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MACHINE EDGE GLOBAL

Navigating the Cutting Edge of Industry News

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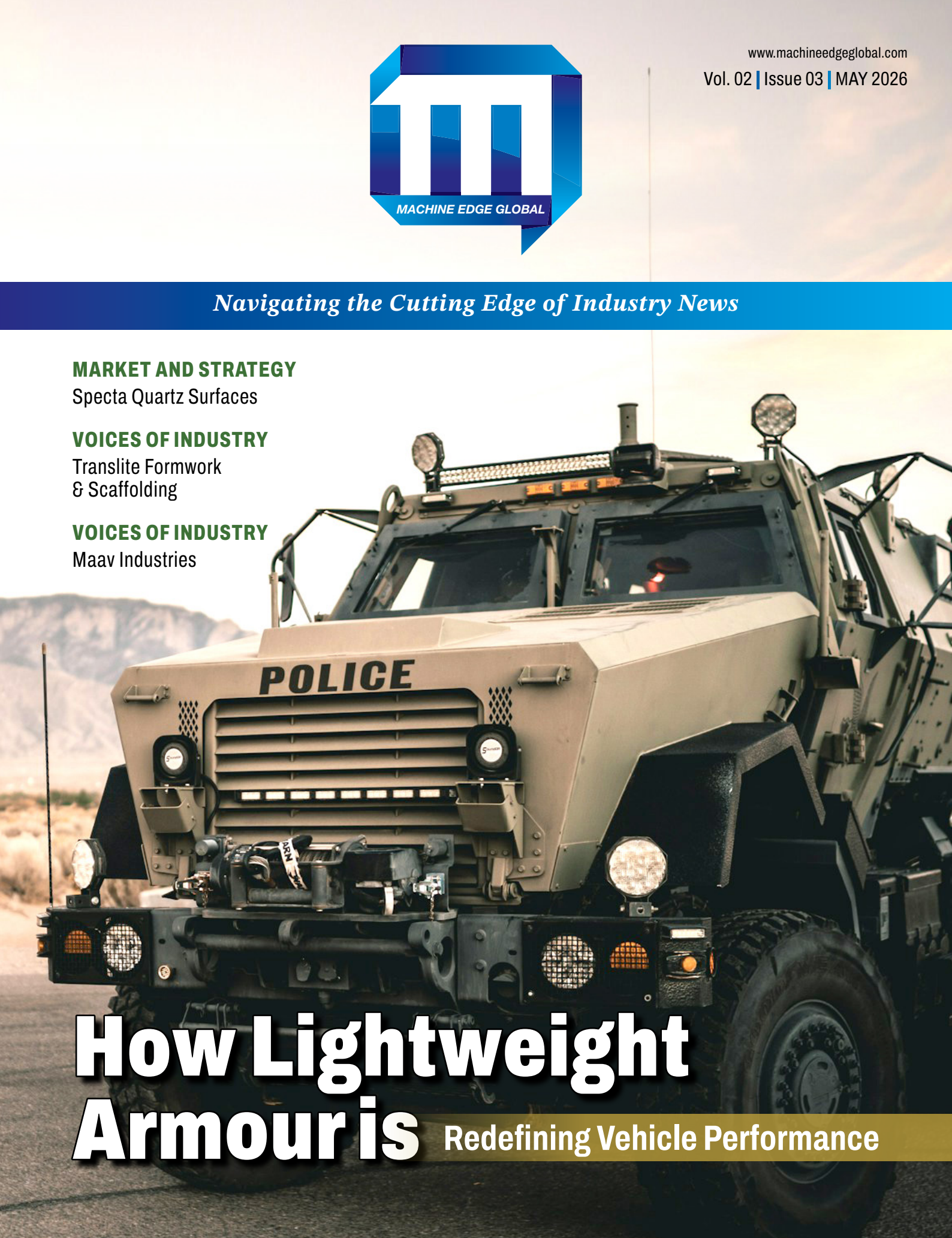

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Engineering the Future with Smarter Manufacturing

Industrial progress today is no longer defined by scale alone, but by how effectively industries balance performance, efficiency, sustainability, and innovation. This edition of Machine Edge Global highlights the evolving nature of manufacturing through stories that showcase how industries are adapting to changing technological and market realities.

Our cover story, Beyond Bulletproof: How Lightweight Armour is Redefining Vehicle Performance, explores the transformation of vehicle armoring from heavy protection systems to advanced lightweight solutions that combine safety with agility, handling, and performance. It reflects a larger industry shift toward achieving more through smarter engineering and material innovation.

This edition also features insights from Ankit Jain of Specta Quartz Surfaces on scaling manufacturing capabilities, sustainability, and strengthening India's global competitiveness in engineered quartz surfaces.

We also examine India's rapidly expanding infrastructure ecosystem, where the challenge today lies not just in ambitious planning but in ensuring world-class execution standards on the ground. Alongside this, we look at how legacy manufacturing businesses are navigating transformation while preserving the values and operational strengths that built their success over decades.

The edition further explores India's evolving mobility transition through the growing role of Bio-CNG and the emergence of recycled plastic as a viable infrastructure material, highlighting how sustainability is increasingly becoming central to industrial growth.

Across sectors, one message is clear — the future belongs to manufacturers that can innovate intelligently, scale sustainably, and adapt continuously. We hope this edition offers valuable perspectives on the trends shaping the next phase of industrial evolution.

