

Pakistan Unveils New Energy Vehicle Policy 2025-30 Amid Climate and Implementation Challenges

Prime Minister Shehbaz Sharif unveiled Pakistan's New Energy Vehicle (NEV) Policy 2025-30, describing it as a landmark initiative to tackle the country's intensifying climate crisis, cut petroleum imports, and usher in a new era of green industrial growth.

The policy, which promotes electric mobility and clean transportation, has been hailed as both a timely response to global environmental imperatives and a bold attempt to reshape Pakistan's economic and industrial future.

At the launch ceremony, the prime minister under-

scored Pakistan's acute vulnerability to climate change



despite its negligible contri-

emissions. He pointed to the devastating 2022 floods that

caused over USD 30 billion in damages, alongside

recurring monsoon catastro-

phes and heatwaves that continue to threaten mil-

the ten countries most affected by climate

change," Sharif said. "Our carbon footprint is negligi-

ble, yet our people, economy, and infrastructure suffer the most."

The new policy seeks to accelerate the transition to electric vehicles (EVs), offering incentives such as toll exemptions, financing reforms, subsidies, and free registration. It also includes the distribution of electric bikes and 100,000 laptops to top-performing students, with a 10 percent quota reserved for Balochistan. "This is not only an environmental measure but an investment in the country's youth, who will lead Pakistan into a greener future," the premier emphasized.

Special Assistant to the Prime Minister on Industries and Production, Haroon Akhtar Khan, described the initiative as a "blueprint for Pakistan's

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NESPAK to Design International Standard Cricket Stadium in Islamabad

The Capital Development Authority (CDA) has entrusted National Engineering Services Pakistan Pvt. Limit-

NESPAK's Project Manager, GM Mukhtar Arshad, led a site assessment visit to the proposed location. He was accompanied by the firm's project coordinator, lead architect, and structural engineer. The visit was also attend-



ed (NESPAK) with the prestigious task of designing and supervising the construction of an international-standard cricket stadium in F-9 Park, Islamabad.

The announcement was made by NESPAK's Managing Director, Muhammad Zargham Eshaq Khan.

This landmark assignment has been awarded on a government-to-government basis and marks a significant step toward enhancing Pakistan's sports infrastructure. The new stadium is envisioned as a state-of-the-art facility that will meet international cricketing standards and serve as a key venue for national and international matches in the capital city.

As part of the initial project activities,

led by former Pakistan cricket captain and national sports figure Rashid Latif, who has been appointed by the Pakistan Cricket Board (PCB) as an expert consultant for the project. His technical input and experience are expected to play a crucial role in shaping the project to global standards.

The project is being carried out under the direct supervision of CDA Chairman and Federal Interior Minister Mohsin Naqvi. His involvement underscores the government's commitment to developing world-class sports infrastructure and promoting healthy recreational opportunities for the public.

NESPAK's engagement in this high-profile project reaffirms its position as a leading engineering consultancy, trusted for delivering large-scale, complex infrastructure developments across Pakistan and beyond. - PR

Pakistan Unveils New Energy Vehicle Policy 2025-30 Amid Climate and Implementation Challenges

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clean transport revolution." He explained that the NEV Policy would not only reduce petroleum demand but also help the country shift from vehicle assembly toward manufacturing advanced EV components, batteries, and charging equipment. "This green revolution is the future of Pakistan," Khan remarked, noting that running an electric motorcycle costs less than one-third of what it takes to operate a petrol-based one.

Federal Minister for National Food Security Rana Tanveer Hussain hailed the launch as a historic moment, asserting that the policy had been designed in alignment with international environmental standards. Ambassadors, federal ministers, and top-performing students from across Pakistan attended the ceremony, while the government hinted at plans to increase the current Rs 9 billion education support budget in the upcoming fiscal year.

However, while optimism around the NEV Policy runs high, experts warn that significant bottlenecks and challenges threaten to delay or dilute its impact. Chief among these is the lack of infrastructure to support mass EV adoption. Pakistan currently has a negligible number of charging stations, raising concerns about accessibility, especially in rural areas where power supply is already unreliable. Without a robust nationwide charging network, the dream of widespread electric mobility may remain out of reach.

Another pressing issue

is the country's fragile energy sector. Pakistan continues to grapple with power shortages, high transmission losses, and dependence on imported fuels for electricity generation. Unless renewable energy is significantly scaled up, critics fear that charging EVs may simply transfer the burden from oil imports to electricity imports, undermining the environmental and economic benefits of the policy.

The financial dimension is equally daunting. Although subsidies and tax exemptions are built into the policy, high upfront costs of EVs remain a barrier for average households and small businesses. Local manufacturing of batteries and EV parts—vital to reducing costs—will require substantial foreign investment, technology transfer, and skill development. Ensuring strict compliance from international partners, as stressed by Khan, will be critical to avoiding delays.

Industry readiness is another hurdle. Pakistan's automotive sector has long been centered on conventional vehicle assembly, with limited capacity for innovation. Transitioning toward electric mobility will demand retraining workers, restructuring supply chains, and incentivizing companies to invest in EV technology. Without adequate government-industry coordination, the policy risks faltering in execution.

Policy continuity also raises concerns. With Pakistan's political transitions often derailing long-term projects, stakeholders fear

the NEV Policy may face setbacks if not insulated from political turbulence. Experts stress the need for bipartisan consensus and legal safeguards to ensure the policy's sustainability through 2030.

Finally, financing challenges loom large. Pakistan is already under immense fiscal strain and has limited room to take on new loans. While Sharif has appealed to the international community for greater climate assistance, uncertainty remains over whether sufficient global financing will materialize. Without international support, Pakistan may struggle to fund both infrastructure and incentives critical to the NEV Policy's success.

In his address, the prime minister acknowledged these concerns, reiterating that Pakistan cannot shoulder the costs of climate recovery and green transition alone. "We are no longer in a position to bear the weight of more loans or financial strain," he said. "The international community must step up and support vulnerable states like Pakistan in building resilient infrastructure."

For now, the launch of the NEV Policy represents a bold declaration of intent: to cut emissions, reduce oil imports, generate green jobs, and empower youth. But whether Pakistan can navigate the complex landscape of financing, infrastructure, industry readiness, and political will remains the ultimate test for turning this ambitious vision into a reality. — ER Report ■

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Pakistan Engineering Council Confers Engineers' Excellence Awards 2023

The Pakistan Engineering Council (PEC) has conferred the prestigious PEC Engineers' Excellence

istan's progress and development.

The awards ceremony, held in Islamabad, was graced by the Federal Minister for Science and Technology, Khalid Hussain Magsi,

from diverse walks of life.

Addressing the ceremony, Federal Minister for Science and Technology Khalid Hussain Magsi lauded PEC's initiative, stating:

"I extend my heartfelt

exemplary achievements of our eminent engineers, serving in diverse fields, stands as a tribute to their invaluable contributions to the progress and prosperity of our nation. These awards are not only a

ership, is setting an inspiring benchmark for the younger generation to follow."

The Minister highlighted PEC's role in national development, digital transformation, and youth engagement.

Generative AI courses, and the Young Engineers National Forum. He further appreciated PEC's achievements on the global front, including securing a six-year extension of Pakistan's membership



Awards 2023, honoring 30 eminent engineers across eight categories for their remarkable contributions to Pak-

who presented the awards to the distinguished engineers. The event was attended by foreign delegates, parliamentarians, bureaucrats, government officials, senior engineers, and prominent figures

congratulations to the Pakistan Engineering Council (PEC) for taking this laudable initiative of organizing the PEC Engineers' Excellence Awards 2023. This prestigious recognition of the

symbol of personal accomplishment but also a national celebration of dedication, ingenuity, and professional excellence that our engineers consistently demonstrate. PEC, under its dynamic lead-

He praised initiatives such as the Smart PEC Drive, Special Programs for Balochistan, PEC Desks in Higher Education Institutions, the Graduate Engineers Training Program (GET), the introduction of

under the Washington Accord and signing a Mutual Recognition Agreement with China. Speaking at the ceremony, Chairman PEC Engr.

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Schneider Electric Drives Strategic Dialogue in Islamabad, Focusing on the Future of Partnerships

Schneider Electric, the leader in the digital transformation of energy management and automation, recently hosted an exclusive

strategic dialogue focused on innovation, growth, and sustainability. The event reaffirmed Schneider Electric's belief that progress is powered by strong partnerships. The discussions centred on unlocking new opportunities

designed to enhance partner enablement and improve digital accessibility across the region. This gathering underscored Schneider Electric's strong commitment to empowering its ecosystem and building



Innovation Talk: Partnerships of the Future in Islamabad. The high-level, boardroom session brought together key stakeholders for a

and aligning on ambitious, shared goals. A key highlight was the strategic conversation around the upcoming e-commerce platform launch, a significant move

resilient, purpose-driven partnerships. By fostering this type of impactful collaboration, the company reinforces its core belief that "Impact Starts With Us".

