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The Hindu Important News Articles & Editorial For UPSC CSE

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Page 03 : GS 3 : Science and Tech

India's space sector has undergone rapid liberalisation in recent years, with private start-ups increasingly encouraged to complement the capabilities of the Indian Space Research Organisation (ISRO). In this context, former ISRO Chairman S. Somanath's remarks highlighting the lack of innovation, over-reliance on classical design approaches, and poor integration of advanced technologies such as Artificial Intelligence (AI) and Digital Twins in aerostructure start-ups raise critical concerns about the quality and depth of India's aerospace innovation ecosystem.

Aerospace start-ups should shed 'classical approach' to innovation: former ISRO chief

The Hindu Bureau
BENGALURU

Former Indian Space Research Organisation Chairman S. Somanath on Thursday expressed concern over the competence and capability to innovate among start-ups and companies working in the domain of aerostructures.

Speaking at the International Conference on Advances in Computational and Experimental Approaches in Aerostructures, Mr. Somanath said, "I think it is a point of concern to me because I have been going around the country and looking at start-ups and companies that have been designing aerospace structures. Concerning hardware, especially in the domain of aerospace structures, I am not seeing that type of competence or that type of capability to innovate or do things differently than in the past."


S. Somanath

He added that "classical approaches still continue" and "integration of artificial intelligence [AI]" is not happening.

Mr. Somanath also said that he has also not been able to see much progress around digital twins – virtual replicas of physical parts – in the aerostructures sector.

"They also talk about digital twins, but I am not able to see digital twins in these domains (aerostructures) on a scale that should have actually happened... So, I think the conferences should debate, discuss what are the limitations and why collaboration is not happening," Mr. Somanath said.

Key Analysis

1. Persistence of "Classical Approach" in Aerostructures

Classical approaches refer to traditional, linear design and testing methods that rely heavily on physical prototyping, incremental improvements, and legacy engineering practices.

While these methods are reliable, they are time-consuming, cost-intensive, and less adaptable to complex modern aerospace requirements.

Globally, aerospace leaders are shifting toward model-based systems engineering (MBSE), generative design, and simulation-driven development, areas where Indian start-ups lag.

2. Limited Integration of Artificial Intelligence

AI can significantly enhance aerostructure design through:

Optimisation of material usage and weight reduction

Predictive maintenance and fault detection

Faster design iterations via machine learning-based simulations

Mr. Somanath's concern indicates that most Indian aerospace start-ups are not leveraging AI as a core design tool, but rather treating it as an auxiliary or theoretical concept.

3. Slow Adoption of Digital Twin Technology

Digital twins are virtual replicas of physical systems that allow real-time monitoring, testing, and optimisation across the life cycle of aerospace components.

Advanced space agencies and aerospace firms use digital twins to reduce failure risks, lower costs, and shorten development cycles.

The absence of scalable digital twin deployment in India's aerostructure sector reflects:

Gaps in high-quality data availability

Limited interdisciplinary collaboration between software, AI, and hardware engineers

Inadequate industry–academia–research linkages

4. Structural Issues in the Start-up Ecosystem

Many start-ups focus on manufacturing contracts rather than deep-tech innovation.

Risk-averse funding patterns and limited access to high-end testing infrastructure discourage disruptive experimentation.

Collaboration deficits among academia, industry, and government agencies restrict cross-pollination of ideas.

Significance for India

India's ambitions in human spaceflight, reusable launch vehicles, space stations, and defence aerospace systems demand cutting-edge aerostructure innovation.

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Without moving beyond legacy approaches, Indian start-ups risk becoming subcontractors rather than global technology leaders.

The issue also affects India's goal of becoming a self-reliant and competitive space economy under initiatives such as Atmanirbhar Bharat and IN-SPACe-led private participation.

Way Forward

Promote AI-first and digital twin–centric design frameworks through targeted funding and policy incentives.

Strengthen industry–academia–ISRO collaboration, especially in computational mechanics, materials science, and data-driven engineering.

Encourage conferences and platforms, as suggested by Mr. Somanath, to move beyond presentations toward problem-solving and collaborative innovation models.

Conclusion

S. Somanath's critique serves as a timely reality check for India's aerospace start-up ecosystem. While policy liberalisation has expanded participation, true technological leadership requires a shift from classical, hardware-centric approaches to integrated, digital, and AI-driven innovation models. Addressing these gaps is essential if India is to transition from a capable spacefaring nation to a global hub of advanced aerospace innovation.

UPSC Mains Practice Question

Ques : The future of aerospace innovation lies in integration of digital technologies rather than incremental improvements in hardware. Discuss this statement in light of India's emerging private space sector, with special reference to AI-driven design and digital twins. **(250 Words)**

Page 04 : GS 2 : International Relations / Prelims

India and the Netherlands have agreed to expand their security and defence cooperation, marking a significant step in strengthening their Strategic Partnership. During talks between India's Defence Minister Rajnath Singh and the Netherlands' Foreign Affairs Minister David van Weel in New Delhi, both sides emphasised co-development, co-production, and enhanced military-to-military engagement. This development reflects India's broader push to diversify defence partnerships and align them with emerging geopolitical and technological realities, particularly in the Indo-Pacific region.

Key Analysis

1. Strategic Significance of the Defence Partnership

The Netherlands is a technologically advanced European power with strengths in defence manufacturing, maritime security, cyber capabilities, and high-end engineering.

Deepening defence ties with the Netherlands complements India's engagement with the European Union and reduces over-dependence on a limited set of defence suppliers.

The exchange of a Letter of Intent on Defence Cooperation provides an institutional framework to ensure continuity and long-term collaboration.

2. Focus on Co-development and Co-production

Emphasis on co-development and co-production aligns with India's Atmanirbhar Bharat and defence indigenisation objectives.

Collaboration in niche and emerging technologies—such as advanced materials, sensors, naval systems, cyber and AI-enabled defence solutions—can enhance India's domestic defence industrial base.

