



Raytheon

Customer Success Is Our Mission

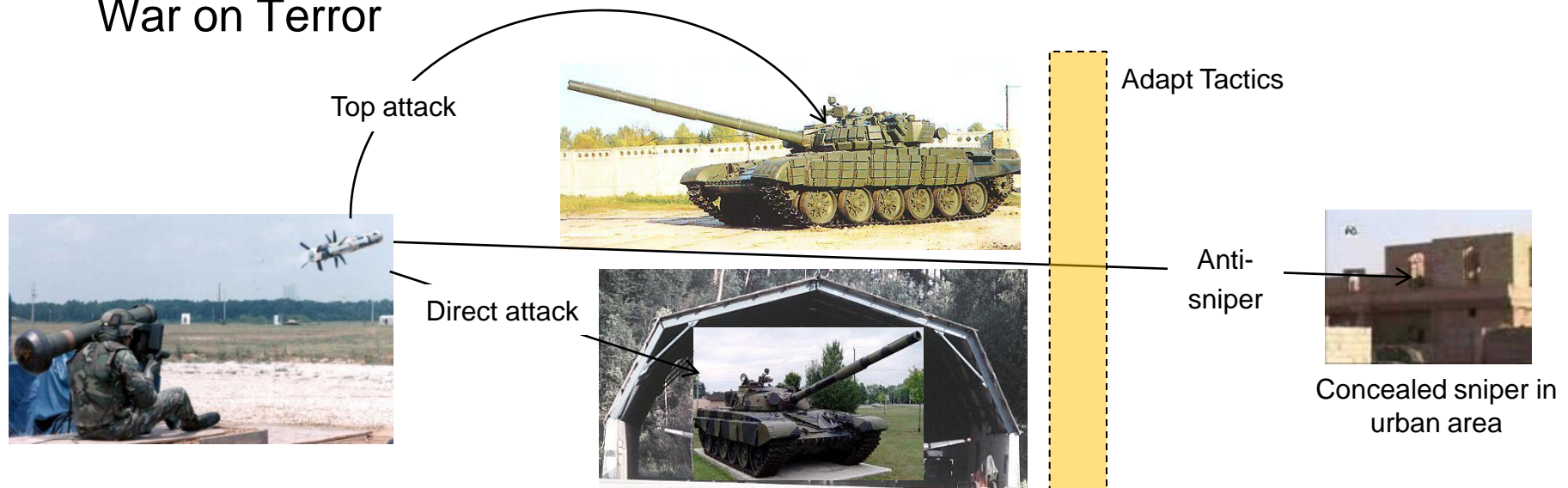
Quick Reaction Capability Programs for Urgent Operational Requirements

E. Russ Althof, P.E.
Engineering Fellow
Raytheon Missile Systems
Tucson, AZ
520.663.7753
eralthof@raytheon.com



Introduction

- Military operations over the last decade has led to the development of new and unique efforts to combat evolving enemy tactics
- The military is constantly developing new uses and tactics for existing weapon systems
 - Ex: Javelin anti-tank weapon system developed during the Cold War adapted for use as anti-sniper weapon in Iraq and Afghanistan in the War on Terror



Introduction - cont

- But adapting existing systems does not always meet mission demands and new systems must be quickly developed and deployed, thus the need for Quick Reaction Capability (QRC) programs
- This presentation will discuss the process and lessons learned from a Chief Engineer's perspective on this type of development and deployment effort

Quick Reaction Capability (QRC)

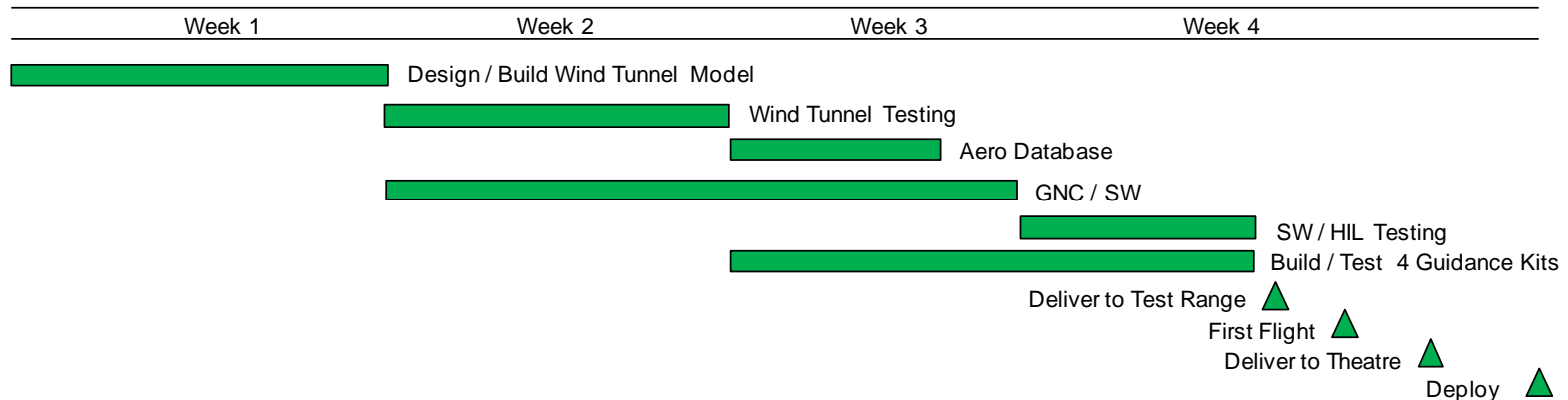
- An urgent operational need indentified by the warfighter can lead to a Quick Reaction Capability (QRC) program
 - Existing weapon systems cannot be readily adapted for the new mission
 - Potential weapon systems available for adaptation are deployed or in use elsewhere

