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TechSphere insights

NO.6

MICRO PLASTICS

MAKING A STAR ON EARTH

FORENSIC BREAKTHROUGHS

TechSphere Insights

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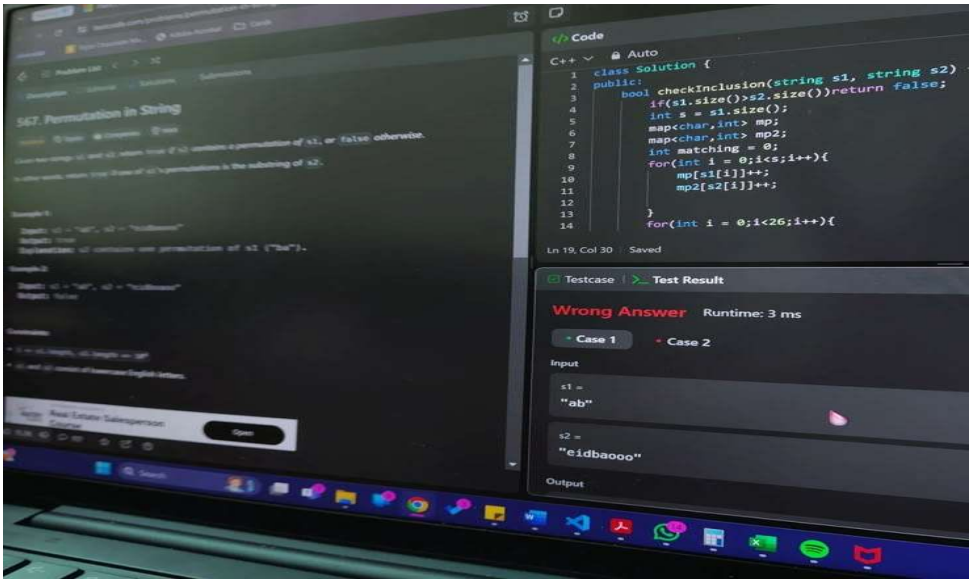
Coding or Cracking?

How Competitive Programming is Reshaping India's CSE Culture

Arushi Singh, TechSphere Insights,

June 2025, Volume 1, Issue 6, pp. 4–9.



If you walk into any college with a Computer Science department in India today, you'll find a new kind of buzz in the air. It's not about exams, practicals, viva, or project deadlines. It's about contests on websites like Codeforces, LeetCode, HackerRank, and CodeChef. You'll see students discussing "two-pointer techniques," "time complexities," or "how I got TLE on test case 7." This is the world of competitive programming, and it's quickly becoming the new face of India's CSE (Computer Science and Engineering) culture.

But what exactly is competitive programming? And why is it taking over CS, including college campuses, students and even job interviews? More importantly, is this new boom making students better at coding, or just better at cracking? That's exactly what we're going to talk about in this article.

Competitive programming, also known as CP, is where participants solve different types of coding problems as fast and efficiently as they can. These

problems are mostly based on data structures and algorithms, also known as DSA, as well as mathematics, and logic. There are time and memory limits. People participate in these contests for fun, for learning, and—let's be honest—for bragging rights.

But in India, it's become more than just a hobby. It's now a full-blown movement. This rise can be traced to a few reasons. One of the biggest? Jobs.

Top tech companies like Google, Amazon, Microsoft, and others often ask candidates to solve problems during interviews that look very similar to those in CP contests. So, students figured out a formula: get good at CP = crack interviews = land a dream job.

In a highly competitive job market like India, where lakhs of engineers graduate every year, anything that helps you stand out is a big deal. CP does exactly that. Your college name doesn't matter as much if you have a top rank on Codeforces or a glowing LeetCode profile. It's become a sort of equalizer—talent over tag.

This has also led to a major shift in how students approach Computer Science. Earlier, focus used to be on understanding core subjects, building projects, or learning different tech stacks like web or app development. Now, it's increasingly common to find students spending their evenings and weekends solving coding problems.

Study groups have turned into "DSA clubs." Students share their submissions and ask for help on Discord servers or Telegram groups. YouTube is full of tutorials breaking down "how to approach dynamic programming" or "how to solve sliding window problems."

For many, it becomes a daily ritual—solve a few problems every day, try out the weekly contests, and keep pushing your rating higher. There's a strong sense of community, where people compete and help each other, but also competition. Everyone is trying to crack the next level and get ahead.

The grind is tough, but there's also good sides to it. First of all, it helps improve problem solving skills. You start thinking logically and analytically. You get faster at writing code and finding errors. You become familiar and more comfortable with failure because, in CP, you're bound to get "Wrong Answer" or

“Time Limit Exceeded” many times, more than you can probably imagine. However, you learn from it and keep going.

Second, it builds discipline. Most top CP programmers didn’t get there overnight. They solved hundreds, sometimes thousands, of problems over days, months or even years. It takes consistency, practice, and patience, which are all valuable skills no matter what career path you choose.

Third, and this is important, it opens doors. Many companies now directly shortlist students based on their CP profiles. Even students from small towns or non-famous colleges have landed big jobs simply because they were great at solving problems. That’s powerful.

Also, CP is free. Unlike expensive coding bootcamps or over the top courses, all you need is a laptop, internet, curious mind and a lot of motivation. That makes it accessible to everyone.

That said, competitive programming isn’t perfect. In fact, it has its share of criticism.

For starters, it’s very focused on one type of coding—algorithms and data structures. But real-world software development is about more than that. You need to know how to build systems, work with databases, understand user needs, write clean and maintainable code, collaborate with teams, and much more. CP rarely teaches you these things.

Some students become so focused on CP that they ignore other important areas. They might struggle with writing actual software or contributing to projects. Recruiters sometimes find that top coders from CP contests don’t always perform well in real-world tasks.

There’s also the pressure. Because CP is so competitive and visible (with public ratings and leaderboards), many students feel anxious or left out. If you’re not good at CP, you might feel like you don’t belong in tech, which is not true at all. There are many paths in computer science, and CP is just one of them.

Burnout is another issue. The constant need to practice, the fear of falling behind, and the obsession with ratings can take a toll on mental health. Some students spend more time worrying about their Codeforces rank than actually enjoying the process of learning.

One more challenge CP faces in India is the gender gap. Despite increasing numbers of women entering tech, competitive programming circles still tend to be male-dominated. Some female students say they find the environment unwelcoming or overly intense. There are efforts to change this—special contests for women, mentorship programs, and community support—but there's still a long way to go.

Interestingly, colleges have started taking competitive programming seriously. Many now host contests themselves, set up CP clubs, and even offer academic credit for competitive coding. Some professors encourage students to participate in ICPC or Hackathons and treat them like sports events—with practice sessions, team selection, and coaching.

Companies, too, have leaned in. Instead of only relying on resumes and interviews, they now organize their own coding challenges as hiring tests. CP platforms often partner with companies to run hiring contests where top performers get interview calls directly.

Even coaching institutes have caught on. We all know about (and most of us have been victims of) coaching for JEE and NEET. There are now coaching programs for cracking CP and DSA rounds. It's becoming a new industry in itself.

Competitive programming is really powerful. It teaches you a bunch of things that are useful when you start working, such as thinking quickly, solving real world problems, and handling pressure well. If done right can also help you get internships and jobs, and it's a great way to grow your confidence and skills.

But it’s not everything.

Being a good programmer also means knowing how to build projects, collaborate with others, explain your ideas, and most importantly, keep learning. CP doesn’t always teach that, obviously. So, if you’re into CP, great! But you also need to make time for building as well as learning about core CSE topics like databases, networks, or maybe even trying out open-source contributions.

And if you’re not into CP, that’s okay too. There are literally so many other paths in tech, including UI/UX design, product management, game development, cybersecurity, data science, and more. Don’t let someone else’s leaderboard define your journey.

The best developers are not just good at solving problems—they’re good at solving the right problems.

India’s CS culture is evolving. From theory to projects, from self learning to now competitive programming, we’re witnessing a fascinating shift. CP has added a new layer of excitement and challenge, and for many students, it’s been life changing.

But like with all the tools, it's the way you utilize it that counts. Competitive programming can make your mind sharp, introduce you to new opportunities,

and give you an edge. But don't become obsessed with it or feel like it's the only path to "making it" in tech.

In the end, whether you're a CP champion or just like creating apps or making funky websites, there's room for you in tech. The sector needs every type of thinker and doer.

So whether you’re coding or cracking, remember—it's your journey. Make it count.

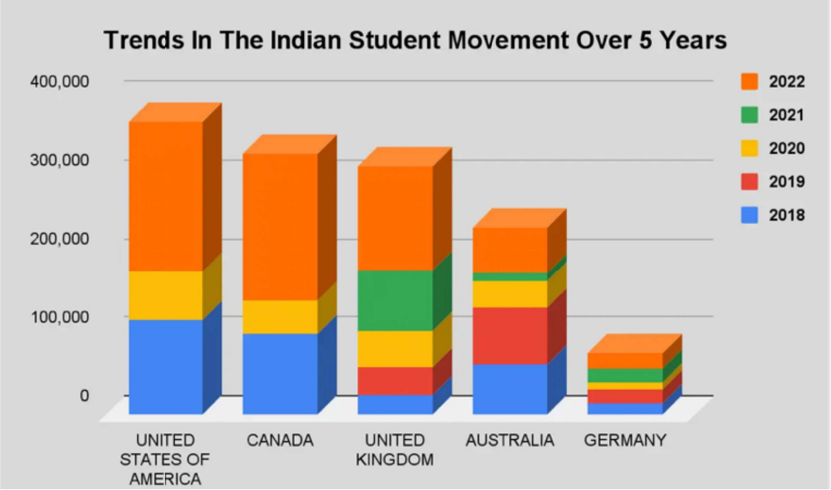
Education in India

and its shift from rote learning

Aditi Panchbhai, TechSphere Insights,

June 2025, Volume 1, Issue 6, pp. 10–14.

In 2023, a significant number of Indian students, estimated at 1.33 million, were pursuing higher education abroad. This represents a substantial increase from 9.07 lakh students in 2022, which reflects a growing pattern of student immigration from the Indian subcontinent at a large.



Although the Indian government has made numerous policy changes and reforms in the current higher education system, the appeal of flying to foreign lands which once only existed among the wealthy and the upper class Indians, has now become an increasingly popular option among students at large, considering the stark and magnanimous differences between the Indian education system and that of other nations.

