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MARITIME HACKING VILLAGE

How Computers Kill People

Maritime Systems

Michael DeVolld, Director of Maritime Cybersecurity
Austin Reid, Senior Cyber Risk Consultant

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What We'll Cover

- Who We Are: Michael DeVolld & Austin Reid
- What is Cyber? 2025 Landscape
- Computers in Control Systems
- Critical Software Issues
- Maritime Software Failure Example
- Challenges in Modern Software Dev
- Addressing Cyber Risks Early
- Summary & Key Takeaways
- Q&A Session



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WhoAmI x 2



Michael DeVolld

- Director of Maritime Cybersecurity at ABS Consulting with 24 years in the maritime sector.
- Dedicated to ensuring the safety and security of the global Marine Transportation System (MTS).
- Retired US Coast Guard Officer with experience in safety and compliance inspections.
- Investigated high-profile marine casualties and established a cybersecurity program at USCG Cyber Command.
- Expertise in managing cyber risks, technical solutions, policy, governance, advisory services and maritime regulatory compliance.



Austin Reid

- Senior Cyber Risk Consultant at ABS Consulting specializing in maritime cybersecurity and operational technology security.
- A decade of experience in maritime sector with background in shoreside cargo operations.
- Witnessed transformative technology in maritime logistics and emerging security challenges.
- Hobbies include hacking navigation systems and restoring a 50-year-old lake boat.
- Holds a Bachelor of Science in Maritime Administration from Texas A&M.

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Acknowledgments

Christopher Stein

Location:
Copenhagen, DK

Current role:
Lead Engineer, Maritime Cybersecurity @ major shipowner

Focus on OT: Automation, Navigation, Propulsion, Power, etc..

Guild master @ MaritimeCyberGuild.com

Redacted

WÄRTSILÄ

L3 Technologies

NORRIQ Your Business - Simplified

MACROware

esoft systems

STEINGROUP

MARITIME CYBER GUILD

MaritimeCyberGuild.com

I am presenting in my own capacity and not as part of my current employment.
The opinions expressed in this presentation and on the following slides are solely my own and not necessarily those of my employer

What is Cyber?



- **In 2025 we keep talking about**:
  - AI, Evolving Threats, Advanced Persistent Threats, Hyperconvergence, Nation-state Actors, Hacks through AIS and other nonsense with the intent to scare you!

- Understanding the difference between hype and real risks helps focus on effective cybersecurity measures rather than fear-based reactions.

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What is a Computer?

This is a computer









These are also computers



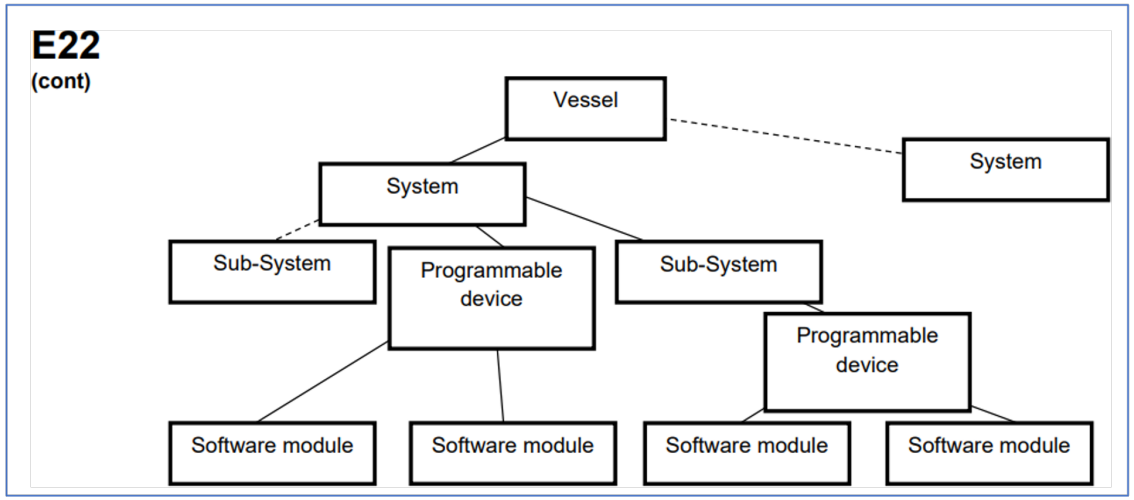




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Computers in Control System Devices



