

A Matter of Trust

Reducing Program Risk with Dependable Solutions for Tomorrow's Battlefield

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Leveraging Trust as a Tactical Advantage

The tactical advantage on the battlefield of the future will be based on trust.

From advanced sensors on autonomous and semi-autonomous air, ground, and sea platforms to cloud-based communications networks, and right down to the electromechanical systems that control everything from turret aiming to helicopter landing, soldiers and commanders will be working with more complex equipment. To be effective on the battlefield, personnel will need a higher level of trust that all systems will work as needed in any situation.

Ultimately, mission success will depend on every module, subsystem, and system on every platform performing exactly as designed under the harshest conditions, while ensuring that critical data is secure and protected. Data acquisition and management, signal processing, mission computing, communications, networking, and equipment handling and stabilization must all be rugged, reliable, robust, and ready for any situation. If soldiers and commanders can't trust the tools they have been given to work with, they will abandon them. If they do, all tactical advantages provided by the blending of advanced digital and electromechanical technologies for modern warfare will be lost.

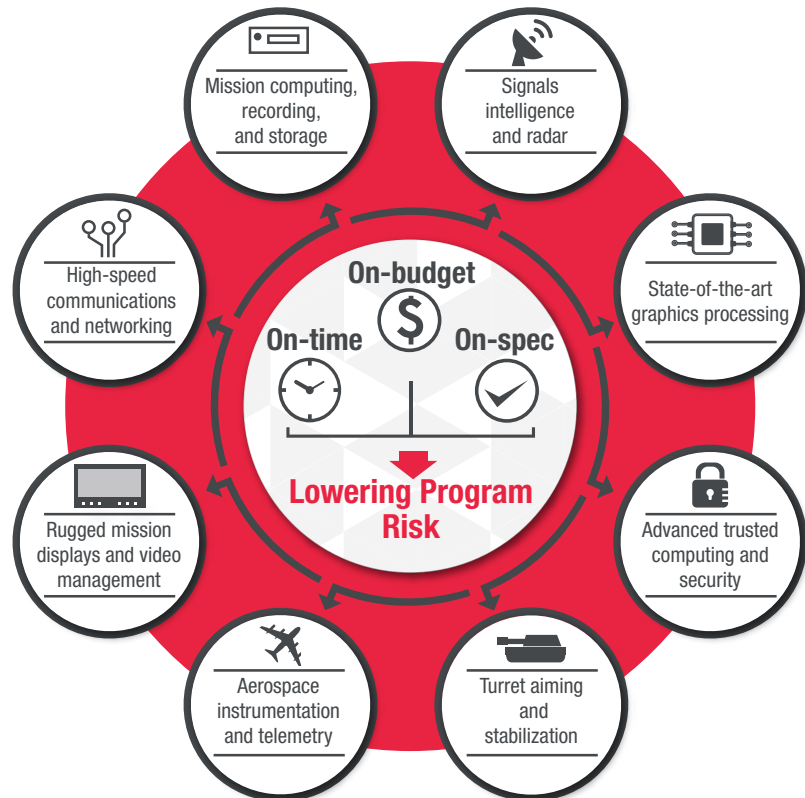


Figure 1: Delivering on-time, on-budget, and on-spec Curtiss-Wright provides comprehensive, rugged and secure mission-critical solutions

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This single, overriding consideration will continue to increase in importance as defense organizations worldwide work to leverage new technologies that will provide warfighters with an indisputable advantage on the battlefield. The technologies themselves and the point solutions they enable — the individual electronic and electromechanical Line Replaceable Units (LRUs) — will no longer be enough. How those technologies and point solutions are developed — their path to deployment — and how they are integrated to work together will be key to creating a higher degree of dependability in every system and solution. This is especially true given the continuing commoditization of hardware based on the adaptation of the latest and greatest commercial-grade components.

