DIGITAL EBOOK
*AN EE WORLD RESOURCE*

# How to minimize risk and address complexity in aerospace electrical programs today

Developing aerospace electrical platforms has become a monumental challenge due to increased complexity. To achieve program profitability while satisfying demands for more mission capabilities, aerospace companies must modernize their development and manufacturing processes. The industry is quickly turning to a digitalized approach. By using a comprehensive digital twin and digital thread, OEMs can speed up program lifecycle development and introduce less risk into the entire process. Digitalization not only allows teams to work in a virtual environment, but introduces a high level of automation across domains and disciplines bringing visibility, insight and traceability to all facets of electrical program and wire system development.

INSIDE...



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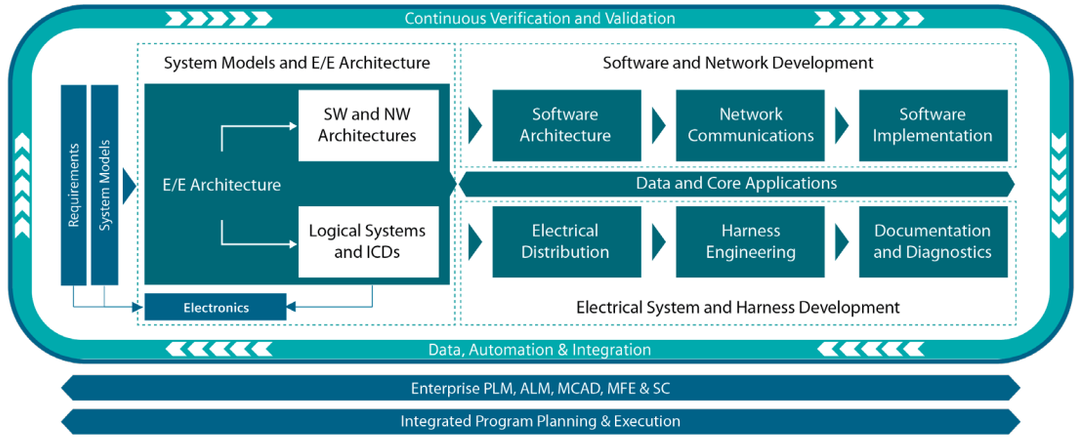
# Addressing complexity and minimizing risk **in modern aerospace electrical platforms**

**Developing aerospace** electrical platforms has become a challenge due to growing complexity and the increased use of electrical and electronic content. To achieve program profitability, while satisfying demands for efficiency and more mission capabilities, aerospace companies need to modernize their development and manufacturing processes. Aerospace companies and their suppliers are quickly turning to a digitalized approach to achieve this. By using a comprehensive digital twin and digital thread, OEMs can speed up program lifecycle development and introduce less risk into both design and manufacturing. Certification becomes a straight-forward endeavor. Digitalization not only allows teams to work in a virtual environment, but introduces a high level of automation across domains and disciplines bringing visibility, insight and traceability to all facets of electrical program and wire system development.

Welcome to the Siemens Capital E/E Systems aerobook. In the following pages you will get a glimpse at how Capital has evolved to meet industry complexities of the 21st century. You'll be introduced to the Capital E/E Systems development environment. Learn how Capital helps teams reduce program risk and meet compliance. Understand Capital's role in the Siemens Xcelerator portfolio. Finally, the popular podcast Talking Aerospace Today has designated an entire season to Capital and electrical system design. See all of the episodes and listen to the podcast of your choice.

# Introducing the Siemens Capital
# E/E Systems development environment




**The Capital portfolio** of electrical systems and wire harness manufacturing solutions has been serving the aerospace and defense (A&D) community for over two decades. The software has evolved over the years as new challenges and complexities have emerged.

Today, Capital contributes the Electrical and Electronic (E/E) Systems development solution which is part of the Siemens Xcelerator portfolio. While Capital has always been a model-based approach to electrical distribution system development, with its integration into Xcelerator, it expands to support systems modeling and definition, E/E optimization, as well as software and network development (Figure 1). This new Capital functionality spans across the product lifecycle and makes use of integrations with many of Siemens' market-leading solutions, such as the Teamcenter product lifecycle management and NX software for mechanical design. Siemens Xcelerator is a comprehensive and integrated portfolio of software, services and an application development platform that accelerates the digital transformation through a comprehensive digital twin and digital thread.