A proposed defence industrial roadmap indicates a shift from buyer–seller relations to technology

India and the Netherlands agree to expand security, defence cooperation

The Hindu Bureau
NEW DELHI

Defence Minister Rajnath Singh met the Foreign Minister of the Netherlands, David van Weel, in New Delhi on Thursday, reaffirming the strong and steadily expanding defence partnership between the two nations.

During the meeting, both leaders held wide-ranging discussions on bilateral security and defence cooperation, including priority areas for the co-development and co-production of defence equipment, the Ministry of Defence stated.

The two countries reiterated their commitment to strengthening military-to-military engagement, and developing defence cooperation as a key pillar of the India-Netherlands Strategic Partnership.

The talks also underscored the shared commitment of India and the Netherlands to a free, open, inclusive, and rules-based Indo-Pacific region.

Emphasising the need for closer defence partnership, the Ministers highlighted the importance of connecting the defence industries of both countries, particularly in niche and emerging technologies.

A Letter of Intent on Defence Cooperation was exchanged to provide an institutional framework for advancing defence collaboration.

Both sides agreed to explore new avenues of cooperation through the development of a defence industrial road map focusing on technology collaboration, co-production, and co-development of defence platforms and equipment for mutual benefit.

Strong people-to-people ties form the foundation of the bilateral relationship, with the large Indian diaspora in the Netherlands acting as a living bridge.

Netherlands Foreign Affairs Minister David van Weel being received on his arrival in New Delhi on Thursday. PTI/@MEAINDIA

partnership models.

3. Indo-Pacific Dimension

Both countries reiterated commitment to a free, open, inclusive, and rules-based Indo-Pacific, a concept central to India's foreign and security policy.

For India, European engagement in the Indo-Pacific helps multilateralise regional security, counterbalance coercive actions, and uphold freedom of navigation and international law (UNCLOS).

The Netherlands' growing Indo-Pacific outreach adds strategic weight to India's regional vision.

4**. Defence Industry and Military-to-Military Engagement**

Strengthening military-to-military cooperation improves interoperability, training, and strategic trust.

Connecting defence industries encourages private-sector participation, innovation, and integration into global defence supply chains.

Such cooperation supports India's ambition to emerge as a defence manufacturing and export hub.

5. People-to-People Ties as a Strategic Asset

The Indian diaspora in the Netherlands acts as a soft-power bridge, reinforcing political trust and economic cooperation.

Strong societal linkages provide resilience to the bilateral relationship beyond formal agreements.

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Challenges and Considerations

Translating intent into outcomes requires clarity on technology transfer, intellectual property rights, and regulatory alignment.

Defence collaboration must be insulated from geopolitical pressures and competing alliance frameworks.

Sustained institutional coordination is necessary to avoid symbolic partnerships without substantive delivery.

Conclusion

The expansion of India–Netherlands defence cooperation reflects India's evolving strategic posture—one that prioritises technology-driven partnerships, diversification of defence ties, and alignment with like-minded democracies. If effectively implemented, this partnership can contribute not only to India's defence indigenisation and security preparedness but also to the broader goal of maintaining stability and rules-based order in the Indo-Pacific.

UPSC Prelims Practice Question

Ques : With reference to India–Netherlands defence cooperation, consider the following statements:

1. India and the Netherlands have agreed to promote co-development and co-production of defence equipment.

2. A Letter of Intent on Defence Cooperation was exchanged to provide an institutional framework for collaboration.

3. The defence partnership explicitly includes cooperation in emerging and niche technologies.

Which of the statements given above is/are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Ans : (d)

UPSC Mains Practice Question

Ques : Examine the strategic significance of India–Netherlands defence cooperation in the context of the Indo-Pacific region. What challenges may arise in translating defence agreements into tangible outcomes?

Page 06 & 07
Syllabus : GS 2 : Social Justice / Prelims

1. Rising Global Diabetes Burden: A Looming Public Health Challenge

The International Diabetes Federation's Diabetes Atlas (11th edition), published in The Lancet Diabetes & Endocrinology (2025), projects that the number of people living with diabetes will rise from about **580 million in 2024 to nearly 900 million by 2050**. The findings underline an unchecked global epidemic, with **middle-income countries**, including India, expected to bear the heaviest burden.

'900 million people will have diabetes by 2050, strong steps needed to slow progression'

Ramya Kannan
CHENNAI

In its projections for 2050, the 11th edition of the International Diabetes Federation's *Diabetes Atlas* has calculated that from around 500 million people living with diabetes in 2024, the number will grow to nearly 900 million people between the ages of 20 and 79.

Publishing the key results as an article in the peer-reviewed journal *Lancet Diabetes Endocrinal 2025*, the authors, who are scientists collaborating across the world, pointed out that in 2024, that figure was 11.11% of the population and just over 580 million adults. As per their projections, diabetes will affect 12.96% of the population – over 850 million people – in 2050. In the

Middle income countries will have the highest prevalence of diabetes, says the study.

paper, Irini Genitsaridi and other researchers say, "As the diabetes epidemic has continued unchecked since the turn of the millenium, stronger efforts are needed to slow down progression." A total of 210 countries and five territories were included in the study.

In 2024, more people with diabetes were living in urban areas (400 million) than in rural areas (189 million). The authors state that this trend would continue with the projection for 2050 for urban centres (655 million), but in rural areas, it is likely to remain almost the same (198 million) in 2050.

A. Ramachandran, one of the authors of the paper, from the India Diabetes Research Foundation, says "one of the unique features of this year's Atlas, is the table listing the top 10 countries of the world with diabetes load. China is right at the top of the table with about 148 million people with diabetes, and India comes up second on the table, with nearly 90 million. The United States comes third, and Pakistan, fourth.

In 2050, while China and India will maintain their top positions on the table, it is projected that Pakistan will climb to the third slot.

Core Analysis

Scale and Distribution of the Crisis

Diabetes prevalence is projected to increase from **11.11% (2024) to nearly 13% by 2050**.

Urban areas will continue to dominate the diabetes load, reflecting lifestyle changes, sedentary behaviour, and dietary transitions.

Rural prevalence remains stagnant, highlighting inequitable access to diagnosis and care rather than lower disease burden.