Sanjay Jadhav

Sanjay Jadhav

Founder & Editor, editor@machineedgeglobal.com

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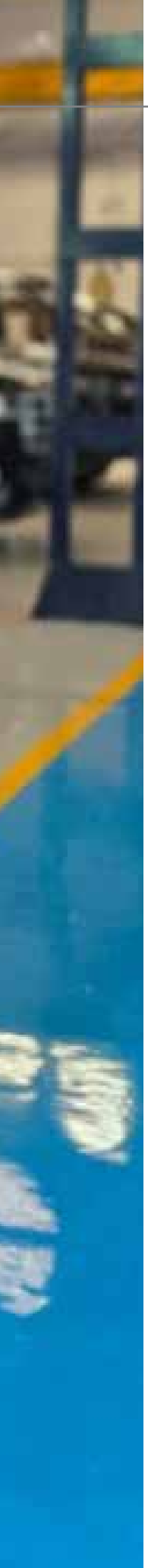
SURINDER SINGH,
Founder and CEO of
Shield Armoring Private Limited



Beyond Bulletproof: How Lightweight Armour is Redefining Vehicle Performance

Over the years, the concept of vehicle armoring has seen a major shift. Previously, the focus was just on stopping bullets; now it has evolved to balancing protection along with performance. The idea is no longer just to make a vehicle bulletproof, but to ensure it can still drive, handle, and respond like a normal car when it matters most.

In the early days, armoring relied heavily on thickness. Ballistic steel was the go-to material, and protection levels were increased simply by adding more of it. While this approach worked from a safety standpoint, it created several practical issues. Vehicles became significantly heavier than what they were originally designed for. As a result, speed dropped, acceleration felt sluggish, and braking became less reliable. Over time, the extra load also took a toll on suspension systems and drivetrain components. In many cases, the vehicle was protected but difficult to handle and expensive to maintain.

The progress in material science led to a complete revolution of the existing paradigm. Currently, the modern concept of armor development does not imply an increase in the amount of steel used, but rather focuses on the implementation of advanced materials that would ensure better performance while maintaining acceptable weight. One example of such material is aramid fiber, commonly used in applications such as Kevlar, which is one of the key components in modern armor designs.

In addition to that, there is a variety of composite armor systems and hybrid armor designs that utilize multiple materials for ballistic resistance. In particular, the use of ceramics for the fragmentation of projectiles and the deformation of their shape is combined with energy dissipation via polymers and fiber layers. Notably, all of these designs allow providing equivalent, and sometimes even higher, protection than that of conventional steel-based solutions, although the weight of these designs is significantly reduced.

New technologies are taking things even further. The use of nanotechnology is considered as a way to increase the mechanical strength of materials on the microscopic level, thus making it possible to create thinner armor plates that will not

Lightweight armor has a transformative impact on vehicle protection. This means that the whole approach to armoring vehicles is no longer based on creating big, bulky, and heavy vehicles but rather on building high-performance systems for protection and mobility.

sacrifice their effectiveness. On the other hand, practical safety measures, like self-healing fuel tanks, are added to armored combat vehicles. These technologies ensure that no leaks occur after the fuel tank has been impacted by a ballistic projectile, thereby lowering the risk of fire and maintaining the maneuverability of the vehicle.

The lightness of composite armor is another one of its advantages. In comparison with ballistic steel, composite armor can be up to five times lighter. The use of such armor has a definite effect on the overall performance of the vehicle since it makes it lighter.

Fuel efficiency also benefits significantly. Larger and heavier cars have a higher fuel consumption rate, while the smaller and lighter armored cars have an almost normal fuel consumption rate. It is more critical when traveling a large distance or in a risky area. Another advantage of light armored cars is that you don't need any adjustments to the car to provide it with armor.

When it comes to the dynamics of such cars, this factor plays an essential role during real-life driving. The acceleration of such vehicles is higher, which allows them to escape hazardous places very quickly. Maximum speed is not limited because of light weight, which can also be critical in risky situations.

Another advantage that results from the reduction in mass is improved cornering and handling stability. Armored vehicles in the past had a tendency of being very heavy and hard to control. The new lightweight vehicles, however, are more like regular OEM vehicles. This feature is essential since drivers are able to maneuver them easily without adjusting to any changes in behavior.

A similar advantage that arises from the reduction in weight relates to the mechanical systems. It becomes easier

for the suspension system, engine, and transmission systems to operate effectively without being overloaded.

The emergence of advanced technology for armored equipment has also expanded the meaning of protection. In addition to the resistance to bullets provided by modern armor, it also provides the general survivability of the armored object. It must be emphasized that contemporary armored vehicles should include multiple systems of protection that would minimize various threats. For instance, blast protection is needed in case of an explosion to protect passengers from its effects. Run-flat tire systems allow for sustained travel even when the tires become flat due to bullet penetration. Automatic fire extinguishing systems prevent potential fires resulting from any kind of attack or incident. With the use of lightweight armor coupled with these smart protection technologies, the complete protection system emerges.

Across the industry, there is a noticeable move towards these newer technologies. The emphasis is on substituting older and bulkier

technology for a more effective one while maintaining safety at the same time. The objective is to provide top-of-the-line protection while retaining the usability of the car for its daily operations.

