will be in capturing growth in emerging markets with low-cost cars, and equally importantly capturing cannibalized/penetrated sectors in developed markets with low-budget cars.

In 1913, Henry Ford introduced the assembly line, and in doing so created the modern automotive industry with its techniques of mass production. It took more than a generation until the Japanese – headed by Toyota – made the next radical break with established philosophies of production. With their sophisticated process, quality and supply chain management systems, the Japanese could achieve higher quality at lower cost. Suddenly "cheap" was no longer simply "cheap" – it was "economical and good". Automotive manufacturers later transferred and adapted these processes to emerging markets where they could exploit lower wages. But low-cost component sourcing and production outsourcing was the result of continuously improving existing models, rather than a truly innovative business model. Initially, the way automotive manufacturers produced and marketed vehicles for emerging markets did not undergo any real changes.

This is about to change. The next paradigm shift in automotive production will happen more quickly than in the past. New approaches are being developed that promise to give customers the vehicles they want at substantially lower costs. China is making headway selling inexpensive cars – targeting not only Russia, the Middle East and Africa, but also the United States and Europe. India's Tata Motors recently introduced the USD 2,500 (ex-India factory) Nano at the Indian Auto Expo. Start of sales is expected in late 2008/2009. The low-cost car has arrived.

Figure 1.1: **THE TATA NANO SHOWS WHAT IS POSSIBLE**

Source: http://tatanano.inservices.tatamotors.com/tatamotors/^

This report will explore whether, as Toyota claims, we are witnessing the birth of a new way to bring vehicles to market or not. More fundamentally, is this a "new way" of cutting costs in not only the A segment, but also in the "B, C and D" segments or is this simply companies making better use of low-cost locations for production? Finally, if this is a "new way" – a paradigm shift – will it result in new price bands with little profit movement or improved profitability for the "winners"? As indicated in our 2006 study on low-cost cars, emerging markets like China and India are driving the global projected annual growth of more than 4 percent in the A/B segment between 2006 and 2012. But as demand for low-cost cars surges, efficient and profitable structures become critical elements of success. Low-budget car creation is now increasingly important if traditional OEMs are to remain relevant in this dynamic and evolving automotive industry.

In fact this does not mean that the underlying car is "cheap" – it means that the underlying processes and structures are very lean and efficient and, thus, very cost effective. Such low-budget paradigms will be applied across vehicle segments.

What is different in this paradigm shift is that emerging market OEMs, responding to market needs, are the "change agents." OEMs from emerging markets are putting established OEMs in the United States, Europe and Japan under pressure by launching low-budget models not only in the A/B segment (e.g. Chery QQ, Tata Indica) but also in the C/D and respective SUV segments (e.g. Shuonghuan, CEO, Brilliance B6). Low-cost cars have become a matter of fact in all volume segments. With a price difference of up to 30 percent on established price brackets, low-cost cars form a challenge for traditional players. To reach these target prices, these cars' development and production concepts as well as sales and marketing structures have to be very lean and efficient.

In order to withstand this mounting pressure, traditional OEMs need to rethink their current business models and adapt to the changing industry market dynamics. These OEMs need to evaluate the necessity of extensive restructuring activities to profitably generate lean and efficient structures and to be successful in this changed market environment. Yet when looking at the current profitability levels of the major OEMs there are few established OEMs in the United States or Europe realizing profitability above 5 percent. In fact, several are just managing to break even. Considering this fact – especially in light of the growing pressure from OEMs in emerging markets that actively pursue low-budget processes and are launching low-cost cars at record speed – the necessity for action is compelling.

Despite having undertaken numerous restructuring and downsizing measures, OEMs in the United States and Europe have been unable to develop a culture that truly champions continuous improvement. Triad OEMs need to radically rethink their established business models and develop new ones that adapt to the growing low-budget and low-cost challenges. One difficulty lies in meeting this challenge without diluting or destroying brand reputations and established customer perceptions or value. Simply put, it is necessary to make the products more valuable but less expensive at the same time.

To help understand how designing and manufacturing low-cost vehicles works in practice, and to discover what lessons the automotive industry as a whole should learn, Roland Berger Strategy Consultants together with Edica-Intrim studied the experiences and strategies of manufacturers, suppliers and developers in the United States, Europe, India and China. We conducted more than 80 interviews world-wide as part of our extensive analysis of this industry. Our findings are presented in this study.

2. Executive summary

Our study identified four low-cost business models. These are an amalgam of common approaches to low-cost car design and production that are driven by regional necessities and emerging market innovations, rather than the approach of a single auto producer:

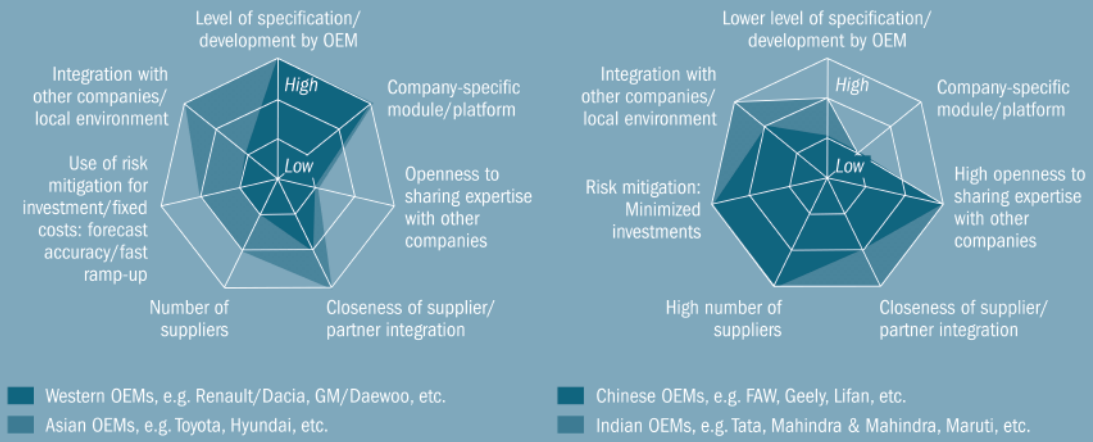
> The European and North American OEM or 'Traditional OEM Model': This is employed by Renault/Dacia and to some extent by GM/Daewoo. Costs are reduced in this model by achieving economies of scale and using strict design-to-cost methods.

> The Japanese and Korean Model: This is employed by companies like Toyota and Hyundai and is best described as process innovation within a global network.

> The Chinese Model: This is employed by private companies such as Chery and Geely. This model focuses on building on cloned solutions and leveraging China's low-cost base to provide vehicles at a low cost. It is sometimes referred to as "clone, plug and play".

> The Indian Model: This is employed to varying degrees by Tata Motors, Maruti, Mahindra & Mahindra and others. It employs a "co-opetition" (cooperative competition) approach, similar to the open source model in IT. In this model, companies draw on the expertise and investment dollars of a broad fraternal supplier and engineering base, and indigenously develop innovations and right-sized market related invest-ments. Invest-ments are further managed through optimized portfolio investments. Institutional support (as described in Chapter 4.2.3) is employed to drive marketing and leverage cost advantages.

Figure 2.1: **FOUR MODELS ARE BEING INCUBATED IN EMERGING MARKETS**



Source: Roland Berger; Edica-Intrim

The four models differ in the following respects:

> The underlying principles of the product architecture and design, the extent to which the manufacturers themselves develop the low-cost vehicles, and the partnering approach taken during product creation
> The manufacturers' basic approach to integrating partners and suppliers, the closeness of the relationship, and the point in time at which integration occurs
> To a lesser extent, the risk mitigation strategies that manufacturers follow to deal with market uncertainties

2.1 Vehicle design and architecture: Economies of scale and functional integration – the key success factors

Rigorously adapting the characteristics of products to meet specific local market and customer needs is a fundamental prerequisite in creating low-cost cars. Historically, the key to reducing vehicle design and material costs is through economies of scale – generally thorough automation and functional integration. While traditional OEMs continue to employ this approach building on existing concepts and systems, and modernizing or building new platforms for automated production, emerging OEMs often

take a blank sheet of paper to low-cost design solutions. They use reverse engineering and new innovations to develop a low-cost design solution. For example, the Logan is basically a modernized Renault X90 platform. This approach helps the manufacturer generate a one-time cost saving when developing a new vehicle of around 25-35 percent. While the development work mainly took place in France, the company is building up its design center at the Dacia plant in Pitesti in Romania and is expected also to leverage the engineering resources of their partner AvtoVAZ in Togliatti, Russia.

The approaches taken by large global manufacturers are similar in several respects. The big companies all make full use of CAE methods. They use virtual prototyping. They also have a high level of vertical integration: 30-50 percent for Western manufacturers and more than 80 percent for Japanese and Korean companies (if we include suppliers closely managed by OEMs through Keiretsus and Chaebols). Volume bundling, stringent design-to-cost methods and a focus on the functions that are actually important to customers enable the major global manufacturers to achieve significant cost savings while basically employing their normal development philosophy.

The Chinese are following a different track that makes a virtue out of necessity. Due to a lack of their own qualified developers, companies such as Chery and Geely are making extensive use of ready-made solutions. Even the vehicle specifications are based on what the suppliers can produce, and not what OEMs require, as is usually the case. Western carmakers provide suppliers with detailed specifications and insist on standardization across different suppliers. By making these sorts of demands, they often miss out on opportunities to cut costs. In China, by contrast, it is often the supplier that sets the specifications. Chinese passenger car manufacturers are only responsible for 10-15 percent of vehicle development. This allows them to focus their engineering resources on a limited number of technical details and on project management, and make full use of external developers and designers both in China and Europe. The benefits of this approach are clear: whereas global manufacturers spend several hundred million euros on developing a new vehicle, Chinese manufacturers spend a low two-digit million euro figure at most.

Like the Chinese players, Indian auto manufacturers leverage the industry to find low-cost solutions, rather than absorb significant development costs. Companies such as Maruti work closely with a large network of vendor partners. In return for guaranteed business, the partners share their expertise with the automakers free of charge. Examples of this process at work are the development of the Scorpio by Mahindra & Mahindra, and more recently Tata's Nano.

In light of the Nano's extremely aggressive cost target, carryover components were ruled out as neither Tata nor any other Indian manufacturer had anything in their 'stable' that could meet the required size and price imperatives. Thus development started with a clean sheet of paper and the cost target was broken down to a targeted component/system cost. In parallel, the vehicle architecture was defined in a way that reduced or eliminated the cost of expensive systems while still allowing a high degree of functional integration. For example, the Nano platform has the engine placed in the rear. Since the weight of the engine is on the rear-wheels, the steering system is designed for a lighter load than would otherwise be needed in other cars. The design also aimed at minimizing the total number of components with a target of each component having at least a dual functionality. The seat riser, for example, serves as a mounting for the seat as well as a structural part for imparting torsion rigidity.

With these approaches, Indian producers have been able to reduce their development costs significantly. And although Indian development costs are generally higher than in China, they remain under 100 million euros – significantly less than incurred by global manufacturers.

2.2 The supply chain: Co-opetition versus closed shop

Global manufacturers apply a high specification set strict cost targets for suppliers, consolidating their buyer power and putting the focus on process innovations. Yet due to the highly specific nature of the different systems or components, suppliers often do not implement the platform solutions across different manufacturers. The Chinese and the Indian model are quite different from the model used by large global vehicle manufacturers. While they also set strict cost targets, they optimize solutions either already developed (China) or drive cumulative innovations across the industry (India).

In a Chinese development project we analyzed, only a rough specification and a cost target existed at the beginning of the project. Local suppliers were selected on their ability to meet those specs and cost parameters. Costs and specification were then made more precise during development. Where Western technology is needed, existing concepts are often used without great modification.

In India, suppliers develop solutions at the system and component level without reference to specific OEMs. This is done on the basis of their knowledge of the vehicle architecture used by various manufacturers. In this way, they create "industry modules" – at a substantially lower cost.

Indian manufacturers also draw on their enormous local low-cost supplier structure. The country has more than 30,000 companies that mainly specialize in two- and three-wheel production. They use these companies for supplying components and new ideas. The Indian system differs from the Japanese Keiretsu and the Korean Chaebol models, in which the partners form a close relationship with a single manufacturer and only exchange information within this network. The Indian model of "co-opetition" – cooperative competition – and open source methods similar to those found in IT development opens the door to economies of scale. The transfer of knowledge and expertise between competitors is a price that Indian manufacturers are willing to pay.

With a planned annual production of over one million units for the Nano, Tata was able to combine the best of both worlds, employing both Indian and global vendors committed to innovation. For proprietary design components, Tata went with established suppliers like Bosch and BASF, which committed to more innovative products than those they have supplied in the past to automotive manufacturers. A long iterative process was used to narrow down to the design which would meet the cost and specification target, and suppliers leveraged their own low-cost engineering hubs. For components and systems engineered by Tata Motors, local suppliers with strong process capabilities who could give valuable suggestions and improve on designs were used. From the inception, nearly everything has been sourced locally taking advantage of low wages. The localization level stands at 97 percent. Vendors are an integral part of the design, development and supply process.

2.3 Resources: Risk mitigation versus planning accuracy

The business models used by car manufacturers also differ in their approach to risk mitigation, particularly with regard to investment. Global OEMs – like other manufacturers – use a high degree of automation. However, with investments in equipment often costing three to five times as much as for manufacturers in emerging markets, global manufacturers often accept ramp-up losses. They then try to keep these losses to a minimum by reaching regular production level as quickly as possible. In China and India they do things differently. Chinese and Indian manufacturers take much smaller and more circumspect steps, employing automation when necessary, not automatically. Indian OEMs also help their suppliers to reduce their investment risks. Instead of having annual contracts for the Nano, Tata negotiated long-term volume contracts with its suppliers. The suppliers receive significant volume commitments, with about 75 percent of the components being single sourced, and about 90 percent of the total car being outsourced.

