

# EMPOWERING E/E SYSTEMS DESIGN AND INNOVATION THROUGH SIEMENS XCELERATOR & CAPITAL X IN THE CLOUD

Electrical and Electronic (E/E) systems designers face numerous challenges, including increased complexity, interdisciplinary integration, safety and reliability, cybersecurity, cost and time-to-market pressures. Cloud-based E/E systems design software offers numerous benefits, promising to help designers tackle these challenges while accelerating development.

The Siemens Capital™ X software makes good on the promise of digitalization while enabling OEMs to leverage the speed, flexibility and scalability of cloud computing. Capital X enables teams to work in a secure, virtual environment from anywhere and leverage a high degree of automation across domains and disciplines for greater visibility, insight and traceability to all facets of systems development.

In this ebook, we'll explore key challenges of E/E systems design, the benefits of the cloud for systems development, and how Siemens Capital X can be quickly and easily deployed and accessed in the cloud.

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# Benefits of cloud-based deployment

Cloud solutions offer several benefits for E/E systems engineers. Let's examine these benefits in detail.

## **Rapid provisioning for fast access to resources**

One of the primary benefits of cloud computing is the ability to quickly and automatically allocate computing resources – computing power, storage and networking and other resources – to handle increased traffic and workloads, and meet the demands of applications or services hosted in the cloud. This flexibility enables efficient resource management and cost optimization.

To enable rapid provisioning, cloud providers offer self-service portals or APIs that allow users to request and configure resources with just a few clicks or programmatically through code, eliminating manual tasks and reducing the time it takes to access additional computing resources. Users can provision resources on-demand, and scale up to accommodate workload fluctuations.

Another benefit of rapid provisioning is that users don't have to worry about physical infrastructure requirements and

configurations – provisioning is a simple process, so engineers have more time to focus on E/E systems development. There are cost savings as well – traditional infrastructure procurement typically involves upfront investments and overprovisioning to accommodate peak loads. In contrast, rapid provisioning in the cloud allows for precise resource allocation based on real-time needs, minimizing wasted resources and reducing overall infrastructure costs.

Automated provisioning also ensures consistency and standardization. Templates or preconfigured images can be used to provision resources, ensuring that the required software, settings and security configurations are consistently applied across instances. This reduces the potential for errors and simplifies management and maintenance tasks.

## **Scalability to handle increasing design complexity**

By providing scalable computing resources and storage capacity, cloud-based systems help designers handle the increasing complexity and data volume associated with E/E systems design and development.

They can quickly stand up and scale resources to meet demand, and enable faster data processing and analysis. Cloud computing offers scalable storage solutions, as well, such as object storage or databases that can accommodate large volumes of data. In the cloud, software engineers can leverage cloud-based data processing services like big data analytics or machine learning to extract insights and build intelligent applications, without worrying about infrastructure constraints.

## **Collaboration and communication**

E/E systems designers need to collaborate with various disciplines such as mechanical engineering, software development and industrial design. Coordinating and integrating these diverse elements can be complex, especially when different teams may have different priorities, timelines and constraints.

Cloud-based software enables seamless collaboration and integration among multidisciplinary teams working on different aspects of design. Designers, engineers and stakeholders can work together in real-time, accessing and sharing design files, specifications and

# Benefits of cloud-based deployment CONTINUED

simulation results. This promotes efficient communication, reduces design iteration cycles and improves overall collaboration.

Additionally, with cloud-based E/E systems, designers can securely store, organize and track design, specifications and other project-related documents in a collaborative environment. This ensures data integrity and simplifies design data access and sharing, reducing the risk of errors and ensuring design consistency.

## Testing and simulation

Designing E/E systems design that can withstand harsh operating conditions, perform reliably over extended periods, and incorporate fail-safe mechanisms requires extensive testing. Plus, the proliferation of electronic components and wireless connectivity increases the risk of electromagnetic interference. Designing E/E systems that minimize electromagnetic interference (EMI) and ensure proper electromagnetic compatibility (EMC) is crucial to avoid performance degradation, malfunctions or safety hazards.