Exactly what is the Siemens Capital E/E Systems development environment? Some of the more popular capabilities include:

- **An accurate electrical and electronic (E/E) functional model** Capital consumes information from a variety of requirements and system modeling environments. It normalizes this information to feed the platform electrical system development process. This begins with the capture of an electrical and electronic system functional model. This functional model incorporates all the tasks and roles expected

# Introducing the Siemens Capital
# E/E Systems development environment

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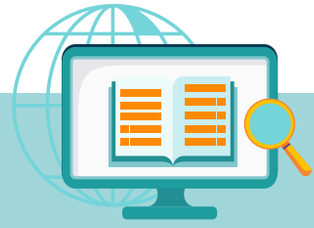
of the electrical system, it also accounts for all communication between these functions and maps the relevant systems requirements to them. These are important features of the model to get right early in the electrical system development process, since, by virtue of the digital thread, these relationships will be preserved throughout the platform life cycle.

- **System architectural exploration**
  With an accurate functional model established, Capital enables the process of electrical system architectural exploration to begin. In this stage, Capital interactively allocates and groups functions into virtual line-replaceable units (LRUs), which are provisionally located within a physical model of the final platform. Capital then analyzes the proposed functional/physical architecture to predict the characteristics of the resulting electrical system (e.g. weight, power consumption, processing and communication bandwidth, cost). By varying the electrical system's functional/physical architecture and repeating the analysis, Capital enables electrical systems engineers to optimize this architecture. Teams can better understand the impact of architectural tradeoffs earlier in the development life cycle and are empowered to pick a better starting point for all the effort that follows.

- **Intuitive and intelligent parsing of data across disciplines**
  Armed with the chosen architecture, Capital extracts the information necessary to implement the electrical system. It intelligently parses this information to feed lifecycle development in four



## Xcelerator AND CAPITAL E/E SYSTEMS EXPLAINED!

What exactly is the Siemens Xcelerator and how does E/E systems development play a role in it? Check out the white paper "**Blurring the Boundaries in E/E System Development**" and you'll understand the many advantages behind Xcelerator. Advanced platforms demanded by the aerospace industry often require the integration of components from across domains whether it's mechanical, electrical, electronics or embedded software. See how Xcelerator brings together advanced technologies to support A&D companies as they strive to overcome complexity.

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# Introducing the Siemens Capital
# E/E Systems development environment

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separate, but related, electrical disciplines: electrical distribution or electrical wiring interconnect system (EWIS), electronics, communication networks and software. Each discipline uses this data across the complete development lifecycle from design through production and finally into operational maintenance.

- **Leveraging the digital thread for cross-discipline collaboration**
  The Capital digital thread not only connects related electrical disciplines, but it also extends to the mechanical discipline and to the platform's product lifecycle and application lifecycle management environments. This allows electrical and mechanical co-design, platform level configuration control and revision control, and the capability to configure the platform – across all domains as well as across the product development lifecycle.

## CONCLUSION

An integrated, end-to-end E/E systems development environment supports aerospace companies as they strive to overcome complexity and reduce time to market. Capital, from Siemens Digital Industries Software, features unparalleled reach to drive electrical distribution system, networks and embedded software design, as well as the creation of manufacturing and product service deliverables from the E/E architecture. As a part of the Siemens Xcelerator portfolio, tight integration with mechanical, PLM, simulation and manufacturing planning solutions, Capital blurs the boundaries between disciplines to improve quality and accelerate product development.

## WATCH THIS POPULAR WEBINAR

The platform interactive flow is at the heart of any aerospace electrical system. This webinar "Mastering the physical context of aerospace electrical system development: The Platform Interactive Flow" provides an inside look at how to master the physical context of an electrical system flow.

**WATCH NOW!**

**CLICK HERE**
**for more information on Capital E/E Systems**
Read an industry blog by Tony Nicoli.

**READ**
**Capital E/E Systems press release**
See the official press release from Siemens.

# Reducing program risk **through a more digitalized work environment**

**For the A&D industry,** delivering aircraft to customers on time and within budget is a task that's increasingly more difficult with growing complexity. The demand for more electrical functionality only exacerbates the situation. To stay competitive, aerospace OEMs must retire risk earlier in the program lifecycle to avoid unforeseen problems during key milestones. Uncovering a problem at a key milestone leaves an aircraft manufacturer with just a few costly options. Issues found late in the development cycle are often extremely difficult to implement back into the process.

During program execution, the cost and impact of a problem greatly increases the longer it goes undetected. Design problems not identified within the design process can slip past traditional Preliminary or Critical Design Reviews (PDR & CDR) and manifest themselves at later

milestones. Late changes not only drive design changes, but also have costly rework and schedule impact that puts at risk milestones such as Integration Complete, Production Readiness Review (PRR), Validation and flight Testing, Type Certification (TC) for commercial or Customer Acceptance for defense, and Entry Into Service (EIS).

To avoid surprises late in the development cycle, aerospace manufacturers are looking for an approach that not only anticipates problems before integration, but delivers insights and key understandings throughout the entire product lifecycle process. To stay on schedule and avoid late-stage surprises OEMs must be able to accelerate the uncovering of potential certification and regulatory compliance issues earlier in the program development cycle.