Pakistan, Russia in Talks to Launch Local Insulin Production

A high-level meeting of the Drug Regulatory Authority of Pakistan (DRAP) was held last week under the chairmanship of Special Assistant to the Prime Minister (SAPM) on Industries and Production Haroon

through collaboration with Russia. SAPM Haroon Akhtar Khan said the proposed venture would mark a "new era" in bilateral ties and reaffirmed the government's commitment, under Prime Minister Shehbaz Sharif's leadership, to encourage foreign investment and technology transfer. He explained that insulin manufacturing



Akhtar Khan to discuss a joint project with Russia for local insulin production. The meeting was attended by Russian government representative Denis Nazarov, Secretary Industries and Production Saif Anjum, and senior DRAP officials. The discussions centred on establishing insulin manufacturing facilities in Pakistan

would be carried out in phases, with bulk production and transfer of technology expected within three years. He added that the project would open new avenues for business cooperation, enhance access to essential medicines for Pakistanis, and stressed that strict compliance from partner companies would be crucial for its success. - ERMD

Bijli Ghar

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Designing Green Technologies for a Scalable Solution

Engr. Dr. Muhammad Nawaz Iqbal

The environmentally friendly technology design has to consider the principle of environmental sustainability along with industrial efficiency.

The conventional definitions of technological development have tended to focus on the economics and efficient performance of a technology at the expense of the applications of ecological considerations. But the pressing issues of climate change, resource rationalization, and stricter regulatory regimes have forced industries to change design responses. The goal of green technologies should not be to facilitate compliance; rather, they are necessary to provide competitive advantage, new markets, and long-term resilience. These technologies can be scaled and when designed that way then they can move on to the mainstream solutions affecting a lot more people around the globe.

Scalable green technologies rest on one of the main issues, that is, modularity. Modular: The solutions can be used within an industry and/or across geographies with limited adaptation. A good example is the idea of solar energy microgrids developed in a

dant or wasteful when up-scaled. This adaptability increases the sustainability outcomes and business adoption.

Integration of digital technologies, including artificial intelligence, Internet of Things (IoT), and blockchain, is also important in the level of scala-

tems with the implementation of IoT sensors can help to lessen wastage opportunities and enable industries to perform with maximum resource usage at scale, since it learns the consumption behaviors. When intelligence is built into green technologies, it is

To overcome this, there should be international partnerships that result in the standardization of green technology design and performance. The automotive sector offers a good example: as electric automobile technologies develop, there is a need to

have common charging and battery standards in order to scale. Scalability will not be possible without harmonization as it can only be limited to individual markets. Standardization also allows industries to establish interoperability that drives adoption at a high velocity due to the priority given to standardization.

Scalable green technologies should also have

the principle of a circular economy to have efficiency of resources within their lifecycle. Innovations should go into the production of products that are sustainable as opposed to designing goods that ultimately become waste. As an example, renewable energy companies are seeking to find means of recycling used wind energy turbine blades into construction-based materials. Compare this to *electronics manufacturers* designing electronics devices so that they can be disassembled to retrieve rare metals. This is because embedded circularity in design enhances scalability in the long term, which is more sustainable and profitable.

Human-centric approach is also important to create scalable green solutions. Although it is necessary to have technical feasibility, social and behavioral aspects determine acceptance and adoption. Technologies that are easy to understand, interact and meet the demands of people are increasing rapidly. Take into consideration energy-efficient appliances: although more expensive initially, it has been much easier to sell appliances with friendly designs, smart connectivity and clearly indicating the financial savings on utility bills. Through co-design with the stakeholders, industries would be able to align the green solutions with the social reality to improve the scalability.

The scalability of green technologies is being defined more and more by such cross-industrial collaborations. Industry solutions that are effective in their own right often plateau, whereas when industries integrate, synergy effects magnify. Examples include partnerships between construction groups and renewable energy groups, resulting in energy-positive buildings where the buildings will satisfy their own energy



requirements and even provide extra energy to the electrical grid. In a similar manner, partnerships between waste management companies and manufacturing companies has led to closed-loop material cycles. The domain of green technologies can be scaled when industries work in ecosystems as opposed to working in silos.

Policy and regulation can become a very strong lever of scalability. Governments that reward research, promote adoption, and pay penalties over harmful behaviors are the fastest way to bring about transformation to the industry. The example of e-vehicle subsidies and solar power installation subsidies in China and Germany, respectively, has seen a multiplier effect whereby the two products have registered an astronomical growth due to governments supporting the initiatives. Policy needs to go further than short-term subsidy towards longer-term plans to promote innovation and resilience. With industries, regulatory trends are expected and should be assimilated in order to be in line with strategic changes in different industries.

When we design green technologies, we should essentially be thinking at a local level so that we can come up with a globally applicable technology. The issues of sustainability are global, and so the response to those issues must vary, subject to local conditions of culture, climate, and the economic realities in each place. To illustrate, water treatment technologies that work in arid areas are likely to focus on solar demineralization, whereas high damp areas may have greater use of condensates. Designing with localization in mind will allow industries to achieve fast adoption and still have a potential of global expansion. Such a coupling of local particularity with global universality is characteristic of a successful green technology.

Industries also need to embrace the thinking of the lifecycle, where scalability is not meant in terms of the ability to produce but also in terms of the footprint that the industry may place on the planet. As an example, with an industrial scale requiring electric vehicles, there is a problem of not looking at the environmental impact of lithium mining, whereby we shift the burden of the problem to

Contd on page 7



portable format and used in the villages of Africa, residential complexes in Asia, and industrial parks in Europe. By making modularity, industries overcome the typical pitfall of building solutions that fit all use-cases that become redun-

bility. The use of such technologies increases the effectiveness of green systems because it allows predictive maintenance, real-time monitoring, and transparent supply chains. As another example, smart water management sys-

expected to help lower the lifecycle cost, quicken the adoption, and stretch the relevance of the technology across markets.

Material innovation is another basis of scalable green technologies. Industries have long depended on rare, expensive, or toxic materials to scale, which hinder scalability. Green material science looks at the biodegradable polymers, recycled composites, and renewable feed stocks, in order to ensure that growing does not have an unforeseen negative impact on the ecology. Again, this is evident in the case of petroleum-derived plastics, which are being swapped out with biodegradable forms based on agricultural waste, thus ensuring that the agricultural industry harvests the new sources of revenue. This scalability is made practical and even economically viable since the change of such material is possible.

Financial scales also have to be taken into consideration; most green technologies do not grow due to the high capital costs, even though they save in the long term. Pollution-reducing industries require green bonds, carbon credits, and pay-as-you-save facilities to provide them with the finance at low costs. As an example, the power purchase agreements (PPAs) in the renewable sector energy industry have allowed businesses to switch to solar power and wind power without large capex. Green technologies have the potential to be compatible with the risk and return profile of mainstream investors, thanks to the funding of innovative financing mechanisms.

Lack of any standardized structures also causes one of the roadblocks to scaling. Industries may also find that regulations are not coherent and certification schemes compete with each other, thus delaying the pace of adoption.

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IEEE MTTS Organizes Seminar Battery-Free Wireless Sensing: A Passive Approach

The IEEE Microwave Theory and Techniques Society (MTTS) Student Branch, Mehran University of Engineering and Technology

Hall, IT Building, MUET.
The keynote speaker, Prof Dr. Valentina Palazzi, from the University of Perugia, Italy, joined us virtually and delivered a compelling session. Her insights into the cutting-edge developments in

tive perspective enriched the discussion further.
Prof. Dr. Bhawani Shankar Chowdhry, Vice Chair of IEEE MTTS, Karachi Section, who joined us virtually from Canada, concluded the session with his encouraging and insight-

enriched today's discussion and opened new horizons for research, innovation, and collaboration. He appreciated the effort of Dr. Permanand, Chair and Advisor of the IEEE MTTS Student Branch, for his dynamic leadership and efforts in making this seminar possible.

Today's exchange of knowledge has truly inspired us. Prof. Dr. Faisal Karim Shaikh, Chairman of the Department of Telecommunication, MUET, appreciated the efforts of the organizing team and distributed shields of appreciation to the keynote speakers and certificates to participants and volunteers.

The seminar was further graced by Dr. Umair Ahmed Korai, Chair of IEEE Com-Soc, and Engr. Talha Kaimkhani, PhD Scholar at MUET. Over 60 participants attended the seminar, comprising faculty, students, and volunteers, which contributed to a vibrant and engaging academic atmosphere.

