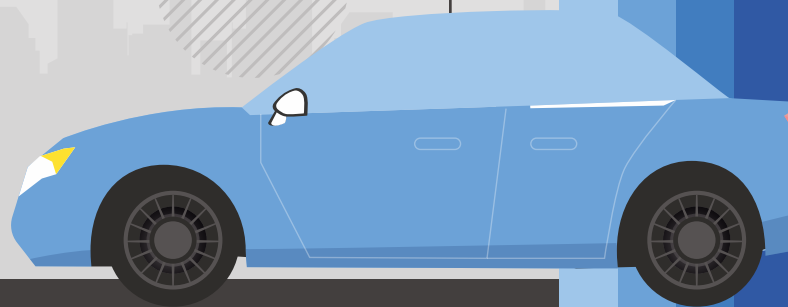
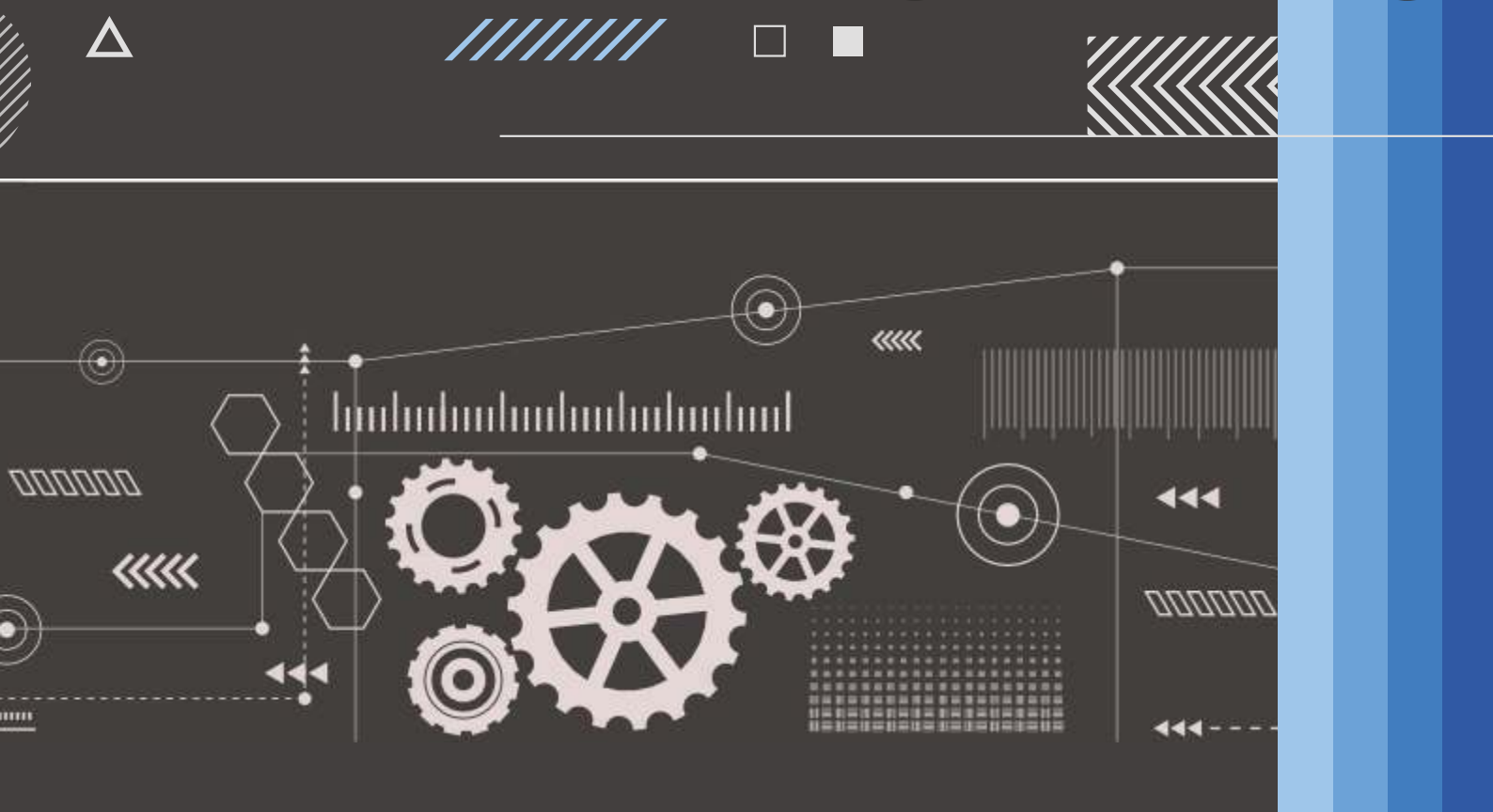