Such an evolution is also brought about by changing customer demands. The current customers, be it corporate executives or affluent individuals, require cars that are not only efficient and comfortable but also inconspicuous, without the inherent limitations of conventional armoring.

Therefore, it is expected that future trends concerning armored vehicles will depend on research and innovation advancements. For instance, nanomaterials will become increasingly important, and their application in the field of vehicle armoring may result in better weight-strength ratios. The use of graphene as a material for armor plates is another promising innovation at an early stage of development, owing to the great resistance and lightness of this element.

Thus, new materials will reduce the difference between standard and protected vehicles, making armor systems more convenient and effective. In addition, systems such as adaptive armor will be developed in order to provide real-time protection from a variety of threats.

Hence, lightweight armor has a transformative impact on vehicle protection. This means that the whole approach to armoring vehicles is no longer based on creating big, bulky, and heavy vehicles but rather on building high-performance systems for protection and mobility.

Scaling New Heights:

Ankit Jain on Specta's ₹250 Crore Manufacturing Leap

As India's engineered quartz surfaces market enters a new phase of scale, design innovation, and global competitiveness, **Ankit Jain, Founder & CEO of Specta Quartz Surfaces,** is steering the company through a pivotal growth chapter. With the commissioning of a ₹250 crore state-of-the-art manufacturing facility and a renewed focus on technology, sustainability, and brand-led expansion, Specta is positioning itself as a future-ready player in both domestic and international markets. In this conversation with **Machine Edge Global,** Jain shares insights on scaling manufacturing capabilities, tapping emerging markets, strengthening export competitiveness, and navigating the evolving global demand for engineered quartz.

ANKIT JAIN,

FOUNDER & CEO OF SPECTA QUARTZ SURFACES

Q. Specta Quartz Surfaces has commissioned a ₹250 crore state-of-the-art plant. What strategic gap does this new facility address in your growth journey?

The commissioning of our ₹250 crore state-of-the-art manufacturing facility marks a significant milestone in Specta's growth journey. At a fundamental level, it strengthens our ability to meet the rapidly growing demand for engineered quartz surfaces in India, particularly as the category continues to see increased adoption across both Tier-1 and emerging Tier-2 markets.

As consumer preferences evolve, there is a clear shift from standard, neutral surfaces to more unique, modern, design-forward offerings. This plant is equipped with advanced technology that enables us to produce a wider range of finishes, colours, and formats with greater precision and consistency, allowing us to stay ahead of design trends and cater to a more discerning customer base. This facility will also enhance our capability to manufacture thinner, lightweight slabs. This will open up entirely new application areas beyond traditional kitchen countertops, including furniture, wall cladding, and other interior surfaces, thereby expanding the overall addressable market for quartz.

Q. With the new plant scaling production capacity to 14 million sq. ft. annually, how does manufacturing scale directly enhance export competitiveness?

The new plant will allow us to significantly strengthen our position as a globally competitive manufacturer. Scale plays a critical role in exports, not just in terms of volume, but in consistency, cost efficiency, and the ability to service large, time-sensitive orders across markets. The higher capacity of production will allow us to optimise production costs through economies of scale, making our products more price-competitive in international markets without compromising on quality. This is especially important in a category like engineered quartz, where global competition is intense and buyers are looking for both value and reliability.

Additionally, increased capacity will give us the flexibility to cater to diverse market requirements. From varied thicknesses and slab sizes to a wider design portfolio, we can customise offerings based on regional preferences while still maintaining efficient production cycles.

Q. Can you walk us through the key technological advancements in this new plant that differentiate Specta from other engineered quartz manufacturers?

Our manufacturing capabilities have been built with a clear focus on combining scale, precision, and design innovation, and the new plant is a significant step forward in that direction. Our existing facility in Bagru, Jaipur, spread across over 400,000 sq ft, already operates on advanced Bretonstone technology from Italy, which is globally regarded as the gold standard in engineered quartz manufacturing. It is powered by robotics and fully programmable systems, enabling high levels of consistency, precision, and quality control, backed by a state-of-the-art in-house laboratory.

One of the key differentiators is production efficiency. Our current high-speed line can produce close to 400 large slabs a day (10.75 ft x 6.5 ft), which is significantly higher than conventional

alternatives. This allows us to scale without compromising on quality or finish.

The new plant is building on this foundation by introducing next-generation capabilities. It is capable of producing larger slab formats (up to 72 sq ft) which help reduce visible joints in expansive applications like large kitchens and island counters. At the same time, it has the ability to manufacture thinner slabs, including 7 mm variants, which unlock entirely new use cases such as furniture, shutters, and vertical applications.

We also use UV-stabilised resins to

ensure long-lasting colour stability, even under exposure to heat and sunlight. Combined with a wider design palette and enhanced thickness flexibility, these advancements position us to deliver more versatile, high-performance surfaces that meet evolving global standards and design expectations.

Q. You have earmarked ₹20 crores for marketing investments across India and the Middle East. How critical is brand building in a segment that has traditionally been manufacturing-led?

Engineered quartz is a product category that has traditionally been driven by manufacturing and distribution, however, brand building is becoming increasingly critical in this category. There is a clear shift toward design-led differentiation and consumer awareness. As more homeowners, architects, and designers become involved in material selection, brand recall and perception play a much larger role in influencing decisions. Today, it is not enough to be a strong manufacturer; it is equally important to build a brand that stands for design innovation, quality, and trust. This is especially relevant as the category expands beyond kitchens into living spaces, bathrooms, and furniture applications, where aesthetics carry significant weight.

