Goldratt Institute
Focused System Improvement

The Enterprise AIR*Speed* Journey:

Strategic Direction and the Integration of the Theory of Constraints, Lean, and Six Sigma (TOCLSS) to Achieve Focused System Improvement

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***VELOCITY*—a powerful business approach combining speed with direction**—consists of three pillars: **Theory of Constraints**, the system architecture; **Theory of Constraints Lean Six Sigma** (TOCLSS), the focused improvement process; and **SDAIS** (*Strategy-Design-Activate-Improve-Sustain*), the deployment framework.

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Strategic Leverage: VELOCITY

In today's world, organizations must constantly change to remain viable and competitive. Most organizations strive to operate at the leading edge of the pace-of-change in their environments; those quicker to improve than the competition will stand a good chance to survive. Within a vast sea of change initiatives, opportunities and pressures, the true leadership challenge is to articulate and inspire good change. To do otherwise creates noise, distraction, and churn. Speed is not the complete answer to leadership's pursuit for good change.

The better change—more focused, strategically agile, and potentially game-changing—is the change that adds the dimension of direction to the measure of speed. A rare handful of organizations are able to continuously posture themselves, both with speed and direction, ahead in their environments. These few have a more powerful and useful strategic leverage to dominate. ***VELOCITY****—AGI's business approach combining speed with direction—is the key to effective and continuous business success.*

A Nation's Military Aviation Leads with VELOCITY

Delivering the right items to the right place at the right time is the goal of every supply chain. Overcoming the challenges of time and distance is vitally important, but what if many of those items also need repair or overhaul? And what if—at the constantly shifting ends of this complex global logistics chain system—lives are at risk, demand patterns are highly unpredictable, and the potential consequences are so severe that failure is not an option? Such is the story of the aircraft maintenance and supply support system for the U.S. Navy and Marine Corps.

Since 2001, the Naval Aviation Enterprise (NAE)—which includes Marine Corps Aviation—has faced overwhelming challenges. While the anticipated number of flying missions around the world was to increase by at least 10%, plans called for the operating budget to be cut $1.5 billion and for personnel to be reduced 70,000. At the mission-execution points of the enterprise, the aircraft were already old and heavily used, the maintenance force was young, and the operating conditions were increasingly harsh, stressful, and filled with uncertainty. The challenge was far beyond "doing more with less."

This situation called for a dramatic directional shift from the decades-old, tried-and-true practices to a new revitalized and reengineered system within stringent constraints and with no tolerance for jeopardizing mission readiness. How could it be possible to transform a $38B logistics enterprise at a time of enormous strategic pressure? The NAE leadership's response was the Enterprise AIR*Speed* program to deliver speed with direction—in one word, ***VELOCITY***.

Catalyst to Enterprise AIRSpeed and "Focused System Improvement"

In the face of such global pressure, Navy and Marine leadership recognized this was not a change they could mandate by an "All Hands" order to "do everything better, cheaper and

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faster." While they understood that an enterprise continuous process improvement (CPI) campaign would enable process speed with repeatability, they also realized that to improve mission response within such a fast-paced and unpredictable environment, direction was the vital companion to speed in delivering the *right* results. For the NAE, a well-designed direction would provide the strategic lens and integrating construct to align and focus the CPI efforts to achieve system-level bottom-line effects.

Vision:

"Enterprise AIRSpeed consists of an integrated blend of commercial practices that includes Theory of Constraints (TOC), Lean and Six Sigma. (TOC is the overarching architecture for Enterprise AIRSpeed.)"

NAE leadership set out to provide the new direction with the following vision: "Enterprise AIR*Speed* consists of an integrated blend of commercial practices that includes Theory of Constraints (TOC), Lean and Six Sigma. (TOC is the overarching architecture for Enterprise AIR*Speed*.)" As the prime contractor, AGI—Goldratt Institute established the strategy and design to blend several disparate process improvement efforts (the separate use of Theory of Constraints, Lean, and Six Sigma methodologies) into a cohesive integrated effort. To realize this vision, AGI recognized the ***VELOCITY*** concept would be a powerful catalyst to propel the enterprise to achieve "focused system improvement" towards their strategic goal.

That goal was for Enterprise AIR*Speed* to achieve readiness by meeting mission requirements, while simultaneously reducing inventory and operating expenses.