India's Position

India ranks **second globally**, with nearly **90 million people with diabetes**, after China.

By 2050, India will retain this position, signalling long-term stress on healthcare systems and productivity.

Implications for Development

Diabetes contributes to cardiovascular disease, kidney failure, and disability, increasing **out-of-pocket expenditure** and pushing households into poverty.

The trend threatens India's demographic dividend and Sustainable Development Goal (SDG) 3 on health.

Need for Stronger Interventions

Experts stress prevention through **lifestyle modification, early screening, and primary healthcare strengthening**.

Current efforts remain fragmented and treatment-focused rather than prevention-oriented.

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Conclusion

The projected diabetes surge represents not merely a medical issue but a **developmental and economic challenge**. For India and other middle-income countries, shifting from curative care to **preventive, population-wide strategies** is essential to slow progression and safeguard long-term human capital.

2. Intimate Partner Violence: An Under-recognised Public Health Crisis

A recent Lancet analysis using Global Burden of Disease (2023) data reframes **intimate partner violence (IPV)** as a major public health risk, particularly for women in South Asia. The study shows that IPV is a stronger determinant of poor health outcomes than obesity, smoking, or alcohol use, demanding a paradigm shift in how health systems respond to domestic violence.

Key Analysis

IPV as a Health Risk Factor

IPV is linked to mental disorders (PTSD, depression), chronic pain, cardiovascular disease, gastrointestinal disorders, and adverse reproductive outcomes.

It acts as a **chronic exposure**, accumulating harm over years rather than appearing as a single clinical event.

Why intimate partner violence is an under-recognised public health crisis

For women in South Asia, intimate partner violence is a greater risk factor for poor health than obesity, smoking, or alcohol use — placing violence among the leading drivers of disability and chronic illness; this situation demands a paradigm shift to view domestic violence as a risk factor that impacts health

Christianez Ratna Kiruba

When Meera (*name changed on request*) first sought medical help, she was 34, a mother of two, and visibly exhausted. She went to a doctor at a private clinic, complaining of tightness in her chest, a rapidly-beating heart, and episodes of intense panic that left her gasping for air. "The doctor ran some tests. Everything came back normal," Meera recalled. "She just gave me multivitamin tablets and told me it would get better."

It did not.

Over the next three years, Meera shuttled between multiple departments at a government hospital in Assam – general medicine, cardiology, psychiatry. Doctors continued to investigate. Her ECGs were normal. Blood tests showed mild anaemia. She was prescribed iron supplements, antacids for gastric discomfort, and eventually, sleeping pills to manage what was described as stress. It was only after a particularly severe episode, when Meera collapsed following an intense panic attack that someone noticed what was really happening. A junior doctor noticed her flinch when her husband answered questions on her behalf and asked to speak to her alone. What emerged was a long history of physical violence, marital rape, economic control, and threats.

Meera was not suffering from an inexplicable collection of symptoms. She was living with untreated post-traumatic stress disorder, and it had taken years for the health system to recognise it.

Call to action: A silent protest calling for an end to violence against women in Mumbai. Intimate partner violence has been identified as a significant and measurable contributor to a wide range of health issues. EMMANUAL YOGINI

THE GIST

- Intimate partner violence is an insidious exposure that accumulates over years, shaping mental illness, non-communicable diseases, and long-term disability rather than presenting as a single, identifiable event. Domestic violence is no longer a social issue but a risk factor that impacts health
- Studies show that women come to outpatient departments repeatedly with non-specific complaints that do not resolve — chronic pain, tiredness, inability to sleep etc. — but medical students are not taught to look for everyday violence
- Reframing intimate partner violence as a public health and chronic disease issue matters. It shifts the focus away from isolated incidents and moral judgment, toward it being seen for the long-term disability and preventable illnesses it causes. Without that shift, the health system will continue to manage diabetes, heart disease, anxiety, and depression — while remaining blind to the violence that fuels them

The burden of violence

Meera's trajectory through India's health system mirrors what a recent Lancet analysis now describes as a global, yet under-recognised, public health failure. Drawing on data from the Global Burden of Disease Study 2023, the paper identifies intimate partner violence as a significant and measurable contributor to a wide range of health outcomes, including post-traumatic stress disorder, depression and anxiety, suicide, chronic pain, cardiovascular disease, gastrointestinal disorders, substance use, sexually transmitted infections, and adverse reproductive outcomes.

For women of reproductive age in South Asia, the analysis finds that intimate partner violence is a greater risk factor for poor health than high fasting plasma glucose, obesity, smoking, or alcohol use – placing violence among the leading drivers of disability and chronic illness.

This enables a crucial paradigm shift. Domestic violence is no longer a social issue but a risk factor that impacts health.

Intimate partner violence is an insidious exposure that accumulates over years, shaping mental illness, non-communicable disease, and long-term disability rather than presenting as a single, identifiable event.

This reframing also helps explain why violence so often remains invisible within the health system – even to the women living through it.

A.K. Jayashree, head, department of community medicine at the Government Medical College in Kannur, Kerala, began her career volunteering with organisations, interacting with a large number of women subjected to intimate partner violence. But when she entered formal medical education as a teacher in 2009, she was struck by how little of this knowledge had translated into training. What was being taught to medical students neither reflected the realities she had seen on the ground, nor did it take into account evidence generated by decades of research.

Studies show that women come to outpatient departments repeatedly with non-specific complaints that do not resolve – chronic pain, tiredness, inability to sleep etc. – but medical students are not taught to look for everyday violence. As a result doctors are often unprepared for what they encounter in real-world settings: women may arrive at emergency departments after being beaten, accompanied by husbands or in-laws who answer questions on their behalf. Junior doctors may sense something is wrong but lack the training to ask safely, document accurately, or refer appropriately.

What information does reach medical students is fragmented. "Most of it is confined to forensic medicine, as a legal and evidentiary exercise," Dr. Jayashree says. "It is not taught in clinical subjects that actually shape how doctors practise."