SIAM

Society of Indian Automobile Manufacturers

Building the Nation, Responsibly

EVOLUTION OF AUTOMOTIVE DESIGN IN INDIA



Evolution of Automotive Design in India

1. Background

India has firmly established itself as a global automotive powerhouse, contributing approximately 7.1% to the nation's GDP and nearly half (49%) of its manufacturing GDP^[1]. Today, India ranks as the world's fourth-largest economy and holds a significant position in the automotive sector with 3rd largest passenger vehicle market, largest two-wheeler market, 3rd largest commercial vehicle market, and the leading three-wheeler manufacturer. These strengths position India as a key player in the global automotive market and one of the largest automobiles manufacturing hubs worldwide.

Driven by rising domestic and export demand, progressive government policies, and rapid technological integration, India is emerging as a major force in the global automotive landscape. This growth not only fuels India's economic development but also strengthens its global competitiveness. To keep pace with evolving global trends, the Indian automotive industry is embracing future-ready technologies such as electrification, connected & autonomous systems, sustainable mobility solutions, and innovative design practices. These advancements will further enhance competitiveness and elevate India's stature on the world stage.

These emerging technological trends, socio-economic developments along with the pressing need to make automobiles greener, safer and sustainable are redefining both the designing and the manufacturing processes of the modern vehicles in India.

Accordingly, to maintain competitiveness and efficiency, respond to evolving consumer preferences, leverage rapid technological advancements, and deliver differentiated products, Indian OEMs are increasingly investing in indigenous automotive design. These shifts are not only altering the technical architecture of automobiles but also reshaping the user experience, positioning next-generation vehicles as integrated, intelligent, and environmentally responsible mobility solutions. This evolution presents both challenges and opportunities for Indian automotive designers and engineers.

Despite India's position as a leading global automotive manufacturing hub, the domestic automotive design sector faces significant challenges. The rapid expansion of vehicle production and localization has sharply increased the demand for highly skilled design professionals; however, this demand is constrained by the limited number of specialized automotive design institutes, resulting in a shortage of industry-ready talent. This gap is further intensified by technological transitions such as electrification, connected and software-defined vehicles, and the adoption of advanced digital design tools including CAD/CAE, AI-driven generative design, and AR/VR applications. Insufficient proficiency in these emerging technologies has widened the skills gap, making it difficult for the Indian automotive industry to indigenously design globally competitive products while meeting stringent time-to-market requirements.

[1] NITI Aayog : PIB Delhi: Automotive Industry: Powering India's Participation in Global Value Chains (GVCs): 15 APR 2025

Manufacturing generates revenues which build the economic foundation of a rapidly emerging nation like India. Design will unlock the value of our intellectual economic prowess. This is crucial to us, collectively achieving our goal of 2047. The social impact of design is both deep and wide, as it builds capabilities as well as attracts talent from all socio-economic strata who impart a larger appreciation for aesthetics and design to the entire society.