# Reducing program risk **through a more digitalized work environment**

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### CAPITAL – NOW PART OF SIEMENS Xcelerator

Risk reduction in many respects is about increasing confidence and constraining outcomes. If OEMs are able to do this more effectively, they are more inclined to take on other kinds of risk to increase innovation and productivity. By transitioning to a more digitalized work environment a company can become more streamlined in their operations, through the ability to automate and optimize their processes with a proven digital twin and digital thread.

Capital, now part of Siemens Xcelerator portfolio, facilitates the digital transformation through the use of a comprehensive digital twin and digital thread.

Integrated within Siemens Xcelerator, Capital can provide a flow that covers the electrical/electronics system 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 (this refers to active design-rule checks

## HOW CAPITAL HELPS TO DERISK KEY MILESTONES:

- **Integration Complete:** Capital 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 enables advanced ECAD/MCAD collaboration to ensure wire harnesses are the correct length given the 3D platform routing.
- **Production Readiness Review (PRR):** This milestone indicates a key hand-off from engineering to production/ manufacturing. Capital 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).
- **Type Certification (TC):** Capital enables customers to demonstrate compliance to applicable regulations. For example, EWIS signal separation can be codified into rules and design constraints from the very beginning of the design process to ensure compliance is achieved. Capital'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.

- **Entry Into Service (EIS):** De-risking the milestones also de-risks this key program milestone. EIS enables the manufacturer to begin making revenue and add profitability to its bottom line, a key objective supported by Capital.

# Reducing program risk **through a more digitalized work environment**

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which run in the background when designing electrical systems, catching errors at the design stage) and prepared for manufacture. As one could imagine, having insight into these processes allows users the ability to mitigate program risk levels.

The manufacturing of electrical harnesses is hugely complex and Capital provides solutions to optimize that process so significant efficiency and operational gains can be realized. Following the entry of products into service, customers then need to be able to efficiently service, diagnose and repair electrical systems, and Capital provides solutions to make that process far more efficient than is typically possible without advanced tools.

Capital is built upon a data and process backbone to enable extremely high levels of automation, data coherency and integration. These core tenets have a significant impact on how Capital users can address risk in a digitalized environment.

## CAPITAL CORE TENETS

The first core tenet is **data coherency**. This ensures data is consistent as it flows up and down the different abstractions in the electrical systems development lifecycle. It enables traceability, robust change management and configuration control. Data coherency means all necessary information is passed to team members during the critical stages of the development process.

The second tenet is **open integration** which recognizes many systems – not all provided by Siemens when developing a platform. Capital offers a rich API

# Reducing program risk **through a more digitalized work environment**

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and many out-of-the-box bridges allowing users to integrate with necessary adjacent domains such as mechanical CAD environments. With integration into MCAD environments, users trade information with legacy systems to gain the capability of bringing in more component data.

The final tenet built into Capital is **advanced automation**. This allows users to take routine manual functions and automate them to increase team productivity. It allows an organization to capture and operationally share best practices arising from the learning and expertise of its team members. These practices can then be applied throughout the company or organization. This codified information enables the transition of information to employees supporting ongoing quality goals and reduces the risk normally associated with staff changes.

Through these core tenets, Capital provides the visibility, traceability and change/configuration management that aerospace and defense companies have come to demand.


Capital customers who are adapting to the digital enterprise.

# Reducing program risk **through a more digitalized work environment**

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**WANT MORE?**
**Check out the E/E Systems Development for Aerospace & Defense web page**

**CHECK IT OUT!**

## CONCLUSION

To minimize program risk, aerospace companies are making the transition to a more digitalized work environment. In addition to addressing risk, a digitalized environment adds significant value to the entire development process. Companies such as Pilatus, KAI, Bell and Boeing have shared publicly how their adoption of Capital to design and manufacture their electrical systems has proved beneficial.

In order for an aerospace manufacturer to stay profitable, it's vitally important to reduce program risk across the entire product lifecycle development process and to hit milestones on time. Advanced digitalized solutions available in Capital can help organizations achieve this goal and give aerospace OEMs the confidence they need as they move through the electrical product lifecycle to successful

### WANT MORE?
**Get the complete details**

Read the full white paper "A closer look: next generation electrical system platform development in aerospace and defense" and see how Capital addresses complexity and helps to lower risk in the development of today's electrical A&D platforms.

### DOWNLOAD
**THESE SIX TIPS!**

Discover six ways Capital can improve the E/E platform development process – and learn how to reduce risk, foster new innovation and reach those stubborn program goals.