Nancy Angeline Gnanaselvam, assistant professor of community medicine at St. John's Medical College, Bengaluru, says the women most visible to the system are not representative of those living with intimate partner violence. "What we see in crisis centres or one-stop facilities are usually women in extreme distress, often brought in by the police after calling helplines or when neighbours report the violence," she says.

Invisible group

The much larger, invisible group, she explains, are women who continue to live with their partners and do not want to file complaints or leave home. "They come with diabetes, hypertension, anxiety, and chronic pain. And we don't recognise what we are seeing." Intimate partner violence remains poorly understood within medicine because it sits at the uneasy intersection of healthcare, social services, and law enforcement, Dr. Nancy adds.

Even when violence is suspected however, care pathways frequently collapse.

Referrals to psychiatry or other mental health services are often resisted by families or blocked altogether. The physicians, who are the only people the women have safe access to, receive little training in even basic mental healthcare, let alone trauma-informed care. "So the woman remains treated symptom by symptom, while the cause remains untouched," says Dr. Nancy.

For Dr. Nancy, this is why reframing intimate partner violence as a public health and chronic disease issue matters. It shifts the focus away from isolated incidents and moral judgment, toward recognising the long-term disability and preventable illnesses it causes. Without that shift, she argues, the health system will continue to manage diabetes, heart disease, anxiety, and depression – while remaining blind to the violence that fuels them.

At this point, says Dr. Nancy, the official training to deal with issues faced by women in the National Medical Council curriculum is a one-hour lecture. According to her, gender must be an ongoing conversation brought up again and again in various health contexts. "This needs to make it into the curriculum of nurses, psychologists and other healthcare workers as well," adds Dr. Jayashree.

Beginning conversations

Last month, at the Sree Uthradom Thirunal Academy of Medical Sciences in Thiruvananthapuram, a panel discussion brought doctors together to talk about intimate partner violence.

The discussion did not frame violence in the language of chronic disease or disability. But its significance lay elsewhere: in the acknowledgement that domestic violence is not external to healthcare.

The conversation was a nod toward to shift that is now happening: moving intimate partner violence out of the margins of emergency care and social work, and into the core of how medicine understands illness, risk, and long-term health.

(Dr. Christianez Ratna Kiruba is an internal medicine doctor, with a passion for patient rights advocacy. christianezlennis@gmail.com)

Health System Blind Spots

Women frequently present with non-specific symptoms such as anxiety, fatigue, and chronic pain, which are treated symptomatically.

Medical education largely confines IPV to forensic or legal contexts, leaving clinicians ill-equipped to identify or manage it in routine care.

Structural and Institutional Gaps

Lack of trauma-informed care, weak referral pathways, and family resistance prevent effective intervention.

IPV lies at the intersection of healthcare, law enforcement, and social services, leading to fragmented accountability.

Public Health Implications

Failure to recognise IPV perpetuates preventable non-communicable diseases and long-term disability among women.

Treating diabetes, hypertension, and mental illness without addressing underlying violence leads to poor outcomes.

Conclusion

Recognising intimate partner violence as a **public health and chronic disease risk factor** is crucial for effective healthcare delivery. Integrating IPV screening, trauma-informed care, and gender-sensitive training into medical education and primary healthcare can transform responses from reactive to preventive, advancing both women's health and social justice.

UPSC Mains Practice Question

Ques: Intimate Partner Violence (IPV) is increasingly being recognised as a major public health risk rather than merely a social or legal issue. Examine how IPV contributes to chronic illness and disability among women in India, and evaluate the limitations of the existing health system response. **(150 Words)**

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Page 10 : GS 3 : Science and Tech / Prelims

On December 15, the Ministry of Electronics and Information Technology (MeitY) announced the launch of DHRUV64, a 64-bit indigenous microprocessor developed under India's Microprocessor Development Programme. The announcement reflects India's strategic intent to reduce dependence on imported semiconductor technologies and strengthen technological sovereignty amid global supply-chain disruptions and geopolitical uncertainties.

Inside the DHRUV64 microprocessor

Who developed the DHRUV64 chip? What are the other chips within India's ecosystem of processors? What aspects have the Ministry of Electronics and Information Technology not revealed about DHRUV64? What are some schemes started by the government to advance indigenous fab technologies?

EXPLAINER

Vasudevan Mukunth

The story so far:

On December 15, the Ministry of Electronics and Information Technology (MEITY) announced the launch of DHRUV64, an indigenous microprocessor that it said would strengthen the national indigenous processor pipeline. Its purported applications span the breadth of electronics to industrial automation.

What is DHRUV64?

The DHRUV64 chip is a fully indigenous microprocessor developed by the Centre for Development of Advanced Computing (C-DAC) under MEITY's Microprocessor Development Programme.

The microprocessor is a general-purpose 'brain' for electronics – a 64-bit, dual-core processor that runs at 1 GHz. These specifications could mean the processor is fast enough to run operating systems while also being efficient enough for embedded deployment.

India is a major market for processors yet continues to depend on imported designs and supply chains. To this end the Indian government has pitched for a "homegrown processor technology". Such processors sit at the base of everything from telecom networks to industrial control. So whoever controls their design, toolchain, and update pathways will also control security assumptions and resilience during export controls or supply shocks.

What do DHRUV64's specs mean?

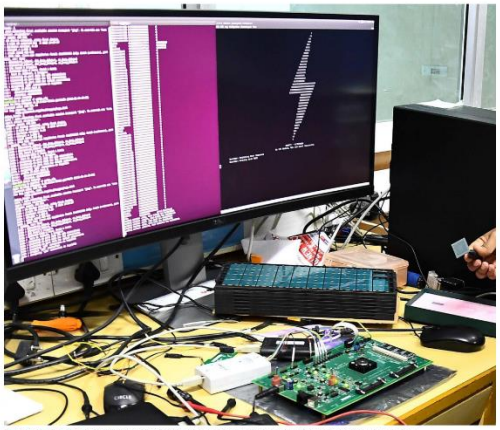
DHRUV64 is not a chip meant only for simple sensing or appliance logic. In general, 64-bit designs are used when users want modern operating systems and contemporary software.