Success Required Integration

The Naval Aviation Enterprise is a large global endeavor—a complex system including Organizational (O), Intermediate (I), and Depot (D) level maintenance with wholesale and retail supply functions, as well as the interfaces between them, both ashore and afloat. Encompassed under the AIR*Speed* vision were hundreds of activities that included depots, aircraft carriers, amphibious assault ships, Intermediate Maintenance Activities (IMAs) and Organizational activities. (See Figure 1.)

With several organizations already on different improvement paths, integration was neither enthusiastically embraced nor readily accomplished. Advocates, champions and experts of each methodology sought to continue their respective efforts to showcase their progress and substantiate their perspectives on how best to proceed. Many insisted that integration was not even a viable objective when a popular belief was the appropriate choice of the CPI methodology depended on the type of problems to be addressed.

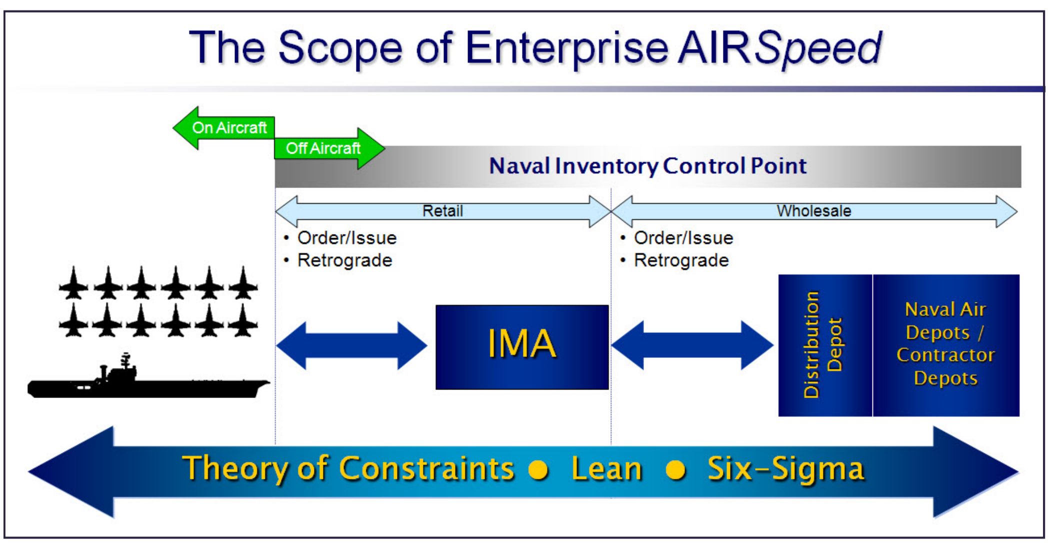

Figure 1. The Scope of Enterprise AIR*Speed*

Even for leaders to agree to a vision of "integration," how to enact it was subject to interpretation and debate. One view was the methodologies should be applied within the same local organization, but at discrete stages addressing particular issues. Consider the history at Naval Air Station North Island in San Diego, California where the improvement methodologies were successfully applied in series. (See box below and Figure 2.) As impressive as the results were, they were not the outcome of an overarching strategic direction based on an "integrated" design of all three powerful methodologies.

Naval Air Station North Island:

An Aircraft Intermediate Maintenance Detachment, which supported three types of aircraft with six component repair divisions.

- October 2002—applied basic TOC supply chain management to proactively prevent out-of-stock items, reduced urgent repairs by 80%, reduced maintenance work-in-process (WIP) by 15%, and improved customer wait time by 95%.
- The next year, received the Admiral Stan Arthur Award for Logistics, a very prestigious national award normally given to logistics units, not maintenance activities.
- February 2004—implemented Lean in all six of their repair divisions. Reduced the physical workspace required by over 32,000 sq. ft. and eliminated 104 personnel billets. Nominated by The Secretary of the Navy for the Secretary of Defense Maintenance Award.
- From January to April 2005, applied advanced TOC concepts to focus on the Time-to-Reliably Replenish (TRR) components and the interdependencies between their repair shops and supply. Improved component repair times between 15-43%.
- August 2005—executed a Six Sigma project addressing T-700 engine repair, further reduced the TRR by two days.