## STAY IN THE KNOW!

**Follow Capital E/E Systems development environment on LinkedIn to get all the latest information**


# TALKING AEROSPACE TODAY

**THE SIEMENS AEROSPACE AND DEFENSE PODCAST TALKS ABOUT CAPITAL IN FIVE IN-DEPTH EPISODES!**

## PODCAST SERIES: "THE EVOLUTION OF ELECTRICAL DEVELOPMENT IN AEROSPACE"

*Here's your opportunity to catch up on all the Capital electrical system podcasts.* Produced by Siemens, the Talking Aerospace Today series "The Evolution of Electrical Development in Aerospace" addresses the many issues and challenges facing aerospace electrical system design today. Each episode dives into a particular topic design teams face today and discusses how these challenges can be solved with Capital as part of a digitalized environment. Fascinating and cutting-edge material!

*A podcast series with Tony Nicoli, Aerospace & Defense Director of Integrated Electrical Systems at Siemens Digital Industries Software*

**Episode #1: "Introduction - The Evolution of Electrical Design in Aerospace"**
The trends shaping electrical platform development in the ever-evolving aerospace industry. Learn about the rise of the digital enterprise and how Capital is meeting these demands.

**Episode #2: "Design Tools and Practices – Past, Present and into the Future"**
Revisit the tools and methodologies engineers used throughout decades. Get a true understanding on how far the engineering community has come – and where it's going as we move into the future.

**Episode #3: "Change Management and the Digital Thread"**
Understand how to handle change as it relates to requirements and configuration control and how to deal with change orders during certification.

**Episode #4: "Addressing Electrical Design Compliance and Certification"**
With more complexity throughout the industry, the traditional approaches to compliance and certification are no longer adequate. How to achieve compliance and product certification in today's competitive marketplace.

**Episode #5: "Increasing Wire Harness Manufacturing and Profitability"**
Uncover the trends impacting manufacturing today and how a digitalized process offers multiple advantages across the entire platform development lifecycle.

Visit the Talking Aerospace Today website for more discussion on aerospace and defense technologies and challenges. See how the rise in complexity is impacting the A&D industry and what aerospace companies are doing about it.

# As electrification increases – a new approach to compliance is needed

**Two major trends** are shaping the aerospace industry today. The first trend is increasing mission demands which are escalating platform performance requirements. Whether it's further extending the range of a twin engine aircraft, increasing battery hold-up on a large commercial aircraft, or enhancing jet fighter effectiveness, OEMs now demand more mission capabilities.

The second trend relates to new levels of complexity due to increased electrification. More than ever, platform developers are implementing new functionality via electrical solutions. These electrically enabled capabilities include fly-by-wire systems, Electronic Flight Instrumentation Systems (EFIS), In-flight Entertainment (IFE), and Combined Vision Systems (CVS). Many of these electrical approaches are replacing mechanical, pneumatic, and hydraulic implementations of existing functionality – and are becoming commonplace on today's aircraft.

## THE RISE OF THE ELECTRICAL WIRING INTERCONNECT SYSTEM (EWIS)

An implication of the increased use of electrical solutions is the increased size, weight, and complexity of the electrical wiring interconnect system (EWIS). On a typical business jet, for example, it's not uncommon to have over 120 electrical systems. This particular jet's electrical system could easily be composed of 350 harnesses, comprising as many as 30,000 wire segments. This could easily add up to over 50 miles of wire – and over 100,000 parts.

With the increased use of digital communications, EWIS

# As electrification increases – a new approach to compliance is needed

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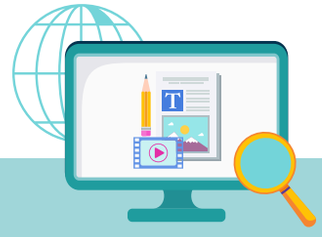
content has moved from simple, point-to-point analog connections to more sophisticated digital network buses. This in turn, can require expensive data cables driving EWIS cost and manufacturing complexity. EWIS complexity is further compounded by a myriad of rules to minimize electrical interference, maintain signal separation for redundant systems, and of course, to ensure compliance and/or commercial certification.

And to complicate matters further, there is now higher compliance risk due to increased complexity of the aircraft platform. To address the many challenges, Capital now offers a compliance tool to assist teams responsible for conducting Electrical Load Analysis (ELA).The goal of this new technology is to simplify aircraft electrical design compliance and certification. This new approach, Capital Load Analyzer, is one of the industry's first electrical systems technologies to leverage automation and digital data continuity to facilitate regulatory compliance.

## OUTDATED METHODS STILL IN USE TODAY

Electrical Load Analysis (ELA) is an important aspect to ensure adequate power for electrical systems during all phases of flight. For the most part, ELA analysis today is done manually using spreadsheet-based tools. Design data is manually transferred into these stand-alone tools, leading to the possibility of incorrectly entered data, not analyzing the most recent design version, and sometimes omitting entire portions of the design in the analysis. With increased electrical complexity the old manual way of doing things no longer suffices because it doesn't scale well for increased complexity. In fact, many of the current methods used today were developed in an era when aircraft electrical systems were far less complicated. The current manual process often results in error-prone data capture and requires an extremely long duration of time to create compliance documents.

