

Integrity Accelerates Innovation of Software Intensive Aerospace & Defense Products

Innovation Drives Success

Rapid innovation and high quality are the hallmarks of market leading organizations and drive corporate revenue growth & increased profitability. Commercial customers worldwide and governments, including the US and its partners and allies, require ever decreasing product development lifecycle time and costs along with rapidly increasing functionality and reusability. Integrity enables significant and measurable improvement in the management of the system and software engineering lifecycle, allowing companies to achieve increasing levels of customer and shareholder value by reaching their business goals:



| Business Goal | Business Benefits | Examples |
|--|---|---|
| Accelerate product innovation | <ul style="list-style-type: none"> Market differentiation & increased market share | <ul style="list-style-type: none"> Innovation is critical to success in building highly complex vehicles, ships, & aircraft. |
| Diversify product offerings | <ul style="list-style-type: none"> Develop new markets & opportunities Improve armed forces performance & safety | <ul style="list-style-type: none"> The F35 Joint Strike Fighter is a single aircraft development program delivering 3 major variants, CTOL, CV, and STOVL, to meet the needs of the US Air Force, Navy, and Marine Corps, as well as the UK Royal Air Force and Navy. |
| Engineer & deliver high quality products | <ul style="list-style-type: none"> Lower costs, improve quality, and reduce cycle times | <ul style="list-style-type: none"> Our armed forces increasingly rely on highly complex technology as a force multiplier, enabling the use of far fewer personnel to meet our security needs. This strategy is driving a rapid increase in dependence on the quality and reliability of supporting technologies. |
| Improve supply chain collaboration | <ul style="list-style-type: none"> Reduce cost, time, and risk associated with compliance | <ul style="list-style-type: none"> Today, government agencies, prime contractors, and sub contractors must collaborate with much greater transparency and agility, exchanging requirements, models, changes, defects, test results, and other lifecycle artifacts with greater frequency and efficiency. |

| | | |
|--|--|---|
| Streamline regulatory compliance | <ul style="list-style-type: none"> • Improve customer and market confidence Improve company profitability | <ul style="list-style-type: none"> • Compliance requirements are increasingly complex and stringent, leading to rapid growth in cost of implementation and validation; The process must be streamlined. |
| Improve product release predictability | <ul style="list-style-type: none"> • Improve customer and market confidence | <ul style="list-style-type: none"> • Release and delivery schedules are increasingly demanding, with cost of missed schedules a significant and growing factor in reduced profitability for companies delivering aviation and defense products. Costs associated with delivery schedule slips can now include a myriad of adverse impacts from negative public perception in addition to contractual penalties and loss of future contracts. |
| Reduce product lifecycle costs | <ul style="list-style-type: none"> • Improve company profitability | <ul style="list-style-type: none"> • Software-intensive projects still frequently overrun budget and schedule by a factor of 2, while often delivering only 60% of the expected functionality (Forrester). At the same time, the negative impact of overruns and reduced or compromised functionality has increased dramatically. |

Software is Innovation

Embedded software is critical to aerospace and defense companies striving to achieve these ambitious business goals. Software has become the key to accelerating innovation and lowering overall engineering, manufacturing, and service costs. The shift from implementing differentiating product capabilities in hardware to software is enabling fundamental improvements in the aerospace and defense sector, including:

- Shorter product development cycles
- Dramatically increased product capabilities
- Significant product variants based on a single hardware platform
- Late-cycle enhancements and defect repairs at much lower implementation cost
- Lower maintenance costs from decreasing variants in hardware line-replaceable units (LRUs)
- Increased product longevity as enhancements and defect repairs are less costly to manufacture and deploy

Software Adds Complexity

As it fuels innovation, software also increases complexity during development. In many war ships and military aircraft, the number of software-lines-of-code is growing exponentially. The cost of avionics in the F-35 is estimated at 60% of overall development cost. In fact, there are several software-driven challenges that must be solved or they will impede progress to business goals:

| Challenge | Challenge Description (Symptoms) | Impetus (Root Causes) | Impact Summary (Prognosis) |
|--------------------------------------|--|---|--|
| Engineering Change Velocity | Teams are overwhelmed with the huge volume of change across engineering artifacts and disciplines | The volume and velocity of engineering change driven from software is 10 to 100 times more than from hardware | <ul style="list-style-type: none"> Engineers spending more time doing manual housekeeping than innovating Late cycle rework |
| Product Variation | A growing number of product variations makes it difficult to manage requirements, change, defects, and reuse across product lines & variants | Software allows organizations to create market and customer specific versions of products to capture additional markets | <ul style="list-style-type: none"> Defects propagate across product lines and variants Reuse is manual and limited |
| Stringent Compliance | Compliance standards are getting more stringent and time consuming | Many industries including aerospace face significant overhead in complying with regulations and standards. Functional safety standards are particularly challenging for software intensive systems | <ul style="list-style-type: none"> Manual compliance traceability and reporting adds time, complexity, and error to development cycles Exceptions and issues create significant risk of expensive product recalls and contract penalties |
| Engineering Collaboration | Engineering disciplines must work together, collaborating earlier in the product lifecycle | System and hardware engineers must collaborate with software engineers throughout the entire design cycle since software has moved from a low-complexity part on the bill of materials to a key driver of development | <ul style="list-style-type: none"> Development cycles are lengthened due to uncoordinated and inefficient interaction between software and hardware |
| Technology Supply Chain Coordination | Customers, manufacturers and suppliers must communicate and coordinate in near real-time | The supply chain has become a key source of differentiating technology where systems and software requirements and design must be shared and communicated early in the lifecycle | <ul style="list-style-type: none"> Manual exchange of requirements leads to costly errors and inefficiencies |