This successful seminar marks another milestone in promoting innovative research and global collaboration under the IEEE MTTS platform.■

Designing Green

Contd from page 6

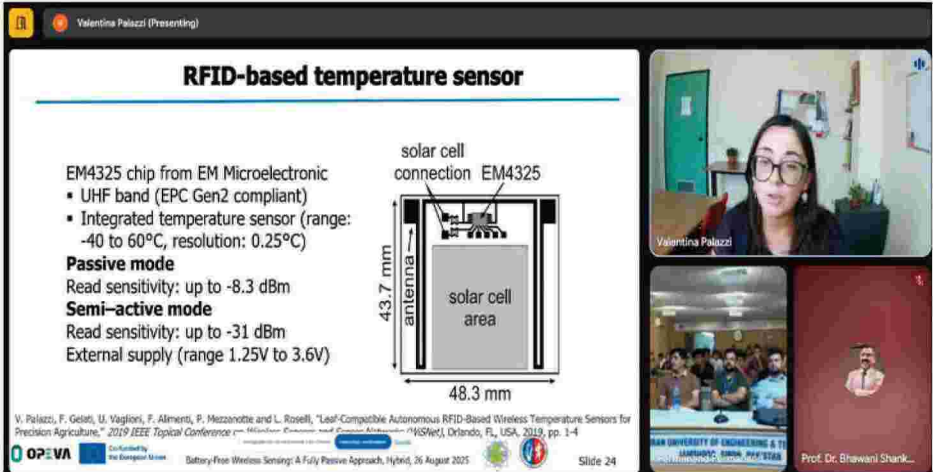
another industry. Lifecycle analysis will prevent that scalability implies financial debt, with hidden costs on the environment. Using this method, companies will be able to gain the trust of their respective stakeholders and be more likely to have the scaling initiatives that they initiate be their reliability and effectiveness.

The second important factor is resilience. Green technologies should be scalable so that they are resilient to perturbations like changes in climate, challenges in the supply chain, and geopolitical uncertainties. The design of decentralized systems like distributed renewable energy grids would make distributed systems scalable without being susceptible to any single point of failure. In sectors such as agriculture, green technologies that are resilient go across regions and accommodate diverse environmental uncertainties. Scalability alone is not resilient, and sectors should design resilience into their development.

Data transparency is another issue that cannot be overestimated in supporting the scaling of green technologies. Blockchain and advanced data analytics offer the capability to establish

open ecosystems in which the environmental performance of technologies can be traced and verified. As an example, the industries adopting the use of green hydrogen can monitor the carbon reductions on blockchain-backed systems, which creates confidence among the investors, regulators, and consumers. Transparent data can not only make the industry accountable but will also make the business case to scale green solutions stronger by showing a measurable outcome.

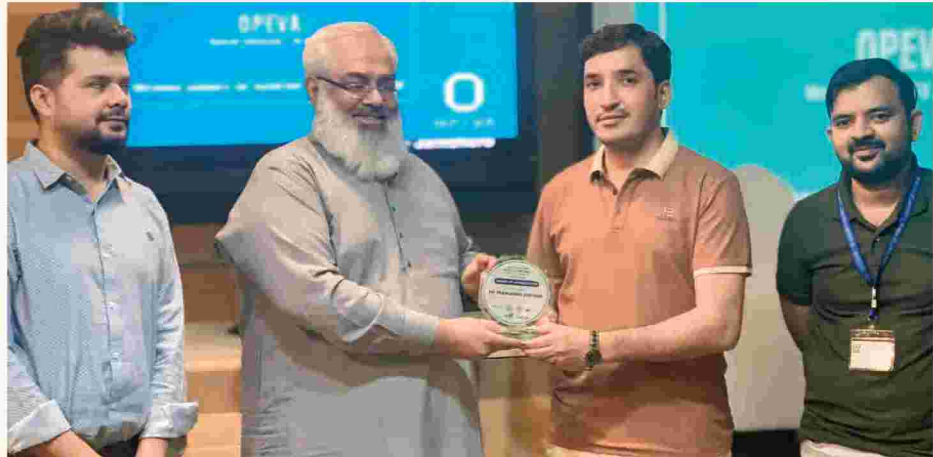
Scalable green technologies are not only a technical labelling process, it is a strategic reimagining of how industries understand their growth process. The paradigm changes to sustainable development or sustainable growth, which is long-lasting. Sustainability in the environment should be at the heart of designing and expanding industries to be the most effective in the emerging global economy. Through combining innovation and responsibility, scalability and resilience with profitability and sustainability, green technologies will not be able to introduce just some partial change in the industry, but will bring it into a regenerative future.■



(MUET), Jamshoro, proudly hosted a thought-provoking research-oriented semi-

passive wireless sensing captivated the audience and opened new directions for future research. We were honored by the in-person

ful remarks. Prof Chowdhry appreciated this highly insightful seminar on Battery-Free Wireless Sensing for broadening our perspec-



nar titled "Battery-Free Wireless Sensing: A Passive Approach" at the Video Conference

presence of Dr. Badar Muneer, a prominent researcher at the University of Perugia, Italy, whose practical expertise and collabora-

tive and for showing us the exciting future directions in this field. He further said that practical dimensions that

Tribute to Anwar Saadat



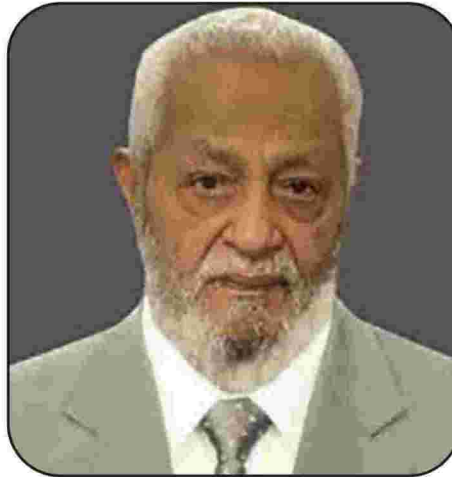
On the 78th Independence Day, Pakistan HVACR Society, Karachi Chapter dedicates its conference hall to the late Engr. Anwar Saadat, in recog-

nition of his invaluable contributions to the HVACR industry.
Engr. Anwar Saadat was the first HVAC consultant in the country. Members of Mr. Saadat's family graced this event.
Independence Day cake-cutting ceremony is also

held on this occasion. A heartfelt dua was made for the continued prosperity and progress of Pakistan, with prayers for peace, unity, and strength for our beloved nation. Past Presidents, current President, managing committee and senior members were attend the event.■

إِنَّا لِلّٰهِ وَإِنَّا إِلَيْهِ رَاجِعُونَ

ممتاز تعلیمی اور انجینئر رہنما جمیل احمد خان
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This year's floods in Pakistan are expected to hit cotton, rice, maize, and vegetable crops, along with vulnerable staples like wheat, potatoes, onions, and tomatoes. The floods are also expected to impact sugarcane and potentially mango orchards, threatening both food security and Pakistan's economy and increasing food prices for millions.

Sindh Notifies Rules for Agricultural Income Tax After IMF-Linked Legislation

The Sindh government has notified the Sindh Agricultural Income Tax Rules 2025, following the unanimous passage of the Sindh Agricultural Income Tax Bill earlier this year.

The move comes in line with commitments made under the International Monetary Fund (IMF) program, amid earlier concerns and reluctance from provincial lawmakers.

According to the notification, every owner of agricultural land liable to pay tax in respect of any agricultural income year must register with the Sindh Revenue Board (SRB). The Finance Department has also introduced registration and return forms, including AIT-01 for individuals and companies. Taxpayers will be required to file their returns electronically by the prescribed due dates, with companies due by December 31 and other taxpayers by September 30.

The rules stipulate that annual agricultural income up to Rs600,000 will remain exempt, while the maximum tax rate on income above

Rs5.6 million will be 45 per cent. A progressive super tax has also been introduced, applying up to 10pc on income exceeding

29pc. Livestock, however, remains exempt, and the advance tax on land cultivation has been abolished.



Rs500 million annually. Corporate farming has been brought into the tax net, with small companies taxed at 20pc and larger ones at

Chief Minister Syed Murad Ali Shah, while addressing the assembly during the passage of the bill in February, criticized the fed-

eral government for bypassing provinces in IMF negotiations. He maintained that Sindh already had agricultural taxation for decades, and accused the Federal Board of Revenue (FBR) of "misleading" the IMF while failing to meet its own tax collection targets. The SRB, he noted, would be solely responsible for collecting the new agricultural income tax.

The new rules also provide detailed procedures for registration, filing, assessment, appeals, and record-keeping. Owners are required to maintain records for five years in Urdu, Sindhi, or English. Returns will be treated as self-assessment, though tax officers retain the power to issue notices in case of non-compliance. Income may be accounted for on either a cash or accrual basis, depending on the nature of ownership.