Further, the current methods used today often mean compliance issues are found after the major electrical design work has been completed. This not only leads to missed critical milestones, but forces expensive design iterations at a crtitical program phase which could result in serious cost and schedule setbacks for the entire program.



# As electrification increases – a new approach to compliance is needed

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## EMPLOYING THE CAPITAL ELECTRICAL DIGITAL TWIN

The electrical digital twin can be employed to meet load, separation, and derating requirements. The Capitol Load Analyzer compliance tool (Figure 1) draws upon Capital's electrical digital twin to perform accurate and rapid load analysis on the aircraft's electrical system. It predicts power demand for the aircraft's entire electrical system as designed to ensure sufficient power for each phase of operation – even for emergency conditions. This also includes electrical load analysis and design validation along with analyzing every generator, rectifier, battery, and bus for each flight phase.

The Capital Load Analyzer ELA methodology follows traditional ELA guidelines and provides a convenient means to address the following key compliance perspectives:

- Manage the required information for ELA, such as single-line wire diagrams,
- Operation scenarios (all flight phases), analysis notes, etc.
- Perform ELA analysis iterations, ELA reports, and ELA analysis & report iterations
- Show compliance for every configuration as needed

## CAPITAL LOAD ANALYZER USER ADVANTAGES:

- **A single place for all ELA-related information management**
  A key component of the Capitol Load Analyzer tool is the data manager. Instead of engineering teams having to copy and paste the data from the design into a spreadsheet, users can manage all ELA-related data as part of the native design data. Some of this data includes: all devices related to ELA, such

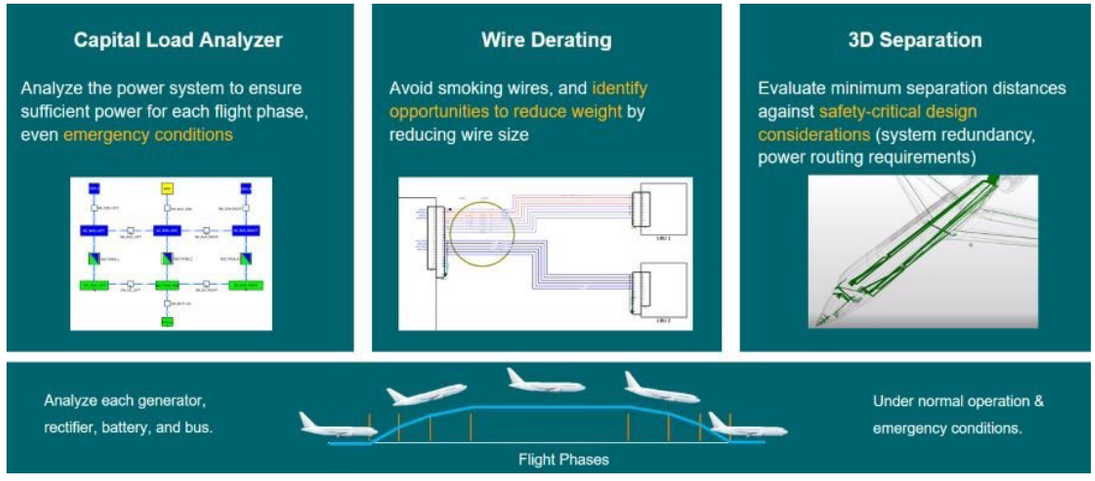


Figure 1: The Capital compliane solution ensures safe electrical design in all flight operations.

# As electrification increases – a new approach to compliance is needed

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as AC/DC sources, AC/DC loads, converters, inverters, and contactors; all design information extracted from related devices, such as power ratings and power factors; all transient load information operation scenarios, engineering notes; and airplane information for the ELA report.

- **Fast creation of the source utilization analysis**
  The analysis results in Capital Load Analyzer are displayed in chart and graph forms. Today, when a user performs an ELA analysis, the analysis results and graphs are manually created, which is an extremely time-consuming process, often fraught with errors. With this capability, charts and graphs can be created immediately and can be inserted into the ELA report, delivering the most up-to-date charts and graphs whenever a report is generated.
- **On-demand analysis of a single-line wire diagram**
  The single-line wire diagram is derived from the underlying product design and is an illustration of the power architecture. Using Capitol Load Analyzer, the creation of the single-line wire diagram is extremely easy to use and is 100 percent in-sync with the underlying design. The styling of the single-line diagram can also be changed to match the user's design preference. The filtered view of the single-line wire diagram also gives the user an architectural view of each individual operation condition. Any component within the single-line wire diagram can be tagged with a certain operation scenario(s) the user specifies. This is particularly useful when evaluating various failure modes and load-shed sequencing.
- **New ways to model the battery**
  The battery onboard the aircraft is a special device. It behaves as a load when there are other power sources feeding into it, and as source device when there are no other sources available. Analyzing a battery manually has been problematic for a lot of platform OEMs. For the purpose of ELA, battery charging has been modeled using a battery charging factor. The battery charging factor is derived from the battery load current chart and can be used to calculate the battery current for each operation scenario and each time interval.
- **Automatic and comprehensive analysis and reporting – in real time**
  ELA engineers spend a vast majority of their time manually creating and maintaining an ELA report. Since