The Indians also try to derive advantages from economies of scope. For example, by building close partnerships with other companies the "House of Tata", like the Korean Chaebols, invests in a specific region with the aim of building up social infrastructure such as education and healthcare. As a consequence, Tata enjoys both a steady stream of loyal, low-cost workers for its factories and a loyal customer base.

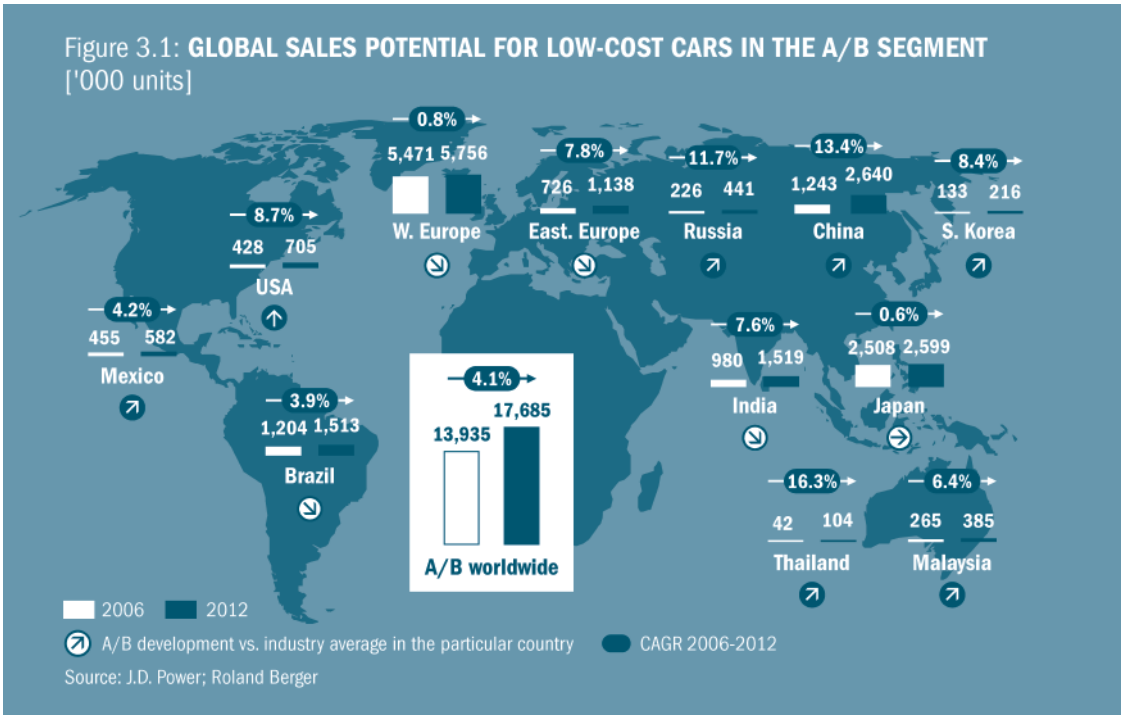
2.4 Low-cost business models are reshaping the industry

In summary, the basic thrust of low-cost business models can be summed up in a single sentence: Focus on costs in all processes and combine economies of scale in a focused way with high functional integration. However, the story does not end there. Along with the use of low-cost resources, new forms of cooperation are establishing themselves – manufacturer and supplier networks that combine cooperation and competition. These new forms of cooperation represent a source of future competitive advantage. Indeed, they may already be ushering in a new revolution in the automotive industry – a revolution affecting not just low-cost vehicles, but all segments. Customers, markets and new competitors are demanding that manufacturers turn their attention to low cost. "Expensive" will no longer be an acceptable rationale for value purchasing. The emerging markets are changing all that in the LCC category, with implications for other categories, too.

3. Market characteristics and current OEM challenges

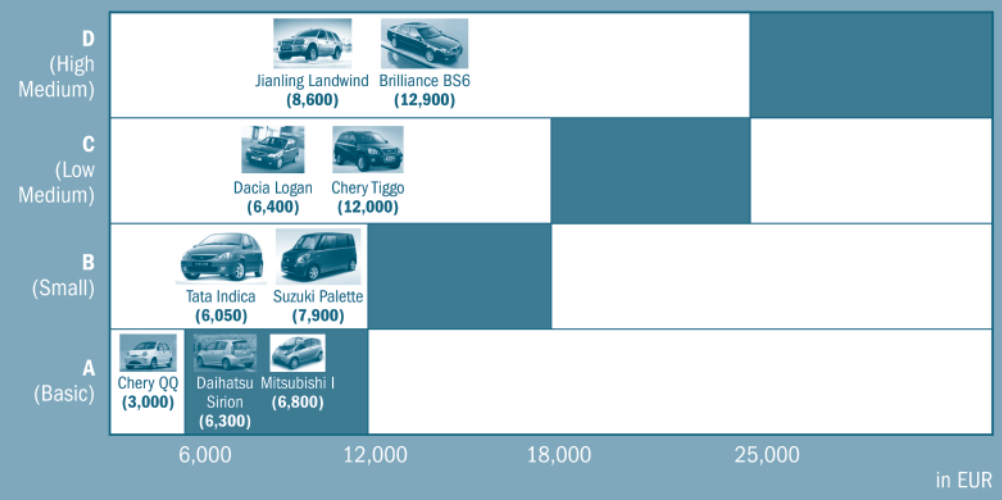
Low-cost cars have high growth potential in many markets and represent significant opportunities for OEMs.

According to a recent Roland Berger Strategy Consultants market study [1], the global low-cost car segment will grow by nearly four million vehicles until 2012, which is faster than the overall automotive market. Demand for low-cost cars will increase in the United States, Europe, Central and Eastern Europe (CEE) and Asia, with the strongest growth expected in CEE and Asia. China and India will see the highest absolute volume growth in this segment. We estimate that 0.7 million low-cost cars will be sold in the United States by 2012. The forecast numbers for the EU are 5.8 million cars, while 2.6 million cars will likely be sold in Japan. Our global forecast for the low-cost segment in the A/B segment alone amounts to nearly 18 million units sold (figure 3.1).



This trend is reflected in the increasing number of available cars in the A/B segment. The top five low-cost models from Chinese manufacturers accounted in 2006 for roughly 500,000 units. Today, nearly all larger volume OEMs as well as emerging market OEMs already have or are at least planning to have a low-cost car available within the next few years. These low-cost cars are not restricted to small ones, but are offered in all vehicle segments. Figure 3.2 shows some examples and their price position compared to cars typically representing the segment.

Figure 3.2: **LOW-COST VEHICLES IN VARIOUS SEGMENTS**



1) Segments are based on J.D. Power classification. Prices based on origin countries adjusted by current exchange rate
Source: Company information; Oanda; EIU; Roland Berger research

With increasing demand for larger cars in the emerging markets, C- and D-segment cars like China's Shuanghuan CEO or the Brilliance B6 integrate some of the low-cost concepts emerging market players have already introduced in the A/B segment.

These larger cars do not fall under the "low-cost" definition as it is often used. Instead, they can be characterized as "low-budget". Being significantly less expensive than the average car of similar size, they fulfill an unmet demand which is also becoming increasingly important in more developed countries.

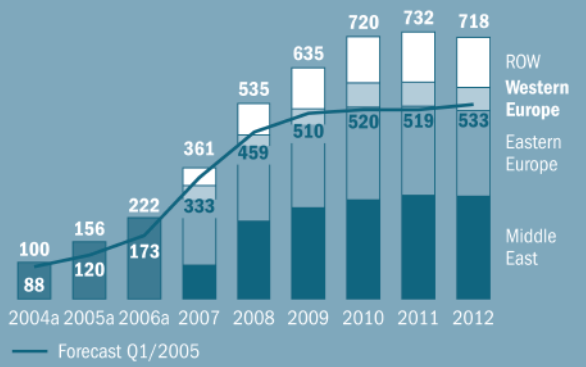
3.1 Challenges for OEMs in and from the developed markets

The growing importance of a low-budget segment in developed countries is driven by a change in customer thinking and related behavior. Driven by weakening economies and falling consumer confidence, Western customers are focusing on value (i.e. North America) or "value for money" (i.e. Europe) in their purchasing decisions. A general and long-term trend appears to be emerging in which the middle-volume market is being squeezed out by the premium and low budget segments. This trend is apparent in such diverse industries as food (increasing market shares of discounters and premium foods) and clothing (the rise of H&M or Zara in the mass market and the significant increase of luxury labels such as Armani and Dolce & Gabbana) and for this study, the all important automotive industry.

In addition, an increasing number of used car buyers in the German, European and North American market are considering lower priced new cars – regardless of size – that come with additional services (e.g. warranty, maintenance). This has become an important selling point for relatively new entrants in the US market such as Hyundai. While Hyundai has opened the door to this segment of the US market and others are exploring it, the demand for low-cost cars in the US has not been sufficiently met. This presents an opportunity for Chinese and Indian low-cost car manufacturers to fill a niche in the US market, as well as to compete in Europe, where steadily increasing demand is being targeted by local players such as Renault/Dacia with the Logan (see the Dacia-Logan example).

THE SUCCESS OF THE DACIA LOGAN

Sales vs. forecast 2004-2012 ['000 units]



Comments

- Forecasts **underestimated** the success of the Logan, reasons:
  - **Value for money** product with no direct competitor
  - **Fast ramp-up** in CKD production locations such as Russia
  - Previously designed only for emerging markets, Logan was **offered in Western Europe**, too – more than 25,000 units sold in 2006 in France and Germany
- **New forecasts** show **no significant increase** in sales in spite of new models – probably **too pessimistic**, again
- **Logan** proved to be a vehicle **suitable for success** in the **entire world**

The Dacia Logan will cover 80 percent of all relevant car body styles by 2009 including sedan, MCV, van, Pickup, and SUV – an indication that low-cost/low-budget concepts have no limitation in meeting the full range of body styles.

Source: Company information; J.D. Power; Roland Berger analysis

The compact class and medium segments provide excellent opportunities for low-cost car structures to be enhanced to create a low-budget business model. Adapting low-budget processes will enable OEMs to deliver value at lower costs for the upper segments and provides an opportunity for them to successfully compete against their rivals from emerging countries such as China and India.

In addition to the competitive tension described above, OEMs are facing other challenges which require actions to trim down costs:

> There is significant overcapacity in the Triad markets. OEMs are currently estimated to be operating at only about 78 percent capacity utilization which implies an overcapacity of around 11.8 million units annually. The problem of overcapacity is not expected to be solved quickly. A slight uplift in capacity utilization to around 81 percent is estimated in 2012 for the top ten OEMs.

> While creating and meeting new car demand will be important for the auto industry's future profitability in developed countries, especially the US, operating paradigms and cost structures may not allow for easy transition to low-budget manufacturing in under-utilized facilities. The three major US OEMs are burdened with significant costs owing to pension and healthcare obligations from past union contracts. These legacy costs increase the cost per vehicle from ~USD 975 for Chrysler to USD 1,873 for Ford. This puts them at a serious disadvantage against competitors and provides additional motivation for introducing low-budget methods into US operations.

> Low-budget cars will reduce the demand for used cars, thus, decreasing trade-in value and further increasing price pressure in the low-cost/ low-budget volume segments.

> Fulfilling environmental and safety regulations will be necessary to compete, but consumers will resist paying more for them. The proposed CO_2 emission regulations in Europe for example will put an additional cost burden of 15 billion euros p.a. on the industry in Europe, as shown in a recent Roland Berger study[1]. This will put further price pressure on the market.

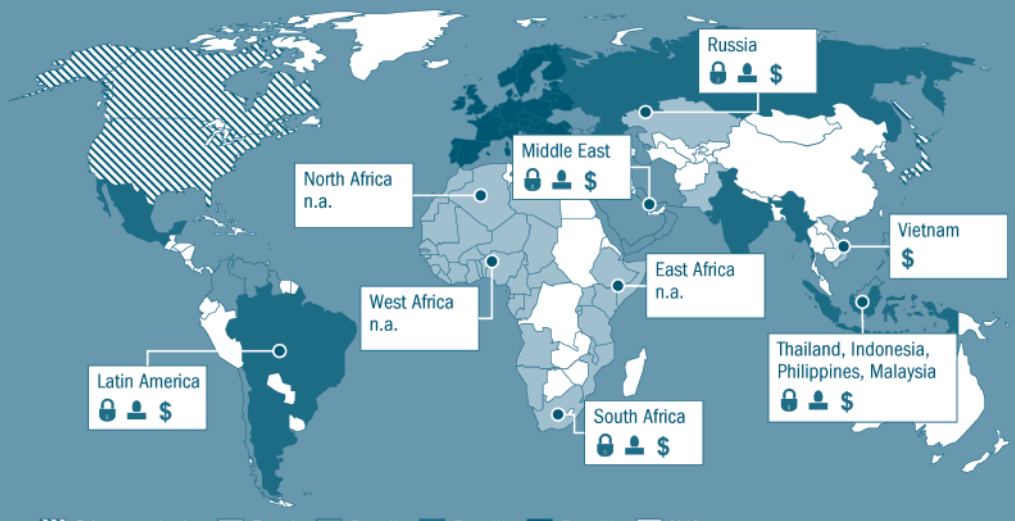
In addition, Western OEMs generally suffer from high organizational complexity and related overhead costs.