One of the major reasons points towards the ignorance of pragmatism in schools. It's often disregarded as something to be of higher level understanding or irrelevant to current educational standards. Students are taught to rely more on rote-learning and memorisation rather than using a hands-on approach to learning by utilising the resources available in their surroundings. Rote learning

is not a flaw; however, solely relying on memorisation is quite deficient. In a world filled with rising inequality, the meteoric progress of artificial intelligence and a highly demanding employment market, students have to address the ever-changing scenario of being intellectual weapons while simultaneously mastering the art of versatility.

An aspect of education abroad that has piqued the interests of countless immigrants, primarily Asian, is that learning in Asian countries tends to be fragmented without incorporating the reality of our world into it. Arbitrarily memorising concepts can only take one so far, the journey is incomplete without the essence of experience.

Holistic education, in its essence, implies a blend of theory and putting it into practice.

In retrospect, internships and workshops are one of the best ways to impart a holistic approach. An interaction with the know-hows of a particular industry or even how the text in our textbooks is integrated into our surroundings is a marvellous way of demonstrating skills that students could offer.

It is beyond conviction that this method helps students to shape their perspectives and create more cogent solutions to the challenges that we face in this day and age. It's always benign to have a sense of direction and purpose in our lives. A more practically oriented approach enhances that. It volumises our thoughts and accrues our attention towards more solution oriented techniques rather than just having a bleak point of view towards situational analysis and understanding.

As a developing country, India has mammoth potential in ramping up its conceptual framework. Instead of using passive learning techniques, an emphasis must be laid on active thinking techniques such as debates, group presentations, projects and discussions. While teachers remain the epitome of learning, the end goal is to equip the students. Hence, they must play the role of a facilitator, in order to broaden the spectrum of a student's cognitive abilities. As the adage goes, knowledge becomes wisdom only after it has been put to practical use.

In an ideal world, teachers would be the stimuli and catalysts to a student's success, not the reason for it. The results of using such a model would be miraculous. In a world with an array of social problems and a hegemony of the have-nots prevailing, we as the future generation cannot remain mere observes of our own destiny. The objective of diluting a traditional and conservative educational system with that of a modern one is to create a more inclusive and diverse society. When students have a distinct perception of what is being taught, the interpretation of the same shall also differ according to each student.

To further illustrate its benefits, students would be able to collaborate with their peers, build on existing concepts and come up with abstract inventions. Not only does this method of education increase student coordination, it also encourages students to communicate and validate their unique thoughts, ideas and feelings to the world around them.
Imagine a place with adept ethical standards and deep-seated moral values. Innovation thrives here and multilateral discussions are often held for key decisions. Everyone has a role to play and marginal communities do not face discrimination. Sustainability is being tackled as one indivisible priority and we have found ways to integrate green practices with business operations.

Although it seems extremely far-fetched, and almost utopian, the benefits of a modern and experiential learning system are cutting-edge. With the advent of

machine learning, students in the field of artificial intelligence can excel at building world class machines that simplify complex tasks and troubleshoot sensitive issues. Moreover, children taught in laboratories with help of various apparatus or equipment, are exposed to different scientific disciplines and their influence on other fields of knowledge. In the business arena, learning based on challenges like building a start up or emulating real business practices have proven to be more effective than exams because, students learn through low stake situations and repetition; thus, limiting their panic and anxiety.

Practicality is not restricted to the intellectual world, it's also very much a part of fine arts. A guide encapsulating tips for writing a good book doesn't produce an articulate novelist; a person who prints his ideas onto paper, be it rubbish or captivating, becomes one. As Monet said, "One can do something if one can see and understand it." Nonetheless, practice is of paramount importance; it gives us outlets to display our skills and perfect them.

After all, knowledge is of no use unless you put it into practice.
On a final note, I believe that the penchant that millions of Indians, and Asians as well, have for western education is wholly justified; considering how covetous an insight into the real world is. However, India too, could stand among one of those nations, if only, it revolutionises its conventional approach and indifferent attitude towards the current educational model. By

incorporating a more modern and flexible approach towards our curriculum, one that emphasises on debating, experimenting, research and discussion, and skill development, India too, can advance to be a nation with a highly competitive, dynamic and skilled workforce.

Finding Focus in Modern Education

Digital Distraction vs. Digital Discipline

Anvitha NJ, TechSphere Insights,

June 2025, Volume 1, Issue 6, pp. 15–20.

Introduction

Finding Focus in Modern Education: Digital Distraction vs. Digital Discipline In the contemporary world, education is no longer limited to textbooks, whiteboards, and classrooms. Digital tools like smartphones, laptops, tablets, and high-speed internet have made it possible for learning to occur outside of traditional settings. With just a few taps on a screen, students can now take tests, watch educational videos, take part in online classes, and submit their work. There is more to this story than meets the eye, even though it seems like the ideal setup. Distractions like game apps, social media alerts, incessant YouTube suggestions, and more can be found on the same devices that are used for instruction. This brings up digital distraction, a prevalent but significant problem in contemporary education. The good news is that pupils can transition from distraction to digital discipline with awareness and a few easy habits. Finding Focus in Modern Education: Digital Distraction vs. Digital Discipline

Education in the modern world is no longer limited to textbooks, whiteboards, and classrooms. Digital tools such as smartphones, laptops, tablets, and high-speed internet have made it possible for learning to occur outside of traditional settings. Now, students can take tests, view instructional videos, participate in online classes, and turn in assignments with a few taps on a screen. Despite appearing to be the perfect setup, there is more to this story than meets the eye. The same devices used for education also contain distractions like game apps, social media notifications, endless YouTube recommendations, and

more. This leads us to a common but important issue in modern education: digital distraction. The good news is that, with awareness and a few simple habits, students can move from distraction to digital discipline.

Let us investigate how. Digital learning technology is a two-edged sword that has significantly changed education. In a village, a student can learn to code. Harvard offers free classes for college students. Teachers can use animated videos to help students understand difficult concepts. This convenience does have a downside, though, in that it is easy to become distracted when using a single device. An Instagram notification may show up ten minutes into your study session on your tablet. You glance at it "for a minute," but before you know it, you've spent 45 minutes scrolling through memes and reels. This is the actual digital distraction trap

“Students engaging in digital learning across diverse environments—using laptops, tablets, and phones at a park, café, home, and library highlighting the flexibility and challenges of modern education. “

What is Digital Distraction?

The term “digital distraction” describes the persistent disruptions brought on by technology, particularly by gadgets and applications that have nothing to do with the task at hand. In the context of education, it refers to the following: • Social media apps (Instagram, Snapchat, WhatsApp); • Video platforms (YouTube, Netflix); • Gaming apps; • Constant pop-up notifications; • Multitasking (moving between a chat, a class, and a reel); Not only do distractions waste time, but they also impair learning quality and disrupt focus. Once your attention is diverted, it takes time to regain it. Repeating this cycle repeatedly has an impact on confidence, productivity, and memory.

The Real Impact on learning

Let’s examine the effects of digital distraction on students:

1. Reduced Capacity to Focus Long-term concentration is a challenge for today’s young brains, according to research. Because they are always scrolling and swiping, students usually look for brief, visually appealing content. This gives the impression that a forty-minute lecture is "boring" or "too long."

2. Insufficient Understanding When students are looking at their phones or switching tabs during class, they miss important explanations. Shallow learning occurs as a result of knowledge being either completely or partially forgotten.

3. An increase in stress and anxiety attempting to multitask, such as studying while talking or watching videos while reading, strains the brain. Students may not be doing much, despite the impression that they are. Eventually, it will cause mental fatigue and deplete self-esteem.

4. Poor Time Management One of the biggest effects of digital distraction is poor time management.

Despite your two-hour study plan, you only manage to get in 30 minutes of concentrated work.

The Bright Side: Digital Discipline

The hopeful part starts now. Technology is not a threat. In fact, if used properly, it can be a very strong ally. Students need digital discipline, which is the ability to manage screen time in a way that improves rather than hinders learning. Here are some strategies for cultivating digital discipline. Easy Routines for Digital Self-Control

1. Make a Study Schedule Planning is the first step towards discipline. Set aside specific periods of time for studying, sleeping, and taking breaks. Set alarms or use digital calendars to help you stay on course. As an example: • 4:00 to 5:00 PM: Avoid using a phone while studying science. • 5:00–5:20 PM: During this break, take a quick walk or unwind. • 5:20–6:00 PM: Go over or view educational films knowing what needs to be done and when naturally reduces distractions.

2. Utilise the Appropriate Apps while studying, some apps, such as Forest, Focus Keeper, or Stay Focusd, block notifications.

Some lock your phone at a specific time. Control technology by using it.

3. Put your phone away. When studying, keep your phone in a separate room if it's not necessary. Anxiety or the urge to check one's phone can be triggered simply by its proximity.

4. Provide Social Media Guidelines give yourself permission to only check social media during downtime. "Only for fifteen minutes in the evening" or "Only after finishing two topics" are two examples. This creates balance rather than completely cutting off enjoyment.

5. Implement Mindful Studying when studying, try to focus on one thing at a time. Distractions should be turned off, your desk should be organised, and unnecessary tabs should be deleted. This helps to enhance and expedite learning and is known as "deep work."

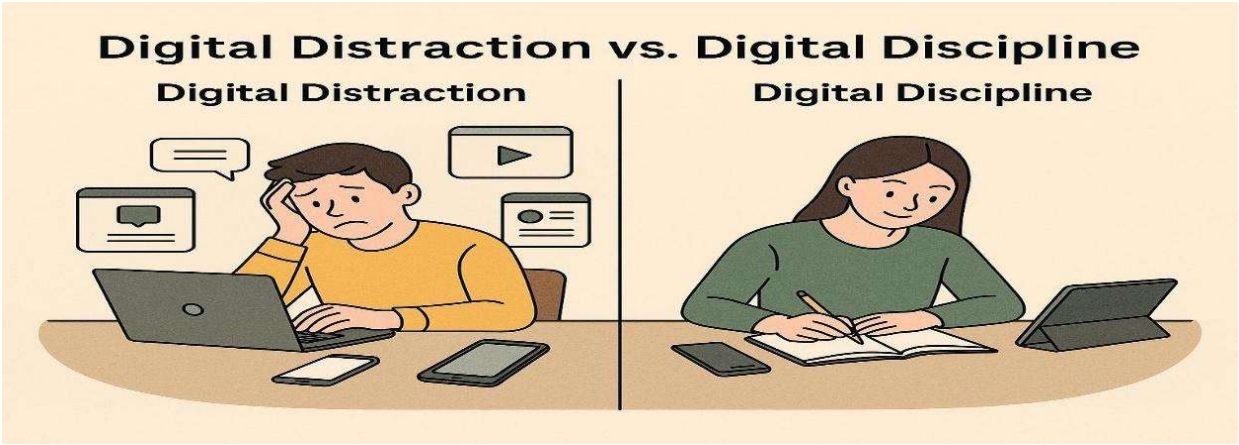
6. Rest, but in the right way during breaks, refrain from aimlessly scrolling. Instead, go for a stroll outside, stretch, sip on some water, or do something offline. As a result, your mind is rejuvenated and ready to focus again.