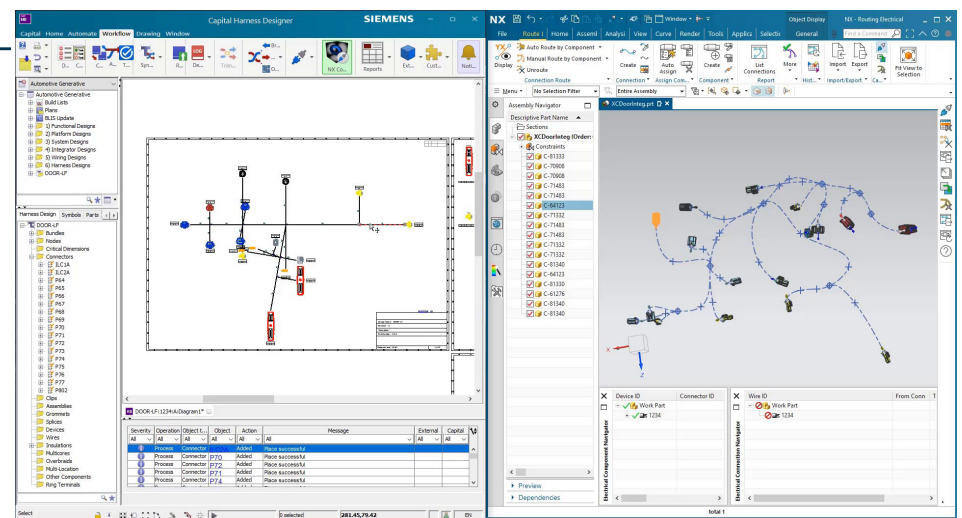
Cloud-based E/E systems design software often includes powerful simulation and modeling capabilities. Designers can perform virtual simulations such as thermal analysis, EMI analysis and performance optimization using the cloud's computing



## SEAMLESS COLLABORATION

During design, seamless cross-probing between the electrical and mechanical environments helps designers understand their counterpart's domain and provides ongoing cross-domain decision assessment. This enables inconsistencies to be identified and resolved early, reducing costly design iterations. ECAD/MCAD codesign, with rich change management support, provides a key enabler for design teams to reach program milestones, ensuring the project proceeds on schedule, while minimizing cost.

Figure 1:  
The integration  
between  
Capital X and NX  
environments



resources. This helps to identify and address design challenges early in the development process.

Cloud-based E/E systems design software can also integrate with cloud-based hardware-in-the-loop (HIL) testing

platforms for scalable and distributed testing of E/E systems via real-time simulations and performance testing. In the cloud, designers can efficiently perform comprehensive HIL testing without the need for extensive hardware setups.

# Benefits of cloud-based deployment CONTINUED

## Cost efficiency and productivity

E/E systems designers must balance performance, functionality and cost-effectiveness while meeting tight deadlines. Cloud-based software can help teams to eliminate the need for local installations and gain access to the latest software updates and features, so they can be more productive. Designers can access software and projects from any device with an internet connection, so they can be productive from remote locations and collaborate effectively with external partners or suppliers, wherever they are.

“*By identifying and addressing design challenges early in the development process, designers reduce the need for physical prototypes and costly iterations.*”

Cloud-based E/E systems design software often operates on a subscription or pay-per-use model, allowing companies to reduce upfront costs associated with purchasing and maintaining on-premise software and hardware infrastructure. Design teams can optimize resource allocation, scale computing resources as

needed and pay only for the resources they consume. In this way, they save money and improve budget management.

## Regulatory compliance and standards

Functional safety standards are crucial for ensuring the safety of E/E systems by defining processes for hazard analysis, risk assessment and the implementation of safety mechanisms. They also need to integrate control systems that monitor and optimize emissions, such as onboard diagnostics (OBD) and emission control strategies, to meet regulatory requirements set by organizations like the Environmental Protection Agency (EPA) and the European Commission. Additional regulations for crash safety, cybersecurity, accessibility and more also impact design.