In markets like the Middle East, where global competition is high and buyers are highly design-conscious,

brand building becomes a key differentiator. Similarly, in India, as Tier-2 and emerging markets open up, there is a growing need to educate consumers about the advantages of engineered quartz and position it as a premium, aspirational material.

Q. The North-East and South India are focus markets for domestic expansion. What opportunities do you see in these regions that were previously underpenetrated?

Our domestic expansion strategy is firmly focused on tapping high-growth, underpenetrated markets across the North-East, Southern, and Western India, with a strong emphasis on Tier-2 cities. We believe these regions will drive the next phase of demand for premium interior surfaces, as rising aspirations translate into higher adoption of design-led materials.

The North-East has traditionally remained underpenetrated for engineered quartz, but this is now changing. Improved connectivity, rapid urbanisation, and growing exposure to global design trends are opening up the market. Cities like Siliguri are emerging as key gateways, supported by infrastructure development and increasing investments in hospitality and luxury housing. We expect the eastern region to contribute close to 5% of our overall sales in the initial phase, with strong long-term potential.

South India is already a significant contributor to our business and continues to show robust growth. Markets like Hyderabad are witnessing accelerated residential and commercial development, driven by a thriving IT ecosystem and rising disposable incomes. The region currently contributes around 18–20% to our overall presence and is expected to grow to nearly 25% in the coming years, with Telangana alone projected to contribute 8–10% of revenues in the near term.

In Western India, cities like Ahmedabad are emerging as important growth centres. With increasing investments in infrastructure, a strong community of architects and designers, and a rise in luxury real estate developments, the demand for premium interior surfaces is steadily growing. Collectively, these regions reflect a powerful convergence of infrastructure growth, design awareness, and evolving lifestyle aspirations, making them central to our expansion strategy.

Q. Sustainability is becoming central to global construction materials. What steps is Specta taking toward greener manufacturing practices?

Sustainability is a core pillar of our long-term vision, and we are consciously building our manufacturing ecosystem to minimise environmental impact while delivering high-performance surfaces. One of the fundamental shifts we are enabling is moving consumers toward engineered quartz, which is inherently more sustainable compared to natural stone. The extraction and processing of natural stone can be resource-intensive, whereas engineered quartz allows for more efficient use of raw materials, controlled production processes, and reduced wastage.

At a manufacturing level, we have implemented several measures to ensure environmentally responsible operations. Our facility operates as a zero-discharge plant. We also utilise biodegradable PVA films and have processes in place to recycle calibration waste, significantly reducing landfill impact. These initiatives reflect our commitment not just to eco-sensitivity, but also to maintaining high standards of employee health and workplace safety.

In addition, we are increasingly incorporating recycled materials into our production processes and continuously working toward optimising resource efficiency across the value chain. We have acquired globally recognised certifications such as LEED, GreenPro, GreenGuard, and ISO 14001, which underscore our adherence to sustainable sourcing, responsible manufacturing, and health-conscious product design. We view sustainability not just as a compliance requirement, but as a responsibility. Our focus is on building a future-ready manufacturing model that aligns with global environmental standards while meeting the evolving expectations of conscious consumers.

Q. Looking ahead to 2026 and beyond, what structural shifts do you foresee in the global engineered quartz market?

India is poised to occupy a crucial spot in the global engineered quartz market, evolving from being a cost efficient supplier to a design-led manufacturing hub. At the same time, the long-term sustainability challenges associated with the mining of natural stone are becoming increasingly evident. This is accelerating the global shift toward engineered quartz as a more viable and responsible alternative. Within India, this transition is clearly visible. The acceptability of engineered quartz is rising steadily, not just in metro cities but also across Tier-2 markets.

From an export perspective, while markets like the United States have traditionally been key demand centres for Indian quartz, evolving geopolitical dynamics and market vulnerabilities are encouraging diversification. Indian manufacturers are now looking at expanding their footprint across newer international markets, while also strengthening domestic demand.

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GLOBAL Benchmarks, LOCAL Execution:

Closing the Gap in India's Construction Standards

India is witnessing one of the largest infrastructure expansion phases in its history. Metro rail networks are growing across cities, expressways are connecting regions, and large industrial campuses are emerging at a rapid pace. These developments signal strong economic progress, but they also bring attention to an important challenge within the construction ecosystem. While many projects aim to meet international benchmarks in design and planning, execution on the ground often struggles to match the same level of consistency.

MAYANK PATHAK,
Founder & Managing Director,
Translite Formwork & Scaffolding (TSL)

Companies working closely on infrastructure execution, such as Translite Scaffolding Ltd., are increasingly encountering this gap between global standards and on-site realities. Bridging this gap has become an important priority, not just at a policy level, but within day-to-day construction practices.

Understanding Global Benchmarks in Construction

Global construction benchmarks typically focus on safety, engineering accuracy, quality control, and structured project planning. Countries with mature construction ecosystems rely on standardized systems that ensure predictable results across projects. These systems include strict material specifications, documented installation procedures, and consistent inspection protocols.

International standards also emphasize modularity and engineering-led design. Temporary structures such as scaffolding and formwork are treated as planned engineering systems rather than improvised site arrangements. This approach reduces errors during construction and improves coordination between contractors, engineers, and site workers.

