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PIONEERING THE FUTURE OF
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About Us

In 2008, we embarked on our journey by establishing the inaugural office of the company in Kochi, where an operational team commenced the execution of industrial automation projects. Within a year, we inaugurated our first training center in Kozhikode. By delivering exceptional service, we quickly attracted students from various regions of India and even from Africa. Subsequently, we broadened our training centers to multiple locations across India, Nigeria, Qatar, the UAE, Kenya, and the Kingdom of Saudi Arabia. As of 2024, we proudly operate a total of 32 branches. IPCS Global has emerged as one of the most esteemed core technical training providers globally, offering a wide array of programs that are future-oriented.

The selection of training programs is guided by several factors, including the potential for growth within each field, the employability prospects for our trainees, the accessibility of various job markets, and other relevant considerations. Our current offerings encompass Industrial Automation, Building Management and CCTV Systems, Embedded Systems and Robotics, the Internet of Things, Digital Marketing, IT and Software Development. Key features of our programs include 100% live and interactive classes, global certifications, and placement opportunities.

We aim to establish a network of 50 centers by 2025, reflecting our commitment to expansion and excellence. We welcome motivated entrepreneurs to collaborate with us in achieving this vision. You can join us as a franchisee, operating under our brand and business model, or as an investor to support our growth. Together, we can create a lasting impact in our communities. Visit <https://ipcsglobal.com/> for more details.

Our goal at IPCS is to expand globally, preparing students for future careers by staying updated on emerging trends and maintaining ethical standards. We emphasize teamwork, professionalism, and mutual respect within our organization. Understanding the impact of technology on our lives is crucial in today's digital era, as it drives business success and innovation. By prioritizing these values, we ensure client satisfaction and student excellence across all fields.

Team IPCS has introduced "Iziar," a magazine focusing on technology trends and market developments. The goal is to increase awareness and accessibility of technology for all. Content covers technology, startups, cyberpunk culture, and more, aiming to inform readers about the latest innovations and trends in the industry.

Technology is like air; you can't live without it. We invite you to immerse yourself in the technological realm of Iziar.

"TIME AND TECHNOLOGY WAIT FOR NONE"

COOKIELESS CONSUMER PROFILING

Easy tips for tracking users without relying on cookies



Bagesri R H
DM analyst
Trivandrum

In addition to my degree in economics, I completed a diploma program in digital marketing. The ever-evolving domains of economics, marketing, and technology have served as a major source of inspiration for my journey into the dynamic world of marketing. With a strong desire to learn about new tactics and resources, I'm dedicated to becoming an expert at making powerful digital experiences. For me, marketing is a passion that unites creativity and technology to create lasting relationships in the digital era, not just a job.



The digital advertising industry is going through a seismic shift. For decades, advertisers have relied on third-party cookies for tracking user behaviors across the web and delivering personalized ads to consumers. Increasing privacy concerns on the part of users and changes to browser policies have rapidly phased out third-party cookies, ushering in the start of a cookieless world. This paper examines how advertisers are best navigating this transition and describes the challenges as well as opportunities afforded to digital marketing ecosystems.

The Changing Landscape of Digital Consumer Profiling

As the industry retires third-party cookies, advertisers are tasked with reevaluating how they recognize and build relationships with their audiences. The old ways of tracking, which relied on gathering data from through multiple sites, are on their way out. This transition is necessitating new ways of thinking, more privacy-oriented solutions that will deliver effective advertising targeting without infringing on users.

Conventional Cookie-Based Profiling

- Depends on third-party cookies for data collection.
- Monitors user activity across multiple websites.
- Enables targeted ads based on browsing patterns.
- Faces criticism due to invasive data collection practices.

Privacy-Focused Profiling in a Cookieless Environment

- Prioritizes methods that protect user privacy.
- Utilizes first-party data and contextual targeting.
- Relies on anonymized and aggregated data.
- Aims to strengthen direct consumer relationships.
- Examples include Google's Topics API and Private Click Measurement (PCM).



Emerging Profiling Techniques in the Absence of Cookies

The phase-out of third-party cookies has inspired a variety of new audience profiling techniques, each with unique benefits and limitations:

- **Contextual Advertising :** Targets ads based on the content of the page being viewed, without referencing personal browsing history, making it a privacy-friendly option.
- **First-Party Data:** Gathers data directly from users via website visits, subscriptions, and loyalty programs. This information is highly valuable because it comes with user consent and reflects genuine interests.
- **Federated Learning of Cohorts (FLoC):** Once proposed by Google, this grouped users into anonymous cohorts based on online behavior. (Note: FLoC has since been discontinued in favor of the Topics API.)
- **Topics API:** Google's updated framework assigns a small set of interest-based topics to each user for a limited time, which websites can access to display relevant ads, providing users with more control over their advertising experience.
- **Privacy Sandbox:** A collection of privacy-first initiatives led by Google, aimed at creating secure alternatives to third-party cookies.
- **Unified ID 2.0 (UID2):** An industry-driven solution that replaces cookies with an anonymized, email-based identifier, used only with user consent.
- **Deterministic Identity:** Matches user identities across devices using personal information like email addresses or phone numbers, requiring explicit consent.
- **Private Click Measurement (PCM):** A secure method to track ad conversions without disclosing individual user data.
- **Aggregated and Anonymized Data Analysis:** Focuses on using grouped data to understand consumer behavior patterns without tracking individuals.

Advertiser Challenges and Opportunities

Challenges

- **Reduced Targeting Precision** : Limited ability to identify and target highly specific audience segments.
- **Measurement Complexity** : Difficulties in accurately tracking and measuring ad performance.
- **Technological Fragmentation** : Managing a growing set of new, unfamiliar tools and platforms.
- **Data Fragmentation** : Issues with integrating and managing data from multiple sources.

Opportunities

- **Building User Trust** : Prioritizing privacy can help establish stronger consumer relationships.
- **Better Data Quality** : First-party data is often more reliable and relevant.
- **Creative Advertising Approaches** : Encourages the development of innovative, non-intrusive ad experiences.
- **Ethical Differentiation** : Brands that adopt transparent, user-centric data practices can stand out in the market.

Privacy, Compliance, and Ethical Advertising

The shift towards cookieless solutions is mainly driven by privacy regulations, like the General Data Protection Regulation (GDPR) in Europe or the California Consumer Privacy Act (CCPA) in the US, and advertisers must obligate themselves to act in transparent, ethically sound ways by:

- **Securing Clear Consent**: Ensuring users actively agree to data collection and use.
- **Offering Data Control**: Allowing consumers to view, edit, or delete their personal information.
- **Protecting User Data**: Implementing strong security protocols to prevent data breaches.
- **Transparent Data Practices**: Clearly explaining how data is collected, used, and shared.
- **Staying Compliant**: Adapting quickly to evolving data privacy laws and guidelines.

Key Trends Shaping the Cookieless Advertising Era

Although the future is still developing, several significant trends are becoming clear:

- **Growing Focus on First-Party Data :** Businesses will increasingly rely on the data they collect directly from their users.
- **Resurgence of Contextual Advertising:** Placing relevant ads based on webpage content will gain prominence.
- **Advancement of Privacy Technologies:** New tools, like differential privacy and homomorphic encryption, will support privacy-preserving data analysis.
- **Emerging Identity Solutions:** Competing systems like UID2 and deterministic identity matching are seeking to replace third-party cookies.
- **Value-Driven Data Sharing:** Brands will need to offer meaningful benefits in exchange for user data.
- **Use of AI and Machine Learning:** These technologies will help analyze behavioral patterns, refine targeting, and optimize campaigns without compromising privacy.



Conclusion

Transitioning from third-party cookie data to first-party cookie data is a big change and an opportunity for digital advertisers. It requires a lot of effort to change how audiences are identified and engaged with ahead of 2024, but it also provides an opportunity for a more transparent and privacy-respecting and compliant digital environment. Using new tools, implementing ethical data practices, and forming direct consumer relationships should not just allow advertisers to navigate the future without cookies, but also to do so successfully.

How to Optimize Industrial Processes with OPC



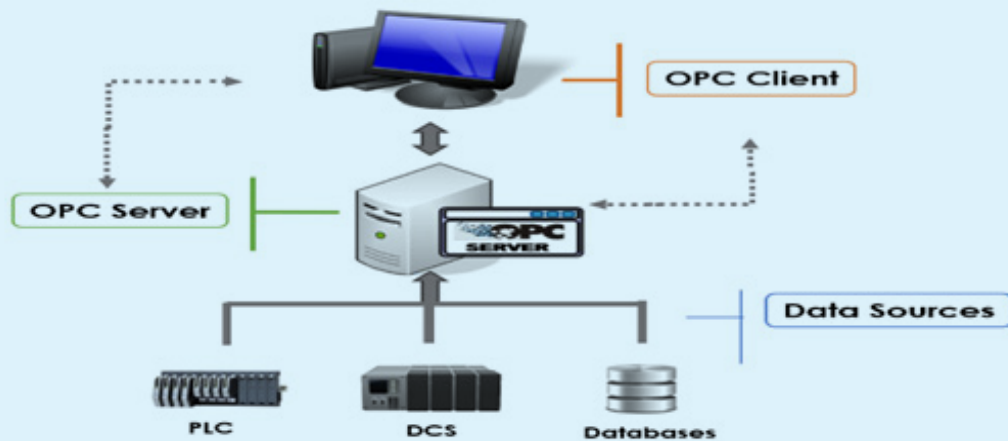
Paul Manuel
Project Engineer,
Mysore

I am an enthusiastic advocate of industrial automation and robotics, dedicated to harnessing intelligent systems to achieve precision and foster innovation. My professional repertoire encompasses the programming, calibration, and troubleshooting of PLCs, the deployment and integration of SCADA systems and possess advanced designing and implementing of human-machine interfaces (HMIs). Furthermore, I am skilled in the conceptualization and assembly of control panels and possess profound knowledge of the Robot Operating System (ROS), including navigation algorithms and mobile robot localization. My focus encompasses diverse facets of industrial environments wherein Programmable Logic Controllers (PLCs) are seamlessly integrated with real-time operational scenarios, complemented by the strategic deployment of SCADA systems. Through the meticulous selection and application of precise communication protocols and modalities, I endeavor to transmute complex industrial challenges into efficacious, real-time solutions.