The specified performance is low compared to top-tier consumer standards. Today's state-of-the-art smartphone and laptop processors tend to combine many more CPU cores with higher peak clock speeds. They also include specialised blocks like Graphic Processing Units (GPUs), which can efficiently handle machine-learning workloads.

This said, a lot of contemporary computing in the modern economy doesn't demand top-line CPUs. These applications include base station subsystems in telecommunications, industrial controllers, routers, and many automotive modules. They prize reliability and better hardware-software integration. At the same time, as the technology publication *The Register* wrote, "Those are fields in which established chipmakers already offer mature products, and accompanying software and hardware development ecosystems. Even the most patriotic Indian electronics manufacturer would surely find it hard to put the DHRUV64 at the top of their bill of materials shopping list. India therefore has plenty left to do if DHRUV64 is going to win customers."

What processors is India working on?

According to MEITY, DHRUV64 is part of India's ecosystem of processors, including SHAKTI from IIT-Madras, AJIT from IIT-Bombay, VIKRAM from the ISRO-Semiconductor Lab, and THEJAS64 from C-DAC (2025). The needs these processors address include strategic operations, control systems in factories, spaceflight systems, and industrial automation. MEITY has also pitched DHRUV64 as a platform on which startups, academia, and industry can build and test products on, "without relying on foreign processors", and can develop prototypes for new system architectures at lower cost. This is commendable because all processors everywhere, from the Intel Core series to the Espressif processors in DIY electronics, only succeed when they have an ecosystem around them.



Another breakthrough: Team Shakti at work on the microprocessor project RISECREEK at IIT-Madras in Chennai in 2018. FILE PHOTO

What is DHRUV?

RISC-V (pronounced "risk five") is a set of basic instructions that a processor understands. A processor is like a cook who can only make the dishes written down in a recipe book. This book is the instruction set: it lists commands like "add two numbers", "move data from memory", "compare two values", "jump to another step in a program", etc.

RISC-V is an open instruction set, which means its core rules are publicly available and anyone can design a chip that follows them without paying a licence fee for the instruction set itself. This is different from instruction sets that are controlled by a company and licensed to others. There the chip designers will need to purchase licences, sign contracts, etc. This is why governments and research groups sometimes prefer RISC-V.

RISC-V is also modular: designers can start with a small, standard core, then add extra features like faster arithmetics or security features depending on what the chip is meant for. Put differently, different chips can speak the same base language while still being fine-tuned for different tasks. DHRUV64 is tied to the Digital India RISC-V (DIR-V) programme, which aims to build a portfolio of RISC-V-based microprocessors for industry, military, and consumer technologies. THEJAS32 was the first India-designed chip DIR-V chip to be fabricated (in Malaysia) and THEJAS64 was the second, made at SCL, Mohali. DHRUV64 is the third on this list. However, MEITY hasn't said where DHRUV64 was fabricated, which leaves doubts about the supply chain.

What is not known about DHRUV64?

MEITY's announcement of DHRUV64 is thin on the engineering information required to judge the chip's readiness. There are five issues in particular.

First, the claim about the chip's performance hasn't been contextualised in measurable terms. The headline specs, that is, 1 GHz, 64-bit, dual-core, are not accompanied by benchmarks, details of the memory subsystem (for example, cache sizes and memory controller features), input/output capabilities, and the performance per watt. The MEITY statement also says the design includes "modern architectural features" and "enhanced multitasking capability" but doesn't specify what they entail.

Second, the statement claims the processor's "modern fabrication leverages technologies used for high-performance chips" but doesn't specify the foundry, packaging, yields or reliability targets. Applications in the telecommunications and automotive sectors require these details because they're used to determine the chip's lifecycle availability and failure rates.

Third, MEITY's claim that the chip is "fully indigenous" is ambiguous. The note highlights RISC-V's open architecture and "no licence costs". However "indigenous" can also mean an indigenous instruction set, indigenous core microarchitecture, indigenous system-on-chip integration, indigenous toolchain, indigenous fabrication or indigenous ownership of critical IP blocks.

Fourth, the announcement doesn't address questions relevant to an Original Equipment Manufacturer (OEM), for example, when developer boards will ship, which operating systems are supported, what security features and audit mechanisms the chip has, and whether the government plans to use them in anchor scenarios (where by using them it will reduce the risks associated with adoption).

Fifth, the development roadmap is not clear. The statement says C-DAC's next indigenous chip will be 'DHANUSH' and 'DHANUSH+'; they appear to currently be in the engineering or design stage.

The MEITY statement indicated DHANUSH will be a 1.2-GHz quad-core processor and that DHANUSH+ will be a 2-GHz quad-core processor. One 2023 C-DAC document also reported that DHANUSH will have a process node – a figure denoting the transistors' size – of 28 nm. *The Register* reported that DHANUSH+'s would be 14 or 16 nm.

What comes next?

India has been focusing on schemes to widen talent and the scope for start-ups. The 'Chips to Startup' programme, with an outlay of ₹250 crore over five years; the Design Linked Incentive scheme; and the INUP-i2i initiative are intended to improve access to nanofabrication facilities and training. As of 2025, the India Semiconductor Mission has also approved 10 projects in six States with investments of ₹1.6 lakh crore.

Against this backdrop, the government's plan for DHRUV64 seems to be a move towards system-on-chip families, more reference designs, better software support, and sufficient manufacturing and testing capacity for domestic products. The end goal is for Indian consumers to choose an Indian chip without assuming unacceptable costs or risk.

THE GIST

- The DHRUV64 chip is a fully indigenous microprocessor developed by the Centre for Development of Advanced Computing (C-DAC) under MEITY's Microprocessor Development Programme.
- DHRUV64 is tied to the Digital India RISC-V (DIR-V) programme, which aims to build a portfolio of RISC-V-based microprocessors for industry, military, and consumer technologies.
- The 'Chips to Startup' programme, with an outlay of ₹250 crore over five years; the Design Linked Incentive scheme; and the INUP-i2i initiative are intended to improve access to nanofabrication facilities and training.