Many of these principles already exist in Indian regulations and engineering guidelines. However, the challenge often lies in translating these frameworks into consistent site practices across thousands of construction locations.

The Reality of Local Execution

India's construction sector operates under a unique set of conditions. Projects often involve multiple contractors, varied site environments, and changing work schedules. Labor mobility, logistical constraints, and tight deadlines can create pressures that affect how standards are implemented on site.

In many cases, construction teams must adapt quickly to evolving circumstances such as weather conditions, material supply delays, or unexpected design adjustments. While such adaptability is part of the industry's strength, it can sometimes lead to inconsistencies in how systems are installed or maintained.

Local execution also varies significantly across project types. Urban metro projects may follow stricter engineering oversight, while smaller infrastructure works might rely more heavily on contractor experience. This variation highlights the importance of strengthening execution frameworks that maintain consistency regardless of project scale.

Engineering Planning as the First Step

One of the most effective ways to close the gap between global benchmarks and local execution is through stronger engineering planning. When temporary structures, construction sequences, and access systems are designed before materials reach the site, project teams can work with greater clarity and coordination.

Engineering planning allows potential challenges to be identified early. Load calculations, structural staging, and access layouts help ensure that systems behave predictably once installed. This approach reduces the need for last-minute modifications, which are often a source of inefficiency and risk.

Planning also improves communication across project teams. When engineers, contractors, and site supervisors work from the same design framework, decision-making becomes more structured and consistent. In practice, companies like Translite Scaffolding Ltd., which provide scaffolding and formwork design along with load calculations, contribute to this alignment by integrating planning into execution.

Standardization and Modular Systems

Standardization plays a major role in maintaining quality across large

construction projects. When components are manufactured according to consistent specifications, installation becomes easier to control and monitor. Modular systems allow construction teams to assemble structures with predictable outcomes rather than relying on improvised adjustments.

In scaffolding and temporary support systems, modular designs ensure that each component connects in a defined way. This reduces variation in assembly and supports safer working platforms. Standardized systems also make inspection processes more straightforward, allowing engineers to verify performance quickly.

Manufacturers and system providers play a key role in this shift. Translite Scaffolding Ltd., for example, supplies modular systems such as Ringlock and Cuplock scaffolding that are designed with standardized dimensions and connection points. Such systems help reduce variability during installation and support more predictable outcomes across project sites.

Strengthening Safety Culture

Safety standards are a central component of global construction benchmarks. International guidelines require not only compliance with safety equipment but also structured procedures for planning, installation, and inspection.

In India, safety awareness has improved significantly over the years. Large infrastructure projects now include dedicated safety teams, training programs, and inspection frameworks. However, maintaining consistent safety culture across every site remains an ongoing challenge.

Improving safety culture involves integrating safety considerations directly into engineering planning and construction processes. When systems are designed to reduce risk rather than simply responding to it, safer work environments become a natural outcome of disciplined execution.

Training and Skill Development

Another important factor in closing the standards gap is workforce training. Construction relies heavily on skilled technicians who assemble scaffolding, formwork, and structural components. Their ability to follow design specifications and safety procedures directly affects project outcomes.

Training programs help ensure that workers understand the purpose behind engineering standards. When workers are familiar with modular systems and installation practices, they can execute tasks more efficiently and with greater confidence.

Skill development also supports long-term industry improvement. As workers gain experience with standardized systems, they carry that knowledge to future projects, gradually strengthening overall construction practices.

Collaboration Across the Construction Ecosystem

Closing the gap between global benchmarks and local execution cannot be achieved by a single stakeholder. It requires coordination among engineers, contractors, manufacturers, regulators, and project developers. Each participant plays a role in ensuring that standards are applied consistently.

Manufacturers contribute by producing components that meet recognized material specifications. Engineers ensure that systems are designed correctly. Contractors manage installation and execution on site. Regulators and clients establish frameworks that encourage accountability and compliance.

When these roles operate in alignment, the construction ecosystem becomes better equipped to deliver projects that meet both national expectations and global standards.

Moving Toward Consistent Execution

India's infrastructure ambitions continue to grow. From high-speed rail corridors to industrial manufacturing zones and urban transport networks, the scale of construction is expanding rapidly. As this growth continues, maintaining consistent construction standards will remain an important focus.

Closing the gap between global benchmarks and local execution does not require dramatic changes. It requires disciplined planning, standardized systems, and stronger coordination across stakeholders. Companies operating at the intersection of design, manufacturing, and execution, such as Translite Scaffolding Ltd., are contributing to this shift by bringing engineering-led approaches into everyday construction practices.

As planning, manufacturing, and site execution become more aligned, India's infrastructure growth can be supported by systems that are not only fast, but also consistent and reliable.

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Why Legacy Manufacturing Businesses Need Modern Governance Models

Legacy manufacturing businesses have been the backbone of industrial growth in India. Many of these enterprises were built over decades through discipline, operational efficiency, and deep product & market understanding. They carry strong brand equity, long-standing customer relationships, and a culture shaped by the founding generation.

SOUMIK BANDYOPADHYAY

These businesses are not just economic entities. They represent continuity, resilience, and accumulated knowledge. However, the environment in which they operate today is very different from the one in which they were built. What worked earlier may not be sufficient going forward. This is where fresh perspective on governance becomes central.

