



DIGITAL INDUSTRIES SOFTWARE

A new era of EDA powered by AI

Siemens has a long history of successfully improving IC design and manufacturing processes and tools with AI

Executive summary

For decades, Siemens has been deploying AI, at-scale, for computer chip design and manufacturing to help our customers deliver better products to people all across the globe. This white paper touches briefly on the development of our EDA software with artificial intelligence and machine learning, looking at some solution examples.

AI is integral to closing the semiconductor engineering gap

Society is demanding technology that is smaller, more efficient and faster, requiring ever-increasing volumes of semiconductor-enabled products and systems. And, as new IC process nodes and packaging technologies are introduced to address this demand, the complexity of designing, manufacturing and implementing integrated circuits (ICs), advanced IC packaging and printed circuit board (PCB)-based systems increases exponentially. Software-defined and silicon-enabled systems are needed to enable continuing innovation and

growth. Traditional scaling approaches are not keeping up and this is now leading to a resource gap in the industry.

The horizon for systems in which semiconductors are put to work is also expanding as manufacturers are bringing traditionally siloed domains together, such as mechanical and electrical and hardware and software, while working to unify systems capabilities for operations, networking, power management, security, monitoring, learning, verification, validation and testing across domains.

While semiconductor design activity is growing, universities are not graduating enough semiconductor engineers who can make the chips for tomorrow's technology. Current engineers are either retiring or seeking other careers. Because of this gap in education, skills and talent, solutions are needed that deliver orders of magnitude improvement, not percentages, to keep up with market demand.



How does AI address these challenges?

We use AI for optimizing EDA software engines, processes and workflows. Building high-quality engines that leverage AI is critical for scalable, hardened results. AI algorithmic models must be verifiable, accurate and robust to be commissioned throughout an enterprise securely while demonstrating consistent and sustainable results over time.

Rather than using AI capabilities to replace engineers, it is leveraged to enhance their work and enable new possibilities. Siemens management and developers see AI as a tool that can be used to bring newer, inexperienced engineers to higher levels of professional proficiency more quickly, while also reducing the number of manual or mundane,

repetitive tasks so experienced engineers can focus on innovation.

Already, the AI we have in EDA applications increases both engineers' and their tools' productivity. For manual and/or tedious, repetitive tasks, AI algorithms used in design space exploration can analyze which variables are beneficial, and then return a recommendation of how to get a better design. This speeds up the engineer's design and simulation work.

AI enhances IC design and reduces the overall resource burden on engineers by eliminating unnecessary tasks, reducing redundant activities and reducing the time and computation needed for root-cause analysis of issues in a design.



How can you leverage AI-enabled chip production today?

AI is implemented in our EDA solutions across three different focus areas: core technology, process optimization and to deliver a scalable open platform. Its use is centered around empowering the human intelligence of engineers, increasing engineers' productivity and capturing the knowledge that exists within design groups. AI is used to provide deeper insights into an IC design, helping to understand the root cause of problems, and avoid potential problems in the future.

The ability to automate with AI and to verify the results from AI are critical. Verification, traceability and openness are central to the needs of AI in an

EDA setting. The verifiable engines within our AI-enabled EDA solutions are built on a foundation of accuracy, robustness, domain expertise and usability so that AI algorithms created on them understand the domain and the data that they are working with to deliver predictable, repeatable and valuable results every time. A knowledgeable human in the loop is necessary at times when verification cannot be automated to qualify the results and ensure that they are correct.

With over a decade of refinement and success in the market, Siemens EDA understands what it takes to scale a trusted, verifiable AI platform.