Cloud-based E/E systems design aids compliance efforts by offering a centralized platform for real-time collaboration and version control, and the ability to share compliance-related documents easily. Accessibility and traceability simplify compliance audits, inspections and regulatory updates, as well. Using cloud-based platforms, organizations can track changes, maintain an audit trail and retrieve information quickly.

When it comes to meeting security standards and regulations, cloud platforms provide robust security measures to help

maintain data confidentiality and safeguard sensitive information. Additionally, organizations can scale resources, adapt to changing compliance needs and integrate with third-party compliance tools available in the cloud ecosystem.

## Integration with IoT and sensor data

Internet of things (IoT) connectivity enables over-the-air updates, enhancing convenience and enabling manufacturers to deliver software updates and new features remotely.

IoT-generated data helps optimize vehicle design, improve reliability and tailor features to meet customer demands. Through the seamless integration of smart devices and services, drivers benefit from advanced safety features and user experiences. IoT also facilitates advanced diagnostics, predictive maintenance and vehicle-to-cloud communication to improve performance and efficiency.

Cloud computing enables the seamless integration of IoT devices and sensor data, allowing engineers to collect, store, process and analyze data in real-time. This makes data-driven capabilities such as predictive maintenance, anomaly detection and optimization algorithms possible. Engineers can also consult the data to identify areas for design improvements.

# Benefits of cloud-based deployment CONTINUED

## Additional benefits of cloud

- **Access to specialized tools and services:** Cloud platforms offer a wide range of specialized tools and services that can enhance the development of E/E systems. Engineers can leverage cloud-based development environments, integrated development tools, debugging tools and libraries to accelerate software development for embedded systems. Additionally, cloud-based test automation frameworks and continuous integration/continuous deployment (CI/CD) streamline the testing and deployment processes, reducing time-to-market.
- **Version control and configuration management:** Cloud-based version control systems and configuration management tools simplify the management of software and hardware configurations. Engineers can track changes and manage different versions and collaborate on configurations more efficiently, promoting consistency and improving the development workflow for faster iterations and fewer errors.
- **Enhanced accessibility:** Cloud computing enables software engineers to access development

environments and tools from anywhere with an internet connection. This flexibility allows for remote work, distributed teams and efficient utilization of resources. Engineers can access their work environment, test applications and deploy software across multiple devices and platforms.

- **High availability and reliability:** Cloud providers typically offer robust infrastructure with built-in redundancy and failover mechanisms. This ensures high availability and reliability of applications, minimizing downtime and disruptions. Software engineers can rely on the cloud infrastructure to deliver their applications consistently, even during peak loads or in the event of hardware failures.
- **Enhanced security:** Cloud-based software providers typically employ robust security measures to protect sensitive design data. They implement encryption, access controls, and regular backups to ensure data integrity and minimize the risk of data loss. Cloud-based solutions often have dedicated security teams and adhere to industry best practices, providing a higher level of security compared to local server setups.

- **Disaster recovery and data backup:** Cloud providers offer robust disaster recovery and backup. As everything is stored in the cloud, even in the event of data loss or system failures, recovery processes can be initiated quickly, minimizing the impact.
- **Remote access and collaboration:** Using a cloud-based platform, organizations benefit from capabilities that allow remote workers to participate in the design, including contractors, suppliers, customers, and partners. This may include the ability to review designs remotely from their devices.
- **Optimize costs over time:** The cloud not only eliminates upfront infrastructure investments required by on-premises solutions, it can accommodate unpredictable growth patterns. Organizations can scale resources on demand, avoiding overprovisioning or idle resources, and leverage cost-effective storage options to reduce the expense of managing data. Over time, as business needs evolve, economies of scale allow cloud providers to negotiate better pricing and pass on the cost savings to customers.

Collectively, these advantages contribute to faster development cycles, increased efficiency and accelerated innovation. ■■



# Siemens Capital X for E/E Systems design

Siemens Capital X is an ideal solution for E/E systems design, and is available as a cloud-based service offering.