A Changing Operating Environment

Manufacturing today is far more dynamic than it was even a decade ago. Technology cycles are shorter, supply chains are more global, and competition is no longer limited to local players. At the same time, regulatory compliances have increased, and access to capital often depends on transparency and compliance. In such an environment, decision-making cannot remain entirely informal or centralized. Businesses need systems that allow them to respond quickly while maintaining consistency and discipline. Legacy structures built around individual leadership often struggle to keep pace with these changes.

The Limits of Founder-Centric Models

Many legacy manufacturing businesses are still led by technocrat founders or closely held family groups. This model offers speed and clarity in decision-making. However, it also creates dependency on a few individuals. As businesses age, grow in size and complexity or at times stagnate, reliance on personal judgement alone becomes a limitation. Strategic decisions require inputs from multiple perspectives such as finance, operations, technology, and compliance. And more often than not, the strategic roadmap needs to be stress tested with third-party, independent and global perspectives.

In addition, generational transition introduces new perspectives. Without structured governance, these perspectives may not be integrated effectively into decision-making. Moving toward governance models does not reduce the founder's role. It strengthens the system around them.

Governance as an Enabler, Not a Constraint

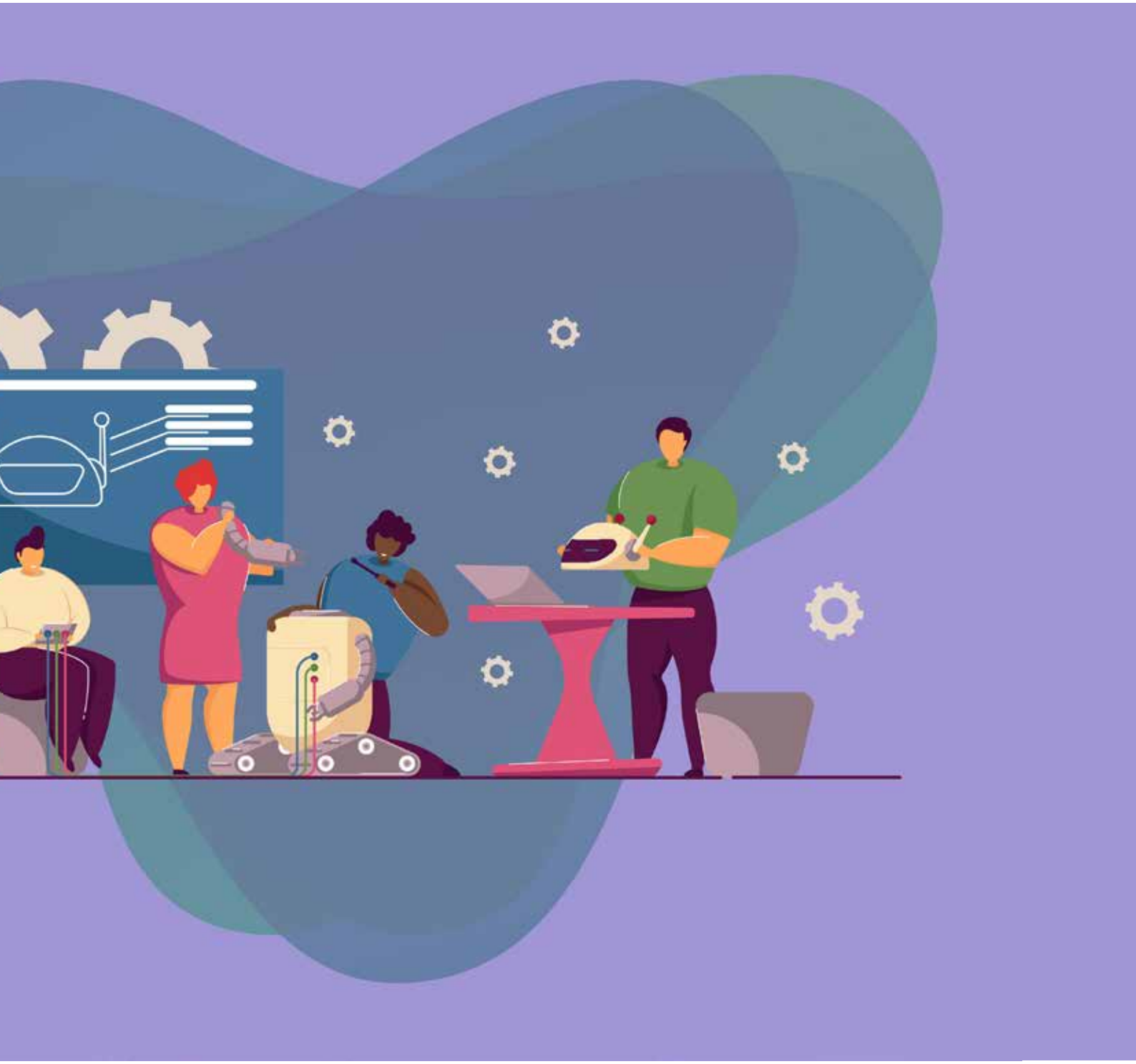
Governance is often misunderstood as a set of restrictions. In reality, it enables better decisions. Modern governance models introduce clarity around roles, responsibilities, and processes. They ensure that decisions are not only fast but also well-informed and aligned with long-term objectives.

For manufacturing businesses, this includes areas such as technology protection, continuous R&D, capital allocation, capacity expansion, vendor management, and customer orientation. When governance frameworks are in place, these decisions follow a consistent approach rather than depending on individual preferences. This reduces risk and improves predictability.