Programmable Logic Controller (PLC)	Pump	Variable Frequency Drive	Flowmeter	Engine Telegraph
				

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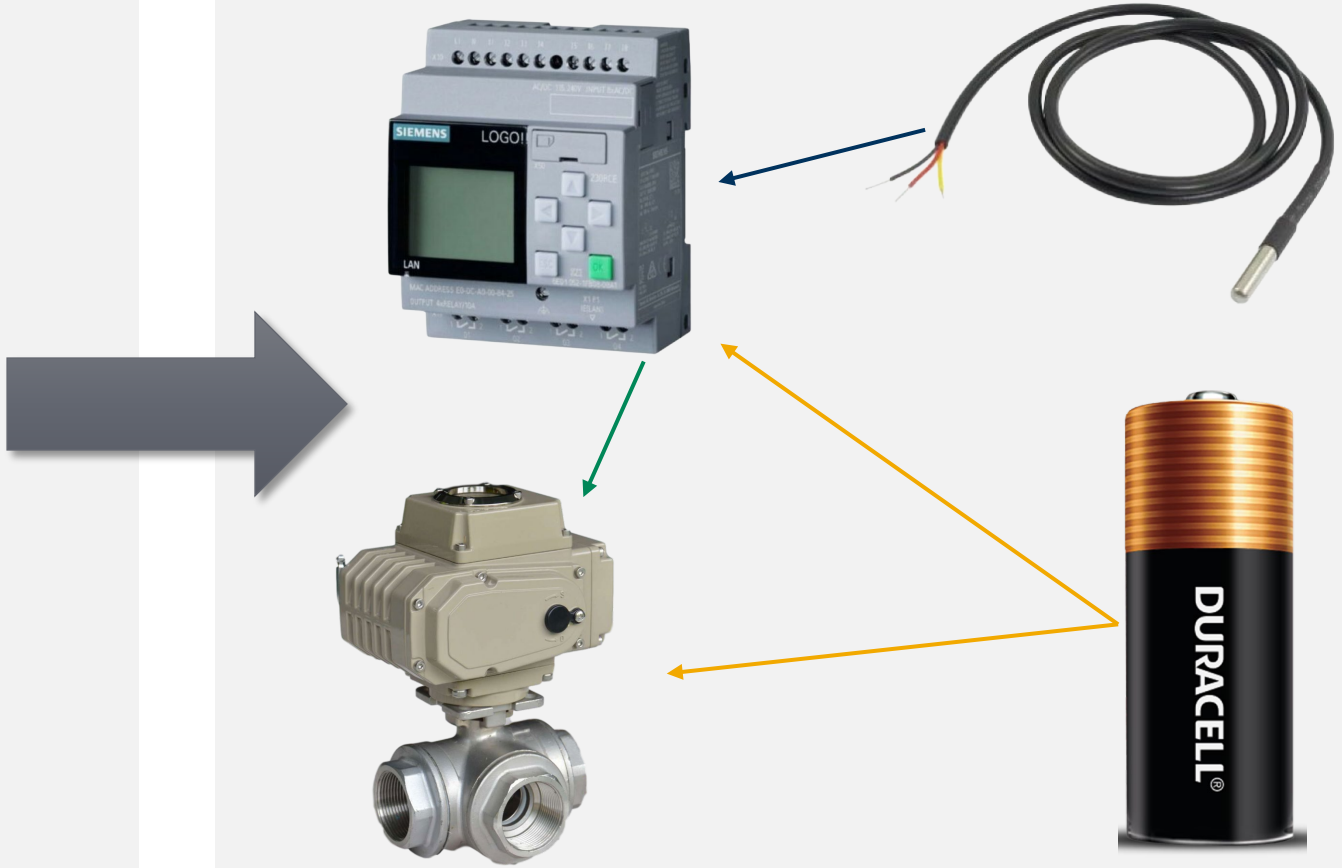
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Temperature Regulating Mechanism