Role of Parents and Teachers

Students are not the only ones who must practise digital discipline. Teachers and parents are extremely important. Parents can create a healthy digital environment at home by limiting screen time and encouraging activities like reading, gardening, or painting. Teachers can guide students to reliable online resources and improve their online instruction. They can also explain the risks of excessive screen time and help students monitor their usage. When everyone works together, digital habits can become strong and beneficial.

Real-life Stories

For instance, Neha, a high school student from Hyderabad, she used to use YouTube videos to aid in her studies, but she often ended up spending hours watching cooking shows and vlogs. After realizing she was falling behind, she devised a plan: she set a timer, turned off all notifications while studying, and gave herself small rewards when she completed assignments. Her ability to focus improved along with her grades. In contrast, Arjun, a college student, frequently studied while using five tabs: a lecture video, music, two social media pages, and a WhatsApp chat. He thought it helped to multitask. He subsequently admitted, though, that he could not remember even half of what he had "learned." After he reduced his digital distractions with a mentor's help, he began to make real progress. These stories prove that change is possible.



"A visual contrast between digital distraction and digital discipline highlighting how mindful use of technology can shift a cluttered mind into focused learning."

The Future of Focused Learning

These stories prove that change is possible. The Prospects for Concentrated Learning Students will need to improve their intelligence and judgement as technology continues to permeate the classroom. Instead of avoiding digital tools, the goal is to master them. Learners who can remain focused, adjust, and develop will be the ones of the future. "Digital hygiene" could be taught in schools as a life skill. Apps may have built-in learning-only modes. Most significantly, though, is that students will learn to take a moment to reflect and make thoughtful decisions when using their screens.

Conclusion

A one of the main problems with modern education is digital distraction, but it is possible to overcome it with awareness and a few daily efforts. Managing screen time is a skill, just like learning science or maths. Digital discipline is the secret.

By creating a balanced approach where technology serves us rather than hinders us, we can make the most of modern tools while preserving our mental acuity and concentration. The real power of education ultimately lies in the learner's mind, not the screen.

How the World Is Trying to Make a Star on Earth

And Why It Matters

Tanushka Bhattacharya, TechSphere Insights,

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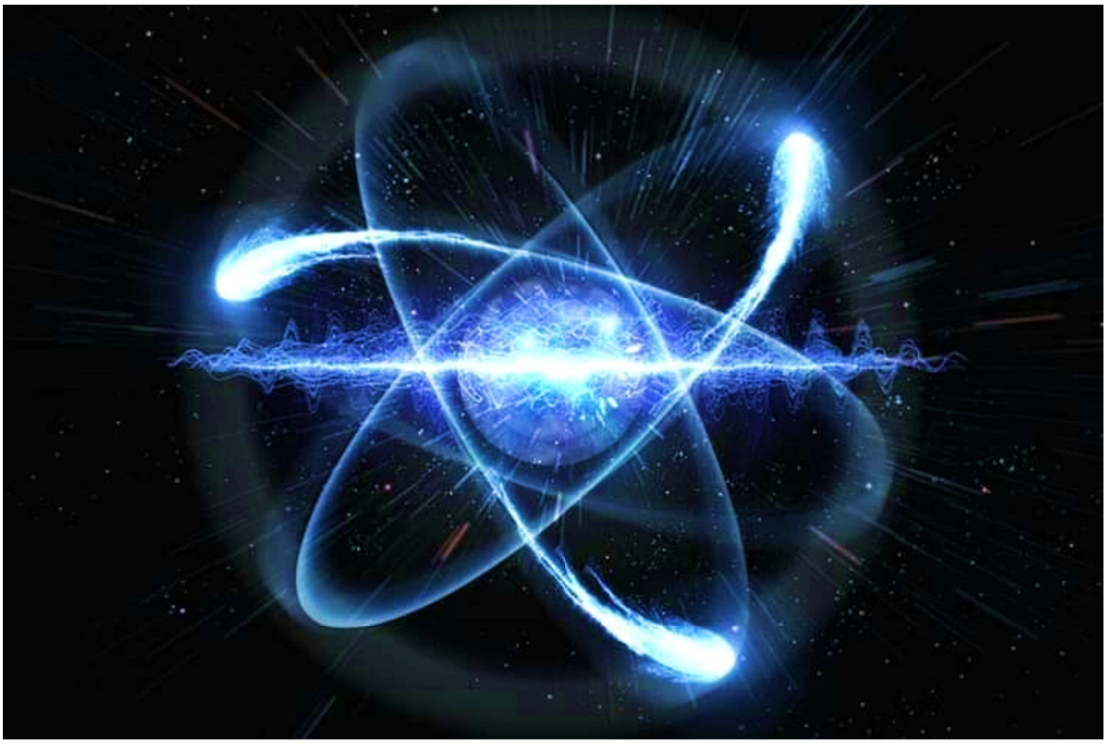
Ever wondered what it would be like if we could create a star right here on Earth?



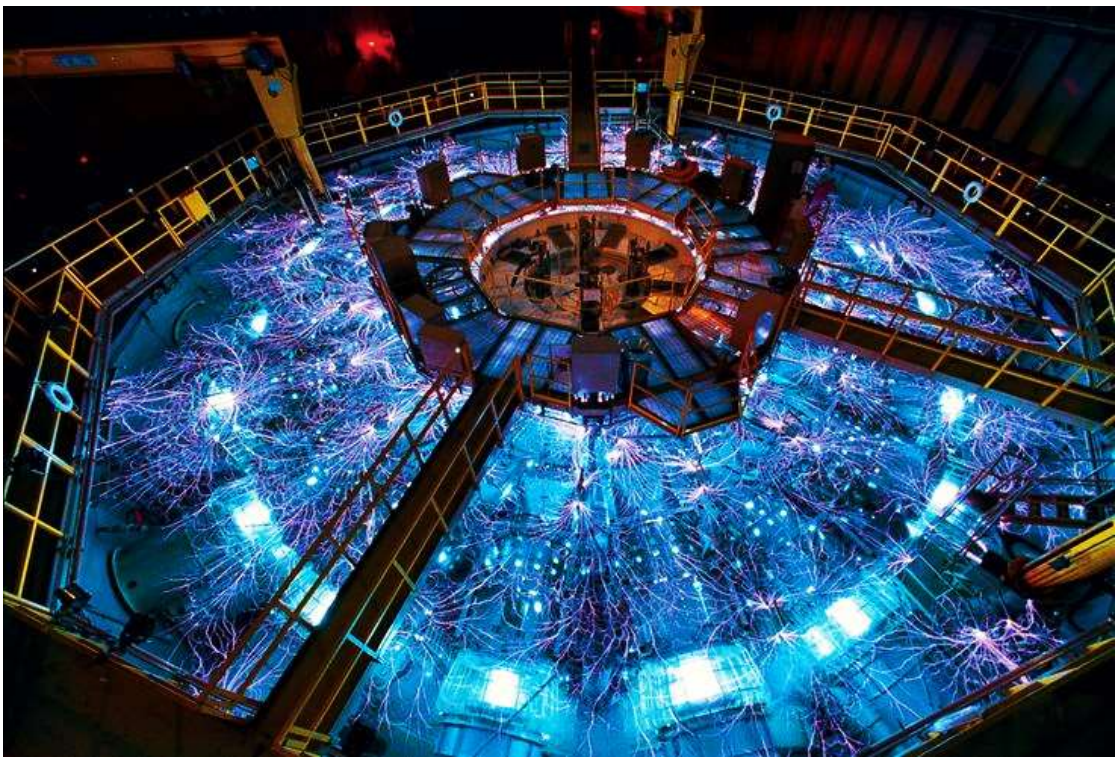
Now it’s possible, because stars gain their brightness by a process called nuclear fusion. In nuclear fusion, light atomic nuclei such as hydrogen isotopes crash into each other, resulting in the formation of heavier atoms, emitting a vast amount of energy in their wake, and even the sun gains power from it. Next could be that researchers discover how to reproduce those same conditions here on Earth: fuse hydrogen gas particles so that they burn hot enough to surpass, albeit just barely, the temperature of the sun's core. Confining it with

powerful magnets or lasers and energy could be tapped from an almost unlimited source.

Current power plants nowadays use fission that ends up producing long-term radioactive waste, whereas in the case of nuclear fusion, it doesn't do so. Nor does it expel carbon dioxide or any other greenhouse gases, so it won't cause climate change. Well, the input of fusion materials is rich beyond one's ken. Freezing hydrogen isotopes from water is a trivial task, since there is nearly no place where water does not cover. That is to say, we may not develop fusion, but once it is made practicable, then we will have almost unlimited clean and safe energy.

The notion of obtaining power from a fusion reaction is not new. According to a British astrophysicist named Arthur Eddington, it was suggested in the 1920s that in order to produce helium, stars generate energy by the help of nuclear burning of hydrogen. Toward the middle of the century, in 1934, physicist Ernest Rutherford performed the first artificial fusion reaction in a laboratory.

But then, the end of World War II resulted in providing the biggest push. As Cold War tensions grew, so did research into nuclear weapons and energy. Fusion was studied for both destructive and peaceful purposes. Soviet physicists Andrei Sakharov and Igor Tamm suggested the design of a fusion reactor, called the tokamak, in 1950, which is a doughnut-shaped device that uses strong magnetic fields to hold hot plasma in place. A fusion machine of another type, the stellarator, also made its first appearance around the same time, through the work of the American physicist Lyman Spitzer. By the 1970s, Europe had initiated the Joint European Torus project in the UK, which today is one of the most technically advanced fusion experiments worldwide.