In addition, evolving regulatory frameworks related to vehicle safety, emissions, cybersecurity, and sustainability are placing new demands on the design process, requiring closer integration between engineering, software, compliance, and design functions from early development stages. As global OEMs increasingly embed advanced electronics, software architectures, and sustainability considerations into vehicle platforms, Indian design teams must simultaneously address cost sensitivity, localization requirements, and global quality benchmarks. Bridging these gaps will be critical for strengthening India's end-to-end automotive design capabilities and for transitioning from a manufacturing-led ecosystem to a design- and innovation-led automotive value chain.

2. History and Evolution of automobile design in India ^{[2][3]}

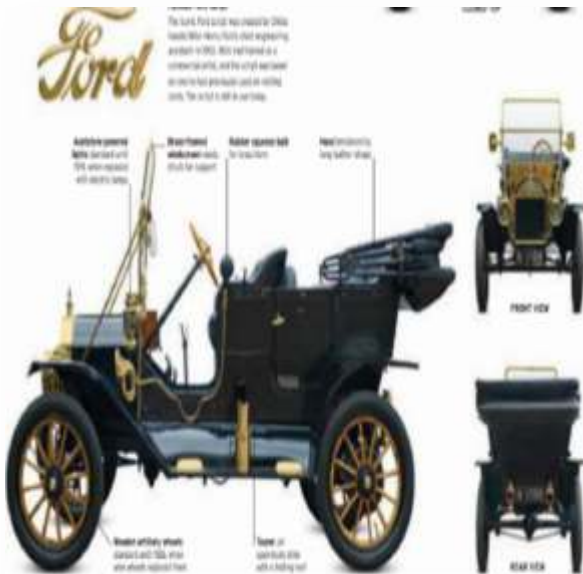
Globally, the automotive design has evolved from early functional simplicity to , technology-driven aesthetics. In the early era (1880s-1930s), designs were carriage-inspired, with pioneers like **Benz & Cie** and **Daimler** in Germany introducing the first motor vehicles, primarily focused on mechanical reliability and basic transportation while Ford revolutionized affordability with the Model T. European brands such as **Peugeot** and **Fiat** focused on compact efficiency, and luxury marques like **Rolls-Royce** emphasized craftsmanship. By the mid-20th century, aerodynamics and aviation influenced styling, seen in streamlined models from **General Motors**, **Mercedes-Benz**, and **Citroën**



Daimler -1885

[2] *Tracing the Evolution of Automobile design: Factors influencing the development of aesthetics in automobiles from 1885 to the present.* Authored by: Jaafarnia, Bass

[3] *Historical Perspectives on Automotive Design: Lessons from the Past for Future Innovations* Wricha Mishra, MIT Art, Design and Technology University, Loni-Kalbhori (MS) Sameer Shitoot, Nachiket Thakur, MIT Art, Design and Technology University, Loni-Kalbhori (MS)



Ford Model -T



Rolls-Royce Silver Ghost, 1906–25

Today, global design is shaped by electrification, connectivity, and sustainability, led by innovators like **Tesla**, **BMW**, and **Toyota**, integrating advanced lightweight materials and efficient manufacturing with digital interfaces and smart tech features.

Indian automotive design has progressed from licensed adaptations to increasingly indigenous innovation. OEMs have successfully transitioned from adapting global models to creating vehicles optimized for both domestic operating conditions and international markets. In the early 50s to 70s, models like the **Ambassador** (derived from the UK's Morris Oxford Series III) and **Premier Padmini** (based on Italy's Fiat 1100) reflected utilitarian philosophy-rugged, simple, and durable suited to challenging road conditions & limited-service ecosystem.