Old



New

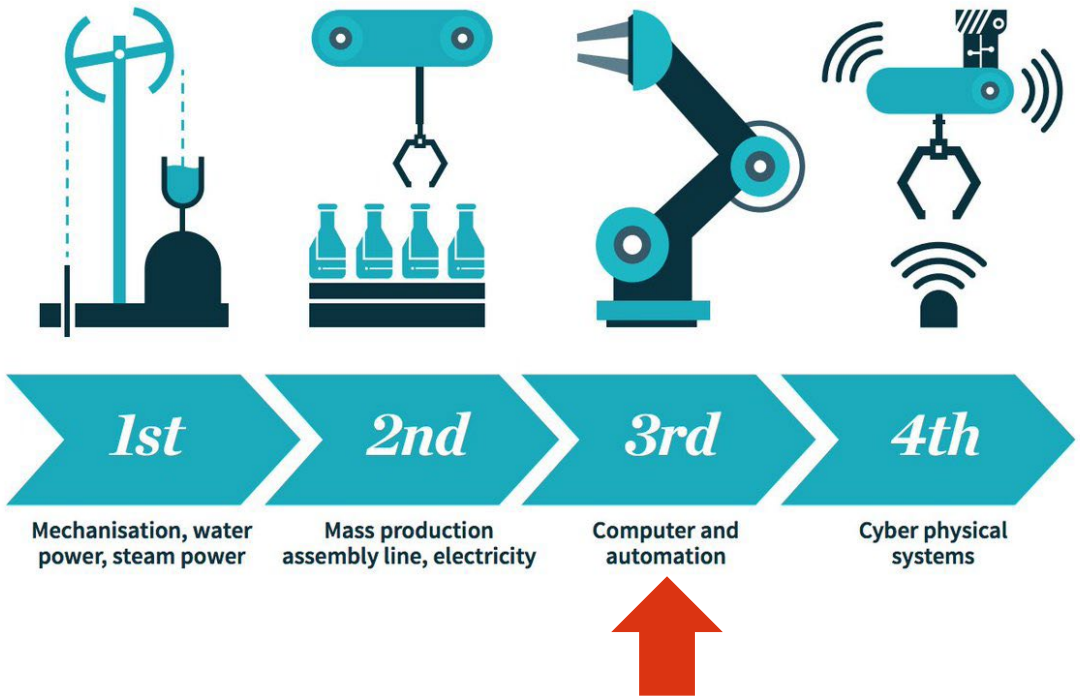


What Does This Have to Do with Cyber?

- Cyber is **everywhere** in the 4th industrial revolution
- Computers can be hacked
- Computers can be infected by malware

But it's not only about hackers, malware and phishing emails!

- Software quality can be poor
- Software developer may not understand process limits
- The control system does not protect itself from the user
- The user may not understand the control system
- Hardware failure is not considered and can have unpredictable results



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Critical Software Development Issues

EE POWER

Power System Software Bug could bring down Boeing 787s

FORCE INDEX

Software Glitch Caused F-35 Crash Over Utah: How Performance Issues Continue to Put Lives in Danger

When Smart Ships Divide By Zer0 — Stranding the USS Yorktown



When NASA Lost a Spacecraft Due to a Metric Math Mistake

WRITTEN BY Ajay Harish | UPDATED ON December 8th, 2023 | APPROX READING TIME 11 Minutes

Blog › Aerospace & Defense › When NASA Lost a Spacecraft Due to a Me

In September of 1999, after almost 10 months of travel to Mars burned and broke into pieces. On a day when NASA engineers ground reality turned out to be completely different, all becaus units, i.e., the metric units! The Scientific American Space Lab r on this very topic.

CNN Money

Toyota blames software for Prius braking woes

February 4, 2010: 7:23 AM ET

TOKYO (CNN) -- Without issuing a recall of its iconic Prius hybrid vehicles, Toyota on Thursday said a software glitch is to blame for braking problems in the 2010 model.