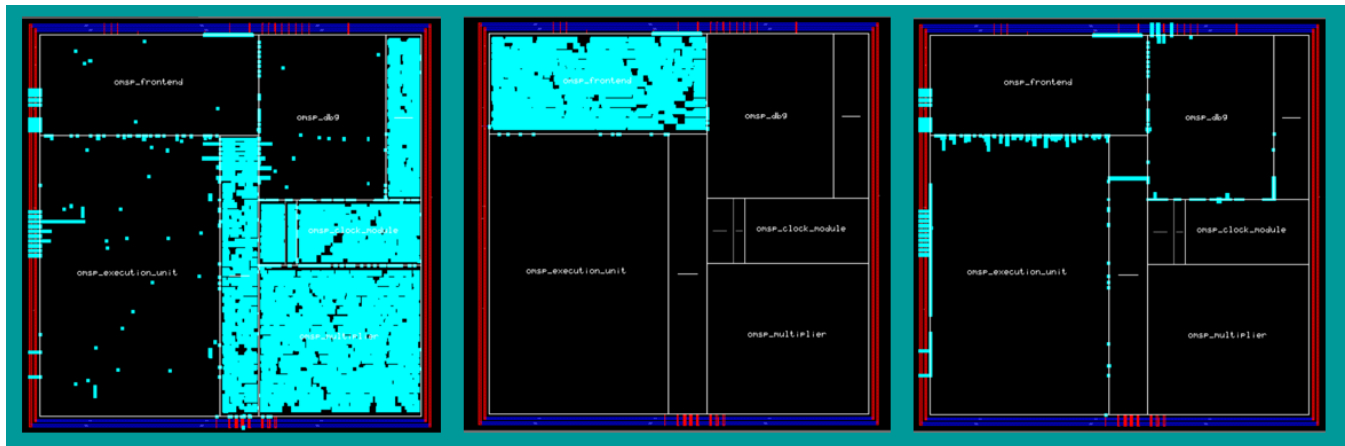


AI powering technology

AI is used in various ways for different technologies in Siemens software. Traditional AI techniques that have been used in EDA for a while have enabled processing huge amounts of data and have been used to address problems that crop up when introducing new products into manufacturing (NPI), whether with graph analytics, reinforcement learning or computational analysis. These are a set of AI techniques that are well-understood and have allowed them to solve this class of problems for years.

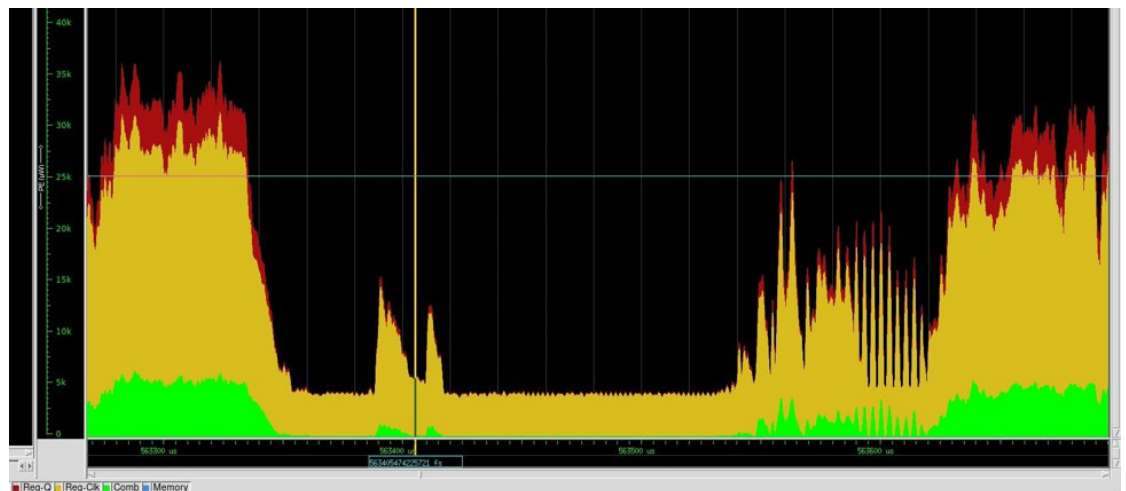
Newer AI technologies that include predictive and generative AI modeling technologies have opened an even larger set of possibilities.

For example, Calibre™ design and manufacturing solutions use AI to accelerate NPIs from design to high-volume manufacturing by providing faster and more accurate tools for DRC/LVS/PEX/DFM/REL checking, yield analysis, and reliability optimization as well as lithography modeling, RET and OPC.



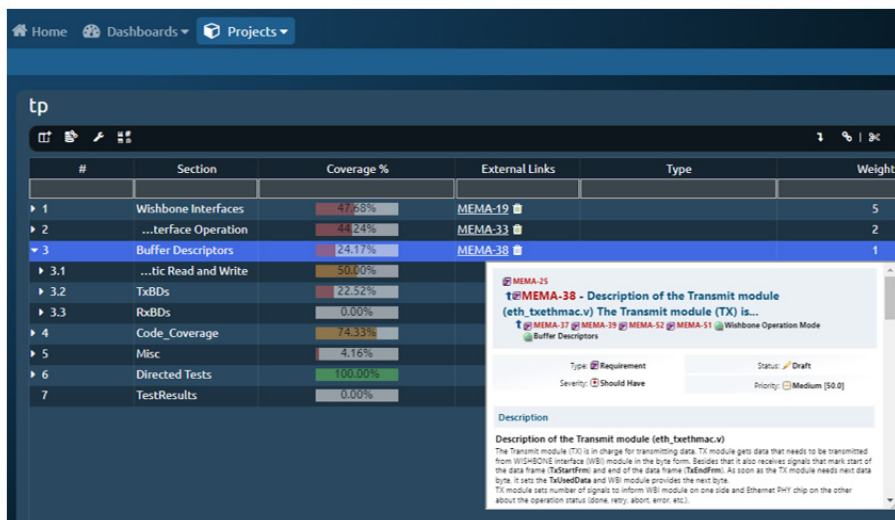
The Calibre intelligent IC design software accelerates verification and debug of errors in complex SoC designs.

