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Finding the "RITE" Acquisition Environment for Navy C2 Software

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Finding the "RITE" Acquisition Environment for Navy C2 Software

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Abstract

The U.S. Navy has increasingly emphasized dominating the information battlespace as a key aspect of its warfighting strategy. As the *Navy Strategy for Achieving Information Dominance* states,

> whether characterized as intelligence, surveillance, reconnaissance, networks, communications, space, cyber, meteorology, oceanography, or electronic warfare, the Navy is inextricably and irreversibly dependent on information. Information provides a source of power but can also be an incapacitating weakness if not protected. Mastering the information domain is critical to the Navy's future success. (U.S. Navy, 2012, p. 3)

A key aspect of mastering the information domain is mastering the Navy command and control (C2) systems that Navy operators rely on to assemble, organize, interpret, and analyze information. In order to agilely respond to a variety of different situations, Navy C2 systems must be agile themselves. The acquisition of Navy C2 systems has historically promoted stove-piped, single-mission systems that cannot react to the needs of today's warfighters.

Space and Naval Warfare Systems Center Pacific (SSC Pacific) has collaborated with PEO C4I to devise and test an alternate acquisition process to address the challenges inherent in Navy C2 software acquisition. The new Rapid Integration and Test Environment (RITE) is a new lifecycle model of Navy C2 software that places increased emphasis on early and frequent software testing, as well as necessary software engineering practices at the source code level. RITE is a combination of commercial best-practice software engineering standards and processes; community process governance; contractual guidance; automated testing and report generation tools; and hosted development, test, and automated distribution facilities using a government and industry team agile acquisition model. Through the use of

RITE, SSC Pacific and PEO C4I have beta-tested a process that can enable streamlined acquisition of Navy C2 software.

Introduction

The United States has reached a possible strategic inflection point in which the recent international paradigm of the United States as a unipolar world power is shifting to one in which a number of near-peer competitors and non-state actors are increasingly gaining influence. Ronald O'Rourke, a specialist in naval affairs for the Congressional Research Service, has stated,

> World events since late 2013 have led some observers to conclude that the international security environment is undergoing a shift from the familiar post-Cold War era of the last 20–25 years, also sometimes known as the unipolar moment (with the United States as the unipolar power), to a new and different strategic situation that features, among other things, renewed great power competition and challenges to elements of the U.S.-led international order that has operated since World War II. (O'Rourke, 2014, p. i)

Since 2013, the United States has seen a shift in the international strategic environment that has been focused primarily on three different factors: Russia's aggression in Eastern Europe, China's growing military modernization and actions in the East and South China Seas, and the increasing need to address non-state actions, including transnational crime and terrorist groups.

Russia is aggressively seeking a larger role in East Europe, a role that includes pushing for regional integration, as well as intervening militarily when it feels its domestic interests are threatened. As the director of National Intelligence, James Clapper (2015) stated, "Moscow is pushing for greater regional integration, pressing neighboring states to follow the example of Belarus and Kazakhstan and join the Moscow-led Eurasian Economic Union" (p. 17). Additionally, "in Ukraine, Russia has demonstrated its willingness to covertly use military and paramilitary forces in a neighboring state—a development that raises anxieties in states along Russia's periphery" (Clapper, 2015, p. 18). In fact, "some observers trace the beginnings of the argued shift in strategic situations back to 2008" (O'Rourke, 2014, p. i) when "Russia invaded and occupied part of the former Soviet republic Georgia without provoking a strong cost-imposing response from the United States and its allies" (O'Rourke, 2014, p. 4). In relations with its Eastern European neighbors, Russia has been using "so-called 'ambiguous warfare' tactics" (O'Rourke, 2014, p. 9), where it has supplied military support—often including troops—but covertly. Taken in context of Russia's recent actions, "the Ukrainian crisis has profoundly affected Russia's relations with the West and will have far-reaching effects on Russia's domestic politics, economic development, and foreign policy" (Clapper, 2015, p. 17).