"We would want to be given a little time," Hiro Yuki Yokoyama, Toyota's managing officer, said when reporters asked whether a recall was in the works.

The company changed braking system software in January as part of what it called "constant quality improvements," but did not say what it would do about vehicles manufactured before then.

Toyota (TM) officials described the problem as a "disconnect" in the vehicle's complex anti-lock brake system (ABS) that causes less than a one-second lag. At 60 mph, though, a vehicle will have traveled nearly another 90 feet before the brakes begin to take hold.

HAL open science

The Ariane 5 Flight 501 Failure - A Case Study in System Engineering for Computing Systems

Gerard Le Lann

▶ To cite this version:

Gerard Le Lann. The Ariane 5 Flight 501 Failure - A Case Study in System Engineering for Computing Systems. [Research Report] RR-3079, INRIA. 1996. inria-00073613

ComputerWeekly.com

EDS report on 'dangerous' Chinook software published for the first time

EDN

Toyota's killer firmware: Bad design and its consequences

OCTOBER 28, 2013
BY MICHAEL DUNN

On Thursday October 24, 2013, an Oklahoma court ruled agai unintended acceleration that lead to the death of one the oc trial was the Engine Control Module's (ECM) firmware.

Embedded software used to be low-level code we'd bang tog assembler. These days, even a relatively straightforward, al l is likely to use a sophisticated RTOS and ten



Overwhelmed by Technology:

How did user interface failures on board the USS *Vincennes* lead to 290 dead?