To create a higher level of trust in the tools warfighters use, developers and system integrators must focus on simplifying the relationship between warfighter and machine and making every system and solution:

- **Smaller** by getting more technology, capabilities, and power into space-constrained environments and providing higher levels of functional density with less weight
- **Stronger** by reducing potential vulnerabilities — environmental, cybersecurity, anti-tamper, denied GPS, etc. — on the battlefield and at every step in the development and deployment process
- **Smarter** by optimizing everything from power management and computing power to data management and human machine teaming
- **Faster** by increasing the capabilities of sensors and systems to respond to threats in real time and streamlining the interface between human and machine

To achieve these objectives, developers and system integrators will be looking at leveraging a variety of technologies, including advanced cybersecurity technologies, resilient networks, and information systems, as well as advanced autonomous systems, Artificial Intelligence (AI), and machine learning systems.

But success will not be achieved simply by selecting and applying the right technologies. The key will be to reduce program risk by finding the right balance between the advanced technology, program requirements, cost, and all the other attributes that must be considered to deliver solutions on time, on spec, and on budget. This can only be achieved by developers and system integrators with a holistic view of how all the individual subsystems, systems, elements, and networks must work together with warfighters to achieve

operating objectives. With a holistic view, the right balance can be achieved at every step of the development and deployment process to reduce program risk and create the level of trust needed to give soldiers and commanders a tactical advantage on the battlefield of the future.

Three Trends Affecting the Delivery of Trusted Solutions

Recent reports forecast that the global electronic warfare market, which was estimated at \$24.2 billion in 2017, is expected to grow at a Compound Annual Growth Rate (CAGR) of 4.61 percent and reach \$30.32 billion by 2022.¹ An increase in expenditures by defense organizations worldwide and more research and development in advanced electronic warfare products are expected to fuel this growth. But the development and delivery of trusted solutions that will capitalize on this market potential will be affected by three key trends.

Changing Warfighter Expectations

To some extent, which advanced technologies will be introduced onto the battlefield will be influenced by the fact that warfighter expectations have changed.

Today's warfighters are digital natives. They were virtually born with a digital device in their hands. From smartphones and social networking to advanced gaming and virtual reality, these warfighters expect and depend on reliable technologies to support their every action. As a result, they expect the same ease of use and instant access to information with the warfighting tools at their fingertips.

At the same time, the commercial technology these warfighters are exposed to in their personal lives is evolving at a pace never seen before and affecting their everyday routines in profound ways. Advances in artificial intelligence, autonomy, and robotics are being announced daily. From virtual assistants that enable effortless navigation through a plethora of information to fully autonomous transportation and delivery systems, advanced consumer products are creating new expectations for how technology should be used to make routine tasks effortless.

To meet expectations, developers and integrators of the next generation of defense solutions will continue to adapt commercial technologies for use on the battlefield. But introducing these advanced technologies and capabilities into defense systems requires an intimate knowledge of the

technologies themselves and how they can best be adapted to provide a higher level of dependability, beyond what is needed for commercial use.

Changing Customer Capabilities

Meanwhile, although defense procurement budgets have increased, the reality is that, from a capabilities perspective, defense organizations and system integrators now need to do more with less. This is making it difficult to deliver all the advanced tools that digital warfighters expect and that defense organizations need.

For a long time, defense organizations and system integrators relied on in-house expertise in key technology domains to engineer, develop, and deliver fully integrated solutions to warfighters. Typically, in-house teams had the knowledge to build a system from the ground up and brought in suppliers to provide support in specific areas. But over the past twenty years, these organizations have streamlined their operations to focus on defining system requirements and managing system integration. In many cases, expertise in key technology domains is limited.

The situation is exacerbated by the speed at which technology is changing, requirements are evolving, and the compressed development schedules under which solutions have to be delivered. Sometimes, because of development schedules, technology evolution outstrips development so that by the time a system is ready for deployment the definition of the most-advanced technology has moved.

In this environment, the role of the external supplier has evolved. It is no longer enough to simply provide on-spec point solutions. Suppliers must now go beyond the specifications sheet and work as a trusted partner in the development process. A partner who can deliver value by providing trusted insights and expertise in the multiple domains needed to achieve program objectives today and in the future.