The Sindh Agricultural Income Tax Act 2025 will take effect from January 1, 2025, marking what provincial authorities describe as a "progressive step" toward broadening the tax net while safeguarding food security and modernizing revenue collection. — ER Report

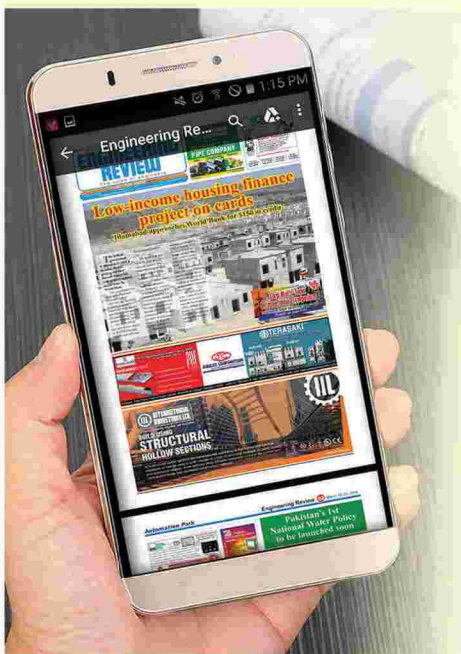
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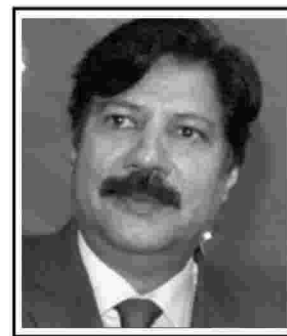
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May Allah the Almighty rest his soul in eternal peace
and grant courage to the family to bear the loss.



All Pakistan Newspapers Society

The Role of Prompt Engineering in Engineering Studies: Empowering Undergraduate, Graduate, and Doctoral Students

By: Syed Umair Ali

Introduction

Artificial Intelligence (AI) has rapidly transformed the way knowledge is created, shared, and applied across disciplines. Among the many skills needed to effectively leverage AI, prompt engineering—the art of crafting precise and purposeful inputs to extract meaningful outputs from AI models—has emerged as a key competency.

For engineering students at undergraduate, graduate, and doctoral levels, mastering prompt engineering can enhance not only their academic performance but also their ability to engage in lifelong learning in an era defined by intelligent technologies.

Prompt Engineering at Different Levels of Study

1. Undergraduate Level

Undergraduate engineering students are in the formative stage of their academic journey. They often face challenges in understanding fundamental concepts, solving mathematical problems, or drafting technical reports.

Applications of Prompt Engineering:

- Simplifying complex theories (e.g., thermodynamics, circuit analysis) into easier explanations.



Impact: By learning to design precise prompts, undergraduates can bridge the gap between theoretical knowledge and practical understanding, reducing frustration and encouraging

with AI-assisted debugging and explanation.

- Drafting lab reports, technical essays, or presentations.

Impact: By learning to design precise prompts, undergraduates can bridge the gap between theoretical knowledge and practical understanding, reducing frustration and encouraging

curiosity.

- 2. Graduate Level Graduate students engage in advanced coursework and often begin spe-

cialized research. At this stage, higher-order critical thinking and synthesis of ideas are essential.

Applications of Prompt Engineering:

- Conducting litera-

ture reviews by asking AI to summarize, critique, or compare research papers.

- Designing research methodologies and generating problem statements.

- Exploring simulation strategies or creating initial drafts of algorithms.

- Preparing technical documentation, research proposals, and funding applications.

Impact: Skilled prompting allows graduate students to save time in research preparation, receive diverse perspectives on complex topics, and enhance the quality of their academic writing.

3. Doctoral Level

Doctoral students pursue original contributions to their field. They require tools to think critically, identify gaps in existing knowledge, and generate



The author is a writer, blogger, and founder of www.thepengenius.com, where he explores ideas that spark growth, creativity, and purposeful living. Fascinated by Personal Knowledge Management (PKM), the future of Artificial Intelligence, and strategies for a more meaningful life, Umair weaves curiosity with clarity to deliver insights that inspire action. His work offers readers fresh perspectives and practical tools to navigate—and thrive in—an ever-evolving world.

innovative solutions.

Applications of Prompt Engineering:

- Identifying unex-

Contd on page 11

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Satellite Technology to Resolve Crop Data Disputes in Punjab

Pakistan is preparing to launch a satellite-based monitoring system next year to address long-standing disputes over crop data, particularly in Punjab, where conflicting figures on acreage and production have complicated policymaking.

The initiative, spearheaded by the Special Investment Facilitation Council (SIFC), will be implemented in collaboration with China and the Land Information and Management System (LIMS), which was launched in 2023 to promote sustainable and technology-driven agriculture. Officials believe the project will help resolve chronic discrepancies between the Punjab Crop Reporting Service (CRS) and the Pakistan Cotton Ginners Association (PCGA).

For years, CRS has been accused of inflating provincial cotton output through controversial sampling methods, while the PCGA's figures—based only on cotton

received at ginning factories—are said to understate the crop. This has left Pakistan with two conflicting national datasets, undermining its credibility in international cotton forums and complicating decisions on imports, exports, and pricing.

In the current fiscal year, CRS reported Punjab's seed cotton output at 609,000 bales as of July 31, while PCGA put the figure at just 301,000 bales. CRS Director General Dr Abdul Qayyum

proof system at ginning factories to ensure transparent and real-time reporting of processed cotton. "This step is essential for strengthening data integrity and improving policy coordination," he said.

Meanwhile, the All Pakistan Textile Mills Association (APTMA) has shown interest in taking over the Pakistan Central Cotton Committee (PCCC). The proposal follows a meeting on cotton revival chaired by Deputy Prime Minister Ishaq

Dar, during which APTMA settled billions of rupees in outstanding dues with PCCC. Industry stakeholders believe the takeover could boost cotton research, helping develop high-yielding and climate-resilient varieties to improve per-acre output.

On the market front, heavy rains across cotton-growing areas have triggered a shortage of quality lint, pushing prices higher. Rates rose by Rs200–300 per maund, reaching Rs16,400–16,600 in local markets. Cotton Ginners Forum Chairman Ihsanul Haq warned that continued depreciation of the rupee could drive prices up further. – ER Report



defended the service's estimates, saying they are based on internationally recognised methodologies, including randomised sampling, GPS-enabled tools, and FAO-endorsed yield estimation techniques. He argued that PCGA data ignores cotton still at farms, transferred to other provinces, or held by stockists.

Dr Qayyum urged the Federal Board of Revenue (FBR) to establish a fool-

Cabinet Committee Approves New Board of Directors for NESPAK

The Cabinet Committee on State-Owned Enterprises (CCoSEs) has approved the reconstitution of the Board of Directors of National

of the Board Nomination Committee, approved a new panel of directors in line with the State-Owned Enterprises (Governance and Operations) Act, 2023. The newly appointed members include Javaid Aslam, Muhammad Ali, Pir Saad Ahsanuddin, Omar Hassan,

nominations must be carried out promptly and in a coordinated manner by relevant ministries and agencies to avoid unnecessary delays.

The meeting was attended by Federal Minister for Housing and Works, Mian Riaz Hussain Pirzada; Federal Minister for Commerce,



Engineering Services Pakistan (NESPAK).

The meeting was chaired by Federal Minister for Finance and Revenue Senator Muhammad Aurangzeb.

The committee considered a single-point agenda and, on the recommendation

and Ms. Shahana Ahmad Ali, all of whom were selected for their professional expertise and strong credentials.

The committee emphasized that, given the importance of timely governance in state-owned enterprises, the selection and scrutiny of

Jam Kamal Khan; Federal Minister for Science and Technology, Khalid Hussain Magsi; and Federal Minister for Maritime Affairs, Muhammad Junaid Anwar Chaudhry, along with senior officials from the relevant ministries and regulatory bodies. - ER Report

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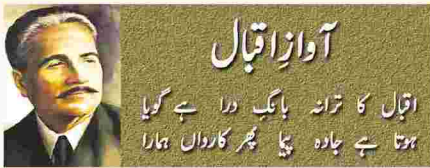
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The Role of Prompt Engineering in Engineering Studies: Empowering Undergraduate, Graduate, and Doctoral Students

Contd from page 9

explored research areas by prompting AI to highlight gaps across literature.

- Refining hypotheses and creating advanced data analysis workflows.
- Drafting scholarly articles, refining arguments, and ensuring academic rigor.
- Exploring interdisciplinary connections between engineering and other domains (e.g., AI in biomedical engineering or sustainability).