What if the baseline design of the improvement effort could take into account the benefits and advantages of each methodology for a comprehensive approach to improve the system, not just improve local processes independently? Taken even further, what if the perspective could address the system of systems, the enterprise level? What if, instead of focusing on local CPI, improvement efforts could be designed by applying strategic direction with speed of execution to achieve focused system improvement? Using the

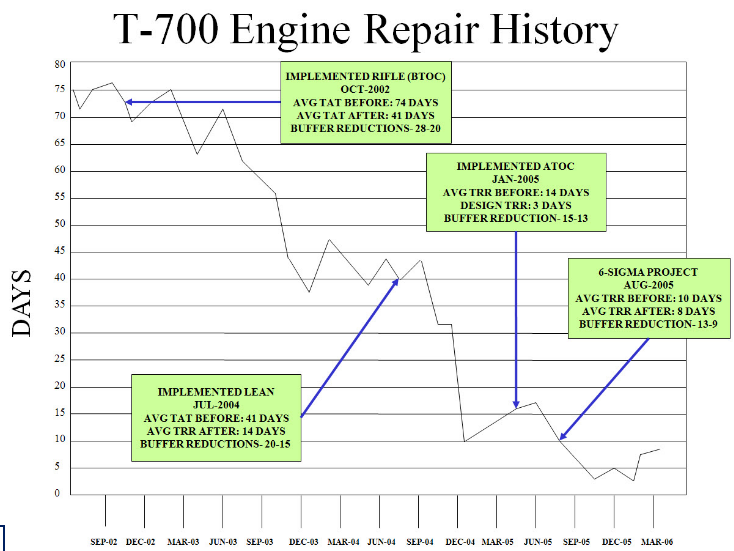

Figure 2. NAS North Island T-700 Engine Repair History (Sep 2002 - Mar 2006)

VELOCITY analogy, where aligned vectors provide even greater speed in the desired direction, AGI led their contractor core team of TOC and LSS experts and the NAE leadership and workforce to realize synergistic results from integration and alignment were possible that would exceed the likely expectations of local efforts.

TOC defines the performance of the system as a function of constraints, variability, and interdependencies that must be viewed multi-dimensionally. For the NAE, what was needed was a systems perspective of maintenance, supply, and operations. A key concept was to understand that the operational demand for components to generate mission-capable aircraft was the prime determinant for the repair and replenishment processes. Aircraft "ready for tasking" at the right time, in the right place and in the proper configuration was the goal of the system. At the enterprise level, *the constraint-based philosophy of TOC would be applied to strategically design the system architecture of the change*. (See Figure 3.) With their previous practical experience, the team articulated the key to sustaining readiness at reduced cost was *integrating TOC, Lean and Six Sigma tools into a seamless focused improvement process* that would combine doctrine, policy,

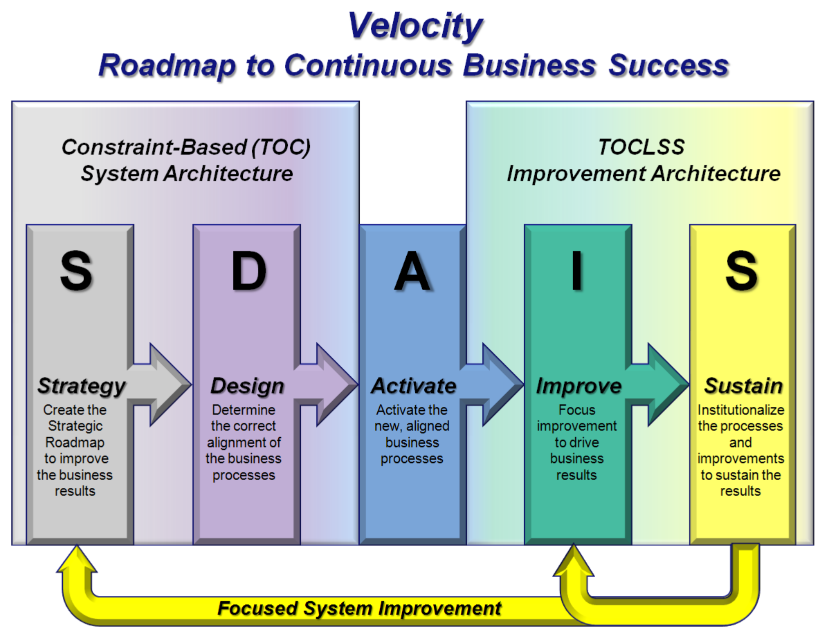

Figure 3. Velocity—SDAIS Model

measurement and behavioral changes with the physical reconfiguration of space, resources and assets. Guided by the strategic direction for the system, tactical level implementations and the integrated toolset became the Enterprise AIR*Speed* methodology towards increasing process flows, reducing waste and reducing variability at key control points. Training and realigned procedures and policies would permeate the organizations and promote a new culture.

