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RNI NO.: MAHENG/2017/73912

Volume 6-Issue 5 September/October 2022 Price ₹100

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## INDIA'S EV REVOLUTION: E2W AND E3W SHOW THE WAY

An EV (Electric Vehicle) revolution is afoot in India. And it is led by 2-wheelers and 3-wheelers. Passenger cars are not far behind. In one of the most comprehensive accounts of India's EV story, sector experts with skin in the game tell us about factors shaping this exciting growth story.



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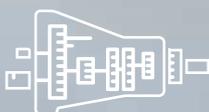
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A Ducati MotoE prototype. For Representational Purposes. Source: Ducati



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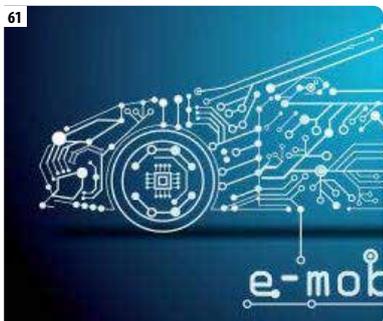
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Message | EDITOR'S NOTE

# Revolutionary Roads

We in the media love to spot a revolution. A quick glance at today's news shows me that we are in the throes of at least three. An OTT (Over-the-Top) revolution, a *Khaadi* revolution, and a "new green" revolution are all underway as I write. While I have no doubt that all these are trends of great import, I haven't heard any news about people clashing on the streets over who will get to watch Netflix or wear a *Khaadi* shirt.

Or perhaps the kind of 'revolution' that the media reports refer to are what Merriam-Webster defines as the type of revolution that causes "a changeover in use or preference especially in technology." Even if so, I wish experts were more diligent about using this term. That they would call an event or a trend a revolution only when it causes a real changeover, or as they say in consultant-speak, a paradigm shift.

Let me give you an example of what I mean from the world of manufacturing. For many years now, analysts have been telling us that the fourth industrial revolution (IR) has arrived in the country. Numbers, however, tell a different story. This year's NASSCOM's AI (Artificial Intelligence) Adoption Index, which covers industrial and automotive sectors, files our industry under the category of "enthusiast" on the AI maturity scale. Artificial Intelligence, as you know, is a key 4th IR technology. I'd argue that, while it's great to be enthusiastic about a technology, we need a far stronger sentiment than that to start a revolution.

There is another one that has been in the news lately. This one concerns the adoption of EV, and I must confess that I have personally championed this one. "India's EV Revolution. E2W and E3W Lead the Way" is the cover title that we chose for our current issue. And since I have made so much fuss about the use of the R word, I feel I owe an explanation to our readers about the use of the term.

First, let's see whether the scale and the rate of EV adoption make it a "changeover in use or preference". As per the recent data shared by the Ministry of Road Transport and Highways with the Parliament, a total of 13,92,265 Electric Vehicles (EVs) were being used on the roads of India in the month of August 2022. During the same period, the total number of

registered vehicles in the country was over 28 crore. These figures translate to a less than 0.5 percent EV adoption share. Clearly, this does not indicate a changeover, and certainly not a revolution.

What about the growth rate? Official data shows a threefold increase in annual EV sales in FY22. A closer look, however, reveals that the increase is over a low base – FY21's EV sales amounted to about 1.34 lakh. Other reports also show a low adoption rate. A recent Arthur D. Little study says that India has currently a low EV adoption rate of 2 percent. The report however points out that the true potential of the Indian market is 50 percent, which can be realized through collaborative stakeholder action.

It, therefore, emerges that our EV story does not make it a revolution. But I still stand by our decision to call it one. Because it has indeed unleashed a big change, one that is different and of a greater potential. This I realized during my recent visits, made after many years, to my native place.

My hometown, situated in the most populous part of the country, has undergone a transformation in a particular aspect. The city's crowded, dusty streets, which not so long ago bustled with cycle-rickshaws pulled by frail, enervated men, and three-wheelers bellowing soot and smoke, looked and felt much cleaner this time. The reason: electric three wheelers (E3W). E3Ws have become the primary mode of shared transport in the city. And that has improved air quality and reduced noise pollution to a surprising degree. As importantly, it has become a major source of employment for the locals as well as the farmers who come from nearby villages looking for seasonal work. When you witness a transformation of this scale and significance in a region battling historically high levels of air and noise pollution and unemployment, you know that you are witnessing a revolution in the making.

That is why the title. Let us know your feedback.

*Stay safe. Stay resolute.*



**ANAND PANDEY**  
Editor DMI

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Message | NOTES FROM THE FIELD

# Even the Present is Electric



Global warming, climate change, sustainability. These are not just buzzwords, but important issues and challenges which have to be dealt with committed actions not just by one country but the entire world.

The use of Electric Vehicle (EV) is emerging to be a global mandate for the automotive industry. Companies worldwide are now keen on manufacturing Electric 2 Wheelers, 3 Wheelers, Buses, and Cars. And India is not far behind in the Electric vehicle revolution. Switch Mobility, a subsidiary of Ashok Leyland, launched a double-decker bus in Mumbai few months back – it was a historic moment for the industry and the city.

Supply chain companies including the last mile delivery companies are also in favours of deploying EV for their supply chain operation. The building of charging infrastructure is also gaining momentum in the country.

I strongly believe that safety is must when it comes to battery technology. Manufacturers are looking at innovations and better technologies to overcome this challenge. I can tell you from my interactions with manufacturers that safety is the key agenda for all the EV makers. Mission Make in India is also getting a push with the many startups that are coming up in the domain. Looking at all these developments I can proudly say that the future is electric.

In our current issue of Dynamic Manufacturing India we have featured responses from industry leaders of Electric Vehicles that help us understand the dynamics of the industry. Please let us know your thoughts on that.

During my recent visit to the Ankleshwar Production Unit of Dormer Pramet, I had the privilege to meet and interview Dormer Pramet's President Eduardo Martin. The interaction was followed by a tour of plant facilities. I want to thank Mr. Martin and his organization for sharing with our readers the capabilities that his company is bringing to the Indian industry and the customers.

We are also gearing up to host the 3rd edition of Industry Samurai Conference and Awards 2022. The Industry Samurai Awards' week-long activities will start from 9 December 2022 and conclude with the Awards Presentation ceremony on 16 December 2022. This is the first time in that we will be hosting an in-person event for awards felicitation. We look forward to felicitating the winners Taj Vivanta Yeshwantpur, Bengaluru. My gratitude to our readers, members of the jury and the sponsors who have put their trust mission Industry Samurai. Entries are open till November 30. I invite all the Indian manufacturing and supply chain companies to apply for the awards. Please visit [www.industrysamurai.com](http://www.industrysamurai.com) to submit your entry.

Happy Reading!

Sincerely,

*Dinesh Mishra*

**DINESH MISHRA**

Senior VP – Strategy

Meshmix Media

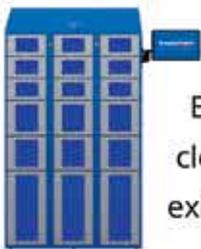
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Cover Story | **ELECTRIC VEHICLES**

# INDIA'S EV REVOLUTION: E2W AND E3W SHOW THE WAY

An EV (Electric Vehicle) revolution is afoot in India. And it is led by 2-wheelers and 3-wheelers. Passenger cars are not far behind. In one of the most comprehensive accounts of India's EV story, sector experts with skin in the game tell us about factors shaping this exciting growth story.



The global EV market never looked this good. Global EV sales grew 38 percent in 2020, and then more than doubled the following year. China, the leading EV-making country reportedly sold more EVs in 2021, at about 52 percent of global sales, than the rest of the world combined. Europe's biggest auto-market Germany sold about 72 percent more EV cars in 2021 than the year before. The International Energy Agency (IEA) estimates that the EV sales will hit an all-time high in 2022.

India's EV story is no less riveting. India Energy Storage Alliance (IESA) expects the country's EV market to grow at CAGR of 49 percent between 2021-2030. The nature of the growth in India, however, is different from the big EV markets. Most EVs sold in India are 2 wheelers, which account for over half of the sales volume. The next popular segment is three-wheelers that are not only making travel efficient and green, but also providing jobs to a large number of people in the metros and the cities.

Our cover story puts the spotlight on India's EV story. The interview-feature explores the main factors that are shaping India's EV present and future growth, such as manufacturing and supply chain, the charging infrastructure, and most important of all, the compelling need for the switch to EVs. Twelve sector leaders, who provide us hard-earned insights include **Randheer Singh, Director – E Mobility and Senior Team Member for Advanced Chemistry Cell Program (ACCP), NITI Aayog; Bipul Chandra, Managing Director, Ducati India; Suman Mishra, CEO, Mahindra Electric - Last Mile Mobility; Dr. Yogesh Bhatia, MD and CEO, LML; Sameer Jindal, Director Engineering, MG Motor India; Atul Arya, Head - Energy System Division, Panasonic Life Solutions India; Uday Narang, Chairman, Omega Seiki Mobility; Amit Das, Founder and CEO, Electric One; Manish Narang, Co-Founder & CEO, EV Plugs (Techilogy Solutions Pvt. Ltd); Kapila Sandeep Soni, Managing Director, Croyance Automotive; Amit Lakhotia, Founder & CEO, Park+; and Rahul Bollini, Head-Emerging Technologies, JLNPhenix Energy.** Presenting, in editing and abridged account.

## MANUFACTURING AND SUPPLY CHAIN

**From your perspective and experience, do we have the right and adequate manufacturing ecosystem in the country in terms of a robust supplier ecosystem, skilled manpower availability, and physical infrastructure for the EV industry to meet the fast-growing local and international demand for the EVs? What are the other factors needed in place for a faster growth?**



**Randheer Singh, Director – E Mobility and Senior Team Member, ACCP, NITI Aayog:**

India enjoys a strong position in the global heavy vehicles market as it is the largest tractor producer, second-largest bus manufacturer, and the third-largest heavy truck manufacturer in the world. The scale of India's prowess in the automobile industry is unparalleled. India's annual production of automobiles in FY22 was 22.93 million vehicles. The automobile sector received cumulative equity FDI inflow of about 32.84 billion USD between Apr'00-Mar'22. These numbers are testimony to the robust manufacturing and supplier base available in India in the Automobile sector. Transitioning to EVs will also lead on the same path and provide an even better opportunity to lead. The government has already initiated several incentive programs to bolster manufacturing, supply, skill development, and infrastructure availability. Some of them are Automobile and Auto components, Advanced Chemistry Cell program (ACC), and FAME II. In addition to this, more than 20 states & UTs have come up with their own EV-specific policies to promote the development of the entire EV ecosystem. In August 2021, we saw the launch of the Vehicle Scrappage Policy, which aims to phase out old polluting vehicles in an environmentally safe manner. These are hallmark policy-level decisions in the right direction that will prove beneficial for India's EV growth story.

Despite all these initiatives, certain opportunities remain untapped, some of them are:

1. EV Financing, which is currently very high at 24-40% rate of interest.
2. Secondary use and recycling of the used batteries and cells.
3. Unavailability of interoperability in EV ecosystem.



**Bipul Chandra, Managing Director, Ducati India:** Electric Vehicles are the latest automotive trend, and all developed and developing nations are switching to EVs from conventional internal combustion engine (ICE) vehicles. While the EV segment in India is still nascent, it has seen steady growth over the last few years. The government's vision of making India an electric vehicle nation by year 2030 is encouraging, and while they have come up with EV subsidy programs, the rate of adoption is still low primarily due to the heavy upfront cost and the lack of charging infrastructure. Moreover, due to the absence of robust ecosystem for the manufacturer of EVs, India imports quite a few components like parts of the drivetrain, battery, battery components, etc.

The idea of transitioning to an all-electric planet – given its zero tailpipe emissions and economic viability in the long-term – is more promising now than ever before. Over the years, the EV and clean energy industry have been working on a sustainable and fuel-efficient transportation mode to tackle and ostracize the demonic duo of pollution and climate change, endangering all life on the planet. It is the electric two-wheeler market, accelerating the country's transition to an all-electric future. While EVs might take longer to become mainstream in the 4-wheeler segment, they've made significant progress in the two and three-wheeler segments for personal use and shared commuting. While there are few practical and operational challenges to overcome, the purpose or meaning of why we are trying to make it all-electric is more evident now.

By improving battery tech, localizing EV manufacturing, building better public charging infrastructure, and reducing production costs, we will be able to accelerate the EV's journey to the mainstream. Other key drivers contributing to this uptake are increased efficiency, battery performance, and lower maintenance costs (because of fewer components, preventive maintenance, and connectivity).

Similarly, it is imperative to educate customers, spread awareness, and bust myths associated with the EV battery, range anxiety, value offered, and

operations cost as these will also contribute to the increase in demand that catalyses the EV industry.



**Suman Mishra, CEO, Mahindra Electric - Last Mile Mobility:** India overall has one of the most proactive supports from the government when it comes to electric vehicles. The ecosystem in India is being built by developing local competencies and technologies to manufacture critical electronic parts & batteries through policies such as ACC PLI and Auto PLI. The key challenge lies in procuring battery cells as well as semiconductors and such conducive policies will help alleviate main challenges in the long run.

Many states have specific electric vehicle policies that attract investments and give out incentives on EV as well as battery cell manufacturing. Upskilling is also being done by many OEMs to ensure that their workforce is thoroughly updated on how to make a safe and reliable EV. All of this, collectively, is expected to boost EV manufacturing. Streamlining the charging infrastructure too will boost confidence of EV buyers.



**Sameer Jindal, Director Engineering, MG Motor India:** Suppliers in India have to take risks for the development even for low volume requirements for OEMs. Currently, mostly the OEMs are importing all HV EV components like

OBCs, inverter, motor, battery, etc. which are 15% to 30% lower even at the landed cost (includes freight and duties). Some other factors of growth are infrastructure development from the government which can increase sales and hence volumes for localization.

A new study from Experian shows that registrations for electric vehicles shot up 60% in the first three months of 2022. Interest in buying an electric vehicle has soared 70% since January, according to a report by Recurrent, a car industry analysis company.

Factors for faster growth – public awareness about EV, range, charging speed, cost and cost comparison, government incentives, charging infrastructure, green energy, grid development, gas price, global economy.



**Atul Arya, Head - Energy System Division, Panasonic Life Solutions India:** The EV transformation in the automotive industry has occurred in a democratic manner as the focus on new technologies presented an opportunity for new players to enter the market. So far, the industry and government have shown a collective intent to boost the conducive EV ecosystem in the country.

The government has been working to foster an enabling environment for EV development and its utility by implementing a number of initiatives, including mission plans and incentive schemes for EV and EV component manufacturers for early adopters. However, to further strengthen the adoption of EVs, a supportive ecosystem is required to achieve its full potential. There are certain challenges faced by electric vehicle (EV) companies in India, including a scarcity of raw materials, testing equipment, and qualified talent. But, if we see the overall opportunity in EV franchising, EV OEM market, battery infrastructure, solar vehicle charging, and battery swapping technology among several others, India is well-positioned to cater to the demand.

Some of the additional factors that will further help foster the industry growth are:

- Battery design with improvements in BMS (Battery Mgmt. System), cell chemistry, compact design to reduce the energy loss and boost performance
- Standardization (to ensure quality) and compatibility (plug design for battery) will further aid in battery swapping
- Boosting the physical charging infrastructure
- The government’s support for EV adoption – Schemes such as Faster Adoption and Manufacturing of Hybrid and Electric Vehicle (FAME), Production Linked Incentive Scheme (PLI), Phased Manufacturing Program (PHP) will help create a conducive environment for manufacturing and driving further awareness for EV.
- The Total Cost of Ownership (TCO) for EVs – Consumers need to be cautious of the TCO for EV in the long run. Upfront cost, charging and maintenance costs and resale value if calculated, both two wheelers and four wheelers come out to be considerably cheap.



**Uday Narang, Chairman, Omega Seiki Mobility:** The auto industry is going through one of its most disruptive shifts in the past few years with electrification being one of the major drivers of this change. Driven by concerns about climate change, energy security, Air pollution and decarbonisation commitments toward a cleaner planet; the Pressure on the EV Supply Chain is huge as the country is pushing for the rapid adoption of EVs. These challenges represent opportunities for innovation. A robust, flexible and a well-coordinated supply chain can help mitigate any risks related to Vendor shortage, logistics etc. The supplier ecosystem is being build, today it’s much ahead of times than it was five years ago. There is clear vision if you don’t have the control of your supply chain, you won’t be able to do the volumes which states true for every OEM.

We at Omega Seiki Mobility believe in association and are working towards becoming a fully integrated company via our national and international tie-ups to have control over the supply chain

dynamics of critical parts such as batteries, power-trains, motors etc.

Many say Electric vehicles are the future of the auto industry; I say it's the present! Skilled Manpower availability is a serious problem. To develop a sustainable and prosperous EV ecosystem, a strong and future-ready workforce is required. There is significant gap in what is taught "One needs to combine three areas – the mechanical motor, electronics to drive it, and smart software to control it. We need engineers who understand multiple domains." there is a significant skill gap. People must keep learning new skills and updated on evolving industry and technologies. What one learns in college isn't enough nor in one job...it's about continuous upskilling and re-skilling.

At Omega Seiki Mobility we are closely working with Universities like Indra Gandhi University for Women, IIT Delhi etc. to work at grassroots levels and educate students about electric vehicles.

The number one thing that will accelerate the EV sector is financing. The PSU banks, State Banks should start financing electric vehicles. We are making a big push towards it by launching an electric vehicle finance subsidiary christened – Anglian Finvest for Omega Seiki Mobility customers to avail financing options. The company has already dispersed more than INR 10 crore worth of loans. Credit facility is the primary concern for the EV market to grow.

Secondly, The Government should support in setting up more charging infrastructure so that the electric vehicles can run smoothly and efficiently.

The last and final pick to accelerate the pace of the EV market growth in India would be, there is a huge requirement for EV's Tier-II, Tier- III cities. And there is a need for more policies towards providing EV solution in these cities for agriculture, farming, mobility etc.

Also, we need charging, we need an ecosystem in terms of battery homogeneity, we need much more battery range fast charging, swapping battery options. The swapping system is something that we believe for intercity will really, really help because that reduces the cost of the vehicle significantly and drops that ICE story competition completely out.



**Kapila Sandeep Soni, Managing Director, Croyance Automotive:** Electric vehicles have been the talk of the town at this time now. With the developing infrastructure to support, Development of effective charging infrastructure is the main key for the masses to star adoption of EVs.

New solutions like fast charging and battery swapping will play major role in India's major EV adoption. OEMs like us are committing to launching new products, technologies and innovations in the field so called electric revolution.



**Amit Das, Founder and CEO, Electric One:** The automotive industry, the electronics industry and the battery manufacturing industry in India have seen the writing clearly on the wall. India is pushing to become a dominant world player, if not the number one country for the production and manufacturing of EVs. Not just vehicles, but also ancillary industries such as batteries, accessories and associated services. The government is recognizing this shift and also positioning itself to prime this burgeoning and future-facing market that has the potential to make India a major global renewables manufacturing contender.