1) Bernhart, Dressler, Kalmbach: "Solving the Powertrain Challenge", Roland Berger Strategy Consultants, July 2007

3.2 Opportunities for OEMs in and from the emerging markets

Inexpensive cars will increasingly be exported and become a key segment in all major markets. OEMs from emerging markets still face barriers such as emission and safety standards, and high tariffs, some of which are shown in figure 3.3. However, to meet technical standards and close the gap, low-cost car manufacturers are rapidly coming-up the learning curve.

Figure 3.3: **EXPORT HURDLES – THE CHINESE PERSPECTIVE**



Source: Roland Berger

They are doing this in a variety of ways.

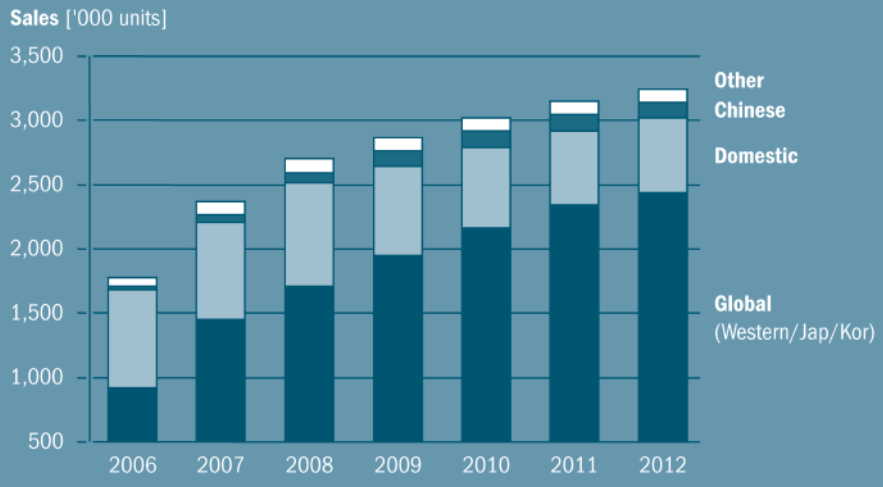
> They cooperate with global manufacturers (i.e. Maruti with Suzuki in India; SAIC with GM in China).

> They acquire technologies and vehicle platforms or even the brand and the complete IP from global manufacturers (i.e. Tata's acquisition of Jaguar/Landrover; SIAC/Nanjing's acquisition of Rover).

> They leverage suppliers and engineering service providers to create new car models and/or components (i.e. Bosch creating new fuel injection systems for Tata's Nano). Working on-site, they also help emerging OEMs improve their own competence level.

Employing a "learn as you go" approach, emerging OEMs from China and India have already begun exporting and gaining market share in other emerging markets such as Russia and the Middle East. For example, Chinese manufacturers have captured a share of the growing Russian market and are expected to double their market share there over the next five years, as shown in figure 3.4.

Figure 3.4: **SHARE OF CHINESE OEMs IN RUSSIAN MARKET FROM 2007-2015**



Source: Roland Berger Market Model Russia 01/2007

Figures 3.5 and 3.6 provide a perspective on how emerging OEMs (i.e. Tata, Chery, and Geely) are competing successfully against outdated models of traditional OEMs in emerging markets.

Figure 3.5: **EMERGING OEMs CATCHING UP: EXAMPLE INDIA**

Emerging market OEM[1)]

PRICE:
> EUR 7,082

Tata Indica V2 DLX Turbo (India)
"Designed by IDEA"

Sales in India 2006: 133,000 vehicles

Established OEM[1)]

PRICE:
> EUR 10,198

Ford Fiesta 1.4 Duratec EXI (India)
"in-house design"

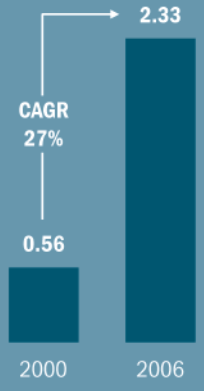
Sales in India 2006: 33,000 vehicles

1) India example: comparable vehicles in size and performance

Source: Roland Berger analysis

Figure 3.6: **EMERGING OEMs CATCHING UP: BEST-SELLING LOW-COST MODELS IN CHINA**

Low-cost vehicle sales in China [m vehicles]



Best selling low-cost models 2006

		MRSP [EUR '000]
Chery QQ	**132,019**	2.82-5.28
Chery Qiyun	**101,265**	3.20-5.65
FAW-TAIC Xiali 101	**89,001**	7.36-9.06
SVW Santana	**80,291**	8.10-10.1
FAW-TAIC Xiali 131	**72,857**	3.20-5.65
Geely Free Cruiser	**70,989**	4.72-6.22
BYD F3	**51,019**	6.98-9.44
Suzuki Lingyang	**47,636**	5.65-7.73
Hyundai Accent	**42,174**	6.88-8.96

Source: Automotive Industry Association; PC Auto; Roland Berger analysis

3.3 Can traditional OEMs meet the threat at home?

Traditional volume manufacturers and their suppliers will continue to be confronted with the effects arising from the low-cost/low-budget car phenomenon. As a consequence, these OEMs will need to rethink their product development paradigms and current business models. In doing this they will need to answer three sets of questions to evaluate the opportunities and threats from low-cost and low-budget business models:

> Are low-budget and low-cost cars a threat or opportunity for my company?

> What are the elements of success for low-budget business models?

  – What principles have to be applied to realize a quantum-leap in "value for money" from product development?

  – How do we change our partnering approach?

  – How can we reduce risks and expenditures?

> How does my company effectively restructure to a low-budget position?

Companies will need to determine how they will participate in this revolution or reposition themselves – if they can – and "get out of the way". Chapter 4 addresses the nature of the innovations being incubated in emerging markets and what it will take to compete in the future.

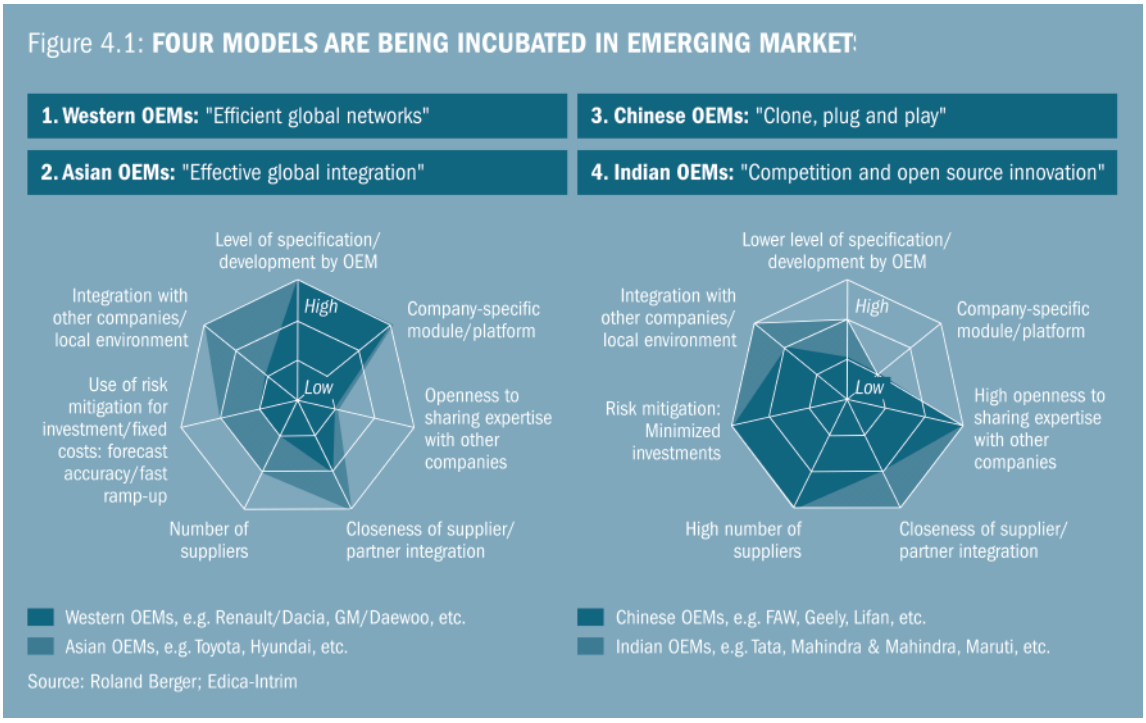
4. Emerging markets innovation: The next wave triggered by low-cost cars

To better understand low-cost cars/low-budget cars and how emerging markets are incubating and driving innovation, we describe the different business models driving this phenomenon in this chapter.

4.1 Low-cost business models being incubated in emerging markets

As shown in figure 4.1, our study identifies four low-cost business models.

Figure 4.1: **FOUR MODELS ARE BEING INCUBATED IN EMERGING MARKET**



Source: Roland Berger; Edica-Intrim

These models are applied either by large traditional OEMs (figure 4.1, left) or by new players from China and India (figure 4.1, right). They are an amalgam of common approaches to low-cost and low-budget car production driven by regional necessities and an evolving vision of the future, rather than the approach of a single auto producer. Within this context there are both similarities between the more developed OEMs and the emerging OEMs, as well as major differences:

> The European and North American OEM or 'Traditional OEM Model':
This is employed by Renault/Dacia and to some extent by GM/Daewoo. This model is based on cost-cutting by means of economies of scale and using strict design-to-cost methods.

> The Japanese and Korean Model:
This is employed by companies like Toyota and Hyundai and is best described as process innovation within a global network.

> The Chinese Model:
This is followed by private companies such as Chery and Geely. This model focuses on building on cloned solutions and leveraging China's low-cost base to provide vehicles at a low cost. It is sometimes referred to as "Clone, Plug and Play".

> The Indian Model:
This is practiced to varying degrees by Tata Motors, Maruti, Mahindra & Mahindra and others. Our research indicates that the evolving Indian way of developing low-cost cars will be based on a business model integrating five elements. When integrated, these five elements will help Indian companies achieve the twin goals of low cost and acceptable quality. In some instances the Indian model is still developing and we have extrapolated trends to describe how the successful model may work. The five main elements of the Indian model are:
  - Fraternity building that includes co-opetition as well as the development of key partners with complementary intellectual capital. Reducing costs through shared intellectual property in return for assured value/business for the cooperating group forms the core of this element
  - Indigenous innovation as a tool for delivering not only low cost but enhanced customer value
  - Logically sized investments that optimally integrate manual labor and automation
  - Institution building outside the firm's immediate environment as a key strategic marketing or cost advantage weapon
  - Portfolio approach to asset utilization where all significant capital investments are designed for multiple uses so that business risks are reduced. Indian companies tend to view different business elements as asset blocks. Land is always acquired under the assumption that it could have a portfolio of uses, ensuring that the acquisition is de-risked. Labor is frequently multi-tasked, tool rooms and even assembly lines are shared. The entire approach is to de-risk and reduce dedicated costs

Indian car manufacturers impose these five elements over and above the classical elements of car design and manufacturing and, when integrated, help develop what Carlos Ghosn famously described as "frugal manufacturing".

Before we compare the different approaches regarding car design and leveraging factor costs on the manufacturing and component side, let us take a closer look at the specific Indian approaches of "Fraternity building", "Indigenous innovation" and "Institution building".

4.2 Specific aspects of the Indian model: Integrating other partners and the society at large

"Fraternity building", "Indigenous innovation" and "Institution building" are three core elements of Indian manufacturers' business models, which we observed only marginally with other OEMs. They do not focus only on the product and "up-stream" processes, but cover the whole value chain.

4.2.1 "Fraternity building" as the critical asset investment

In its Indian context, "fraternity building" is co-opetition in an "open source architecture", where the OEM attracts, orchestrates and works with an array of partners to support a project. The aspect of suppliers "infusing" their intellectual capital for little or no cost in a development project will be described when we look at "design effectiveness" in chapter 4.3. Indian manufacturers' approach of convincing their business partners to make equity investments in return for assured business is another one of their innovative partnership solutions.

An example for this is Hero Honda Motorcycles. The Hero group was able to get many of its dealers to invest capital in component plants and dealerships at very low initial returns but guaranteed growth in business volume and social stature. Hero now intends to repeat this motorcycle experience for their low-cost car project.

4.2.2 "Indigenous innovation" to deliver consumer value

To gain a broader, more macro perspective, a typical brand launch would involve making large investments in R&D, engineering, manufacturing, logistics, media & marketing and other functional areas. As such, it would be expected that the key component of successful low-cost car manufacturing would be superior R&D and engineering by the OEM, as described later in this study. In actual fact, the most important initiative is arguably the early investments made by fraternity partners to support the OEM's brand initiative. This 'cradle to grave' open source structure extends to reducing the cost of OEM warranties as well. In this case, they reduce the lifecycle costs of maintenance by leveraging/employing the service skills

of a vast number of independent roadside mechanics that have low-cost garages with low overheads supported by a free flow of spare parts not only from original component makers but by after-market vendors as well.

In addition to engineering and product innovations, Tata has created an innovative manufacturing model that moves some of its manufacturing costs off the balance sheet. Specifically, it has created a model where non-Tata corporate-owned dealers do some of the "last mile" assembly at the dealership. For the new low-cost car, Tata is planning to shift the assembly of mirrors, wipers and other such accessories to the "last mile dealers". This will reduce Tata's manufacturing costs as well as manufacturing taxes. In addition, the dealers have a lower cost structure (i.e. operating and benefits costs), resulting in lower costs to the consumer. This can be accomplished because Tata has the processes to train and monitor staff performance in more than 1,000 dealerships – thanks to systems developed for training staff in more than 100 of its hotels in the country and now replicated for the automobile industry.