- National Defense Industry Association (NDIA) in a study on the subject defines it as¹:
 - Design, Build, Integrate, Test And Fielding Of A Time-critical, High-priority Capability Needed By Operational Forces That Meets System KPP's
 - Typically a 6 – 12 month timeline

1. "Systems Engineering Best Practices - Air Launched Tactical Weapons Quick Reaction Capability Programs", NDIA Gulf Coast Chapter, October, 2011

QRC Classic Example

- GBU-28 “Bunker Buster” in Desert Storm – 1991
 - GBU-24A/B and GBU-27 penetrator guided bombs could not penetrate the deep Iraqi command and control bunkers (BLU-109 2000 lb warheads)
 - The Air Force created a modified version of the BLU-109 weighing nearly 5000 lbs for additional penetration capability
 - The initial warheads were made from surplus 8 inch artillery barrels (MK 110 Howitzers)
 - Texas Instruments (now part of Raytheon) modified GBU-27 Paveway III guidance kits for the new warhead



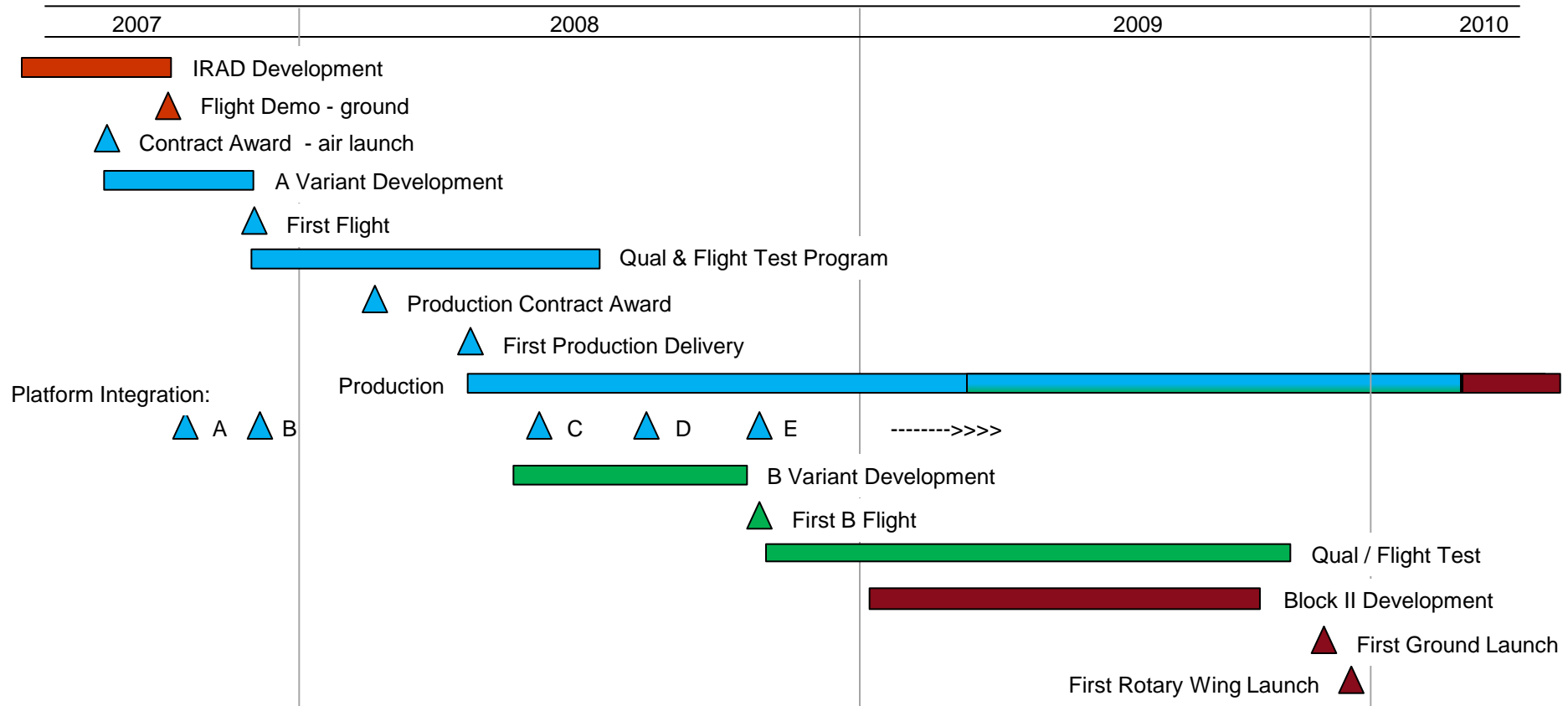
Griffin[®] QRC

- Griffin[®] Real-Time Attack System is an air- and ground-launched, precise, low-collateral-damage weapon for irregular warfare operations
 - 43 inches long, 33 lbs
 - 13 lb low collateral damage warhead
 - GPS guided, laser seeker for precise targeting
 - Fixed or moving targets
 - Rapid integration
 - Air or ground launched
 - A variant – aft eject from platform
 - B variant – forward firing from platform or ground launch