Clarity & Accountability in Management

One of the key aspects of governance is clarity and accountability in management roles. In many legacy businesses, these roles of family members in the management of the businesses are closely intertwined. As the business grows, this overlap can create confusion. Family members may be involved in operations without clearly defined responsibilities. Professional managers may not have full authority despite being accountable for outcomes.

Governance helps address this by defining roles clearly. Ownership focuses on strategic direction, while management focuses on execution. This clarity improves accountability



and allows professionals to contribute effectively. It also prepares the organization for future expansion.

Preparing for Generational Transition

Legacy manufacturing businesses are increasingly entering phases of generational transition. The next generation often brings new ideas, including interest in automation, digital transformation, product expansion and global expansion. At the same time, the founding

generation brings experience and a deep understanding of the business.

Governance frameworks provide a platform where these perspectives can freely come together. Family councils, boards, and advisory committees allow structured discussions rather than informal debates. This helps ensure that transition is gradual and aligned, rather than abrupt or disruptive.

Managing Risk in a Structured Way

Manufacturing businesses face multiple types of risk. These include technological risks, operational risks, supply chain disruptions, financial exposure, and regulatory compliance. In the absence of governance, risk management is often reactive. Issues are addressed after they arise rather than anticipated in advance.

Modern governance models introduce structured risk assessment. This includes identifying potential risks, evaluating their impact, and creating mitigation plans. Such an approach not only protects the business but also builds confidence among stakeholders, including lenders, partners, and employees.

The Role of Professionalization

As businesses scale, professionalization becomes necessary. This does not mean replacing family involvement altogether. It means complementing it with specialized expertise. Governance models support professionalization by creating an environment where professionals can operate effectively. Clear reporting lines, defined authority, and performance metrics help align teams.

For manufacturing businesses, this is particularly important in areas such as technology adoption, quality control, and supply chain management. Professionalization also prepares the business for future opportunities, including partnerships and expansion into new markets.

Adapting to Technological Change

Technology is reshaping manufacturing at every level. Automation, data analytics, and digital platforms are becoming integral to operations. Adopting these technologies requires structured decision-making. Investments in technology are often significant and long-term in nature. They require careful evaluation of costs, benefits, and risks.

Governance frameworks help ensure that such decisions are aligned with the overall strategy of the business. They also enable continuous monitoring and adaptation as technology evolves. Without governance, technology adoption can become inconsistent or fragmented.

Building for the Long Term

Legacy manufacturing businesses have already demonstrated their ability to survive and grow over decades. The next challenge is to ensure that they continue to do so in a changing environment. Modern governance models provide the foundation for this continuity. They bring clarity, reduce dependency on individuals, and create systems that can adapt over time.

Importantly, governance also helps preserve the core values of the business. It ensures that growth and change do not come at the cost of identity. The objective is not to change what has worked, but to strengthen it for the future.

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KISHAN KARUNAKARAN,
Founder and CEO, Buyofuel

Bio CNG and the rise of waste to fuel mobility

India's mobility transition is no longer a one-dimensional shift toward electrification—it is evolving into a multi-fuel strategy rooted in practicality and scale. Among the most promising solutions is Bio-CNG (compressed biogas), a fuel that embodies the principles of a circular economy by converting organic waste into a viable, low-carbon alternative for transportation.

At a time when India grapples with rising fuel demand, urban pollution, and mounting waste management challenges, Bio-CNG presents a unique convergence point. It transforms agricultural residues, municipal waste, and industrial organic by-products into a clean-burning fuel that can directly replace conventional CNG. Unlike many emerging fuels that require new vehicle technologies or infrastructure overhauls, Bio-CNG seamlessly integrates into existing CNG ecosystems—making it immediately deployable.

The opportunity is immense. India generates millions of tonnes of organic waste annually, much of which is either burned—contributing to seasonal air pollution—or dumped in landfills, releasing methane, a potent greenhouse gas. Bio-CNG plants offer a solution by capturing this methane and upgrading it into transport-grade fuel. In doing so, they not only reduce emissions but also create value from what was previously considered waste.

This waste-to-fuel model is particularly impactful in rural and semi-urban India. Farmers, who often resort to stubble burning due to limited alternatives, can now monetize agricultural residues. Similarly, urban local bodies struggling with waste disposal can channel organic waste into energy production. The result is a decentralized energy system that supports both environmental and economic sustainability.

From a mobility standpoint, Bio-CNG is gaining traction across fleet-based applications. Public transport systems, logistics operators, and last-mile delivery fleets are increasingly adopting the fuel due to its cost competitiveness and lower emissions profile. With global fuel markets subject to volatility, Bio-CNG offers a degree of price stability, making it an attractive option for cost-sensitive operators.

Policy support has further strengthened the ecosystem. Government initiatives such as the SATAT scheme have laid the groundwork for scaling compressed biogas production, with oil marketing companies providing assured offtake. This has significantly reduced market uncertainty and encouraged private investment. At the same time, discussions around carbon markets are opening new revenue streams, allowing Bio-CNG producers to monetize emissions reductions.

However, scaling Bio-CNG is not without challenges. Feedstock aggregation remains a critical hurdle,

given the fragmented and decentralized nature of biomass supply. Efficient logistics, aggregation networks, and digital platforms are essential to ensure consistent plant operations. Platforms like Buyofuel are playing an emerging role in bridging this gap by connecting waste generators with processing units, thereby streamlining supply chains.