This form of innovative operational planning is inherently very strong and sustainable since it is unique and not easy to replicate by others. What Tata, Mahindra and others have achieved is process innovation as a dynamic or continuous activity within their organizations, thereby institutionalizing the process and leveraging it to benefit consumers. Honda in India, in distinction, is reluctant to let its Indian subsidiary play a leading role in local (process) innovations as it believes that quality may suffer. As a result, it has some of the more expensive vehicles in India. By acting globally, but not thinking locally, Honda's salary levels are high. This extends to its dealerships too, where standardized salaries result in increased dealer manpower costs. Its competitors allow local dealers to manage their salary costs, enabling them to keep these costs down and transferring the benefits to customers. Generally, Indian companies standardize training but not salaries and cost structures.

4.2.3 "Institution building" outside the firm's environment as a strategic competitive weapon

It is well known that firms doing business in developing countries are often saddled with extra costs because institutional frameworks like labor markets, financial markets, taxation systems, and logistics providers are weak. It was assumed that such weaknesses would reflect in higher costs. However, Indian companies have developed effective strategies to transpose these barriers into opportunities to drive down costs.

The prime example is the House of Tata, which like the Korean Chaebols invests in a particular geography and builds the social infrastructure (education, health, etc) in the area. By creating effective partnerships within the society at large, Tata receives loyal, committed, and cheaper labor flow for its factories.

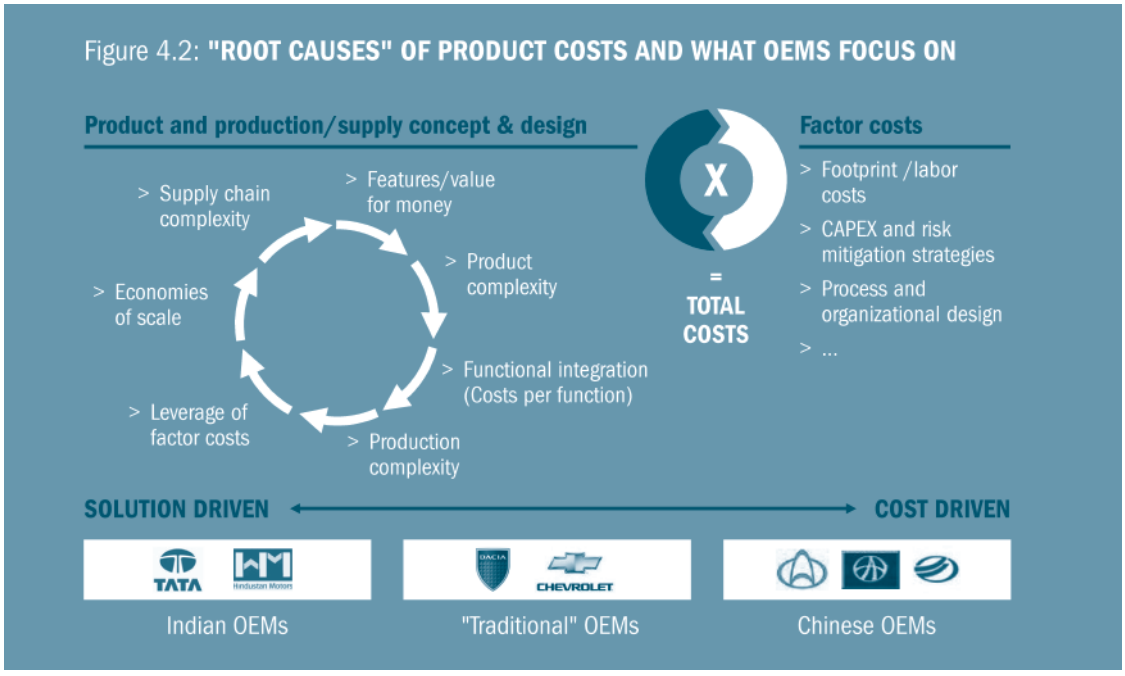
In a similar fashion, Maruti is training a generation of roadside mechanics and developing rated driving schools. Despite the initial costs involved in setting up these programs, these activities help reduce costs in the long term. The plethora of trained mechanics helps Maruti deliver after market support for its brands at costs lower than the competition. Rated driving schools, which are revenue earning units, create a set of customers who choose Maruti as their first car. This is a paid form of market development somewhat similar to Apple giving away free computers to US schools. The creation of rated and certified used cars is another low-cost self-paying market growth initiative from Maruti. A similar initiative is also being run by the Mahindras.

In another example, the logistics industry is supported by the Indian auto industry and finance groups to enable easy purchase of trucks and vehicles. In return for this help the auto companies negotiate up to 25 percent lower transport rates from the transporters they help finance. It is important to note that even if a trucker is financed by one manufacturer he is not restricted from carrying another's goods as long as costs are being driven down.

4.3 Key levers in reducing ex-factory product costs

Low-cost car manufacturers address both root causes of high "ex-factory" product costs, by achieving superior design effectiveness and by achieving the lowest factor costs possible.

But they all do it with a different focus, as shown in figure 4.2. In our observations, Indian players (i.e. Tata) put a high emphasis on effective solution based design (while they also leverage their factor cost advantages). Chinese OEMs focus much more on minimizing costs by leveraging their extremely low-labor costs and ability to reverse engineer and clone the competencies of others.



Companies that integrate design effectiveness while leveraging low operating costs (i.e. low labor) are able to achieve (ex-factory) cost reductions up to 60 percent. Figure 4.3 summarizes our findings and gives an estimate of achievable cost reductions:

> "Component engineering and supply" summarizes all direct material costs, including engineering costs for subsystems and components of suppliers and OEMs. These can be reduced by more than 50 percent.

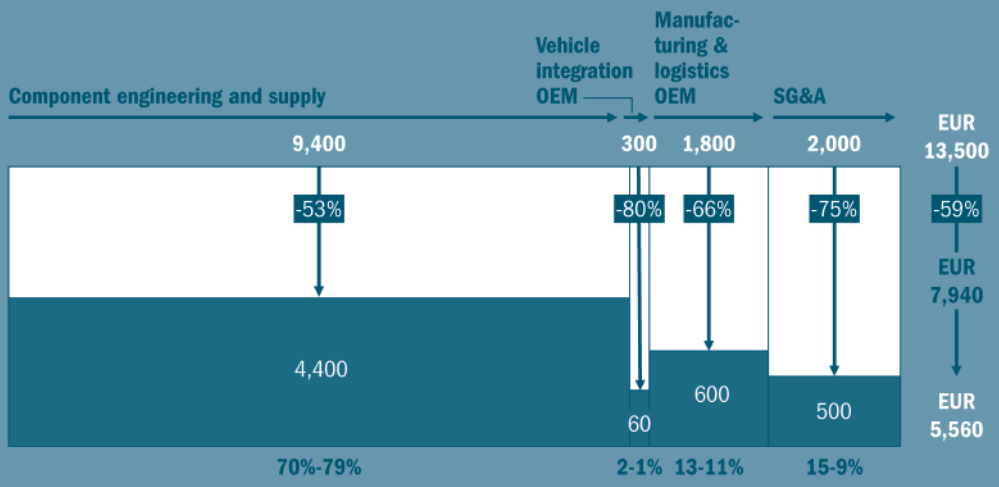
> "Vehicle integration OEM" includes all engineering and testing for the complete car and powertrain integration/application. Costs can be reduced by up to 80 percent. However, as we will see later, there are various trade-offs related to this figure, especially with lower overall platform production volumes.

> "Manufacturing & logistics" costs for OEMs comprise all direct and indirect manufacturing costs including depreciation. They can be reduced by over 65 percent, mainly by taking advantage of lower wages and optimized manual labor processes that minimize capital expenditures (CAPEX) as well as other approaches to reduce factor costs.

> "SG&A" covers all other administration and sales/marketing expenses at the corporate level. Reductions up to 75 percent are possible.

Figure 4.3: **"EX-FACTORY" COST REDUCTION POTENTIAL C-SEGMENT VEHICLE**

Cost structure comparison low-cost vs. Golf class car [ex-factory, EUR]



Source: Roland Berger

These potential cost reductions are achieved by leveraging "design effectiveness" and "low factor costs" as described in the following sections.

4.4 Design effectiveness – key for sustainable low-cost solutions

Interviews and benchmark results confirmed four key principles for design effectiveness used by most low-cost manufacturers:

> Adapt rigorously product characteristics to specific local market needs – Consider customer and legal requirements.

> Update vehicle design and offer an attractive, affordable exterior and interior that reflects the brand.

> Use modular platforms: leverage existing platforms and architectures until production volumes justify new platform development. However, start developing new platform architecture with a "clean sheet of paper" in close cooperation with suppliers to position new platforms when volume, target prices and cost positions justify it

> Apply rigorous design to cost and design to manufacturing concepts, while considering local supplier capabilities

Only product concepts that are adapted to specific market requirements can be successful. For example, customers in India focus more on functionality, while Chinese customers focus more on "fancy features" and exterior design.

4.4.1 Styling as differentiator

Styling and design plays a major role in attracting prospective buyers in nearly all markets as shown in the examples in figure 4.4.

Figure 4.4: **STYLING OF SELECTED LOW-COST CARS**

Source: Roland Berger

Early synchronization of styling and technical requirements plays a crucial role in designing appealing low-cost vehicles. With the right design, interior costs can be reduced by at least 20 percent without switching to cheaper poor quality materials or compromising on haptics, interior space, comfort or optics. Approaches used to accomplish this include:

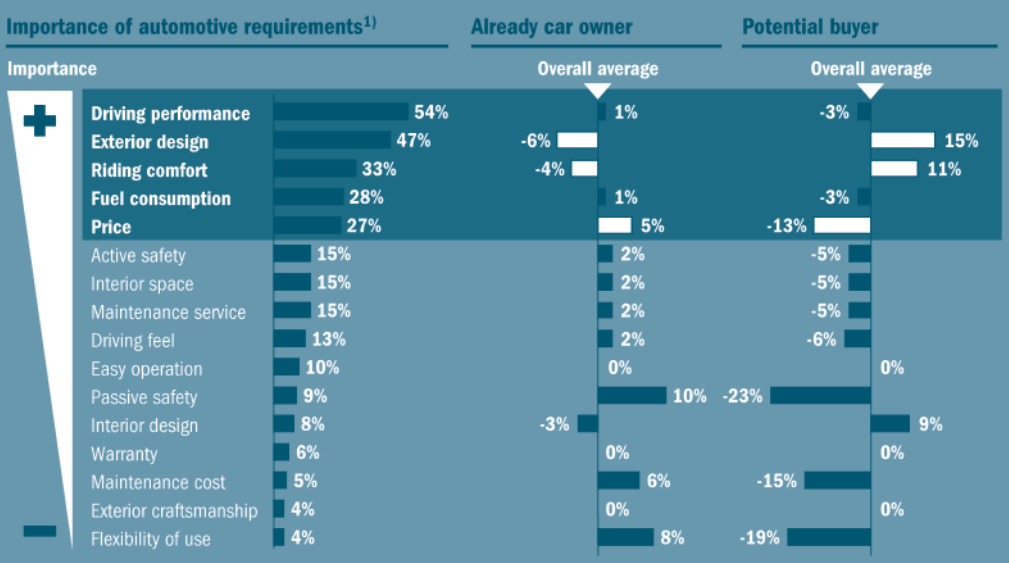
> Interior designs that avoid narrow clearances between the dashboard, A-pillar and door

> Simpler exterior designs (i.e. avoiding sharp edges in sheet metals) which require less complicated (e.g. no in-mold slide) tools. These can be inexpensive to purchase and when not purchased, can be easily produced in low-cost countries

4.4.2 Product features: Finally applying the "Kano" principles

In addition to design, functional product features play a major role in buying decisions. Figure 4.5 demonstrates car purchasing criteria for Chinese customers. Here, we differentiate between first time car buyers and those who already own a car. It becomes apparent that in all groups, driving performance is the most important criterion. For those that have never owned a car, exterior design is significantly more important than for existing car owners.

Figure 4.5: **PURCHASING DECISION CRITERIA FOR CHINESE CAR BUYERS**



1) Question: " When you buy a car, what factors are most important to you"
Source: Roland Berger survey

A similar purchase criteria analysis can be applied to other countries as well. However, keeping the low-cost approach in mind, it is important not to overload the vehicle with features and functions. This concept, based on the "Kano" principle, is clearly apparent in the development of the Dacia Logan, the Tata Nano and various vehicles designed by Toyota for emerging markets.

KANO ANALYSIS

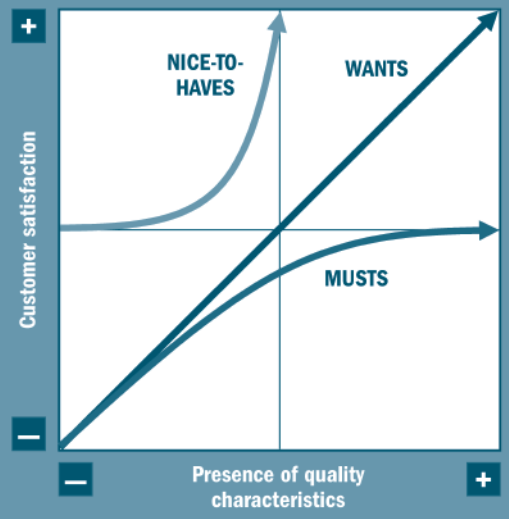
The Kano analysis differentiates between three different types of features:

MUSTS:
Basic features that the customer expects to be there without explicitly asking for them

WANTS:
Features customers specifically ask for

NICE TO HAVES:
The subconscious desires that customers did not think of – they generate customer excitement if they are part, or become a part of the deal or are offered for a small additional charge

The category specific features fall into depends heavily on the target market and customer segment



A Chinese OEM for example was faced with the demand for an entertainment system in one of their low-project models. Instead of integrating a CD player, they went with an USB port to play MP 3-music. That solution was not only cheaper, it also created customer excitement in that sense that consumers didn't expect such an innovative solution from a local manufacturer.