If the mushrooming of start-ups which are manufacturing and servicing the EV sector and industry is anything to go by, the objective of a green, carbonless footprint is almost a certainty. However, this future will only become real if the government

sets up an ecosystem that establishes several symbiotic relationships between vehicle manufacturers, battery manufacturers, service providers and other IoT companies.

**Other Factors Needed in place for faster growth:**

**1. UNDERSTAND THE COUNTRY'S UNIQUE MOBILITY PATTERNS**

A bottom-up understanding of mobility patterns can help in choosing vehicle and battery technologies that meet people's needs on the ground in a resource-efficient manner with the same or better convenience offered by conventional vehicles.

**2. ESTABLISH NEW FINANCE MODELS**

High capital costs of vehicle and charging infrastructure have contributed to slow uptake of electric vehicles in India. And with few EVs and infrastructure in place, the country lacks performance benchmarks to help investors understand the risks and opportunities from use cases and hedge against potential failures of new technology

**3. TREAT USED BATTERIES AS VALUABLE ASSETS**

There are two reasons why stakeholders in India should pay special attention to batteries. For one, batteries retired from EVs can be used as stationary storage devices to store renewable energy, such as solar. Creating easy and affordable ways to use batteries in their secondary life could help grow the share of renewables by increasing storage capacity and mitigating the intermittent nature of some renewables. Another important role of retired batteries is as a source for mining raw materials for locally manufacturing new batteries for EVs. India doesn't have the lithium and cobalt reserves to make lithium ion batteries. Battery recycling is one possibility that could create an additional stream of raw materials to create new batteries locally aside from international procurement.

**4. BALANCE SUBSIDIES WITH CONSUMER INCENTIVES**

Subsidies, whether for consumers or industry, can help meet an initial share of electrification targets. India needs to strike a balance between subsidies and consumer incentives that puts EV users at an advantage. These could include both fiscal and non-fiscal strategies that incentivize use of EVs, such as exemptions from road and registration taxes, accessible battery charging networks, designated EV parking spots, priority lanes for electric vehicles, and low-emission zones, which EVs can access more easily than internal combustion engine vehicles.

**5. LEARN FROM VEHICLE OWNERS AND DRIVERS**

Handing someone an electric vehicle and a key

isn't enough. When buying conventional vehicles, drivers have a well-established network of expertise to help them manage their vehicles, from refuelling to repairing.

**6. USE EXISTING INFRASTRUCTURE JUDICIOUSLY**

The advent of electric mobility requires new infrastructure. But the financial burden of the EV transition will be much lighter if existing vehicle infrastructure is adapted to support EVs instead of scrapped altogether. Existing fuel stations in prominent locations might be set up as charging points and battery-swapping centers.



**Manish Narang, Co-Founder & CEO, EV Plugs (Techilogy Solutions Pvt. Ltd):** After recent strong uptake, EV sector in India is poised for exponential growth over the next decade, and the credit should be aptly given to policymakers for their push and existing value chain players, mostly new, for their sincere efforts. Certainly, as there are new components in EVs that were not present in the ICE vehicles and there is an emerging ask for quality improvements, will require resilience and improvements in the established automotive value chain. We will witness changes in partnership amongst OEMs and their tier-1 and tier-2 suppliers as the size of volumes and local manufacturing capabilities grow.

Currently, OEMs are building components in-house or calling for a buy and assembly decision due to limited manufacturing capabilities. As the growth passes on, the product and quality will be shifted to tier-1 and tier-2 suppliers, and the scope of the experiment and innovation will expand for manufacturers to build new designs, technologies, and manufacturing capabilities. Strategies need to be shifted to create a more integrated value chain that aims to achieve improved efficiency and range in vehicles with the reduced cost which will eventually come with indigenous R&D, development of dedicated platforms, design validation, and lifetime ownership of component performance. After recent concerns over fire incidents, extensive testing

and compliance with safety standards should be the topmost priority for OEMs to build confidence in customers.

An extensive network for repair and service will also be needed at the level of ICE vehicles. The transition will likely impact assembly and production lines to deal with high voltage systems required for EVs, and therefore, the industry needs to prepare and handle capacity building, swift changes in methods and practices, and reskilling and upskilling for the workforce at the same pace.



**Amit Lakhotia, Founder & CEO, Park+:** India being the world's fifth-largest market for automobiles, has a significant OEM presence in the conventional automobile market. However, with the recent boom in the EV industry, players like, EV manufacturers, EV battery makers, EV charger manufacturers and EV OEMs have entered the market to cater to the rising demand in the industry. With record year-on-year sales being clocked by electric vehicles, a massive push to the charging zones and battery swapping stations, India's EV industry is all set to notch consistently.



**Rahul Bollini, Head-Emerging Technologies, JLNPhenix Energy:** India's growth over the past year has been groundbreaking, the sales of EV in 2W and 4W has grown multifold. It will continue

to grow at a past pace for the coming years. It has more to do with the growing awareness of owning an EV and fact that they have a smooth driving experience along with low running cost and very low maintenance.

Coming to the point if India has the right and adequate manufacturing ecosystem, the answer is yes and no. Yes, because there has been an immense improvement in the manufacturing ecosystem over the past years. No because localization has not been achieved completely. But the good thing is that serious efforts are being put from the EV industry as well as the government to boost this field.

**Since the battery technology is central to the EV strategy, do we have the adequate infrastructure and trade network that can support battery production. To what extent do we depend on the international markets for components and raw material procurement? What measures could the govt and the industry take to improve procurement and production?**

**Randheer Singh, ACCP, NITI Aayog:** In an EV, typically the battery cost is anywhere between 35-45% of the total vehicle cost. Also, the battery runs the risk of obsolescence. Currently, the Lithium-ion cells used in batteries powering the EVs are mostly imported. That is why Govt has successfully launched the ACC PLI for 50 GWh and successful bidders are moving in the right direction. We have already reviewed the work progress of two successful bidders and they are on right track. In addition to these successful bidders, other organisations are also in the process of setting up cell manufacturing in India. It includes the Amaraja, Lucas TVS, Suzuki etc. All this will result in indigenisation of cell manufacturing in India with higher localisation levels. All the components except the natural raw material can be localised in India and that is why ACC PLI has a strict localisation condition too. This will result in the EV ecosystem development to thrive in India and the value chain to further develop.

**Bipul Chandra, Ducati India:** India continues to depend on imported Lithium-ion cells owing to limited local manufacturing capacity and scarcity of raw materials. India needs access to Lithium and other rare earth metals to ensure unrestricted domestic battery production. There are several rare earth metals, which are crucial for battery production, and most important of them is Lithium. Now we have some reserves of metals which are used in battery production like nickel, copper, aluminium, but we lack in others, most importantly Lithium. The focus should be to procure high-value battery

components and minerals for local and even international cell companies. For metals like Lithium, for which we don't have ores, we should focus on processing of these metals.

Government can support here by giving access to Indian EV manufactures for procuring the raw material. For example, India has done and is doing partnerships with countries like Argentina and Bolivia which have large reservoir of Lithium. Government should see securing Lithium supplies as securing India's energy supplies. India's EV push will be more effective if without securing supplies of key metals used in EV battery production.



**Dr. Yogesh Bhatia, LML:** Supply chain of manufacturing, raw materials, and components is the rule rather than the exception in today's supply chain. Businesses have developed more connections with third-party providers outside of their own nation during the past few decades. A global supply chain with numerous factories in various nations is used to produce the items essential to international trade.

A business must buy a variety of products and services from many suppliers, and in order for a business to be more lucrative, all costs, including procurement costs, must be kept to a minimum.

An organization's tactical and strategic objectives are accomplished with the aid of an efficient procurement procedure. And regular adjustments must be made after assessing the effectiveness of the current processes if the process is to be effective. You will continually identify areas for improvement as you manage supplier relationships and optimize your supply chain.

**Sameer Jindal, MG Motor India:** Currently most of the OEMs has shifted to assembly of batteries in India. Battery assemblers in the country have adequate technology like TACO, Amarraja and Exide, however the cost is still high as the cells are imported which constitute 50-60% of the cost, BMS, CMS and other power electronics like EDM –

electric discharge modules, inside battery can now be developed by several startup companies in India. HV wiring harness and copper connectors are standard buy items for W/H suppliers in India. We are still dependent on a lot of raw material imports which our country should develop in India to make this localization viable. Government has to reduce duty on EV child parts imports so that we start at least with assembling the components. Current import duty is approx. 20 % which is still high and costs a lot on the final assembled components. Initially the government has to make import cheaper. Localization will increase automatically when the suppliers understand the physics of the same.

**Atul Arya, Panasonic Life Solutions India:**

Panasonic has decades of electrified-vehicle experience, from the development of battery cells to the mass production of technologies for OEMs. In addition to supplying battery cells for hybrid, plug-in hybrid, and full-electric vehicle lines, we also design, engineer, and manufacture complete battery systems with the objective of optimizing safety and performance. Globally, Panasonic is one of the leading suppliers of Lithium-ion Battery technology for Hybrid Electric and Electric vehicles. Our advanced Lithium-ion battery technology is designed to provide improved energy density, lower costs, and improved driving range, all intended to reduce the vehicle's environmental impact.

Moreover, the adoption of electric vehicles underscores the need for quality relays and components to ensure a robust electric vehicle supply equipment (EVSE) infrastructure. Due to various charging demands, Panasonic is invested in the different types of relays to be used in electrified vehicle charging, including safety cut-off on the AC side, insulation detection for the battery inside the inverter, safety cut-off on the DC side, and signal control for IC card activation. As a diversified technology company, Panasonic Life Solutions India has the capabilities to support the EV ecosystem.

**Kapila Sandeep Soni, Croyance Automotive:**

Battery manufacturers need proper infrastructure for the development of battery. The most important thing is supply of the technology and the raw material. Another major factor is skilled workforce that is to be trained in operating latest technologies. The lack of sufficient supply of raw material is a major challenge as we are still dependent on the international market for it.

**Manish Narang, EV Plugs:** We [India's manufacturing sector] cannot claim to have full-scale indigenous lithium-ion cell manufacturing capability currently and nearly all OEMs are relying on imports

from China, Japan, and Korea. Cell assembly is localized for modules and battery packs. These capacities are being improved to cater to local demands. The supply-side dependency keeps us exposed to the risk of the global supply chain as was witnessed in the global semiconductor chip shortage months ago in the automotive sector. Despite developing a local ecosystem for sub-components and assembly; dependency on cells, low volumes, and lack of standardization in the battery have caused a consequential increase in EV prices. There exist challenges like the development of battery packs suited to the Indian scenarios and climate. Lithium-based chemistries have a higher energy density, and are well-tested and adopted worldwide, but could have supply-side constraints and environmental concerns in long run. It is argued that within lithium-based batteries, NMC batteries carry higher energy density but may have the risk of thermal runaway over LFP batteries. NMCs also have increased dependency on active materials from foreign players whereas LFPs offer stability due to local supply. To address these concerns, intensive research and development will be required to develop cell chemistry and thermal management, paving a way for metal, sodium, and solid-state batteries in upcoming future.

The quality of the Battery Management System (BMS) is another area of concern. The development of substandard BMS will hurt the growth of the EV sector as the management of the thermal stress of vehicles will be at stake. To focus on the future, battery standardization for public commute will cut costs and allow companies to build resources on a single technology for reuse and recycling. From the policy side, the Government push is already there for local manufactur-

ing with incentives from Make in India and FAME-II schemes. Recently announced Advanced Chemistry Cell (ACC) PLI scheme is likely to boost indigenous advanced manufacturing cell capacities for future demands.

**Amit Lakhotia, Park+:** Make in India and Startup India measures by the Indian government have bolstered the infrastructure and trade network that is needed to design, develop electric vehicles and batteries in the country. To reap the rewards of zero emission and sustainable mobility in the nation, it is more important than ever for the industry to implement economies of scale to support rapid EV adoption in the nation, particularly among mass market buyers. Even so, expensive parts like batteries, which make up 40% of the cost of an EV, remain essential, due to the lack of access to raw materials for lithium-ion batteries, Indian start-ups are getting affected. The government think-tank NITI Aayog has specified that Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME II) and other policies supporting electric mobility.

**Rahul Bollini, Head-Emerging Technologies, JLNPhenix Energy:** The industry and government have been putting a lot of effort to improve the EV industry in every way. Government has announced a series of PLI (production linked incentive) schemes to support the EV industry.

Today, Lithium-ion cells are imported from China, South Korea, etc. and these cells are being assembled into a battery pack in India. There are many companies planning to manufacture Lithium-ion cells in India, so this void will be filled after they are setup. In fact, I am myself actively working towards this.



Along with Lithium-ion cell manufacturing being planned in India, some of the raw materials that are required to manufacture Lithium-ion cells are also being planned to be manufactured within India. But it all boils down to the fact that some resources will not be available in India such as Lithium, Nickel and Cobalt.

In fact, battery management system (BMS) and battery chargers used to be imported few years ago but many companies are manufacturing it in India these days.

Other important components of EVs such as motor, motor controller, cluster, vehicle control unit, etc. are prototyped and being validated by many companies. These products are expected to hit the market very soon.

## THE CHARGING INFRASTRUCTURE

**The EV charging infrastructure is key to a country's EV adoption curve. India's charging infrastructure at 1,640 operational public EV chargers dwarfs in comparison with China's 810,000 public charging points, and even lags far behind Germany's 35,000 charging stations, a country one-tenth our size in population. One reason, of course, is the lower EV sales as a percentage of total vehicle sales in the country. What are the other main reasons behind our country's sparse charging station density? What are top measures that the industry and the government can adopt to boost and expand the country's EV charging infrastructure.**

**Manish Narang, EV Plugs:** Developing a public charging infrastructure has its own challenges. During this early adoption of EVs, the utilization of chargers is roughly estimated to be around 5-6% at max in India which makes it a difficult use case for businesses to invest in charging infrastructure. This difficulty is compounded by the lack of uniformity and interoperability of chargers. Public charging Infrastructure guidelines allowed and adopted globally acknowledged charging protocols along with Indian standards and subsequently, relaxed the deployment of single and multiple categories of chargers addressing the industry concerns for high capex. However, there still exists the need for one charger with a unique standard to service another standard-following vehicle. Hence interoperability across these standards is still missing and needs a global call to address.

The placement of chargers is equally important as increasing the counts. It should be futuristic. Different stakeholders need to come together and attempt to coordinate and plan the placement of chargers as per the actual demands and revenue potential. The government's role is most important in creating appropriate ecosystem governance and economic frameworks. In this direction, the priority cities and highways are already selected by the government, tenders are floated, and subsidies are being disbursed.

Utilities have a critical role to play by providing distribution networks and load sanctions for wider charging infrastructure deployment and management of harmonics and grid balancing. Many DISCOMs are yet to develop a tariff rate structure at par with the residential rate to deploy retail charger outlets for EVs, this needs to be addressed



immediately. Then comes entities like oil marketing companies (OMCs), commercial spaces, and housing societies which can take lead in making lands available for parking and charging. Partnering with Charger OEMs, EV manufacturers can also improve utilization by predicting the actual demands based on geography-wise sales numbers.

Sharing and utilization of data and information on installed chargers are as important as partnerships in the industry. The central database of chargers and their details enhances the visibility of existing chargers during navigation. This not only improves the utilization but also when shared, allows aggregator platforms to offer value-added services such as pre-booking and digital transactions to commuters while planning their journey. Riding on economic incentives, we expect to witness a growth in the number of charging points soon, however, if these measures are not adopted sincerely by the industry, we may witness a scattered network of underutilized and redundant chargers which should be avoided at any cost.

**Randheer Singh, ACCP, NITI Aayog:** The Indian automobile [usage] mix is different from other countries. Two wheelers dominate the Indian market in terms of volume. 76-80% of the total automobiles are two-wheelers. The EV transition will also follow the same trajectory. Therefore, the charging needs are also different.

We need charging points not charging stations. We need disruptive models such as BaaS to enable mass charging and zero downtime. Home-based charging for these LEVs dominates the Indian market. Having said that, the industry has multiplied its

efforts to set up the charging points, similar to the West where industry-led efforts to create the charging infra. However, the industry also needs to come together to improve the asset utilisation of these charge points. That will only happen if interoperability is established by the industry players themselves. This will boost the utilisation and availability of the charging infra. In the United States and EU, companies have come together to create common charging infra, resulting in faster penetration and a wider availability of charge points, and reduction of range anxiety. India will soon witness a boom in the number of charging stations, and would cross Germany and China's numbers in no time.

**Bipul Chandra, Ducati India:** According to a recent report by JMK Research, India has around 1 charging station per 32 EVs which is extremely low. To have about 5 crore electric vehicles by 2030 of which E-two wheelers alone will account for about 70% of total EV sales, India will need about 20.5 lakh charging stations till then.

One of the reasons for low penetration of charging stations is that establishing a charging station is expensive, and since there is low penetration of EVs, setting up charging stations does not account for profit for many players in the industry. Similarly, lack of organized parking spaces, inefficient power distribution system, etc are among few other reasons for the lack of charging infrastructure in India.

To combat this, the government and its public sector undertakings are in plans to install charging stations around the highways, like NHA's plans to install 40,000 charging stations around highways, which is quite impressive. Similarly, companies like IOCL, BPCL, Tata Powers etc., have also come forward and committed to set up substantial number of charging stations in the country.

**Dr. Yogesh Bhatia, LML:** Although electric vehicles have a long way to go before they are a common form of transportation in India, the market for them has seen rising demand. Electric vehicles could revolutionize the global transportation industry. By 2030, the number of electric vehicles in all categories—two, three, or four wheels—will continue to rise. With more study, EVs can perform on level with conventional vehicles. The quick uptake of electric vehicles requires a sufficient infrastructure for charging them.

The government must concentrate on creating a supply chain by domestically producing batteries. India should put more effort into encouraging both domestic and foreign battery producers to establish local production facilities. It will contribute to a decrease in the price of batteries and EVs, enhancing cost competitiveness.



**Sameer Jindal, MG Motor India:** Charging infrastructure development can boost the growth of EVs by leaps and bounds. This is one of the main anxieties in buyers currently for buying cars for longer distance travels as battery charging infrastructure is still concentrated in and around metros. The commercial agencies or big business houses must come forward for developing chain of EV Chargers across India at very fast pace. Government has to provide incentives for taxes and interest free loans for such ventures to increase this as an entrepreneurship ventures. As the number of EV automobiles will increase on roads, this business will become more lucrative like Petrol Pumps licences in India.