Impact: Proper prompt engineering empowers doctoral researchers to navigate vast amounts of data, enhance originality in their work, and streamline the communication of complex ideas.

Lifelong Benefits of Learning Prompt Engineering

- Enhanced Critical Thinking: Crafting effective prompts requires clarity of thought and goal-setting, skills transferable to problem-solving in professional life.

- Efficient Knowledge Acquisition: Students learn how to retrieve information quickly and accurately, which is invaluable in fast-evolving fields like engineering.
- Improved Communication Skills: Formulating clear prompts improves how students articulate technical ideas to both machines and humans.
- Adaptability to Emerging Tools: As AI technologies evolve, strong prompting skills ensure that engineers can leverage future tools without steep learning curves.
- Continuous Learning: Lifelong learning is sustained by the ability to query AI for new concepts, tools, and innovations long after formal education ends.

Free Courses for Students to Learn Prompt Engineering
Several platforms offer free or open-access resources that students at all levels can use:

- Elements of AI (University of Helsinki) – <https://www.elementsofai.com>
A beginner-friendly course that introduces AI concepts and helps learners understand how AI interprets human input.
- DeepLearning.AI: ChatGPT Prompt Engineering for Developers (Coursera, free-to-audit)
A practical introduction to prompt engineering with examples applicable to problem-solving, writing, and coding.
- Learn Prompting (<https://learnprompting.org>)
A community-driven, open-source curriculum covering fundamentals, intermediate techniques, and advanced prompt design strategies.
- Google AI and Machine Learning Resources (<https://ai.google/education>)
Free resources and guides on effective use of AI tools,

with applications in engineering and research.

5. OpenAI Cookbook and Documentation (<https://platform.openai.com/docs>)

Practical examples of prompt usage, fine-tuning, and advanced applications for engineering problems.

Conclusion
Prompt engineering is not merely a technical skill; it is a cognitive tool that strengthens how students learn, solve problems, and communicate in the age of AI. For undergraduate students, it simplifies foundational learning; for graduate students, it enhances research preparation; and for doctoral candidates, it fuels innovation and originality. By integrating free learning resources and practicing this skill, engineering students can prepare themselves for academic excellence and lifelong adaptability in an AI-driven world. ■

Sales Blog for Young Engineers and Entrepreneurs

A TALE OF FOUR Fs

Muhammad Tariq Haq | www.eslpc.com

In the heart of Dhaka, where rickshaws weave through the morning bustle, a young entrepreneur named Samirul dreamed of making his mark.

He had put his heart and soul into developing a new generator's franchise, convinced it would transform businesses in Bangladesh.

With his laptop tucked under his arm, Samirul made his way to the glass towers of Motijheel to meet the leadership of "Shonar Bangla Textiles", one of the city's most respected companies. The meeting room overlooked the Buriganga River, and on the table, steaming cups of cha and platters of mishti awaited.

Samirul greeted everyone with a "Assalamu Alaikum" and addressed the senior-most manager, mindful of the importance of hierarchy and titles in Bangladeshi business culture. The meeting began with small talk about family and the recent Eid celebrations, as is customary in Dhaka to build rapport before business.

Confidently, Samirul presented his franchise. Yet, as the meeting wore on, he sensed hesitation. Mr. Rahman, with decades of experience and a reputation for wise decisions, nodded politely but did not commit.

The others, followed suit.

After the meeting, Samirul sat at a roadside tea stall, pondering what went wrong. His mentor, Uncle Bashir, joined him, sipping cha.

"Maybe your franchise didn't fit their real needs. Here, businesses want solutions tailored to their unique challenges, not just fancy technology. Did you ask enough about their

The Third F: FINANCE

Budgets can be tight, and decisions are often made by the most senior person after careful consideration. Sometimes, they need flexible payment options like deferred LCs."

The Fourth F: FEAR – The Biggest F for Failure

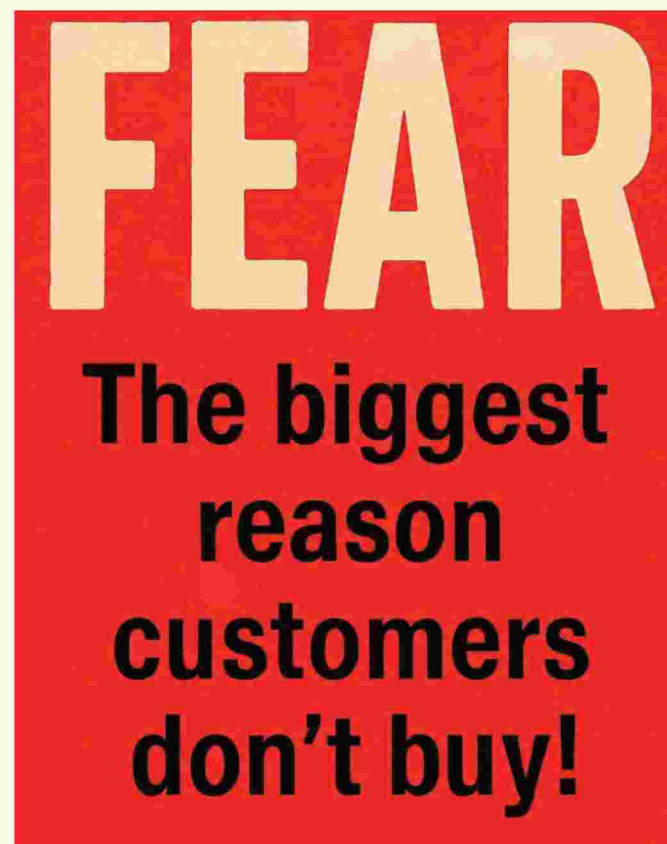
"Most importantly, there's FEAR. In Bangladesh, business is built on trust, relationships, and reputation. No one wants to risk their job or the company's future on an unknown. The higher the project value, the more this fear becomes.

Samirul realized that in Dhaka, success wasn't just about having a great product. It was about understanding the local community, respecting elders, taking time to build relationships, and earning trust—sometimes over many cups of cha and several meetings.

He returned to the customer, not with a sales pitch, but with genuine questions and a willingness to listen. He learned about their challenges, offered to customize his franchise, and even joined them for iftar during Ramadan to conquer the BIGGEST F

PLEASE ALSO READ MY ARTICLE

"FEAR - THE BIGGEST REASON SALES PEOPLE DON'T SELL! - ANOTHER STORY FROM BANGLADESH ■



Uncle Bashir began, "in Dhaka, closing a deal is like crossing the Buriganga in the rainy season. There are four currents—four Fs—that can sweep your sale away."

The First F: FIT

daily hurdles?"

The Second F: FEATURES
"Bangladeshi clients often look for specific features—sometimes even small ones like Bangla language support or integration with old equipment.

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وفاقی حکومت ملک میں نئے ڈیمز کی تعمیر کیلئے کمر بستہ موسمیاتی تبدیلیوں، سیلابی صورتحال اور ڈیمز کی تعمیر کیلئے گرینڈ ڈائلاگ شروع کر نیکا فیصلہ

ٹھوکر نیاز بیگ سے ہر بنس پور تک اب الیکٹرک ٹرام چلے گی

لاہور میں اورنج لائن ٹرین، الیکٹرک
بسوں کے بعد اب الیکٹرک ٹرام بھی چلے گی
جب کہ چین سے پہلی الیکٹرک ٹرام
میں کیا جائیگا۔ رپورٹس کے مطابق چین سے
درآمد کردہ ٹرام 3 باکسز پر مشتمل ہے جو مکمل طور
پر بجلی سے چلے گی۔



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ہے، مگر یہ کامیاب رہا تو کراچیوں کا فیصلہ بعد
چین سے منگوائی گئی یہ ٹرام علی ٹاؤن ڈپو
میں آئیں کی جارہی ہے جو صرف 10 منٹ کی
چارجنگ سے 27 کلومیٹر تک چلنے کی
صلاحیت رکھتی ہے۔ ■

وفاق ڈیموں کی تعمیر قومی اتفاق رائے سے کریگا، متنازع آبی منصوبہ نہیں بنایا جائیگا، کھیتل داس

وفاقی حکومت نے ملک میں موسمیاتی
تبدیلیوں، بارشوں، سیلابی صورتحال اور نئے
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ڈائلاگ شروع کرنے کا فیصلہ کر لیا، اس
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اعلیٰ سطح کی سیاسی کمیٹی تشکیل دی جائے گی جو ان
معاملات پر پارلیمانی جماعتوں سے رابطہ کر
کے حکمت عملی مرتب کرے گی۔
ان لیگ کے اہم ذرائع نے بتایا کہ لیگی
قیدت نے ملک میں موسمیاتی تبدیلیوں،