The United States' rebalance to the Asia-Pacific region has been initiated in large part due to China's growing economic and military might, as well as its actions in the East and South China Seas. Clapper (2015) stated, "China will continue to pursue an active foreign policy—especially within the Asia Pacific—bolstered by increasing capabilities and its firm stance on East and South china Sea territorial disputes with rival claimants" (p. 19). In addition to maintaining an active foreign policy, like Russia, "China will probably seek to expand its economic role and outreach in the region, pursuing broader acceptance of its economic initiatives, including the Asia Infrastructure Investment Bank" (Clapper, 2015, p. 19). In pursuing its claims in the East and South China Sea, China has focused on a "so-called 'salami-slicing'" (O'Rourke, 2014, p. 9) tactic in which it chips away at others' claims to slowly extend its power.

As noted in the *National Security Strategy*, “The threat of catastrophic attacks against our homeland by terrorists has diminished but still persists” (Obama, 2015, p. 9). Moreover, potential terrorist adversaries “are not confined to a distinct country or region. Instead, they range from South Asia through the Middle East and into Africa” (Obama, 2015, p. 9). As Clapper (2015) stated, “Sunni violent extremists are gaining momentum and the number of Sunni violent extremist groups, members, and safe havens is greater than at any other point in history” (p. 4), so clearly, the threat is persistent. The DoD will continue to need to structure the military forces to address this threat in a variety of ways as terrorist attacks continue to evolve.

This shift in the international strategic environment has led the DoD to seek for new ways for the military to continue to support our national interests of

> security of the United States, its citizens, and U.S. allies and partners; a strong, innovative, and growing U.S. economy in an open international economic system that promotes opportunity and prosperity; respect for universal values at home and around the world; and a rules-based international order advanced by U.S. leadership that promotes peace, security, and opportunity through stronger cooperation to meet global challenges. (Obama, 2015, p. 1)

The Quadrennial Defense Review and the National Security Strategy outline the underpinnings of the defense strategy as it stands today. Based on this strategy, the United States will focus on the three following defense missions:

- *Protect the homeland*, to deter and defeat attacks on the United States and to support civil authorities in mitigating the effects of potential attacks and natural disasters. (DoD, 2014, p. v)
- *Build security globally*, in order to preserve regional stability, deter adversaries, support allies and partners, and cooperate with others to address common security challenges. (DoD, 2014, p. v)
- *Project power and win decisively*, to defeat aggression, disrupt and destroy terrorist networks, and provide humanitarian assistance and disaster relief. (DoD, 2014, p. v)

While each of these missions is necessary to preserve the national interests set out in the National Security Strategy, achieving all of these, given the shifting international strategic environment, is a tall order. To address the evolving security environment, the DoD introduced *The Defense Innovation Initiative* on November 15, 2014 (Hagel, 2014c).

This Defense Innovation Initiative (DII) has its roots in the offset strategies developed by national security professionals in the 1950s and the 1970s to ensure America’s military’s superiority. The first of these was President Eisenhower’s New Look in the 1950s, which prioritized nuclear deterrence. This was followed in the 1970s by the offset strategy of the Long-Range Research and Development Planning Program, which shaped future investments in leap-ahead capabilities such as standoff precision strike, stealth aircraft, wide-area surveillance, and networked forces. Under Secretary of Defense for Acquisition, Technology, and Logistics, Frank Kendall, explained that these two previous offset strategies yielded an impressive set of military capabilities, comprising a “revolution that we unleashed on the world in the first Gulf War” (Roulo, 2014). He went on to state that while the United States has continued to rely on this set of capabilities in the decades since, adversaries have had time and space to respond by building similar capabilities, which has spurred focus on the development of a Third Offset Strategy (Roulo, 2014).

Defense leaders—including Secretary of Defense Chuck Hagel and Deputy Secretary of Defense Robert Work—explain that the Third Offset Strategy is being driven by the growing risk to America's continued technological superiority. In particular, Secretary Hagel (2014a) has stressed the threat posed by technology proliferation, noting that "disruptive technologies and destructive weapons once solely possessed by only advanced nations have proliferated widely, and are being sought or acquired by unsophisticated militaries and terrorist groups." He also identified the threat from near-peer competitors China and Russia, stating that while the United States has been conducting stability operations for the past decade, China and Russia have been heavily investing in military modernization programs in order "to blunt our military's technological edge" (Hagel, 2014b). In particular, Secretary Hagel emphasized that "they are … developing anti-ship, anti-air, counter-space, cyber, electronic warfare, and special operations capabilities that appear designed to counter traditional U.S. military advantages—in particular, our ability to project power to any region across the globe by surging aircraft, ships, troops, and supplies" (Hagel, 2014b). Budgetary constraints facing the DoD have made this threat environment even more challenging, limiting the Department's ability to respond through an increase in the size of our military or simply outspending adversaries.