Through the use of a comprehensive digital twin and digital thread, the portfolio provides a design flow that spans E/E systems design, harness manufacturing engineering and in-service publication creation. This is where the electrical distribution system is designed (both logically and physically), verified by correct-by-construction methods with active design-rule checks running in the background, and prepared for manufacture. Insight into these processes enables teams to:

- Gain insights throughout the entire product lifecycle
- Mitigate certification and regulatory compliance issues earlier
- Avoid the high cost of rework and missed milestones
- Stay on schedule and avoid late-stage changes

“*Using Capital for electrical design and after-sales documentation has produced tremendous time and cost savings.*

*– Yves Bouvier, Vice President of Diagnosis, Groupe PSA*”

## E/E systems functional model creation

Capital X consumes and normalizes information from a variety of requirements and system modeling environments to inform electrical system development to capture an E/E systems functional model. The model incorporates all the tasks and roles expected of the system – as well as the communication between functions – to which it maps the relevant systems requirements. Creating a model of all required features and tasks early in the development process enables them to be preserved throughout the development lifecycle, via the digital thread.

## Architectural exploration

With Capital X, engineers can leverage the functional model for electrical system architectural exploration. Capital X dynamically allocates and groups functions into virtual electronic control units (ECUs) to create a physical model of the final platform. It analyzes the proposed functional and physical architecture to predict the characteristics of the resulting electrical system, including weight, power consumption, processing and communication bandwidth and cost. Engineers can vary parameters to explore various options and optimize the architecture and understand potential changes and tradeoffs earlier in the development cycle.

“*...we shifted approach to allow us to optimize the vehicle as a whole, with all possible variations considered in the early development stage...Capital provides this environment*

*– Kazuichi Fujisaka, Technical Leader, Mazda Motor Corporation*”

# Siemens Capital X for E/E Systems design CONTINUED

## Data parsing across disciplines

Capital X provides intuitive and intelligent data parsing, to extract information from the functional model and make it instantly available for multiple disciplines: electrical distribution system (EDS), electronics, communication networks and software.

## Cross-discipline collaboration

Using the digital thread, all disciplines involved in the E/E systems design have access to a single source of system data, from the electrical disciplines to mechanical engineering and manufacturing, enhancing collaboration and increasing data consistency throughout the development lifecycle. The digital thread enables efficient electrical and mechanical co-design, platform-level configuration and revision control, and the ability to configure the platform across all domains. ■■

“As a part of the Siemens Xcelerator portfolio, tight integration with mechanical, PLM, simulation and manufacturing planning solutions, Capital X blurs the boundaries between disciplines to improve quality and accelerate product development.”



## CAPITAL X AND THE DIGITAL TWIN

Given the increasing complexity in automotive E/E systems design, digital transformation is a top priority for many automotive manufacturers. Siemens Xcelerator portfolio offers the industry's most comprehensive digital twin solution, enabling teams to design, validate and build in a virtualized environment.

The digital twin and digital thread enable multiple processes across domains to integrate data throughout the product lifecycle, providing a richer understanding of the products, while reducing risk and accelerating innovation. Companies and organizations that adopt a digital twin and digital thread can use digitalization as a competitive advantage.

# ANALYST VIEW: ENHANCE AND STREAMLINE E/E SYSTEMS DESIGN WITH SAAS AND CLOUD-BASED SOLUTIONS

## E/E SYSTEMS DEVELOPMENT HAS NEVER BEEN MORE COMPLEX

Electrical/electronic (E/E) systems development in the manufacturing sector is undergoing a radical transformation. As demand for products with advanced, software-driven features and connected functionality has grown, these systems have become increasingly complex. Today's E/E systems act as a product's central nervous system. They enable communication and data exchange between electronic endpoints, serve as the interface between software and hardware, and provide the computing power necessary for leading-edge capabilities.

The rising complexity and rapid evolution of E/E systems make it more challenging than ever to design, test, and integrate them efficiently. Suppliers working on disparate multi-domain systems must coordinate their development so each system integrates seamlessly with the others in a shared E/E infrastructure. At the same time, companies are under pressure to bring new products to market on shorter timelines. This requires them to develop and validate systems more quickly while meeting stringent quality and safety standards.