This new culture was vitally important as the relationship between maintenance and supply was typically well known for its tensions, turmoil and occasional antagonism. Steps toward the new culture began during the first weeks of on-site training provided to each organization to understand the overarching constraint-based supply chain solution—the system architecture of the AIR*Speed* change. In subsequent weeks, site leaders would cooperatively try to understand and define their "AS-IS" states and determine their desired "TO-BE" designs. Those designs, based on strategic understanding, took into account the process flows and the sustainability and support systems needed for implementation. Site leaders would develop the transition plans to move from the AS-IS to the TO-BE states over the subsequent 12 to 18 months. Throughout these efforts, TOC and LSS experts would instruct and facilitate the activities with more than just the expertise of their particular methodology, but more importantly with a tightly integrated roadmap, their combined knowledge and the lessons learned from previous implementations.

AIR*Speed* TOCLSS Site Implementation

The experience of the Marine Aviation Logistics Squadron 24 (MALS-24) is a fairly typical implementation story. MALS-24, at Kaneohe Bay, Hawaii, transformed to the new culture with some dramatic results. Their unit included maintenance and repair activities and an internal supply division. They began their CPI efforts in June 2005 with some Lean events using their best intuition to identify what the overall problems were. The box below shows where their new integrated effort began:

MALS-24 beginning (AS-IS) state:

- They measured total items repaired and the ability to repair them (with little concern about time to repair or whether that item was needed; unless it was urgently needed and then it was usually too late).
- Their culture pitted Maintenance and Supply against each other
  - If something needed parts, it was no longer a Maintenance concern; it was Supply's problem.
  - If Supply restocked an item, it was then Maintenance's responsibility to come and get it.
  - Maintenance did not understand how Supply determined the amount of stock to carry and why, which caused a lack of trust in the system, ordering extra "just-in-case," and local hoarding.
  - Supply was convinced that Maintenance would order "it all" if they could.
- They had no real understanding of "a swim lane."
- They had a "Frozen Middle," i.e., seasoned middle management, with enough experience to be wary of "new and improved" methods and generally resistant to change.

After their AIR*Speed* training and design experience, the site leaders learned to see their organization as a system that had multiple interdependencies. They used swim lanes to map their activities and as a divining rod to find their constraints. They started looking at how components and material flow in time and stopped focusing on counting items on the shelf. The constraint-based (TOC) design provided a way to focus LSS efforts at the most important activities before things became urgent. In quantitative terms, previous practice called for 15 engines to be "ready for issue (RFI)" for the CH-53 helicopter. After redesigning their engine shop with AIR*Speed* methods, the site leaders realized they could reduce repair times to improve the TRR (Time-to-Reliably Replenish) from 224 days to 14 days. Their analysis indicated they could reduce the number of RFI engines from 15 to 3. Since that data didn't account for deployments and urgent missions, they chose to reduce the RFI level to only five (still a 66% reduction in required inventory). After two years of additional data, including wartime deployments, further review with AIR*Speed* decision paradigms indicated three RFI engines would have been sufficient. With less anxiety and turmoil, the workforce was able to give greater attention to the quality of their work and consequently the engines needed repair less often and produced greater horsepower during flight.

As the squadron activated their new designs and implemented the new rules of behavior and performance measures, previously chaotic and erratic performance began to stabilize. (See Figure 4.) As the system came under control, leaders were able to more clearly identify additional areas for improvement.

For example, a work center noted that despite their improvements they were failing to meet the "designed" TRR of 15 days for the main tires for the P-3 surveillance aircraft—the actual TRR was 17 days. The site leaders then used the focus provided by the TOC design to highlight the need for a Rapid Improvement Event (RIE). Their analysis identified a policy constraint that delayed the timeliness of the tire being brought to the work center. They also repositioned fresh rubber closer to the work to be performed. Because their good original design work had stabilized the performance, they were able, first, to recognize the underperforming situation and second, to take focused actions to meet the demand requirements. In the end, the work center improved the tire repair TRR to 13 days.