لایا جائے گا۔ ان لیگ ایک سیاسی کمیٹی تشکیل
دے رہی ہے، مشاورت کی روشنی میں آل
پارٹیز کانفرنس بلائے گی۔ اس معاملے ایک
تجویز یہ بھی زیر غور ہے کہ ایک پارلیمانی کمیٹی
تشکیل دی جائے جس میں ارکان اسمبلی اور آبی
وماحولیاتی و موسمیاتی ماہرین سمیت دیگر شامل
کیے جائیں، جو نئے ڈیمز کی تعمیر اور موسمی و
ماحولیاتی تبدیلیوں کے حوالے سے پالیسی و
منصوبہ بندی کرے۔ ان تجاویز کو روکنے میں
اتفاق رائے کے بعد ٹاسک فورس تشکیل دی

معاہدے پر صوبائی حکومتوں سے بھی مشاورت
کرے گی۔ ان تجاویز کو روکنے میں اتفاق رائے
کے بعد ٹاسک فورس تشکیل دی جاسکتی ہے،
ذرائع کا کہنا ہے کہ وفاقی حکومت ملک میں
فوری چھوٹے، درمیانی اور بڑے ڈیمز تعمیر
کرنے کا ارادہ کر رہی ہے۔ اس حوالے سے
فیڈرل کے انتظامات کے لیے اپنے وسائل
سمیت متعلقہ عالمی مالیاتی اداروں سے رجوع
کیا جائے گا۔ وفاقی حکومت کی پالیسی ہے کہ
نئے ڈیمز کی تعمیر اور موسمیاتی تبدیلیوں سے



سیلاب اور دیگر صورتحال پر تفصیلی مشاورت کی،
اس مشاورت کے حوالے سے معلوم ہوا ہے کہ
موسمیاتی تبدیلی اور اس سے پیدا ہونے والے
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فوری تعمیر کے حوالے سے اقدام کرے گی۔
ذرائع نے بتایا کہ وفاقی حکومت اس

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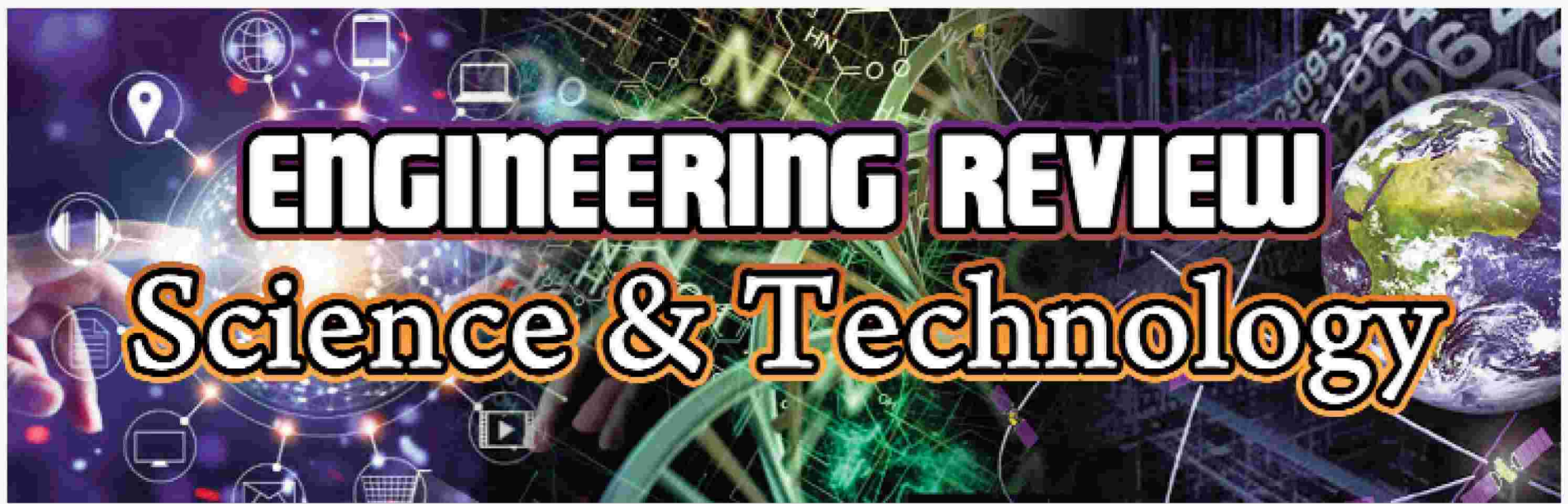
پاکستان ریلوے اور حکومت بلوچستان
کے درمیان پیلز ٹرین سروس کے آغاز پر اتفاق
کوئٹہ میں منعقدہ ایک اعلیٰ سطح کے اجلاس میں
حکومت بلوچستان اور پاکستان ریلوے کے
مابین پیلز ٹرین سروس کے آغاز پر اہم پیش
ہوئی ہے۔ یہ سروس سریاب سے کچلاک کے
درمیان چلائی جائے گی۔

اجلاس کی صدارت وزیر اعلیٰ بلوچستان
سرفراز بگٹی نے کی۔ اجلاس میں بتایا گیا کہ
مشاورت مکمل ہو چکی ہے اور عملی اقدامات کا
آغاز جلد کر دیا جائے گا۔ سرفراز بگٹی نے کہا کہ
وہ اس منصوبے کی ذاتی طور پر نگرانی کریں گے
اور کسی قسم کی تاخیر برداشت نہیں کی جائے گی۔
اس سروس کے لیے انجن اور بوگیاں بیرون

ملک سے درآمد کرنے کے بجائے پاکستان
ریلوے سے خریدی جائیں گی۔
وزیر ریلوے حنیف عباسی نے یقین
دہانی کرائی کہ چھ ماہ کے اندر انجن، بوگیاں اور
دیگر ضروری سہولیات فراہم کر دی جائیں
گی۔ اس سروس کے آغاز سے عام افراد اور
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The '100,000-year data gap': Researcher explains why robots lag behind AI chatbots

AI chatbots have advanced rapidly over the past few years, so much so that people are now using them as personal assistants, customer service representatives and even therapists.

The large language models (LLMs) that power these chatbots were created using machine learning algorithms trained on the vast troves of text data found on the internet. And their success has many tech leaders, including Elon Musk and NVIDIA CEO Jensen Huang, claiming that a similar approach will yield humanoid robots capable of performing surgery, replacing factory workers or serving as in-home butlers within a few short years.

But robotics experts disagree, says UC Berkeley roboticist Ken Goldberg. He is a professor of industrial engineering and operations research and William S. Floyd Jr. Distinguished Chair in Engineering at UC Berkeley.

In two new papers published online today (Aug. 27) in the journal *Science Robotics*, Goldberg describes how what he calls the "100,000-year data gap" will prevent robots from gaining real-world skills as quickly as AI chatbots are gaining language fluency.

In the second article, leading roboticists from MIT, Georgia Tech and ETH-Zurich summarize the heated debate among roboticists over whether the future of the field lies in collecting more data to train humanoid robots or relying on "good old-fashioned engineering" to program robots to complete real-world tasks.

Below, UC Berkeley News spoke with Goldberg about the "humanoid hype," the emerging paradigm shift in the robotics field and whether AI really is on the cusp of taking everyone's jobs.

Recently, tech leaders like Elon Musk have made claims about the future of humanoid robots, such as that robots will outshine human surgeons within the next five years. Do you agree

with these claims?

No; I agree that robots are advancing quickly but not that quickly. I think of it as hype because it's so far ahead of the robotic capabilities that researchers in the field are familiar with.

We're all very familiar with ChatGPT and all the amazing things it's doing for vision and language, but most researchers are very nervous about the analogy that most people have, which is that now that we've solved all these problems, we're ready to solve [humanoid robots], and it's going to happen next year.

should be able to do it, too. AI systems can play complex games like chess and Go better than humans, so it's understandable that people think, "Well, why can't they just pick up a glass?" It seems much easier than playing Go. But the fact is that picking up a glass requires that you have a very good perception of where the glass is in space, move your fingertips to that exact location and close your fingertips appropriately around the object. It turns out that's still extremely difficult.

In your new paper, you discuss what you call the

get the data from videos of humans—for instance, from YouTube—but looking at pictures of humans doing things doesn't tell you the actual detailed motions that the humans are performing, and going from 2D to 3D is generally very hard. So that doesn't solve it.

Another approach is to create data by running simulations of robot motions, and that actually does work pretty well for robots running and performing acrobatics. You can generate lots of data by having robots in simulation do backflips, and in some cases that transfers into real robots.

field without first creating all this data?

I believe that robotics is undergoing a paradigm shift, which is when science makes a big change—like going from physics to quantum physics—and the change is so massive that the field gets broken into two camps, and they battle it out for years. And we're in the midst of that kind of debate in robotics.