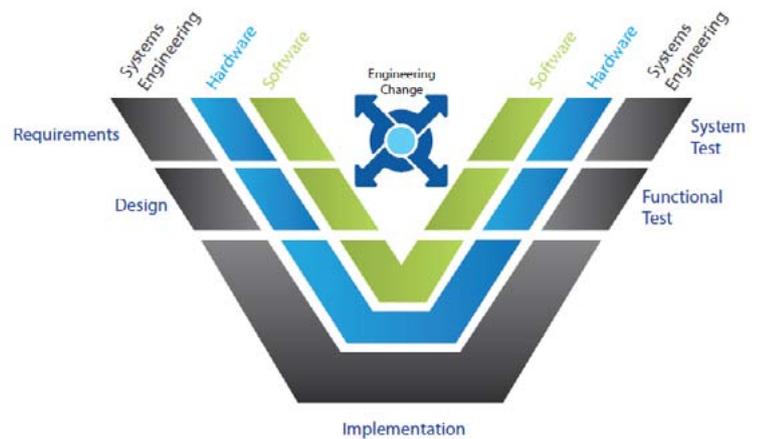
| | | | |
|------------------------------|---|---|--|
| Release Readiness Visibility | Management and executives are struggling with visibility into the state of product release readiness | System and hardware measures are inadequate for software. | <ul style="list-style-type: none"> Sub-optimal decisions are made without timely and accurate metrics, leading to cost and schedule overruns |
| Product Quality | Product quality and safety issues are very difficult to diagnose as electrical, electronic, and software components grow in complexity and become more interconnected | As system complexity increases, driven significantly by software, the process of identifying failure modes, unwanted interactions, and extraneous behavior has become costly and highly unpredictable | <ul style="list-style-type: none"> Product quality suffers if impact analysis cannot be automated |
| Globally Distributed Teams | Large, globally distributed, cross functional teams using different languages, processes, and technologies | Software development teams are commonly distributed for many reasons including the economic value gained by off-shore or near-shore outsourced development | <ul style="list-style-type: none"> Lack of coordination creates significant overhead, redundancy, and waste that can lead to much longer development cycles |

Integrity Solves the Software-Driven Challenges Allowing Organizations to Meet or Exceed Business Goals

Integrity is a proven system and software lifecycle management product that allows teams to tame the overwhelming complexity of developing software intensive products. Integrity delivers 3 critical differentiators:

- **Engineering Artifact Orchestration** – We believe the key is bringing all stakeholders together by providing a single source of truth that allows engineers to collaborate across geographic boundaries. All development artifacts including requirements, change requests, tests, and code are managed in a single data model providing full lifecycle traceability.
- **Ecosystem Integration** – It is critical that any lifecycle management solution integrate with key technologies and processes. Systems, software, and hardware engineering tooling must act as a single solution to deliver the necessary results.
- **True Enterprise Visibility and Value** – With a single data model, critical performance metrics can be collected automatically and rolled up to provide management real-time visibility into progress, quality, budget, and timeline.

Integrity unifies engineering artifacts, integrates with the ecosystem, and provides enterprise visibility across the product development lifecycle with a cross-disciplinary strategy that enables system, hardware, and software teams to work side-by-side during product development from earliest product inception to final delivery.



Customers using Integrity have realized significant and measurable improvements across the product development lifecycle:

| Our Customer's Business Goals | Customer-stated Benefits |
|--|--|
| Accelerate product innovation | "33% reduction in time to market allowing launch of more products to market in same time period." |
| Diversify product offerings | "Managing requirements for hundreds of customers across many product variants." |
| Engineer high quality products | "97% first time right measure up from 80%." |
| Improve supply chain collaboration | "Automated change synchronization reduces cycle time and improves consistency." |
| Streamline regulatory compliance | "60 seconds to show compliance vs. weeks." |
| Improve product release predictability | "93% on time up from 70% just 2 years prior." |
| Reduce product lifecycle costs | "Automated our processes from software development to production, enabling significant time and cost savings." |

Integrity Business Unit Locations

North America
1 800 613 7535

United Kingdom
+44 (0) 1252 453 400

Germany
+49 (0) 711 3517 75 0

Asia Pacific
+65 6830 8338

Japan
+81 3 5422 9503

integrityinfo@ptc.com

© 2011, Parametric Technology Corporation (PTC). All rights reserved. Information described herein is furnished for informational use only, is subject to change without notice, and should not be construed as a guarantee, commitment, condition or offer by PTC. PTC, the PTC logo, Creo, Shrinkwrap, Mathcad, Associative Topology Bus, Pro/ENGINEER and all PTC product names and logos are trademarks or registered trademarks of PTC and/or its subsidiaries in the United States and in other countries. All other product or company names are property of their respective owners. The timing of any product release, including any features or functionality, is subject to change at PTC's discretion.