In today's industrial roundtable, the integration of platforms, hardware devices, and software applications is essential for achieving efficient, reliable, and flexible automation solutions. A key technology that enabled this integration is OPC (OLE for Process Control). In this article, we will examine OPC, looking at its architecture, technical underpinnings, historical development, and role in industrial systems.

What is OPC?

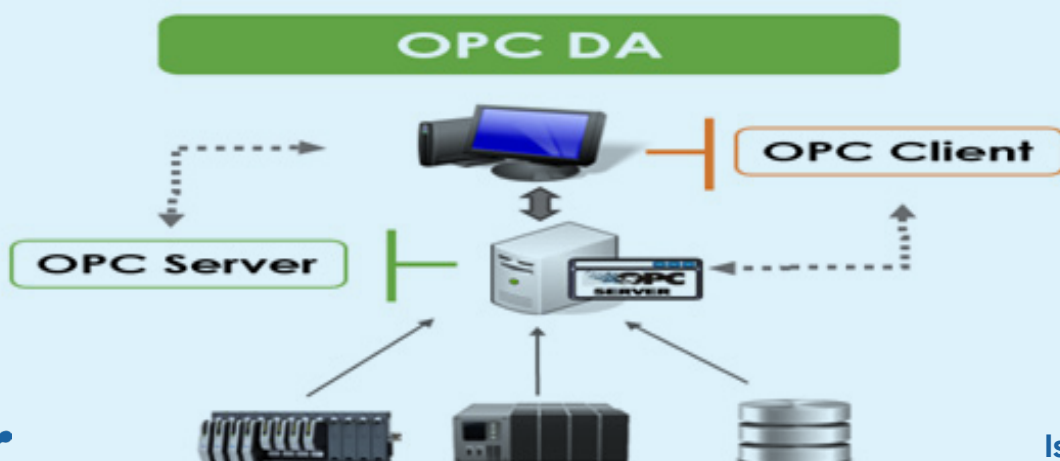
OPC is a family of standards and specifications that are open, and the primary purpose of OPC is promote interoperability between automation hardware (PLCs, sensors, controllers, etc.) and supervisory software (SCADA, HMI, data historians, etc.). OPC allows different systems from different vendors to communicate since they are able to use a common communication interface which eases integration and lowers costs.



Historical Background and Development

OPC was first developed in the late 1990s by representatives from several industrial automation organizations that aimed to resolve shortcomings of proprietary communication protocols which prevented system interoperability. The initial OPC technology was called OPC DA (Data Access) and was built on Microsoft COM/DCOM technologies, which enabled it to be integrated into the widely used Windows environment.

As industrial networks developed, so did the need for a cross-platform and secured communication which led to the development of the OPC UA (Unified Architecture). OPC UA was intentionally designed to overcome the shortcomings of COM/DCOM-based OPC and to allow cross-platform, secure, and scalable communication. Technical Foundations of OPC



1. Client-Server Architecture

At its core, OPC operates on a client-server model:

OPC Server : connects directly to hardware devices (PLCs, sensors, etc.), gathers real-time process data, historical data, or event information, exposes standardized interfaces to allow clients to access data without concern for hardware-specific protocols.

OPC Client : software applications such as SCADA, HMI, or data analysis tools, requests data from OPC servers, subscribes to updates, and writes control commands to hardware via the server.

2. Communication Protocols

Original OPC (OPC DA) : built on Microsoft COM/DCOM technology, requires network configuration (firewalls, permissions) for remote access, best suited for Windows-based systems.

OPC UA : uses Web services and platform-independent protocols (like TCP/IP with SSL/TLS), supports complex data types, event handling, alarms, and historical data, designed for distributed, scalable, and secure industrial environments.

3. Data Models and Interfaces

OPC defines standardized data models and interfaces to ensure uniform data access:

Data Items : Standardized representation of process variables (e.g., temperature, pressure).

Methods : Operations like read, write, subscribe, and event notification.

Services: For browsing available data points, reading/writing data, and subscribing to updates.

In OPC DA, data access is primarily read/write of real-time data. OPC UA extends this with support for complex data types, historical data, alarms, and conditions.

4. Security and Reliability

OPC DA: Security relies heavily on Windows security settings; DCOM configurations can be complex.

OPC UA: Incorporates built-in security features such as encryption, authentication, and user authorization, making it suitable for critical applications.

How OPC Works in Practice

► Hardware Connection

The OPC server interfaces directly with physical devices using vendor-specific protocols (e.g., Modbus, Ethernet/IP, Profibus).

► Data Exposure

The server maps hardware data into standardized data models and exposes it via COM/DCOM or web services (for OPC UA).

► Client Interaction

Clients connect to the server using OPC interfaces, subscribing to data changes or polling for information, clients can also write control commands to hardware via the server.

► Data Flow

Data flows bidirectionally, enabling real-time monitoring, control, and data logging.

Significance and Advantages of OPC

► Vendor-Neutral Integration

Eliminates the need for custom communication drivers, reducing development time and costs.

► Flexibility and Scalability

New devices or systems can be added with minimal reconfiguration.

► Real-Time Data Access

Facilitates timely decision-making in manufacturing, process control, and automation.

► Data Security and Reliability (with OPC UA)

Ensures secure data transmission across networks, suitable for critical infrastructure.

► Support for Complex Data and Events:

Modern OPC standards support alarms, events, historical data, and complex data types.



Evolution to OPC UA

While OPC DA served well in traditional Windows-based environments, the advent of OPC UA has significantly expanded OPC's capabilities:

► Platform Independence

Runs on Windows, Linux, embedded systems, and cloud platforms.

► Enhanced Security

Built-in encryption, authentication, and secure communication channels.

► Rich Data Modelling

Supports complex data types, methods, and event-driven communication.

► Scalability

Suitable for small devices as well as large distributed systems.

Industry 4.0 via Real-Time and OPC UA

The OPC Unified Architecture (UA) industrial communication protocol has been around for almost two decades and slowly helping to digitize many segments of industry. As a key technology building block, OPC UA is necessary for safe and trusted communication within an industrial site and is a critical piece for achieving Industry 4.0.

With its open architecture and platform independence and adopting a client-server approach, OPC UA is designed so that every relevant data node can be connected – from small controllers to enterprise servers – and enable the interoperability between Operational Technology (OT) and Information Technology (IT). It also allows remote access to plant infrastructure, machinery, sensor data, and combined databases, which facilitates operational flexibility and control.



Conclusion

The acronym OPC (OLE for process control) has fundamentally changed the area of industrial automation and has provided an open standard for data interoperability. Its client-server architecture, standardized interfaces, security provisions, and configuration have made it a mainstay for connecting systems that were developed upon a multitude of technological architectures.

With the advent of OPC UA, the standards evolution and bring flexibility to an evolution of requirements for Industry 4.0, Industrial Internet of Things (IIoT) and smart manufacturing systems. A thorough understanding all the fundamental concepts and architecture of OPC is very important for engineers, systems integrators, and automation professionals wanting to create adaptable, scalable, and secure systems.

In summary, OPC is significant beyond data exchange; it is a worldview of openness, interoperability, and reliability that is essential for the continued evolution of industrial automation. While technology evolves, OPC and its developing standards will continue to play a central role in creating smarter, safer, and better connected industrial solutions; paving the way for a better future of adaptable, reliable and smart automation.

Answer Engine Optimization (AEO)



Pioneering the Future of Search Experiences



Bhavanshaarathy
Digital Marketing Analyst
Coimbatore

A results-driven Digital Marketer with a passion for building impactful brand narratives and driving measurable growth in the digital landscape. I specialize in leveraging the power of SEO, performance marketing, content strategy, and social media to craft compelling campaigns that resonate with audiences and deliver results. With a keen eye for analytics and emerging trends, I transform data into actionable insights that elevate online presence and business performance.

Beyond strategy, I take pride in mentoring aspiring digital marketers, nurturing talent in areas such as SEO, Google Ads, content creation, and audience engagement. Rooted in a commitment to continuous learning and innovation, my mission is to harness the ever-evolving digital ecosystem to solve real-world business challenges and make meaningful contributions in every project I undertake.

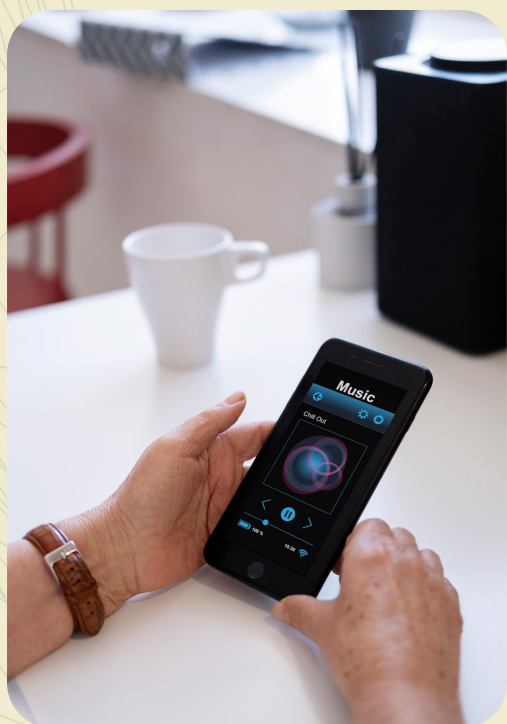


Digital marketers and SEO professionals need to constantly evolve as technology and consumer behavior shift. The optimization of a blue link in a search engine results page (SERP) is quickly becoming a thing of the past. Nowadays, being found is not as important as being understood and getting quick answers. Enter Answer Engine Optimization (AEO), a strategic approach designed to ensure your content is selected by an AI-powered platform or search engine as the ultimate answer. As voice assistance, conversational AI, and zero-click searches become the new normal, AEO is quickly moving to the front of the line as a value of digital exposure. But what is AEO, why it is important, and how can businesses prepare for it? This blog explains the basics of AEO and gives actionable tips for making sure your content is future proof.