Some of their "frozen middle"—those managers who were so resistant to change at first—became the strongest advocates for the strategically directed, integrated TOCLSS approach. The approach gave a voice to Sailors and Marines to speak openly about innovative ideas without the risks often associated with differences in rank or experience. They established awards for "Innovator of the Quarter" and "Innovator of the Year" to recognize outstanding contributions to improved performance and cultural change. The Supply and Maintenance functions gained significant insight into each other's realms and worked more cooperatively towards achieving breakthrough solutions. In their first year, MALS-

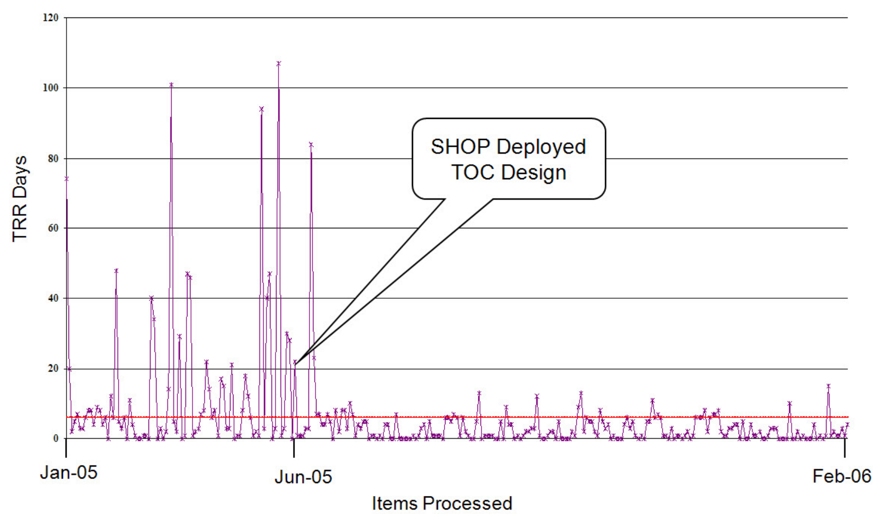

Figure 4. Typical Stabilization in AIR*Speed* TOC designs

24 was able to return $500,000 to their command. In addition, their Aviation Life Support Systems Division realized a cost-avoidance in excess of $750,000. Beyond their own unit, they initiated exchange programs between their intermediate maintenance personnel and their supported customers' operational maintenance personnel to further improve communication and bridge another long-standing cultural divide. Throughout the world, other aircraft maintenance and supply support units accomplished equally impressive results.

AIR*Speed* Addressed Strategic Opportunities

As sites achieved maturity in AIR*Speed* design and the entire enterprise operation gained increasing stability, previously hidden opportunities began to surface. Perhaps more impressive were the global business opportunities that the AIR*Speed* design and approach offered to the NAE leadership. Two cases exemplify how the leadership seized these strategic opportunities and realized breakthrough ideas that would not have been possible through singular and locally applied CPI endeavors. The first case was the NAE's strategic response to the external pressure to restructure (the Congressionally-mandated Base Closure and Realignment [BRAC] Commission of 2005). The second case revealed how the NAE leadership, based on the results of implementing the AIR*Speed* methodology, challenged universally accepted business rules to impact organizations beyond the Navy to enable enterprise-wide performance gains. Only with the strategic method, roadmap, and thinking toolset of AIR*Speed* could the U.S. Navy and Marine Corps shape enterprise-wide business paradigms in such strategic and proactive ways to profoundly increase capacity to cover future growing worldwide requirements at less cost and footprint.

Enterprise Response to "Down-Sizing" Mandate

In the midst of all the internal efforts to improve the aircraft maintenance and supply support system, the NAE was confronted with challenges and changes imposed from outside the U.S. Navy. Established in law, the recommendations of the 2005 Defense BRAC directed the NAE to consolidate 20 IMAs (Intermediate Maintenance Activities) and from 3 depots into six, geographically-aligned Fleet Readiness Centers (FRCs). (See Figure 5.) In addition to budget cuts indicated previously, this law mandated a $1.2 billion budget cut over a 5-year period, counting on $967 million to be saved through the consolidation of workload and infrastructure and additional CPI initiatives. Despite the imposed reductions, the new FRCs of integrated intermediate and depot activities would still comprise the substantial share of the NAE.