Griffin[®] QRC - cont

■ Development Timeline



Basics of the QRC program

- A successful QRC effort requires many elements
 - Know the mission
 - Minimize design
 - Documentation
 - Spiral development
 - Assume limited production
 - Capture the capabilities
 - Stay positive!

NDIA Outline of QRC Critical Activities

- Program Direction
- Capabilities Development Document
- Service Use Profile
- RFP Content
- QRC Early Program Coordination Requirements
- Proposal
- Risk Management
- Contract Award
- Design and Development
- Test and Integration
- System Integration
- Platform Integration
- System Verification
- Manufacturing Considerations
- Initial Operations Capability (IOC)
- Post IOC Support

Know the Mission

- Mission requirements will come from the user, not from a System Requirements documents developed over a long period of time
- The mission, platform and proposed tactics must be identified and understood
- Understand the user's needs and communicate with them on the solution(s)



Platform



Fire Control
System



Target

Minimize Design

- Minimize design efforts and focus on integration and test activities
 - This requires re-use of existing sub-systems as much as possible
 - Desired solution for all new programs – but re-use often becomes a tailored design of existing sub-system which then becomes a new, unique component
 - Sub-systems are not always hardware items – re-use of software, tools and services will also reduce schedule and cost

Minimize Design - cont

The “Franken – missile”