Commoditization of Advanced Technology

The insights and expertise needed from a trusted partner go beyond selecting and applying the right technology. In many cases, the technology and its application have been commoditized to the point that it is hard to differentiate one supplier's LRU from another's.

For example, advances in System on Chip (SoC) design have, to some extent, simplified the development and delivery of single board computers. Ten years ago, multiple processors,

bridges, interfaces, and memory devices were needed to achieve the required functionality, and only a few suppliers had the expertise to integrate all the components properly. Today, a single SoC can be used to deliver the same functionality. The SoCs are now commodities, and the engineering expertise that was originally needed to make all the standalone components work together in the past is no longer a concern.

As a result, defense organizations and system integrators have to look beyond the component to determine the true value a trusted partner can bring to a program. Since the application of technology has been commoditized, the real concern is the oversight the partner can provide on everything that goes into delivering the technology to the battlefield, protecting it when it is there, and securing the information — the data — that it relies on at all times.

Creating Dependable, Trusted Solutions

To address evolving technology requirements in this changing industry environment, the needs of warfighters can no longer be addressed by point solutions. The suppliers that defense organizations and system integrators partner with must understand how all the disparate technologies, components, and systems on a battlefield should work together to deliver capabilities that can be trusted to meet expectations. They must also be able to leverage that understanding to deliver solutions that are smaller, stronger, smarter, and faster. This can only be achieved by trusted solution providers that have the expertise and experience to provide a holistic view of requirements and the application of technologies for defense systems.

From a practical point of view, it's no longer enough for a supplier to be an expert in one specific technology; system and application knowledge is needed. Technology partners for all products, systems, and solutions must have expertise in the platform and the environment in which the system will be deployed, as well as all of the areas that may affect a system's operation. So, whether it's a helicopter lift on a carrier, a turret stabilization system on a tank, or a mission computer with multiple technologies, including multiple core processors, understanding what the lift, turret, and the mission computer are needed for and how to optimize the integrated technology that enables them is where the real value lies.

Ultimately, with a holistic view a trusted partner should be able to help customers reduce development and integration risks

by providing access to advanced technologies and solutions faster. To do this, the partner must anticipate customer needs, identify technology requirements, and invest in innovations and capabilities in the areas that will address projected needs. This will help the customer reduce program risk by ensuring any solution that is proposed strikes the right balance between:

- What the customer needs
- What's commercially available in terms of products, components, or modules that can address those requirements
- How best to deliver on those requirements at a cost-effective price point

Modular solutions based on open standards will be the key to meeting customer expectations.

Solution Requirements

A trusted partner must be focused on creating modular technology innovations that are designed and packaged to:

- Meet rugged environmental and usage requirements
- Ensure safe operation
- Eliminate vulnerabilities to adversarial access or attack
- Provide reliable, error-free operation throughout its useful life
- Be readily available over an extended lifespan

Ruggedization

A trusted partner will provide true innovation through the ruggedization and packaging of the technology so that warfighters can depend on it to operate while exposed to extreme environmental conditions. This requires suppliers to integrate ruggedization techniques at key points in the development process.

For example, at the design stage, Physics of Failure (PoF) modeling should be used to provide insights into potential root causes of failure, such as fatigue, fracture, wear, and corrosion. Likewise, it's not enough to choose leaded or lead-free soldering. Since the majority of modern electronic components only come with lead-free solder terminations, true ruggedization should be achieved by choosing the right solder assembly process for each component based on where it will be used:

- Solder/assembly with lead-free
- Re-terminating components with tin-lead and solder/assembly with tin-lead
- A mixed solder approach that uses lead-free terminations with tin-lead solder

Safe Operation

Beyond ruggedization, the components, modules, and systems should be packaged to ensure safe and secure operation. A trusted partner will address this requirement by integrating safety plans and concepts into the design and development process for all electrical, mechanical, and software elements.