It has been a punishingly difficult effort to tame fusion, one that has soaked up billions of dollars over several decades. The problem is that the conditions required are extreme, in practice, more than 100 million degrees Celsius, and specific types of pressure that squeeze nuclei together so hard that they will fuse. We don't benefit from the Sun's immense gravitational pull here on Earth, so we have to find other ways to keep that reaction in check. None of those fusion experiments have yet to generate more energy than they consume, an achievement called net energy gain or Q greater than 1. But a series of recent breakthroughs suggests we may be closer than we assume.

The most ambitious global project so far is ITER, shorthand for International Thermonuclear Experimental Reactor, which is a large project taking place in southern France. Around 35 countries, such as India, Japan, South Korea, China, etc, have collaborated to make this project a success. ITER aims to prove to the world that a fusion reactor can produce energy, a factor of over ten times the amount of energy fed into it, and it aims to do so by building the largest tokamak in the world. ITER will not produce electricity, but it will be the last experiment before there are fusion power plants that do produce electricity, and it is aiming to achieve its first plasma in this year of 2025.

Even though ITER is such a big project, it is not the only big project in this area of technology. The US has a major project that takes a different approach using the National Ignition Facility (NIF). NIF utilises inertial confinement fusion, whereas ITER uses magnetic confinement fusion. NIF has continued to improve, including showing an output of 8.6 megajoules of energy in 2025 since its last breakthrough in laser fusion. These are negligible amounts of energy in practical terms, but it does demonstrate that we can validate the science of fusion ignition.

India has also made a significant contribution to ITER, having provided big components, including the cryostat, the world's largest vacuum-tight vessel, made of stainless steel and within which is contained the whole fusion reactor. India had joined ITER back in 2005 and is one of its 7 main partners. Apart from the cryostat, Indian industries are also building other crucial systems for ITER, including power supplies, cooling systems, and diagnostics. The centre of India’s domestic fusion efforts is directed towards the Institute for Plasma Research in Gandhinagar, Gujarat. IPR operates the Aditya-U tokamak, which has been running fusion experiments since the late 1980s. Initiated in 2013, the Steady-State Superconducting Tokamak (SSST) is the second major project and the first of its kind in India. These projects will train scientists and engineers, develop indigenous technologies, and ready the country for future commercial reactors.

Meanwhile, MIT and a private startup called Commonwealth Fusion Systems are building SPARC, a compact, high-field tokamak. SPARC aims to have net positive energy by 2027 and ultimately lead to ARC, a commercial fusion power plant. The team at SPARC is betting on new superconducting magnets that allow stronger magnetic fields in smaller devices. If successful, SPARC could make a better change and make fusion more compact and cheaper to build.

In the field of fusion research, the progress made by China is pretty impressive because they have successfully created the Experimental Advanced Superconducting Tokamak (EAST), also called the “artificial sun”, and this has resulted in breaking many world records. In January of 2025, the EAST held plasma for over 1,000 seconds, just under 17 minutes, as compared to 2021 when the EAST sustained around 160 million degrees Celsius for 20 seconds.

China’s next target is the China Fusion Engineering Test Reactor, which will connect the worlds between commercial power plants and experimental reactors. As part of this broader strategy for energy independence and technological leadership in fusion, China's HL-2M tokamak, which continued an earlier HL-2A tokamak and became operational in 2020, is targeted at the same time. India’s contributions to fusion energy, while they may not be as known publicly to a global audience, are vital and growing.

If we look a bit further, the Indian Government hopes to build two 1000-megawatt fusion reactors by 2050. The Department of Atomic Energy is preparing a planning roadmap and beginning international partnerships.

Indian scientists are also involved in the theoretical modelling, plasma diagnostics, and fusion materials studies. While fusion is experimental everywhere else, India is proactively putting itself in a position to be in the game in the time period when they are commercial reactors.

The potential of fusion is much more than we imagine it to be. So to say, Fusion reactors also have no risk of meltdown, so they are safer as well. The fuel, which is essentially isotopes of hydrogen such as deuterium and tritium, can be derived from seawater and lithium. There are estimates that a bathtub's worth of seawater could yield as much energy as 300 barrels of oil.

In economic terms, the long-term potential of fusion is massive. Cheap fusion could save the world trillions of dollars by limiting climate damage and replacing fossil fuel, an M.I.T. study found. As the technology develops, fusion power plants would be set up across the globe, from remote and developing regions to the developed world. That could change the way energy access looks, particularly in countries such as India, which still has significant energy poverty in many areas. Fusion also has the possibility to help fuel things off the grid, too: space missions, large-scale desalination plants and hydrogen production for fuel cells.

But as obstacles still remain. It is said that one of the most complicated engineering projects in existence could potentially be a fusion reactor. We’re looking at materials that will be subjected to very intense temperatures,

pressures and neutron irradiation. It also needs precision control systems to manage the delicate balance inside the plasma. And of course, it needs money. ITER alone is projected to cost over 22 billion US dollars. Private fusion startups have raised billions, too, but scaling up will require sustained investment and political will. The good news is, governments, research institutions, and private companies are increasingly aligned in pushing fusion forward.

Public interest and awareness are also growing. Even in recent years, science communication about fusion has gotten better, with more youth-targeted content and the availability of information in the open-access domain. From engineering to policy, from materials science to machine learning, a new generation of fusion-literate people will be needed, and that calls for the youth, especially in countries like India.

Some Indian universities are already offering specialised courses and internships in plasma physics and fusion engineering. International exchanges and fellowships are also on the rise.

And so, this dream of creating a star on Earth will require more than energy; it will require ambition, cooperation, and long-term thinking. Fusion represents humanity's ability to solve massive problems through science, patience, and collaboration.

Microplastics in the Food Chain

A Hidden Global Crisis

Aryaman Mann, TechSphere Insights,

June 2025, Volume 1, Issue 6, pp. 27–31.

Plastic waste chokes the natural environment everywhere, but while this is in plain sight, one significant threat is unseen. Such small plastic fragments have found their way to the very farthest reaches of Earth. Microplastics come from the breakdown of larger plastics like bottles, packaging, and tires, as well as intentionally made particles like microbeads in cosmetics. Once released, they become a dangerous pollutant that travels in water, air, and ground. In the past 10 years, researchers have found microplastics not only in oceans and lakes but also in tap water, bottled water, table salt, honey, and even inside human bodies. Such shocking and frightening omnipresence implies that microplastics have already circumvented our food chain and everyday lives, potentially causing a threat to wildlife and humanity.

What are microplastics, and how do they enter the environment?

Microplastics are those plastic particles that are smaller than 5 millimetres. By going with this definition, even the tiny fibres shed from synthetic clothing qualify. Microplastics are either manufactured small on purpose; they are called primary microplastics, for example, microbeads in cosmetics, or secondary microplastics, fragments formed when larger plastic items break down under sunlight, heat, waves, etc. At this age, almost every activity generates these particles. For example, tires release tiny plastic fragments as they wear down on roads, or, more obviously, plastic bottles and bags gradually crumble into these dangerous microscopic pieces.

All in all, as time passes, plastic debris in the world breaks down into countless tiny pieces. Wind, waves, and UV light accelerate this breakup. In water, boat paint and ropes also degrade into extremely tiny shreds. Even everyday wear and tear on furniture or sports equipment generates such dust. Once in the environment, they travel far and wide via wind or water currents.

Alarmingly, various research now confirms that microplastics are found everywhere on the planet. Even the highest mountains full of snow or the deepest ocean parts contain these microplastics, as detected by numerous scientists. A NOAA fact sheet notes that microplastics are there in river mud, tap and bottled water, and even in the air we breathe. On further discovery, they have also been discovered in all 62 human placentas (the organ that develops inside the uterus of a pregnant woman to provide food for the developing baby) tested, while another analysis shows the particles in human liver, kidney, and even brain tissues. This omnipresence highlights the silent scale of the problem: plastics are so abundant that the microplastic particles inevitably reach the majority of the ecosystems and food sources worldwide.

Health and Ecological Implications

Microplastic effects on living organisms are subject to current research, and the results do not seem to indicate good news. Physical injuries (obstructions or sores) and chemical exposure can be inflicted by the ingestion of plastics in wildlife. Microplastics, in turn, as NOAA puts it, can attract and carry pre-

existing pollution sources into water, as well as release the additives that plastics are intended to contain (dyes, flame retardants, softeners) into the animal tissues.

It is documented that high microplastic doses may cause a delay in development, growth impairment, lower fertility, and weakened immunity among different marine animals. For instance, a news report highlighted a sea turtle found dead with 104 pieces of plastic in its stomach. An underlying ecological crisis is emphasised in these tales: animals are increasingly consuming plastic rather than food, perhaps mistaking plastic for food, and the effects of plastic on the animals are lethal or sublethal and dangerously contagious to the food web.

Human beings also belong to this ecological chain; thus, the possible health effects of the consumption of microplastics attract a lot of concern. Even though proven consequences remain undiscovered, researchers have found some threatening outcomes. We can also see how microplastics themselves can behave rather like miniature sponges: toxic chemicals, such as PCBs or heavy metals, can be adsorbed onto the surfaces of the microplastic, and once taken into the body, can then be released. Microplastic exposure has been shown to cause endocrine disruption (hormonal imbalances), oxidative stress, and inflammation in lab animals. In human cases, studies have found that it can even cause cancer. Even if the risks from one meal containing microplastics are low, the lifetime accumulation is extremely worrisome.

Human tissue studies show that microplastics do not end up in the gut. Recent research found plastic in the blood, lungs, and other human organs. Interestingly, in 2024, microplastics were discovered in the placentas of all sampled mothers, and this indicates that they are reaching developing babies. According to University of New Mexico researchers, plastic was found in placenta samples and was as high as 6.5 to 790 micrograms per gram of tissue weight. As co-author Dr. Matthew Campen cautioned, should placentas be a factor, “all mammalian life on this planet could be affected.” Worse still, the most recent study (published in Nature Medicine, 2024) established the levels of microplastics in the human body: liver and kidney samples have an average of 400 micrograms per gram, whereas in the human brain, thousands

of micrograms are found per gram. This implies that plastics are not merely being transported through human body systems, but that they are bioaccumulating in body tissues up to far greater concentrations than they do in other tissues (such as the placenta and testes previously studied).