The greatest cost reductions from "feature de-contenting" can be realized in the electronics, exterior trim and interior domains. Powertrain and body structure costs savings are mainly influenced by emissions and safety regulations as well as the overall product architecture. However, fulfilling a certain safety level is often a pre-defined criterion – depending on the targeted country. As a rule of thumb, within European countries, cars receiving a minimum of three stars in the NCAP crash test ranking have a solid basis for market success because of safety concerns, but reaching higher standards does not automatically result in higher market success, as shown in figure 4.6.

Figure 4.6: **SAFETY LEVELS OF LOW-BUDGET VEHICLES**

Vehicle model	NCAP-Rating	Segment	Target markets	Market success
Brilliance BS6	★☆☆☆☆	D	Asia, Europe	↓
Chevrolet Matiz	★★☆☆☆	B	Europe, Asia, RUS	↗
Chevrolet Kalos	★★★☆☆	B	Asia, Europe	↗
Dacia Logan	★★★☆☆	C	RUS, EU, Middle East, South America	↑
KIA Picanto	★★★☆☆	B	Asia, Europe	→
Tata Nano	★★★☆☆	A0	India, Asia, ...	→
Renault Twingo	★★★★☆	B	Europe	↑
Fiat 500	★★★★★	A	Europe	→ 1)

1) High pre-order levels

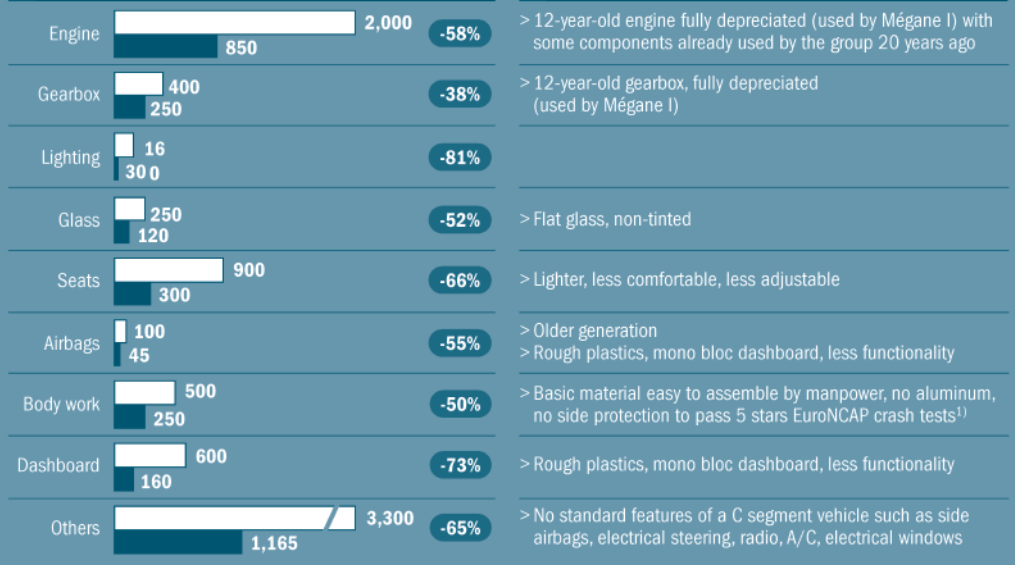
↑ Expected total sales >2m ↗ Expected total sales >1m → Expected total sales >700 ↓ Expected total sales <500

Source: EURO NCAP; J.D. Power; Roland Berger

Even very inexpensive cars such as the A0-segment Tata Nano with an ex-factory price of 100,000 Rupees (1 Lakh Rupees), or about USD 2,554/ EUR 1,714 at Jan.'08 exchange rates for the base model can achieve the basic safety levels. The Nano is designed to comply with current European safety standards, and at launch will meet the prevailing Indian emission standards equivalent to Euro 3. It will also meet Indian emission standards equivalent to Euro 4, due to take effect in April 2010. However, the 33-hp, 50-mpg Nano, which can only reach 105 kph, has only a single windshield wiper, no radio, power steering, power windows or air conditioning in the base model. The instrument panel is rudimentary – containing just a speedometer, odometer and fuel gauge.

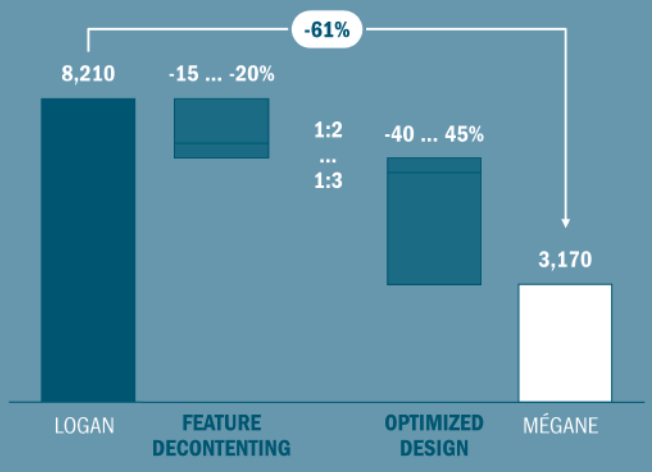
Based on our interview results, we estimate the effect of reduced functionality to be typically in a range between a quarter and a third of the overall cost reduction potential compared with a "standard" car. This is shown in figure 4.7 for the Dacia Logan, which is based on the Renault Mégane platform.

Figure 4.7: **COMPARISON PRODUCTION COSTS MÉGANE – LOGAN (1/2)**



Source: Auto Journal; Deutsche Bank; Roland Berger

Figure 4.7: **COMPARISON PRODUCTION COSTS MÉGANE [EUR] – LOGAN (2/2)**



FEATURE DECONTENTING:

> Reduced product functionality/ features due to different positioning /market requirements

OPTIMIZED DESIGN:

> Indirect effects of reduced functionality

> Variance reduction and functional integration

> Economies of scale on supply side

Source: Auto Journal; Deutsche Bank; Roland Berger – LOGAN base vehicle

The remaining two thirds of the cost reduction potential is realized from an optimized product design that drives manufacturing efficiency, carefully balancing functional integration and economies of scale with standardized/ replicable concepts and components.

4.4.3 Platform design, vehicle architecture and supplier integration

The key to reducing vehicle design and component (integration) costs lies in smart modular engineering during the volume ramp-up stage and economies of scale through common concepts and components with early and intense supplier involvement.

Two basic approaches can be observed when we look at low-cost cars:

> Modification of existing vehicle platforms

> Development of new vehicle platforms

Whether an existing vehicle platform (or the major systems of existing platforms) are used as a base for a low-cost vehicle or whether a new platform is being developed is mainly a question of the vehicles cost target and the total number of vehicles (or systems) to be produced over a lifetime that can share the burden of one-time engineering costs and investments.

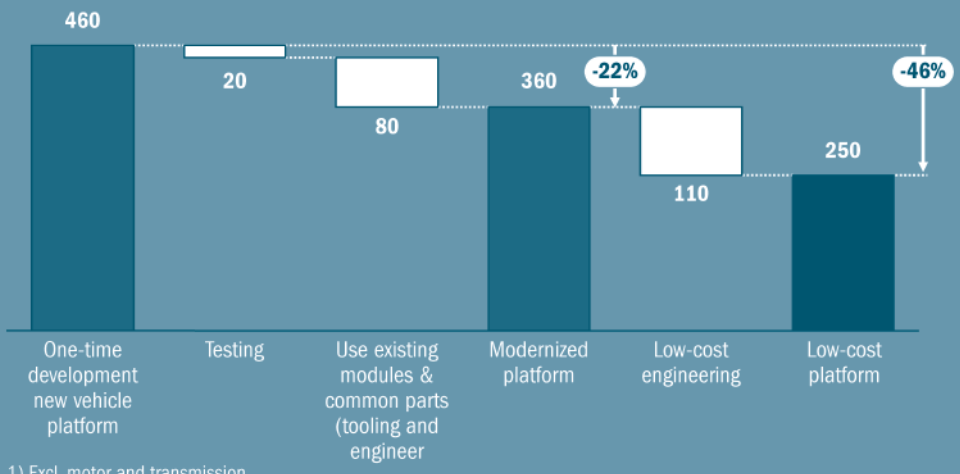
Modification of existing vehicle platforms

Modernizing and modifying an existing vehicle platform is a feasible approach if the target costs of the low-cost vehicles are similar in magnitude to the costs of the existing platform. By using existing concepts, validation and integration costs can be reduced for both vehicles and components, thus realizing significant savings in initial engineering costs (see example in figure 4.8).

This approach is mainly used by traditional global OEMs such as Renault, VW and GM. Existing car architectures (mainly defined by the packaging concepts and certain fixed points within the vehicle and the electronics architecture) and major subsystems like powertrain and chassis are often used while other, especially visible, components are modernized or developed new, which is shown in figure 4.9.

Figure 4.8: **COST REDUCTION OPPORTUNITIES BY MODIFYING EXISTING PLATFORMS**

Cost savings opportunities in platform development [EUR m]



1) Excl. motor and transmission

Source: Roland Berger

Figure 4.9: **TYPICAL CARRY-OVER AND NEWLY DEVELOPED COMPONENTS IN PLATFORMS**

Car section	Share of total cost	Proven concept	Modernize	Innovate
Powertrain	19%	> Engine > Gearbox > Drive train > Exhaust sys. > Cooling sys. 80 %	> Engine cover > Radiator grill > Engine mounts	> Engine cover > Radiator grill > Engine mounts
Chassis	11%	> Axles > Suspension > Breaks > Steering sys. 90 %	> Wheel trims > Tires	> Wheel trims > Tires
E/E	40%	> Battery > Sensors > Wiring harness 95 %		> Software
Body/ exterior	16%	> Fuel tank > Wiper system > Floor panel > Lighting 30 %	> bumper > body shell, closures > windows > external mirror	> Bumper > Body shell, closures
Interior	14%	> HVAC > Safety belts > Seat frames > Hand break system 65 %	> Switches > Seat covers > Steering wheel	> HVAC front end > Switches > Seat covers > Steering wheel

15 % = Share of production cost within domain, percentages may vary according to specific vehicle

Source: Roland Berger

Dacia's Logan is based on that approach and is basically a modernization of Renault's X90 (old Mégane) platform. This helped Dacia to save 25-35 percent of the one-time costs involved in developing a new vehicle and to reduce component and integration costs significantly, as shown for some examples in figure 4.10.

Figure 4.10: **MODERNIZATION OF MAJOR MEGANE PLATFORM COMPONENTS AND COST EFFECTS FOR THE LOGAN**

Design modifications	Cost reduction vs. Base platform
FRONT AXLES AND STEERING	
> Lower all mountings with fitted ball joints (reduce production process)	Front axis: -7%
> New shock absorbers, no spacers and suspension housing (comply to road conditions/reduce costs)	Steering: -29%
REAR AXLE	
> Design not modified, component from Laguna platform	Rear axis: -20%
BUMPERS	
> Front bumper surrounded in stainless steal	Bumper trims: -44%
> Identical painted and non-painted bumpers	
DESIGN FOR MANUFACTURING AND ASSEMBLY	
> Exhaust system with only 3 hangings	Final assembly: -26%

Source: Renault development report

Traditional OEMs focusing on high volume sales and economies of scale usually rely on their own vehicle platforms, sharing them within the corporate family (of brands) and – sometimes – with other OEMs. They set out in great detail the specifications they require from their suppliers, insisting on standardization across different suppliers, but compared to the new players from emerging markets, they do not leverage the capabilities of their suppliers in the most effective way.

Unlike the traditional global OEMs, Indian and Chinese OEMs do not sell enough vehicles to develop a complete new low-cost platform of their own. This is offset by the way they leverage vendor capabilities.

The Indian low-cost car model leverages supplier capabilities through a form of co-opetition best described by its IT frame of reference as an "open source architecture" to car design and manufacturing. In this structure, the OEM invites, orchestrates and works with an array of partners to support a project. In the spirit of co-opetition, partners either infuse their intellectual capital into the project at no cost or actually make equity investments in return for assured business.

Major examples of sharing intellectual capital can be seen in the way the Scorpio by Mahindras and the Indica (as well as the Nano) by Tata were developed. In both cases, the OEMs were often able to have their potential partners exchange knowledge in return for assured business. In addition, having limited accumulated knowledge, Indian (as well as Chinese) companies have no prejudices against co-opting internet sourced know-how to reduce R&D costs. The net result is that Tata's Indica and Mahindra's Scorpio have leveraged their low cost R&D to develop these cars at one-sixth of the global norms (start to finish at costs between USD 50-70 million) and converted their gains to benefit consumers by pricing them well below similar cars in their respective segments.

Similarly, design suggestions by fraternity partners' are reported to have reduced the cost of Maruti's new SX4 by 10-15 percent. When Hyundai launched its first vehicles in India, both Hyundai and Maruti (a Suzuki joint venture partner) benefited from having vendors that could bring down the costs of both vehicles by using the marginal costs from all the vehicles they supplied to.

Taken as a whole it is clear that the Indian vendor fraternity system differs from both the Western Tier system and the Japanese Kereitsu system. In the Japanese Kereitsu model, vendors are locked into doing business with only one manufacturer. A free flow of knowledge from outside the Kereitsu which could bring down costs is not encouraged. In contrast, borrowing from the open source system employed in segments of the computer industry, a multiplicity of vendors that understand the architecture of the various vehicles innovate and realize internal economies to bring down the costs of all vehicles, regardless of which carmaker they are supplying.