For example, for ground platforms, system offerings should include detailed documentation about reliability calculations, maintenance requirements, and safety considerations for the system over its lifetime. This information gives system integrators important insights into the frequency at which parts need to be replaced based on mission profiles, environmental conditions, and length of time in the field.

Likewise, for air platforms, a trusted partner will deliver safety-certifiable Commercial Off-The-Shelf (COTS) Airborne Electronics Hardware (AEH) that allows system integrators to jump-start development efforts for avionics systems. Safety-certifiable AEH components are already developed and tested to DO-254 and DO-160 standards. There is no question that certification is achievable. The certification audits have already been completed and the documents required for certification are provided with the hardware. This eliminates the considerable risks associated with the mammoth effort that is required to develop and document certifiable AEH and pass certification audits. Readily available, safety-certifiable hardware also accelerates system prototyping efforts, which further reduces program risks.

Security

The technology solution must also be designed and packaged to eliminate vulnerabilities to adversarial access or attack, both physical and cyber. A trusted partner will address this requirement by developing and delivering solutions that leverage innovative:

- **Anti-tamper** mechanisms and methodologies that protect against physical attacks.
- **Cybersecurity** measures that protect against remote attacks.

- **Reliability** initiatives that are designed to prevent hardware and software failures.

The protection capabilities delivered should be based on state-of-the-art technologies, techniques, and processes:

- **Core protection capabilities** such as secure boot techniques, cryptography, and protection for data at rest.
- **Key management** that focuses on designing the life cycle of cryptographic keys used in a system from generation, storage, and use through destruction.
- **Safety-critical processes** that ensure that COTS hardware is designed and developed in a way that results in a safety-certifiable product with the supporting artifact packages.
- **Supply chain and manufacturing integrity** that ensures parts and software provided by other vendors do not introduce vulnerabilities into the system.

Reliability

Rugged, safe, and secure systems must also be reliable. Therefore, any technology-based component, module, or system should be thoroughly tested to ensure reliable, error-free operation throughout its useful life. A trusted partner will address this requirement by defining the projected useful life of the product and the conditions under which it is expected to operate without exceeding acceptable failure levels. With a deeper understanding of reliability requirements, the partner

should be able to go beyond traditional metrics like Mean Time Between Failures (MTBF) by leveraging PoF modeling techniques to clearly define the reliability of its product.

As with ruggedization, reliability calculations, processes, and mitigation techniques should be applied to all aspects of the product to ensure longevity in the field. For example, this may include choosing the right solder assembly process, applying RAD tolerance and fault tolerance techniques, or specific packaging and ruggedization processes that have been proven to improve reliability over an extended period of time.

Availability

The technology, and the products it is applied in, must also be available over the life cycle of the system. This is an important consideration, given that most deployed systems are expected to continue to operate as intended for an extended life of 20 to 25 years, while the pace of technological change can often make today's state of the art seem obsolete in a few short years. Therefore, a trusted partner must be able to ensure availability through the design and development process, which can often take a year or two, and engineer the components to enable upgrades and enhancements as needed.

For example, the availability of COTS products should be ensured based on a complete program life cycle predictability chart that maps availability requirements from the design and development phase through to deployment (Figure 2).