What is Answer Engine Optimization (AEO)?

The act of structuring and presenting your online content or material in such a way that answer engines (like Google's highlighted snippets, Siri, Alexa, ChatGPT or Bing AI) can quickly understand, extract and display your content as an authoritative answer to a user request is known as answer engine optimization, or AEO.

AEO focuses on direct answers, or answers that are pulled and displayed as answers without clicking, when traditional SEO is focused on promoting the rank of links found in the search results. Answers can be displayed as featured snippets, People Also Ask boxes, knowledge panels, or as a spoken answer by virtual assistants.



Why is AEO important now?

- **Shift toward zero-click searches** : Over 50% of searches now end without a click. Users get their answers straight from the search page.
- **Voice search growth** : Voice assistants favor concise structured answers they can easily speak aloud.
- **Rise of AI assistants** : Tools like ChatGPT and Google Gemini are being used as search alternatives, providing summarized answers drawn from trusted content.
- **Enhanced user experience** : People want fast direct answers. AEO aligns with this behavior.

In essence, AEO helps your content be the answer not just an option.

How is AEO Different from SEO?

Aspect	SEO	AEO
Goal	Rank high in SERPs	Be selected as the best answer
Metric	Click-through rate rankings	Inclusion in featured snippets, AI summaries
Focus	Keywords, backlinks, meta tags	Clarity, structure, semantic relevance
Audience	Search engine algorithms	Answer engines, AI, virtual assistants

AEO and SEO are closely related, but their end goals differ. Think of SEO as optimizing for visibility, and AEO as optimizing for understanding.

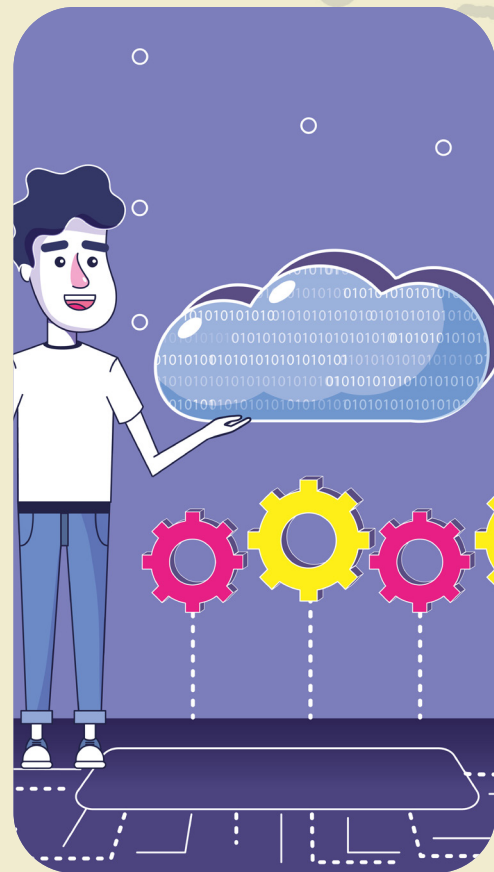
How Do Answer Engines Work?

Answer engines rely on natural language processing (NLP) and machine learning to understand questions and locate accurate relevant answers across the web. They prioritize content that is:

- Semantically rich
- Structured logically
- Clear and concise
- Contextually aligned with the query intent

They will not just look for keywords, but rather, they will check for meaning, meaning making connections between concepts, and clearly show the source is credible.

For example, if someone types in "How do solar panels work", an answer engine will look for a paragraph that explains how it works in plain language, with schema markup and references cite to credible content.



Key Elements of AEO Strategy

To optimize your content for answer engines, here are the key strategies to follow:

1. Understand User Intent (Deeply)

Go beyond keywords. Focus on the why behind the question. Is the user seeking a quick definition? A step-by-step guide? A product comparison? Create answer types accordingly:

- Short factual answer → For definitions or statistics
- Step-by-step guides → For how-to questions
- Comparative formats → For Xvs Y searches

Pro tip: Use forums, "People Also Ask" boxes, Reddit, and tools like Answer The Public to discover real questions your audience asks.

2. Create Concise, Direct Answers

Start your content sections with clear, one-paragraph summaries answering the main query. Think of these as "answer boxes" within your content.

For example:

Question : What is block chain technology?

Answer: Blockchain is a decentralized, digital ledger system that records transactions across multiple computers, ensuring data integrity and transparency without needing a central authority.

This style works well for both featured snippets and AI answer engines.

3. Use Semantic SEO and Structured Data

Answer engines love contextual clarity. Using semantic SEO (i.e., related phrases, concepts, and entities) helps machines understand your topic deeply.

Also, implement schema markup—especially:

- ▶ FAQ Page
- ▶ How To
- ▶ Article
- ▶ Product
- ▶ Organization

These mark ups help search engines recognize your content's structure, making it easier to pull for direct answers.

4. Organize Content Clearly

Break down your content with:

- ▶ H1/H2/H3 headings
- ▶ Bulleted or numbered lists
- ▶ Clean paragraph spacing
- ▶ Anchor links to sections (especially on long-form guides)

A well-organized article increases the chances that parts of it can be extracted as answers.

5. E-A-T still Matters

Answer engines prioritize trustworthy sources. Google's E-A-T principles—Expertise, Authoritativeness, Trustworthiness—are critical.

- ▶ Include author bios with credentials
- ▶ Cite credible sources
- ▶ Keep your content up-to-date
- ▶ Use a secure website (HTTPS)
- ▶ Get mentions or backlinks from trusted sites

The more authoritative your content appears, the more likely it is to be chosen by answer engines.

6. Optimize for Voice Search

Voice queries are often more conversational. Tailor some of your content to long-tail, question-based keywords like:

- ▶ "What's the best way to...?"
- ▶ "How can I start...?"
- ▶ "Why does...happen?"

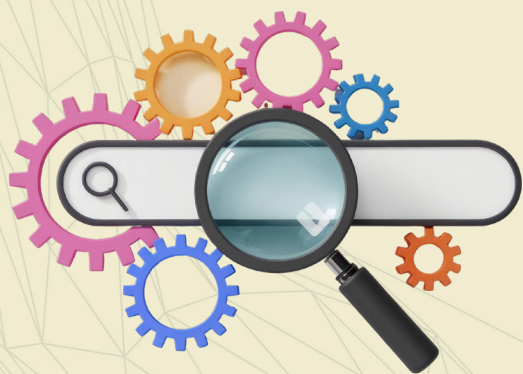
Use natural language and avoid jargon. Reading your content a loud can help test how voice-friendly it sounds.

Measuring AEO Success

Unlike traditional SEO, AEO success isn't just about traffic. Here's what to watch:

- ▶ Featured snippet presence
- ▶ Visibility in "People Also Ask"
- ▶ AI assistant mentions (e.g., ChatGPT citing your site)
- ▶ Voice assistant answers
- ▶ Decreased bounce rate (users getting what they need fast)

Tools like Semrush, Ahrefs, and Google Search Console can help track featured snippets, while newer tools like Also Asked and SEO Testing focus more on AEO indicators.



The Role of Ai in AEO

Ai plays a dual role in the AEO landscape:

1. As the interpreter: AI engines scan and analyze your content to determine its relevance to queries.
2. As the competition: AI tools like ChatGPT can synthesize answers without sending traffic to the source site.

To stay ahead, content creators must make their content indispensable, offering original insights, proprietary data, or visual aids that AI can't easily replicate.

Conclusion

Answer Engine Optimization isn't simply a trend. It is indicative of the larger shift towards intent-driven and AI-informed, instant-answer digital behavior.





If you're a brand, blogger, or business, optimizing for answer engines means:



- You are discoverable with, or even without, clicks,
- You are a designated destination for AI and virtual assistants, and
- You are keeping up with a changing competitive search landscape

Start small, identify some questions that your audience commonly is asking, and create content to directly answer the question clearly, credibly, and contextually. In the area of answer-first search, those who can give the best answer will win.

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THE EVOLUTION OF INDUSTRIAL NETWORKS FROM DETERMINISTIC TO DYNAMIC



Muskan Inamdar
Project Engineer, Bhopal.

I am a highly skilled professional in Industrial Logic Development and Training, specializing in PLC programming, SCADA systems and HMI developing, with an experience in Siemens and Allen-Bradley platforms. My strengths are PLC Logic Development (Ladder Logic), Industrial Communication Networks, and Corporate Client Functionality.

With industries transforming to intelligent, more autonomous systems, industrial communication networks are undergoing a revolutionary shift. Classically built for real-time control and high-speed data transfer in physically isolated environments, these networks are now being transformed into intelligent ecosystems. They're being connected to advanced analytics, artificial intelligence (AI), edge computing, and cyber-physical systems, setting the stage for Industry 4.0 and driving the promise of Industry 5.0. The convergence of information technology (IT) and operational technology (OT) is making factories not just automated but also adaptive, resilient, and human-focused

Industrial communication networks have now progressed from simply being a backbone, to becoming the nervous system of intelligent manufacturing that provides predictive insights, autonomous decision-making, and integrated collaboration between humans and machines.