Two main challenges for future-ready EV charging infrastructure are building enough charging stations in the right places and having the electric grid to support its trouble-free operation. At this juncture, it is crucial for OEMs to step forward and carry out the strengthening of charging infrastructure on their part. MG Motor India is taking conscious steps toward strengthening the EV infrastructure to further enhance customer confidence. Even before the launch of the ZS EV in 2020, the brand introduced a 5-way charging ecosystem to enhance customer confidence towards EV adoption. The 5-way charging system included a plug-and-charge cable onboard, an AC fast-charger (installed at the customer's home/office), DC superfast chargers at MG dealerships, public charging network, and charge-on-the-go with RSA (Roadside Assistance).

Now, as the consumer mindset has also evolved, MG has recently introduced 6-way charging solutions for the customers, with a plan to in-

stall 1000 AC fast chargers at residential localities and corporate offices across India in 1000 days. In the past, the brand has also joined hands with companies like Fortum, Delta, eChargeBays, Exicom, Electreefi, and Tata Power to introduce DC and AC fast chargers across the country. Recently MG has also announced a partnership with Bharat Petroleum Corporation Limited (BPCL) to install EV chargers across highways and within cities.

At the current growth rate, only a quarter of the expected total number of public charging stations will be realized by 2032. This is very slow growth. The sluggish creation of charging points is partly due to a global shortage of essential EV charger components and also precious metals, such as lithium. There are efforts from EV OEMs like MG, Tata and Hero to tie up with giants like Indian Oil and Bharat Petroleum etc. to install charges across country but as fuel prices are stable these efforts are also slowing down. A big thrust from the government sector is required in this area.

**Uday Narang, Omega Seiki Mobility:** Adequate charging infrastructure is the key prerequisite in the Electric mobility space which will define adoption trends of EVs in India at large. The charging requirement depends not only on the kind of vehicle but also on the utility purpose. The Government of India has set a target to electrify 70% of all commercial vehicles, 30% of private cars, 40% of buses, and 80% of two-wheeler and three-wheeler sales by 2030. This target requires coinciding penetration of charging stations across India.

The Government of India has been supporting the EV industry through schemes such as FAME1 and FAME2 with a major focus on charging in-



frastructure. ROME was not built in one day, an ecosystem for the development of chargers, charging stations, and other services are gradually being built.

The charging infrastructure is the mainstay of electric mobility high operating cost, Discom load, and the uncertainty related to utilization rates of charging stations are holding back the expansion. The government needs to put more effort in terms of giving, business incentives to put charging station. This is something that is important, can be done for a short period of time when the charging infrastructure is set up, then they can pull the plug on incentives.

**Kapila Sandeep Soni, Croyance Automotive:** As Electric vehicle is in developing stage so as Charging infrastructure too, electric vehicles are in the advancing stage increasing demand and sales of electric vehicles will definitely paved the way for the same, for deploying charging stations less documentations and fast approval is needed with proper back up by subsidise rate of power.

**Amit Das, Electric One:** The country is struggling with several challenges like high prices of electric vehicles especially in four-wheelers, battery production capabilities, electricity consumption, charger compatibility, improper charging location, and a lack of vigorous electrical charging infrastructure. Let's understand the other main reasons behind our country's sparse charging station density.

#### **HIGH INITIAL INVESTMENT**

Setting up the EV charging station is quite high in cost. To set up the EV charging infrastructure, some requirements need to be fulfilled like proper location, land, right vendor, grid power stability, remittance of power, varieties of charger types, cables, and other auxiliaries.

#### **MULTIPLE TYPES OF CHARGING CONNECTORS**

There are some connectors such as CCS (Combined Charging System), CHAdeMO, and Bharat DC-001, and AC-001, all should be installed in a single charging station so the consumers will have a choice of having fast and slow charging as per their requirements as well as timing perspective.

#### **LOCATION TO SET UP THE EV CHARGING STATION**

To set up the Electric Vehicle charging station, the location of the charging station is a major challenge. Location or design of charging station should be such that it is easily visible, accessible, save time, and charging queue can be minimized.

#### **TECHNICAL SAFETY AT EV CHARGING STATIONS**

Setting up the EV charging stations requires specialized technical safety. Voltage fluctuations, over current, frequency mismatch, and ground fault are major concerns. To overcome Voltage fluctuations, stabilizers, proximity sensors, and control pilot sensors need to be integrated to keep a check on it. Otherwise, it may damage the expensive components.

#### **SOFTWARE RELATED CHALLENGES**

Finding the availability of the charging slot is one of the most important tasks, for this, it is very helpful to develop such software, it makes life easier and saves time.

The Government of India has undertaken the many measures to boost and expand the country's EV charging infrastructure.

The Government has made 360-degree efforts to enhance public charging infrastructure by involving private and public agencies (BEE, EESL, PGCIL, NTPC, etc.). Many private organisations have also come forward to install EV charging stations to develop convenient charging network grid to gain consumers' confidence. Ministry of Power (MoP) has planned that charging stations should be in an area of 3x3 km grid. Currently, India has a total of 1640 operational public EV chargers. Out of which, 9 cities (Surat, Pune, Ahmedabad, Bengaluru, Hyderabad, Delhi, Kolkata, Mumbai, and Chennai) account for approximately 940 stations.

In this direction, the Oil Marketing Companies have announced the setting up of 22,000 EV charging stations in prominent cities and on national highways across the country. Out of 22,000 EV charging stations, 10,000 will be installed by IOCL, 7,000 will be installed by Bharat Petroleum Corporation Ltd. (BPCL), and the rest of 5,000 will be installed by Hindustan Petroleum Corporation Ltd. (HPCL). IOCL has already installed 439 EV charging stations and plans to install another 2,000 EV charging stations over the next year. BPCL has installed 52 charging stations, while HPCL has installed 382 charging stations.

**Amit Lakhotia, Park+:** The following challenges exist both on the supply side and demand side:

#### **Installation & Supply:**

1. Real estate: Finding safe & accessible real estate locations to install EV charging stations is a major challenge, as it comes with its associated cost. Additionally, finding and activating prime (high EV footfall) locations where EV users can charge their cars/two wheelers is a major challenge. Various commercial models and different types of real estate locations add to the chaos. No standard guidebook exists, which can be used by all stakeholders for rapid deployment.

2. Awareness & education: Lack of awareness with respect to types of charging points (trickle charge, AC charge, DC charge). No universal charging point consensus exists, which adds to the confusion.
3. Installation & maintenance: Requires a dedicated and hyperlocal engineering team to setup/manage charging infra. Additionally, 24x7 uptime required IOT based advanced monitoring and agile/skilled on ground teams. Which turns into an expensive proposition if done in isolation by individual EV players.
4. Electricity grid management: Grids need to be updated and strengthened to withstand the additional load from the EV charging network. Furthermore, load assessment needs to be done locally to address gaps.

#### **Demand & Discoverability:**

- Fragmented Demand: The Indian EV story is still unfolding. It's a chaotic mix of two wheelers, three wheelers and four wheelers. In other words a fragmented market where the consumer is not sure what to buy and why to buy an EV.
- Discoverability & stickiness: Unlike petrol pumps, EV charging zones have not yet reached the desired penetration rate of at least 1 EV zone, within a 500-metre radius. This lack of discoverability leads to apprehension and reduced stickiness among EV users. According to a recent on app survey done by us, we found that 80% Gurugram residents were planning to buy an EV (a two or three-wheeler), however both their residential location and offices did not have EV charging points. Which resulted in them delaying their purchase.
- Payment system: Seamless payment options will also need to be embedded in the EV charging network ecosystem to ensure customer satisfaction and reduce payment anxiety.
- Customer delight: There is immense scope in developing an unparalleled EV customer experience, starting with the EV they buy and the EV charging network they use.

Governments at both the central and state levels have re-energised their policy incentives, approval processes and GST process, enabling EV players to unlock their latent potential. However, they need to create and announce a unified EV policy, empowering stakeholders to work together from across state borders. Additionally, a conducive environment needs to be provided to trigger public-private collaboration, tech innovations and investments.

**Rahul Bollini, JLNPhenix Energy:** Countries having a large number of charging stations cater to the electric cars and larger segment of electric vehicles. India's electric vehicle revolution has been traditionally driven by 2W and 3W. These smaller vehicles, specially 2W, have limited usage every day and their owners prefer charging their vehicles at home at the end of the day. Their priority to charge at a charging station is very less because charging the vehicles at home is cheaper than charging at a charging station. Also, because these vehicles have a different charging port and charging speed, traditional fast charging stations might not be compatible.

India's electric 4W revolution is yet to take off in a big way. Let us give it some time and India will notice an exponential rise in the number of charging stations. Many companies are putting efforts towards it and a lot of support is there from the government as well.

#### **INDIA'S EV SECTOR GROWTH: TODAY AND TOMORROW**

**India's EV market has many interesting characteristics. The biggest one is that the fastest growing sectors in terms of adoption (also referred to as market penetration) are the 2-wheelers and 3-wheeler segments, not so much the 4-wheeler passenger and commercial segments (source: The EV reporter). Which also means that the big traditional automotive OEMs do not dominate this market, as they do the ICE market. What are the top reasons/factors that shape this peculiar trend of the 2W and 3W segments leading other segments in adoption, with the 4W being the slowest one to catch up.**

**Randheer Singh, ACCP, NITI Aayog:** Initial penetration and adoption take time and disruption needs some incentives to be tried and tested before reaching to the scale of economies. The idea of transition is not to increase the number of private vehicles in the country, but to transition ICE vehicles to EVs, only then the motive of pollution control, taking lead in sunrise sector of EVs, reducing dependency on fossil fuels etc. can be achieved. Therefore, the government launched the FAME II incentives program to boost the 2W (a mass segment with 76-80% of total registered automotive in India) segment. And we can see the results. The growth from 2021 to 2022 has been phenomenal. EV sales of 390,399 units in H1 2022 surpassed 2021's total sales.

The traditional OEMs in bus and 4W segments are also adopting this transition. It includes the

TATAs, Hyundai, Mahindra, and others. The battery requirement in 4W is quite high and product testing, homologation, and maturity takes time. Some of these companies are completing their testing phase etc. by the end of 2022 and we will see a surge of low-cost EV availability in India by 2023. In terms of 2W and 3W the lead is being taken by the start-ups like Ather, Ola, Kinetic Green, etc. The biggest reason is the type of technology and platform development required for 2W/3W is not as complicated as for 4W. To add to this, the logistics and final-mile delivery segment which has the power to scale EV adoption significantly remains one of the biggest adopters of two-wheelers in the country. So, it is no surprise that two-wheelers are leading the curve but I'm certain that buses and 4 wheelers will soon follow suit.

**Bipul Chandra, Ducati India:** The adoption of EVs has been slow in India as it's a new technology and there is limited charging infrastructure. Additionally, high price of EVs is another major factor for less interest in the price-sensitive market in India.

Indians have now started shifting in large numbers from petrol two-wheelers to electric ones due to attractive prices, lower running costs, and lower maintenance. Also, thanks to the policies introduced by the government like PLI schemes, Fame I and II along with various subsidies allowed by the state government, progressive induction of reliable, affordable and efficient electric vehicles is being encouraged. A significant percentage of customers also factor in the environment and sustainability in their decision to buy an electric two-wheeler.

An electric two-wheeler (E2W) demands an average of 50 paise per km as compared to fuel consumption bikes that cost around INR 4-5 per litre. The low maintenance factor is also key in the adoption of E2Ws.

When it comes to electric three-wheelers (E3W), it is because of the increased demand of last-mile connectivity for delivery of goods, which is pushing the growth of E3Ws in India. For businesses in the last-mile delivery space, it is important for them to have quick and efficient transportation system in place. This is where E3W, well-known for its low-carbon footprint, wins the race.

**Suman Mishra, Mahindra Electric - Last Mile Mobility:** Mahindra Last Mile Mobility, as an OEM, is focussed on EVs with a rapidly increasing product portfolio that includes the Treo, Zor Grand as well as Alfa range of 3-wheelers in lead acid and Li-ion battery options. A Total Cost of Ownership (TCO) comparison shows that 2- and 3-wheeler EVs have already reached price parity with fossil-fuelled vehi-

cles due to their attractive subsidy support as well as the lower operating cost. In fact, during the life of the 3-wheeler, a customer earns much higher with an EV in comparison with a petrol/diesel/CNG equivalent.

A mass appeal with the ubiquitous 3-wheeler EVs in both passenger as well as cargo segments is something that is laying the foundation for electric vehicle adoption. As for 4-wheelers, once the global cell prices reduce, the cost parity will be achieved. Currently, 4-wheeler EV penetration is just under 5% and it is expected to go up to 20-30% in the next 4-5 years. In 3-wheelers, industry projections suggest we should reach 20-30% electrification in L5 category by FY25 and 60-70% by FY30.

**Sameer Jindal, MG Motor India:** One of the main reasons behind slow adoption for 4W EVs was limited number of affordable and reliable models. As Tata Motors brought Tata Nexon EV which is affordable and convenient, it suddenly became highest selling model in India. As 2W and 3W have lower cost, they have suddenly become very popular as users find them more convenient than ICE counterparts with less maintenance. Also 2W has very wide penetration of market.

2W - As of September 1, 2022, two-wheeler EV registrations in August stood at 50,346 units, up 13% from 44,599 units in July. With this, August became the month to see the second-highest number of registrations in 2022, slightly below March's 50,372 units.

4W - Though at present, EVs account for less than one percent of the total automobile market in India, demand is growing year on year. Of the total 30,69,499 PVs sold in FY2022, 21,821 were EVs and accounting for 0.7% of the market, up from 0.2% in FY2021.

Ever since MG ZS EV entered the Indian market, it has carved quite a niche for itself in the matter of just a couple of years. While it continues to rule key markets across the globe, including Europe and Australia, the ZS EV is the second most sought-after electric 4W in India. With ZS EV, we ensure a superior ownership experience by building a robust & sustainable EV ecosystem, and we are confident to change the mindset and accelerate EV adoption in India.

**Uday Narang, Omega Seiki Mobility:** It is absolutely feasible to electrify trucks. OSM is the only Indian company which is running 1 ton 3.0 ton and 6.5-ton electric trucks. Indeed, some leading countries have already set targets to phase out internal combustion engine medium and heavy trucks. So, if the electrification of trucks is possible, then why is it not happening in India? There are multiple reasons for the same:

**Legacy trucking businesses are largely unorganised:** The trucking market is highly unorganised and three-quarters of the fleet is operated by those who have five or fewer trucks. In addition, 30%-50% of trucks return empty after delivering their cargo: creating challenges of high costs, waste of resources, heavily intermediated returns and redundancies in the sector. This legacy business model creates a huge barrier in innovation of the segment.

**Lack of financial incentive:** The FAME I and II Scheme did not include any support at all for trucks. Right now, we have few electric truck models available on the Indian market like OSM M1KA, Tata ACE Electric, and there is a huge demand for these electric trucks. However, due to absence of any incentive from the Govt. the parity of cost in ICE engine trucks and electric trucks is very high.

**Still waiting for a policy push:** India is the sixth-largest commercial vehicle market in the world and a large exporter of vehicles and spare parts. Because there is a large ecosystem that exists in the incumbent system, electrifying the commercial vehicle sector will need the right policy push. Many states in India have come up with electric vehicle policies, but most of them are currently silent on the freight sector. India needs a policy for electrifying its trucking fleet. Accelerating the use of electric trucks in India is doable. Doing this will be more than worth the effort because zero-emission trucks are aligned with India's ambitious climate, air quality, and energy security goals.

**Kapila Sandeep Soni, Croyance Automotive:** 2W and 3W are indeed leading in this segment but when it comes to 4 W passenger and 4 W cargo segment the major challenge is the range anxiety people expect 4W cargo to be on highway as an ICE vehicle, but the lack of charging infrastructure has had its impact.

**Amit Das, Electric One:** There appears no doubt that EV revolution is bound to invade two-wheeler (2W) space much faster than 4w. I can support my argument by stating some facts.

1. The rapid entry by small private sector players in the manufacture of 2W EV demonstrates that it's not a one-off event rather it is becoming a reality as the big players in 2W Auto sector is also quickly changing gears and refocusing their plans to make 2W EV.
2. In fact, on common observance, we see that there is an increasing shift which is happening in the fleets of delivery services of ecommerce players from ICE engine to EV, which also prefer 2W EV.
3. Since we are a Budget-conscious nation and EV 2W are undoubtedly cheaper to buy so this also

makes the choice for 2W EV in comparison to 4w.

4. As most of the cities are crowded in India so citizens over here prefer to buy 2W over 4W.
5. As India is taking the steps to solve the connectivity issues in small towns people are using 3W EVs as a medium of transport over 4w EV

All these points discussed above are the main reasons for this peculiar trend of the 2W and 3W segments leading other segments in adoption.

**Manish Narang, EV Plugs:** The transition of electric mobility in India has followed a different trajectory as compared to its western and developed counterparts, where the transition was driven by 4-wheelers initially and was shifted to other segments of vehicles gradually. However, in India, the adoption has taken place predominantly in 2-wheelers and 3-wheelers category and in the shared mobility space. This is because of the unique mobility landscape present in India. The ownership of 4-wheelers vehicles was historically low due to comparatively lower per capita income. As data say, India has just 22 cars per 1,000 individuals. This number stands close to 900 in US and UK. An average Indian buyer prefers to use 2-wheeler and public commute being price sensitive and opting for a cost-effective solution. Secondly, it is the dense traffic on Indian roads and shorter trip length requirements that encourage average Indian buyers to own 2W and use 3W public transport.

When this unique landscape is coupled with the electrification of vehicles, the total cost of ownership (TCO) makes 2W and 3W the most viable solution for being the early adopters in the uptake. With the affordable purchase and maintenance and availability of low-cost charging sockets nearby, 2W and 3W EVs became ideal for personal short commutes, last-mile connectivity, and multiple logistic deliveries. Policy incentives and early adoption by e-commerce and start-up food delivery companies have also played a catalyst role in this. However, it is likely that the presence of adequate charging infrastructure and an improved range of advanced vehicles will build confidence in buyers and subsequently help pick up the pace of EV adoption in the 4-wheelers segment also.

**Amit Lakhotia, Park+:** The Indian EV revolution is being written by two-wheelers and three wheelers which have turned out to be the game changers. (Bikes, Autos, Tuktuks). This business vertical will keep evolving and growing to meet the Indian customers' demands as the need for last-mile deliveries have massively increased. Several logistics and food-tech start-ups have introduced 2Ws that are used specially for food, courier, transportation, and essen-

tials delivery. Additionally, they have developed a full ecosystem, from production to setting installation of charging stations, which has accelerated the use of two-wheel electric vehicles and subsequently reducing the carbon footprint. We at Park+ have also recently tied up with Battery Smart, a battery swapping network providing company to make our services more holistic and a one-stop platform for all the EV users in the country. For 4W's, considerably long charging time, range anxiety, higher cost than ICE vehicles and limited number of options available have been a reason for slow catching up.