Conclusion and Proposed Solutions

One of the most evident cases of how human activity can potentially impact the environment with a non-obvious yet wide-ranging effect is the entry of microplastics into the food chain. Plastic particles previously considered insignificant have turned out to be a hidden global crisis that causes harm to wildlife and could be causing harm to humanity. As we have noted, microplastics are generated by ordinary means, and they penetrate most of the ecosystems and end up in seafood, water, and even terrestrial foods that we consume. As such, steps have to be taken and, fortunately, have already been taken to control microplastics.

A historic breakthrough happened in 2022 when 175 countries collaborated to work on reducing plastic pollution through a legally binding global treaty to be implemented in 2025. There is great support among environmental NGOs and polls of the population; e.g., a survey by WWF states that 85 per cent of the population want an end to single-use plastics, and 90 per cent want a decrease in toxic chemicals used in plastics. Governments are already making moves: more than 60 countries have banned microbeads in cosmetics, banned disposable plastic bags and straws, or better managed waste to ensure plastics are contained before they can escape.

Technological and practical innovations are helping combat the crises. One promising way is to reduce microplastic release at the source. A 2025 study found that modern washing machines are equipped with inline filters that potentially block over 90% of textile microplastics from being released in the wastewater.

But addressing this global issue requires multifaceted efforts. Regulators need to tighten the rules (e.g., new plastics treaty, plastic bans, product standards), industries should develop new non-hazardous materials and reclaim waste,

and individuals should limit their consumption of plastic. Already, there are advancements: research clearing filters on washing machines, international treaties regulating plastic, and a thriving body of microplastic research. Yet time is limited. Plastic production & pollution are still increasing, so unless we take action, the legacy of microplastics is only going to worsen. By shedding light on these pesky contaminants that have entered oceans and our plates, we can come up with solutions. Only by treating microplastics as a serious threat can we protect ecosystems and our future food safety.

How did Informatica become such valuable to Salesforce?

Tanushree Saha, TechSphere Insights,

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Informatica is a platform that helps to see all the information in one place. As companies maintain records, progress, and workflow on different platforms, it becomes very hard to evaluate the overall data. In order to run a smooth operation, companies invest in Informatica's software.

Salesforce is the number one choice of businesses for CRM (Customer Relationship Management) platform. They focus on maintaining each and every detail for customers, which helps to boost sales. With the help of this platform, the marketing team can run personalized marketing campaigns.

The two companies are operating in totally different niches, then how did Informatica become such valuable to Salesforce?

What are the problems businesses face?

When a business grows, it diversifies into various departments. Each department works in its own way that aligns with business goals.

The problem comes when the communication between departments ends. The top-level decision makers have to gather all the information from different departments, which is very time-consuming and is not as effective as it could be.

Even in each department, each report of each task is stored in different platforms. The manager has to juggle between too many software programs before sending the final reports to higher decision makers.

The market is ever-changing. Depending on the business, markets can sometimes be very volatile. The faster the business adapts to the changes, the faster it grows. If they predict the future change, that business can beat direct competitors and become an industry leader.

On the other hand, if they don’t react fast to the changing environment, the business may also face serious consequences.

An example of this problem arose at AO World, a leading UK online retailer of electronics. With their growing business, their customer service, supply chain, and logistics functions each had different systems that didn't really talk to each other. When the pandemic hit, causing global supply chains to break down, AO World couldn't get an accurate view of its operations. The leadership team took too long to understand the real-time effect, missing sales targets and causing a £200 million fall in market value. It wasn't a lack of effort that inhibited their response, but that their data was dispersed, and decision-makers didn't have an integrated, consolidated view.

How is Salesforce going to solve this problem through its acquisition?

This move by Salesforce will resolve all the problems of businesses with operations and sales. The decision-makers will get reports on time, can predict upcoming changes in the market, and react accordingly.

This is how:

Informatica specialises in something called data integration. If we put it simply, it stores data from various departments and systems together into a single, clean, organised structure.

Salesforce has customer-related information stored within it, but companies require more than that. They want to know about their finances, logistics, operations, and the performance of their employees as well.

Informatica functions as a bridge that gathers all this information, interprets it, and inputs it into Salesforce so leaders can see everything at once.

Now, instead of jumping around ten tools to see what's happening, they can simply log into Salesforce and see the whole picture:

- How marketing campaigns are performing?
- How many products are selling?
- Which part of the business needs attention?
- Where expenses are increasing?

This single data system speeds up decision-making and makes it more accurate.

As one Salesforce executive put it during a Dreamforce conference, “In a world full of dashboards, clarity is the competitive advantage.” Informatica helps provide that clarity.

Another huge advantage is automation. Informatica cleans and organizes cluttered data. Therefore, you don't have to deal with duplicates, old records, or missing information.

And most companies nowadays operate in hybrid environments. Part of their data resides on cloud platforms such as AWS or Google Cloud, and other sections are still on local office computers. Informatica can bridge both.

Gartner analyst Saul Judah once noted, “Data without context is just noise. Informatica gives organizations the ability to turn that noise into a clear signal.” That signal, when routed through Salesforce, becomes real-time business intelligence.

What about security and compliance?

In any big business, the responsible handling of sensitive information is not optional. Customer information, staff records, or financial information, and regulations such as GDPR and HIPAA mandate that businesses store and utilize data ethically.

Informatica has tools built in to ensure data gets treated in compliance with these regulations. This implies that businesses that use Salesforce and Informatica together can not only go fast but do so securely and lawfully.

Case study

A micro-hospital operator in the US is struggling to manage patient information. They require a secure, integrated platform for patient records to facilitate personalized care.

Solution

They used Salesforce Health Cloud together with Informatica Cloud to centrally and securely manage patient data flows:

Data Centralization: Informatica Cloud brought in patient data from EHRs, labs, billing, and scheduling systems into a unified structured source.

Secure Integration: It made sure that the information coming into Salesforce Health Cloud was clean, consistent, and compliant with regulations such as HIPAA and GDPR.

Operational Efficiency: Employees could view updated patient data using one platform, which cut back on administrative lag and streamlined care coordination.

Impact

Quicker patient interactions: Clinicians drew entire patient profiles in seconds, not minutes.

Greater patient trust: The hospital showed strict data privacy and governance, instilling confidence among patients.

Better compliance: The integration allowed for native protection of sensitive information, lowering legal risk and business friction.

What does it signify for small- scale and medium-scale businesses?

This buy isn't only for big companies. Small companies that employ Salesforce will gain as well. But through Informatica's integration, Salesforce is made intelligent and easier to understand. For instance, a small online business may view all its customer orders, website traffic, and social media comments within

a single dashboard. Such insight was once reserved for big firms. That is no longer the case.

Looking forward: A smarter Salesforce ecosystem

Salesforce is a CRM platform with solutions like Slack, Tableau, and now Informatica. It is a complete digital operating system for companies. Imagine it as a control tower with all the things in sight, like sales, customer service, marketing, HR, and finance. With Informatica in the mix, the data powering this tower is no longer patchy and fragmented.

It's also a clever defensive strategy. In a world where Microsoft, Oracle, and Google are constructing all-in-one platforms, Salesforce must remain in front. Having control over a powerful data integration player like Informatica ensures their ecosystem is well-integrated and difficult to switch from.

As Marc Benioff, CEO of Salesforce, once stated, “The business of business is to make the world better. But to do that, you have to understand the world first. Data is how we understand.” That quote feels especially relevant here.

Conclusion

The partnership of Informatica and Salesforce is not a commercial deal. Instead, it's a strategic move that makes companies smarter, faster, and more productive. In today's data-centric world, those who are successfully adjusting to information win.

With the acquisition, Salesforce is enabling companies to do exactly that: have a better view of their world, make decisions more quickly, and drive growth faster.

Informatica is no longer merely an enabling tool. It's a fundamental component of the engine that enables Salesforce to provide actual value.

Sugar-Free Doesn’t Mean Tooth-Friendly

What Parents Must Know About Snacks

Banisetti Sravya, TechSphere Insights,

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Introduction

You reach for the ‘sugar-free’ snack, feeling confident that you are making a healthy choice for your child’s teeth. After all, we have been told that sugar is the main cause of cavities. So, removing it must solve the problem, right? But here’s the truth. Just because something is sugar free doesn’t mean it's safe for kids’ teeth. Labels like ‘no added sugar’, ‘100% natural’, ‘sugar free’, or ‘organic’ build a sense of trust, but they still cause tooth decay. It’s because these snacks might contain hidden sugars or fermented carbohydrates; they are acidic, which wears down enamel, and can be sticky, sticking to teeth for long periods. Sadly, most parents don’t realize these so-called healthy snacks can still feed the same harmful bacteria that cause cavities. This article helps to understand what ‘sugar-free’ really means on labels, how these snacks affect

children's teeth, and helps parents choose snacks that are genuinely safe and tooth-friendly. Let's break down the facts and support you in caring for your child's smile the right way.

What does 'Sugar-Free' really mean?

A 'Sugar-free' label on food packaging doesn't mean zero sugar. As per the law, the product can be labelled as 'sugar-free' only if it contains less than 0.5 g of sugar per serving. Sugar substitutes replace refined sugar, but they aren't all the same for teeth. Common substitutes include sugar alcohols like sorbitol, maltitol, and xylitol as well as artificial sweeteners like aspartame, sucralose, Saccharin, and Acesulfame K. These sugar alcohols are found in sugar-free chewing gums, candies, baked goods, and protein bars. Xylitol has a positive effect on teeth and can reduce carcinogenic bacteria, whereas Sorbitol and maltitol are less harmful than sugar but can still promote bacterial activity in large amounts. Artificial sweeteners are often found in diet sodas, sugar-free flavoured water, yoghurts, and desserts. These do not promote the growth of acid-producing bacteria, but some sweetened products are still acidic, which can damage teeth. A product labelled 'no added sugar' may still contain naturally occurring sugars from fruit concentrates like apple juice concentrate, dry fruits like dates and raisins, others like maple syrup, honey or coconut sugar. These natural sugars still act like regular sugar in the mouth, feeding bacteria and causing enamel-damaging acids. For example, a granola bar with 'no added sugar' still contains dates (high in natural sugar), raisins (very sticky and sugary), and fruit puree (acidic). So always check the ingredients list, not just the fancy labels.

The hidden risk of Acidic snacks

Acidic foods and drinks can soften and also wear down the enamel, which serves as the outer protective layer of teeth. Upon weakening of the enamel, teeth become more vulnerable to cavities, sensitivity, and erosion. When a pH value is below 5.5, it is considered acidic, which in turn causes enamel damage. Let's check out some common sugar-free yet acidic snacks.