Background and Key Features

Developer:

DHRUV64 has been developed by the Centre for Development of Advanced Computing (C-DAC) under MeitY.

Technical Overview:

64-bit, dual-core processor

Clock speed: 1 GHz

General-purpose design

Intended for embedded systems, industrial automation, telecommunications, and strategic applications

Strategic Rationale: Microprocessors form the backbone of modern electronics—from telecom infrastructure to industrial control systems. Dependence on foreign processors creates vulnerabilities related to supply shocks, export controls, cybersecurity, and technology denial regimes.

India's Indigenous Processor Ecosystem

DHRUV64 is part of a broader indigenous processor ecosystem, including:

SHAKTI – IIT Madras (RISC-V based, strategic and academic use)

AJIT – IIT Bombay (safety-critical and aerospace applications)

VIKRAM – ISRO–Semiconductor Laboratory (space systems)

THEJAS32 / THEJAS64 – C-DAC (under Digital India RISC-V programme)

Together, these processors address needs ranging from space and defence to industrial automation and academic research.

Role of RISC-V and DIR-V

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RISC-V is an open-source Instruction Set Architecture (ISA), allowing countries to design processors without paying licensing fees.

DHRUV64 is part of the Digital India RISC-V (DIR-V) initiative, aimed at creating a portfolio of RISC-V processors for civilian and strategic use.

Open architecture supports customisation, security auditing, and long-term strategic autonomy.

Critical Gaps and Unanswered Questions

Despite its strategic importance, MeitY's announcement leaves several concerns unaddressed:

Lack of Performance Benchmarks

No data on real-world performance, power efficiency, cache design, memory bandwidth, or I/O capabilities.

Fabrication Ambiguity

The fabrication location and foundry details are undisclosed, raising concerns about supply-chain indigenisation.

Ambiguity of "Fully Indigenous"

It is unclear whether indigenisation applies to:

Core microarchitecture

SoC integration

Fabrication

Toolchains

Critical IP blocks

Ecosystem Readiness

No clarity on:

Developer boards

OS support (Linux, RTOS, etc.)

Security certifications

Government-backed anchor customers

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Roadmap Uncertainty

Future processors DHANUSH (28 nm) and DHANUSH+ (14–16 nm) have been announced, but timelines and manufacturing readiness remain unclear.

Government Schemes Supporting Indigenous Semiconductor Development

To address structural gaps, the government has launched multiple initiatives:

Chips to Startup (C2S) Programme – ₹250 crore to build chip design talent

Design Linked Incentive (DLI) Scheme – incentives for semiconductor design startups

INUP-i2i – access to nanofabrication facilities for academia and industry

India Semiconductor Mission (ISM) –

₹1.6 lakh crore investment

10 approved projects across six states (as of 2025)

These schemes aim to strengthen design capability, fabrication capacity, and human capital.

Conclusion

DHRUV64 represents an important milestone in India's pursuit of technological self-reliance in semiconductors, particularly in processor design. However, for it to transition from a symbolic achievement to a commercially and strategically viable product, greater transparency, ecosystem support, fabrication clarity, and anchor adoption by government and public sector units are essential.

In the long run, India's success in indigenous processors will depend not merely on designing chips, but on building a complete, trusted semiconductor value chain—from design and fabrication to software, testing, and market adoption. DHRUV64 is a step forward, but the journey towards true semiconductor sovereignty is still underway.

UPSC Prelims Practice Question

Ques : With reference to the DHRUV64 microprocessor, consider the following statements:

1. DHRUV64 is a 64-bit dual-core general-purpose processor developed by C-DAC under the Ministry of Electronics and Information Technology.

2. It is based on the RISC-V instruction set architecture and is part of the Digital India RISC-V (DIR-V) programme.

3. DHRUV64 has been fabricated at the Semiconductor Laboratory (SCL), Mohali**.**

Which of the statements given above is/are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Ans : a)

UPSC Mains Practice Question

Ques : Examine the significance of the Digital India RISC-V (DIR-V) programme in strengthening India's semiconductor ecosystem. Highlight the challenges that limit the commercial adoption of indigenous processors like DHRUV64. **(150 Words)**

Page 12 : GS 3 : Indian Economy

In December 2025, the Union Finance Minister tabled the **Securities Market Code Bill, 2025** in the Lok Sabha, marking a major step towards reforming India's securities market regulation. The Bill seeks to consolidate three key laws governing the capital market into a single, modern legal framework and has been referred to the **Standing Committee on Finance** for detailed scrutiny.

FM tables Securities Market Code Bill 2025 in Lok Sabha

The Bill, which seeks to unify three laws governing the securities market, has been referred to the Standing Committee on Finance for review

Ashokamithran T.
MUMBAI


Union Finance Minister Nirmala Sitharaman speaks in Lok Sabha during the Winter session of Parliament on Thursday. PTI

Finance Minister Nirmala Sitharaman on Thursday tabled the Securities Market Code Bill 2025 in the Lok Sabha.

The Bill, which seeks to unify three laws governing securities market, was referred to the Standing Committee on Finance for review.

The Bill proposes to consolidate the Securities Contracts (Regulation) Act, 1956, Securities and Exchange Board of India (SEBI) Act, 1992, and the Depositories Act, 1996.

The move was announced in the Union Budget in 2021-22 and the Bill has now been tabled to rationalise and consolidate the existing provisions, and provides a modern regulatory framework for investor protection and capital mobilisation at scale, according to the statement of objectives in the Bill.

As per the Bill, the government proposes to increase the number of members in SEBI to 15 from the current nine, including the Chairperson.

This will include the Chairperson, two officers appointed by the Central Government and one from the RBI as ex-officio members, and 11 others, of whom at least five will be whole-time members. Currently there are three whole-time members.

In another significant change, Union Government also proposed to decriminalise violations of "minor, procedural and technical nature" into civil penalties to "facilitate the ease of doing business and to reduce the compliance burden."