**Rahul Bollini, JLNPhenix Energy:** Since batteries are the single largest priced component in any EV, the price of battery dictates how the EV is positioned in terms of price. Who doesn't want more range in their EV? After all everybody experiences range anxiety – it gets more worrisome when the battery percentage goes down, especially when we are away from home or a charging station. To reduce range anxiety, having a high-capacity battery helps but it increases the overall price of EV.

Since energy consumption of 2-Wheelers and 3-Wheelers per kilometer in terms of watt-hours per km is lower, it does not significantly increase the overall price of the vehicle. In fact, premium high-speed scooters with extended range versions are priced under 2 Lakhs after FAME 2 subsidy. Moreover, users of these vehicles don't expect very high range. But in the case of 4-Wheelers, the realistic range expected by its end users is typically more than 250Km and this is why earlier vehicles with a range of up to 150Km didn't sell much.

Even Tata Nexon delivering up to 250Km realistically didn't seem enough for most vehicle owners and Nexon EV Max was launched to fill this void. The newly launched Mahindra XUV 400 has a battery capacity that can deliver a realistic range of above 250Km. It is not like the user has a requirement of up to 250Km range on a daily basis, but this kind of high number makes them feel better and reduces their range anxiety.

People are not comfortable paying above 20 Lakhs (on-road) when it comes to buying an electric car because of the whole concept being new to them. ZS EV from MG and Kona from Hyundai are priced above 20 Lakhs and hence their sales volume has been low.

Also, there are not many reasons when it comes to 4-wheeler segment and the end users have very little to choose from. More models are expected to be launched in 2023 and 2024 and this variety of options will encourage people to buy EVs. The newly launched Tata Tiago EV is well positioned in terms of price and is expected to drive the 4-Wheeler numbers up. Its extended range version is expect-

ed to provide close to 250Km per charge.

Designing, testing and validating an electric 4-Wheeler takes a much larger time, since its electric platform is expected to last for 15 years, as much as life of the road tax. Moreover, they have to provide a warranty of a minimum of 8 years on the battery as compared to just 3 years in 2-Wheeler and 3-Wheeler EVs.

Coming to the point that traditional automotive OEMs do not dominate the EV market, it is mostly true for 2-Wheeler and 3-Wheeler market segments. Startups have played a vital role in the EV revolution and they have been the front runners while traditional automotive OEMs played wait-and-watch. These startups enjoy the first mover advantage and the traditional OEMs are now playing catch up. Also, the recurring margins on vehicle servicing and consumables are lower in EVs as compared to ICE (internal combustion engine) vehicles.

## ENVIRONMENTAL SUSTAINABILITY: THE EV IMPACT

**The biggest attraction of the EVs is its transformational impact on the environment. Its large-scale adoption in India, which unfortunately has some of the world's most polluting cities, will significantly reduce the carbon footprint of the transportation sector locally and globally. Could you share with our readers the topmost factors that make EV so much environmentally efficient, and how its adoption could not only reduce vehicular pollution, but also make the energy sector overall more sustainable?**

**Randheer Singh, ACCP, NITI Aayog:** EVs are also termed as ZEV (zero emission vehicles) in terms of tailpipe emissions. This helps to reduce vehicular pollution in cities and dense areas. Despite India's current energy mix, lifetime emissions from EVs today are 19%-34% lower than ICE vehicles and in the future with an increase in the renewable energy mix, this delta will increase making it more sustainable. In addition to this, the maintenance cost and consumables in EVs are far less. The drivetrain in an ICE vehicle contains 2,000+ moving parts typically, whereas the drivetrain in an EV contains around 20. Further, from a well-to-wheel (W2W) basis renewable power, low maintenance cost, high vehicle life, falling battery prices, increasing battery capacities, and the development of a secondary market will boost the sustainable transformation in India's mobility sector.

**Bipul Chandra, Ducati India:** Transport is a fundamental requirement for modern life and one

clear advantage of EV is that fully EVs have zero tailpipe emissions and are much better for the environment. This results in reducing air pollution considerably. If there are more EVs on the roads, simply put together, air quality will be clean, ultimately adding in ease of living. Driving an electric vehicle will not only help reduce carbon footprint but also reduce the environmental impact of charging vehicle further by choosing renewable energy options for home electricity.

While the production of EV batteries also creates upstream emissions, still, EVs remain the cleanest option for transportation as their entire life cycle is much more sustainable overall.

EVs has advantage in reducing noise pollution also. The engine of a petrol or diesel car will make more noise than an EV. Thus, for reducing noise pollution in a city, EVs are a good solution.

Also, in the future, there is a lot of scope for newer battery technologies, which can reduce emissions even at the time of production. Battery recycling is also a promising area. If we can archive optimum recycling, we can further cut net emissions.

**Suman Mishra, Mahindra Electric - Last Mile Mobility:** In an EV, as we are aware, there are zero tailpipe emissions. The EV batteries too are emission-free when in use and these can be depleted and charged repeatedly without contributing to pollution. EVs create a lower carbon footprint over the course of their lifetime than the traditional ICE vehicles even after accounting for the production emissions. The OEMs are also continuously innovating green manufacturing technologies to further reduce the carbon footprint across the value chain. For a sustainable ecosystem, there is a huge potential for battery recycling and reusability. There are some concrete measures being undertaken by the Govt to propagate the battery reuse as well as safe disposal.

Through EV adoption, customers will engage in more sustainable energy behavior because they are the ones who made a sustainable choice with their vehicle. As more and more people adopt EVs, there is scope for the energy sector to change the way the world operates and catalyze the eventual shift to sustainable sources of energy like wind, solar, and hydropower. While the main concern of customers is the charging infrastructure, through renewable sources of electricity, a huge role can be played by OEMs as well as energy providers through the various aforementioned processes.

**Dr. Yogesh Bhatia, LML:** Electric Vehicles are a significant development in sustainable mobility since they offer a greener option. Known for their high fuel efficiency, EVs might be an affordable method to lower operating costs for your entire

fleet. Many businesses have started using electric vehicles (EVs) in their fleets as a result of rising fuel prices and a push for greener initiatives. Known for their high fuel efficiency, EVs might be an affordable option to lower running costs.

EVs are a more environmentally friendly option than gas or diesel automobiles in addition to having cheaper fuel expenses. They can lower a fleet's carbon gas emissions by getting rid of exhaust. This benefit aids companies in continuing to operate sustainably and in compliance with legal requirements.

**Sameer Jindal, MG Motor India:** Electric vehicles are more efficient, and that combined with the electricity cost means that charging an electric vehicle is cheaper than filling petrol or diesel for your travel requirements. Using renewable energy sources can make the use of electric vehicles more eco-friendly. Electric cars are far more energy efficient (85-90% efficient) than internal combustion engine cars (17-21%). Less energy used means less pollutants produced, which in turn means less CO2 emissions produced by non-renewable energy sources and the wider energy supply chain. Certainly, we have to move to a cleaner and greener environment as committed by our Prime Minister in the COP26 Summit in Glasgow that by 2030, India will reduce the carbon intensity of its economy by more than 45 percent.

**Atul Arya, Panasonic Life Solutions India:** The focus on EVs stems from the government's focus on curbing rampant pollution in the major cities and cutting oil imports. India is the world's third-largest oil importer and home to some of the world's most polluted cities. Road transport contributes around 90% of the total emissions in the transport sector in India. Energy demand in India is anticipated to grow faster than that of all major economies, on the back of continued robust economic growth. Being the third largest energy consumer globally, reports have indicated that the demand for primary energy in India is expected to grow threefold by 2035 to 1,516 million tonnes of oil. Given the large dependence on oil imports, it is imperative to shift the focus to alternative fuels and electric mobility to support mobility in a sustainable manner. Some of the key factors that will have a direct impact on environment are:

**Reduction in tailpipe emissions** – using EVs will reduce the emissions to zero. Consumers can further nullify the impact by charging their EV using renewable energy at home

**Better energy efficiency** – EVs can convert around 60% of the electrical energy from the grid to power the wheels, but petrol or diesel cars can only convert 17%-21% of the energy stored in the fuel to the wheels. That is a waste of around 80%.

**Curbing noise pollution** – EVs have silent functioning capability making zero noise

**Uday Narang, Omega Seiki Mobility:** Environment and sustainability is extremely important. At OSM our vision has always been on how we get green energy and sustainability on the map. Thirty-one of the most polluted cities in the world are in India, we have got our future generations that are needed to be protected against Mother Earth's environment that is getting worse and worse by the day. Specifically, the developing country like India, has to make a major step towards electrification of mobility. EVs are environmentally efficient, the carbon dioxide emissions are less, particulates are less amongst the other advantages of EVs

**Kapila Sandeep Soni, Croyance Automotive:** Out of 20 most polluted cities in the world are from India. As per research passenger travel in individual ICE vehicle contributed 62 per cent of emissions attributed to road transport which is too high.

The health effects of this pollution are grave, with 35 per cent of the population of India exposed to emissions above the limits, as determined by the World Health Organization (WHO), leading to over 1.24 million deaths annually very tragic,

And nationwide lockdown provided evidence of the role road transportation plays in carbon emissions, between March and May 2020, the levels of nitrogen dioxide nationwide recorded their lowest value in 20 years. 19 out of 20 warmest years have occurred in 21st century. So the solution to all the above problem is Switch to Electric Vehicle, to create a better environment start working Now, adopt Ev in all the possible ways is the only solution to solve Environment and economic problems. As it is said "the future will either be green or not at all? So what we choose is critical to the future of humanity.

**Amit Das, Electric One:** Following are some of the topmost factors that make EV so much environmentally efficient

#### **1. EVs produce zero tailpipe emissions**

Full electric vehicles do not need a tailpipe, as they don't produce exhaust. Traditional engines combust gasoline or diesel, creating energy at the cost of producing harmful carbon emissions. By contrast, the batteries found in EVs are completely emission-free.

#### **2. Even when using fossil fuels, EVs contribute fewer emissions than ICE vehicles**

Many electric charging stations use renewable energy to charge EVs. However, some are still powered by coal-burning power plants and similar

energy sources considered harmful to the environment. In countries that primarily use coal, oil, or natural gas for power, charging EVs can leave a more significant carbon footprint.

#### **3. EV battery production are becoming cleaner**

Although EVs don't contribute much to air pollution on the road, manufacturing EV batteries can be harmful if done irresponsibly. Nearly all EV emissions are well-to-wheel emissions created during the battery production process. As EVs are still a newer technology, industry standards are inconsistent with the energy sources used for making batteries, resulting in larger carbon footprints. But, this is already beginning to change.

Today's EV batteries have a carbon footprint that is 2 to 3 times lower than two years ago, and growing cleaner still. Manufacturers of EVs are setting guidelines for their battery suppliers.

#### **4. ICE vehicles pollute**

Apart from the limited use of coal-fueled charging stations, EVs do not contribute to air pollution after they are manufactured. Most emissions are produced during the battery manufacturing process. That means total emissions of an EV can be measured before it even starts up for the first time.

#### **5. EV manufacturers use eco-friendly material**

One of the major obstacles facing EV manufacturers is producing a functional, lightweight vehicle. Lighter EVs have a greater range and smaller carbon footprint, but traditional materials make it difficult to achieve this. However, recycled and organic materials are now comparable to traditional materials. They're lightweight, eco-friendly, strong, and durable.

The digitalization of the power grid to smart grid provides value added services to the prosumers and other stakeholders involved in the energy market, and possibly disrupts existing electricity services in smart cities. The use of Electric Vehicles (EVs) do not only challenge the sustainability of the smart grid but also promote and stimulate its upgrading. Undeniably, EVs can actively promote the development of the smart grid via two-way communications by deploying Vehicle-to-Grid (V2G) and Grid-to-Vehicle (G2V). EVs have environmental benefits as compared to hybrids or even internal combustion engine vehicle as they can help minimize noise levels, pollution, and greenhouse gas emissions. The integration of EVs could bring substantial changes for the society not only in providing transportation services but also shifting economies from petroleum and reducing the carbon dioxide (CO<sub>2</sub>) emission from the transportation sector. Therefore, this study employs secondary data from the literature to explore how EVs can achieve

sustainable energy as a service business model in smart cities. Findings from this study suggest that EVs are major assets for a sustainable energy future as EV batteries offers an untapped opportunity to store electricity from renewable energy sources.

**Manish Narang, EV Plugs:** At COP 26, India committed to reducing total carbon emissions by one billion tonnes from now until 2030, to fulfil 50% of its energy requirements from renewable sources, and pledged net zero emissions by 2070. With the transport sector alone accounting for 70-95% of diesel and petrol consumption and 14% of CO2 emissions in India, it becomes critical to prioritize the de-carbonization of the automotive industry to achieve our set targets. There are studies that find achieving 30% EV penetration by 2030 will not only curb CO2 emissions but also reduce other concerning elements such as particulate matters, nitrogen oxides and dioxides, carbon monoxide and GHGs from environments in a significant manner. With zero tailpipe emissions, as the power charging of batteries is associated and integrated with a greater mix of renewable sources of energy such as wind and solar power, the CO2 footprints will be greatly reduced, giving a push towards sourcing energy from renewables.

Since EV adoption in India is picking up, it becomes critical for the focus to be driven on End of Life (EOL) management such as reuse and recycling the components to cut wastage. Data management and data analytics capability on energy charging bring in new business use cases utilizing the time of day (ToD) tariff, energy storage, managed charging, and vehicle-to-grid (V2G) infrastructure backed by renewables. These advanced opportunities offer not only efficient and cost-effective mobility solutions but also create a sustainable energy ecosys-

tem based on responsive and smart grid management for energy demands.

**Amit Lakhotia, Park+:** The potential for the electric vehicle (EV) industry to propel India into a new era of growth is enormous. By installing EV infrastructure, the government and EV charger installation players are giving a huge push to the 'Smart Cities Mission' launched by Ministry of Urban Development close to seven years back. With robust EV charging zones, users would experience a steep decline in range and charging anxiety. Systematic and planned installation of charging points will help in profitable use of real estate. For example: Over the next three years, the Indian Railways is all set to install EV charging points at all major stations across the country under a new policy of promoting e-mobility. This initiative will take India one step closer to its EV dream.

**Rahul Bollini, JLNPhenix Energy:** EV adoption is just the beginning and going green and environment friendly would be made possible when the energy with which it is charged comes from renewable energy sources such as solar, wind, etc. You see this why the renewable energy push came first in most countries including India and then came the EV revolution.

Oil, on the other hand, also has transmission losses. Diesel is required for the transportation of oil from other countries to India. The most effective way to reduce carbon footprint and going environment friendly would be to generate energy using solar modules at homes to charge vehicles. This would additionally reduce the transmission losses involved in energy transmission from solar power plant to homes. This would also ensure that the grid is stable and can adjust to the growing demands of energy for charging EVs.

## WHAT THEY DO

**Readers can glean more about the experts quoted in the feature and their organizations from the following websites:**

- Advanced Chemistry Cell Program, NITI Aayog: [www.niti.gov.in](http://www.niti.gov.in)
- Ducati India: [www.ducati.com/in/en/home](http://www.ducati.com/in/en/home)
- Mahindra Electric - Last Mile Mobility: [www.mahindraelectric.com](http://www.mahindraelectric.com)
- LML: [www.lmlemotion.com](http://www.lmlemotion.com)
- Croyance Automotive: [www.croyanceauto.com](http://www.croyanceauto.com)
- MG Motor India: [www.mgmotor.co.in](http://www.mgmotor.co.in)
- Panasonic Life Solutions India: [lsin.panasonic.com](http://lsin.panasonic.com)
- Omega Seiki Mobility: [omegaseikimobility.com](http://omegaseikimobility.com)
- Electric One: [electric-one.com](http://electric-one.com)
- EV Plugs: [evplugs.co.in](http://evplugs.co.in)
- Park+: [parkplus.io](http://parkplus.io)
- JLNPhenix Energy: [jlnphenix.com](http://jlnphenix.com)

Lead Interview | DORMER PRAMET

# We will continue to invest in our people in India: Dormer Pramet President

Leading machine tools manufacturer and supplier Dormer Pramet's Eduardo Martin President recently visited the company's Ankleshwar Production Unit. He shared with DMI his company's vision and growth strategy for the Indian market.



Dormer Pramet's President Eduardo Martin

In October, **Dormer Pramet's President Eduardo Martin** visited the company's Ankleshwar Production Unit, Gujarat, as part of the Dormer Pramet Management Group (DPMG) team. It was the first gathering of the entire DPMG team in Ankleshwar following the acquisition of Miranda Tools in December 2020.

Among the visit's main purposes were interactions with customers and colleagues, and seeing in-person the latest developments at the facility.

**DMI's VP Strategy Dinesh Mishra** met Mr. Martin at the occasion and interviewed him on a range of topics about the company and the

industry. Presenting, an edited and abridged version of the interaction.

**What were the main reasons behind Dormer Pramet's decision to increase the manufacturing capacity of its M3 – M12 taps assortment at the company's Ankleshwar production unit (PU)?**

The main reasons of increasing our production capacity in India is the demand that we are receiving for our Miranda products in India. We are focusing on industries like automotive, and general engineering where this category is well received.

Dormer Pramet has dedicated significant investments for the facility, demonstrating the company's confidence in the Ankleshwar PU. The unit became part of the company following the Miranda Tools acquisition in 2020. We place a high degree of importance on its round tools assortment which will support our growth projection in India and around the world.

To increase the taps production capacity, we installed a series of machines powered by new technologies that included thread, flute and chamfer grinding machines. For instance, this was the first time that robotics has been deployed in this PU.

The improved machine equipment has not only grown productivity at the unit, but also significantly increased the quality of taps produced, helping to bring it in line with global standards. Recent tests have shown big improvements in the taps' performance. Further investments and activities are planned in the coming months to support the development of the Ankleshwar production unit and the company's growth in India.

**The last two years have been challenging for industries that are the biggest consumers of your products, such as automobile and heavy engineering and their machine toolmakers. What are the business continuity strategies you deployed at Dormer Pramet to tide over these times?**

We are a multinational company operating in more than 30 countries, and we have different growth strategies based on regional demands. Our goal is to stay closer to our customers and be as rooted to local requirements as possible. During the pandemic, in order to closely support our customers through the challenging period we were conducting remote training and assistance. We have used these challenging years to focus ways to better serve our customers' needs.

**Could you share with our readers the top focus areas of your three product brands – Dormer, Pramet and Miranda – which are available across India?**

With our Dormer and Pramet product brands, we are focusing on segments like automotive and general engineering with the most competitive offerings on the market. We are strengthening our positioning as the most reliable supplier in this area. For that, we are ensuring that we are strong in areas like training our employee with the latest skills, hiring the right product managers to benefit our customers, and introducing products with newer capabilities.

With Miranda, during the pandemic we reviewed the product portfolio and decided that we are going to concentrate on our core business which is drills and taps. And the demand for drills is really extraordinary. Our people here in the [Ankleshwar] production unit have been doing an excellent job to meet the demand. We will continue to invest in our people in the Indian market.