Most roboticists still believe in what I call good old-fashioned engineering, which is pretty much everything that we teach in engineering school: physics,

engineering, math and science are still important because they allow us to get these robots functional so that they can collect the data that we need.

This is a way to bootstrap the data collection process. For example, you could get a robot to perform a task well enough that people will buy it, and then collect data as it works.

Waymo, Google's self-driving car company, is doing that. They're collecting data every day from real robot cars and their cars are getting better and better over time.

That's also the story behind Ambi Robotics, which makes robots that sort packages. As they work in real warehouses, they collect data and improve over time.

In the past, there was a lot of fear that robotic automation would steal blue-collar factory jobs, and we've seen that happen to some extent. But with the rise of chatbots, now the discussion has shifted to the possibility of LLMs taking over white-collar jobs and creative professions. How do you think AI and robots will impact what jobs are available in the future?

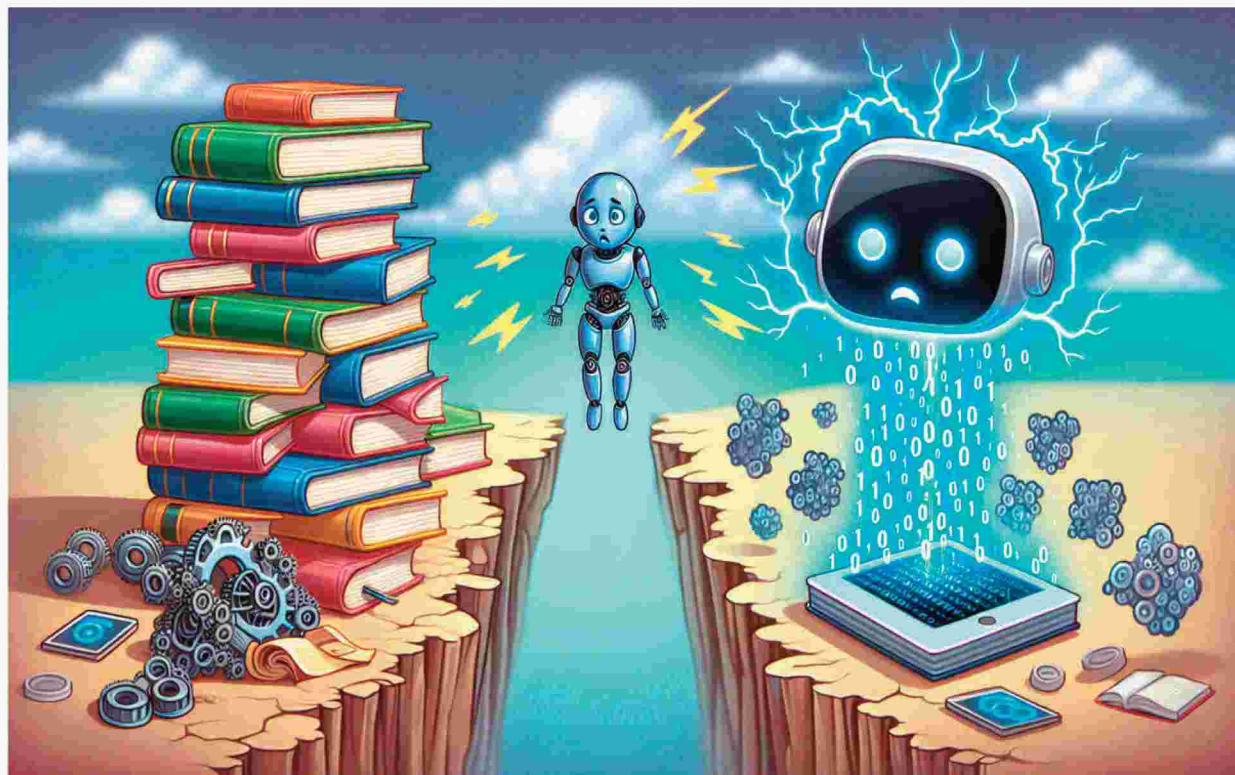
To my mind as a roboticist, the blue-collar jobs, the trades, are very safe. I don't think we're going to see robots doing those jobs for a long time.

But there are certain jobs—those that involve routinely filling out forms, such as intake at a hospital—that will be more automated.

One example that's very subtle is customer service. When you have a problem, like your flight got canceled, and you call the airline and a robot answers, you just get more frustrated. Many companies want to replace customer service jobs with robots, but the one thing a computer can't say to you is, "I know how you feel."

Another example is radiologists. Some claim that AI can read X-rays better than human doctors. But do you want a robot to inform you that you have cancer?

The fear that robots will run amok and steal our jobs has been around for centuries, but I'm confident that humans have many good years ahead—and most researchers agree. - TX



I'm not saying it's not going to happen, but I'm saying it's not going to happen in the next two years, or five years or even 10 years. We're just trying to reset expectations so that it doesn't create a bubble that could lead to a big backlash.

What are the limitations that will prevent us from having humanoid robots performing surgery or serving as personal butlers in the near future? What do they still really struggle with?

The big one is dexterity, the ability to manipulate objects. Things like being able to pick up a wine glass or change a light bulb. No robot can do that.

It's a paradox—we call it Moravec's paradox—because humans do this effortlessly, and so we think that robots

100,000-year "data gap." What is the data gap, and how does it contribute to this disparity between the language abilities of AI chatbots and the real-world dexterity of humanoid robots?

To calculate this data gap, I looked at how much text data exists on the internet and calculated how long it would take a human to sit down and read it all. I found it would take about 100,000 years. That's the amount of text used to train LLMs.

We don't have anywhere near that amount of data to train robots, and 100,000 years is just the amount of text that we have to train language models. We believe that training robots is much more complex, so we'll need much more data.

Some people think we can

But for dexterity—where the robot is actually doing something useful, like the tasks of a construction worker, plumber, electrician, kitchen worker or someone in a factory doing things with their hands—that has been very elusive, and simulation doesn't seem to work.

Currently people have been doing this thing called teleoperation, where humans operate a robot like a puppet so it can perform tasks. There are warehouses in China and the U.S. where humans are being paid to do this, but it's very tedious. And every eight hours of work gives you just eight more hours of data. It's going to take a long time to get to 100,000 years.

Do roboticists believe it is possible to advance the

math and models of the environment.

But there is a new dogma that claims that robots don't need any of those old tools and methods. They say that data is all we need to get us to fully functional humanoid robots.

This new wave is very inspiring. There is a lot of money behind it and a lot of younger-generation students and faculty members are in this new camp. Most newspapers, Elon Musk, Jensen Huang and many investors are completely sold on the new wave, but in the research field there's a raging debate between the old and new approaches to building robots.

What do you see as the way forward?

I've been advocating that

Predicting sudden traffic congestion in real time using optical fiber cables

NEC Corporation has developed an optical fiber sensing technology to monitor road conditions and accurately predict sudden traffic congestion in real time.

By collecting data from existing optical fiber communications cables and analyzing real-time traffic flow data using a proprietary AI model, the researchers have reduced prediction errors by 80% compared to conventional methods.

congestion mitigation and proactive avoidance, as well as highly accurate congestion prediction based on up-to-date data.

Current monitoring approaches primarily rely on point-based instruments, including cameras and loop detectors, as well as probe vehicle data. However, both have limitations: the former is costly to install and maintain over entire road networks, and the latter only provides data when equipped vehicles pass by specific receiver points, limiting real-time and continuous coverage. Moreover, existing congestion prediction

gestion.