In response to this challenge to the United States' technological and military superiority, the Third Offset Strategy—as instantiated in the Defense Innovation Initiative—seeks to put "the competitive advantage firmly in the hands of American power projection over the coming decades" (Hagel, 2014c). It will do so through several interrelated areas: a technology effort through the Long Range Research and Development Plan, leadership development practices, a new approach towards wargaming, operational concepts, and a continued focus on more efficient and effective business practices. As Secretary Hagel emphasized in assessing the previous two offset strategies, "The critical innovation was to apply and combine these new systems and technologies with new strategic operational concepts, in ways that enable the American military to avoid matching an adversary "tank-for-tank or soldier-for-soldier" (Hagel, 2014b).

A key concept of the DII is the focus on efficient and effective business practices. This area builds on a number of efforts the DoD has stood up in the last several years focused on streamlining both the oversight structure and business practices of the entire department. One central effort of this focus on efficient and effective business practices has been Under Secretary Kendall's series of Better Buying Power strategies designed to reform the defense acquisition system to enable more efficient and rapid fielding of DoD technologies. On September 19, 2014, Under Secretary Kendall released an interim draft of the third instantiation of the Better Buying Power, Better Buying Power 3.0. Kendall (2014) noted in the release,

> Better Buying Power (BBP) is based on the principle that continuous improvement is the best approach to improving the performance of the defense acquisition enterprise. The evolution from BBP 1.0 to BBP 2.0 was based on the premise that emphasis would shift as initiatives were put in place, experience was accumulated, data was collected and analyzed, and conditions changed. BBP 3.0 continues that approach with a shift in emphasis toward achieving dominant capabilities through innovation and technical excellence. (p. 2)

BBP 3.0 is a key part of the DoD's DII, in part because of their common concern that the technologies needed by military services are not being provided in a timely and efficient manner. The interim draft of BBP 3.0 states,

> Underpinning BBP 3.0 is the growing concern that the United States' technological superiority over potential adversaries is being threatened today in a way that we have not seen for decades. Our military today depends on a suite of dominant capabilities that originated in the '70s and '80s, has been enhanced and upgraded since, but has not fundamentally changed. This suite includes precision munitions, wide area surveillance systems, networked forces, and stealth technology. (Kendall, 2014, p. 2)

The concerns noted in the interim draft released in September are exactly aligned to the strategic concerns that underpin the DoD's effort to create a third offset strategy.

BBP 3.0's focuses on changing the culture and mindset in the defense acquisition community as well as ensuring that there are agile processes that defense acquisition experts can use to acquire and deliver cutting-edge capabilities. BBP 3.0 states,

> One of the dominant characteristics of defense acquisition is its scope and complexity. There are no simple solutions to all the myriad problems acquisition professionals have to solve. There is no short "rule set" that will tell us all we need to know. (Kendall, 2014, p. 3)

This is true in part because the defense acquisition system is used to acquire a large variety of technologies. The same acquisition processes are used to acquire technologies that range from Navy Aircraft Carriers to command and control software systems, and Army tanks to cyber security constructs. Given the fluidity of the current and future security environment, there is no reason to expect that the need to acquire this wide variety of technologies will change any time soon. In fact, BBP 3.0 states,

> Potential adversaries are modernizing at a significant rate, and they are responding rapidly to our development programs and fielded systems. This is true of peer, near-peer and even less capable potential adversaries. Our technology development and system designs must accommodate this reality. We must plan for likely responses to our designs, and we must be watchful and responsive ourselves to emerging threats. (Kendall, 2014, p. 4)

Thus, the DoD acquisition system must be able to accommodate the ability to agilely acquire and field a variety of systems.

The U.S. Navy—as well as the other services—relies upon the defense acquisition process to field its crucial command and control systems. While these systems do have a variety of "hard" physical components, much of the value of the system is based upon the "soft" software components that act as the brains of the systems. The software pieces of C2 systems—like Naval Integrated Tactical Environmental System–Next Generation (NITES-NEXT), Maritime Tactical Command and Control (MTC2), and Distributed Common Ground Station–Navy (DCGS-N)—are being updated continually in order to address a variety of the challenges that command and control systems face today.