In the past, industrial networks were always designed with determinism, robustness, simplicity, and low latency as priorities. Technologies such as PROFIBUS, Modbus RTU, and CANopen served serial communication needs in automation to successfully connect sensors, actuators, and controllers. Industrial Ethernet (e.g. PROFINET, EtherNet/IP) pushed the boundaries of bandwidth and interoperability.



Today, the requirements have changed drastically. Modern industrial networks must now:

- Manage massive amounts of data in real-time
- Support different devices and provide seamless interoperability
- Integrate and make possible both cloud and edge
- Allow dynamic reconfiguration
- Provide security across complex, distributed architectures

This demand drives businesses to implement new exposure solutions that coalesce beyond the traditional paradigms of industrial environments, thus ushering in the new era of smart communication.

Next-Generation Communication Technologies

Time-Sensitive Networking (TSN)

TSN is a groundbreaking set of IEEE standards that brings real-time communication capabilities to standard Ethernet. It offers:

- Low and bounded latency
- Guaranteed delivery times
- High synchronization accuracy

TSN enables converged networks where control traffic, video streams, and enterprise data can coexist without interference, which is vital for applications like synchronized robotics and high-speed packaging lines.

5G in Industrial Automation

Private 5G networks are set to redefine industrial connectivity. With features such as ultra-reliable low-latency communication (URLLC), enhanced mobile broadband (eMBB), and massive machine-type communication (mMTC), 5G enables:

- Real-time control over wireless links
- Flexible manufacturing through mobile robots and AGVs
- Secure remote monitoring and AR-based maintenance

5G also supports network slicing, allowing factories to create isolated virtual networks tailored for specific tasks—ensuring performance and security.

Wi-Fi 6/6E and Wi-Fi 7

Advancements in Wi-Fi standards are making wireless communication more reliable and deterministic. Wi-Fi 6 and beyond offer:

- Higher data throughput
- Reduced latency
- Better performance in congested environments

These improvements make them viable for mobile HMI, diagnostics, and machine-to-machine (M2M) communication in flexible production setups.



Integration with Edge and Fog Computing

Edge Computing

Edge computing brings data processing and analysis closer to data sources, resulting in lower latency and lower bandwidth use. Edge computing is critical for time-sensitive industrial applications such as predictive maintenance, vision inspection, and adaptive quality control, while new edge devices utilize AI accelerators and contain real-time analytics engines to make decisions in milliseconds.

Fog Computing

Fog computing serves as an intermediary level between the edge and the cloud. It collects and pre-processes data from multiple sources producing a distributed, scalable approach to computing that reduces reliance on the cloud and keeps response time low. They often manage local AI inference models, control loops, and any event in smart manufacturing systems.

AI and Machine Learning Integration

AI and ML are transforming how industrial communication networks operate by adding intelligence to both the data and the infrastructure.

Applications include

- Predictive maintenance via anomaly detection
- Adaptive control algorithms that self-tune in real time
- Dynamic network optimization through AI-based traffic routing

Future networks will self-monitor, diagnose, and correct issues autonomously, reducing human intervention and operational downtime.

The Rise of the Industrial Internet of Things (IIoT)

The IIoT connects industrial assets across the entire value chain, enabling real-time visibility, traceability, and optimization. Emerging IIoT protocols such as MQTT and CoAP are designed for:

- ▶ Lightweight communication
- ▶ Publish/subscribe models
- ▶ Secure cloud integration

Combined with edge gateways and protocol converters, IIoT facilitates seamless integration of legacy and modern systems in hybrid industrial environments.



Blockchain for Secure Industrial Communication

Blockchain offers decentralized trust, making it an ideal candidate for secure industrial communication. Key applications include:

- ▶ Device authentication and identity management
- ▶ Tamper-proof audit trails for regulatory compliance
- ▶ Secure M2M transactions in autonomous manufacturing

In future factories, blockchain-enabled smart contracts could automate service-level agreements between systems, ensuring accountability and transparency.

Cybersecurity Innovations

The rise of interconnected systems has made cybersecurity a paramount concern. New approaches include:

- **Zero Trust Architectures (ZTA)** : Verifying each device and user continuously
- **AI-powered threat detection** : Identifying anomalies and malicious behavior in real time
- **Post-quantum encryption** : Preparing for the advent of quantum computing threats

Future communication networks will embed security at every layer—from field devices to cloud platforms—ensuring resilience against evolving cyber risks.

Human-Machine Collaboration and Industry 5.0

While Industry 4.0 emphasizes automation, Industry 5.0 focuses on human-centric design. Emerging technologies enhancing human-machine interaction include:

- Cobots (collaborative robots) with safety-aware AI
- Augmented Reality (AR) for guided operations and training
- Haptic interfaces and exoskeletons for ergonomic assistance
- Brain-Computer Interfaces (BCI) for intuitive control systems

Communication networks must support these technologies with high responsiveness, precision, and bandwidth.

Autonomous Decentralized Systems

The future of industrial automation lies in autonomous decentralized systems—smart agents that make decisions locally while collaborating globally.

These systems will

- Reconfigure dynamically based on task or condition changes
- Self-optimize through AI and local learning
- Coordinate with minimal central supervision

This requires peer-to-peer communication protocols, mesh networking, and edge AI capabilities.

Digital Twins and Simulation Ecosystems

Digital twins will evolve into real-time replicas of physical assets and processes, capable of:

- Monitoring performance with real-time feedback
- Predicting outcomes using simulation
- Supporting virtual commissioning and training

These systems demand ultra-reliable and low-latency communication networks capable of syncing physical and digital realms instantly.

Sustainability and Green Automation

Future industrial networks will also support sustainability through:

- Energy-efficient protocols and hardware
- Smart power management for connected devices
- Network-aware load balancing to reduce energy consumption

By optimizing processes in real time, these systems will help reduce waste, emissions, and operational costs.



Conclusion

Industry communications are moving toward convergence, intelligent, and adaptable networks. As we enter the future of Industry 5.0, industrial communication networks will drive smarter factories, improve operational resilience, and enable human-machine collaboration. 5G, TSN, and blockchain coupled with AI innovations will unlock new frontiers of efficiency, customization, and sustainable development. For industries ready to embrace change, the benefits are paradigm-shifting—turning to a landscape where machines learn, adapt, and collaborate with humanity in ways we may have once considered science fiction.

LOW-CODE/NO-CODE PLATFORMS

Strategic Threat or Transformative Opportunity



Amal Lalu K K
IT Engineer, Trivandrum

Dynamic and results-driven IT Trainer with extensive experience in Python, Java, Artificial Intelligence, Machine Learning, and Data Science. Known for delivering engaging, hands-on training sessions that bridge the gap between theory and real-world application. Adept at designing customized training modules for students, professionals, and corporate clients, with a focus on practical skills and industry trends. Strong ability to simplify complex technical concepts, making them accessible to learners of all levels. Passionate about mentoring aspiring tech professionals and committed to fostering a culture of continuous learning and innovation in the ever-evolving world of technology.



The landscape of software development is radically changing. For decades, creating applications has required programming knowledge of languages, frameworks, software architecture, and engineering best practices. Now, that's changing—not with a new language or framework—but with the democratization of software creation. Low-code and no-code (LCNC) platforms give all users, developers to business users with no experience, the ability to create functional applications through drag and drop visual interfaces, prebuilt components, and very little custom code. Out Systems, Mendix, Microsoft Power Apps, App Gyver, and similar platforms are leading the charge.

Sounds great, right? The time-to-market is faster, implementation costs are lower, and more insights will be brought to life, accelerating innovation. However, with every technological shift, low-code/no-code brings challenges—security vulnerabilities, governance issues, and questions around scalability and long-term viability of change and continuous improvement. The critical question for organizations today is not whether or not they should adopt LCNC platforms, but how best to leverage what they offer to maximize benefit and minimize risk.

Understanding the Low-Code/No-Code Spectrum

Low-code and no-code (LCNC) platforms have useful functions that Low-code platforms are intended to provide speed for developer professionals. They while also reducing boilerplate code using visual modeling, reusable components, and plugins with continuous integration/continuous deployment (CI/CD) solutions, and allow developers to write custom code when it is needed. Low-code is great for organizations requiring enterprise application capabilities, extensive maintenance, and all the interesting possibilities of an extensible platform.

No-Code Platforms

SME Self-Serve, Modular Interface, Immediate



Coding Spectrum

Low-Code Solutions

Citizen developers, Simplified,
Cost efficient, Lower technical debt

Traditional Programming

Specialists, Complex, Expensive
high technical debt

No-code platforms, on the other hand, target "citizen developers," non-technical users that have an intimate knowledge of a business problem and the capability to create digital outcomes without writing any code. No-code is very much about simplicity, user experience, and other ways to build dashboards, workflow automations, and internal tools. Some platforms are somewhere in between low-code and no-code. They try to offer low-code extensibility but under no-code simplicity. This hybridization is becoming increasingly relevant in EC where there needs to be business agility with IT governance possible across an entire organization.



Opportunities: Speed, Innovation, and Inclusion

Empowering Citizen Developers

A key disruptive factor of LCNC platforms is the next generation of builders—the citizen developer. These are the employees best positioned to solve certain business problems: the sales reps, HR managers, analysts, and employees in operations. With the right tools, they can create applications that address day-to-day problems without having to wait in line for IT services.

This significantly reduces time-to-solution and improves employee engagement. It also allows “professional developers” to refocus their energy and time on complex and mission-critical systems and not arbitrary distractions.

Example : Unilever rolled out Power Apps across its internal teams to allow non-technical employees to automate repetitive workflows to create efficiencies. The initiative saved tens of thousands of hours of work that would traditionally require external IT, and they also cut down on central IT dependencies

Accelerating Digital Transformation

In the fast-moving world of business today, digital agility can be the difference between failure and success. LCNC platforms greatly reduce the application development life cycle from inception to deployment, minimizing lead times to realization of digital services and solutions.