To collaborate effectively and overcome the difficulties inherent in modern E/E system development, stakeholders require solutions that can:

- facilitate cross-domain coordination;
- iterate on E/E infrastructures more rapidly; and
- manage the full complexity of advanced E/E systems.

## CLOUD-BASED SOLUTIONS ENABLE ROBUST COLLABORATION

Cloud-based solutions are a natural fit for organizations that desire high levels of both flexibility and functionality but want to keep costs down. Cloud-based E/E solutions enable engineering teams to quickly and easily integrate suppliers and contractors into development projects. Companies that want to leverage the knowledge of experts in the rapidly evolving field of E/E systems development can do so without long, lagging efforts to get them plugged into the design process. Companies can also opt for software-as-a-service (SaaS) models that allow them to add and remove access to solutions as needed, without waiting for



*By Chad Jackson, Lifecycle Insights CEO and Chief Analyst*



additional installations or paying for perpetual licenses. In addition, SaaS providers typically handle routine maintenance tasks, software updates, and security management, which reduces the burden on internal IT teams.

In addition, cloud solutions for E/E systems development provide users with a centralized platform for communication and



## ANALYST VIEW: ENHANCE AND STREAMLINE E/E SYSTEMS DESIGN WITH SAAS AND CLOUD-BASED SOLUTION *(continued)*

data sharing that can be accessed from anywhere with an internet connection. Then cross-domain stakeholders can collaborate seamlessly, regardless of their location, and ensure that everyone involved in the design process is aligned on the system's technical details. As E/E systems become more complex, such alignment is essential to managing project timelines and costs. When contributors miscommunicate or make decisions based on inaccurate or outdated information, they increase the likelihood of significant delays and budget overruns.

Along with advanced collaboration capabilities, manufacturers also need robust design functionality that enables them to develop and visualize E/E systems in their full complexity. Cloud-based solutions that offer these capabilities serve two vital needs by providing users with a flexible, collaborative design environment and ensuring that complex E/E models are represented accurately and in complete detail. As a result, cross-domain stakeholders can more efficiently navigate the complexities of the design and integration processes, reducing time to market.

### SIMULATION IS ESSENTIAL TO ACCELERATING DEVELOPMENT

Just as engineering teams need powerful collaboration capabilities to drive cross-domain design work, they also require tools that empower them to verify E/E system architectures and integrations earlier in the design process. As these architectures become more complex, the consequences of failed tests late in the development cycle—project delays, rising costs, and excessive material waste—have only grown more severe. Companies can avoid these issues by leveraging digital tools to accelerate the verification process and minimize reliance on costly, time-consuming physical prototyping and testing.

E/E systems developers, therefore, need cloud-based solutions that offer not just modeling capabilities but simulation and emulation functionality as well. Such solutions enable engineers to identify and resolve potential issues early in the design process, long before they manifest as prototype failures during testing. By tapping into the cloud's powerful computing resources, engineers can run complex simulations on detailed E/E models, testing system behavior and interactions under numerous sets of conditions before

building a single prototype.

This approach both accelerates the development cycle and elevates the overall quality of E/E systems design. Engineers can iterate rapidly, verifying design changes with speed and efficiency. Digital verification also supports better integration of various E/E subsystems, as users can discover and address potential conflicts before physical assembly.

### CONCLUSION

Engineering teams are facing unprecedented challenges in E/E systems development, including increasing complexity, shorter development timelines, and growing demand for advanced features. Cloud-based SaaS solutions can provide companies with the robust collaboration tools, flexible design environments, and advanced simulation capabilities they need to design, test, and integrate today's E/E systems more efficiently.

Companies seeking to reduce time to market, minimize prototyping and testing costs, increase system quality, and ultimately remain competitive in today's rapidly evolving industry should adopt cloud-based SaaS solutions for E/E development.

# How to deploy Capital X in the cloud

For over two decades, Capital has been the leading solution for comprehensive electrical/electronic systems development, trusted by the world's most respected companies. Now, with Capital X we deliver Capital in a more accessible, scalable, and flexible form than ever before. By choosing Capital on the cloud, you can shift the burden of IT and reduce and/or reallocate those costs to other business priorities.