Product	Approximate pH
Diet sodas	2.5-3.5
Energy drinks	3.3-3.6
Electrolyte drinks	3.0-4.0
Sugar-free gummies	3.0-4.5
Flavored yoghurts	4.0-4.6

Due to the thin enamel, kids are more likely to acquire dental caries than the adults. The enamel can have no possible time to recover when one exposes themselves to acidic substances or drinks regularly and often. Enamel will never come back. Some of the warning signs of acid wear on the children include the white chalky on the children teeth and teeth sensitivity, color of the teeth turns yellowish (as the enamel rinses away the underlying dentin can be seen) as well as wavering and flattened edges of the teeth.

Sticky Snacks Are Still Harmful

Sticky foods adhere to the teeth in the grooves and between teeth where bristles of a toothbrush can't reach easily. These foods remain on the tooth surface for a longer period, providing a good source for bacteria, which eventually produce acids and increase the risk of cavities. The most common examples are fruit chews (e.g., Starburst, Fruit Roll-Ups), caramel, toffee, licoricey, and nut bars. These are especially risky when eaten between meals, as saliva flow is lower and less able to wash away food. The consumption of sticky foods when combined with poor oral hygiene may worsen the condition of teeth.

Better Snack Choices for Healthy Teeth

While it's essential to know what snacks harm your child's teeth, it holds equal importance to know what options are tooth-friendly. Making smart snack choices helps maintain oral health and lays the groundwork for lifelong healthy eating habits. Crunchy vegetables such as carrot sticks, cucumber slices, and celery are rich in fibre and water. They stimulate saliva production and also clean teeth while chewing. Firm, water-based fruits such as apples, pears, and melons have a crunchy structure to cleanse the tooth surfaces. Additionally, its high-water content helps dilute sugars, leading to rinsing of the mouth. Nuts such as walnuts, almond, pistachios and cashews. Also, seeds like sunflower seeds and pumpkin seeds offer a good source of protein and healthy fats. Unsweetened yoghurt, abundant in calcium and probiotics, supports enamel health and balances oral bacteria. A combination of snacks can smartly promote the balance of their effects on teeth. Example: Banana, when paired with a handful of nuts, provides a moderate natural sugar along with a cleaning effect for teeth.

Simple Practices to Keep Your Child's Teeth Healthy

Set the number of meal make-ups a day to 3 and snack time to 1-2 times a day. Small snacks should not be fed to the child at very frequent intervals during the day since the more your child opens his or her mouth to eat, the more the bacteria have time to work with the acid and the less the mouth has time to repair itself. Make your child drink a glass of normal water especially between and after snacks to wash away the pieces of food substance besides eliminating the acids. The problem is that children do not brush teeth decently, do not go in the back of the mouth: molars among others, and interproximal. Consequently, sticky or sugary foods can accumulate if not cleaned properly. So, brush twice a day with fluoride toothpaste (especially before bedtime), and floss once a day. After consuming acidic items, wait at least 30 minutes before brushing to avoid brushing softened enamel away. Supervise the child until he reaches 7- 8 years of age. Opt for healthy foods that are non-sticky, have high water content, are alkaline or have a neutral pH value, low in sugar, and provide a natural cleansing effect on teeth instead of acidic and sticky snacks. Including sugar-free gums like xylitol occasionally also helps to protect teeth. Visit a paediatric dentist every 6 months, even if there are no visible issues since regular check-ups allow for early detection, preventive care, and cleaning of teeth.

Conclusion

In today's realm of smart packaging and misleading buzzwords, it's easy to get fooled by the use of the terms 'sugar-free', 'no added sugars', and 'natural', especially when they are marketed for children. From concealed sugars to clingy consistencies to acidic components, many seemingly harmless snacks can still nurture harmful microbes, alter oral pH levels, and increase the chances of tooth decay, especially when accompanied by improper dental care routines. But here's the good news. With some awareness and easy changes, such as checking ingredients, limiting sugary treats, and maintaining good oral care, you can ensure your child's teeth stay healthy for years to come. Remember, it's not about perfection rather it's about intention. Every

smart snack swap and good habit you build today becomes a protective shield for your child's future smile.

Because when parents know better, kids smile better.

Autonomous Vehicle

Navigating challenges using AI and Machine Learning

Aranya Ghosh, TechSphere Insights,

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Introduction to Autonomous Vehicles

Autonomous vehicles, also known as self-driving cars, are futuristic cars and automobiles capable of operating on their own without any human intervention. Considered as one of the most important technological advancements in the 21st century, autonomous vehicles use sophisticated sensors, radars, GPS systems, Artificial Intelligence and machine learning. These futuristic vehicles can navigate through roads, make decisions and ensure the utmost safety of the commuter. Even in places like crowded streets, risky terrains and slippery roads where even humans find it difficult to drive, autonomous vehicles seamlessly sail across their way.

The concept of autonomous vehicles was first envisioned in the early 20th century. After years of research and experimentation, the first semi-autonomous car was developed in 1977 by Japan's Tsukuba Mechanical Engineering Laboratory. It used cameras and elevated rails to drive the car at 30km/hr. The 1980s saw significant progress with projects like Carnegie Mellon University's Navlab and ALV, funded by the United States' Defence Advanced Research Projects Agency. Gradually, companies like Mercedes-Benz also developed a robotic van capable of collision avoidance and with better navigation systems. Over the next few decades, advancements in technologies and the emergence of Artificial Intelligence and Machine Learning have made the concept of Autonomous Vehicles a reality.

Modern autonomous vehicles function using three main processes: Perception, Decision making and Control. Cameras, sensors, and radars perceive the environment, identify objects on the road, pedestrians and analyse the condition of the road. A GPS, along with LiDAR, helps the vehicle track its real-time location. These data are then processed by machine Learning algorithms and complex artificial neural networks to predict potential outcomes and make real-time decisions. Control systems receive commands from the complex AI system and execute the commands using the accelerator, steering wheel, gears and brakes.

Technologies that power Autonomous Vehicles

Artificial intelligence and Machine learning are the two most fundamental technologies in an Autonomous vehicle. Artificially intelligent systems built into cars use sensory data to perceive the surroundings and navigate safely in complex environments. Machine learning is a part of Artificial intelligence that enables vehicles to learn from data and work on their own without being explicitly programmed. Autonomous vehicles trained with machine learning algorithms learn from previous mistakes and experiences and improve over time.

Autonomous vehicles integrate several branches of artificial intelligence and machine learning to operate seamlessly.

Computer Vision

Computer vision is a technology that enables autonomous vehicles to interpret visual data and use it to drive safely. Cameras and sensors are used to capture real-time videos, and the complex algorithms recognise lane markings, traffic signals, road signs, pedestrians, other vehicles and animals. Other than AV manufacturing companies, computer vision is also used by space agencies to carry out interplanetary missions. NASA's Curiosity rover and China's Yutu-2 rover use this technology to navigate on the surfaces of Mars and the moon.

Natural Language Processing (NLP)

NLP is a domain of artificial intelligence that enables autonomous vehicles to interpret and communicate in human language. With the help of this technology, humans can give directions or commands to the vehicle for a better experience. Upon receiving the commands, the AV decodes the human speech to machine processes it and performs the given task or gives a response in the same language as the human. The use of NLP in autonomous vehicles creates a trust and connection between the passenger and the vehicle, just like a human driver.

Reinforcement Learning

Reinforcement learning is a type of machine learning algorithm that trains the autonomous vehicle to learn and make decisions on its own. This type of learning works on the trial-and-error method. That means if the AV performs any task with accuracy, it gets positive feedback and negative feedback for any mistakes. With the acquired feedback, the AV trains itself to avoid the previous mistakes and thus performs better with every use. Using this revolutionary machine learning algorithm, AVs adapt to changes easily and work with precision and efficiency.

Neural Network

A neural network is a machine learning algorithm inspired by the structure and function of human brains. Just like the neurons in human brains, these are made of interconnected nodes organised into layers. Each node performs complex processes to analyse the input data, identify patterns and learn from them. Neural network enables autonomous vehicles to think and act similarly to humans.

Advantages and Ethical Concerns of Autonomous Vehicles

Autonomous vehicles will be “a dime a dozen” shortly. With more technological innovations, more production and numerous advantages, autonomous vehicles will be widely used by a majority of people. The most significant advantage of autonomous vehicles is their enhanced safety. Autonomous vehicles aim to eliminate accidents caused by human error. Additionally, autonomous vehicles can communicate with each other and redirect to routes with minimal congestion. By optimising the distance between vehicles and controlling the speed, traffic congestion can be easily reduced. AVs can prove to be very helpful to people who cannot drive due to physical disability or old

age. Moreover, the sustainable nature of autonomous vehicles proves to be the "cherry on top". Governments around the world and NGOs are motivating people to opt for AVs that run on electricity due to their low carbon footprint. The several advantages of this revolutionary technology make it preferable to users.

However, the rise of autonomous vehicles also raises serious ethical concerns. A major issue developers face is decision-making during unavoidable accidents. Let's take an example of a hypothetical situation where a young boy has accidentally come in front of the car, and the autonomous vehicle has two options. One would be to run into the boy and injure him. The other is to turn the vehicle and hit a pole, injuring the passenger inside as well as damaging the car. In unpredictable situations like this, where the decision taken by the vehicle can cause major consequences, a lack of an ethical framework can prove to be fatal. Data privacy and cybersecurity are some other major issues that AV manufacturers face. The vast amount of sensitive data used by autonomous vehicles needs to be kept safe from breaches. The mass unemployment of taxi drivers and large-scale job displacement caused by AVs is another serious issue that needs to be considered.

Leading companies manufacturing Autonomous Vehicles

The autonomous vehicle (AV) industry has witnessed remarkable growth over the past decade. The global AV market is projected to grow from 54 billion USD to a staggering 556 billion USD by 2035. According to a 2025 survey conducted by McKinsey & Company, 67% of global respondents expressed their affinity towards the usage of autonomous vehicles shortly. As interest in people and global demand surges, several companies have started manufacturing autonomous vehicles on a large scale.

Tesla

Founded: 2003

Tesla, founded by Elon Musk, has become the most popular autonomous vehicle manufacturing company. Features like smart summon, better lane-centring, and advanced traffic navigation make it shine over others. While Tesla currently operates in level 2 and level 3 autonomy, continuous research and upgradation improve the vehicle's capability over time.