Figure 5. BRAC-directed consolidation into Fleet Readiness Centers

Compared to the challenge of bridging the maintenance and supply gap in a squadron, the challenges of integrating and consolidating these diverse communities appeared overwhelmingly difficult. Over 100 distinctive differences in policies, measures and behaviors needed to be addressed, including as the most significant, the following:

- Intermediate level focused on repairs - Depot level focus was overhaul
- Different funding streams used at each level that cannot be crossed – both in Material & Labor
  - Artisan labor (civilians) - Navy Working Capital Funded
  - Sailors - Mission Funded
- Different maintenance data systems used
- Different suppliers utilized
- Different Quality Assurance policies, certifications and tool controls
- Intermediate level demand was in a closed loop system – depot demand scheduled from supplier

To meet these challenges, the BRAC FRC implementation team used the same ***VELOCITY*** approach. Although at a different scale, the approach was consistent with other AIR*Speed* efforts—use the strategic direction to develop a prototype design that could be exported throughout the system to enable rapid implementation. Key stakeholders at the FRC Southwest, with expert facilitators, evaluated their AS-IS situations, designed their desired TO-BE states, and developed implementation plans to accomplish the transitions. The NAE leadership provided strategic guidelines. The integration within work centers had to be genuine and complete—sailors and artisans would work side-by-side to eliminate any possibility of preserving stovepipes from the old perspectives of intermediate and depot level work. Military and civilian career paths and promotion opportunities had to be sustained. Work would be redefined by the tasks required, not by the historical record of what type of work it had been or who had accomplished the work in the past. The transition needed to be transparent to all customers. Cost and personnel savings were a necessary outcome. Finally, no negative impact on mission readiness was acceptable.

Five teams—maintenance, supply, production control, information technology and human resources—worked collaboratively to develop the integrated depot/intermediate maintenance prototype. Using the array of TOCLSS tools, the initial integrated work center improved their first product's TRR (Time-to-Reliably Replenish) from 138 days to 25 days. Included in this effort was reconfiguration of the data systems to effectively share data between previously independent financial and production control systems. Additionally, the design incorporated an execution management software tool to effectively manage activity in the time domain, instead of focusing exclusively on inventory stock levels. Execution management reports provided early warning indications that improved work prioritization and the timeliness of delivery of demanded components. This focus precluded tampering with the system of interdependencies, variability and constraints–where so doing would only deteriorate system performance.

The results exceeded NAE leadership's expectation—both in magnitude and in speed of delivery. In an activity where three shifts plus overtime labor had been the norm for more than seven years, process-owners reduced the required work day down to two shifts, without any overtime. In the overtime category alone, they saved over 5,300 hours. Although they have completed only 9 designs for integrated shops, they project a 10% to 46% reduction in direct labor hours, 7% to 36% reduction in costs to the customer and 62% to 92% reduction in TRR.

Challenging Universally-accepted Enterprise Business Rules

The second strategic opportunity was how AIR*Speed* leaders, armed with critical thinking tools, exploited universally accepted business rules to improve the system beyond the scope of the Navy alone—in particular to the Defense Logistics Agency (DLA) in support of NAE customers. An AIR*Speed* pilot project between MALS-14 and DLA Richmond set out to address the concepts of material re-order point / periodicity and subsequent wholesale-retail supply positioning and world-wide distribution. Fully exploiting the Enterprise AIR*Speed* constraint-based system architecture; their effort first identified misalignments between wholesale and retail inventories that resulted in supportability gaps. Items were either redundant (stocked at both levels) or not carried in either inventory. Both sets of inventory situations, when compared with each other after injecting alternative AIR*Speed* business rules (replenishment re-order batching), represented an opportunity for wholesale-to-retail "trade-space" exposed by two potential outcomes: either a 58% overlap of inventories (too much inventory globally that could be divested) or a potential 122.5 day reduction in supply-chain TRR (items that offer repositioning or investment opportunities). The successful identification of these savings opportunities led to the pilot being expanded to 14 other NAE sites (MALS, Naval Air Stations, and Ships afloat) beginning in 2008.