SaaS not only gets you started fast, but also shift your IT burden, significantly. The visual on the right compares the burden of Capital management across deployment models – on-premises and SaaS. With SaaS, Siemens takes the burden of managing the software, hardware, security, maintenance and even the upgrades/updates for you.

With on-premises, you typically have software licenses associated with this deployment model. These licenses are typically purchased and planned for in CAPEX (capital expenditure) budgets. With a on-premises deployment, you can see

cost categories such as implementation, customization, IT personnel, maintenance, hardware and training. In addition to this there are many ongoing costs such as applying fixes, patches and upgrades, ensuring and monitoring security, reducing



Figure 2: This visual compares deployments options: Software-as-a-Service, and On-premises.

# How to deploy Capital X in the cloud CONTINUED

downtime, maintaining hardware, network and databases, rewriting customizations, integrations and dependent applications.

With SaaS, the license fees turn into subscription fees which are required in a SaaS deployment model. Subscription costs are not realized in CAPEX budgets, they are typically realized in OPEX (operation expenditure) budgets. Additionally, with a SaaS deployment, you see the burden is being shifted to the software vendor for operations and maintenance of the software – reducing your need for hardware and supporting personnel who can be relocated to focus on other business needs. The focus with SaaS is on implementation, configuration of the software and training. Your ongoing costs are in the subscription fee, configuration choices you make and ensuring users are continually up-to-date with the provided training.

## **Capital X - Siemens expert operations ensures your success**

When you choose Capital X software, you're not just getting a powerful tool for your business, but you're also getting access to expert operations that ensure your success.

With Siemens-managed infrastructure, software, hardware, monitoring, backups, and application support, you can trust that your software is being managed by the best in the industry. We've learned valuable lessons from over 70,000 implementations and have 3000+ professionals that are committed to ensuring you realize the full value of your investment.

Plus, with over 1 million searchable knowledgebase articles and technical resources as well as Xcelerator Academy training, you can feel confident that you have all the resources you need to succeed with your new software. ■■

# Key Considerations for cloud deployment

Selecting the appropriate cloud delivery method for a sophisticated portfolio of software and solutions such as Capital X requires careful forethought and planning. Here are some key considerations:

- **Cloud provider selection:**  
Choose a reliable and reputable cloud provider that offers the necessary infrastructure and services to support Siemens Capital X. Consider factors such as data center locations, security measures, compliance certifications, performance guarantees and scalability options. Ensure that the cloud provider aligns with your organization's requirements and standards, and has robust security measures in place, such as encryption, access controls, data backups and disaster recovery capabilities.
- **Infrastructure requirements:**  
Determine the appropriate cloud instance types, storage options and networking configurations needed to meet performance and capacity demands of Capital X applications.
- **Data transfer and integration:**  
Determine how data will be transferred between on-premises systems and the cloud, as well as between Capital X applications and other cloud-based or on-premises systems. Evaluate options such as secure data transfer protocols, data synchronization mechanisms and integration frameworks to ensure seamless data flow and interoperability.
- **Performance and latency:**  
Assess the cloud provider's network latency, bandwidth limitations and availability of low-latency connections if real-time collaboration or interactive use cases are involved. Optimize network configurations to minimize latency and ensure optimal performance.
- **Cost optimization:**  
Features such as autoscaling can help to optimize resource utilization and keep costs well managed. Be sure your cloud provider offers this and other advanced features.
- **Availability and redundancy:**  
Assess the cloud provider's service level agreements (SLAs), uptime guarantees, backup and recovery mechanisms, and data replication options to ensure high availability and business continuity.
- **Migration strategy:**  
Plan and execute a migration strategy for transitioning Capital X applications to the cloud. Consider factors such as data migration, application compatibility, testing, user training and change management. Develop a phased approach, starting with a pilot or proof of concept, to minimize disruptions and mitigate risks. ■■

# ○ The role of Capital in the Siemens Xcelerator portfolio

As part of the broader Siemens Xcelerator portfolio, Capital X electrical systems and wire harness manufacturing solutions have been used in the industry for more than two decades. While Capital X has always provided a model-based approach to electrical distribution system development, the platform has evolved over the years as new challenges and complexities emerge. Today it encompasses support for systems modeling and definition and E/E optimization.