Example : During the pandemic, the U.S. Department of Health utilized a low-code platform, deploying contact tracing apps and resource allocation apps in less than two weeks when the problem could have taken months using a traditional development team. If people want to deliver on digitising manual processes or to rapidly deliver new experiences to customers, LCNC offers a powerful way to do that.

Reducing Technical Debt and Development Costs

Maintenance on software and upgrades for legacy applications take up a large portion of IT budgets. LCNC platforms are built with reusable and adaptable parts, as well as standardized logic to reduce the possibility of bugs, make maintenance and updates easier and reduce technical debt in the long term. Additionally, the cost barrier is lowered for smaller teams or departments that do not have dedicated resources to build and sustain development capabilities, and this also extends digital capability to the edges of the organization.

Enabling Innovation at the Edge

Frontline employees often notice opportunities and pain points that leadership simply cannot. By giving these employees, the ability to build, test and iterate a solution, LCNC platforms help to propel grassroots innovation that that can scale. This decentralization of innovation allows organizations to move faster, learn rapidly, and have a culture of experimentation.



Threats: Risk, Complexity, and Control

Shadow IT and Governance Challenges

Though enabling, LCNC also increases the chances of the thousands of apps created without proper governance procedures. These “shadow IT” applications have unknown security controls, compliance validations, or connection to enterprise/business core applications. If an organization does not centrally govern their environment, expect data fragmentation, policy infringements, and heightened cyberthreat landscape. Therefore, organizations should establish policies on development practices, organizational access controls, and enterprise monitoring tools to monitor app usage, data transfer, and platform access.

Scalability and Complexity Limitations

Numerous no-code platforms meet the requirements of basic workflows or organizational tools, but their limitations are exposed with higher complexity. Complexity can be in the form of business logic, performance, or legacy systems.

For example, organizations may need to look for limits of LCNC platforms when customizing APIs, concurrent users with scale, or high uptime. Organizations will need to be cognizant of platform limits and appropriately plan. The plan might include a hybrid architecture using LCNC for the front end workflows but traditional development for back-end processes and enterprise systems.

Commoditizing Software Development Talent

Some professional developers view LCNC as a challenge to the position they have held for years. If anyone can build applications, what happens to all that knowledge and expertise of engineering?

While this concern is perfectly valid, the better way to look at LCNC is as a form of augmentation, instead of replacement. Developers will always be required to build scalable architecture, manage edge cases, and integrate complex systems. LCNC allows developers to spend their time on tasks of high value as opposed to building CRUD applications or reports.

Looking ahead, forward-thinking organizations are adopting fusion development – collaborative models that combine the efforts of professional developers with citizen developers to develop solutions.

Real-World Adoption: Success Stories Across Industries

- Airbus utilized Mendix to streamline its factory floor processes, decreasing development time by 75% and increasing visibility.
- Schneider Electric leveraged OutSystems to quickly develop a global customer portal, improving the customer experience and reducing costs.
- Low-code allowed Walmart to automate its HR operations and store operations, yielding millions in savings each year. These examples show that LCNC is not just about small tools—it can be leveraged for high-impact initiatives when adopted strategically.

Strategic Integration: Best Practices for Enterprises

To leverage LCNC effectively, organizations should:

- ▶ **Create governance frameworks** for app approvals, data policies, and lifecycle management.
- ▶ **Establish training programs** to upskill citizen developers and professional developers alike.
- ▶ **Adopt a fusion team model**, combining business users with IT specialists to co-develop robust solutions.
- ▶ **Choose platforms based on use case fit**, integration capabilities, and scalability potential.
- ▶ **Monitor and measure impact**, tracking ROI, user satisfaction, and platform usage metrics.

Conclusion

Low-code and no-code solutions aren't a fad; they represent a significant, system-wide shift in how organizations build, manage, and scale digital solutions. It can be transformative for organizations, especially at a time when digital urgency is higher than ever, to use these platforms to democratize innovation and accelerate delivery. That said, success is built on a foundation of careful combinations. Organizations that couple LCNC tools with structure, governance, architectural simplicity and a collaboration-first culture may be able to turn a very real threat into a competitive advantage. The organizations that will thrive in this new reality will be those who adapt to change strategically as opposed to those who resist it. In other words, the future of software development is changing at a pace that many organizations are struggling to keep up with, but change can become manageable if they embrace it one drag, drop, and deploy at a time.

The Secret Sauce

How Prompt Engineering Shapes Ai Output



Deekshitha S
IT engineer,
Mysore

Driven by a passion for data and technology, I thrive at the intersection of IT and analytics. As a forward-thinking IT Engineer, I specialize in transforming data into strategic insights using Python, Machine Learning, SQL, Power BI, and Tableau. With a solid foundation in programming and data science, I create intelligent solutions that empower businesses. Blending technical expertise with analytical acumen, I deliver impactful, data-driven results. I focus on smart automation, efficient data pipelines, and interactive dashboards that turn complex data into actionable insights—continuously learning and evolving to stay ahead in the dynamic world of IT and analytics.

In the world of generative AI, where machines can write poems, create logos, and write music, a new type of creativity has emerged that does not use brushes, instruments, or keyboards in any traditional way. This new creativity is prompt engineering. It is both an art and a science of talking to AI and this age of prompt engineering has just begun.

It does not matter if you are using Midjourney to create images, using ChatGPT to write a script, or using something like Suno to generate music—everything begins with a prompt. This is the text you are giving the AI to tell it what to do. But writing a prompt is not as simple as typing in a few words. Ultimately drafting a good prompt involves knowing the model, shaping the model's output, and enticing creativity from a machine that needs your words to glow.

Prompt engineering is the process of developing and iterating over inputs (prompts) that instruct an AI model to produce output that meets a specific task and is of high quality. In a way, think of a prompt as the creative brief for an AI—except instead of a person reading it, it's a machine that can understand your words and analyze with billions of parameters.

What is truly revolutionary about this development is it empowers anyone to produce output—art, code, stories, music—without any significant technical skill. However, like most creative craft, the final output quality is greatly dependent on the prompt engineer's skill.

A prompt is what you type into the AI to get a response. The better your prompt, the better the AI's answer will be.

For example, let's say you want the AI to write a story. If you type:

- ▶ "Tell me a story."

You might get a very general and simple story. But if you say:

- ▶ "Write a short story about a lonely robot who finds a friend on Mars."

Now, the AI has more detail. It knows the main character, the setting, and the theme. This is a better prompt.



Types of Prompts

There are many kinds of prompts depending on what you need. Here are a few examples:

● Informational Prompts

Used to get facts or summaries.

Example:

"What is the capital of Brazil?"

"Summarize the causes of the American Civil War."

● Creative Prompts

Used for stories, poems, or creative writing.

Example:

"Write a funny story about a cat who wants to become president."

"Create a poem about friendship in the style of Dr. Seuss."

● Instructional Prompts

Used to get step-by-step help.

Example:

"Explain how to bake a chocolate cake."

"Give me steps to start a small online business."

● Coding or Technical Prompts

Used for help with programming or technology.

Example:

"Write a Python program that checks if a number is prime."

"Explain how blockchain works in simple terms."

The Rise of the Prompt Artist

A new breed of creators is emerging; people who may not view themselves as artists, but who excel at leading AI to create powerful visuals or poetry. They adjust, hack, and manipulate prompts like chefs adjusting a recipe.

"Prompt packs" are being sold on social media and marketplaces, as well as job listings for "Prompt Engineers" paying six figures. This isn't just about the right tool; it's about how to talk to the tool.

Some AIs even have features that allow its users to share the history of their prompts, establishing a subculture to share, remix, and collaborate on prompts

Why Prompt Engineering Matters

- **AI is only as good as your input.** Even the best models produce low-quality content from vague or poorly worded prompts.
- **It empowers non-technical users.** Artists, marketers, writers, educators, and small business owners can create advanced outputs without coding.
- **It saves time and boosts quality.** A well-crafted prompt reduces the need for multiple revisions or manual editing.

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What Makes a Good Prompt?

Successful prompts often include.

- **1.Clarity –** Avoid vague language; be direct about what you want.
- **2.Specificity –** Provide details like tone, format, audience, or style.
- **3. Context –** Give background or role (e.g., "Act as a UX designer...")
- **4.Constraints –** Limit length, format, or content type (e.g., "200 words, bullet points").
- **5. Iteration –** Refine prompts based on AI output and test different versions.

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Tools and Tips to Improve Prompt Engineering

As you get more comfortable with writing prompts, here are some extra tips and tools to help

● Use Examples

You can give the AI an example of the answer you want

Example:

"Write a review of a movie. Example: 'I loved this film because...'
Now write a review of Inception."

● Use Templates

Make your own templates to save time. For example:

- "Write a [type] in [style] about [topic]."
- "Explain [topic] to a [age group] in [number] steps."

● Use AI Tools to Help Write Prompts

Some tools suggest prompt ideas or improve your current prompt. These can help you learn faster.

Why to Choose Prompt Engineering as a Career?

- ▶ **High-demand skill** : Companies now hire prompt engineers full-time, often with salaries over \$100K/year.
- ▶ **Cross-disciplinary use**: Found in product development, content marketing, UX design, and even legal analysis.
- ▶ **Freelance opportunities**: Prompt marketplaces are emerging where creators sell prompts for specific use cases.

Prompt engineering is definitely one of the most valuable skills in a future increasingly driven by AI fueled creativity. Generative AI is changing many industries, including art, design, and marketing to education, and understanding which tools and systems to use at the moment you decide to make something unique will become the one thing that achieves success for the individuals created work. Knowledge of the ability to create helpful prompts turns a more complex technology into a collaborative tool that anyone can access with creativity. In the near future, when human creativity and machine intelligence are working together, people will look for capable individuals who can demonstrate their mastery of the art of prompt engineering. Prompt engineering is art of developing good questions and instructions for a range of AI tools. This will ensure you get better answers and save more time; more time to do other things with technology. The key is to be clear, specific, and intentional in your prompts. Anyone can learn prompt engineering. With more practice you'll clearly articulate more powerful instructions and questions that elicits better responses from AI. In an increasingly AI driven world, learning prompt engineering is essential and not just nice to have.