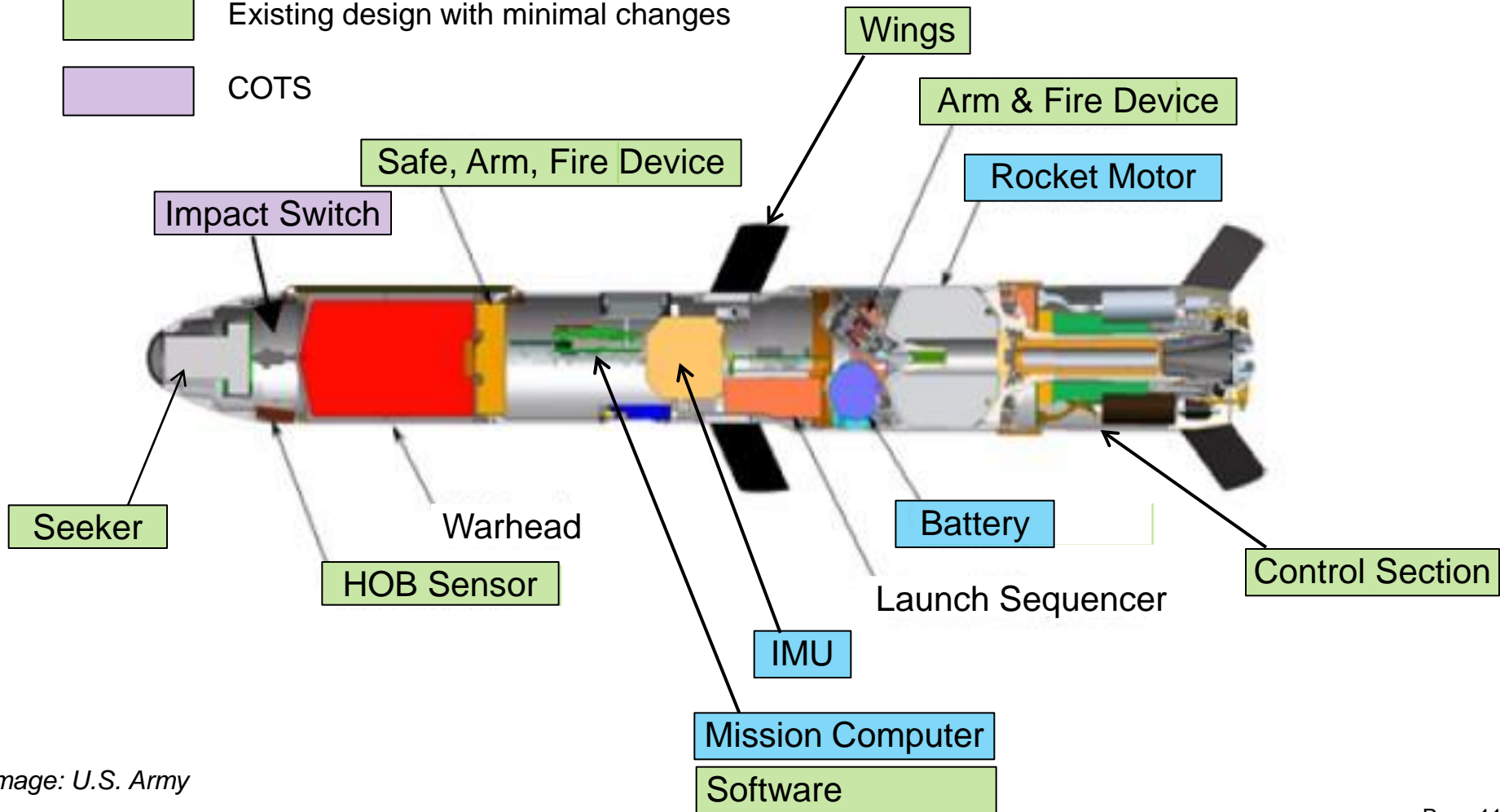
No change to existing design



Existing design with minimal changes



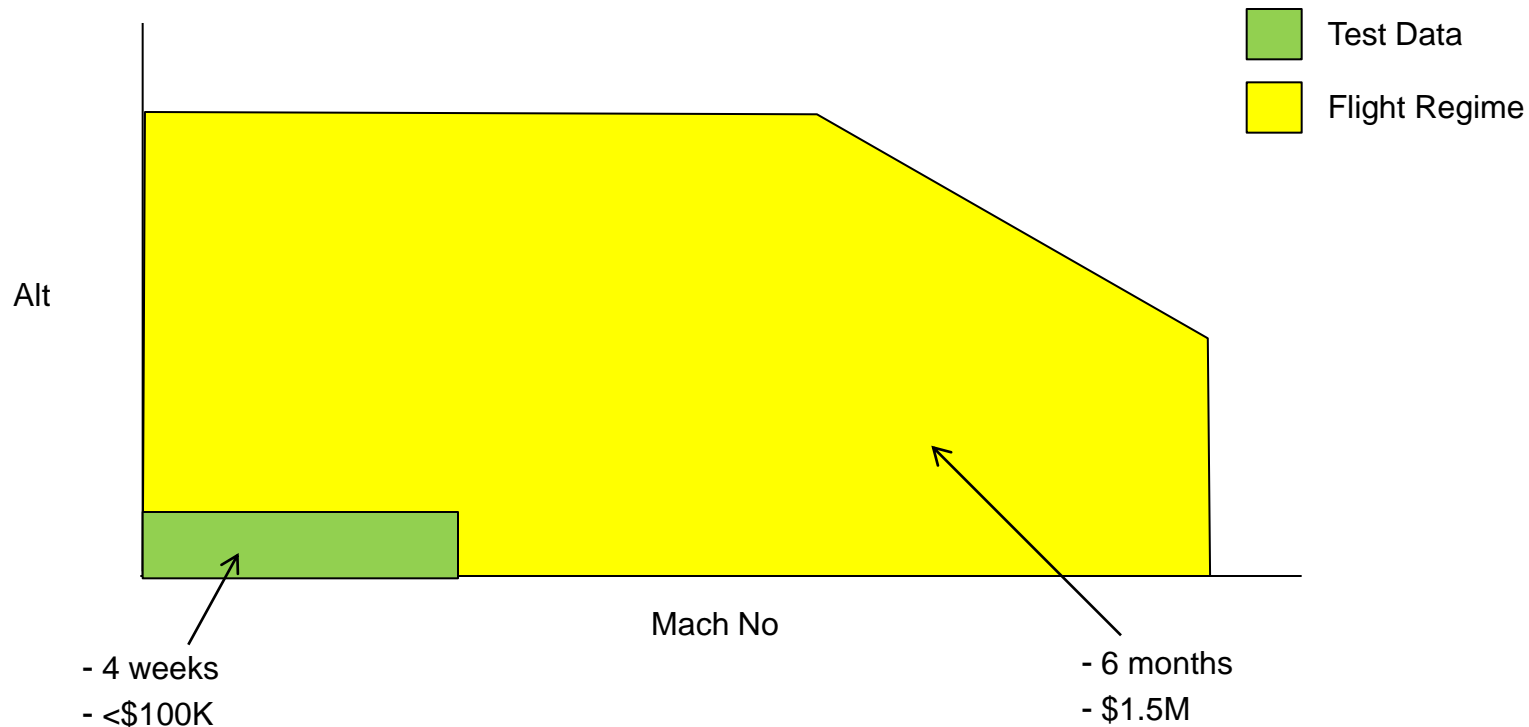
COTS



Minimize Design - cont

– Design with large margins

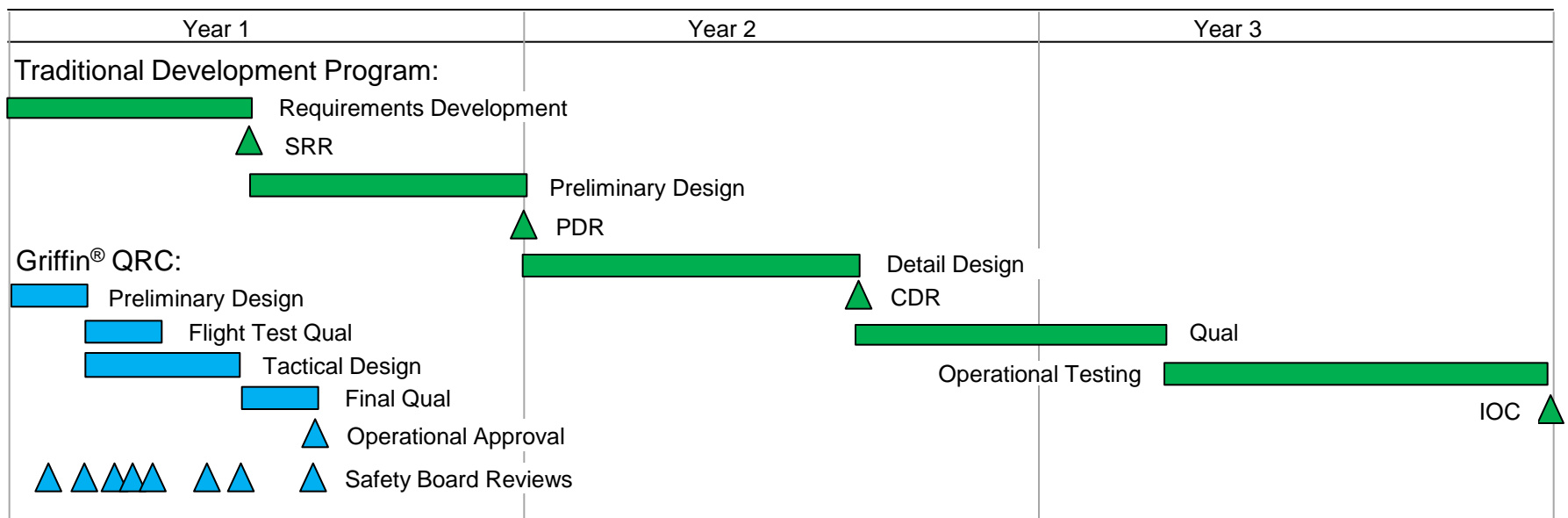
- Exact requirements are not always known, so large margins on assumed requirements reduces the need for extensive and time consuming detailed analyses
- Example: wind tunnel testing vs aero database