Civil penalties

The Bill, if enacted in its current form, would bring "unlawful gains or losses" under civil penalties and limit punishments only to cases of market abuse such as insider trading or trading while in possession of material or non-public information. Further, in the case of contravention of any rules or provisions of the code, no inspection can be done if eight years had passed from the date of contravention. The Bill also mandates that the members of the board disclose any direct or indirect interests before making a decision to eliminate conflict of interest.

"These changes appear to be made in keeping with extant requirements balancing faster adjudication processes with the need for better deterrence," said Paras Parekh, Partner at CMS INDUSLAW.

Even as the Bill was being introduced, DMK MP Arun Nehru and Congress' Manish Tewari opposed it saying it gave excessive powers to a single body, which was against the principle of the separation of powers.

Responding to this, Ms. Sitharaman said that since the government was referring it to the standing committee, such details could be discussed by the panel.

(With inputs from Sreeparna Chakrabarty)

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Background and Objectives

The Bill was first announced in the **Union Budget 2021–22**, reflecting the government's long-term intent to simplify and rationalise financial sector laws. India's securities market is currently governed by multiple legislations enacted at different times, leading to regulatory overlaps, compliance complexity, and fragmented enforcement.

Primary objectives of the Bill include:

Strengthening investor protection

Facilitating capital mobilisation at scale

Improving ease of doing business

Modernising regulatory and enforcement mechanisms

Key Provisions of the Bill

1. Consolidation of Laws

The Bill seeks to unify:

Securities Contracts (Regulation) Act, 1956

SEBI Act, 1992

Depositories Act, 1996

This consolidation aims to create a **single Securities Market Code**, reducing legal ambiguity and duplication.

2. Strengthening SEBI's Institutional Capacity

SEBI's Board strength to be increased from **9 to 15 members**.

Composition to include:

Chairperson

Two Central Government nominees

One RBI nominee (ex-officio)

11 other members, with **at least five whole-time members**

This reflects the growing complexity and size of India's capital markets.

3. Decriminalisation of Minor Violations

Minor, procedural, and technical violations to be shifted from criminal prosecution to **civil penalties**.

Criminal punishment to be restricted to serious offences such as:

Insider trading

Market manipulation

Trading on material non-public information

This aligns with broader economic reforms aimed at **reducing regulatory fear and compliance burden**.

4. Civil Penalties and Time Limitation

"Unlawful gains or losses" to attract civil penalties.

No inspection permitted if **eight years** have elapsed since the date of contravention.

This introduces certainty and predictability for market participants.

5. Conflict of Interest Safeguards

Mandatory disclosure of **direct or indirect interests** by SEBI board members before decision-making.

Aimed at enhancing transparency and regulatory credibility.

Significance of the Bill

Investor Confidence: A clearer, predictable regulatory framework can enhance domestic and foreign investor trust.

Capital Market Deepening: Simplified regulation supports long-term goals of financialisation of savings and capital formation.

Ease of Doing Business: Decriminalisation reduces fear of prosecution for technical lapses.

Regulatory Efficiency: Consolidation improves enforcement consistency and adjudication speed.

Concerns and Criticisms

Concentration of Power: Opposition members raised concerns that the Bill grants excessive authority to SEBI, potentially violating the principle of **separation of powers**.

Regulatory Overreach: Expanded powers without adequate checks may affect accountability.

Parliamentary Oversight: The effectiveness of safeguards will depend on the recommendations of the Standing Committee.

These concerns highlight the need for **robust checks and balances** within the regulatory framework.

Conclusion

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The Securities Market Code Bill, 2025 represents a **structural reform in India's capital market regulation**, aiming to align the legal framework with the needs of a fast-growing and increasingly sophisticated economy. While the consolidation of laws and decriminalisation of minor offences are progressive steps, concerns regarding regulatory concentration and accountability warrant careful parliamentary scrutiny.

If implemented with adequate safeguards, the Bill has the potential to strengthen investor protection, enhance market efficiency, and support India's ambition of becoming a **global financial hub**, while maintaining regulatory balance and institutional integrity.

Page : 08 : Editorial Analysis

A bold step amid an ambitious nuclear energy target

R.B. Grover

is Distinguished Professor Emeritus, Homi Bhabha National Institute, and Member, Atomic Energy Commission

The SHANTI Bill, 2025, will help India's nuclear energy plans

Human development correlates with energy consumption. In a seminal paper published in *Scientific American* in 1971, Earl Cook traced the growth in per capita energy consumption through stages, from primitive to technological man. The primitive man needed energy only for food. The energy needs for home and commerce were added at the hunting stage. When humans became agriculturists, their energy needs also arose from industry, agriculture and transportation. The energy needs for food, home, commerce, agriculture and transportation continued to increase through the industrial and technological stages. The present era belongs to digital technologies, and the digitalisation of the economy demands additional energy.

Growth rate and generation

The metric "Human Development Index (HDI)" is a fair representation of human development. It combines three important indicators, *viz.*, per capita income, education and health. Using the correlation between HDI and per capita Final Energy Consumption (FEC), one can determine the level of energy needed to reach a specific HDI.

As a member of the G-20 grouping, India rubs shoulders with countries that have an HDI above 0.9. Estimates indicate that to reach 0.9, and considering further improvements in energy efficiency and electrification of end uses, India will need to generate about 24,000 Terra-Watt-Hours (TWh) per annum (*Curr. Sci.*, 2022, 122(5), 517-527). As a part of it, about 60% will be used as electricity, and the rest to generate hydrogen in electrolysers. Hydrogen is needed to decarbonise sectors such as the production of steel, fertilizers and plastics. When alternative processes for producing hydrogen are developed at scale, less electricity will be needed.

The generation in 2023-24 was about 1,950 TWh, and the CAGR in the recent past has been about 4.8%. Maintaining a growth rate at about this level, it would be possible to generate 24,000 TWh per annum in four to five decades. However, there are two complexities. First, India has to decarbonise its energy mix. Therefore, the growth in electricity generation must be accompanied by end-use electrification and a redesign of the energy mix.

The present share of electricity in the FEC is about 22% and must rise significantly. The present energy mix is one that is heavily reliant on fossil fuels, and has to be replaced by energy sources that do not emit carbon. That implies that India has to generate more using hydro, nuclear, solar and wind power.