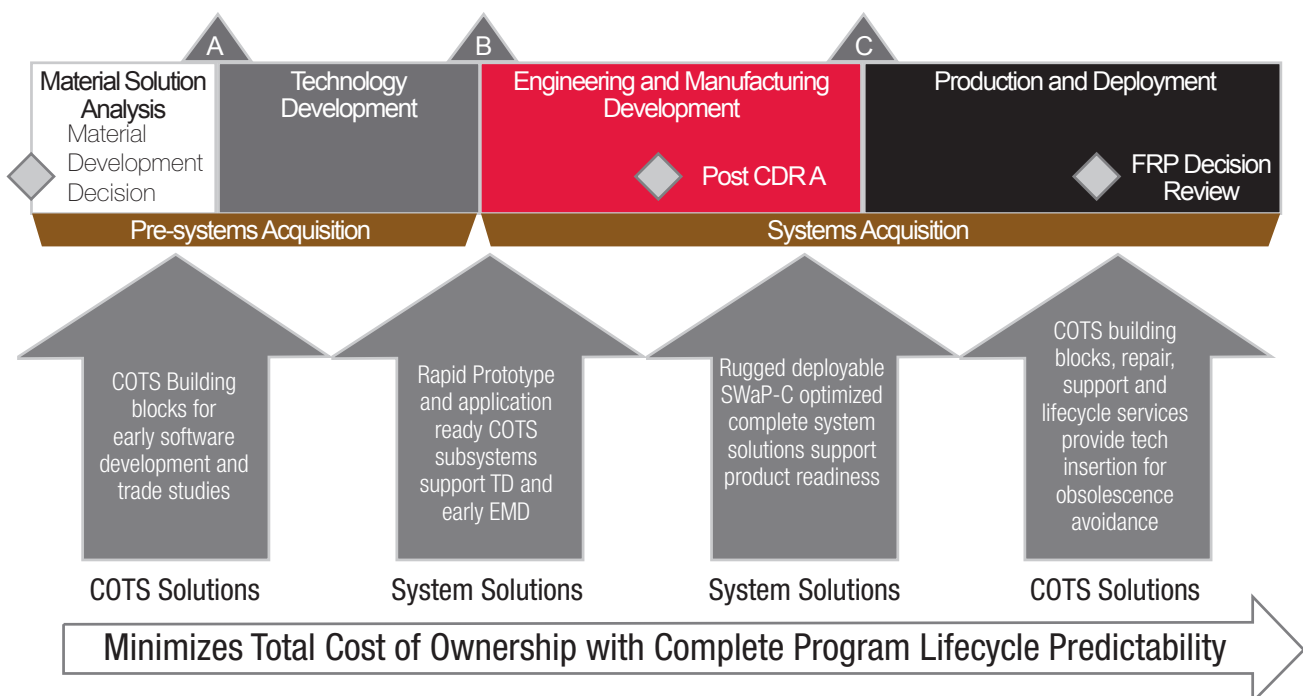


Figure 2: Lifecycle predictability map for COTS products

The top of the chart represents a typical defense program life cycle. When a program starts, the latest technology is available for early analysis and development. This is because COTS products follow a roadmap approach that sees new technology being introduced regularly (yearly or every couple of years). Since the defense COTS electronics industry follows standards that support a Modular Open System Approach (MOSA), the technology is available from multiple sources and products are readily available and interoperable across multiple suppliers.

As the defense program progresses through development and manufacturing, the COTS-based standards form the basis for the system's electronics architecture and specific solutions are developed based on the availability of current technology. Since there could have been years between the evaluation phase and the manufacturing phase, the latest technology may be instantiated in one or two generations of COTS product evolution. Then as the system is produced and deployed, Total Life Cycle Management (TLCM) services ensure the availability of product through longevity of supply and longevity of repair services. At the same time, the MOSA enables technology insertions of the latest COTS technology to keep the system current.

Curtiss-Wright Defense Solutions Is a Trusted Solution Partner

The chain of trust that defense organizations will need to establish a tactical advantage on the battlefield of the future can only be provided by suppliers with a holistic view of how all the individual subsystems, systems, elements, and networks must work together with warfighters to achieve operating objectives. That holistic view must include an understanding of supply chains, testing procedures, manufacturing, program management commitments, and so much more that are key links in the development, delivery, and integration of solutions that are on-time, on-spec, and on-budget.

Curtiss-Wright Defense Solutions provides that holistic view and is the trusted, proven leader for comprehensive, rugged, mission-critical solutions. From innovative COTS modules to highly engineered subsystems and fully integrated systems, we provide the technology insights, engineering innovation, application experience, and regulatory knowledge trusted by defense departments, commercial avionics companies, and systems integrators worldwide.