Working with PEO C4I's PMW-150, SSC Pacific has instituted the Rapid Integration and Testing Environment (RITE) to improve software development, testing and fielding. As Garcia explained, RITE is one of the strategic objectives that has been implemented "to support the Maritime C2 Roadmap" (2010, p. 17). He went on to note that "RITE is changing PMW 150's software development methodology and modernizing the development process" (Garcia, 2010, p. 17). Utilizing the RITE will be a key component in enabling C2 software capabilities to be deployed more efficiently and effectively to the warfighter.

What is RITE?

RITE is a combination of commercial best-practice software engineering standards and processes, community process governance, contractual guidance, automated testing and report generation tools, and hosted development, test and automated distribution facilities using a government and industry team agile acquisition model. RITE is composed of four pillars—contracts, infrastructure, processes, and organization—which work together to facilitate the development and distribution of Navy C2 systems.

RITE was first initiated as a response to PEO challenges in managing, producing, and fielding C2 systems. The initial effort focused on finding ways was to improve product quality, move to competitive contract strategy, streamline acquisition cycle to meet aggressive timelines, and maximize release confidence and integration flexibility. The idea was to recognize that there is no silver bullet to solve these problems, but the approach should instead start with the most basic item: source code management. The key behind right is focus on improving component quality before delivery to decrease the average time needed to correct defects. Figure 1 illustrates how the average time needed to correct a defect increases based on how far it is from the initial code stage.

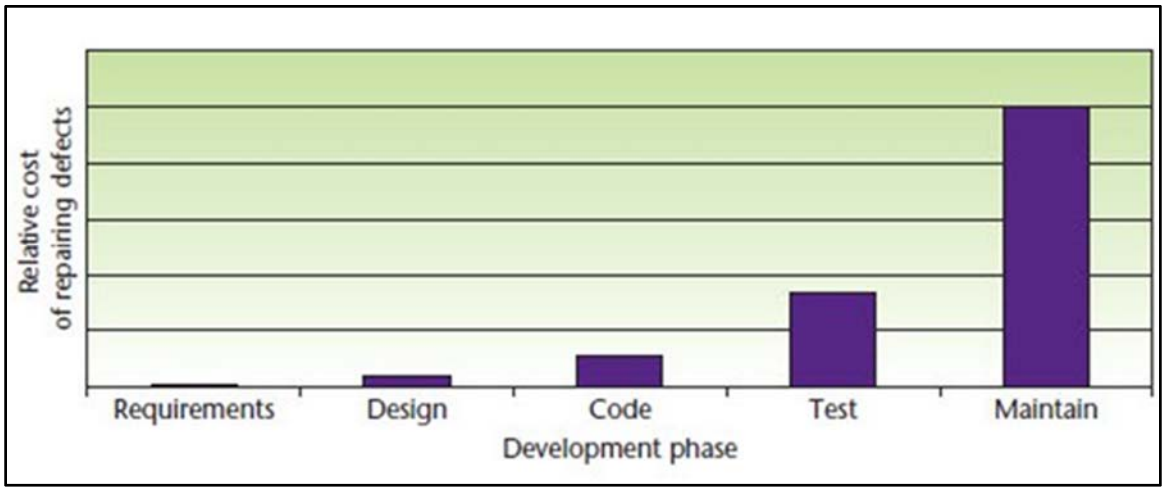

Figure 1. Average Time to Correct Defect

As Figure 1 illustrates, the closer the defect is identified to the code stage, the less time is needed to fix the problem. Together, the four RITE pillars work together to create an environment that makes it possible to manage software development as close to the source as possible.

RITE Contracts

The RITE contract pillar focuses on providing specific language that can be used in any contract that encourages a collaborative relationship. The RITE, as implemented by SSC Pacific, does not require a special contract vehicle type and, to date, has been delivered using existing Cost Plus Fixed-Fee (CPFF) contracts. Overall, CPFF has proven to provide the most cost-effective vehicle to support the research and developmental nature of the work that SSC Pacific performs. SSC Pacific has found that system engineering, software development, and test and integration support requirements are best met when the vendor is able to support evolving program requirements and to take advantage of changes in technology. SSC Pacific has inserted specific contract language within individual contracts/task orders and has tailored selected Data Item Descriptions (DIDs) to ensure that

the vendor is contractually obligated to work in close collaboration with SSC Pacific to implement the RITE model.