Waymo

Founded: 2009

Waymo manufactures fully autonomous vehicles that can achieve level 4 autonomy. The self-driving taxis operated by Waymo in cities like Phoenix and Arizona sets a benchmark for global autonomous transportation. Hi-tech technologies like LiDAR, complex machine learning algorithms, and elaborate testing make it the safest autonomous vehicle.

Ford Motor

Founded: 2016

Ford, in collaboration with Argo AI, has developed self-driving cars with level 4 autonomy. The vehicle, currently in its testing stage in Washington, promises to be the most sustainable AV with almost no carbon footprint. Along with other features, Ford has kept its main focus on safety and affordability.

Tata Elxsi

Founded: 1989

Tata Group is taking India to the forefront of the world through Tata Elxsi. The semi-autonomous AVs created by Tata are tailored to operate smoothly on Indian roads with heavy traffic. Along with hi-tech features, Tata has kept its vehicles cost-effective and affordable.

Forensic Breakthroughs

How Science Solves Modern Crimes

Niti Jha, TechSphere Insights,

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In a world where crime always leaves behind its tale, forensic science is the interpreter. It interprets the silence of death, the absence left by a missing person, or the inconsistency in a well-crafted alibi. With the criminals becoming more sophisticated, the science used to outsmart them also gets more advanced. Forensic science has, in the last few decades, gone through a radical transformation, combining biology, chemistry, physics, computer technology, and even artificial intelligence to construct impenetrable cases out of the most tenuous of clues.

From cracking century-old cold cases to catching perpetrators on a single hair or a faint digital trace, forensic advances have flipped the balance of justice. This article takes a deep dive into how contemporary science is empowering forensic investigations, exploring the tools, techniques, and technologies that are shaping the future and current state of criminal justice.

1. The Genetic Revolution: DNA as the Ultimate Witness

DNA profiling has been the single most significant breakthrough in criminal investigations. This evidence was first introduced as admissible evidence in the late 1980s and has now become the gold standard of forensic identification. Investigators can take genetic material from a crime scene, and using that genetic material to compare with biological samples from suspects, databases, or even relatives, investigators can link or eliminate individuals with near-perfect accuracy.

The move from Restriction Fragment Length Polymorphism (RFLP) methods to Short Tandem Repeat analysis (STR) has moved the science forward, where tests can be done quickly with highly sensitive DNA, producing conclusive results with biological samples no bigger than a drop of blood or a few skin cells. Mitochondrial DNA and Y-STR analysis have also been developed to analyse diminished or degraded samples (often post-mortem remains such as bones from mass disasters or deinstitutionalised historical remains).

One of the more remarkable uses of DNA in our modern memories is the case of the Golden State Killer; a serial killer/spree rapist that evaded law enforcement for over 40 years. In 2018, investigators turned to genetic genealogy, which utilises genetic analysis of DNA to engage publicly available ancestry databases to help identify a suspect. They were able to identify Joseph James DeAngelo, who was a former police officer. This case is a paradigm shift in that they were able to identify a suspect using genealogical and familial shared genetics, which breathes life back into cold cases; either a suspect can be identified or thousands of unidentified offenders could be eliminated.

India, too, is embracing this transformation. The DNA Technology (Use and Application) Regulation Bill, aiming to standardise and expand forensic DNA use, is poised to strengthen law enforcement capacities in the country, provided ethical and privacy concerns are adequately addressed.

2. The Digital Sleuth: Cyber Forensics and the Footprints We Leave Behind

Today, almost every facet of human interaction leaves an electronic trail: an unintentional footprint that can prove to be pivotal evidence. Digital forensics - to include recovering and analysing data from electronic devices - has evolved into one of the most innovative fields in forensic science.

Digital forensics can describe the steps taken by a suspect, before, during, and after a crime, from recovering deleted texts and data from cell phones to unlocking hard drives, tracking IP addresses, and recovering erased files from the cloud. Digital forensics is now indispensable, especially in cases of cyber fraud, sextortion, cyberbullying, and even homicide.

In India, the development of its digital forensics infrastructure, including cyber labs established in states like Telangana and Gujarat, is addressing the increase in cybercrime. Forensic tools can identify and exploit geolocation metadata, detail the time-stamped string of interactions, and recover conversations from applications - even encrypted apps like WhatsApp or Signal (with the appropriate legal access).

A powerful example was in the Sheena Bora murder case, in which digital communications recovered between the key suspects enabled a timeline of events leading to and following the murder.

As cybercrime becomes more complex, law enforcement agencies are investing in AI-driven analytics, machine learning tools, and even dark web surveillance systems to keep up with the growing volume and intricacy of digital evidence.

3. Truth in Traces: Toxicology and the Science of Substances

Forensic toxicology is one of the most captivating and complicated fields of forensic science because it investigates both the presence and effect of substances (drugs, poisons and chemicals) in humans. It requires both accuracy and interpretation. Identifying a substance is just the start of the investigation, as assessing its effect is where the truth is uncovered.

Forensic toxicologists have an entire range of substances to investigate, from traditional poisons such as arsenic and cyanide, to recently developed synthetic drugs such as fentanyl and methamphetamines. Toxicologists utilise various instrumentation (presence or effect) for identification and quantification of drugs and poisons, including Gas Chromatography-Mass Spectrometry (GC-MS), and High-Performance Liquid Chromatography (HPLC) to investigate blood, urine and tissue samples.

Forensic toxicology has played an integral role in many high-profile investigations across the world. In 2020, the mysterious death of actor Sushant

Singh Rajput drew national interest in toxicology reports and the role various substances played.

New forensic technologies also allow researchers to look at hair and nail samples when assessing drug exposure over longer time frames. For post-mortem interval estimation, new technologies can detect drug metabolites that degrade over time. In crimes involving drug-facilitated crimes, particularly sexual assault or incapacitation, testing time frames are highly critical.

4. The Third Dimension: Crime Scene Reconstruction and 3D Imaging

Shortly, you could review a hyper-realistic virtual crime scene long after the crime was committed. Not physically, of course, but through some seriously advanced technology. This is not pure science fiction, as forensic teams can now collect many aspects of a crime scene in excellent high resolution using 3D laser scanning technology (like FARO) to document evidence locations, evidence relationships in real-time, evidence conditions and positions in exact scale, how the environment contributed to the physical evidence, and many other rich details.

3D virtual models provide many benefits in and out of the court system, including the virtual walkthrough for parties to a case, including judges and juries. This is especially important when looking at the multiple possibilities of ballistic trajectories and bloodstain patterns.

Further, virtual autopsies, or “virtopsies,” are bolstering popularity, with MRI and CT scans of postmortem examinations providing non-invasive options when, culturally or logistically, traditional methods would not be feasible. Amid these changes, digital technology is continuously revolutionising how we investigate crime and contextualise crime.

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5. Nature’s Testimony: Entomology, Palynology, and Soil Forensics

In some cases, blood spatter and weapons don't resolve the case; it's simply insects, pollen grains, and dust.

Forensic entomology makes observations about the lifecycle of insects (often blow flies) to determine the post-mortem interval (PMI). The type of insects on the body (the accumulation of these species), the age, and the stage of development provide information about the timing and conditions of death. This approach to forensic science has been extremely useful for rural and outdoor crime scenes, where environmental evidence is louder than human testimony.

In the same vein, forensic palynology includes pollen and spores found on clothing, skin, or objects. Since plant pollen is location and time-of-year-specific, it can place victims or suspects at geographic locations and timeframes.

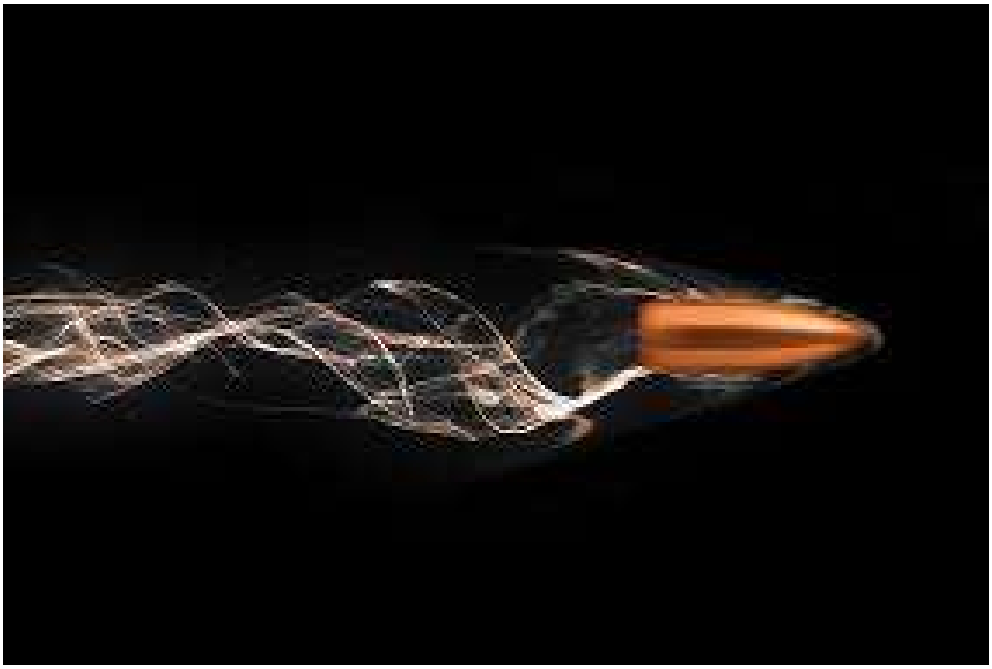
Soil forensics, while not as commonly recognised, can be just as powerful by connecting soil residues found on a shoe, tool or vehicle to specific environmental qualities; it has been used in illegal burials and in a variety of environmental crimes.

6. Ballistics and Toolmark Analysis: Every Weapon Leaves a Signature

Every gun leaves (or creates) a unique, identifiable (or individual) mark on the bullet, cartridge, and/or scene. Forensic ballistics is investigating the marks on (or left by) bullets or cartridge cases to evaluate the weapon used, the path of the bullet, the range of fire, and the impact.

Law enforcement officers are now able to use databases such as the Integrated Ballistics Identification System (IBIS) and India's Crime and Criminal Tracking Network System (CCTNS) to connect bullets or casings from/traced across multiple crime scenes and jurisdictions.