**What are the biggest growth-opportunity areas that Dormer Pramet has identified across the Indian market, and what are the measures and strategies the company is taking to harness them?**

Dormer Pramet sees significant opportunities to grow across India, providing customers with easy access to high quality products for various application and production environments.

Dormer, Pramet and Miranda together have strengthened our position in the Indian industry. We aim to expand our operations in the country with main focus on General Engineering, Die & Mould and Automotive sectors, where we have established ourselves as one of the most reliable brands. These are strong growth areas, where quality and the cost per piece are key to success and I think we are faring successfully on these parameters. So we are really looking forward to our journey in India and are excited about it.

**Indi's government is keen on making India a prominent industrial hub under mission Make in India. In what ways can Dormer Pramet's India presence help with the country's growth ambitions?**

We deeply care about our people and the larger community. I hope that we all are pushing in the same direction to make India better in any possible way.

We are positively ambitious about our growth in India, and are expecting to grow fast in the coming years. I understand that

we need to do the investments that are required with or without the growth connect, for example, on critical areas like safety, the environment, and the community. We can see the big difference that people locally have made, working really hard with our focus on safety. It's impressive.

**What is the message you want to convey to our readers?**

I want to thank our customers for their support for the business. We are really looking forward to meeting them. We will continue proving to them that we are their most reliable partners in their growth journey.



**Executive Profile:  
Eduardo Martin, President, Dormer Pramet**

Eduardo Martin became the President of Dormer Pramet on 1 February 2022. He lives in Malaga, Spain and enjoys spending time with family, meeting people, and getting to know different languages and cultures. "I like engaging and communicating with people around the world. I enjoy gadgets and playing with new technology as soon as they arrive on the market," he says. Languages he is conversant in include Spanish, English, Swedish, Italian, and Portuguese. Mr. Martin has worked with Sandvik Machining Solutions, the parent company of Dormer Pramet for 33 years.

His previous role at the company was Senior Vice President - Head of Global Sales at Sandvik Coromant. He has lived in four different countries, including Sweden, Italy, the USA and Spain.

At Sandvik, he started in production, working on a grinding machine for milling inserts. He has been a designer of special tools and product manager engineer for Sandvik Automation company. Also, he was a product manager engineer for short hole-making products in Sweden for three years. He has been the managing director for Iberica (Spain and Portugal) then also Italy, as well as the President for the Americas sales area.

He has a Technical Engineering Degree in Machine Tools and an Executive Master's in Business and Administration.

Dormer Pramet is a global manufacturer and supplier of tools for the metal cutting industry. Its comprehensive product program encompasses both rotary and indexable drilling, milling, threading and turning tools for use in a wide variety of production environments. An extensive sales and technical support service operate from 20 offices, serving more than 100 markets worldwide. These are assisted by dedicated production facilities in Europe, Americas and Asia, along with a highly developed distribution and logistics network.

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Product Showcase | JUNKER

# Hot Buzz

JUNKER develops innovative and unique process for hard-coated brake disc production. Hard-coated brake discs become a hot topic.

**A**longside tire wear and the combustion of fossil fuels, brake abrasion contributes to the high particulate pollution caused by vehicles with combustion engines and electric or hybrid drives. The automotive industry needs innovative technical solutions to reduce this contamination.

A series process, in which laser cladding provides brake discs with high-quality corrosion protection and a wearresistant hard coating, is now available to reduce brakerelated particulate emissions. This innovative hard coating process leads to high-quality anti-corrosion and wearresistance.

## Coating and grinding process

JUNKER offers brake disc coating and grinding innovations, allowing optimum friction pairing and reduced particulate emissions. During the grinding process, the brake disc is simultaneously ground on its parallel sides with two opposing grinding wheels. This state-of-the-art manufacturing process achieves perfect flatness and precise axial runout, and the coating thickness deviation is significantly reduced.

## Highlights

- Shortest cycle time compared to competitive processes
- Optimal turnkey solution for coating and grinding
- Highly productive grinding process
- Tooling costs per brake disk at benchmark level
- Exact parallelism and axial runout
- Minimum thickness deviation (DTV)
- Lowest media consumption costs compared to competitive processes
- Reduced heat due to innovative grinding process leads to minimal distortion
- Closed loop between coating system and grinding machine

## Technical data JUDISC machine

- X-axis travel: 200 mm
- Z-axis travel: 650 mm
- Grinding wheel diameter: 500 mm
- Grinding wheel width: 90 mm

## Technical data brake disc

- Friction lining outer diameter: min. 220 mm, max. 500 mm
- Total width: max. 150 mm
- Weight: max. 30 kg



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**INDIA'S EV REVOLUTION:  
E2W AND E3W SHOW THE WAY**

An EV (Electric Vehicle) revolution is afoot in India. And it is led by 2-wheelers and 3-wheelers. Passenger cars are not far behind. In one of the most comprehensive accounts of India's EV story, sector experts with skin in the game tell us about factors shaping this exciting growth story.



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Industry News | Kirloskar

# Kirloskar Wins Energy Prize

Kirloskar Oil Engines (Kolhapur & Nashik Plants) win the prestigious ‘National Award for Excellence in Energy Management & Energy Efficient Unit 2022’ from CII

**P**une, 26th September 2022: Kirloskar Oil Engines Limited’s (KOEL) - Kolhapur & Nashik plants have won the ‘National Award for Excellence in Energy Management’ & ‘Energy Efficient Unit’ from CII for the year 2022. This award is bestowed upon organizations for their energy optimisation, use of best industry practices, use of renewable sources of energy and self-sustenance.

The award was presented to Kirloskar Oil Engines in the presence of eminent dignitaries that included E. Freddy Svane, Ambassador at the Royal Danish Embassy in New Delhi, Mr Rakesh K Rai, Secretary, BEE, Ministry of Power, Govt. of India, Mr K S Venkatagiri, Executive Director – IGBC and CII, and Mr P V Kiran Anath, Deputy Executive Director, CII. Mr Santosh Parab, AGM, Utilities Department, and Mr Nitin Kulkarni, Energy Manager received the award on behalf of Kirloskar Oil En-

gines, Kagal. For Nashik Plant Mr Paresch Joshi & Mr Hemant Upadhye received the award.

Gauri Kirloskar, Managing Director, KOEL, said: “This is another feather in the cap for KOEL in its efforts towards energy efficiency, using energy efficient sources and sustainable practices. As a market leader in engine technology and power generation solutions, KOEL has always been at the forefront in developing cutting edge technology that is energy efficient and sustainable for our customers. Our manufacturing locations are state of the art and energy efficient - 64% of our energy requirements come from renewable sources, and 58% of our water needs at the plant are self-generated. We will continue to invest, design and develop solutions that are clean and sustainable, at a cost and quality that is acceptable to our customers and our manufacturing locations will continue to be energy efficient”





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# Needed: Improved Battery Management System for EVs

EVs are good and green, but carmakers and innovators must address the various concerns surrounding their systems, particularly the safety concerns



Written by Prof. Dr. Ganesh Kakandikar, Professor and Head of School, Mechanical Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune

**N**ikola Tesla, a physicist born in Austria-Hungary who later immigrated to the United States, discovered the alternating current in the late nineteenth century. He is credited with generating, transmitting and consuming electricity over long distances, as it was not possible with direct current. Induction motor was a major part of his invention, which led to the comprehensive use of electricity in the manufacturing and industrial sectors.

About a hundred years ago, Benjamin Franklin came up with the idea that lightning in the sky is caused by an electric charge. In 1879,

Thomas Edison invented the first incandescent light bulb in his laboratory. The contribution of these three scientists in this field is commendable. The electrical energy we use today is a secondary source, produced from primary sources such as coal, natural gas, solar, wind and nuclear energy. It was during this period, around 1890, that the use of vehicles running on crude oils instead of steam-powered began in England. Even though the same secondary energy was being used in vehicles in other systems, it took us about one and a half hundred years to realize that the speed of vehicles could be obtained from it.

The main reasons for this are depletion of oil reserves, rapidly growing population, increasing air and noise pollution due to vehicles, use of obsolete old vehicles and increased international travel after globalization. In India, the discussion of electric vehicles has been going on for the last two decades, but real progress can be seen over last four to five years only. The United Nations Sustainable Development Goals No. 7 - Clean Energy and No. 13 - Climate Change was also global pressure. Due to rising petrol-diesel prices, the market has also started responding towards electrical segment. With the growing demand for electric vehicles, all the automotive manufacturers want to encash this opportunity, as it emerged as entire new product segment.

Consumers are now getting attracted to the benefits of electric vehicles, over conventional engines. But there is also matter of concern also, seen the incidence of fires with electric vehicles on the roads. There are some questions about the safety of electric vehicles in common consumers. The most important factor when switching from a petrol or diesel engine to an electric vehicle is the battery management system because the battery is the most important component. The battery management system plans and manages the entire battery set and ensure the safety of the battery system. Its electronic circuits have complete control over the charging

and discharging of the electrical components. Provides up-to-date information on the working characteristics of battery such as type, temperature, capacity, charge status, power consumption and charge cycle. The management system controls power and voltage, manages heat, ensures electrical safety, detects faults in advance, optimizes power efficiency, balances the charging of all units, and controls noise.

These functions apply to the entire battery pack or even to a single battery. The most important of all these functions is the management of power safety and capacity building. Safety falls into two parts: electrical protection and thermal protection, which can be combined into functional safety. Consumers expect that the life of the battery must be extended with safety and also with stable efficiency. Uniform charging of all the batteries or same discharging, is what expected from an ideal battery management system.

Battery management systems available in the market are currently dependent on the manufacturers, with a difference in the efficiency. Considering the complexity of the system and its variety of functions, there is need for stand-

ardisation of the system, urgently needed. The government and the industrial establishments need to work together. Lithium ion battery are currently the most widely used, as lithium ions are more efficient at recharging than any other. Lithium is a very light metal and has a high electrochemical potential, so it has a maximum energy density per unit of volume and per unit of weight. The current challenges are to increase the safety of the battery, reduce the cost, find new metals for the battery, increase the capacity and reduce the charging time.

The vehicles caught fire due to non-compliance with the standard procedure given to the battery. But if similar incidents occur with vehicles parked in the parking lot of a residential building, the consequences can be dire. Therefore, the customer should follow all the instructions, do not keep the vehicle in the sun, charge the battery as per the given standard, keep the vehicle in continuous use and do not exceed any limit of use. But the rate of such fires is negligible, so there is no reason to worry. Since success from failure is the key to engineering, it is certain that an effective power management system will soon be in use.

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Success Story | **ZEISS**

# Measuring Technology Key to Series Production in E-mobility

Volkswagen and ZEISS are working together to solve challenges



The Volkswagen components plant in Salzgitter manufactures important components for the APP 310, an electric drive which will make electromobility accessible to a wide range of customers starting this year. The drive's innovative hairpin stator concept presented entirely new challenges for quality assurance. The answer came in the form of a measurement solution from ZEISS Industrial Quality Solutions. Now, large-scale series production of the electric drive can proceed unobstructed.

A maximum torque of 310 newton meters, 204 PS and a range of 550 kilometers. These are the basic specifications on the VW ID.3, Volkswagen's first purely electric production vehicle. The compact car is the first in a series of electric vehicles planned by the Volkswagen group, whose consistent efforts to go electric are nearly unmatched by any other automobile manufacturer. And VW's electric future is about to become reality: soon, up to 500,000 ID.3 cars are expected to roll off the assembly line in Germany alone. Additional production facilities in countries with high demand for electric cars, such as China, will see this quantity increase even further.

Essential components of the APP 310 electric drive — part of Volkswagen's modular electric drive matrix (MEB) platform — are produced in the Volkswagen Group Components plant in Salzgitter. These include the rotor and the stator. For the stator, Volkswagen has opted for an innovative design using hairpin technology. This enables the stators to be manufactured in cycle times similar to those used in combustion engines, but this isn't the only advantage: "The hairpin engine



Hairpins made of coated copper place new demands on measurement technology.



The fully assembled stator is reproducibly fixed on a ZEISS device.

is noticeably more powerful than standard electric drives, and it's also significantly lighter," explains Philip Kurz, who is responsible for engine design and testing at the components plant in Salzgitter. This, says Kurz, is a technology that many manufacturers are working on, "but we are without a doubt the first to achieve large-scale series production of it." But an essential piece of the puzzle, quality assurance, initially presented the plant with a problem. The nature of the hairpins makes it impossible to measure them using the tactile or optical methods traditionally used in the manufacture of engines. For this reason, ZEISS has been working with Volkswagen over the past year to develop a measuring solution which meets all of VW's requirements and which enables the automaker to begin large-scale series production of its electric vehicles as planned.

#### **Quality assurance for an entirely new kind of engine manufacturing**

The new stator used in the APP 310, as the electric drive is called internally, uses copper-coated hairpins instead of traditional copper wire coil. In an automated process, these are bent into the shape of oversized hairpins, as the name suggests. Due to the nature of the hairpins and the process used to manufacture them, the effectiveness of traditional measuring technology proved limited, explains Pascal Schmidt, a member of the quality assurance team in Salzgitter. "Copper is easily deformed, which is why we can't use tactile methods. Also, it is shiny and semi-transparent, which makes it difficult for optical sensors to detect."

This is compounded by the fact that the shape of the hairpins in production does not match the shape they have when they are installed as a group into the notches on the stator. And last but not least, the "virtual installation envelope" demanded an entirely new approach to quality assurance in engine manufacturing. The winding head, which is comprised of over

100 hairpins, must be scanned with sensors. The virtual installation envelope corresponds to the dimensions of the electric drive housing, and under no circumstance may the hairpins be allowed to come into contact with it. Hence, Volkswagen needed to find a measurement solution capable of handling the hairpin material while also being capable of scanning the entire winding head and the hairpins in both their production state and their installation state. They also needed to develop an efficient measuring strategy capable of meeting all of the statutory and company-internal safety and quality requirements on the electric drive. The drive's ability to reach up to 16,000 rpm demands the highest quality components.

#### **The answer: Multisensor systems and adapted equipment**

"Accuracy wasn't the issue at all," emphasizes Philip Kurz. "In traditional engine manufacturing, it is sometimes a question of thousandths of a millimeter. The tolerances on our electric drive are smaller. It was much more a matter of feasibility." At the start of 2019, ZEISS and Volkswagen Group Components in Salzgitter began a collaborative project with the aim of finding solutions to these quality assurance challenges. "Once we had defined internal requirements on the sensors, it became clear that the ZEISS PRISMO multisensor coordinate measuring machine was the ideal solution," says Kurz. In the chosen configuration, the coordinate measuring machine comes fitted with the ZEISS VAST XXT tactile scanning measuring head, the ZEISS LineScan optical form sensor and the ZEISS DotScan chromatic white light sensor, as well as a rotating swivel unit. Where possible VW prefers to use the tactile procedure for measuring the bundle of laminations on the stator, as this is the most precise method. The virtual installation envelope is inspected using ZEISS LineScan. This digitalizes the winding head in the form of a point cloud, which can then be

compared to the target CAD model. The hairpins are measured using the ZEISS DotScan.

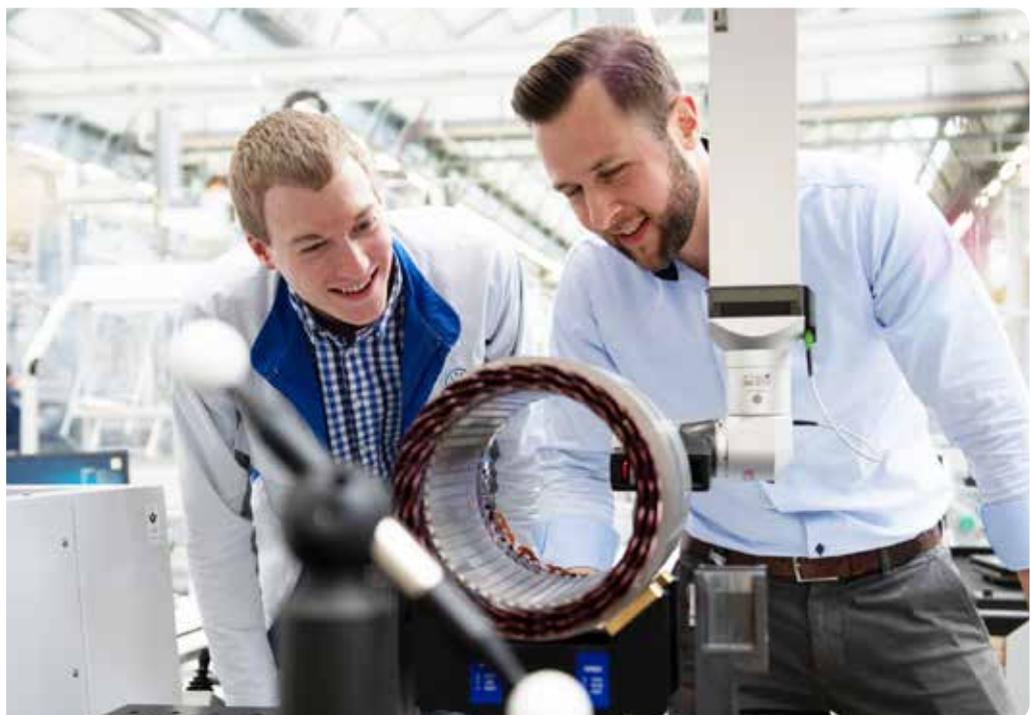
To inspect the individual hairpins prior to installation on the stator, ZEISS developed a piece of equipment capable of clamping the hairpins for measurement in precisely the same position they will predominantly be in when they are installed on the stator. “This is by no means a new procedure. It’s also used in body construction, for example. They call it a master jig,” says Philip Kurz. “We are now applying this principle to engine manufacturing for the first time.” Also, for the lamination bundle, ZEISS developed a clamping device which enables the bundle to be secured for reproducible tactile measurement.

#### **A jointly developed, comprehensive solution**

ZEISS’ hardware expertise was only one of many factors that convinced Volkswagen to partner with them. “Another decisive point for us was that the hardware and the software work together seamlessly,” said Kurz. “I work with ZEISS CALYPSO for all sensor types. All of the measurement data is collected there, and I’m able to document everything in parallel in ZEISS PiWeb. This is a comprehensive solution which is unbelievably smart, stable and user-friendly.” This is particularly important for Volkswagen, since quality assurance of the electric drive is performed right within production. It is not the measuring engineers, but rather the production workers, who conduct random checks on the manufactured and assembled components every day. Pascal Schmidt, who oversees

the production workers in these tasks, says they are optimally equipped for this: “With CALYPSO, ZEISS offers a clear interface with images and text which allows the operator to select what he wants to do. The operator inserts the part that is to be measured, enters which machine the part is from, selects the measurement program, and then the rest runs automatically. There’s virtually nothing that can go wrong.” And ZEISS PiWeb is also convincing with its ability to generate meaningful measurement reports quickly and easily, and to clearly visualize the measurement data – including with CAD views, form plots, false color displays and histograms.