Luke Swartz

Background

IEEE Spectrum

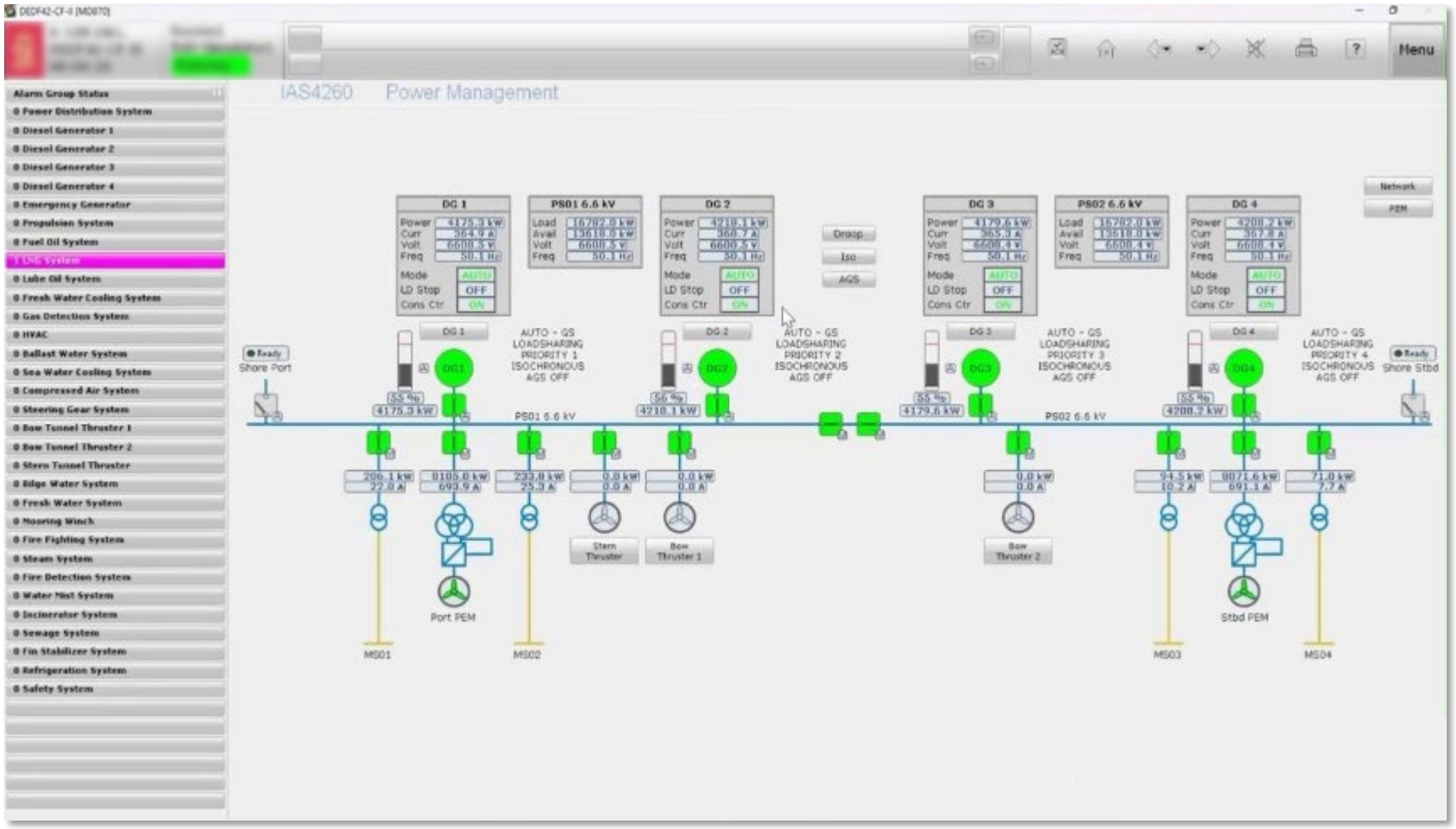
HOW THE BOEING 737 MAX DISASTER LOOKS TO A SOFTWARE DEVELOPER

Design shortcuts meant to make a new plane seem like an old, familiar one are to blame

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Let’s Watch a Video!



Video: A. Schliemann-Haug & C. Stein

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Software Failure Scenario

Manipulation of Setpoint

- Hardware failure
- Software failure
- User error
- “Evil hackers”
- Something else

No Circulation Through Heat-Exchanger

Failure in circulation leads to overheating due to lack of coolant flow.

- Temperature sensor data
- Flowmeter readings
- Heat-exchanger performance reports

Engine Overheating

Engine temperature rises beyond safe limits, risking damage and system failure.

- Engine temperature logs
- Overheat alarms
- Maintenance checks and reports

ESD Shutdown Triggered

Emergency Shut Down (ESD) activates to protect the engine from damage caused by overheating.

- ESD event logs
- Shutdown procedure documentation
- Operator response records

Blackout

Loss of power disrupts all shipboard systems, compounding operational hazards.

- Power outage logs
- Backup power system status
- Impact assessment reports

Loss of Propulsion

Complete failure of propulsion systems leaves the vessel stranded and vulnerable.

- Propulsion system diagnostics
- Incident investigation reports
- Recovery and mitigation plans

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This Is Why People Die

EE POWER

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Home › News › Power System Software Bug could bring down Boeing 787s

Power System Software Bug could bring down Boeing 787s

NEWS May 04, 2015 by Jeff Shepard

The U.S. **Federal Aviation Administration** (FAA) has released a new airworthiness directive (AD) for all **Boeing 787** airplanes. This AD requires a repetitive maintenance task for electrical power deactivation on Model 787 airplanes. This AD was prompted by the determination that a Model 787 airplane that has been powered continuously for 248 days can lose all ac electrical power due to the generator control units (GCUs) simultaneously going into failsafe mode. This condition is caused by a software counter internal to the GCUs that will overflow after 248 days of continuous power.

â€œWe are issuing this AD to prevent loss of all AC electrical power, which could result in loss of control of the airplane. We have been advised by Boeing of an issue identified during laboratory testing. The software counter internal to the generator control units (GCUs) will overflow after 248 days of continuous power, causing that GCU to go into failsafe mode. If the four main GCUs (associated with the engine mounted generators) were powered up at the same time, after 248 days of continuous power, all four GCUs will go into failsafe mode at the same time, resulting in a loss of all ac electrical power regardless of flight phase,â€ the FAA commented in a statement.

248 days = 21,427,200 seconds

Variable Type in Generator Control Unit = 32-bit signed integer

`integer`	`int32`	A 32-bit signed integer. It has a minimum value of -2,147,483,648 and a maximum value of 2,147,483,647 (inclusive).