Ai Learning Path

Everyone Can Do It

The World's Trusted Industry-
Based Training Institution

- 📍 100% Placement Assistance
- 📜 Industry Recognized Certificate
- 💰 Stipend Based Internship

☎ +91 9846 770771
✉ info@ipcsglobal.com
🌐 www.ipcsglobal.com



Bridging Legacy Systems and IIoT for Future Success



Varghese Sabu
Junior Project Engineer,
Perinthalmanna

Enthusiastic and detail-oriented fresh Industrial Automation Engineer with a strong foundation in PLC programming, SCADA systems, and robotics. Skilled in troubleshooting and eager to apply academic knowledge to real-world automation challenges. Passionate about optimizing processes and learning advanced technologies to improve efficiency. Committed to contributing to innovative solutions in industrial automation.



Much of today's industry still relies on older machines and systems to execute the company's operations. Legacy systems are perfectly functional, however, usually do not have the ability to connect with modern Industrial Internet of Things (IIoT) technologies. Instead of replacing costly equipment, many companies are enhancing their operations with IIoT solutions to increase productivity, monitor performance, and extend the life of their machines. This article will outline how organizations are able to make an effective connection between legacy systems and IIoT.



What Are Legacy Systems and Why Are They Important?

Legacy systems, as distinguished from legacy applications, consist of older equipment, systems, and control systems (e.g. industrial machines, PLCs, SCADA, DCS) that were designed around to work independently and implemented older, non-standard methods to share data that IIoT platforms are not interoperable with. Legacy systems, despite their age, will continue to play a vital role in industries such as manufacturing, energy, transportation, and other similar industries for the foreseeable future. Legacy systems are expensive and time-consuming to replace with new technologies. The best consideration, therefore, is to maintain the existing legacy systems for continued operation, upgrade as possible for continuous productivity, and ensure businesses avoid unnecessary capital expenses that replacing these respective technologies would incur, while capitalizing on the opportunity to transition into modern technology with respect to business disruption planning.

Challenges in Legacy-IIoT Integration

► PROTOCOL & INTEROPERABILITY GAPS :

Legacy devices speak in Modbus, Profibus, OPC UA, or even proprietary standards—far from the MQTT/HTTP world of IIoT. Middleware or protocol converters (IIoT gateways) serve as translators, bridging protocol mismatches.

► SECURITY VULNERABILITIES :

Legacy systems weren't built with cybersecurity in mind. Once connected, they risk exposing entry points. Best practices demand audits, network segmentation, encryption, authentication, and ongoing security updates.

► PERFORMANCE BOTTLENECK :

Shifting data-intensive workloads to old hardware can cause overloads. Introducing edge computing, gateways, and selective filtering helps manage data and reduce latency.

► RESISTANCE TO CHANGE :

Teams may fear learning new systems or losing control. Address this through stakeholder engagement, training, and by showing tangible benefits.

Effective Integration Strategies

1. Comprehensive Assessment :

Start with a full audit: inventory hardware/software, dependency mapping, and stakeholder interviews. Evaluate business goals to define clear scope and success criteria.

2. Choose the Right Architecture :

- » IIoT Gateways deliver protocol translation, security, and local data processing, and can scale as systems grow.
- » Middleware or Edge Computing solutions (like APIs or SOA) connect legacy systems to cloud platforms, filtering and normalizing data at the edge

3. Phased Implementation :

Begin with proof-of-concept or non-critical paths, then expand gradually. This approach minimizes downtime and technical debt.

4. Prioritize Security :

Perform thorough audits, segment networks, and implement encryption, authentication, and continuous monitoring.

5. Training & Stakeholder Buy-in

Educate teams early, include them in planning, and highlight efficiency, safety, and uptime benefits. Providing ownership encourages change adoption.

6. Continuous Testing & Optimization :

Monitor data quality, system performance, security posture, and iterate on improvement. Apply lean integration principles—automate, measure, and refine.

Tools & Technologies at Glance

Category	Solution Examples
Gateways	IIoT devices with Modbus → MQTT translation
Middleware/API	Custom adapters, REST, OPC UA
Edge Computing	On-site servers for filtering & analytics
Security Tools	Firewalls, ID/PS, encryption, segmentation

Why This Integration Matters More Than Ever

► Unlock Hidden Business Value :

There's no reason to discard machines that still work. By adding IoT sensors and gateways, you transform existing assets into data-powered tools without breaking budgets or disrupting workflows.

► Gain Real-Time Operational Visibility :

Legacy systems often operate in silence. IIoT integration brings them into the light—delivering real-time insights, early issue detection, and proactive upkeep.

► Power Predictive Maintenance :

Sensors and analytics onboard aging equipment allow teams to fix problems before they hit critical levels—reducing downtime and extending machine life.

► Maximize Competitive Edge :

Blending legacy reliability with modern intelligence strengthens quality, agility, and innovation—key differentiators in today's fast-paced markets.

The Human First Advantage

► Practical and manageable:

Smart retrofits are affordable and minimally disruptive—no plant shutdowns, no expensive rip-and-replace scenarios

► Embracing your team :

Plant staff don't want their world turned upside down—they want clarity and efficiency. When they see fewer breakdowns and smoother operations, their confidence grows.

Why It Matters

By thoughtfully integrating IIoT capabilities with legacy infrastructures, companies can:

- Gain real-time visibility
- Unlock predictive maintenance
- Improve asset utilization
- Avoid costly replacements
- Reduce security vulnerabilities

Legacy equipment can serve for another decade when paired with modern intelligence—delivering improved efficiency, safety, and ROI.

Practical Steps to Make It Happen

1. **Map what's in place :** Audit legacy assets, control systems, and data needs.
2. **Pick a pilot:** Choose a critical line or machine where IIoT will deliver visible benefit.
3. **Deploy smart devices:** Add sensors, edge gateways, or protocol translators.
4. **Connect to your platform:** Enable dashboards, alerts, and analytics—ideally close to or in the cloud.
5. **Measure real impact:** Track KPIs like uptime, maintenance cost, quality, and efficiency.
6. **Expand step-by-step:** Scale what works, iterating without drastic change.

Why It's Not Just Smart—It's Essential

- ▶ **Sustainable investment** : It respects your existing assets while building for the future.
- ▶ **Operational resilience** : Your proven systems stay online while gaining transparency and responsiveness.
- ▶ **High ROI, low risk** : Incremental upgrades reduce costs and disruption while delivering clear value.
- ▶ **Future-ready foundation** : IIoT upgrades set the stage for AI, process automation, and smart manufacturing.

In Summary

When you connect reliable legacy systems with today's IIoT, you are not only preserving the past but you are also enhancing it. You are gaining the ability to make real-time decisions, be predictive, and be competitive—all while not losing the stability of the past. That is true transformation, rooted in both reality and possibility. You are human-forward in your approach to innovate.



FROM STRUGGLES TO STRENGTHS

The Hidden Rewards of Self-Discovery



Muhammed Shahal N
Project Engineer, Cochin

Experienced Industrial Automation Engineer with hands-on expertise in PLC programming, SCADA systems, and HMI design. Skilled in configuring and troubleshooting automation systems across various industrial applications. Proficient with major PLC platforms such as Siemens, Allen-Bradley, Mitsubishi, and Delta. Expert in designing user-friendly HMI interfaces and developing real-time monitoring solutions. Capable of handling complete project lifecycles from planning and commissioning to maintenance. Strong knowledge of industrial communication protocols like Modbus, Profibus, and Ethernet/IP. Experienced in integrating automation systems for process optimization and energy efficiency. Committed to ensuring system reliability, safety, and compliance with industry standards. Effective team player with excellent problem-solving, analytical, and documentation skills. Driven by innovation and continuous improvement in industrial automation technologies.

The advantages of personal development go way beyond the motivational platitudes and productivity tips that have overwhelmed our social media feeds. While the average person thinks about personal growth as something that often means developing a career or learning a new skill, overlooked benefits are constantly changing every aspect of our lives. Outside how we definably improve, personal development rewires neural pathways in our brains, makes relationships deeper and richer, and, in unimaginable ways, affects our physical health.

The True Meaning of Personal Development

Self-development is much more than a series of self-improvement techniques. It includes the actions you take which increase your awareness and identity, develop your inherent talents and potential and empower you to live a more fulfilled life. Personal development is about becoming instead of only fixing an identified flaw.

Building on the rich tradition of self-help work as it applies our focus here in self-development is about the ongoing process that leads to a transformational perspective. It gets you, "(driven to create more in spite of (not) where you have been, (not) where you are, then start to shape, shape, then identify who you are trying to mindfully become...."

How It Differs from Self-Improvement

Although often used interchangeably, the terms personal development and self-improvement refer to distinctive pathways of growth. Self-improvement focuses on the enhancement of specific skills or competencies through one's own doing; personal development encapsulates self-improvement as one part of a broader growth journey.

When thinking about personal development, consider it the "how" and self-improvement the "what." Self-improvement is primarily outcome-based, dealing with measurable advancement in particular areas; personal development is the journey itself.

Essentially, self-improvement focuses on improving how you do something; personal development attempts to broaden who you are. The former does indeed help you build capabilities, while the latter revolutionizes your very approach to life.

Mental Shifts That Go Unnoticed

Beyond visible achievements, personal development creates profound internal transformations that often go unnoticed yet fundamentally alter how you experience the world.





Increased Emotional Regulation

As you make progress on your path of personal development, your skill of emotion management improves dramatically. You develop metacognitive awareness – being aware of your emotional state and applying an effective strategy to regulate your responses accordingly. Personal development creates healthier patterns and regular personal development exercises strengthen the neural pathway to your emotional regulation.