The same philosophy applied to two-wheelers, commercial vehicles and buses. There were rare examples of indigenous designs inspired from global models, like the early Maruti and the Sipani Badal, which highlighted the underlying need for India specific mobility solutions. Starting with the opening up of the automobile sector in the early 1980s, post-1990s liberalization introduced global OEMs such as

Maruti Suzuki, Hyundai, and Honda, bringing compact, fuel-efficient cars designed for urban mobility and affordability. By the 2000s, Indian brands like **Tata Motors** and **Mahindra** embraced a design philosophy blending local aspirations with global styling, targeting middle and upper middle class for eg, Tata Nano, SUVs and hatchbacks etc. for aspirational buyers. Today, design priorities are shaped by **electrification, autonomous connectivity, safety and regulatory norms and sustainability**, featuring aerodynamic profiles, lightweight materials, and Experience-driven interiors, combined with consumer demand for comfort and digital features, are steering India toward smart, eco-conscious, and hyper personalized automotive design. This evolution positions India not merely as a global manufacturing hub, but as an emerging centre for automotive design and engineering innovation, capable of supporting domestic mobility needs while contributing meaningfully to global vehicle development programs.



Indian OEMs & Design Evolution^{[2][3][9]}

Era/Phase	OEMs Involved	Design Trends
1940s–70s	HM, Premier, Mahindra	License-built models; minimal local styling
1970s	Standard, HM	Early attempts at adaptation (Gazel)
1980s–90s	Maruti Suzuki	Compact indigenous design (Maruti 800)
2000s–2010s	Tata, Mahindra, Maruti	First fully designed and developed vehicles (Alto, Indica, SUVs, hybrid platforms)
2015–Present	Tata, Mahindra, Hyundai, MG, Ola, Maruti Suzuki	Global design centres, EV packages, premium interiors, sustainability
Tech-driven era (2020s)	All OEMs	Digital first design, EV-first architecture, Hyper personalized aesthetics

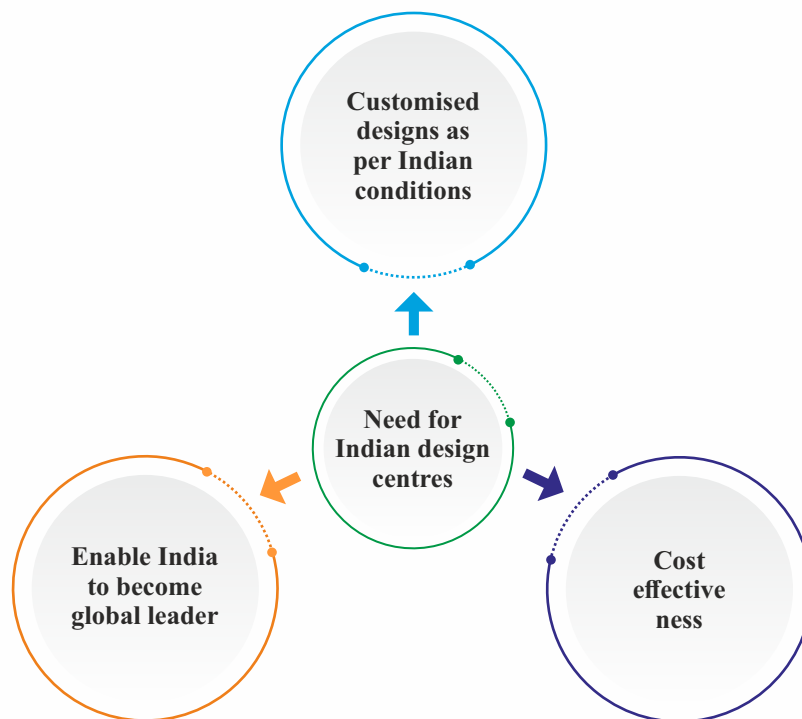
[9] CAR: The definitive visual history of the automobile www.dk.com

1. Need for Indigenous Design Centres:

Despite being one of the largest automotive manufacturing hubs contributing to about 49% to its manufacturing GDP, India continues to depend on overseas markets for select

design and development activities. Considering India's unique geographical and socio-economic conditions including diverse factors such as varying road infrastructure, congested urban zones, hilly terrains and unpaved pathways as well as distinct safety and regulatory norms, global design solutions can be adopted only after significant localization.