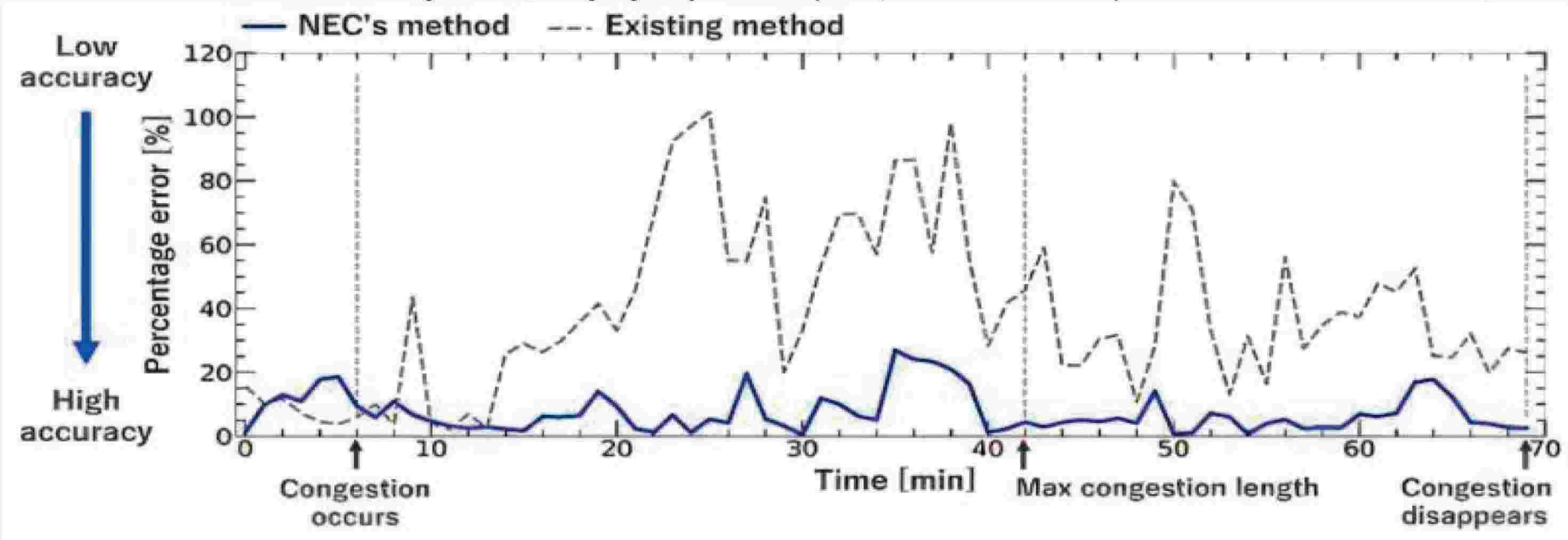
Technical features

NEC has developed a data assimilation algorithm that combines advanced model parameter optimization and data adapting techniques, enabling accurate simulations of real-time traffic flow using comprehensive data collected along the entirety of roadways.

The team has created an algorithm to optimize theoretical model parameters—such as driver behaviors (e.g., inter-vehicle distance adjustment)—so that simulations faithfully

travel time prediction errors (a key indicator for congestion forecasting) can be reduced by approximately 80% compared to the existing method that relies on cross-sectional data from point sensors such as cameras.

NEC is further advancing the realization of a dynamic road digital twin that enables real-time, network-wide traffic monitoring, the prediction of congestion evolution, and optimization of responsive measures. Real-world trials are currently underway in close collaboration with road authorities, with the



This technology enables effective traffic control, including the arrangement of detour routes, thereby contributing to the resolution of societal challenges such as logistics issues and CO2 emissions.

Technology overview

Traffic congestion is a significant social issue, threatening safety and causing substantial economic losses. In particular, congestion on expressways—the backbone of many logistics networks—has a significant economic impact. Addressing this issue requires real-time understanding of road conditions for both immediate

models heavily rely on long-term historical data, making it difficult to capture the emergence and propagation of sudden, unexpected congestion patterns.

To address these challenges, NEC has developed a technology that utilizes optical fiber cables—originally installed for communications purposes alongside roads—as extensive, distributed sensors for collecting real-time, continuous traffic flow data across entire routes. NEC's unique AI-powered model then provides real-time, high-precision predictions regarding the development and clearance of sudden con-

reproduce observed traffic flow data for entire road segments.

Data adaptation algorithm

An advanced algorithm converts diverse traffic flow data, including "average speed" and individual vehicle "position/speed," into formats compatible with simulation inputs. This makes it possible to set the initial conditions for simulations based on comprehensive traffic flow data obtained on entire routes, significantly enhancing the reliability of simulation outputs.

Through these innovations, the researchers have confirmed—using real-world data—that

goal of practical deployment by fiscal 2026.

This technology was developed using data provided by Central Nippon Expressway Company Limited (NEXCO CENTRAL) and was presented at the Transportation Research Board 104th Annual Meeting held in Washington D.C. January 5–9, 2025 as a paper titled "A Novel Approach to Real-Time Short-Term Traffic Prediction based on Distributed Fiber-Optic Sensing and Data Assimilation with a Stochastic Cell-Automata Model." It is available on the arXiv preprint server. - TX

From mushrooms to new architecture: The rise of living, self-healing buildings

EU researchers are cultivating fungi on agricultural waste to create smarter and greener construction materials able to adapt and react to their environment, and even repair themselves.

In his office in the Netherlands, Professor Han Wösten holds up a hard sponge-like block for show. It is a material he made in 2012 using the intricate rooting network of fungi. He has bold predictions about the potential of this stuff.

"Ten years from now, we should have the first fungal buildings," said Wösten, a professor of molecular biology at Utrecht University.

He is not talking about moldy walls, but something far more exciting—materials that are alive, sustainable, and full of potential.

Wösten studies how different fungi operate within a mycelium—nature's internet, a living network of threads that nourishes fungi and connects plants by sharing resources and information.

He is now engineering fungal "threads" into sustainable, biodegradable alternatives to plastic, wood and leather—materials already sparking new uses in fashion, furniture and construction.

Future-proof 'living' buildings

Wösten is part of a team of researchers from Belgium, Denmark, Greece, the Netherlands, Norway and the UK who are exploring a radical idea: what if the materials we build with could grow, repair themselves, and even sense their environment?

This research initiative, called Fungateria, is developing engineered living materials (ELMs) by fusing fungal mycelia with bacteria—creating adaptable, self-healing materials that do what conventional products cannot.

Unlike traditional materials like concrete or plastic, ELMs can grow, repair themselves, sense changes in their environment, and sometimes even adapt over time.

The researchers aim to design these materials so that they combine the strength of natural growth with the functionality of engineering. For example, walls that fix their own cracks, building blocks that absorb CO2, or surfaces that can clean the air.

The goal is to create sustainable, low-waste materials that work with nature instead of against it, opening the door to smarter, greener architecture and products.

"Already we can make leather-like materials or insulation panels from these extended fungal networks," said Wösten. "Now we want to go to the next stage and grow buildings, but in a controlled way."

Low waste, high efficiency

There are considerable savings to be made. The construction sector generates more than one third of the EU's total waste.

Greenhouse gas emissions from material extraction and manufacturing construction products, as well as construction and renovation of buildings, contribute an estimated 5% to 12% of the total national emissions of EU Member States. Greater material efficiency could save 80% of those emissions.

Crucially, while manufacturing concrete emits very large quantities of CO2 into the atmosphere, contributing to climate change, fungal-composite buildings could upcycle agricultural waste into building material while reducing carbon emissions.

The idea of living organisms in buildings may unsettle some people. But for Professor Phil Ayres, a pioneer in the field of biohybrid architecture at the Royal Danish Academy of Architecture, Design and Conservation in

Copenhagen, this is a social adaptation that will happen over time.

"We've eaten foods with living organisms for hundreds of years. We have only been looking at the potential applications of these organisms in the building sector for the last 20 years."

Ayres, who coordinates the work of the Fungateria research team, wants to overturn the dogma of his fellow architects that materials are controllable and have fixed properties.

"All constructions change over time in quite dramatic ways. If we began to think about buildings more like organisms in a continuous state, we might create architecture that is more ecologically connected," he said.

Bridging fields from microbiology to architecture and ethics, the researchers are also engaging the public through exhibitions like the Venice Biennale and workshops that challenge traditional ideas of what buildings can be.

Growth control

A mushroom in the forest is just the tip—hidden below it is a massive mycelium network, sometimes weighing tons.

For construction, the fungal hyphae—the thread-like filaments—can be encouraged to feed on agricultural waste to form a strong, lightweight and insulating composite. But controlling this growth is key to making safe, durable structures.

The fungal species being used by the researchers is the splitgill mushroom, or *Schizophyllum commune*. It primarily grows on dead wood, which poses a potential risk.

The growth of the mycelium needs to be stopped when the structure is completed so that it does not begin eating through wood supports.

One method uses nature's own signals:



light and temperature can cue the fungus to grow or stop. Another involves bacteria genetically engineered at the University of Ghent in Belgium.

These bacteria feed the fungus essential nutrients. Therefore, killing the bacteria halts fungal growth. The same bacteria can even be programmed to release antifungal compounds on command, providing an extra safety layer.

Future proof

Already, the Fungateria researchers, who will continue their collaboration until late-2026, have shown that the fungus can grow and survive under stressful conditions such as drought and high temperatures. That means it is resilient to the possible impact of changing climatic conditions.

The research team is already envisioning a time when buildings are made from wood and fungus matter grown on agricultural waste in a living process of construction.

"In the future, I can imagine that we will grow complete buildings where the wood will be the supporting structure and the fungus grows along and between the wood frames," said Wösten.

As global demand for sustainable solutions intensifies, this research points to a future where architecture is not just inspired by nature, but made of it—alive, adaptive and intertwined with the ecosystems around it. TX