One clear benefit is reduced reactivity in stressful situations. You learn to respond rather than react. Rather than instantly blaming the external circumstances when you are triggered, you begin to notice your reactions, take a breath, center yourself, and respond.

Better Decision-Making Under Stress

When people are in stressful situations, the brain often moves away from thoughtful, flexible thinking and toward fast and automatic reactions. Personal development allows you to have tools to offset, or work against, this effect and allow you to still access higher-order thinking despite the stress!

Personal development will also improve the way you assess benefits and costs in difficult situations, so that you do not fall for the anxiety level that will push your brain into what researchers refer to as a “toxic stress state.”

Improved Focus and Clarity

Development and personal growth allow you to see what really matters to you and separate it from collective conditioning. Your priorities dictate your behaviour and decisions.

Personal development and growth foster psychological flexibility—the ability to be present and mindful, accept that your experiences are what they are and open yourself up to taking action on the things that are important to you. This recognizes experiences in our lives as opportunities to learn rather than threats to our identity.

Unexpected Benefits in Relationships

As we develop ourselves, the quality of our connections with others naturally evolves in unexpected ways.

Stronger Communication Patterns

By engaging in self-development, we are growing stronger active listening skills. Research shows we are only hearing about half of what others say in conversations, but our self-development practices allow us to focus on the speaker and fully hear their intended message. Self-development also increases emotional intelligence, which we need to build our communication effectiveness. By being more conscious of our own emotional selves, we can better control them in conversations and be more empathic to others.



Healthier Boundaries

Personal development helps us recognize our limits and communicate them assertively. Without clear boundaries, relationships deteriorate as people become overwhelmed and resentful. This clarity benefits both individuals, as it reduces confusion and creates trust.

Greater Empathy and Patience

Studies have found that adopting a growth mindset about empathy— the belief that we can enhance this skill— will cause people to try harder to empathize and with greater vigor towards those who are different than them. Developmentally, we promote that kind of growth mindset.

When we develop more effective emotional regulation, we learn to pause, regroup, and not act defensively or aggressively when we are frustrated, and add patience within our relationships.



How Personal Growth Boosts Physical Health

The journey of personal development creates profound changes in physical health that many overlook.

Better Sleep and Energy Levels

As you work on your own development, it is only natural that you also form healthier habits around sleep – for example; an earlier regular bedtime, consistent bedtime routines or, minimizing time spent with screens prior to sleep. Quality sleep becomes available as a physical resource; more cognitively strong, more adept at memory consolidation, more emotionally stable.

Reduced Stress-Related Symptoms

Personal development provides the tools to effectively manage stress. Practices such as meditation can reduce stress hormone levels and induce relaxation. The physical impacts of stress, such as heart disease, diabetes, and high blood pressure, can be reduced through consistent application of personal development methods.

Improved Lifestyle Habits

Personal development organically supports healthier lifestyles by mitigating barriers to healthy living with increased self-awareness, identification of negative thought patterns, and creating tracking mechanisms for continued progress. These fundamental changes in thought processes and behaviors become permanent changes and not just temporary alterations.

Increased Confidence in Leadership

Self-improvement directly impacts confidence in leadership, which is a key element in helping employees and peers rely on your decisions. Leaders who understand their strengths and develop on them become more confident, more engaged and more likely to reach goals.

Clarity in Long-Term Goals

Through development practices, you learn to create SMART goals, develop career roadmaps, and align professional aspirations with personal values. This clarity becomes motivating and helps break down larger ambitions into achievable milestones.

More Meaningful Work Engagement

Meaningfulness is the single most important component of work to employees—beyond even pay. Growth and development is a source of meaning because it connects the dots between what employees contribute and the organization's mission, and the result is deeper engagement, stronger emotional commitment, and ultimately, higher performance.

Conclusion

Personal development is a transformative journey that is much bigger than the normal perceptions of self-improvement. These profound changes influence not only the outcomes we accomplish, but also profoundly shift who we are.

The power of personal development is its compounding effect; an improvement in one area supports the improvement of the others and contributes to an upward spiral of development and growth. This journey is sustainable because change is derived from addressing root causes of patterns rather than surface-level symptoms. Unlike short term fixes which provide only temporary relief for ineffective behaviors, personal development yields a fundamentally different way of being in the world rather than developing individual skills. Although the journey will take patience and commitment, its fruits will pay dividends in every area of your life. The possibility to create a life that is more fulfilling and impactful than you previously imagined can be realized.





Solid-State Transformers Revolutionizing the Power Grid

Electricity transmission and distribution have relied on conventional transformers for more than a century. These electromechanical devices use electromagnetic induction to convert voltage levels, enabling the safe and efficient transport of electrical power over long distances. However, the 21st-century grid faces unprecedented challenges: the integration of renewable energy, rising electric vehicle (EV) adoption, the decentralization of power generation, and the demand for real-time control and smart grid functionality.

In this new energy landscape, Solid-State Transformers (SSTs) emerge as a game-changing technology. More than just voltage converters, SSTs are intelligent, multifunctional power electronics-based systems that offer improved efficiency, compact design, real-time control, and bi-directional power flow. This article delves into what solid-state transformers are, how they work, their advantages, applications, and the future they hold for modern electrical systems.



D A Anand
Regional Technical Head
Chennai

I possess over 13 years of experience in the electrical and automation sectors. I have managed various responsibilities related to the operation and maintenance of shop floor machinery and the installation and commissioning of 25 kV traction substations and OHE equipment for railway electrification projects. I was the technical lead in installing and commissioning PLC panels, with numerous industrial automation projects programmed using PLCs. I am well-versed in programming PLCs, SCADA, VFD, and HMI of various brands, including Schneider Electric, Siemens, Allen-Bradley, Mitsubishi, Honeywell, ABB, Delta, and Omron. I am skilled in developing standard operating procedures and troubleshooting manuals for automation systems.

A Solid-State Transformer is an advanced form of transformer that uses power electronic components, such as insulated-gate bipolar transistors (IGBTs) or silicon carbide (SiC) MOSFETs, in conjunction with high-frequency transformers to perform voltage conversion and power regulation. Unlike traditional transformers that rely solely on magnetic induction, SSTs incorporate digital control systems and semiconductors to offer greater flexibility and intelligence.

SSTs can perform multiple functions beyond voltage transformation, including:

- Bi-directional power flow management
- Voltage regulation and reactive power compensation
- Power quality improvement
- Frequency conversion
- Real-time data communication with grid control systems
- In essence, SSTs act as the “smart routers” of the future electrical grid.

Working Principle

SSTs typically follow a three-stage architecture:

1. AC-DC Conversion (Input Stage)

Incoming AC voltage is converted to DC using a rectifier. This conversion allows the system to manage power electronically.

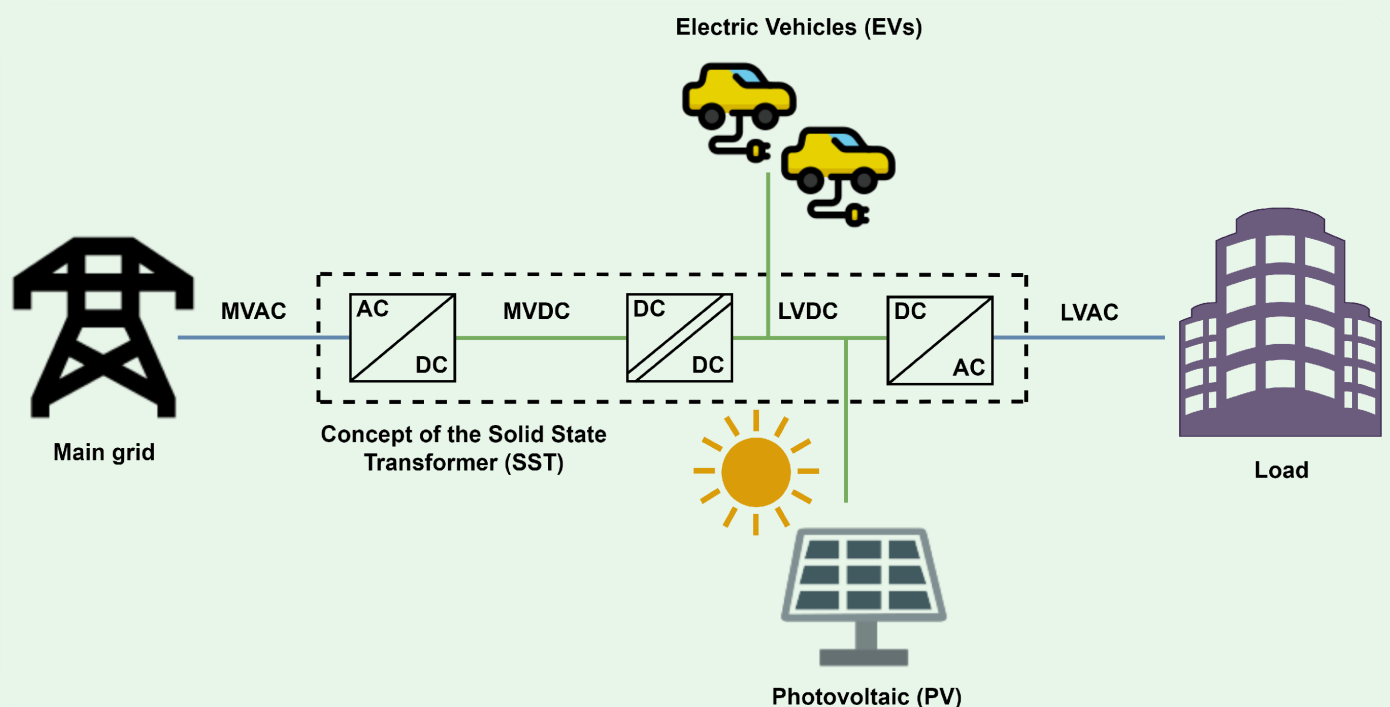
2. DC-DC Conversion (Isolation and Voltage Transformation)

The rectified DC is fed into a high-frequency inverter that drives a compact high-frequency transformer. This allows voltage transformation (step-up or step-down) while also providing galvanic isolation, which is critical for safety.