Philip Kurz, too, is pleased that Volkswagen Group Components has found a comprehensive solution for this latest generation of drives: “I need good equipment from suppliers who understand what is at stake. ZEISS makes outstanding, thoroughly developed products. Those of us in planning are never looking for specific devices, but for a comprehensive measuring solution. ZEISS understands our products and our measuring needs and is able to develop within its portfolio the ideal solution that best matches our requirements.” Volkswagen can now focus on meeting their target production quantities. Additional MEB platform models, such as the VW ID.4 electric SUV and the VW ID.5 coupe, are already on the starting blocks. The future of Volkswagen’s hairpin electric drive is full of potential applications — and thanks to the measuring solutions developed together by ZEISS and Volkswagen, this future is now guaranteed.



Pascal Schmidt, Quality Assurance and Philipp Kurz, Engine Design and Testing, discuss the measurement challenges.

# MAKERS & MOVERS

## Dynamic Manufacturing India Editor Launches *Makers and Movers*, a Web-series.

Aanand Pandey, Editor, Dynamic Manufacturing India, has launched *Makers and Movers*, a YouTube channel about people, ideas and organizations that make and move things, that is, the stakeholders of India's industrial sector. In Episode 01, he has talked about 3 Critical Focus Areas for Mission Make in India 2.0 and explores:

- What India must do to create quality jobs.
- How India can leverage the US-China trade war.
- What stops India from becoming a global industrial powerhouse.

And many more.

In the coming episodes, *Makers and Movers* will cover many relevant and burning industry issues. Let us know if you want your ideas, your success stories or your brand to feature in the series.

Watch the Video

 YouTube



Interaction | **Oracle**

# Get Ahead in The Cloud

Digital technologies play a prominent role in the transformation of supply chains, says Kaushik Mitra, Senior Director, Oracle



Kaushik Mitra, Senior Director, Oracle

**T**oday, with the vulnerability of supply chains coupled with changing consumer expectations, supply chain management has become a critical area for the overall smooth functioning of operations for supply-oriented businesses. By leveraging digital technologies specifically Cloud, AI/ML, and Analytics and advanced analytical capabilities companies can streamline the entire supply chain. In an exclusive interview, **Kaushik Mitra, Senior Director- ERP/EPM Sales, Oracle India**, explained to **DMI's VP Strategy Dinesh Mishra**, the role of Cloud in allowing businesses to address their bottlenecks pertaining to complex supply chains.

## **What are the major issues and challenges businesses these days are facing in supply chain management and how it can be handled effectively?**

Over the past few years, we have observed a series of fundamental changes in consumer behaviour. Additionally, supply chains have been hugely disrupted over the last few years, especially post pandemic. The vulnerability of supply chains coupled with changing consumer expectations, supply chain management has become a critical area for the overall smooth functioning of operations for supply oriented businesses. Several components including increased costing for operations, labour costs, compliance related challenges, slow production, talent gap, rise in demands for personalisation and customization from consumer and expensive IT systems that require modern technologies among others are the prime reasons for creating disruptions in any supply chain network. To address these hurdles, it is extremely vital for businesses to ensure quality and speed at the supply chain process and address all the escalations on time. To do so, there is a need for solid data and analytics capabilities that help in understanding supply chain complexity, anticipating potential disruption, and quickly developing a response. In a nutshell, businesses should navigate all the operational challenges while addressing the needs of consumers and suppliers as well.

As per Oracle SCM survey 2021, supply chain disruptions have negatively impacted consumers as well as ultimately affecting the overall business. As per this survey, over 93% of Indian consumers worry that supply chain issues are here to stay for a longer period in the future. Also, over 76% of people would trust and more

willing to buy from a company if they knew it used advanced technologies like artificial intelligence to manage its supply chain. Hence, it is imperative that businesses evaluate their supply chain management strategies and develop a proactive business plan to address these difficulties. Furthermore, it is critical for companies to soon adopt the required digital technologies to streamline the entire supply chain.

**How do companies with the implementation of new-age digital technologies develop smarter and stronger supply chains? Also, which technologies, in particular, can bring a significant impact?**

We are in modern times, where every organization, including the ones operating in logistics and supply chain processes need constant improvement in terms of digitalisation and innovation. Logistics and supply chain operations already are quite multi-faceted and complex processes in nature and are integral part of most trade and market relations, thus it needs to be constantly improved. We believe that businesses can gain competitive advantages over factors such as costs, delivery times, pre-sales preparation, time, and after-sales service by smart digitization of delivery chain.

Many new-age technologies have emerged which are changing the way of traditional working, but specifically Cloud, AI/ML, and Analytics have the inherent ability to help manufacturers with supply chain disruptions. The adoption of digital technologies and solutions will overall benefit manufacturers and suppliers and help increase the level of collaboration and openness of the supply chain. Furthermore, leveraging digital technologies and advanced analytical capabilities will assist companies in garnering what is required to support customer fulfilment, integrated business planning, physical process, and other more proactive business process decision-making needs.

**Why are business leaders today moving towards more flexible models that allow them to modify the scale of their operations?**

Over a period of time, it's proven that supply chain alignment is one of the critical components for any company in forming its business and operational strategy. The last few years were extremely transformational due to the global pandemic when businesses have faced unimaginable challenges related to production, financial crunch, mobility, and flexibility issues. In these challenging times, the majority of organizations and their

CIOs & business leaders realized the importance of keeping their supply chain network aligned.

They were indeed witnessing dramatic fluctuations with respect to transparency, lack of visibility, and bottlenecks. As a result, business leaders realized the vulnerabilities of their supply chains. To streamline their supply chain, they had to take conscious decisions to enhance their supply chain by adopting flexible models that allowed complete visibility of their supply chains from complete production to delivery cycle.

**How can Cloud bring agility, scalability, and flexibility to supply chain and logistics management and create operational transparency within any business?**

Cloud technology has taken a centre stage in the transformation of the supply chain and logistics industry as well along with many other key sectors. Cloud-native applications can essentially streamline the entire supply chain network and overcome all the disruptions companies are facing over a period of time. Cloud applications and SCM solutions can truly provide a comprehensive view of the entire supply chain, ultimately allowing businesses to address their bottlenecks. Hence, these solutions help organizations respond quickly to changing demand, supply, and market conditions.

Cloud build applications have the potential to improvise planning, optimize inventory management, streamline integrated manufacturing, increase reliability, improve coordination across channels, even minimise logistics costs and accelerate product innovation. Additionally, cloud applications with embedded technologies like IoT, Data Analytics, and Blockchain enable data-led and strategic decision-making. It allows businesses across industries to streamline and enhance their supply chains. All these benefits account for bringing the kind of agility, scalability, and flexibility to manage the supply chain.

**Tell us how Oracle is helping businesses to leverage cloud solutions to develop leaner, smarter, and more agile supply chains, please support your answer with examples.**

Oracle has supported many leading industry players in streamlining and modernizing their supply chain network and helped them overcome challenges pertaining to flexibility, automation, scalability, user accessibility and mobile enablement which were causing major disruptions. Talking on a global level, DP World is one great customer example to share. One of the leading and fast-growing logistics company that was strug-

gling with slowed operations and increased costs due to its on-premises systems sprawl for a long time. They were required to streamline their internal operations and build a back office that could support growth, including quickly integrating acquisitions and starting up new facilities. They had opted for Oracle Fusion Cloud Applications and soon after implementation, could maintain critical operations during the pandemic with most of the staff working remotely.

While talking about Indian companies, Apollo Tyres is one such example. They are one of the leading tyre manufacturers in India and one of our key customers in this segment. By using Oracle SaaS platform, Apollo Tyres were able to create smarter, more transparent, and streamlined supply chains. Safexpress is also another great example, who uses Oracle’s ERP to fine-tune their operations, as well as our OTM (Oracle Transport Management Solution) to quickly and efficiently onboard their customers. Whereas, leading manufacturer, Hindalco, also implemented Oracle’s EPM solution to modernize its financial management and regulatory reports in a cost-effective manner by leveraging data and smart automation.

Another, aspect that Oracle SCM solutions is covering and helping our customers is with respect to ESG. As our customers focus on their sustainability mandates, our SCM solutions are supporting their ‘save the planet’ initiatives. For instance, our global customer Unilever is using Oracle Transportation Management (OTM) solution to advance their ESG goals; they have achieved 29M fewer vehicle KMs driven and 9% reduced CO<sub>2</sub> emissions.

Similarly, one of the biggest Generic Pharma companies in India was facing challenges around Excess Inventory. Inventories were touching around 12 months which was unsustainable. To produce that inventory the needed natural resources are – Water, electricity, resources among others. Also, there was a situation wherein some inventory because of FDA Shell Life restrictions, had to be written off. That’s almost criminal – manufacturing something which can’t be consumed and robbing earth of its natural resources. We are working with this organization to streamline their Supply Chain to ensure that inventories and at the optimum levels only and they do not keep on manufacturing. Not only will it reduce Inventory costs, but it will also reduce the manufacturing costs to produce these inventories.



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HANDBOOK

Feature | **Marposs**

# Marposs takes up the challenge of electromobility

The Automotive market has always represented one of the most important sectors for the Marposs Group's activities. The transition to sustainable mobility therefore represents an important challenge but also a great opportunity for the company. Marposs has prepared for this challenge by studying the process behind the creation of electric cars, investing in collaborations with universities and internal R&D activities and taking over companies with specific know-how and a portfolio of products and dedicated applications.

Competence Centres have also been established to develop innovative measurement, inspection and testing solutions for the various electric powertrain components as well as offering relative training activities.

By Franco Stanghellini



The Automotive market has always been one of the Marposs Group's strategic business sectors. The transition to electromobility is both a major challenge and a great opportunity for Marposs. In this time of great changes, the company has taken up the challenge of continuing to be a strong reference for the automotive market. Traditional product lines have been integrated with new technologies to provide a mixture of measurement, inspection and testing solutions that ensure the complete monitoring of the main electric vehicle components production process. These range from batteries to fuel cells and electric motors to complete Electric Drive Units.

**Developing company know-how.** Unlike the Internal Combustion Engine (ICE), the quality control and process monitoring for electric powertrain components cannot be limited to an assessment of mechanical parameters and dimensions. The performance of battery components, electric motors and fuel cells also depends on the links between their physical, chemical, electric, and magnetic characteristics. It is therefore essential to build interdisciplinary skills and use them to develop products and applications that can be integrated into the production line.

Marposs has prepared for this challenge by studying the process required to create an electric car. To achieve this, it has invested in collaborations with universities and internal R&D activities and taken over companies with



## Franco Stanghellini

Graduated from the University of Bologna in nuclear engineering, he began working in 1995 in the R&D department of Marposs on the development of new measurement sensors. Since 2001 he has worked as product and industry manager for the automotive injection industry.

On the beginning of 2018 he has been appointed as responsible for the market development policies of the Marposs group in the electro-mobility sector. In this position, he coordinates

the development activities of the Marposs competence centre's for solutions dedicated to batteries, electric motors and hydrogen fuel cells, and their dissemination within the commercial organization.

specific know-how and a portfolio of products and dedicated applications. It has also created Competence Centres for developing innovative measurement, inspection and testing solutions for the various electric powertrain components as well as offering training activities for the sales and service network.

**Rotor and stator dimensional measurement and inspection.** Marposs has focused its developments on new products and applications for dimensional measurement and inspection at the



Hairpinflash: optical gauge for hairpin.

headquarters in Bentivoglio, which already featured transversal competencies in this field.

In fact, traditional product lines like Optoquick, the flexible optical gauges for shafts, have been adapted to allow them to measure fundamental dimensions on components like rotors for electric motors. More specifically, using optical technology to gauge permanent magnet rotors ensures that the measuring operations are accurate and reliable, even in production environments, as they do not allow the powerful magnetic fields that are generated to affect their performance.

New product lines have also been developed to test other key components, like stators, especially in the 'hairpin' versions that are increasingly used in the production of electric motors for electromobility. The special characteristics of the components to be measured also require the use of contactless technologies.

The Hairpinflash product line, for instance, uses a combination of images taken by different 2D cameras with telecentric optics to measure the main dimension and shape parameters of hairpins before they are assembled in the stator. The test is extremely fast and can be performed in an offline station or integrated in the production line, depending on the specific automation conditions. In this case, using contactless technology also guarantees reliable measurements for components that are easily deformable and difficult to gauge with other technologies.

**Dimensional measurement and inspection on assembled stators.** A more complex area is that of the dimensional measurement and inspection conducted on assembled stators, before or after twisting operations and subsequent hairpin terminal welding. In fact, when measuring angular positions or the distances between all the various hairpin terminals, a high number of checks are required, not only to verify the quality of the product but also to control its assembly process.

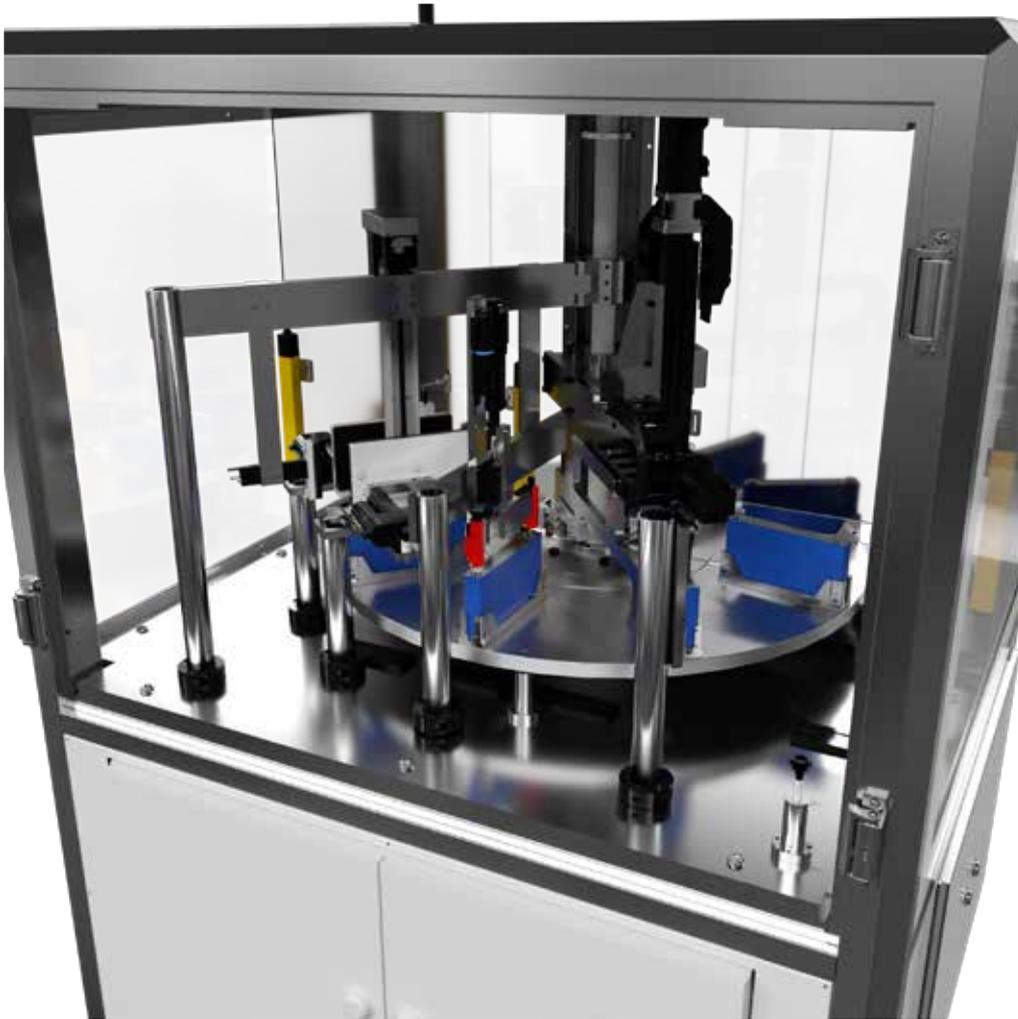
The new Optocloud product line uses laser profilometers to scan the part and then through a special calibration process to reconstruct a cloud of matching points on which all the required measurements can be performed. The 3D image of the points cloud allows to make accurate dimensional measurements and to perform a visual inspection on the geometry of the welding joints and the insulating paper.

**E-motor functional and end-of-line tests.** Functional and end-of-line checks are also extremely important in the production of electric powertrain components.

The most advanced solutions based on Marposs e.d.c. technologies are proposed for the insulation tests and functional checks on completely assembled stators, rotors, and electric motors. These are ideal for testing electric motors for the automotive sector, where the highest quality standards are required and the motors are submitted to severe operating conditions



Application for leak test on battery cells with electrolyte tracing



Machine for electrical testing on prismatic battery cells.

created by an inverter-based power supply. In addition to the standard insulation tests (Surge, Hi-Pot), partial discharge tests that can detect any latent defects are also available. In this case, the tests are performed using the capacitive coupling technique that makes them particularly immune to electromagnetic disturbances and are therefore ideal for use in both laboratory environments and production lines.

Marposs' portfolio is completed by End-Of-Line testing machines for complete electric motors and inverters either for use in laboratories or production lines.

**Testing of the core of electric vehicles: the batteries.** Leak testing is crucial for all electric powertrain components and fundamental for batteries, as their operating performance and safety standard certification require a perfect seal guarantee.

MG SpA, a company of Marposs Group that has always supplied applications for leak testing of ICE components, has now become the Group's

Competence Centre for the test on batteries.

Perfect sealing involves, above all, guaranteeing that no moisture can enter and no electrolyte can leak out of the battery cells. The check must be made on 100% of production and therefore the solutions offered are all highly sensitive, accurate and extremely fast. In this field, Marposs' solutions are fully automated and, depending on the operations, can combine conventional technologies with new testing methods. Helium testing in vacuum chamber is typically proposed for test on the open cell, while direct electrolyte tracing, allows finished cells to be checked when sealing has been completed, before or after they are activated.

**Assembled battery pack or pack component seal checks.** Just as important are the tests carried out to ensure that all the battery pack components (tray, cover, cooling circuit, etc.) or the completely assembled pack are correctly sealed. In this case, the tests are usually characterised by higher reject thresholds, but the operation is equally



Optoflash, an optical measurement system for shafts.

complex due to the high components volume and the low-testing pressure requirements. Different technologies can be implemented depending on the testing specifications, from air testing methods to helium sniffing or in accumulation chamber. Marposs' long-term application experience ensures the customer can always choose the best technology for each specific test.

The supply of applications dedicated to the verification of the main electrical parameters and functional characteristics integrates and completes Marposs' proposal for battery testing.

The transversal skills developed in different technologies allow Marposs to integrate into the same machine all the tests required for the quality control of the battery cells at the end of the manufacturing line; dimensional measurements, visual inspections, electrical insulation tests, leak tests and finally measurements of the main electrical parameters of the cell such as OCV, ACIR, etc.