Financing is another key barrier. Bio-CNG plants require significant upfront capital, and project viability is often influenced by feedstock costs and long-term pricing mechanisms. Innovative financial models—ranging from green financing to leasing structures—will be crucial in unlocking broader adoption.

Infrastructure development also needs attention. While India's CNG network is expanding, integrating Bio-CNG into these systems and building dedicated refuelling networks will be vital for widespread usage. Standardization in quality and pricing will further enhance market confidence.

Looking ahead, Bio-CNG stands out as one of the most practical solutions for decarbonizing India's transport sector. Unlike electric mobility, which depends heavily on grid decarbonization, or hydrogen, which is still in its infancy, Bio-CNG is ready for deployment at scale today. It not only reduces emissions but also strengthens rural economies and addresses waste management challenges.

In essence, Bio-CNG is more than just a fuel—it is a systems solution. By turning waste into energy, it redefines the way India approaches mobility, sustainability, and economic growth, paving the way for a cleaner and more resilient future.

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Building the Future with Recycled Plastic Materials

Recycled plastic is steadily transitioning from the margins of environmental discourse into the core of modern infrastructure development. What was once dismissed as low-value waste is now being re-engineered into durable materials capable of serving long-term structural and public needs. As urbanisation accelerates and demand for construction materials increases, the conversion of discarded plastic into infrastructure components presents both an environmental response and a practical materials solution.

One of the most prominent areas of application lies within underground and utility infrastructure. Recycled polymers are increasingly used in drainage systems, cable ducts, utility chambers, and moisture-resistant piping. These applications are supported by several material characteristics. Recycled plastics are resistant to corrosion, making them suitable for environments exposed to water and chemicals. Their relatively low weight simplifies transportation and installation, which can reduce logistical complexity in urban projects.

In densely built environments, these properties contribute to more efficient installation processes and reduced disruption during construction. Over time, the durability of such materials can result in lower maintenance requirements. Resistance to chemical exposure and environmental wear allows these components to perform consistently over extended periods, which is a key consideration in infrastructure planning.

Above ground, recycled plastic composites are being incorporated into surface infrastructure. Products such as paver blocks, kerbstones, tiles, and modular construction elements are being developed using recycled polymers. When properly engineered, these materials can offer impact resistance and flexibility, which may reduce cracking under certain conditions. Their application is gradually expanding across walkways, parking areas, and public-use zones.

Advancements in material science continue to improve the consistency and performance of these composites. As formulations become more refined, their structural reliability is being evaluated in a wider range of use cases. This has contributed to a gradual increase in their adoption within both public and private sector projects.

Recycled plastics are also being used in the production of public and institutional furniture. Items such as outdoor benches, school desks, playground components, waste bins, decking boards, and landscaping fixtures are now commonly manufactured using recycled high-density polymers. These materials are generally resistant to weather conditions, pests, and moisture-related damage, which can extend the usable life of such products.

In public settings, where durability and low maintenance are important, these characteristics can be particularly relevant. Compared to some traditional materials, recycled plastic products may require less frequent upkeep. Their use in visible, everyday applications also reflects a broader shift in how recycled materials are integrated into functional design.

From an economic perspective, lifecycle considerations are central to material selection in infrastructure. Recycled plastic products can reduce reliance on virgin raw materials and may offer cost efficiencies related to transportation due to their lighter weight. More significantly, their durability can contribute to reduced repair and replacement frequency over time.

When assessed over long service periods, these factors influence overall cost structures. Infrastructure investments are typically evaluated on performance across decades, and materials that demonstrate stability and longevity are often prioritised within such frameworks.

Material recovery systems are also evolving to improve the utilisation of plastic waste. In addition to recycling higher-grade plastics, residual materials such as polymer dust and lower-grade plastic fractions are increasingly being processed into refuse-derived fuels and alternative energy sources.

Through controlled thermal processes and waste-to-energy systems, these materials are repurposed instead of being directed to landfill.

This approach supports broader efforts to improve resource efficiency and reduce environmental impact. By extending the usable value of waste materials, such systems contribute to more integrated waste management strategies.

Beyond infrastructure and industrial

applications, recycled plastics are also being used to manufacture household and community-level products. Items such as plates, containers, flower pots, and other everyday goods are being produced through decentralised recycling initiatives. These models enable smaller-scale processing and localised production, often closer to the point of waste generation.

Such approaches can reduce the burden on centralised waste systems while supporting local reuse of materials. They also encourage more direct engagement with recycling practices, as communities participate in the transformation of waste into usable products.

The increasing range of applications demonstrates that recycled plastic is being considered across multiple sectors, from infrastructure to consumer goods. Its use is shaped by ongoing developments in material engineering, waste processing technologies, and policy frameworks that support sustainable practices.

When applied appropriately, recycled plastic serves as a functional material that can contribute to infrastructure systems, public amenities, and everyday products. Its role continues to evolve as new technologies and processes expand the scope of what can be achieved with recovered materials.

As urban systems grow and resource management becomes more complex, the integration of recycled materials into construction and manufacturing reflects a broader shift in how materials are sourced and utilised. This transition highlights the importance of aligning material use with long-term environmental and operational considerations, while maintaining performance standards across applications.

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