Minimize Design - cont

– Work parallel efforts aggressively

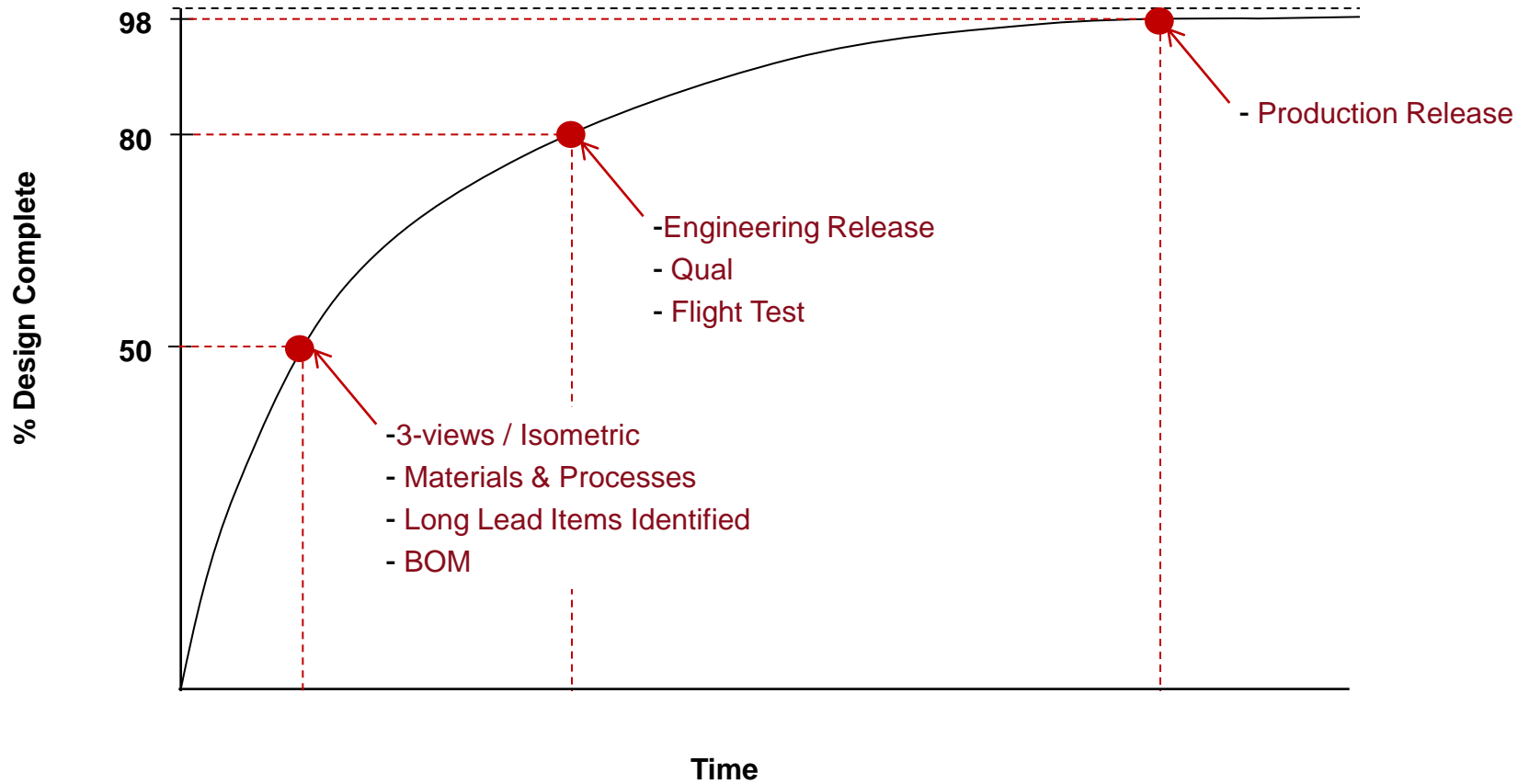
- All tasks to meet safety approvals, flight clearances and platform integration must be worked immediately and in parallel to the design effort
- Continuous flow of information to the pertinent customer communities is imperative – don't wait to get “all of the information” before reporting
- Ex: Safety Board Approval for Energetic Devices