The objectives of the RITE contract pillars are focused on the five aspects: ask, use, receive, verify, and ensure. First, SSC Pacific uses contract language to ask for what the project needs, including specifics and requirements. Second, RITE is focused on using developers based on performance measures. The idea is to reduce the reliance on a single vendor, reduce barriers to entry, and decrease switching costs. RITE uses performance measures to ensure that there are increased choices at a competitive price throughout the development system. Third, RITE contracts ensure that SSC Pacific receives all of what it pays for. To that end, RITE requires that SSC Pacific receives buildable source code only as delivers—this includes source code for science and technology projects. Fourth, with RITE, SSC Pacific verifies that it receives what was promised through a rigorous software quality assurance. Finally, RITE uses enterprise repository contents and buildable source code operations to ensure that SSC Pacific can reproduce what it paid for. Integrating all five of these aspects into a single contract requires a great deal of planning up front, but pays big dividends over the life of the project.

The key feature in making RITE contracts as effective as they can be is the government—contractor relationship that is formed. SSC Pacific engages early to help determine the correct contract type. This engagement includes providing assessed risk of integration development or adapter software development and mitigating risk using RITE's program comprehensive and coordinated Software Developer's Kit (SDK). It is also key that all parties provide necessary documentation to ensure full and open competition. SSC Strive to create documentation consistent with the performance-based contracting approach. SSC Pacific will also advocate for the government's unlimited rights in the technical data and software delivered by the contractor. Finally, RITE allows the government to use Multiple-Award Contracts—creating a truly competitive award environment.

RITE Processes

RITE processes include source code analysis tools to provide better cost estimates at source code level, internal inspection of code to reveal the state of the system from a software engineering level and software complexity, dependencies and coverage, and incorporation of automated test tools, able to reduce the time required to run a large number of test cases and increase the number of test events completed in less time.

RITE processes rely upon an iterative "sprint" model of development and delivery. Figure 2 illustrates the RITE development model.