The Government of India's '**Make in India**' initiative further amplifies this need by promoting domestic manufacturing and innovation to reduce dependency on imports and strengthen India's position as a global automotive hub. Create in India has to inspire Design in India to finally "Make in India", which is the final



objective of any developed and matured nation. In this context, strengthening indigenous automotive design capabilities-particularly across vehicle interiors and exteriors-becomes critical for designing vehicles that are better aligned with Indian operating conditions, cultural preferences, and cost sensitivities, while progressively reducing reliance on overseas design inputs. At the Bharat Global Mobility Show in 2024, the Honourable Prime Minister had expressed the desire of looking forward to the day when the world will buy a car 'fully designed in India'.

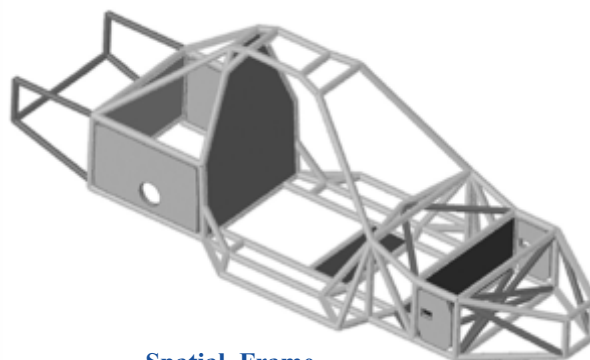
Accordingly, establishing dedicated, India-focused automotive design centres is imperative for building long-term design self-reliance, fostering innovation across the value chain, and supporting the transition toward a globally competitive yet locally relevant automotive design ecosystem.

2. Automotive Design & Current Trends

India has become a huge attraction for car manufacturers around the world. However, despite having a relatively low passenger vehicle penetration rate of approximately 35 vehicles per 1,000 people, India's large population base and status as one of the world's fastest-growing major economies are driving a sustained increase in demand for personal mobility solutions.

A major shift in automotive design is also witnessed by the rapid rise of electric vehicles (EVs). Unlike traditional internal combustion vehicles, EVs offer new unique challenges but also offer greater flexibility in layout due to the absence of large engines and complex drivetrains. This allows designers to prioritise spacious, modular interiors and experiment with aerodynamic, minimalist exteriors that enhance energy efficiency. Moreover, as the concept of sustainability takes centre stage for both consumers and brands, the use of light weight, eco-friendly materials, recycled components, and energy-efficient manufacturing processes to reduce waste and extend vehicle lifecycles is gaining momentum. Consequently, vehicles are evolving beyond purely mechanical products into connected, software-enabled platforms and mobile extensions of the broader digital ecosystem.

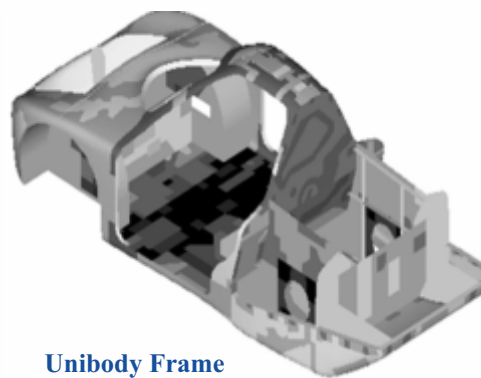
The selection of vehicle body structure plays a critical role in improving weight reduction and energy efficiency. Unibody structure is gaining momentum over traditional space-frame architectures [5].



Spatial Frame

As already mentioned, rising aspirations, urbanization, and lifestyle changes have influenced both the aesthetics and functionality of vehicles. Indian consumer's increasing focus on the look and feel has emerged as a key driver of automotive design evolution in India. Qualified, smart and tech-savvy workforce, and domain experts having deep knowledge of the best global practices and aesthetic sensibilities, further strengthens India's position as a competitive automotive manufacturing and design destination.

Aesthetic design: Automotive exterior design is not just about superficial changes in vehicle appearance, but also a complex process that combines creativity, art, and technology. The core elements like the form, proportions, colours, materials, and interfaces of automobiles help differentiate between models and help achieve a personalized expression and brand differentiation.