With this expanded functionality, Capital X portfolio capabilities span the entire product development lifecycle, making use of integrations with many market-leading solutions from Siemens, including Teamcenter product lifecycle management and NX software for mechanical design. ■

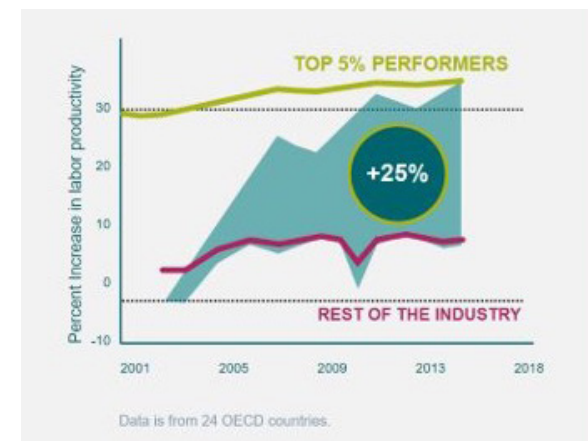
“ Our Siemens Xcelerator open digital platform enables customers to accelerate their digital transformation easier, faster and at scale and offers cloud-base SaaS solutions powered by Amazon Web Services (AWS). We help you build a comprehensive digital twin of your automotive product and follow it through from design to creation via a digital thread. ”



# How Capital X helps to de-risk key milestones

As part of the Siemens Xcelerator platform, Capital X helps to reduce risk throughout E/E systems development:

- **Built to Integrate:**  
Capital X checks to make sure everything is connected as expected. Design Rule Checks (DRC) ensure logical electrical connectivity is correct and the downstream physical piece parts have been defined and are coherent with the logical schematic. Furthermore, Capital X enables advanced electronic computer-aided design/mechanical computer-aided design (ECAD/MCAD) collaboration to ensure wire harnesses are the correct length given in the context of the 3D platform.
- **Production Readiness:**  
This milestone indicates a key hand-off from engineering to production/manufacturing. Capital X delivers critical elements of this milestone by enabling complete physical harness design using data defined in the logical schematic. This can be used to automatically generate work instructions based on the production floor layout and equipment, designing formboards based on customizable placement rules and providing a structured bill of materials (SBOM).
- **Certification/Compliance:**  
Capital X enables customers to demonstrate compliance to applicable regulations. For example, signal separation can be codified into rules and design constraints from the very beginning of the design process to ensure compliance is designed in. Capital X's electrical load analysis, wire de-rating, voltage drop, failure mode and effects analysis (FMEA), and sneak circuit analysis are additional analyses that support electrical regulations and can be used to confirm the intended function is correct.
- **Start of Production (SOP):**  
EIS enables the manufacturer to begin making revenue and add profitability to its bottom line, a key objective supported by Capital X.



**The top 5% of companies are dominating the economy by exploiting digital competencies**

The Best Versus the Rest: The Global Productivity Slowdown, Divergence Across Firms And The Role of Public Policy, OECD Productivity Working Papers