To some extent, the Chinese follow a similar track. Due to a lack of qualified developers and only rudimentary vehicle engineering capabilities, especially the newly established manufacturers rely heavily on external support and optimize known systems and capabilities. This is typified by companies such as Chery and Geely which make extensive use of ready-made solutions and supplier driven vehicle specifications. In China it is often the supplier who sets the specifications.

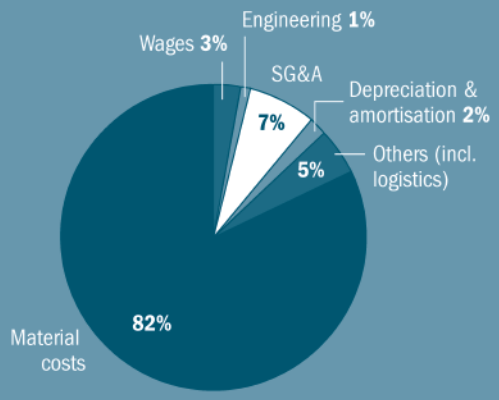
Similar to Indian carmakers, Chinese OEMs develop only 10-15 percent of a passenger car on their own. This allows them to focus their finite and still evolving engineering skills on a limited number of technical details and project management, while making full use of external developers and designers in both China and Europe.

One Chinese manufacturer we analyzed outsourced the complete development of its first vehicle to Tongji University (Tongji employs around 420 engineers in a subsidiary providing engineering services to Chinese OEMs). A number of its own staff worked on-site during the development period, serving as a production planning staff interface. By leveraging these inexpensive resources, the manufacturers were able to do all the product development for tens of millions of dollars, as compared to hundreds of millions of dollars for global manufacturers.

The OEM provided only a rough specification and a cost target. Based on that, suppliers were selected and the vehicle was defined around subsystems and components available on the market. Target costs and specification were later made more precise during the detailed design phase. The company leveraged a large supplier base coming from the two- and three-wheeler sector. Material costs were calculated by both parties, the OEM and the supplier, and development was remunerated in the parts.

While Chinese companies are able to realize very low-cost figures through their own local supply base, they still lack strategic supplier management skills and tend to pay relatively high prices for the critical technologies they source from global suppliers.

Figure 4.11: **COST STRUCTURE OF A CHINESE LOW-COST CAR**



- **Significant lower wages and depreciation/amortization on OEM level** (at comparable share of in-house manufacturing/higher HPV)
- Very low material costs for "low-tech" commodities, comparable level for high tech components; **very little/no supplier development costs**
- **Significant productivity gaps** to Western, Japanese and Korean OEMs leave much room for improvement to **compensate future wage increases**

Source: Roland Berger analysis

As a result, material costs of Chinese OEMs account for an extremely high share (see figure 4.11) compared with other cost elements which they can leverage thanks to extremely low local factor costs (see Chapter 4.2).

Development of new vehicle platforms

If vehicle target costs are much lower, modifying an existing platform is not a feasible way to create a car with an acceptable price-performance ratio. A "clean sheet" approach is necessary for platform development.

GM for example is known for both modernizing platforms as well as for developing new platforms (i.e. at the Daewoo design center in Korea) in an attempt to cover the needs of various markets at a competitive cost and at a reasonable margin.

The guiding principle for GM is to use much simpler and proven product concepts and manufacturing processes to enable significant cost reductions and to facilitate similar processes being replicated in low-cost countries. For example in its new low-cost platform, GM will not use tailored blanks and high strength steel for the body and will avoid complex processes such as hydro-forming. This will not only reduce material costs (switching from extreme strength to high-strength steel reduces costs by approximately EUR 200 per ton or EUR 50 to 100 per vehicle respectively), it will also increase GMs ability to assemble and repair vehicles globally. Necessary crash resistance will be achieved on a managed cost basis through extensive use of CAE and simulation tools.

While this approach clearly places design effectiveness at the heart of engineering efforts, it is still rather traditional when it comes to supplier integration and cooperation in the value chain.

Tata, in contrast, applied the above described concepts of co-opetition in its planned high-volume, low-cost production of the Nano. Carryover components were ruled out for the Nano as there was no existing architecture and nothing in either Tata or vendor component shelves that could be used in terms of size and price. Adhering to its open source approach to engineering and design, Tata requested a product suitable for emerging markets conditions, with a durability of 100,000 miles, low running and maintenance costs and modern interior and exterior styling. The packaging and powertrain concept included gasoline and diesel versions and an alternate fuel engine for the future. It also requested that all the existing safety and emission norms in India and Europe be met, as well as have the capability to meet future (known) emission and crash-test norms. In parallel, the vehicle architecture was defined in a way to minimize or

avoid the need for costly systems while achieving a high degree of functional integration. By reducing the weight of the base Nano to 1,278 pounds, the car needs less equipment to operate and the engine can have two cylinders instead of three or four. The new architecture was then defined in a way that allowed the engine to be placed in the rear. With the weight in the rear, the steering system specifications were designed for a lighter load – and a lower cost – than needed in other cars.

At the component level, Tata employed both proprietary designs and its own designs in the Nano. For proprietary design components, Tata went with established suppliers like Bosch (which supplies the Engine Management System for the gasoline engines and made similar contributions to the diesel engine system) which had strong design, testing and integration capabilities. A long iterative process was used to establish a design that would meet cost and specification targets. Bosch did not downgrade existing solutions, but innovated around concepts used in other vehicles. For example, they adapted a motorcycle starter motor, as well as redesigned sensors to reduce size and weight. To minimize engineering costs, the German supplier also divided the development effort between its design centers in Bangalore (India) and Germany. Using local design capabilities was a crucial decision as most global design centers were accustomed to designing high-end systems and employing development staff at significantly higher wage levels than in India.

For Tata designed components and systems, they took advantage of the huge low-cost local supplier base for two- and three-wheelers and used local suppliers with strong process capabilities that could innovate and improve upon suggested specifications and designs.

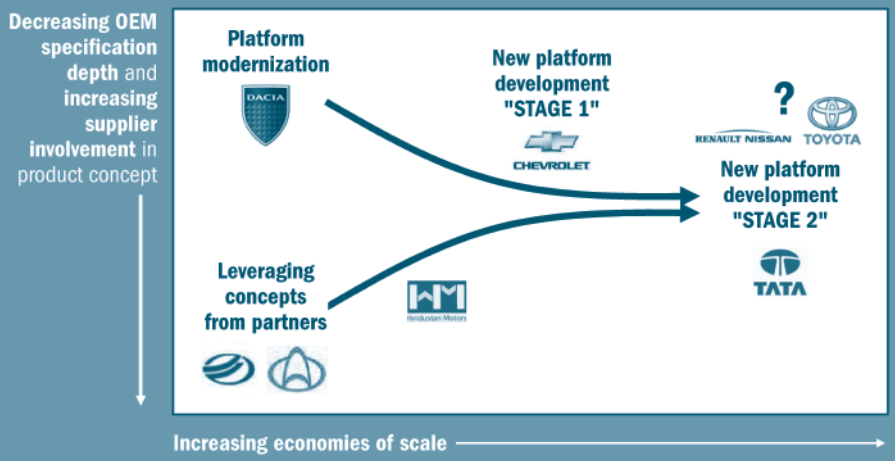
Being involved very early on, suppliers were able to participate in the specification process as well. For example, Rico, an Indian engine-block and cylinder-head casting firm, advised Tata even before the project team decided on whether the Nano's base engine would be two or three cylinders. As Vikas Saxena, Rico's assistant general manager for business development and project management, pointed out in an interview after the Nano launch, "the range was from 550cc to 750cc so when the answer was 624cc, it was a very close decision on how many cylinders to use".

Combining and comparing the approaches

With the Nano, Tata was the first to leverage innovative concepts from a wide network of partners in the spirit of co-opetition while developing a new low-cost platform – thus setting the benchmark for effective design. Figure 4.12 illustrates the different approaches. Competitors wanting to enter the same segment probably need to follow a comparable approach

to that showcased by Tata when developing the Nano. This is not because established OEMs do not have better technology or in-house capabilities, but rather because open architecture environments foster innovative ideas to flow freely. They rule out the "only invented here – holy cow" syndrome.

Figure 4.12: **COMPARISON OF DIFFERENT APPROACHES**



Source: Roland Berger

4.4.4 Benefits of rigorous design-to-cost

Besides the overall vehicle architecture, design-to-cost is mission critical. The main levers are functional integration, part simplification and designing for targeted manufacturing and assembly costs. By applying these principles, as shown in figure 4.13, the cost of the Logan's exterior accessories are 28 percent lower than the Clio's, and its bumper trim costs are 44 percent lower. This has been done by using:

> Stainless steel for the front bumper

> Identical painted and non-painted bumpers

> Integrated mountings in the headlamps to ensure alignment on the front bumpers

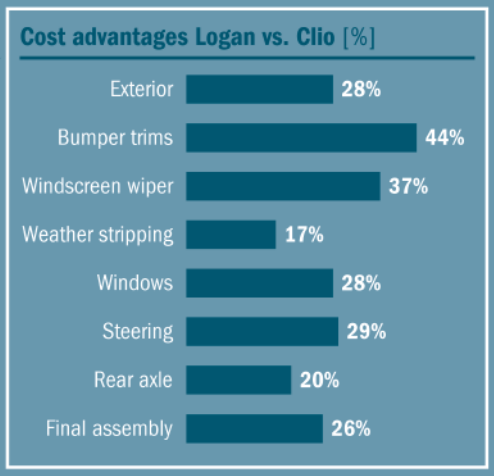
> Identical left and right door trim parts

> A single bulb in the third stop light, which has been integrated into the rear parcel shelf unit

Figure 4.13: **DESIGN-TO-COST PRINCIPLES APPLIED AT THE LOGAN**

Cost reduction design principles

Component re-usage	Usage of common parts to reduce development costs and increase part volume (if not "over-engineered" for low-cost application)
Part simplification	Reduction of processing and manufacturing costs and equipment investment
Functional integration	Integration of multiple function in one part to reduce process complexity
DFMA[1)]	Reduce number and complexity of assembly operations to increase productivity and quality



1) Design for manufacturing and assembly

Source: Roland Berger

When designing to cost, careful material selection can be a significant differentiator as is apparent when comparing the Logan to its predecessor, the Mégane. While the ratio between metals and polymers is 6.4:1 for the Logan, it is 4.7:1 for the Megane. The Logan makes greater use of metallic materials (74.5 percent compared with 71.8 percent). More significantly, it uses classic uncoated steel sheet because high strength steel grades are not readily available in many emerging markets. In this regard GM follows a similar approach, as discussed earlier in this study. The Logan requires less polymer materials than the Mégane, with 11.7 percent versus 15.4 percent. Logan only uses one raw material supplier who provides a competitive range of types and grades. A basic requirement in this approach was using well-known, robust materials that can be employed in standard processes and which can be easily handled by local parts suppliers in numerous countries.

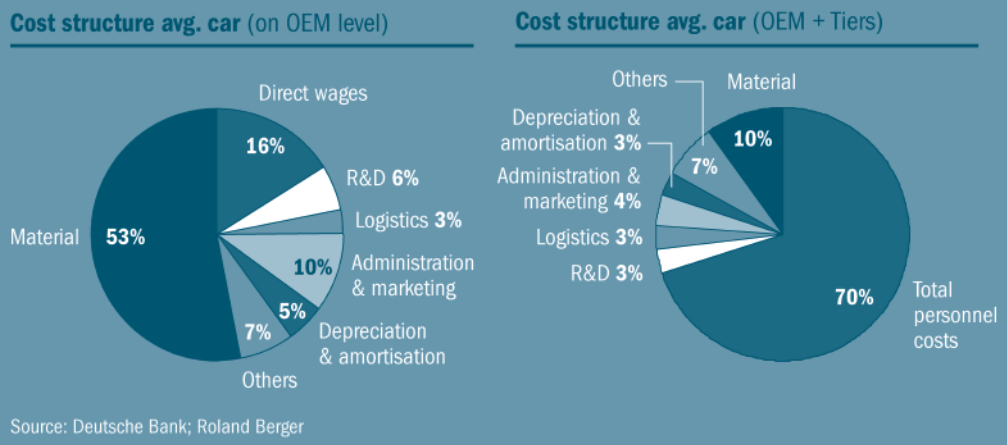
Material selection, "design for manufacturing" and complexity reduction also played a crucial role in the design of Tata's Nano. Major components have been designed in a way in which CAPEX is minimized. Hydro-forming is used for all tubular structures, which reduces weight and creates simpler production processes. Stamping has been replaced by roll-forming. While stamping requires different tools for different shapes, roll forming allows common tooling for a number of parts and fewer operations. Wherever the design allowed, thinner materials are used.

The bumpers of the Nano for example are only 2.5mm thick in contrast to the Tata Indica, with bumpers of 3mm thickness. As a result, not only is weight reduced (resulting in lower specification requirements), but forming and equipment requirements are modified as well. While Tata considered using plastics, most of the exterior is made from sheet metal, as this turned out to be less expensive.

4.5 Driving down factor costs

Besides design effectiveness, driving down factor costs is another major lever to realize quantum leaps in ex-factory product cost reductions. In the average car, direct wages make up approximately 15-20 percent of total ex-factory costs. While this figure does not seem very high, it is often used to justify production in high-wage countries. However, when viewing labor costs through the value chain, its impact dwarfs material costs. This is shown in figure 4.18.

Figure 4.14: **VEHICLE COST STRUCTURE BY COST TYPES – OEM AND VALUE CHAIN VIEW**



Source: Deutsche Bank; Roland Berger

Leveraging labor cost advantages in all company functions, sourced components, equipment and infrastructure is a "must" for low-cost car creation. The chart on the right in figure 4.14 also hints at the extent at which costs can be driven out of products assembled in Western Europe and the United States, if OEMs reduce their vertical integration.