Documentation

- Document the design
 - In the haste of a QRC effort, details can be forgotten quickly
- How it's documented is not as important as getting it right
- Get the information under configuration control quickly
- Simplify the change control process early; move to company compliant process as soon as possible
- Move to formal documentation as soon as feasible within or soon after the QRC effort

Documentation - cont



Spiral Development

- A successful QRC is Spiral 0
 - If it's not necessary to meet the basic mission needs, don't include it

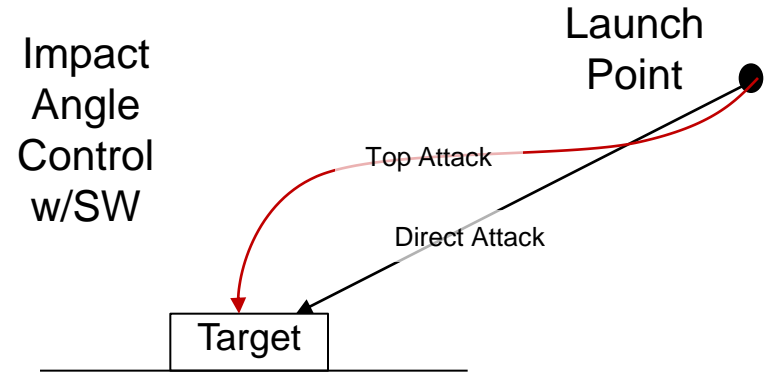
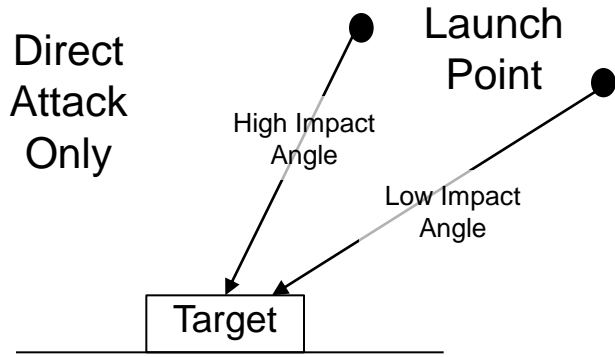
- Capture the “nice to have” ideas for future spiral growth
 - Key is knowing the difference between a QRC threshold and objective requirement quickly and be able to react if it is a threshold requirement
 - Provision for growth where possible
 - Let the customer tell you what he wants next after the QRC is complete