The decarbonised energy mix

In India, hydro and wind potential in India is limited. India is densely populated and it precludes diverting large tracts of land for the deployment of solar photovoltaic. While the full potential of hydro, solar and wind must be exploited, their potential is insufficient to provide the energy level necessary to achieve an HDI above 0.9. Therefore, nuclear generation has to be ramped up. Until that is done, India will have to continue exploiting fossil fuels.

Second, solar and wind are intermittent sources. Electricity generated by photovoltaic cells or windmills is variable. Therefore, to match electricity supply with demand, it must be stored when it is in excess and augmented when generation is less than demand. Storage is expensive and providing storage to address seasonal variations in solar and wind is prohibitively expensive. To provide affordable electricity to consumers, the electricity mix must have sufficient baseload generation capacity – that is, generation that is not dependent on seasons or time of day. Nuclear power plants are base-load and must be a part of a decarbonised energy mix.

Realising this imperative, the units of the Department of Atomic Energy, in cooperation with Indian industry, have been working to harness nuclear energy in a manner so that the complete supply chain is indigenous. It is only uranium that has to be imported as India does not have enough uranium. India has developed technology for fabricating fuel, producing heavy water, and manufacturing all the equipment that is needed to support the construction of Pressurised Heavy Water Reactors (PHWRs). The Nuclear Power Corporation of India Limited has mastered the design and operation of PHWRs of various ratings, the highest being 700 MW. Three 700 MW units are already working, and the fourth is about to be completed. Two more are in an advanced stage of construction. In 2017, the central government sanctioned the construction of 10 700 MW PHWRs and work on these units is progressing.

A regulatory body was established in the 1980s and has developed the capability and capacity to regulate nuclear power plants. The Bhabha Atomic Research Centre has developed technologies to reprocess spent nuclear fuel to recover valuable materials and handle nuclear waste. As a result of these efforts, nuclear power generation is a technically-feasible, affordable and safe option for India.

The SHANTI Bill

These successes have emboldened the central government to set a target of 100 GW of nuclear installed capacity by mid-century. Both Houses of Parliament have passed The Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India (SHANTI) Bill, 2025. The Bill is an overarching piece of legislation and combines provisions included in the Atomic Energy Act, 1962, and the Civil Liability for Nuclear Damage Act, 2010. It says that the existing Atomic Energy Regulatory Board "shall be deemed to have been constituted under this Act". The Bill ensures that the prime responsibility for safety, security and safeguards lies with the licensee of the facility.

The target set for nuclear energy is ambitious. The Bill passed by Parliament is a bold step. India needs ambitious targets and bold steps to become a developed country.

GS Paper 2 : International Relations

UPSC Mains Practice Question : Human development is closely linked to energy availability and the nature of the energy mix. In this context, examine the role of nuclear energy in achieving India's long-term development and decarbonisation goals. Discuss the significance of the SHANTI Bill, 2025, in strengthening India's nuclear energy framework. (150 words)

Context :

Energy consumption is a critical determinant of human development. As India aspires to transition into a developed economy with a **Human Development Index (HDI) above 0.9**, the scale, reliability, and sustainability of its energy supply become decisive factors. In this context, the passage of the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India (SHANTI) Bill, 2025 marks a significant policy intervention aimed at expanding nuclear energy as a core component of India's long-term, low-carbon energy strategy.

Key Analysis

1. Energy–Human Development Linkage

Empirical evidence shows a strong correlation between per capita Final Energy Consumption (FEC) and HDI.

Estimates suggest that to reach an HDI of 0.9, India would require nearly 24,000 TWh of annual energy generation, a more than tenfold increase from the current level (~1,950 TWh in 2023–24).

This growth must occur alongside decarbonisation and electrification of end-use sectors, including industry, transport, and hydrogen production.

2. Limits of Renewable Energy Alone

While solar, wind, and hydro are essential for decarbonisation, their potential in India is constrained by:

Land availability in a densely populated country

Geographical and ecological limits to large hydro expansion

Intermittency of solar and wind, leading to reliability challenges

Large-scale energy storage to address daily and seasonal variability remains technologically and economically prohibitive at present.

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3. Strategic Role of Nuclear Energy

Nuclear power provides baseload electricity, independent of weather or time of day, making it indispensable in a stable, decarbonised energy mix.

India has developed strong indigenous capabilities across the nuclear fuel cycle, including reactor design (PHWRs), fuel fabrication, heavy water production, waste management, and regulatory oversight.

With multiple 700 MW PHWR units operational or under construction, nuclear energy is technically feasible, scalable, and cost-competitive for India.

4. SHANTI Bill, 2025: Key Significance

The Bill consolidates earlier legal frameworks, including the Atomic Energy Act, 1962, and the Civil Liability for Nuclear Damage Act, 2010, providing regulatory clarity.

It formally recognises the Atomic Energy Regulatory Board under the new law, strengthening institutional continuity.

The legislation reinforces the principle that primary responsibility for safety and security lies with the licensee, aligning India with global nuclear governance norms.

The target of 100 GW nuclear capacity by mid-century signals long-term policy commitment and investor confidence.

5. Developmental and Climate Implications

Nuclear energy supports India's commitments under the Paris Agreement and its net-zero aspirations.

It enables clean electricity for hydrogen production, crucial for decarbonising steel, fertilisers, and chemicals.

A reliable nuclear backbone reduces dependence on fossil fuels while ensuring affordable power for economic growth.

Challenges and Considerations

Public perception and safety concerns must be addressed through transparency and community engagement.

Uranium import dependence necessitates robust international cooperation.

Nuclear expansion must be synchronised with renewables to ensure a balanced and resilient energy mix.

Conclusion

The SHANTI Bill represents a bold and strategic policy choice at a time when India faces the twin challenges of rapid development and climate responsibility. Given the scale of energy required to achieve high human development and the limitations of renewables alone, nuclear power emerges as an indispensable pillar of India's decarbonised energy future. Ambitious targets backed by institutional reform and indigenous capability reflect India's resolve to align energy security with sustainable development.

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