IEEE Spectrum FOR THE TECHNOLOGY INSIDER

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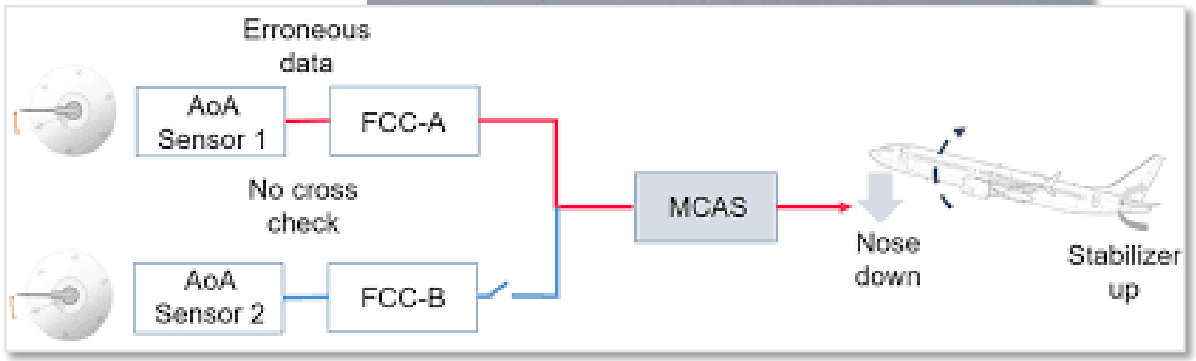
FEATURE AEROSPACE

HOW THE BOEING 737 MAX DISASTER LOOKS TO A SOFTWARE DEVELOPER

Design shortcuts meant to make a new plane seem like



346 dead!



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A Maritime Example



USS Yorktown (CG-48)
US Navy Smart Ship



U.S. NAVAL INSTITUTE

Smart Ship: The Future Is Here

By Alexander J. Krekich

"workload savings and other benefits can be achieved by the infusion of technology and the willingness to rid ourselves of redundant backups"



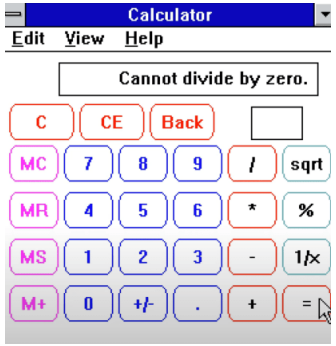
NT applications aboard the Yorktown provide damage control, run the ship's control center on the bridge, monitor the engines and navigate the ship when under way.

When Smart Ships Divide By Zer0 — Stranding the USS Yorktown

Bishr Tabbaa · Follow
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The cause?



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GCN Home > July 13, 1998 issue

Software glitches leave Navy Smart Ship dead in the water

By Gregory Slabodkin

Story Tools: Print this | Email this | Purchase a Reprint | Link to this page

The Navy's Smart Ship technology may not be as smart as the service contends.

Although PCs have reduced workloads for sailors aboard the Aegis missile cruiser USS Yorktown, software glitches resulted in system failures and crippled ship operations, according to Navy officials.

Navy brass have called the Yorktown Smart Ship pilot a success in reducing manpower, maintenance and costs. The Navy began running shipboard applications under Microsoft Windows NT so that fewer sailors would be needed to control key ship functions.

"We are putting equipment in the engine room that we cannot maintain and, when it fails, results in a critical failure," DiGiorgio said. It took two days of pierside maintenance to fix the problem.

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Modern Software Development – From Low Level to High Abstraction

The Most Popular **Programming Languages** by Decade

The start of a new programming era driven by generative AI

	1970	1980	1990	2000	2010	2020	2030
1st	Fortran	Pascal	C	C	Java	Python	English
2nd	COBOL	Fortran	Ada	Java	JavaScript	JavaScript	Mandarin
3rd	Assembly	BASIC	Pascal	JavaScript	PHP	Java	Hindi
4th	ALGOL	C	C++	C++	C++	C#	Spanish
5th	BASIC	Ada	Fortran	PHP	C	PHP	French
6th	APL	COBOL	Lisp	Visual Basic	Python	C++	Arabic

www.linkedin.com/in/jeffreywinter

Jeff Winter

In 2025, being a software developer is like working in sales. Developing WinZip one day, and propulsion control systems the next.