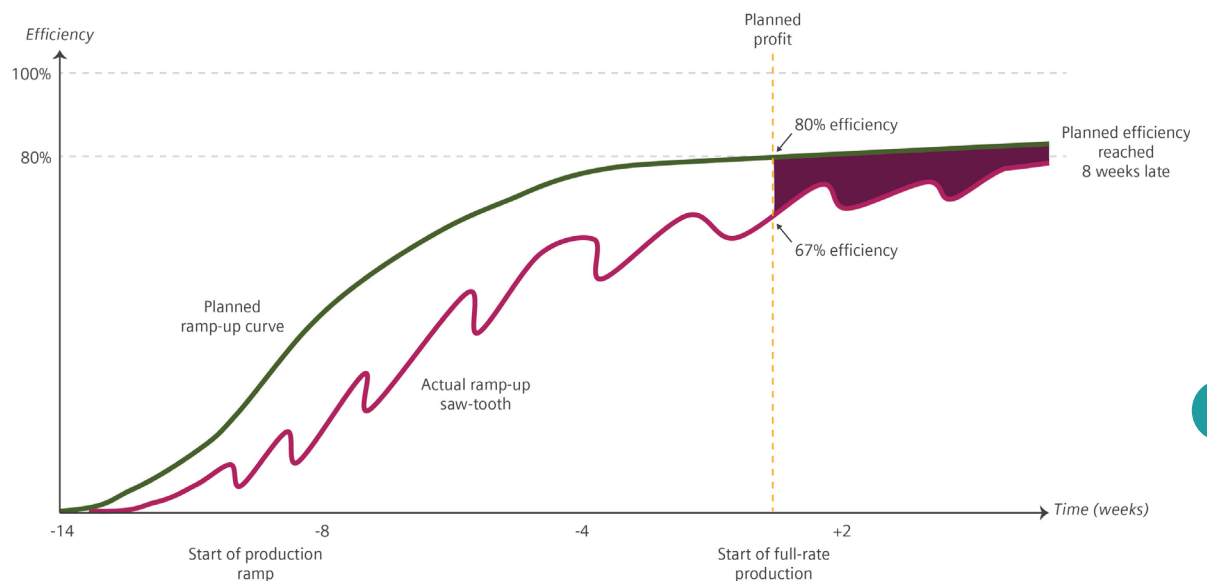
# How Capital X helps to de-risk key milestones CONTINUED

## Hit 80% production efficiency the first time

Typically, a harness manufacturer will develop a detailed plan to ramp production of a new harness. Harness manufacturers will carefully execute this plan, targeting 80% production efficiency by the time they reach the start of full rate production. Hitting this efficiency target is important since production run profitability depends on it.

However, because the harness is complex and organizations rely on multiple, distinct environments to prepare for production, mistakes are often made in creating the tooling, work instructions or other production support artifacts. The result? Actual production ramp-up starts and stops to resolve these issues. At the time full production begins, an organization may only be at 67% operating efficiency, and by the time it takes to reach the 80% target, money is lost on every harness built, potentially consuming the entire predicted profit for that specific run.

Capital X addresses this challenge by connecting harness product and process engineering to the electrical system's digital twin. Direct access to the electrical system



digital twin enables an automated harness manufacturing engineering flow that requires no manual data re-entry. The flow encompasses product engineering, including product cost optimization, form board design, assembly and subassembly design, manufacturing process design, optimization and documentation. This capability allows harness manufacturers to meet expectations for responsiveness, quality, delivery time and profitability.

# How Capital X helps to de-risk key milestones CONTINUED

## Capital X core tenets

Capital X provides the visibility, traceability and change/configuration management that manufacturers have come to demand by adhering to three core tenets:

1. **Data coherency:** Data is consistent as it flows up and down the different abstractions in the E/E systems development lifecycle, enabling traceability, robust change management and configuration control.
2. **Open integration:** A rich API and out-of-the-box connectivity to adjacent MCAD environments enable teams to trade information with legacy systems to gain the capability of bringing in more component data.
3. **Advanced automation.** Capital X automates routine manual functions to increase team productivity, enabling teams to capture and share best practices arising from the learning and expertise of its team members, so they can be applied throughout the organization.

## Conclusion

The automotive and aerospace markets continues to evolve at record-breaking speed, and consumers and businesses want vehicles and aircraft that are connected, sustainable and packed with advanced features. Design complexity will continue to increase, and the pressure to deliver innovative automotive products to market faster and more cost-effectively is unlikely to let up. In this environment of rapid innovation and intense competition, cloud-based E/E system development software empowers manufacturers to streamline their processes, accelerate development, and deliver high-quality vehicles and automotive products to market faster and more efficiently.

Now available in the cloud, Siemens' Capital X empowers automotive E/E systems designers with a comprehensive suite of engineering software and solutions. Engineering teams can reap the benefits of a common, integrated data-driven environment, enhanced collaboration and faster time-to-market, as they design the automotive products of the future. ■■

# SIEMENS

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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