Similarly, toolmark analysis links (not the cases or toolmarks themselves) microscopic impressions left by tools, such as a crowbar in a break-in, or a knife in a stabbing, to a specific weapon. Analysts have been able to improve their comparisons of tool marks, with new advanced microscopy and a growing need for the use of software to support their conclusions and opinions.



7. Psychological Profiling and Behavioural Science

Learned behaviour based on physicality can be computed, measured and compared. The mind of a criminal often lingers in the shadows. Forensic psychology and criminal profiling tries to shed light on the unknown. Profilers try to predict characteristics, habits, and potential future actions based on various behavioural patterns, characteristics of crime scenes, and psychological theory.

Profiling is increasingly being enhanced by data. Behavioural databases such as the FBI's ViCAP (Violent Criminal Apprehension Program) allow for analysing serial crimes for similarities. The National Crime Records Bureau (NCRB), along with its counterparts in Europe, have taken initial steps toward considering behavioural science in the occurrence of serial killings, or against crimes against women and children.

Neuroforensics is expanding into areas like evaluating brain scans and psychophysiological responses to the determination of deception, memory recall and moral cognition, among other applications. Though not without controversy, this area of applied forensic psychology is still considered highly speculative, but emerging.

8. Artificial Intelligence and Predictive Forensics

AI is slowly becoming a quiet partner in investigations. By breaking down surveillance footage frame-by-frame or analysing anomalies in financial transactions, AI is saving time and identifying things that humans could miss.

Predictive forensics is still in its infancy and is meant to see potential criminal behaviour or areas of a future crime using statistical models and recognition of patterns. There are legitimate ethical concerns about predictive forensics, although it is already being piloted in places like London, New York City, and Delhi.

AI is helping forensic document examination, voice pattern examination, and facial recognition, reducing the time taken to identify persons and reducing the potential for human error.

Case Files: Science in Action

Let's explore some compelling examples from recent Indian criminal cases that highlight the critical role of forensic science:

1. Nirbhaya Case (Delhi, 2012): In this horrific case, scientific methods of forensic biology and forensic fingerprinting, along with digital forensic evidence retrieved from the victim's phone, assisted in laying down important evidence that secured convictions. The use of these forensic methods also emphasised the importance of science in aiding justice for a tragic case that drew great public outrage.

2. Aarushi Talwar Double Murder Case (Noida, 2008): This intriguing double murder case resulted in many discussions, calls for forensic science value, and ultimately calls for improvement of forensic science in India. Blood spatter analysis provided important insights into the nature of activity as it dictated events in the crime scene, while narco-tests were indeed controversial, yet they invoked discussions of respect and usefulness. Although there were opportunities at the beginning of the investigation to find out what had

happened, the subsequent investigations were limited by any uncontrolled distractions, precluding a full investigation and an understanding of the case.

3. Shraddha Walkar Murder Case (Delhi, 2022): In this terrible case, forensic odontologists simply used dental records to match the jawbone parts (which were later loosely referred to as jaw parts) to Shraddha Walkar. This forensic DNA identification helped identify remains and established a clear view of how important forensic teeth can be in identifying cases with skeletal elements. This work using forensic science helped tie together the circumstances around the crime and further coordinated the connections to her death.

These cases vividly demonstrate how advancements in forensic science have become indispensable tools in the pursuit of justice, illuminating the path from crime scene to courtroom.

Conclusion: A Science of Truth

Forensic science transcends mere technique; it embodies a profound philosophy of truth-seeking, firmly anchored in the principles of evidence. Each year, as the realms of science advance, the silent witnesses of crime become increasingly articulate. They communicate not just through molecules and algorithms, but also through the intricate patterns of fractures and the life cycles of fly larvae. Their stories are narrated by the unwavering dedication of forensic scientists, who labour diligently behind the scenes, often in obscurity, to guarantee that justice is not merely served, but meticulously supported by scientific validation.

As we gaze into a future defined by the burgeoning fields of artificial intelligence, virtual simulations, and genetic editing, one truth prevails: forensic science will steadfastly serve as a beacon of justice. It will continue to illuminate the shadowy recesses of human behaviour with unyielding logic, unwavering reason, and a clarity that never falters...

Vision Viksit Bharat

India's Strategies to boost its economy by 2047

Shobana Vidhya Somasundaram, TechSphere Insights,
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Introduction

On August 15, 2025, the 78 th anniversary of India will be provided. The country has been able to propel its economic well-being over the years by utilizing such concepts as technology, super conductors, space program and research as its areas of priority. Since then, India is making itself felt in the global world. Today India has surpassed Japan and it is currently rated number four and it is known as one of the strong nations in the world. What were the changes that India made in its economy in the years? Now, let us know about the same.

Post-Colonial India

India’s economy after independence dropped from 22.6% to 3.8%. The Industrial Revolution in 1948, the five-year plan starting in 1951, the green (agriculture), and the white revolution (milk production) of the 1960s contributed to initial economic growth. In the 1990s, Former Finance Minister and our late Prime Minister Dr. Manmohan Singh, along with then Prime Minister Narasimha Rao, introduced the LPG (Liberalisation, Privatisation and Globalisation) scheme, which paved the way for investments from international markets. Then, slowly, we start setting up domestic businesses and firms.

India in 2016-2022

November 8, 2016 Prime Minister Narendra Modi demonetised to make the Rs 1000 and Rs 500 be illegal notes to make the process be as transparent as possible. This was quite damaging to the rural background since they have a poor banking as well as internet services. It has been realized that godown shutdown lowered GDP by 5.7 percent as people are rushing to banks in order to withdraw their money.

The rate of employment decreases and the pandemic completely whitewashes jobs. In the current 2020-2021 year, there has been a massive decrease in the GDP of 7.3 percent. All this contributed to a huge loss in the economic rate of the nation.

The growth of the online transaction to 100 billion dollars by 2021 gradually translated to an increase in the GDP. The development of the GDP value is a pointer of sustainable development, and this is estimated to grow to 9 percent in 2021- 2022 and 2023. In this manner, India came fifth in the ranking of the world economy.

India Today

Today's India is the fourth-largest economy in the world with a GDP of 4 trillion dollars, only behind the US, China, and Germany. It is expected to cross

Germany by a year or two, according to an India Today report, and will become the 3rd largest economy.

From this graph, it is seen that India is potentially showing an increase in the Gross Domestic Product (GDP). That is, in the Financial Year 2024 (FY24), it is showing a pace of 5.3%, which slowly increased to 6.2% in the Financial Year 2025(FY25) and is expected to pick up to 7.6% in the 4th quarter of the Financial Year 2025 (Q4 FY25)

What are the main reasons that are causing this rise?

Factors like technology and digitalisation have attracted businessmen to invest in these companies. India is slowly seeing the growing middle-class urbanisation, which is an all the more important driving force to increase the economy.

India has seen a sudden increase of 10.35% in travel within the country. There is an increase seen in foreign exchange, the Purchasing Manufacturing Index (PMI) is 58.4 as of April 2025 from March 2025, which is 58.1, and wheat procurement shows a 34% contribution to the economy. These are some of the major factors that drove India's economic growth.

Areas where India needs Improvement:

Even though India is growing, there are a lot of factors that still need improvement.

Agriculture contributes 18% of GDP, yet it does not have enough labourers in the market. So, employing more farmers is needed. Improvement in terms of manufacturing goods and products can do better work, as it is not able to meet the 25% target.

Unemployment, increasing in the level of disparity in workforces, 1% of the entire population is enjoying the power and money, which certainly raises concerns. India is far behind China, the US, and even Israel in terms of contributing quality research work.

India is growing, but India should take care of lots of matters at hand to enhance its growth.

Viksit Bharat: India's Vision in its centenary year

This Viksit Bharat is a mission to encourage Indian nationals to use Indian products and make India a developed and independent nation. In the 2025 budget, our Finance Minister, Nirmala Sitaraman, laid down some pathways to achieve this vision. This project was introduced to see a tremendous increase in the employment rate, more women's contribution to the economy, no poverty in the country, providing quality education, and an increase in the value of farming and agriculture.

Some objectives of this mission are:

The Prime Minister of India's objective is to increase the national economy by $30 trillion. Vision India@2047, a project taken by NITI Aayog, laid down India's plans for the next 22 years. Here, many industrialists, businessmen, and influencers came together for the planning and execution of this project. Some of the main objectives are:

- Building up great infrastructure, establishing growth in roads and transportation,
- Overcoming challenges due to climate change and taking immediate action towards it.
- Facilitating more ways for start-up companies, and depending more on Indigenous products than foreign goods.
- Development in space technology and sending out Indian astronauts to space for research purposes
- Enhancing the quality of research and building up laboratories.

- Empowering education students and providing quality skills to youth so they get placed at top companies.
- Employing more people in the workforce and increasing employment opportunities
- Improve the quality of the Internet network by paving the way to transfer from 4G to 5 G.

Launch of 4G technology, a prime Viksit mission

The launch of 4G technology has created tremendous improvement in the country's economy.

- This creation has vastly improved our internet quality and paved the way for easier communication.
- The 4G internet has provided clarity in terms of video calls and facilitated means for staying in touch with families and conducting online meetings.
- Technology took off, especially during COVID, because it enabled people to work from home. Online education platforms emerged, and students were able to finish their classes and degrees without interruption.
- E-commerce and online business were at peaks and continuing to be at the top so far since the 4G technology.
- 4G technology opened doors for social media platforms- reaching out to customers and marketing their products and services for regular businesses has become easy.

In the field of agriculture, it has assisted farmers in predicting weather conditions and temperature and helped them carry out irrigation and harvesting.

Challenges to India's Economic Journey

- Dollar-rupee exchange depends largely on inflation, trade, and capital flows. This has to be in checks

- Maintaining a higher GDP growth rate.
- To be able to overcome geopolitical burdens, especially from China and Pakistan.
- Boosting the growing rates of the middle class by cutting down taxes and giving more employment opportunities.
- Even 4G technology is unable to provide better infrastructure. India has to take high measures to improve it.

Conclusion

In short, India is a rapidly growing country with enormous growth in every sector. India needs lots of improvement in terms of employment, education, inequality, and technology. India needs to focus more on its aims for the development of environmental progress and climate control. The citizen should also follow and cooperate with the norms of the central government. There is a website where Indian nationalists have access to the 2047 vision, wherein they can incorporate their ideas. In this way, if people and the government work together, nothing can stop India from achieving its dream of becoming a developed nation by 2047.

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