Veloce emulation, integrated with an AI power model, delivers highly accurate RTL design power estimations, with orders of magnitude faster results than traditional flows.



AI streamlining processes

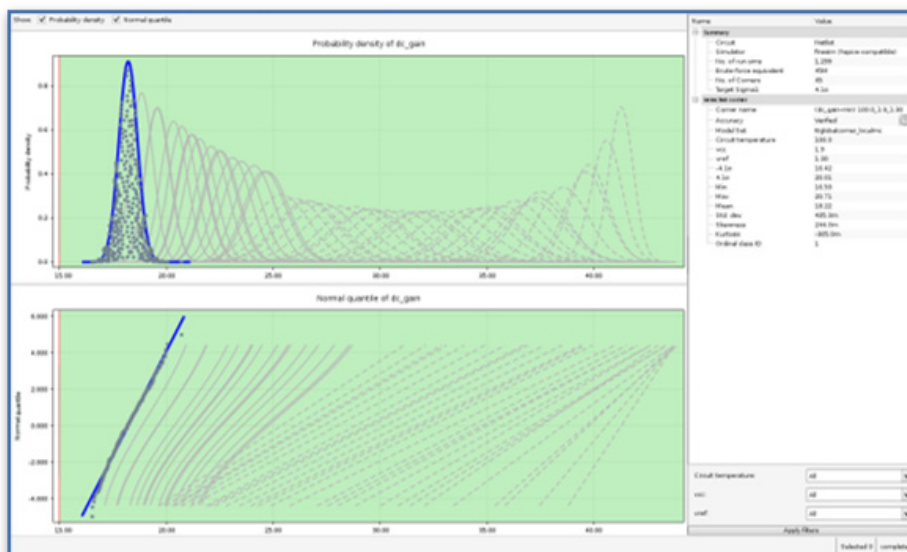
AI can be used to build new processes and capabilities and to gain new insights into data, allowing previously unknown yet valuable trade offs to be made. AI can be implemented to perform an existing task within the EDA space more efficiently than before. For example, the Questa™ Verification IQ suite of tools for digital verification allows approaching coverage closure much more quickly.



Questa's AI-powered verification processes reduce time to closure with far fewer tests needed.

And the Solido™ Characterization Suite and Solido Design Environment enable getting exactly the same quality of results with orders of magnitude reduction in the amount of verification needed.

Across the IC design to production flow, Siemens EDA tools use AI to automate, scale and collaborate, making processes more efficient than ever before.



The Solido AI-driven custom verification tools provide faster and more accurate design, characterization and simulation for analog ICs.