For more than 80 years, we have taken the lead in defining and developing innovative technology solutions and open system standards that creatively integrate hardware and software to meet the most demanding rugged defense and aerospace requirements. Our focus on quality and reliability has enabled us to significantly reduce program risk for thousands of customers and countless programs. While our technology innovations have been applied to hundreds of platforms worldwide.

Today, we stay ahead of current technology with tomorrow's ideas about ruggedization, reliability, data security, and safety. As a result, our customers rely on us to deliver trusted solutions that provide the rugged performance, reliability, improved safety, and data security needed for any mission, anywhere, and at any time. We continue to innovate by finding new ways to make our products and solutions smaller, stronger, smarter, and faster. And we deliver on expectations by staying focused on:

- Delivering proven, highly engineered and manufactured technology solutions
- Leading innovations in ruggedization, reliability, safety, and security
- Reducing program risk and improving mission success by leveraging our experience and expertise in a variety of technology, product, system, and solution areas

Proven, Highly Engineered and Manufactured Technology Solutions

With development, assembly, and manufacturing centers of excellence around the world, we provide trusted technology solutions based on best commercial practices and exacting quality standards. We have invested hundreds of millions of dollars in advanced manufacturing and engineering facilities and equipment to ensure we deliver solutions with the highest quality and reliability for any platform.

Based on decades of experience contributing to the success of programs and platforms worldwide, our engineering and development teams have the expertise to address a variety of size, weight, and power (SWaP) considerations, while improving safety and ensuring the security of data for any mission. We also offer comprehensive approaches for mitigating obsolescence, blocking the use of counterfeit parts, and developing product roadmaps to ease the integration of future generations of technologies.

Leading Innovations in Ruggedization, Reliability, Safety, and Security

All our products and solutions are ruggedized to withstand the extremes of temperature, shock, vibration, and environmental hazards based on ruggedization processes built on decades of research and development we have conducted into:

- Advanced packaging techniques
- Materials technology
- Cooling techniques
- Signal integrity

As a result, our customers get the most innovative, reliable, high-performance, and feature-rich products available for rugged applications.

All our products are based on open standards, rigorous design methodologies, and disciplined product development that ensure reliability, reduce program risk, and get products to market faster.

To ensure the security of data, we go beyond simply adding cybersecurity and encryption features. We apply rigorous supply chain processes that protect the integrity of all components on every module, system, and subsystem.

We ensure our products are designed with safety in mind and conform to a variety of standards and regulations for ground, air, and sea platforms. Our hands-on experience with platforms and programs worldwide has allowed us to develop hardware and software with reusable design artifacts that meet unique requirements, reduce certification risks and project costs, and accelerate time to market for everything from embedded computing to turret stabilization.

Most importantly, we maintain our eye on the future by leading and working collaboratively with defense and aerospace industry standards bodies to develop the next generation of standards for rugged defense and aerospace modules, subsystems, and systems.

Experience and Expertise That Reduces Program Risk and Improves Mission Success

Our focus on quality and innovation is built on decades of experience and expertise delivering COTS modules, highly engineered subsystems, and fully integrated systems that are used worldwide in defense, commercial, and industrial applications. We produce ITAR and ITAR-free products and solutions for the U.S. and global defense markets. From commercial aerospace and public safety aviation applications to rugged defense platforms, we provide reliable solutions for the harshest environments and back them with extended support programs that ensure optimal performance for decades.

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Conclusion

The significant depth and breadth of our technology expertise, solution portfolio, and industry-leading innovations across a diverse range of platforms and applications have been proven to reduce program risk by enabling delivery of projects on time, on spec, and on budget. As a result, customers around the world recognize us as the largest vendor of COTS products worldwide, and the trusted, proven leader for comprehensive, rugged, mission-critical solutions built from the ground up to deliver optimal, reliable performance at sea, on the ground, in the air, or in space.

Learn more

Blog: [Leaders in Innovation since 1903](#)

Learn more: [Curtiss-Wright Defense Solutions](#)

References

1. [Electronic Warfare Market: Global Forecast Until 2022, MarketsandMarkets, March 2018](#)