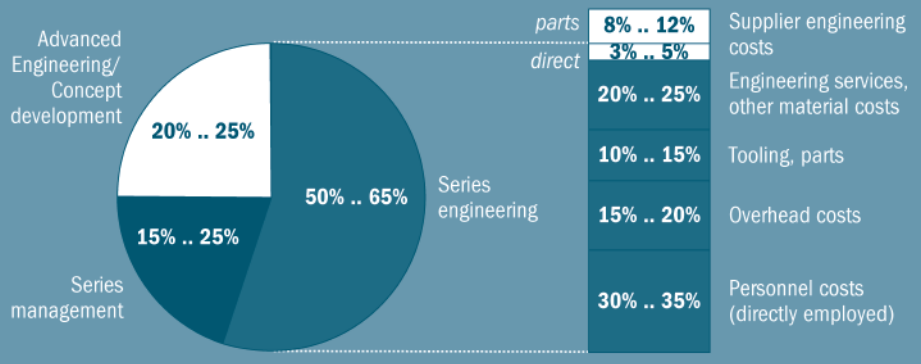
4.5.1 Leveraging low-cost engineering hubs

A closer look at engineering budgets reveals the potential for driving down factors costs. Figure 4.15 shows the typical engineering cost distribution of a Western OEM:

> Advanced engineering/concept development represents roughly a quarter of total costs, while series engineering and series management represent 50-65 percent, and 15-20 percent of costs, respectively.

> From a cost type perspective, OEM direct personnel costs represent roughly a third of total costs, third-party services are 15-20 percent, tooling and parts account for another 10-15 percent and overhead costs are an additional 15-20 percent of total costs. Direct supplier development has been reduced in the last few years to 3-5 percent of the OEMs engineering budget, while up to an estimated 10 percent of the OEMs own engineering budget are supplier engineering costs which are included in the parts price.

Figure 4.15: **WESTERN OEM ENGINEERING COST STRUCTURE**



Most design centers in developed countries are accustomed to designing high-end systems and the development staff are paid extremely well. With personnel costs representing up to 50 percent of engineering costs (include engineering service providers), leveraging a global development network is critical to driving down costs. Recognizing this, global OEMs are increasing the number and capacity of design centers in emerging market and striving to organize them either as "integrated network hubs" or "global lead centers" (figure 4.16).

Figure 4.16: **ENGINEERING CENTER MODELS IN EMERGING MARKETS**

Organizational model[1)]	Product and engineering approach	Importance
"LOCAL ANTENNA"	Developing and adapting a car in the **home market** and selling it in the local market	↓
"LOCAL SATELLITE"	Developing a car in the home market and making **minor modifications** in the local engineering center before selling the car	↘
"INTEGRATED NETWORK HUB"	Developing the basic architecture in the home market while allowing the local engineering center to add **major modifications** or **develop local derivates**	↑
"GLOBAL LEAD CENTER"	Assigning **global leads** for systems/modules or even entire vehicles to the local engineering center	↑
"INDEPENDENT CENTER"	Maintaining/facelifting cars based on **phased-out technology** from the home market in the local center	↘

1) A specific engineering center's operations may be characterized by more than one organizational model
2) OEMs that are not tied into a global alliance and that focus on a centralized engineering in the home-market HQ; mainly premium OEMs, e.g. Porsche and BMW

Source: Interviews; Roland Berger

A few examples highlight this trend:

> While Renault's development of the Logan still takes place primarily in France, it is building up its design center at the Dacia plant in Pitesti in Romania, where resources are considerably cheaper. In doing this, it is moving from a "local satellite" structure to an "integrated network hub" model. A similar move can be expected in Russia, after Renault was successful in acquiring a controlling a stake in AvtoVAZ in Togliatti

> Volkswagen began a similar initiative with SVW, but seems to be retrenching to a more centralized model

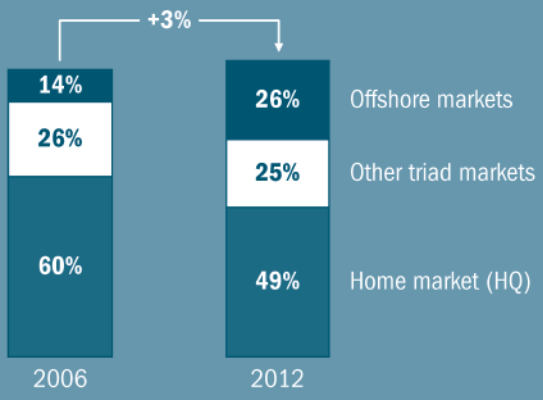
> With Daewoo in Korea, GM has clearly established a "global lead center" responsible for low-cost cars. They realized that it is very difficult for engineers in the United States or Europe to cover the whole spectrum of vehicle development from near premium to low-cost vehicles

In addition to Korea and Eastern Europe, Brazil is ideally suited for low-cost engineering and design. As this trend continues, vehicle engineering staff will continue to grow in emerging markets, with China, India, Eastern Europe and Brazil being destinations of choice.

Suppliers are even more advanced in developing their global engineering networks than most OEMs. For instance, to develop the new generation of low-cost injection systems, Bosch asked for new concepts from three competing design teams in China, India and Germany. As a result, Bosch has chosen to work closely with both China and India (e.g. for Tata's Nano), to create a low-cost solution.

While adding resources only moderately overall, suppliers are likely to significantly increase their engineering headcount in offshore markets. This is shown in figure 4.17.

Figure 4.17: **SHARE OF SUPPLIER ENGINEERING HEADCOUNT IN DIFFERENT LOCATIONS**



Source: Supplier interviews (#=27); Roland Berger

Similarly, along with this migration in engineering staff, tooling and prototyping will continue to move overseas, further enhancing low-cost operations.

4.5.2 Leveraging low-cost operations

Leveraging low-cost manufacturing locations and replacing capital expenditure (investments in plants and equipment) by low wages (operational expenditures) are important components in driving down factor costs and mitigating business risks, especially in the fast changing and high-growth emerging markets.

Having transplants in multiple locations forms the core of many low-cost approaches followed by Western and Asian manufacturers. A modular production concept with a high degree of vertical OEM integration, high supplier integration and standardized processes are typically used. Many Western OEMs continue to view high levels of automation as a key to success. However, the more successful traditional and emerging OEMs manage investments by minimizing automation, at least initially, by leveraging low wages.

Reducing capital expenditures and related investment risks

Any successful launch requires long term investments that reflect sales forecasts. The intuitive method is to estimate the need and then invest significant capital for large volume sales and realize economies of scale. In many instances we see Western companies willing to absorb losses until volume catches up with the equipment installed. But this approach is not the best one for emerging markets.

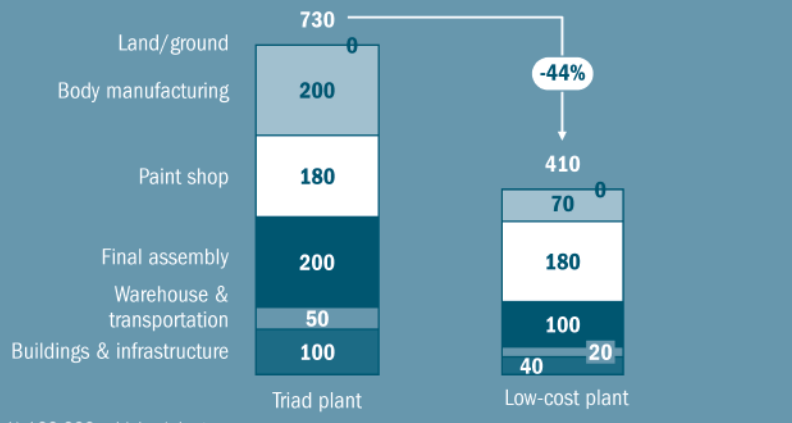
During the current transition phase of Indian automotive industry development, Western companies have failed to become profitable as they've employed capital and manufacturing structures that are not sensitive to local conditions. Those that are successful in India have broken their investments into logical modules and then phased them out in a balanced manner, in effect right-sizing their investments. For example, Indian companies have always been wary of robotized manufacturing and often employ quasi-automation where precision engineering is not mission critical and further automation is not cost justified. Semi-automation is prevalent in almost all components. Automated CNC controlled production takes place only in very high precision components like fuel injection components, pistons, crank shafts, gears, etc. Robotized production is used very sparingly and only in areas like chassis welding and assembly. Indian management always seek low-tech/low-cost solutions when high-tech more expensive solutions are not justified. For example, simple and effective techniques using locally assembled furnaces are used for the hardening and tempering of metal parts compared to expensive digitally controlled induction furnaces.

Similarly, at the end of the supply chain, car dealerships may establish retail space in areas totaling as low as 2,000-3,000 sq ft. All these right-sizing activities result in an overall drop in costs in the chain. This obsession to control investments goes a long way to ensuring that business risks are contained and costs brought down.

Locally sourced equipment helps to dramatically reduce CAPEX and related depreciation. Compared to high-cost countries, CAPEX reductions of more than 40 percent can easily be reached for a new production plant, as shown in figure 4.18.

Figure 4.18: **COMPARISON OF CAPEX FOR A 100,000 VEHICLE PLANT**

CAPEX for a new production plant[1)] [EUR m], "Triad standards"



1) 100,000 vehicles/plant

Source: Roland Berger

The numbers shown in figure 4.18 are very conservative savings estimates more or less based on Western standards.

A Chinese manufacturer we visited in the course of this study was able to drive down investments for a plant of similar size to less than hundred million euros. The plant, which currently runs well below its capacity limits, relies mainly on a manual workforce. With personnel costs for blue collar staff of around 1,000 RMB/month, 6-days working-week with 8 working hours per day, hourly costs are in a range of EUR 0.5 per hour. With a similar work content as seen in triad plants, fixed costs per car are at around 1,600 RMB (EUR 160) and variable costs (wages + utilities) in a similar range, based on less than 3,000 cars per month:

> The press shop consists of five hydraulic presses, four for cutting, edge trimming, etc; and one for drawing. Chinese machines are used for cost and service reasons (service is guaranteed within 24 hours). Except for small parts which are outsourced, all BiW components and panels are manufactured in-house. There is no automation in handling or transport between presses and the total investment is reduced to less than 10 million euros

> In general, there is no automated welding. Despite one operation, where the main parts of the body are automatically fixed by means of automatic axes and welded automatically, all operations are done manually. Figure 4.21 shows similar investments in painting for both a Triad and a low-cost plant assuming an automation rate between 20 percent and 40 percent; automation in the Chinese paint shop is zero

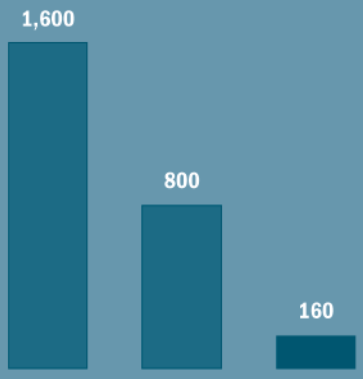
> Productivity in final assembly is relatively poor compared to Triad plants. While benchmark HPV figures lie in a range of 7.5 to 15 HPV for similar vehicles, HPV in China was more than 30. However, due to the extremely high difference in personnel costs (in Chinese tier 2/3 cities they are up to 10 times lower than in "traditional" low-cost regions in Asia and Eastern Europe) and the obvious productivity reserve, expected wage increases can easily be compensated for by productivity improvements in the foreseeable future

Reducing infrastructure investments

A closer look at infrastructure investments also shows a significant potential to reduce capital expenditures. Figure 4.19 compares square meter prices for a 300,000 vehicle plant in Europe, Russia and China. This real life example of a vehicle plant in central China shows that investment can be reduced by up to 90 percent compared to Europe.

Figure 4.19: **INVESTMENT FOR A PLANT BUILDING TO PRODUCE UP TO 300,000 VEHICLES ANNUALLY**

Price per m² [EUR][1)]



1) Without machinery
Source: Roland Berger

Example calculation for a plant building in China

SPECIFICATIONS	
Body shop	29,400 m²
Paint shop	31,800 m²
Assembly	35,400 m²
Σ	96,600 m²
Hall grid column (distance between columns)	18m x 24m 24m x 24m
Building height	8.4 m
Ultimate floor load	5 tons/m²
Price	**EUR ~15-16m**

Focus on **key necessities** and avoidance of too high specifications and over-engineering **keep cost for a Greenfield plant low**

Successful low-cost manufacturers also use public subsidies to minimize owner investments even further. Tata for example picked an undeveloped state, West Bengal, in Eastern India to build the Nano plant. The regional government streamlined the construction process for the Singur site and leased the site to Tata for free.

4.5.3 Reaching out to leverage the local low-cost supply base

As discussed, leveraging the local low-cost supply base with their low personal costs is of utmost importance to realize low-cost vehicles. Some Chinese as well as Indian suppliers do this by leveraging the huge network of suppliers in the motorcycle and three-wheeler industries, which are accustomed to both low-cost manufacturing and the needs of automotive manufacturers.

Localization

By using open sourcing, Indian OEMs reach out to more and more of the approximately 30,000 component players in India, seeking to absorb ideas and components at very low costs. In this environment, supporting

partners/vendors are also encouraged to work with competitors to help them de-risk their business. The challenge for Indian OEMs that strive for quality automobiles will be to sustain quality in this quite amorphous setting.

In the evolving Indian model, larger financial investments are often made in selected areas by the fraternity partners than by the parent OEM. In the Indian context these investments are being extended to other major components and assemblies like steering systems, engine blocks, power-trains, and brake systems. In return for these investments, the partners expect and will receive a steady and growing business which in the long-term will give acceptable returns.