# As electrification increases – a new approach to compliance is needed

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this is primarily a manual process, the report does not always synchronize with the design changes as they occur – and thus, the report quickly becomes outdated by the time the product design is finished. Capital Load Analyzer automatically extracts all electrical load analysis data into the user's own reporting template for easy and efficient report generation. This technology pulls directly from the electrical digital twin so the user can see the impact of design changes at any time and at any stage of the design process. The ability to quickly generate real-time reports enables users to monitor design tasks and identify potential issues early in the design process, thereby mitigating program risk.

## CONCLUSION

By applying a more modern method to meet the challenges of program compliance – and to address the rising use of electrification – teams can more effectively mitigate program risks. An automated, template-based report generation mechanism not only allows teams to reuse the ELA report template across the organization, but enables users to create the ELA report with the most updated design data using the electrical digital twin. With this approach, users are able to generate a report and send it across multiple teams, or locations, in real time, so the entire design team can act accordingly and ensure that all aspects of the design are consistent and in doing so, users can more rapidly demonstrate compliance and meet all regulatory requirements.

**CLICK HERE**
**For industry white paper**
Download and read the white paper "Electrical wiring interconnection system risk (EWIS) assessment tools buy-down compliance risk in aerospace" and learn how teams are effectively lowering program risks for electrical compliance.

**Electrical compliance made easy!**
Stay in the know on electrical compliance topics. Siemens has devoted an entire website to electrical compliance challenges design teams face today. Visit the website now.


*Have you heard?* As if the industry isn't facing enough challenge there are now generations of older workers leaving the front lines of aerospace electrical system development. These workers leave with a wealth of institutional knowledge learned over the decades. How are the workers leaving the company supposed to share this knowledge with those just beginning their careers? It's a tricky situation. The digitalization of data might have some answers. Learn more on this highly unusual topic.

**WATCH THE VIDEO!**

**READ THE BLOG!**

# Capital in the age of **digital transformation**

**The move towards** a digital transformation is critical to the growth and innovation of the industry.

As companies seek to develop new products faster and better manage their costs, they need to manage risks. They also need to develop higher performing products. With all the innovation going on, including the amount of electrification in new products, the transition to a more digitalized enterprise should be a top consideration for aerospace companies both large and small. The transition must also include the industry's diverse and expansive supply chains.

To help advance the digital transformation, the Xcelerator portfolio from Siemens Digital Industries Software offers one of the industry's most comprehensive digital twin solutions and connected digital threads. A digital twin allows companies to design, validate and build in a virtualized environment. Digital threads enable multiple processes across domains to integrate data from the beginning of the product lifecycle to final sustainment.

A fully operable digital enterprise offers a richer understanding of products, reduced risk and faster implementation. In addition, companies and organizations that adopt a digital twin and digital thread are finding they can use digitalization as a competitive advantage (Figure 1).

## INTEGRATION AND COLLABORATION ACROSS DISCIPLINES

No question there is immense pressure on aircraft design teams to move quickly and hit program milestones. Without proper communication between the

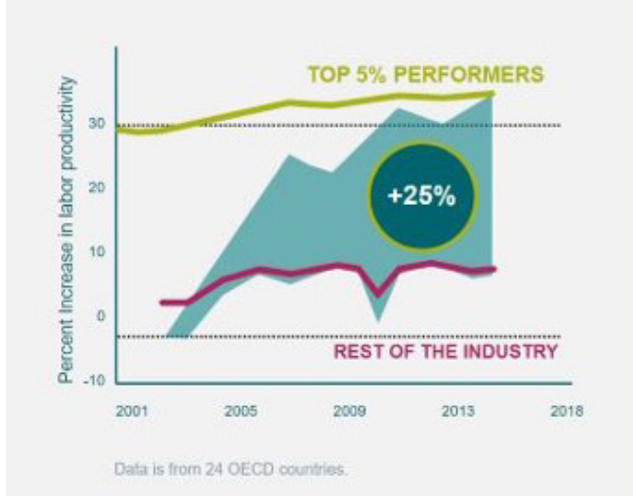


Figure 1. The A&D industry is still early to digitalization of operations and there is still a lot of territory in which to grow and become more profitable.