Machines for in-line electrical insulation tests, or for End-of-Line functional testing, complete the proposal for the assembly lines of modules and packs.

**Hydrogen: a new challenge for future mobility.** While BEV vehicles are today a reality to face, other technologies appear on the landscape of sustainable mobility. Although Fuel Cells vehicles currently represent a marginal percentage of the market, they could be able to gain significant space in some application areas in the future.

Taking advantage of the synergies with other industrial sectors related to hydrogen, Marposs has therefore chosen to invest in technologies dedicated to quality and process control in this field. HeTech, a company of the Group specialized in leak testing applications with helium in vacuum chamber, has been identified as Competence Center for hydrogen technologies.

Starting from the long-term experience in leak testing of fuel cells components, new solutions have been developed for their complete functional check.

These range from measuring the electrical resistance of the interface between GDL and BPP in powered-up assembly conditions, to activation machines and tests on completely assembled stacks.

Marposs' mission is to continue to be a strong reference for its partners in the automotive world. Its commitment to the growth of numerous Competence Centers and its continuous research and development in the electromobility sector reflect that. In this major transition of the automotive market from ICE to E-Mobility, Marposs Group is ready to play a key role by providing a global answer to customer requirements throughout the quality control, testing and process monitoring field.

Technology | **TRUMPF**

# Laser, A Crucial Tool for Battery Makers

TRUMPF produces laser solutions for the complete battery production process chain. Efficient production, from battery cells to battery packs.

**T**RUMPF, a high-tech business, is presenting laser applications for the entire lithium-ion battery production process chain. "We cover the entire spectrum, from the manufacture of electrodes to the connecting of cells into larger units to the finished battery pack," emphasized Mr. Sachin Gambhire, Associate Director at TRUMPF India. The high-tech company has a lot of expertise in laser applications.

## **E-mobility picks up speed – and laser technology benefits from this**

The shift toward electromobility is advantageous to TRUMPF. The high-tech business sold more than 1,000 lasers for making batteries in the most recent fiscal year alone. "Globally, e-mobility is currently booming. E-mobility is getting a boost from the political and economic environment. India is developing plants for multi-gigawatt batteries. For their manufacturing, each of these firms needs lasers," Mr. Gambhire added.

Today, high-power lasers, or lasers with at least 3 kW of power, are used for the majority of applications. Manufacturers frequently utilize lasers with increased power to boost production.

## **Production of battery cells is boosted by a disk laser welding technique.**

Busbar welding, which involves touching individual battery cells, is one of the many laser applications used in the manufacture of batteries. For this, TRUMPF provides a system made up of processing optics, process sensors, and six and more kW TruDisk disk lasers, along with the necessary software and control system, software for checking the welding depth, and process sensors. The combination of these parts and thorough application expertise speeds up battery cell production and lowers scrap.

## **TRUMPF is a specialist in can-cap welding**

Another use is "can-cap welding," which is the process of media-tightly sealing the cover (cap) with the battery housing (can). Aluminum housings with electrode packs are sealed to the cap by TRUMPF lasers without any pores or cracks. Here, high quality is very crucial. Risky battery problems could result from even the slightest cracks. The BrightLine Weld technology from TRUMPF guarantees minimal welding scatter and maximum process stability. A two-in-one laser light wire with an inner and an outer fiber core functions as the system's brain.

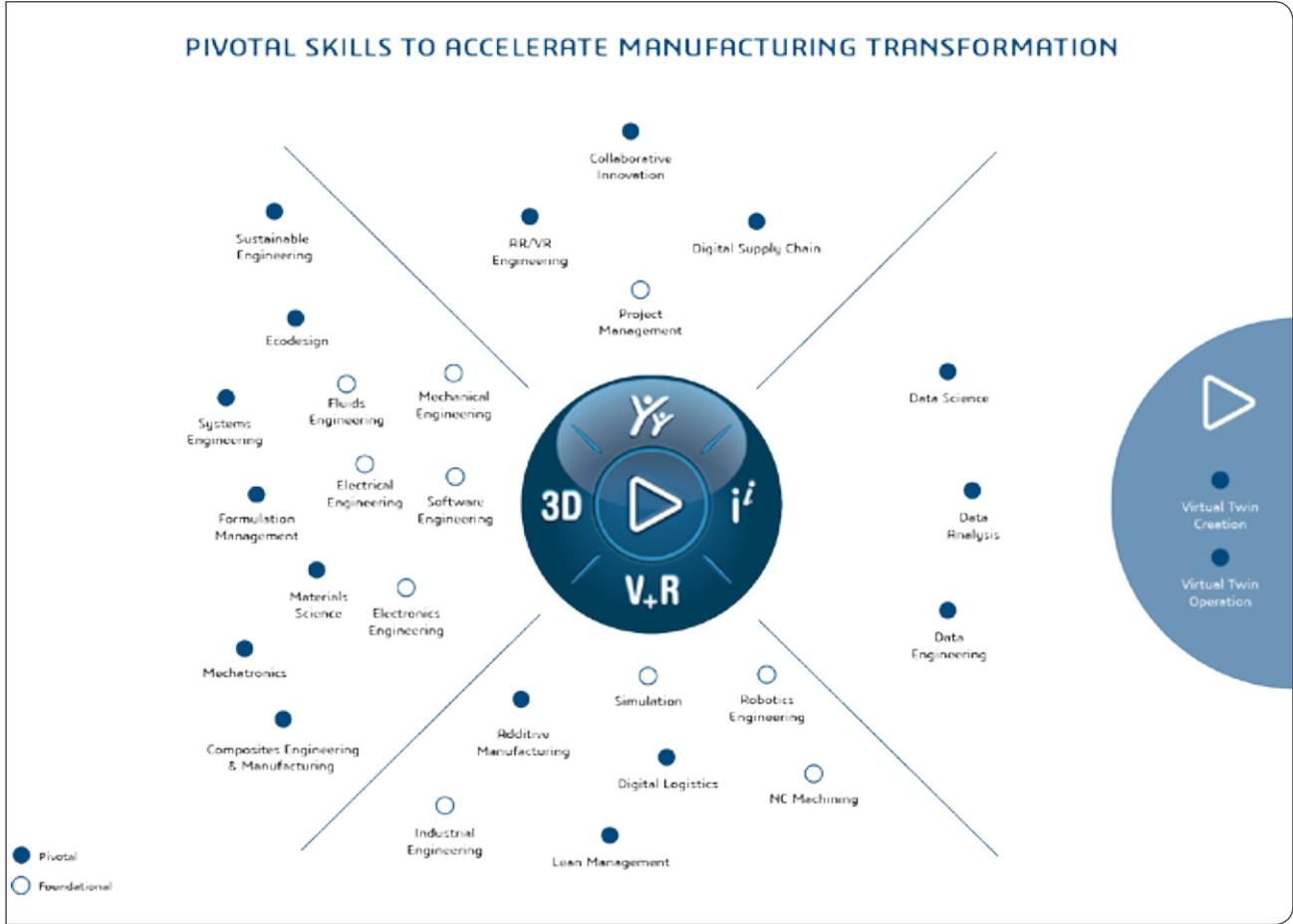
## **Gas-tight welding of aluminum heat exchangers is possible with lasers**

Heat exchangers for battery packs require very difficult gas-tight welding. Special aluminum alloys are used to create heat exchangers. They have typically been made by their manufacturers utilizing soldering techniques up to now. In the medium term, laser technology will take the place of soldering. But in order to accomplish so, it must weld incredibly quickly, multi-focus optics created by TRUMPF allow for welding speeds of more than 15 meters per minute.

Making battery packs requires a laser, which is absolutely necessary. There are many uses for it. TRUMPF is an expert in all of these fields.



Industry News | Dassault Systèmes



# Manufacturing Skills. Revealed.

Key Skills for Sustainable Innovation in Manufacturing Unveiled in Study from Dassault Systèmes

France — September 29, 2022: Dassault Systèmes revealed key skills to accelerate the manufacturing sector’s transformation to create sustainable experiences. Design for sustainability, mechatronics, additive manufacturing, data science and model-based systems engineering are among the core and emerging areas presenting opportunities for industry and academia to prepare the workforce of the future for new and evolving jobs in the sector.

The findings came from an analysis of social media activity that was commissioned by Dassault Systèmes’ 3DEXPERIENCE Edu. The aim was to provide insights on how manufacturing skills are discussed, and to empower its ecosystem to reduce the skills gap in a sector that accounts for 41% of global GDP and whose transformation presents a major opportunity for minimizing

impacts on the environment and creating more sustainable systems. For 40 years, Dassault Systèmes has been the catalyst and enabler of unparalleled industrial innovation, connecting and strengthening the efforts of industry and academia to collaboratively nurture the continuous learning environments needed to deliver innovations that improve quality of life for consumers, citizens and patients.

Findings from the analysis of discussions about the manufacturing sector include:

- Design for sustainability is becoming part of the everyday day conversation from consumers to companies, with academic institutions trying to become leaders in this space by featuring short programs and informational lectures.

- Mechatronics has the most active community on social media with more emotion and engagement than all other skills combined, revealing how technical topics can be highlighted primarily through videos or other engaging formats to attract a younger audience.
- Additive Manufacturing accounted for 55,100 discussions with more than 278,000 engagements in English, dominated by companies and universities around academic publications, new innovative usage methods, ongoing projects and promotional corporate material.
- Data science is primarily discussed at a high level focused on industry certifications or open positions offered for data scientists. Few universities and companies talk about this skill on social media, although it is critical for their future business.
- Few actors or communities are engaging on the topic of Model-based System Engineering, revealing opportunities to increase conversations and awareness of such a critical discipline for the future of many industries.

“We launched this study to get a glimpse into the discussions trending on social media across a diverse horizon of stakeholders: students, teachers, businesses, experts and others. With this insight, we can federate our ecosystem to help prepare students and the workforce to work efficiently, collaboratively and productively to solve major sustainability challenges,” said Florence Verzelen, Executive Vice President, Industry, Marketing & Sustainability, Dassault Systèmes.

In addition to this analysis, Dassault Systèmes

is taking action to develop the skills required to transform the development of products into the development of sustainable experiences within its ecosystem of schools, training organizations and customers through multiple channels such as a series of e-books on skills and an online academic community where experts share best practices.

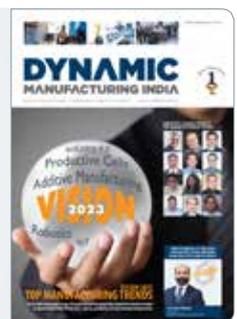
These channels also include the 3DEXPERIENCE Edu Centers of Excellence global program, which accelerates experiential lifelong learning by providing businesses and governments with a network of centers to develop the 3DEXPERIENCE platform expertise needed for the digital transformation of industry. The program now counts 11 members, most recently: Instituto Maua de Tecnologia, a private non-profit technical university in Brazil; L’Industreet, a technical college in France to provide young people who have left school with training in the field of industry of the future; ZHAW, a university of applied sciences in Switzerland; and Trier University of Applied Sciences, in Germany.

“We offer our learners multiple opportunities to consider the broad context of engineering. Central in such a context is the imperative of design for sustainability,” said Michael Hoffmann, Director of the Laboratory for product development & manufacturing, Trier University of Applied Sciences. “Minimizing material and energy consumption, enabling the use of biomaterials and optimizing the lifecycle with a virtual twin are some of the methods we promote and the 3DEXPERIENCE provides countless opportunities to develop the competencies required, for our students and our industry partners as well.”

Design for sustainability, mechatronics, additive manufacturing, data science and model-based systems engineering are core or emerging areas of opportunity for accelerating the manufacturing sector’s transformation. The insights were revealed in a one-year analysis of social media discussions on manufacturing skills and disciplines, commissioned by Dassault Systèmes’ 3DEXPERIENCE Edu and conducted by Bloom. Dassault Systèmes, with 40 years of industrial expertise, federates its ecosystem to prepare the workforce of the future for new and evolving jobs.



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# Into the Electrical Future

Nearly all German and many Asian automobile manufacturers and suppliers rely on GROB's competence and forward-looking technology in e-mobility.

**A**fter more than six years of research and development work in the field of electric mobility, GROB-Werke has firmly established itself as an extremely competitive player in the global market for alternative drive systems. Against the background of its decades of experience in the manufacture of highly efficient production and assembly systems, GROB has been investing heavily in the field of electric mobility for more than six years. With its large number of new developments, GROB is in an excellent position to cope with the constant technological changes in alternative drive systems and to meet the requirements of the automotive industry and its suppliers. Nearly all major automobile manufacturers in Germany, as well as the American automobile manufacturers rely on electric mobility by GROB.

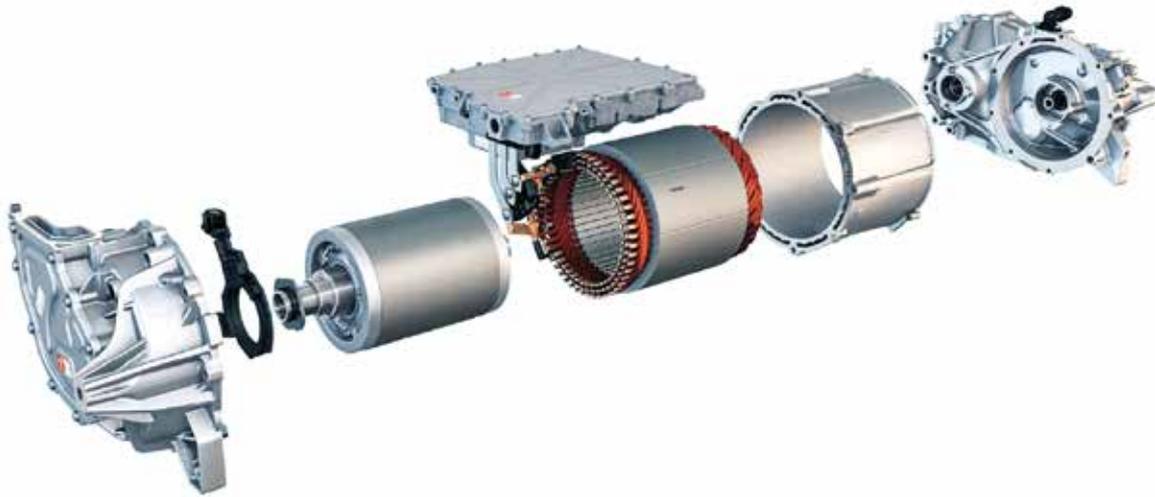
GROB e-mobility is also used in the automotive supply industry.

## **Automotive industry's growing needs**

Plant concepts for the reliable and cost-effective series production of new drive variants are in demand to meet the increasing demand in the coming years. Based on its strength and experience in the manufacture of highly productive production and assembly systems for series-ready production, GROB is meeting this challenge. As a general contractor, machinery, automation and bought-in components for electromobility and the necessary management expertise are offered.

## **A strong market response**

The GROB product portfolio ranges from



complex assembly systems for stators, rotors, and electrical machines to the assembly of the complete electrical axis. The range also includes battery module assembly, the construction of a laboratory system for battery cells, and the further development of assembly systems for fuel cells. Particular focus is placed on in-house prototype production of an electric motor with hairpin technology, continuous hairpin, or insertion technology.

#### **GROB expertise - from initial idea to series production**

The highly flexible and servo-controlled machines are used for mass production of the stator and rotor electric motor components. In stator production, in particular, there are various manufacturing techniques for guiding the copper wires into the slots of the stator. The GROB machine portfolio covers the entire production process for an electric motor, from various winding and shaping processes for the wires to assembly, to contacting. One of the core processes in the production of an electric motor is the process of guiding the copper wires into the stator. GROB covers all known processes here, including wave winding technology, the hairpin process and fan-coil technology. GROB Italy S.r.l. also covers the winding/inserting technology as well as the needle winding. This means that GROB can market and operate all the production processes required in the automotive industry.

GROB is the market leader in hairpin technology and has been able to win almost all major orders from the international automotive industry within the last three years. With its highly flexible and NC-controlled components and machines, GROB has the ideal technology to fully automat-

ically manufacture almost any drive for the vehicles of the future. With increasing system and machine standardization and modularization, nothing will stand in the way of high unit and type flexibility in the future.

#### **Pioneer in battery module assembly**

With growing requirements for automotive powertrains, the reliable assembly of battery systems as well as the efficient production of battery cells have also become increasingly important. In the development and manufacture of highly automated production systems for the production of energy storage devices, GROB benefits from its many years of experience in assembly technology. The high demands on quality and safety intensify the technically demanding basic conditions of the production steps that had to be undertaken by GROB during the past months. The fact that GROB has successfully mastered these challenges is proven by the extremely good market response with currently more orders for battery module assembly. Besides battery module assembly, GROB is currently developing innovative solutions for the battery cell assembly of lithium-ion cells. A dedicated application laboratory was created especially for the process development of new and scalable manufacturing methods.

#### **Outlook - fuel cell assembly**

Fuel cell technology represents a further promising technology within electromobility. For the assembly of automotive fuel cell drive components, innovative and scalable production and assembly lines are required that guarantee high flexibility, precision and reliability. On the basis of its variant-rich



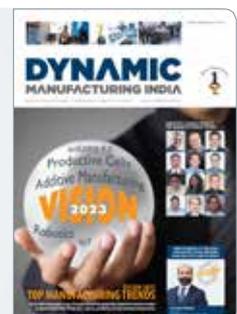
product portfolio, GROB develops suitable solutions with high-quality equipment for customers in different development phases of the electrification of their vehicles. We support our customers throughout the entire project, from the initial idea to system design for prototypes and large-scale production. Our comprehensive range of services includes planning, engineering, execution, commissioning and turnkey handover.

**Identifying and exploiting opportunities at an early stage**

The importance of electromobility is growing. However, their manifestations, unit numbers and markets, cannot be accurately predicted at present. As in the past, the mechanical engineering sector will continue to be very strongly influenced by developments in the automotive industry. Consistently, GROB-WERKE will also continue to be very innovative and convince the market of its technological know-how with ever new products. As a company, we are facing up to the demands of new drive technology, lightweight construction, but also digitalization.



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Service Showcase | **IPC**

# Upholding Standards

## Electronic Industry Standards for the Automotive Market

IPC, The Global not for profit Trade Association established in 1957 at USA representing all facets of the electronics manufacturing industry in 70+ countries, including India. IPC India Regional Office help organizations to achieve high-quality end product in the manufacturing process and builds capability in export market & supply chain. Member representations are from SMEs, large, Global & Government organizations. We provide industry standards, certification, skill training, global market report and create networking platform for connecting local & global companies. IPC members comprising OEMs, EMS, PCB manufacturers, cable and wire harness manufacturers, advanced packaging companies, and Electronics industry suppliers serves Automotive Industries.