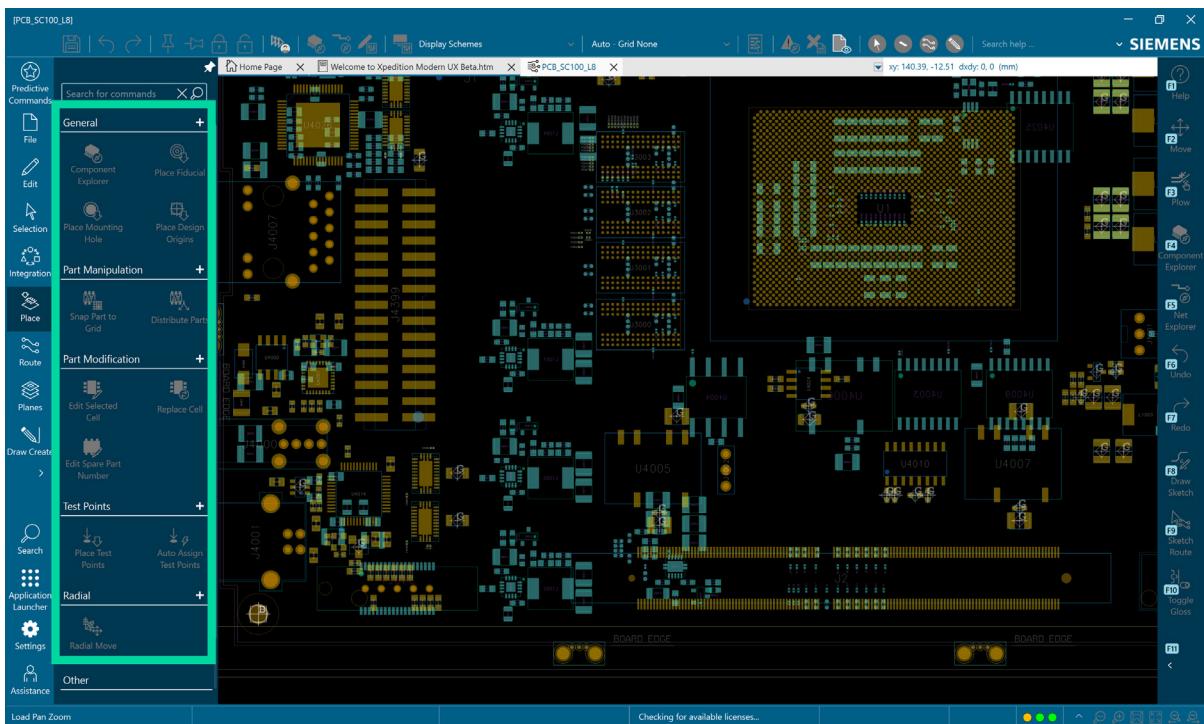
AI empowering people

Leveraging machine learning to build domain-specific predictive models significantly reduces the computational resources needed in certain domains such as simulation and can be used to speed root-cause analysis when problems are identified.

The latest large-language models and generative AI also are changing the way we use EDA tools. Generative AI is making it easier for engineers to save and share their knowledge, automate the abstraction of cross-domain information and accelerate design creation and system optimization. AI within Siemens EDA covers a range of technologies that work together to empower our customers to make better chips and electronic systems.

For example, Xpediton™, HyperLynx™, and PADS Pro™ are able to predict the likely next command based on the last one used with an on-the-fly machine-learning model when designing PCBs.

AI also can be used as a guide through design optimization. All of these technologies are centered around empowering engineers and enabling them to become more productive quickly. For example, AI can assist with high-level exploration at the system level or down to task-specific exploration, leading to closure. Whatever level engineers are operating in, AI can deliver new insights and automation capabilities for creating semiconductor designs.



Using AI, design engineers' experience can be enhanced by reducing repetitious and tedious tasks.

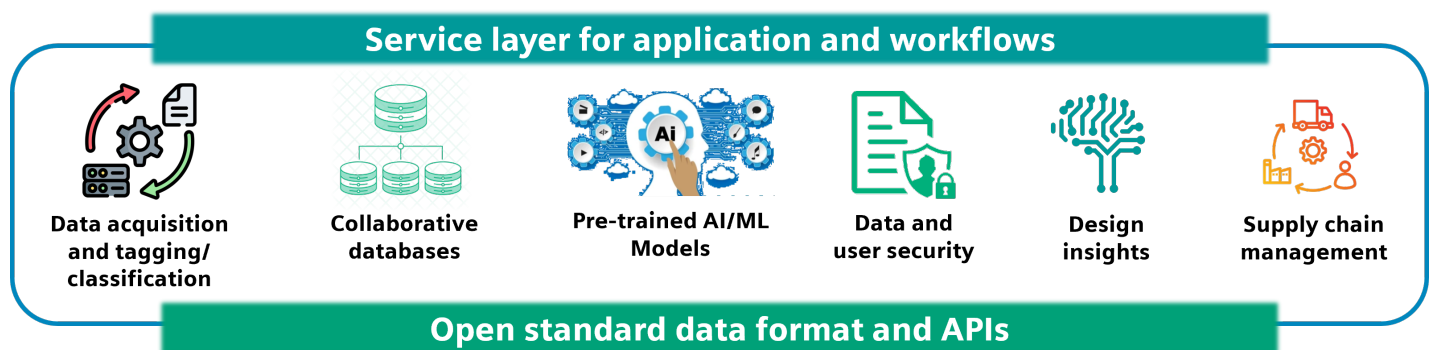
Get verifiable results, industry-scale reliability and own your data

The quality and security of data is critical. When Siemens delivers tools with pre-trained AI models that are working with customer data, the models that are built from that customer data remains within the customer's control. We never take customer data without permission to improve the models. When a partner customer is willing to share data, it can be used to improve modeling while ensuring that there is no data leakage through the models.

Our customers can use their data to build on a layer of application-specific AI, including EDA data, source control data, logistics data and a wide range of internal data not available to Siemens. Using our EDA AI platform, customers can integrate their data with the EDA tools to extract data and control them for their own needs.