Unibody Frame

User Interface (UI/ UX): Features like touchscreen infotainment systems, OTA (over the air) updates,, smart OBD, voice assistants, and advanced driver information displays are today standard equipment in many models. This integration enhances overall ownership experience through convenience, entertainment, and safety, making vehicles an extension of the consumer's digital ecosystem.

[5] Comparison of unibody and frame body versions of ultra efficient electric vehicle . W. Skarka1 · T. Pabian1 · M. Sosnowski1

3. Key Drivers of Design Evolution in India

With the increase in the economic growth and the paying capacity of the Indian customers coupled with the democratizing of technology and the pressing need to make vehicles safer, greener and sustainable, the automotive sector in India is reimagining how vehicles are designed, manufactured and experienced.

This fast evolution of Indian customer's lifestyle choices is building new design paradigms necessitating the need to move faster.

When viewed in broader perspective, the automobile design is influenced by factors such as political, economic, social, technological, legal, and environmental.

These factors become key drivers influencing following trends:

Key Drivers	Trends
Technological Advancements	Alternative powertrains, Electric/ Hydrogen powered vehicles Autonomous and Connected car, Software Defined Vehicles, vehicle electronics and digitization to name a few necessitating new advanced interior/exterior designs
Regulations	Fast evolving Safety Standards and emission norms: Airbags, ABS, design using lightweight materials, aerodynamics design to minimize drag while maintaining visual appeal.
Environment	Sustainability: Norms for Reuse & Reduce: leading to develop designs that utilise less resources and components suitable for easy replacement.
Consumer Behaviour	Increase in paying capacity of Indian Middle and upper middle-class consumers is demanding both interior and exterior design with modern looks with a Globally competitive visual appeal.
Economic	Designs that offer highest value within set cost for a demanding customer

4. Status of Automotive Design in India [4][8]

Automotive design in India has evolved significantly alongside global trends from utilitarian design forms in the early 20th century to sleek, sophisticated, aerodynamic styles influenced by technology and societal trends. Modern design process not only leverages advanced materials, manufacturing processes but also relies heavily on a mix of core skills like sketching, clay modelling, craftsmanship with advanced digital tools such a CAS, CG, VR-AR (Computer Graphics, Augmented Reality and Virtual Reality) assisted by AI advancements. The increasing influence of Interior and experience design on the overall vehicle form and packaging reflect not only aesthetic considerations but also the influence of societal trends and technological advancements [4]

Today's globally aware but vividly local India customer's requirements are also very unique and are pushing automobile companies in India to establish local R&D and design Studios. This trend started with domestic manufacturers followed by global brands.

Some of the key and biggest design facilities in India include Maruti Suzuki, Tata Motors, Ashok Leyland, Hero MotoCorp, Mahindra & Mahindra, Hyundai, Kia, Renault to name a few. New mobility related startups who need outside creative support are also helping build design eco-system of creative suppliers and vendors in India.

1. Future trends in Automotive Design

With the advent of advanced and emerging technologies, cars are evolving from mere modes of transportation into experience-driven platforms, innovation both aesthetics and ergonomics plays a pivotal role in transforming vehicles into immersive environments that offer personalised comfort, entertainment, and transform the vehicle into a more connected place for the consumers.

And therefore, to remain competitive and to deliver superior products on time, and achieve efficiency and cost-effectiveness, advanced design tools and technologies such as next-generation CAS/CAD software, 3D printing for physical prototypes, digital twins, Human Machine Interface and immersive solutions like Virtual Reality (VR) and Augmented Reality (AR) play a pivotal role in managing design complexities, accelerating development cycles, and enabling seamless collaboration.[1] Knowledge-Based Engineering (KBE) has also emerged as a critical enabler for improving design efficiency and consistency. Advanced techniques like : Knowledge-Based Engineering (KBE), generative design, powered by computational tools, allows to capture and reuse of engineering knowledge to explore a varied pathways for multiple objectives such as mass, stiffness, and manufacturability, By automating routine design tasks and supporting multidisciplinary integration, these approaches have been shown to significantly reduce development time and cost, particularly for repetitive and variant-driven design activities. [6][7].