Spiral Development - example

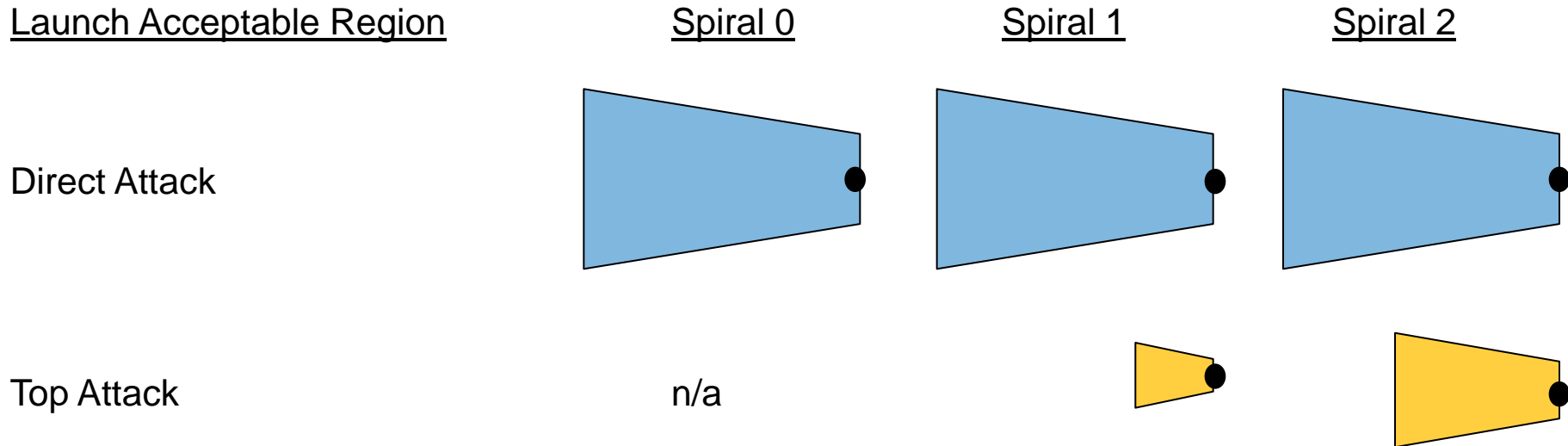
■ Impact Angle Control

- Original development and deployment did not control impact angle – purely a function of geometry between launch point and target
- Once the customer had the system and understood its performance, there was a strong desire to be able to control impact angle for increased effectiveness against some targets
- Spiral 1 – use simulation to establish the launch conditions that create the geometry required between launch point and target to achieve the desired impact angle – **1 week**
- Spiral 2 – develop, test and qualify new SW to actively control impact angle – **3 months**

Spiral Development - example



Launch Acceptable Region



Assume Limited Production

- Delivering hardware to the customer is difficult in a QRC effort
 - If successful, the customer wants the product now and in sufficient quantity to meet his needs
- Long lead times can delay meeting the urgent operational needs of the user
- Assume that the QRC will be successful and plan accordingly
 - Avoid designing with long lead hardware
 - Procure long lead items early and of sufficient quantity to meet the user's needs
 - Funding is always an issue for long lead items pre-contract – having a good finance and supply chain team will definitely help make this successful

Assume Limited Production - cont

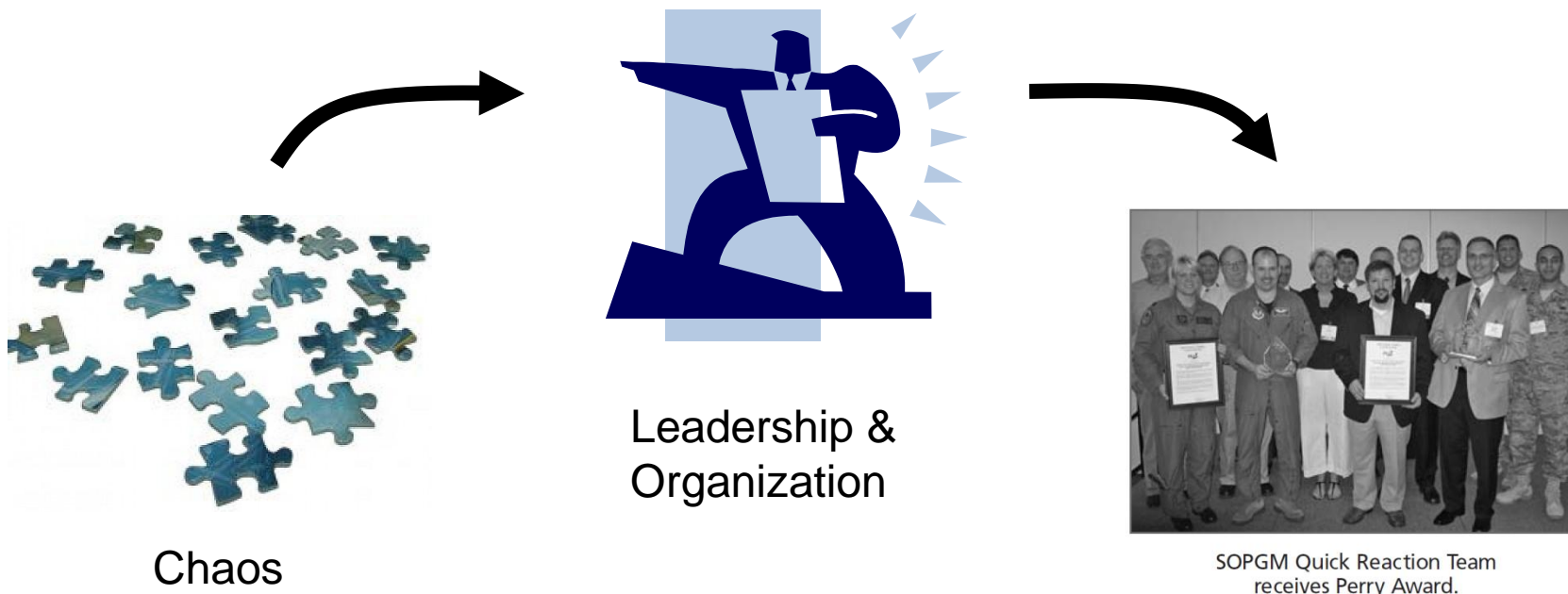
- Establish and maintain a Bill of Materials (BOM) early
 - It is imperative that the BOM be kept up to date on a regular basis
 - Identifies the long lead items needed to meet limited production needs and provides a database to track Line of Balance (LOB) for initial build of hardware
 - Assures critical components are not “dropped”
 - Expedites the cost estimating process when production contracts are requested
- Involve Operations early, even if just to observe progress early to get familiar with the project
 - Even though we were months away from a production environment, we assigned a manufacturing manager to the program early to attend daily stand-up meetings in preparation for taking over the program

Capture the Capabilities

- Since the requirements are not always completely defined, document the capabilities that the QRC provided
- This becomes the Spiral 0 requirements documentation or performance specification and is the basis for documenting margins and future growth opportunities
 - When using existing components or sub-systems or slightly modified version of these, “cut and paste” from existing documentation is a wonderful tool!!