To help customers create their own scalable AI for EDA and related processes, Siemens provides the production-grade, industry-proven Siemens Xcelerator Open Business Platform. Custom AI applications built on the platform can be assured of verifiability, which is especially important when working with acceptable failure at levels of parts per billion or parts per trillion.

We have many customers today that are already doing this. Siemens and our partners are investing in a future of AI that is an open ecosystem, which enables semiconductor designers and manufacturers to build their own customizable, scalable and verifiable AI tools and optimized processes. Our software developers work with keeping the goal of openness, collaboration and flexibility in mind.



Siemens EDA AI solutions acquire data through open APIs where possible, use a data lake for distributed data, and ensure that all data stays with the customer, while providing comprehensive security.

Looking ahead—AI enables transformation

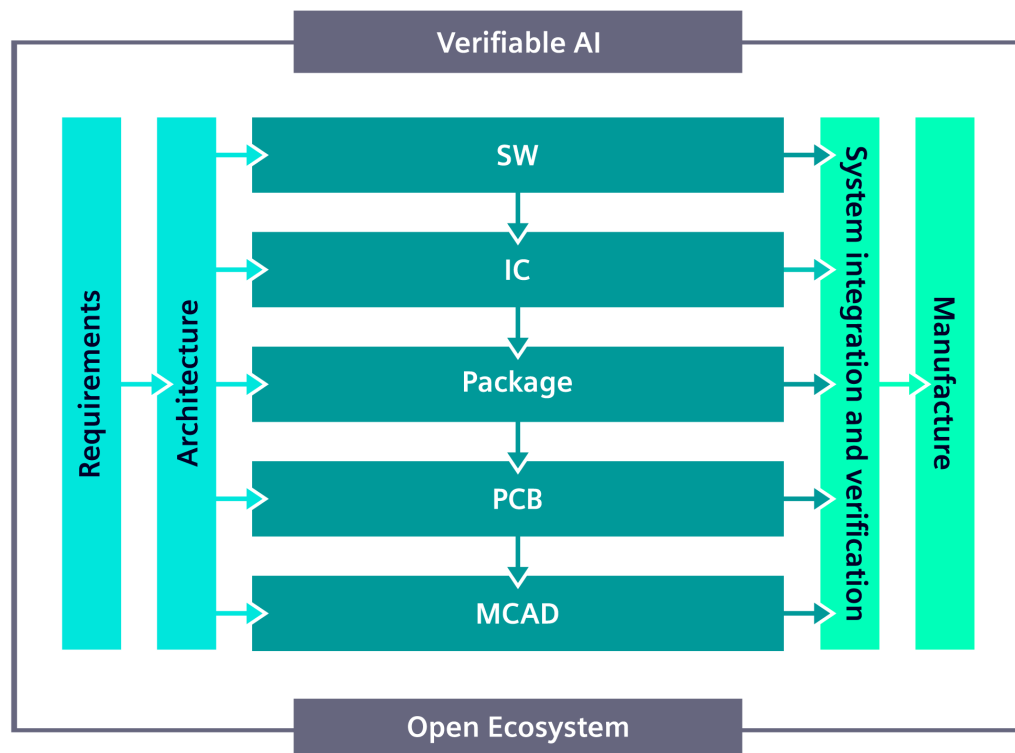
Siemens software engineers are taking the knowledge and the capabilities gained over more than a decade of implementing AI to extend its role in the company's tools and services—we are still scratching the surface of what is possible.

Siemens R&D actively collaborates with customers to investigate how this capability of learning can be refined, not just during the design and the production phases of a semiconductor, but throughout its lifetime.

AI can be used to integrate semiconductor technologies into the comprehensive digital twin. Collaborating closely with customers, our EDA

developers and support team are able to see beyond the traditional EDA at how the complete product life cycle is affected by the insights that come from deep knowledge of semiconductor design processes, working to decrease the time and resources needed to make the products while increasing engineering capabilities.

According to Amit Gupta, VP and GM of Siemens Digital Industries Software's custom IC verification division, we are entering a new era of design from concept to manufacturing enabled by AI. When working with Siemens EDA, partners and customers can be assured of a long history of successfully improving IC design and manufacturing processes and tools with AI.



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For additional numbers, click [here](#).

Siemens Digital Industries Software helps organizations of all sizes digitally transform using software, hardware and services from the Siemens Xcelerator business platform. Siemens software and the comprehensive digital twin enable companies to optimize their design, engineering and manufacturing processes to turn today's ideas into the sustainable products of the future. From chips to entire systems, from product to process, across all industries, [Siemens Digital Industries Software](#) – Accelerating transformation.

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