To do that, TATA started a development program for a number of Indian three-wheeler suppliers. The aim was to use them for their ultra-low-cost vehicle. The objective for the Nano with its extremely aggressive cost targets was to source nearly everything locally. In fact, the Nano has had a localization content of 97 percent from its inception. While Tata began this initiative for this platform with 600 suppliers and a total of 1,800 supplier-part combinations, it eventually narrowed this down to 100 suppliers.

Half of the 100 vendors for the project are located in a 350-acre vendor park in Singur (Eastern India) adjacent to the new Tata plant. This will provide significant logistical cost savings. Instead of having annual contracts, Tata went with long-term volume contracts with its suppliers, driving down the costs even further. The suppliers for their part received significant volume commitments from the OEM, with about 75 percent of the components being single sourced and about 90 percent of the total car being outsourced. Three-shift operations and consolidated purchasing with the vendor allowed for further cost reductions. Tata's current challenge is to have all the suppliers in the vendor park up and running by Tata’s targeted plant start-up date. With the Nano, Tata is aiming for a less than 100 ppm rejection rate (better than in existing Tata plants) and a ten-fold improvement in warranty costs. This will need to be closely monitored. Boeing, for instance, has faced significant difficulties in managing and integrating its numerous parts manufacturers with its more complex Dreamliner.

Dacia's Logan is another example of how this has been done. Dacia's pilot plant is in Pitesti (Romania) and combines production, development and a supplier park.

The Pitesti plant achieves a local content rate of more than 80 percent, mainly through the supplier park's six main suppliers (figure 4.20).

Figure 4.20: **SUPPLIERS TO THE DACIA LOGAN PLANT IN ROMANIA**

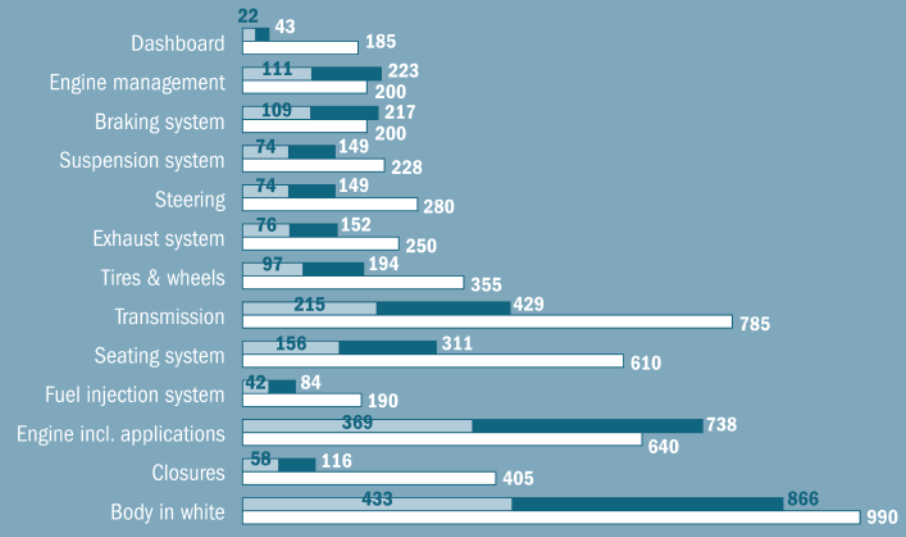
The high level of local content helps the carmaker to avoid additional inbound costs and ensures that the advantages of the low-cost region are fully exploited. In the supplier park in Pitesti, six strategic (global and domestic) suppliers are present. In the start-up phase, all other worldwide production sites are supplied with CKD kits from the Pitesti CKD center. In subsequent phases, the other plants (i.e. Iran and India) are required to develop a local network of 30-60 suppliers to achieve 60-80 percent local sourcing (some parts, such as stamping parts, are not planned for other production sites).

Supplier training plays an important role for Dacia, just as it does for Tata. The intensive Logan supplier training plan program, which is called ASIP (Alliance Suppliers Improvement Program), increases local supplier quality and transfers key technologies.

What component cost levels can be achieved

Figure 4.21 shows a comparison of European and Indian manufacturing costs for different components. The figure highlights that Indian costs lie in a range of 15 percent to 50 percent of European costs. However, it is necessary to adjust these percentages with respect to product content and quality. By applying a 100 percent mark-up, it still remains clear that a very large localization share will lead to a significant lower component cost position.

Figure 4.21: **COMPARISON OF MANUFACTURING COSTS EUROPE – INDIA** [EUR]



EUR 1 = Rs. 55

Source: Edica-Intrim

5. The Next Wave: Conclusions and unanswered questions

Are we really witnessing the birth of "a new way to bring vehicles to market" or not? Perhaps more importantly, is this a way of cutting costs not just in the A segment, but also in the B, C and D segments or simply a sign that companies are beginning to make better use of low-cost locations for car production? Irrespective of that answer, will this phenomenon result in a substantial hollowing out of automotive manufacturing in western countries in favor of emerging markets, as has been the case with electronics and appliances? If this is a paradigm shift, will it result in new commoditized price bands with little room for profits or will the winners see improved profitability?

Shifting perspective a little, is this phenomenon sustainable for emerging market OEMs and their partners? And as volumes increase and consumers move past entry stage vehicles will the epitaph be "the more things change the more things stay the same"? Does it even matter whether the paradigm shift is sustainable if the transition period continues for ten to fifteen years?

The low-cost/low-budget phenomenon is here to stay

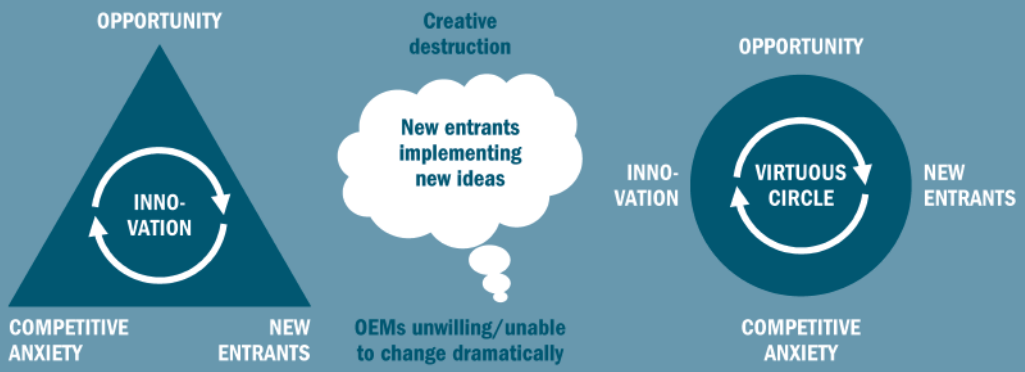
Based on our analysis, we can conclude that without a doubt the low-cost/low-budget phenomenon is here to stay. The squeezing out of the middle class in many societies, the high cost of gasoline, and surging demand in emerging markets are but a few of the macro drivers that will assure its endurance on the demand side. Competition and innovation from those players with the financial resources, technical know-how and whose founding credo is "necessity is the mother of invention" will be the macro drivers on the supply side.

On the micro level, our analysis leads us to the overwhelming conclusion that very substantial savings (30-45 percent) are there to be had for those that seek out new operating and business paradigms. Those that gain will be players who are not afraid to innovate based on a "Solution Driven Strategy (SDS)" to engineering, design, sourcing and manufacturing. This is true both for traditional and emerging OEMs.

A unique characteristic of this "next wave" is that the experimental laboratory – the incubator for innovation – is located in emerging markets. As with Silicon Valley and other incubators, innovation is being fed by local talent and foreigners rushing in to participate. In this case, Triad manufacturers introduce current technologies or design innovative new ones, while benefiting from the new ways of doing things in these high-growth markets.

The opportunity and threat to the industry will be in capturing growth in emerging markets with low-cost cars and, equally importantly, capturing cannibalized/penetrated sectors in developed markets with low-budget cars. Companies are faced with a choice between integrating their own strengths with those of their vendors to meet the challenge posed by this new business paradigm, trying to reposition themselves and get out of the way of this movement, or watching their company/brands atrophy or perish. Figure 5.1 shows how business model innovation drives change. New entrants with novel ideas are change agents ushering in a form of creative destruction for the industry. While the industry will have some winners and losers, the combination of opportunities, new entrants, competitive anxiety and innovation will result in a virtuous circle and renewed health for the industry.

Figure 5.1: **BUSINESS MODEL INNOVATION DRIVES CHANGE**



A Solution Driven Strategy that holistically looks at vehicle creation and its value proposition to the consumer will be critical in this next wave. Companies that get their strategy right and manufacture (A/B/C/D) cars in emerging markets can realize savings of 30-45 percent. Companies in developed markets that for logistical, technical or other market related reasons continue to manufacture these vehicles in their home markets can realize savings of at least 20-30 percent, if they consequently rethink their make-or-buy, production network and sourcing strategy.

Given the cost differentials, the dynamics of change will inevitably result in emerging market exports penetrating developed markets – until a point of stability is reached. Such a point will be reached when the rising cost of labor and operating practices combine with political resistance in importing markets to such a degree that the importing country will have to resurrect manufacturing. However, we anticipate that both Western Europe and the United States will see imports of low-cost and low-budget cars, components or systems/modules for many years to come. The virtuous circle above will assure that new innovations will arise over time to build on the next wave we are witnessing today.

Change agents of the next wave

What are the change agents that companies should focus on when designing a holistically based Solution Driven Strategy in this new environment?

The change agents are the following:

> Holistically defining the vehicle's cost and design parameters

> Integrating design effectiveness while leveraging low operating costs. This impacts component engineering and supply, vehicle component/system integration, manufacturing, logistics and SG&A. By addressing this key element, up to 60 percent cost savings (including feature de-contenting) can be achieved. Design effectiveness includes the following:
  - Adapting product characteristics to meet specific local market needs
  - Seeking innovative design architecture that minimizes parts and assembly
  - Using modular platforms: leveraging existing platforms and architectures until production volumes justify new platform development. Start developing new platform architecture from scratch in close cooperation with suppliers when volume, target price and cost position justify new platforms.
  - Optimizing labor costs and automation, with cost driven simplicity the objective
  - Updating vehicle design and offering an attractive, affordable exterior and interior that reflects the brand. Key elements in achieving this are simpler exteriors and interiors
  - Applying the Kano principle to the standard and optional features offered
  - Applying design-to-cost and design-to-manufacturing methodologies that incorporate local supplier capabilities
  - Optimizing the engineering organization and footprint

  - Optimizing factor and operating costs
    - Thinking globally means optimizing locally
    - When optimizing locally, employ a KIS (Keep It Simple) principle that allows local manufacturers to use their low-cost capabilities and local equipment manufacturers to supply low-cost equipment
    - Manage the technology growth process from a frugal perspective rather than a sophistication or complexity capability vantage

> Integrating suppliers and other business partners:
  - Consider the Indian and Chinese OEM models
    - India: Early integration of partners in the form of "co-opetition" and open source design that takes advantage of cost free, non-exclusive usage of its partners intellectual capital.
    - India: Taking advantage of indigenous innovation, rather than "our innovation is the only innovation"
    - India: Integrating other partners in the whole value chain to rigorously drive down operational costs and investment needs
    - China: Integrating vendors early on that excel in replicating standardized parts and assemblies
    - Reduce the degree of vertical integration, focus on most brand-relevant product features, technologies and production processes

> Leveraging low-cost manufacturing locations
  - Replacing capital expenditure (investments in plants and equipment) with low wages (operational expenditures)
  - Employing a portfolio approach to asset deployment, where all significant capital investments are designed for multiple uses

Individual companies will need to answer three sets of questions to evaluate the opportunities and threats to their companies from low-cost and low-budget business models:

> Are low-budget and low-cost cars a threat or opportunity for my company and/or our individual brands?

> What are the elements of success for low-budget business models that we can internalize?
  - What principles have to be applied to realize a quantum leap in "value for money" from product development?
  - How do we change our partnering approach?
  - How can we reduce risks and expenditures?

> How does my company effectively restructure to a low-budget position while maintaining its brand image, or do we need to reposition to "get out of the way"?

Consequences for OEMs
How OEMs worldwide answer these questions will have a significant impact, as indicated below:

> Western OEMs: Without dramatic change, companies in this group could lose significant market share, product lines/brands or be consolidated or liquidated. With the rise of electric vehicles, the overall vehicle architecture will become less complex, thus reducing technical entry barriers for emerging OEMs, and additional demand for "low-budget" city cars will be seen

> Asian OEMs: This will be another challenge to the Keiretsu structure; some will succeed and further improve their competitive position, others may reposition out of the LCC market

> Chinese OEMs: Their model is consistent with other manufacturing industries in which China participates. Inconsistent quality and lack of innovation is their Achilles heel. An eventual revaluing of the yuan may pose barriers to their outward expansion. Joint ventures with companies like Chrysler may be the solution

> Indian OEMs: Co-opetition, open source architecture is highly innovative and might be the greatest challenge to the global industry. It is the next "Big Big" for India and the world

Consequences for suppliers
As for OEMs, the next wave poses both opportunities and threats for suppliers:

> Established suppliers accepting the challenge will position themselves as front-runners that are able to leverage experience gained from projects like the Tata Nano for their other businesses and act as true global players

> Established suppliers refraining to take the challenge will face tough times; they will lose in the long run against more agile competitors from emerging markets or the real global players

> Suppliers from emerging markets will learn and establish themselves as a strong force in the global automotive industry if they are able to increase quality while maintaining a frugal operations approach

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