2025











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Is This Enough?

E22 Computer-based systems

(Dec 2006)
(Corr.1 Oct 2007)
(Rev.1 Sept 2010)
(Rev.2 June 2016)
(Rev.3 June 2023)

1 Introduction

1.1 Scope

These requirements apply to design, construction, commissioning and maintenance of computer-based systems where they depend on software for the proper achievement of their functions.
These requirements apply to systems which provide control, alarm, monitoring, safety, or internal vessel communication functions that are subject to classification requirements.

New in rev 3

4.2.6 Internal system testing before FAT

Requirement:
The system shall as far as practicable be tested before the FAT. The main purpose of the system test is for the system supplier to verify that the entire system delivery is according to the specifications, approved documentation and in compliance with applicable rules and regulations; and further, that the system is completed and ready for the FAT.

The testing shall at least verify the following aspects of the system:

- Functionality
- Effect of faults and failures (including diagnostic functions, detection, alerts response)
- Performance
- Integration between software and hardware components
- Human-machine interfaces
- Interfaces to other systems

Faults are to be simulated as realistically as possible to demonstrate appropriate system fault detection and system response.
Some of the testing may be performed by utilizing simulators and replica hardware.

4.2.5 Software code creation, parameterization, and testing

Requirement:
The software created, changed, or configured for the delivery project shall be developed and have the quality assurance activities assessed according to the selected standard(s) as described in the quality plan.

The quality assurance activities may be performed on several levels of the software-structure and shall include both custom-made software and configured components (e.g. software libraries) as appropriate.
The verification of the software shall as a minimum verify the following aspects based on black-box methods:

- Correctness, completeness and consistency of any parameterization and configuration of software components
- Intended functionality
- Intended robustness

4.3.7 Testing of integrated systems on vessel-level (SOST)

Requirement:
Integration tests shall be conducted after installation and integration of the different systems in its final environment on board. The purpose of the tests is to verify the functionality of the complete installation (system of systems) including all interfaces and inter-dependencies in compliance with requirements and specifications.

The testing shall at least verify the following aspects of the system of systems:

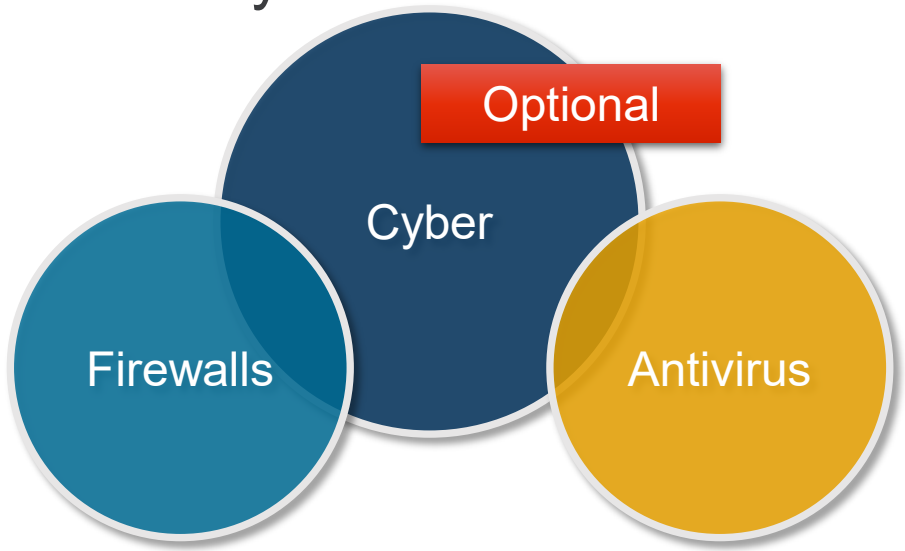
- The overall functionality of the interacting systems as a whole
- Failure response between systems
- Performance
- Human-machine interfaces
- Interfaces between the different systems