IPC has been delivering standards for the electronics industry for over 65 years. Through market research we know that electronics systems will ac-

count for over 50% of cars cost by 2030 (Freescale/NXP). We all know that various electronic systems within a vehicle have become more complicated and critical to the safe operation of a vehicle. To ensure electronics systems are meeting the high-reliability requirements demanded by the automotive industry, IPC is working with the electronics industry to deliver the quality standards required to meet these stringent automotive requirements.

Global and Indian Automotive companies are associated with IPC's "automotive solution" mission. To ensure electronics systems are meeting the high-reliability requirements demanded by the automotive industry, IPC is coordinating with the electronics industry to deliver the quality standards required to meet these stringent automotive requirements. Currently IPC is working on EV sector focusing on e-Mobility Quality, Reliability and Safety.

IPC's e-Mobility Quality and Reliability Advisory Group (EVQR) represents a cross-section of the automotive electronics supply chain, collaborating to identify solutions and best practices to assure design, materials, process optimization, and qualifications to achieve reliable and quality-built products while protecting innovation.

The EVQR can be your resource for solutions in advancing the automotive and e-Mobility quality, reliability, and safety. You can become part of the solution impacting the success of the industry and helping industry keep up with the pace of change.

### How can you help?

1. Bring your automotive expertise to standards development
2. Share automotive needs with current and anticipated issues
3. Contribute to standards gap analysis (across standards development organizations)
4. Collaborate with IPC on automotive and electronics industry conversations



Industry News | HONEYWELL

# Power Alliance

Honeywell, Hindustan Aeronautics Limited to jointly manufacture high-power turbogenerators. High-power, high-voltage generators will have applications in hybrid-electric and unmanned aircraft, as well as urban air mobility vehicles.

**B**engaluru, September 27, 2022: Honeywell has signed a memorandum of understanding (MoU) with Hindustan Aeronautics Limited (HAL) – India’s premier aeronautics company and a Navaratna defense public sector undertaking, to jointly manufacture high-power, high-voltage turbogenerators.

Honeywell will provide its 1-megawatt electric machine, to be utilized as a generator, that will enable a turbogenerator which can power hybrid-electric aircraft, including traditional airframes, unmanned aircraft and urban air mobility vehicles. This generator, which can also efficiently run as a 1-megawatt motor, can be seamlessly integrated with new and existing gas turbine engines to create highly power-dense turbogenerators.

Speaking on the announcement, Rajesh Rege, president, Honeywell India, said, “In continuance with our commitment to deliver world-class, industry-leading technologies to India, we are delighted to partner with HAL once again. This MoU builds on a four-decade-long partnership with the country’s aeronautics leader and is an affirmation of our Make in India vision.”

R. Madhavan, former chairman and managing director, HAL, said, “This MoU is intended to allow both parties to jointly develop a business plan which outlines the market potential, investment, returns and partnership model. Once the business plan’s viability is established, we will enter into contract arrangements. Going ahead, we hope to work with Honeywell to develop a number of new, India-specific applications.”

Traditionally, aircraft use fuel-burning engines to mechanically turn rotors, propellers or fans. Many new designs, however, use a distributed electric propulsion architecture, in which many electric motors can be tilted or turned off for vertical takeoff and horizontal flight. A Honeywell turbogenerator can provide electric power for multiple electric motors anywhere on an aircraft.

The Honeywell turbogenerator is capable of running on aviation biofuel, including green jet fuel as well as conventional jet fuel and diesel. It can be used to operate high-power electric motors, charge batteries and can satisfy missions from heavy-lift cargo drones to air taxis, or commuter aircraft.

The MoU was exchanged between Eric Walters, senior director OE Sales, Honeywell Defense & Space, and B. Krishna Kumar, executive director (E & IMGT), HAL, in the presence of R Madhavan and M.K. Mishra, CEO (BC), HAL.





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Primer | **Computational Fluid Dynamics**

# Computational Fluid Dynamics for Safer EVs

Can CFD simulation of thermal runaway help address the electric vehicle battery flaming issue?



Article written by Dr. Karthik Sundarraj,  
Technology Advisor (To MD) – Special Projects Technical &  
Business Development – Electronics, Life Sciences & CFD, Hexagon

As India works to fulfil its pledge to reduce its carbon footprints and introduce sustainable ground transportation, to reach net-zero by the year 2050; with the launch of electric vehicles (EV) in India, the automotive sector was boasting of it as a new revolution which will change the future. However, several incidents of EV fires in recent months has led to considerable fear and unrest, forcing the government to set up a panel to address the issue.

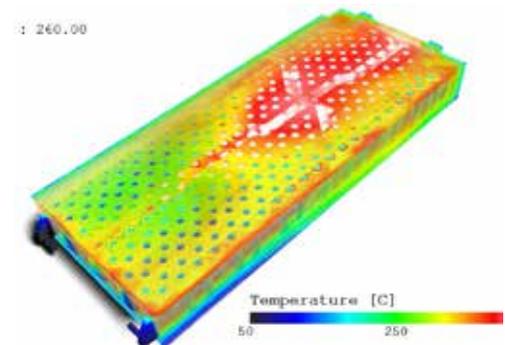
A new question has been arising on how safe are the EVs in India and how can EV fire be prevented.

Signs of lithium-ion battery about to catch fire may be experienced by the EV owners and

requires regular monitoring. If the battery is getting extremely hot, or swells up, chances are high it may catch fire. Also, discolouring, causing damage, blistering and beginning of smoke emission can also result in fire incidences.

In order to eliminate battery fires, it is important to understand the concept of thermal runaway, which is the leading cause of battery fires.

## What is Thermal Runaway?

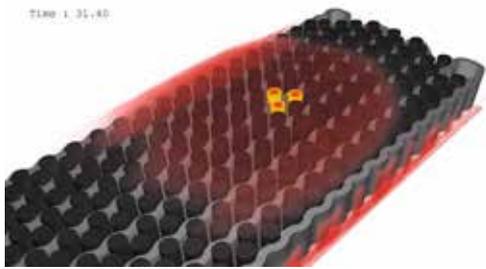


### 1. CFD Simulation of a Thermal Runaway in a battery

Thermal runaway in a battery is the result of a chain reaction of one exothermic process which triggers other processes resulting in an unstoppable reaction. When the temperature inside the battery reaches a point, an electrochemical reaction occurs that leads to an uncontrollable increase in temperature. In simple terms, if the temperature reaches the critical point, the battery begins to release energy which accelerates further the increase of temperature.

During thermal runaway, temperatures in the battery increase within milliseconds. The energy stored in that battery is suddenly released, producing a very high temperature of around 400 degrees Celsius. These temperatures can cause

the battery to release gas and catch fire that is nearly impossible to extinguish. In some batteries (for example, lithium-ion batteries), thermal runaway causes the battery to explode, making prevention of such failures critical.



**2. Gas Release Simulation during Thermal Runaway**

Thermal Runaway usually happens during charging batteries, particularly in high-rate applications such as Hybrid Electric Vehicles (HEV). Understanding the cause and elimination of such failure mode is of great interest as it is one of the most common failure modes. The ascent of plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs) as viable modes of transportation has coincided with the advancement of lithium-ion battery technology and electronics, that have enabled the storage and use of large amounts of energy previously only possible with internal combustion engines.

However, addressing the safety aspects of using these large energy storage battery packs is a significant challenge. Even though every effort is made to avoid thermal runaway situations, unexpected events such as the recent incidents of electric vehicle explosions can occur.

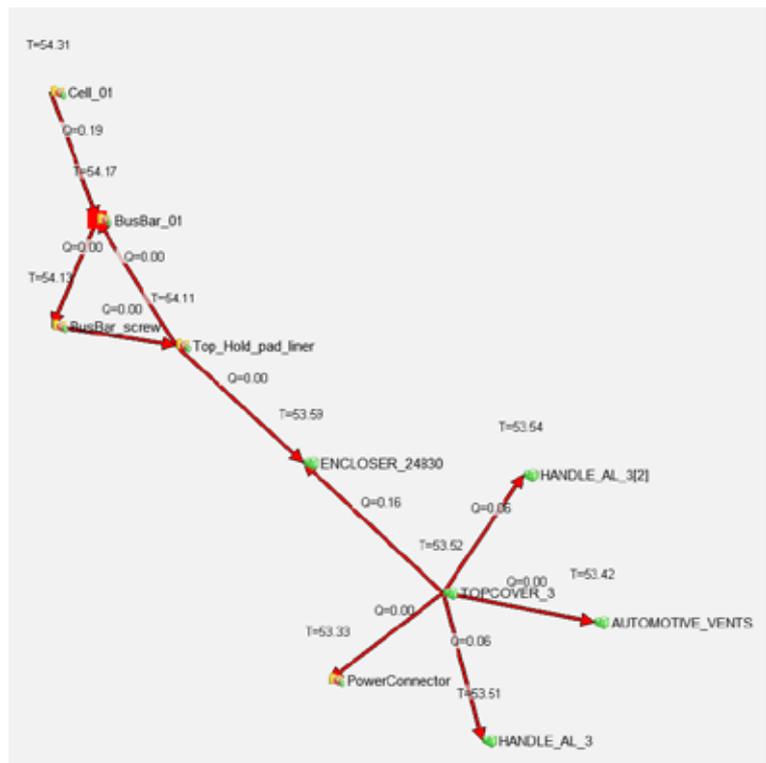
Battery Thermal Management Systems are required for overall vehicle efficiency and life cycle, as well as passenger and vehicle safety because elevated operating temperatures harm the efficiency, life cycle, and safety of Li-ion battery packs. Many studies recommend an operating temperature of around 25°C for improved performance and a longer life cycle of Li-ion batteries. In the worst-case scenario, high operating temperatures can cause thermal runaway in the battery, resulting in massive heat generation and even an explosion.

**Design and Testing with CFD to address thermal runaway**

As a result of these factors, the industry's focus has shifted to the thermal management of large battery modules. The use of Computational Fluid Dynamics in testing such battery modules has always been more effective rather than the 'build and test process. Various CFD

tools such as Cradle CFD can be best used to simulate various thermal upset conditions and assess the performance of the thermal management in avoiding thermal runaway. Battery thermal management is used to regulate the temperature of the battery pack to avoid all these dangerous events.

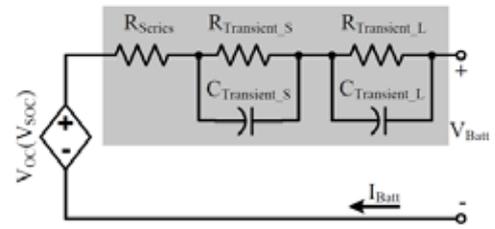
The battery pack's design and application integration are crucial in preventing cell failure propagation. For example, an adequate design of the battery pack and the electric-powered vehicle for protection against battery deformation in the event of a crash is extremely crucial, as a mechanically damaged battery can end up causing both external and internal short circuits of the battery cells. CFD software can perform simulations of general heat generation and cooling of Li-ion batteries during normal cycling (battery charge/discharge) within the battery specifications. Furthermore, external heating in an oven, external heating by a cell heating element, short-circuiting, overcharging, and mechanical deformation/crash/nail penetration can be used to effectively simulate Li-ion cells and battery packs with multiple cells. The advanced CFD tools possess features that enable 1D post-processing and network representation which gives a pragmatic view of such battery phenomena. Such results are easily quantifiable.



**3. Thermal Network**

Researchers have created a dual-purpose cooling plate for prismatic lithium-ion batteries (LIBs) to improve battery pack life and safety for use in vehicles, aircraft, and stationary electric storage systems for grid and renewables. The cooling plate can effectively control and dissipate the generated heat during thermal runaway to prevent heat propagation from one cell to the adjacent cells in the battery pack, thereby increasing battery life, and can effectively control and dissipate the generated heat during thermal runaway to prevent heat propagation from one cell to the adjacent cells in the battery pack, thereby increasing safety. During normal operation, this cooling plate can keep the battery temperature below 25 °C whereas, during thermal runaway, this cooling plate can keep the battery at 75 °C for 30 seconds. Also, during normal operation, the coolant pressure drop in the cooling plate is 75 Pa whereas, during thermal runaway, the coolant pressure drop in the cooling plate is 54 kPa. CFD simulations performed to test such cooling plates can be very effective to avoid repetitive design changes in the prototype.

An RC Equivalent Circuit Model feature enables the representation of the behavior of the sub-cell domain in terms of non-instantaneous response. A battery is modeled with an equivalent circuit consisting of capacitors and resistors, to fit the decay curve for voltage with exponential functions, when there is a non-instantaneous voltage response against electric current. In this model, each resistance and capacitance is defined as a function of the State of Charge. This enables the representation of voltage with SOC.



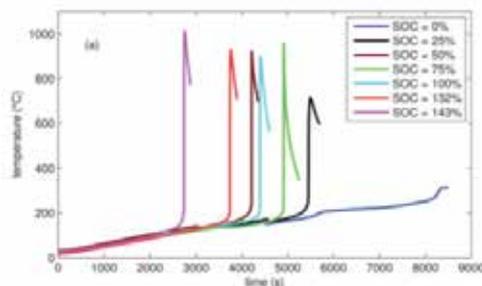
**5. Equivalent RC Circuit**

As such, numerical simulations have also shown that cooling systems such as heat pipe cooling systems though cannot remove thermal runaway in a single battery but can prevent the propagation of thermal runaway to the other batteries. The thermal environment that balances cell internal heat release and decomposition kinetics is predicted by the simulation tool. It allows for the exploration of some parameter space and identifies heat-dissipation strategy sensitivities, insulation, ventilation, and so on.

CFD simulations have also been performed on developing a coupled electro-thermal runaway model which was implemented using finite element methods based on the electrochemical and thermal models. Furthermore, by varying the spacing of adjacent cells, the solder joint area, and the cross-sectional area of the electrode tab, the characteristics of different modes of heat transfer of each cell during thermal runaway propagation of the battery module in an open environment can be studied. With the increase of cell spacing, the heat transfer capacity of the three heat transfer modes decreases for all cells.

CFD has demonstrated the successful simulation of thermal runaway which can be avoided by using heat sinks that limit the temperature rise in turn protecting the transistor. Based on the results of the heat transfer path, heat radiation effect, and the bottleneck, CFD simulations can effectively proceed with the thermal design. Also, the simulations of Heat Sinks and Fins have been demonstrated by the software which gives a visual understanding of ways to avoid such phenomena Proper Storage Temperature, Proper Ventilation, and prevention of overcharging can help avoid thermal runaway at its early stage.

Thermal runaway in batteries is a major financial risk as well as a barrier to consumer acceptance, which has become a major issue in the emerging Electric Vehicles Industry. Cradle CFD offers the best simulation platform to avoid such issues as well as reduce the computation cost and time for testing.



**4. Graph of temperature vs time during thermal runaway**



## MeshMix Media presents



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Machine Insider is a dedicated portal designed to keep the manufacturing sector in full gear. The portal will carry elements that will announce innovation, stimulate change and help the sector move forward.

The portal will reflect upon the constant developments, issues, challenges and solutions experienced by the industry, better than anyone.

To the purists, the portal will offer detailed stories on machines, technology and products worthy of your valuable time. Machine Insider aspires to be the voice of the manufacturing industry.

Advertising in our portal Machine Insider will be an effective tool to reach out to the target audience.

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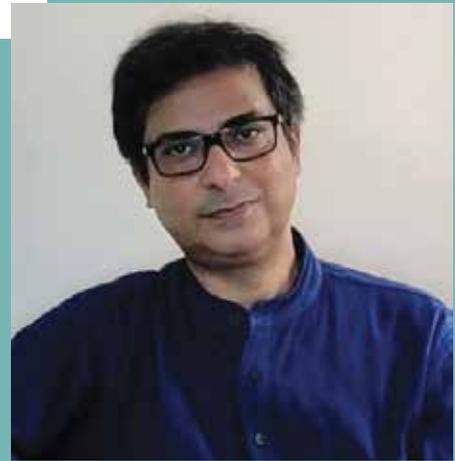
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**DYNAMIC  
MANUFACTURING INDIA**

Volume 6–Issue 4 July/August 2022

**IMPRINT**

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Place of Publication:  
Meshmix Media Private Limited  
# 63, Ruia Park, J. R. Mhatre Road,  
Juhu, Vile Parle West, Mumbai, Maharashtra – 400049, India

Editorial Office:  
Meshmix Media Private Limited  
# 1403, C-wing, Olivia, Neelkanth Woods Bldg,  
The Verraton, Tikuji Ni Wadi Road, Manpada Thane West - 400610  
E: accounts@meshmixmedia.com  
CIN No: U74999MH2016PTC287532

Volume 6–Issue 4 Printed by Meshmix Media Private Limited, India

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**Published and Printed by Preeti Mishra on behalf of MeshMix Media Private Limited Printed at Anitha Art Printers, Place: 29/30, Oasis Industrial Estate, Opp Vakola Masjid, Next to Vakola Market, Santacruz (E), Mumbai, Maharashtra- 400 055, India and Published from 63, Ruia Park, J. R. Mhatre Road, Juhu, Vile Parle West, Mumbai, Maharashtra – 400049, India**

**Editor: Aanand Pandey**

Publishing frequency: 6 times per year



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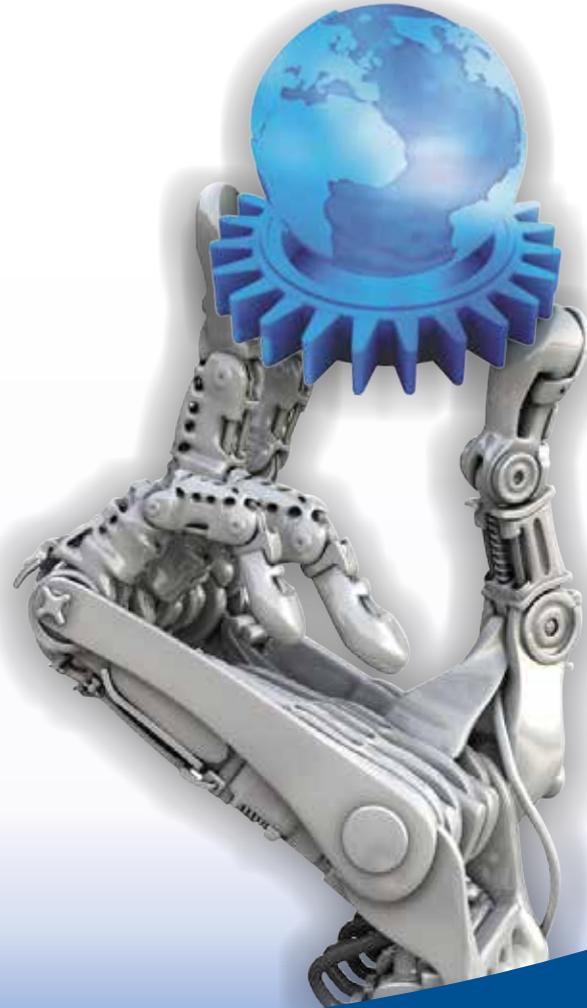
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