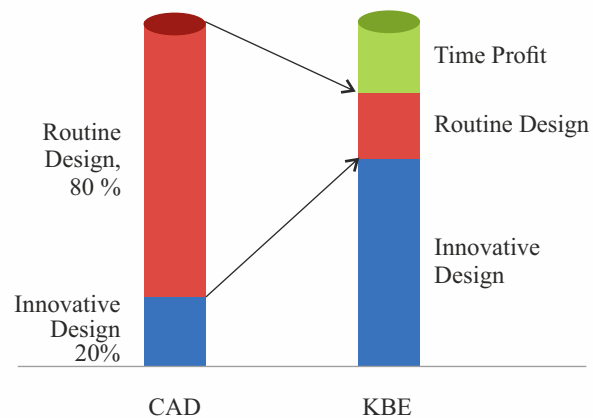


Figure: Design time allocation using CAD and KBE

2. Challenges and opportunities for Automobile Design in India

The automotive industry has experienced a growing need for advanced engineering design approaches driven by increasing vehicle complexity, stringent regulatory requirements, and the push for more sustainable transportation solutions This convergence of advanced technologies and changing consumer demands is reshaping how vehicles are designed, manufactured, and experienced. As automotive design continues to evolve, there are several challenges the automotive designers are facing with conceptualizing new forms with advanced materials, and designing new experiences while ensuring that the design remains emotionally relevant for evolving customers while complying with changing regulations. An analysis of strength, weakness, opportunities, and threats of automotive designing in India is mentioned below:

[6] Knowledge Based Engineering: Notion, Approaches and Future Trends E. Jayakiran Reddy1,*, C. N. V. Sridhar1, V. Pandu Rangadu2 -2015

[7] Applications and Challenges of Engineering Design in Automotive Sector: A Review
By Aarush Patwari -The Ahmedabad International School, Ahmedabad

3. Way Forward

To position India as a global leader in automotive design and innovation, a multi-pronged approach is essential:

1. **Strengthen Indigenous Design Capabilities:** Establish advanced design centres focused on India-specific requirements, integrating local aesthetics, ergonomics, and sustainability. These centers should leverage cutting-edge tools such as fast digital sculpting, CAS , AI assisted generative design, and immersive technologies (VR/AR) to accelerate development cycles.
2. **Expand Education and Skill Development:** Increase the number of specialized automobile design institutes and upgrade existing curricula to include emerging technologies like Human factors, Experience design, Platform architecture, Design management etc while strengthening core skills like ideation and clay based form generation, craftsmanship etc. Strong academia–industry collaboration will ensure industry-ready talent. Such institutions need active support of the industry through financial participation, projects and mentoring.
3. **Promote Research and Innovation:** Encourage R&D in new age materials, faster prototyping, modular architectures, and eco-friendly manufacturing processes. Government incentives and public–private partnerships can foster innovation in areas such as electric mobility and connected vehicles.
4. **Adopt Advanced Digital Tools:** Implement AI, Knowledge-Based Engineering (KBE), digital twins, and 3D printing to reduce design time and cost. These technologies will enable faster prototyping and enhance collaboration across global teams.
5. **Policy Support and Industry Collaboration:** Bring more focus on “Create in India” to strengthen initiatives like *Make in India* and formulate policies that incentivize indigenous design, sustainability, and building local design eco-system. Collaborative platforms between OEMs, startups, and design houses can accelerate innovation.
6. **Focus on Consumer-Centric Design:** Incorporate studies on evolving lifestyle preferences, and digital integration to deliver vehicles that are not only functional but also aspirational, connected, and environmentally responsible. That might help us create a unique Indian design DNA that will endear our expressions of mobility far and wide across the world, from a two-wheeler to three-wheeler, four-wheeler, bus and heavy truck.