# Capital in the age of **digital transformation**

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electrical and mechanical domains, any change made can inadvertently introduce electrical wire interconnect systems (EWIS) violations into the design. If these changes go undetected until critical design review, the manufacturer will need weeks, or even months, to re-design, re-verify, re-release, and retrofit each plane under construction.

Therefore, facilitating collaboration between the electrical and mechanical engineering domains is a crucial strategy moving forward. The optimal strategy is to use a process that allows for the incremental and digital exchange of ECAD/MCAD design data throughout the design process. Incremental data exchange ensures that the relevant multi-disciplinary features in the ECAD/MCAD platform representations are synchronized at each point in the design. This continual synchronization creates a steady line of communication between the electrical and mechanical engineers, increasing productivity and reducing design errors.

Previous efforts of collaboration between these two disciplines have met with limited success. In the past, teams resorted to internally developed software and processes for collaboration that they had to test and verify with each new release of the underlying ECAD and MCAD tool suites. These locally developed software and processes were costly to maintain and required dedicated in-house support.

## INTEGRATION BETWEEN ECAD AND MCAD DISCIPLINES

Modern electrical (Capital) and mechanical engineering (NX) solutions, which are part of the Siemens Xcelerator portfolio, have been integrated at a much deeper level for unprecedented levels of collaboration. Capital and NX support API level integration which connects these two domains so when any new change or information is added, both domains are quickly updated. Engineers no longer swap files. Integration is made in real-time, automatically – at the data level.

With this type of integration, the design of the electrical system and wiring harness takes place with explicit knowledge of the other domain. For example, when looking at hazardous areas, such as severe weather and moisture-prone areas, the ECAD designer can take into account the impact of the electrical performance when designing the electrical system.

On the mechanical side, space reservations can be made and the severity of bends in the harness can be adjusted to account for the wiring bundles that must route through the mechanical structures. With access to this contextual information from other domains, both electrical and mechanical engineers can quickly reconcile incompatibilities between the ECAD and MCAD designs (Figure 2).

Modern electrical systems engineering capabilities found in Capital can also automatically integrate design changes from multiple domains with a high degree of control by the

# Capital in the age of **digital transformation**

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engineer. Engineers can review changes individually, using live cross-probing between electrical and mechanical tools, and accept or reject each change individually (also shown in Figure 2). Electrical engineers can also preview the result of a set of changes in a 3D, orthogonal, or unfolding flattened diagram.

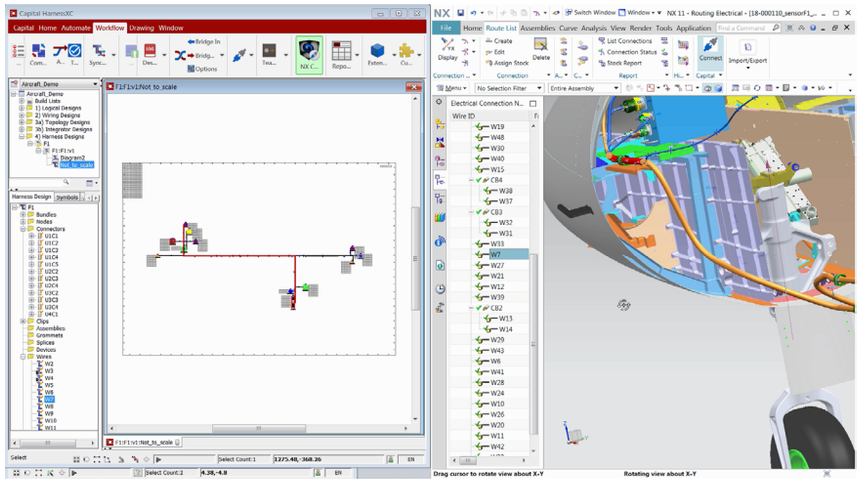

Figure 2: The integration between Capital and NX environments.

collaborate more effectively on critical design items, thereby ensuring proper implementation of design intent.

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 co-design, 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.

Furthermore, ownership over data is determined in a granular fashion so that the change policy can be tailored to individual design flows. The pieces available for selection are highly detailed, such that rules may be set for specific attributes of individual components.

Technological advancements and new market demands have contributed to the exponential rise in the complexity of aircraft designs over the last decade. ECAD/MCAD automated co-design leads to increased productivity while ensuring a robust design while reducing the cost of the final product. Aerospace mechanical and electrical designers are able to synchronize their data more efficiently and

## INTEGRATION BETWEEN WIRE HARNESS DESIGN AND MANUFACTURING

Siemens digital thread technology not only integrates different domains as explained in the ECAD/MCAD example, but also links and strengthens processes within a defined

# Capital in the age of **digital transformation**

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discipline for real-time sharing of data with increased levels of visibility and traceability.