3. DC-AC Conversion (Output Stage)

The output from the transformer is rectified and then converted back into AC using an inverter, which can be precisely controlled in terms of voltage, frequency, and phase.

This modular structure not only allows for compact size and high efficiency but also enables programmability and real-time control.



Key Features of Solid-State Transformers

- ▶ **High-Frequency Operation :** The use of high-frequency transformers significantly reduces size and weight.
- ▶ **Programmable Control:** Digital controllers enable dynamic voltage regulation, harmonic filtering, and real-time grid communication.
- ▶ **Bidirectional Power Flow:** SSTs can receive and supply power, making them ideal for renewable and energy storage integration.
- ▶ **Multi-Port Input/Output:** Some designs allow connection of multiple AC or DC inputs/outputs (e.g., PV systems, battery storage, and loads).
- ▶ **Improved Power Quality:** SSTs can correct power factor and filter out harmonics, enhancing grid stability.
- ▶ **Smart Grid Compatibility:** Equipped with communication interfaces (e.g., Ethernet, IEC 61850) for integration with SCADA and other grid control systems.



Advantages of Solid-State Transformers

1. Compact and Lightweight

SSTs are significantly smaller and lighter than traditional transformers of similar rating, thanks to high-frequency operation. This is crucial for space-constrained environments like urban substations and EV charging stations.

2. High Efficiency and Reduced Losses

Although early models faced higher conversion losses, modern SSTs using SiC and GaN semiconductors achieve high efficiency levels (>97%), especially in partial-load conditions.

3. Voltage and Frequency Flexibility

Unlike traditional transformers fixed to a single frequency (50/60 Hz), SSTs can convert between different frequencies, supporting applications like marine and aviation power systems or coupling regional grids.

4. Enhanced Grid Resilience

By enabling fast switching, isolation, and control, SSTs can quickly react to grid faults, disconnect faulty sections, and support self-healing grid operations.

5. Support for Distributed Energy Resources (DERs)

SSTs facilitate seamless integration of solar, wind, and battery systems by providing stable DC/AC conversion and bi-directional power flow capabilities.

6. Smart Monitoring and Control

SSTs allow real-time monitoring of power quality, load conditions, and fault detection, enabling predictive maintenance and dynamic optimization.

Applications of Solid-State Transformers

► 1. Smart Grids

In future-ready smart grids, SSTs act as intelligent nodes capable of dynamically regulating power, supporting distributed generation, and enhancing communication between grid components.

► Electric Vehicle (EV) Charging Stations

SSTs enable fast and bidirectional charging (Vehicle-to-Grid, or V2G), allowing EVs not only to charge but also to supply power back to the grid during peak demand.

► Renewable Energy Integration

SSTs can manage variable outputs from wind and solar sources, regulate voltage levels, and synchronize them with grid frequency, promoting greater adoption of renewables.

► Data Centers

Modern data centers require reliable, regulated power supply. SSTs offer compact and efficient power management with seamless integration of backup energy storage.

► Traction and Railway Systems

SSTs are ideal for railway substations, offering compact design, AC/DC conversion, and support for multiple voltage levels and frequencies.

► Offshore and Marine Power Systems

In ships and offshore platforms, SSTs offer frequency and voltage adaptability, making them suitable for isolated and variable load environments.

► Defense and Aerospace

Lightweight and programmable power conversion makes SSTs ideal for applications in aircraft, drones, and portable military power systems.



Challenges and Limitations

While promising, SST technology is not without its challenges:

High Initial Cost : SSTs are currently more expensive than conventional transformers due to advanced materials and components.

Thermal Management: Power electronic components require effective cooling to prevent overheating and ensure longevity.

Electromagnetic Interference (EMI): High-frequency switching can introduce EMI, requiring advanced shielding and filtering.

Complexity and Reliability: The integration of digital control increases system complexity and the potential for software-related faults.

Limited Standardization: Industry standards for SSTs are still evolving, which can affect compatibility and mass adoption.

However, with ongoing R&D, costs are expected to decline, and technical barriers will gradually be overcome.

Future Outlook

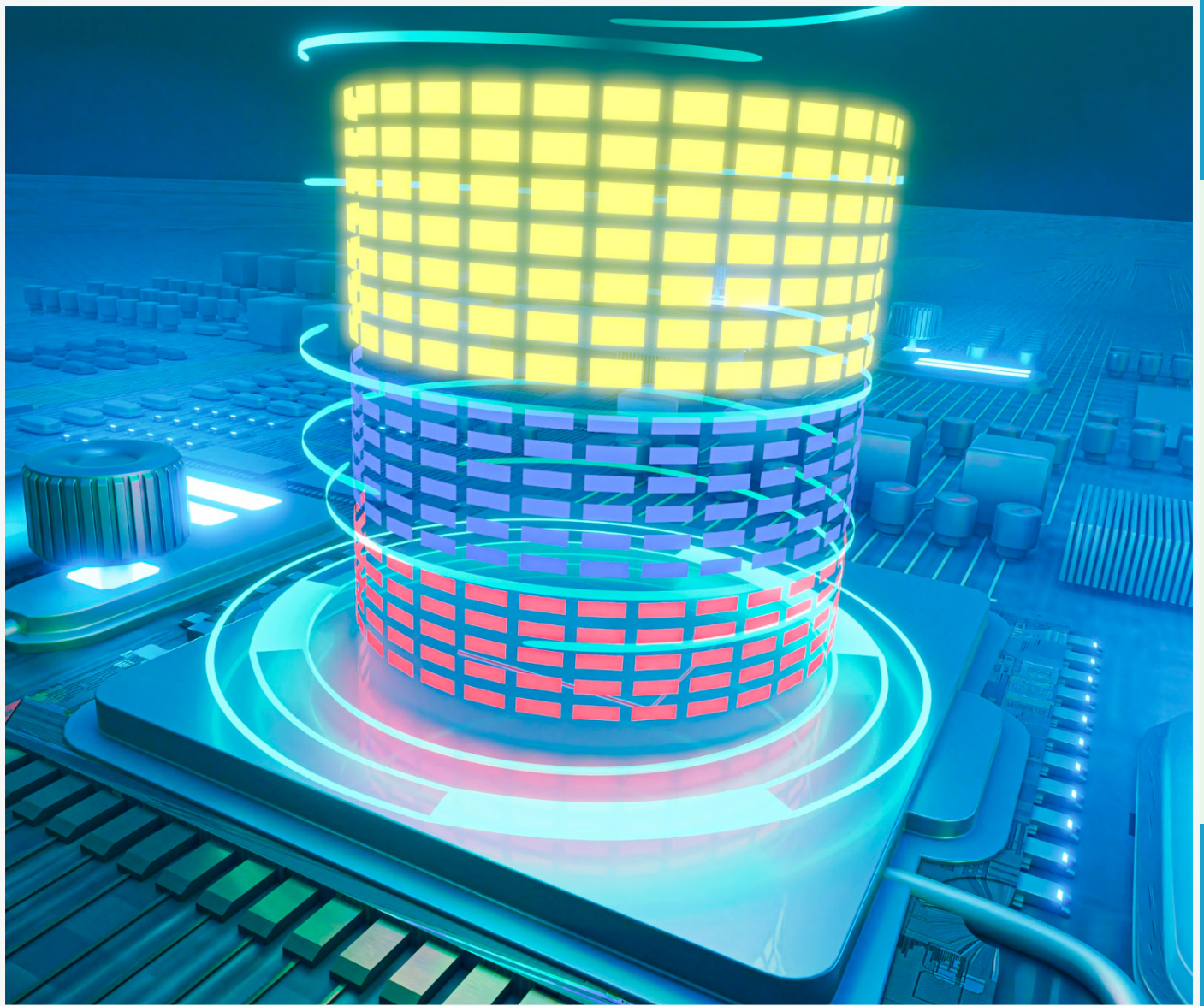
The future of solid-state transformers is closely tied to the evolution of the smart grid, renewable energy integration, and electric mobility. Governments and utilities around the world are investing in pilot projects and testbeds to explore SST capabilities.



Key trends shaping SST adoption include

- ▶ Wider use of silicon carbide (SiC) semiconductors for higher voltage and temperature performance.
- ▶ Modular and scalable SST designs for urban, rural, and industrial settings.
- ▶ AI-based control algorithms for predictive maintenance and adaptive power routing.
- ▶ Global standardization efforts to ensure interoperability and safety.

As costs fall and performance improves, SSTs are expected to replace many conventional transformers, especially in applications demanding intelligence, compactness, and multi-functionality.



Conclusion

Solid-state transformers represent a paradigm shift in power transmission and distribution. By combining the functions of a transformer, inverter, voltage regulator, and communication device, SSTs offer unprecedented flexibility, control, and efficiency.

As the world transitions toward a decarbonized, decentralized, and digitized energy system, solid-state transformers will play a pivotal role in building the infrastructure of tomorrow—smart, adaptive, and resilient.

THANKS

EXPERT PANELS

Ajith Surendran
Rakesh K C
Jomesh Jose
Vinod

MAGAZINE EDITOR

D A Anand

CONTENT EDITING

Bagesri, Paul Manuel,
Bhavanshaarathy, Muskan
Inamdar, Amal Lalu,
Deekshitha, Varghese Sabu,
Muhammed Shahal, D.A Anand

DESIGN

Merin Sujith M.R

EDITING

D A Anand