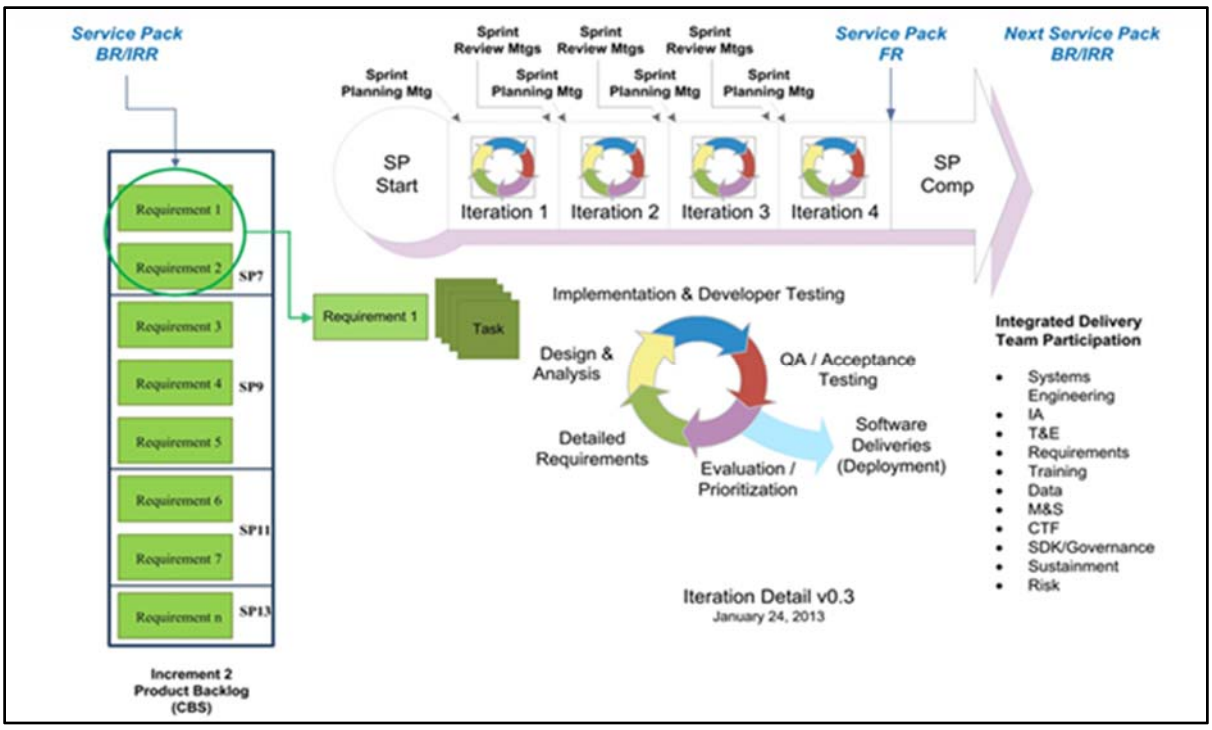

Figure 2. RITE Development Model

As Figure 2 illustrates, each requirement is first broken down into a number of tasks. These tasks are then accomplished in a series of "sprints" with each sprint including a full iterative cycle of the product. As the iteration detail shows, each of the sprints includes the full cycle of examination of detailed requirements, design and analysis, implementation and testing, quality assurance and acceptance testing, and software deployment, and finishes up with an evaluation of the deployed software and a prioritization of tasks for the next sprint.

As Figure 3 shows, the sprint model allows for the product to be released in short bursts to the customer, rather than waiting for release only at the final Milestone C.

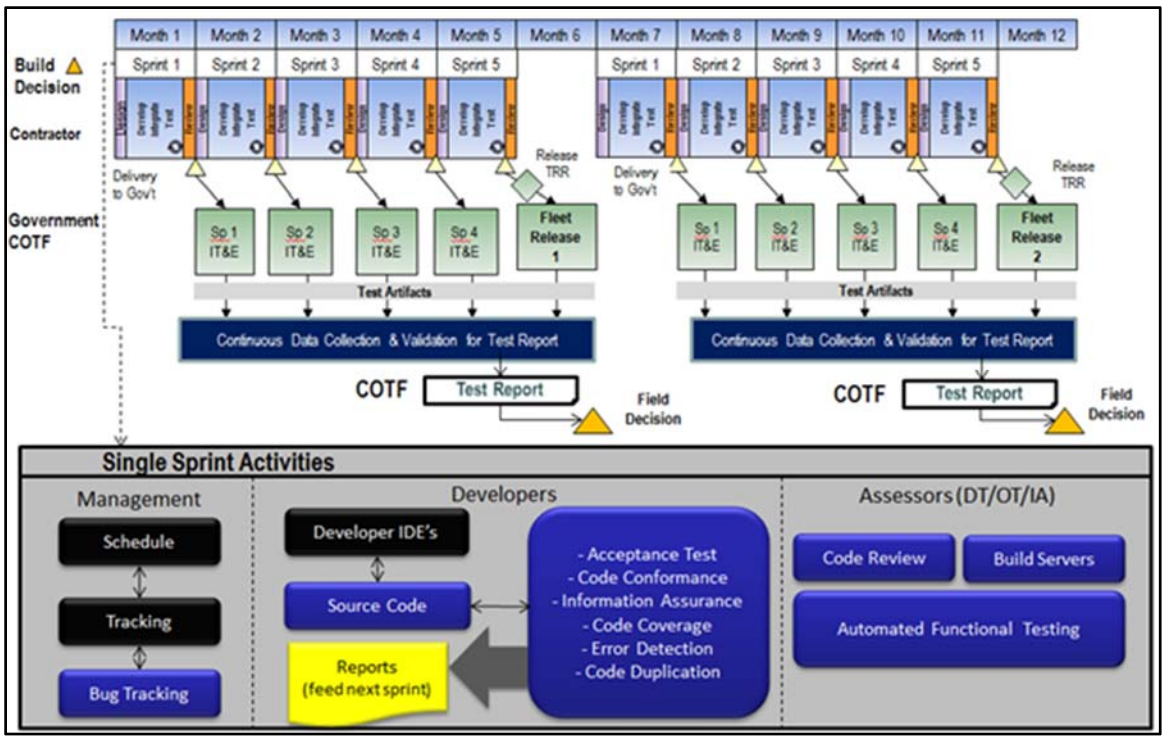

Figure 3. Sprint Model

The release of C2 software products as the development and demonstration phase progresses will get the C2 capability into the warfighter's operations quickly, as well as enabling much shorter testing time, as the problems are found *during* the product build cycle, rather than after it.