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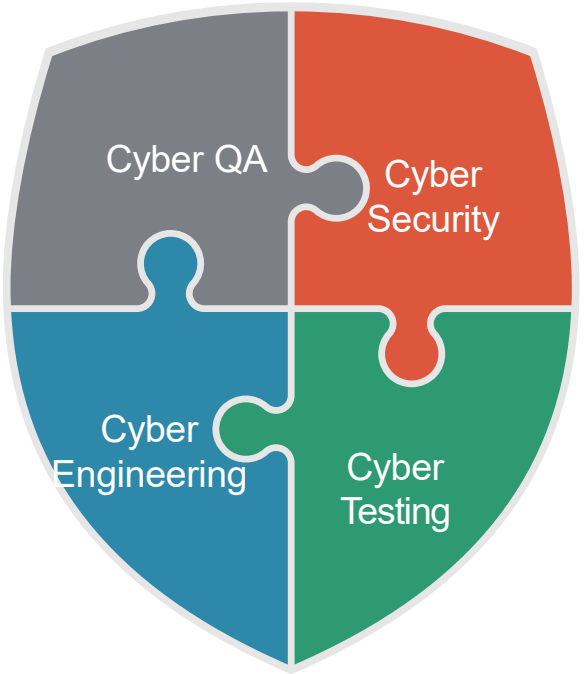
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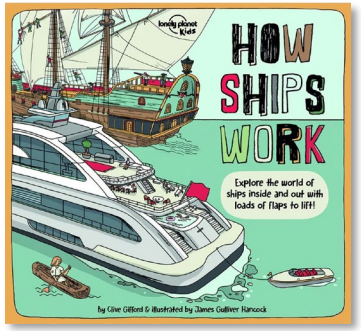
Address the Risks at Inception

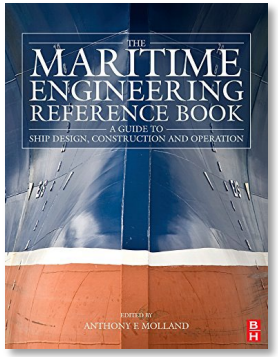
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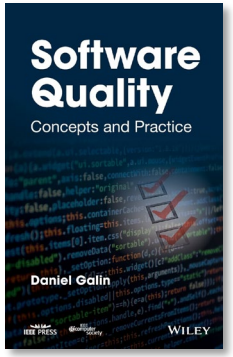


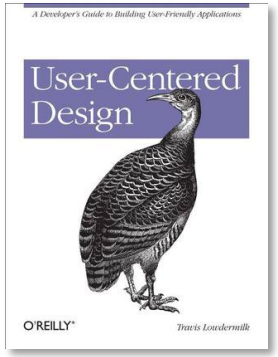
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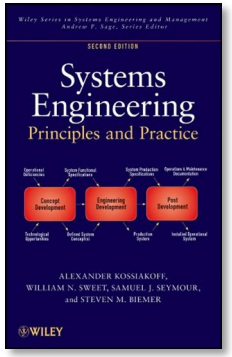


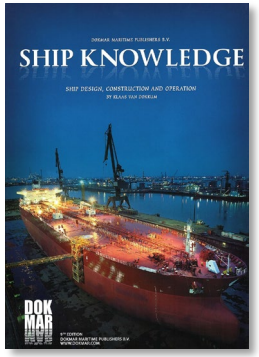


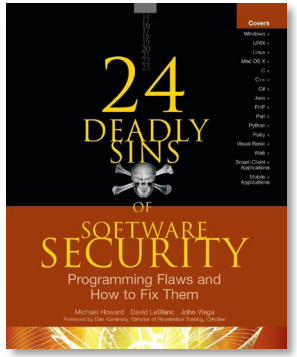












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In Summary

- As systems become increasingly dependent on software, the highest risks come from within.
- Understanding those risks early is crucial to addressing and mitigating them effectively.
- Mitigation should avoid adding yet another layer of technology risk.
- Successful risk management requires collaboration and transparency from vendors.
- Early risk identification helps prevent safety incidents and operational failures.

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