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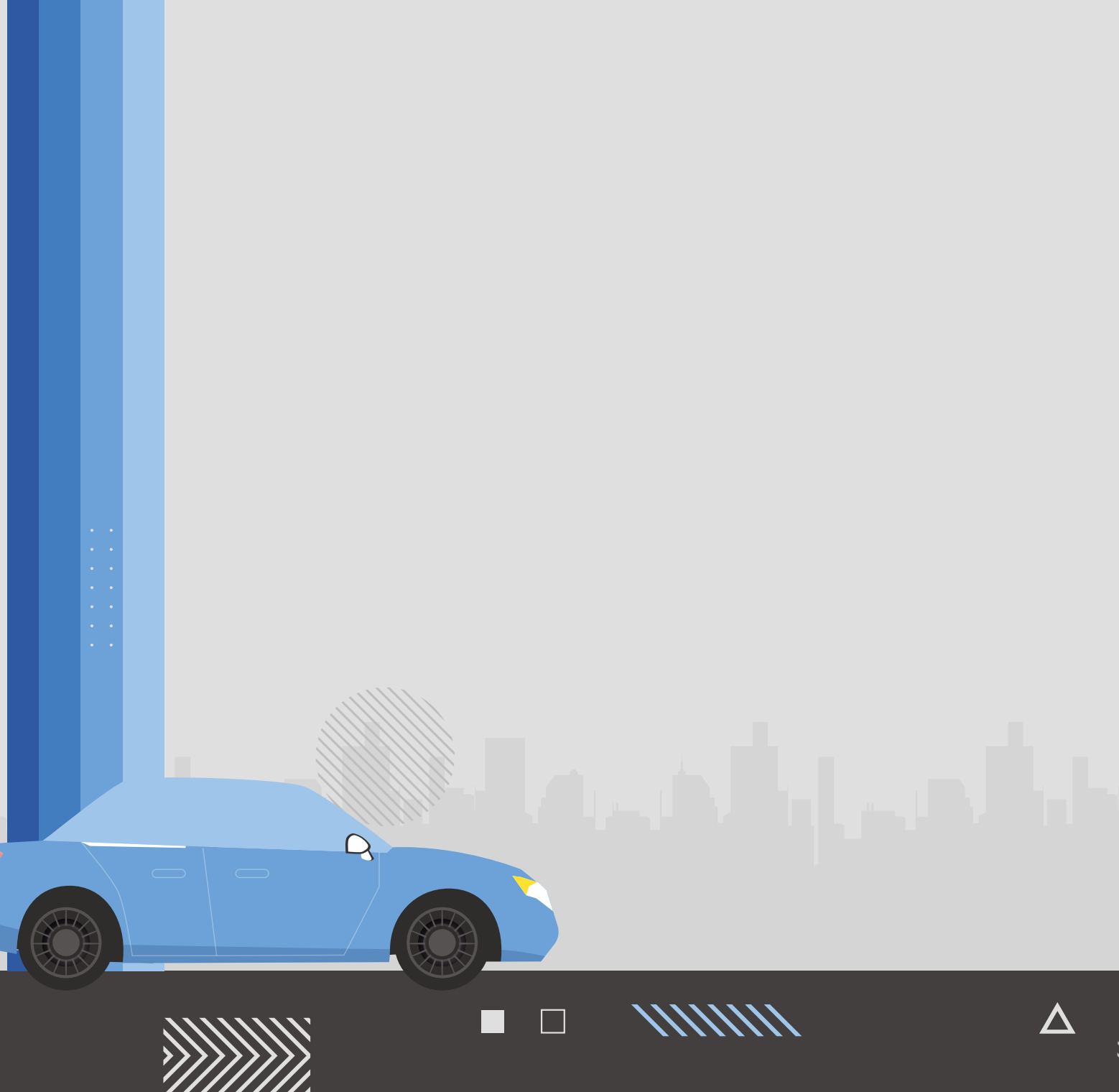
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