RITE Infrastructure

RITE infrastructure relies upon a centralized repository to enhance project communication and collaboration. The centralized repository creates a framework for software distribution (i.e., an application store), documentation library, development areas, software testing tools and data, and centralized software configuration management. Essentially, RITE creates a Distributed Development Environment (DDE), which is a virtual collaborative environment that spans multiple organizations and/or multiple physical locations. As Garcia (2010) has described, "in a DDE, project members share ideas, information and resources, and actively collaborate to achieve a common goal. The primary advantage of DDE is availability of resources and access to software development tools from different locations" (p. 17). Figure 4 details the RITE central repository infrastructure.

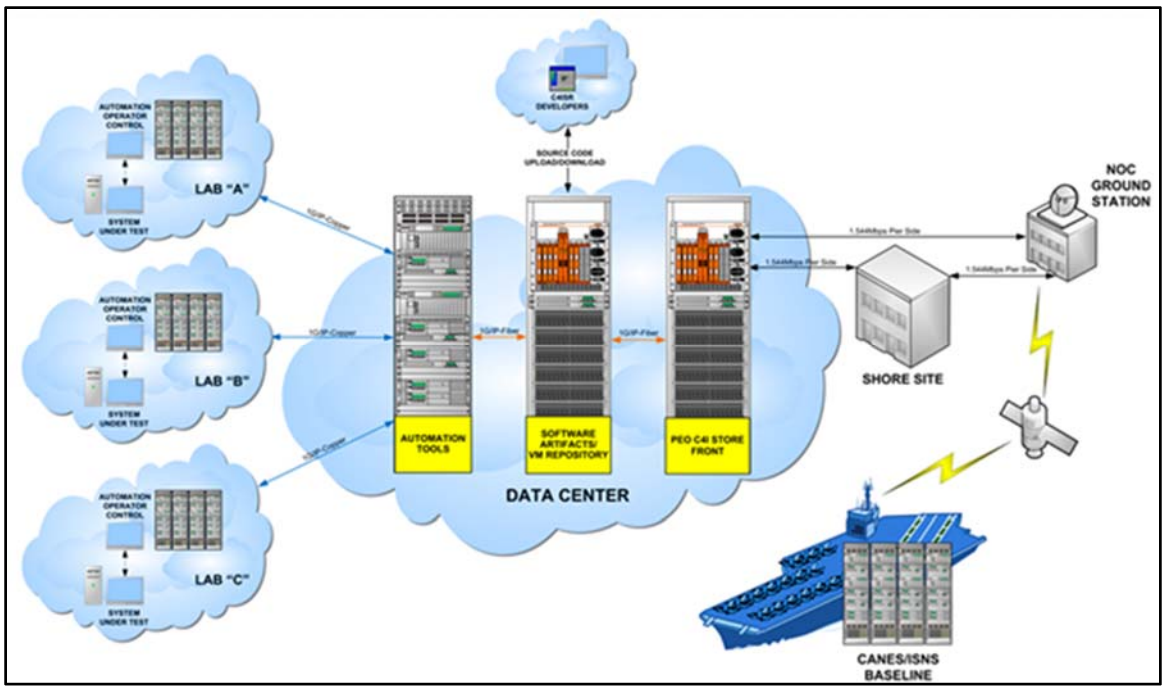

Figure 4. RITE Central Repository Infrastructure

As Figure 4 illustrates, the C4ISR developers, each of the testing labs, and the operational users are all connected to a central repository where the C2 applications, software artifacts, and automation tolls are housed.

Having a single infrastructure with a central repository greatly aids in the effort to maintain configuration management (CM). RITE includes management of configuration management and planning. This allows the parties to produce and adjust the CM plan as needed as well as ensuring timeliness of the lifecycle. This centralized repository also helps in identifying artifacts to be under CM control for functional, allocated, and product baselines. Enabling configuration control allows for baseline, change, and release management. In addition, various control boards are established to oversee overall CM. The central repository also allows for a designated project lead to maintain complete access control. The central repository will also store reports on artifacts as to their status in lifecycle, release state, configuration, interfaces, and physical environment as well as reports on who has accessed the different pieces, when the pieces were accessed and the delivery schedule. The final piece of CM in the central repository includes validation that all artifacts are held, available, and in proper status as well as the functional configuration audit (FCA) which documents whether the system does what it is proclaimed to do.