Stay Positive!

- Keeping a positive attitude and the team focused will contribute to a successful QRC
 - One challenge is finding the right team of folks that can be comfortable operating outside “normal processes” and staying focused on the end result



SOPGM Quick Reaction Team
receives Perry Award.

“The SOPGM team demonstrated that with innovation and focus needed capability can be rapidly put into the hands of the warfighter”

Key Lessons Learned

- Meet the minimum mission requirements and plan for growth; know and understand the system capabilities
- Re-use is key to success, not only hardware but also software and tools
 - Extensive hardware re-use with critical SW products was key to meeting performance and schedule goals
- Select components that are readily available for even limited production, not what's available on hand for a few systems
- Create and maintain a BOM; update on a regular basis; status LOB daily

Watch Out! Items

■ Staffing

- It's difficult to find folks who can work in this demanding environment and stay focused and positive

■ Contracting

- Keep in mind that the user has an urgent need and may not always care how to get there – assure contracts is staffed appropriately and engaged early

■ Operations

- The QRC does not always address the expectations of an organization's internal processes and procedures as would have been addressed in a typical development to production program
- As the program moves into production, exceptions can be negotiated, but must be addressed quickly
 - Additional time with appropriate funding to satisfy these requirements should be planned and agreed to early

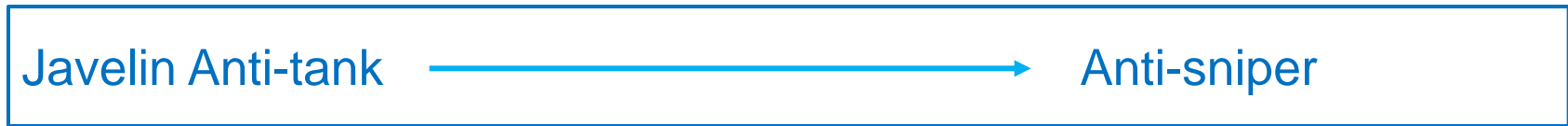
Summary

- Recent military operations have driven the armed forces to utilize QRC programs to meet urgent operational needs
- Standard processes and practices must be tailored, tossed and turned upside down as necessary to meet the user's needs
- Assume success and plan for limited production, keeping in mind that the standard processes and practices for production will need to be slowly integrated into the program
- Maintain a positive attitude and remember who you are supporting

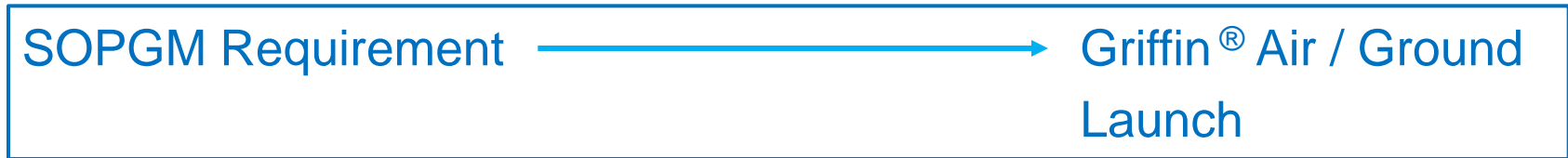


“What Goes Around – Comes Around!”

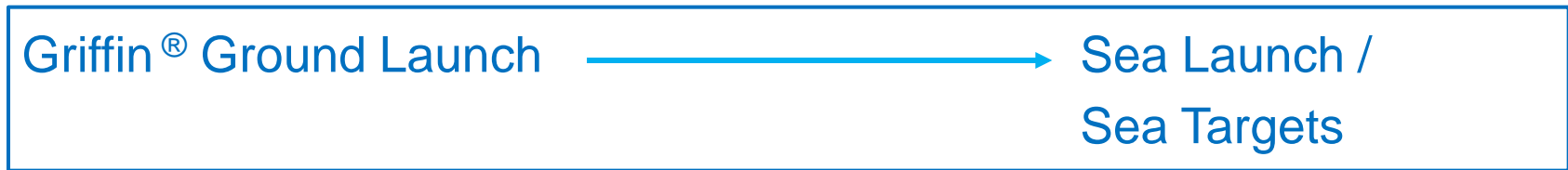
Operational Needs → Develop New Tactics



QRC → Basic New Capability



Operational Needs → Develop New Tactics



US Navy engages speeding boat with Raytheon Griffin[®] missile

Griffin demonstrates capability against small attack craft

PARIS, June 12, 2012 /PRNewswire/ -- The U.S. Navy proved the ability of Raytheon Company's (NYSE: RTN) [Griffin[®] B missile](#) to engage rapidly moving small boats during a recent live-fire demonstration.