Whether an aerospace manufacturer or independent supplier, aerospace harness manufacturing teams operate under a great deal of stress. They find their business suffering from profitability constraints on all sides; from increased harness complexity driven by more electric platforms, to the need to rapidly transition design changes into production, to serving demanding customers who expect ever lower cost assemblies delivered just-in-time, while they threaten to further vertically integrate into harness manufacture.

Meanwhile, platform designers are changing their electrical systems, and consequently, harnesses more frequently need to respond to the changing demands of their customers. They expect their harness suppliers to keep up, transitioning these changes into production quickly and with a minimum of cost and schedule impact. All this results in a new harness manufacturing reality: more harness variants, produced in more frequent, shorter duration production runs and in smaller quantities.

With the combined need for multiple and shorter-duration production runs with increased EWIS, individual harness complexity is increased, which results is an extremely challenging environment to achieve profitability.

Typically, a harness manufacturer will develop a detailed plan to ramp production of a new harness (Figure 3). Harness manufacturers will carefully execute this plan, targeting 80 percent 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.

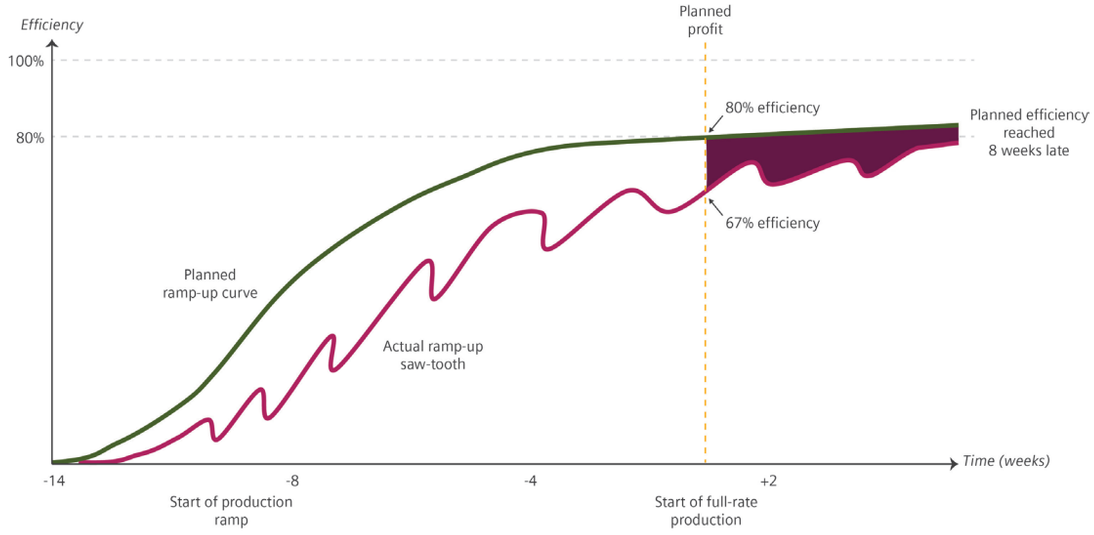


Figure 3. Traditional "planned" production ramp versus typical "actual" ramp.

# Capital in the age of **digital transformation**

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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 percent operating efficiency.

By the time it takes to reach the 80 percent target, teams lose money on every harness built. By the time teams recover, they have often lost enough money to consume the entire predicted profit for that specific run.

Capital addresses this challenge by connecting harness product and process engineering to the electrical system's digital twin. The tools and processes that comprise this domain represent an advanced solution unto themselves. Direct access to the electrical system digital twin enables an automated harness manufacturing engineering flow that requires no manual data reentry. Consequently, generating important manufacturing aids, tooling and even cost estimates can be done quickly and accurately, the first time. The flow ranges from harness design to work instruction generation. It encompasses product engineering, including product cost optimization, form board design, assembly and sub-assembly design, manufacturing process design, optimization and documentation.

This capability allows harness manufacturers to meet expectations for responsiveness, quality, delivery time and profitability. In fact, many harness manufacturers using Capital now welcome change requests from their customers, seeing it as a source of competitive differentiation, rather than an onerous burden.

**GET ALL THE DETAILS**

Read the industry white paper "Applying ECAD/MCAD integration to reduce program risk" and see how aerospace mechanical and electrical designers are able to synchronize their data more efficiently and collaborate more effectively..

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Siemens Digital Industries Software is driving transformation to enable a digital enterprise where engineering, manufacturing and electronics design meet tomorrow. The Xcelerator™ portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, helps companies of all sizes create and leverage a comprehensive digital twin that provides organizations with new insights, opportunities and levels of automation to drive innovation. For more information on Siemens Digital Industries Software products and services, visit siemens.com/software or follow us on LinkedIn, Twitter, Facebook and Instagram. Siemens Digital Industries Software – Where today meets tomorrow.

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