RITE Organization

In order to ensure that RITE is implemented effectively, it must be organized with deliberation. The organization managing the product must be a carefully selected team of people who all understand their jobs up front, and is organized for success. Figure 5 details the ideal organization for a RITE project.

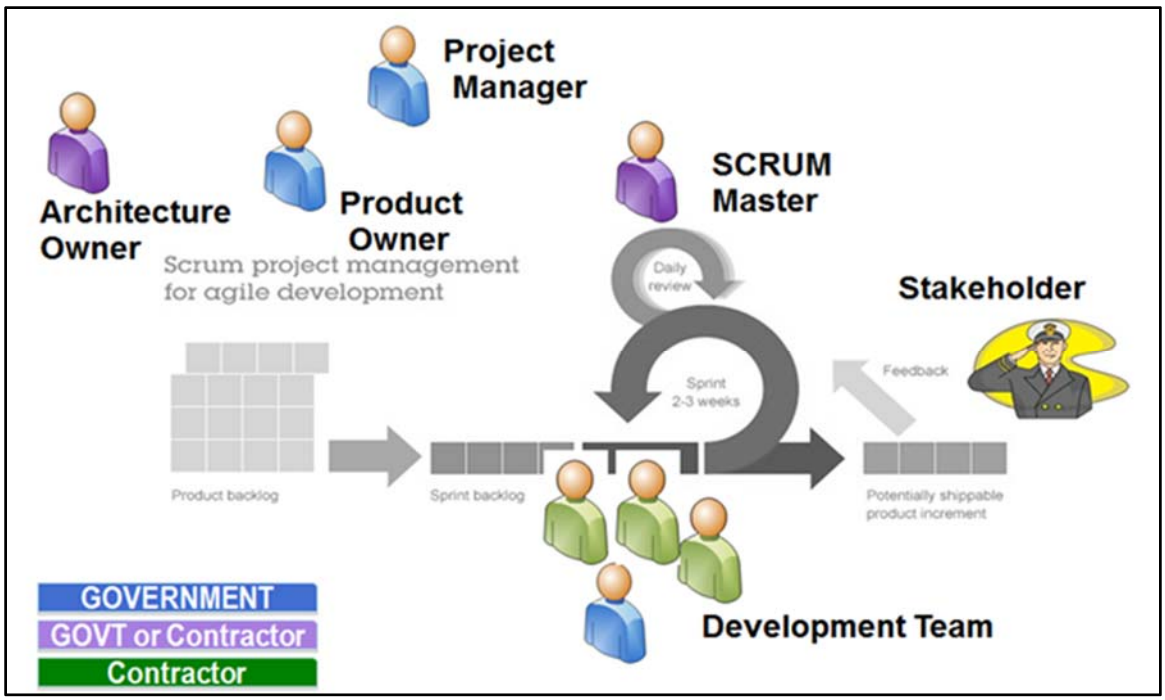

Figure 5. Ideal Organization for RITE Project

As Figure 5 illustrates, the government ownership of the project and process is a key aspect of ensuring that the RITE project is successful. In particular, it is important for the project manager, product owner, and at least part of the development team to be government employees. The utilization of contractors is a key aspect of RITE, as it is unrealistic to expect that the government will be able to supply all the qualified personnel needed for the software engineering required by RITE. In addition, contractors can often offer other key skills that may not be present in the government workforce. Utilizing a mix of government employees and contractors allows for the project to reap the benefits of each group's unique skill set.

RITE in Action

SSC Pacific and PMW-150 have already used RITE with a variety of programs. The past record of RITE demonstrates that it can provide significant cost and time savings. The agile nature of the software development institutionalizes end user input all along the development process, and also gets the capability into the end user's hands much earlier. Using this agile process enables quick changes to current C2 programs of record, which has the potential to give the Navy an asymmetric C2 advantage over adversaries with outdated systems. Finally, the RITE process can—and should—be utilized by the entire DoD as all services grapple with the challenge of fielding twenty-first-century technology with a twentieth-century acquisition system.

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