The exposure of these enterprise-wide business rule implications, and the subsequent impact toward increased performance support with less overall footprint, enabled the Marines to further validate and refine a strategy for applying the AIR*Speed* logistics architecture to forward-deployed supply chains. This new logistics strategy—called the Marine Aviation Logistics Support Program II (MALSP-II)—extends the AIR*Speed* site design of the demand-pull system architecture across a deployed network of aviation logistics. (See Figure 6.) The outcome increased aviation forces performance with less infrastructure footprint needed at multiple forward and remote sites. Applied to Marine Aviation forces operating during OPERATION Iraqi Freedom, the Marines demonstrated a dramatic improvement for aircraft-on-ground (AOG) supply effectiveness from 45% in 2006 to 98% in 2007 across a specified population of critical consumable components. These results came from AIR*Speed* business rule changes, not with new technology or by pushing more parts forward, and enabled the Marines to reduce inventory footprint while increasing mission effectiveness and supply chain reliability. The Marines continue to exploit this strategic opportunity as they reshape their logistics business doctrine and modify decision rules for future war-fighting planning and execution.

The Enterprise AIR*Speed Journey continues…*

A vital element in developing the ***VELOCITY*** approach of constraint-based system architecture and the integrated TOCLSS focused improvement process was the compelling challenge to create a methodology that would not only yield system improvements, but one that would sustain those results organically. In addition, the approach needed to produce a culture that valued on-going improvements and included the training, knowledge transfer and management tools to make improvement activities repeatable and scalable to any organization in the system. The results to date indicate the sustainment requirement is well on its way to being fulfilled. For example, the FRC Mid-Atlantic in Norfolk, Virginia, achieved improvement results compara-

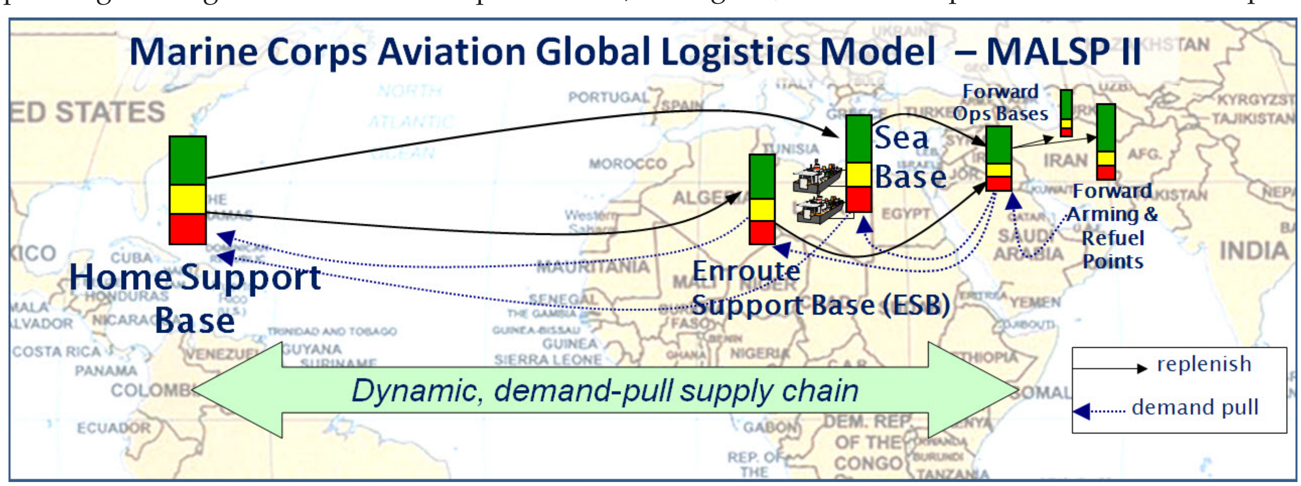

Figure 6. Marine Corps Aviation Global Logistics Model—MALSP II

ble to other units previously cited, but in addition they have shared their AIR*Speed* training and philosophy beyond their own unit. Other units at Norfolk, especially operational aviation and carrier units, who are the customers that benefit from the FRC's improved results, have sought insight and awareness of the Enterprise AIR*Speed* methods. The AIR*Speed* methods have become daily practice as sailors and civilians in their workforce now routinely look for improvement opportunities and are rewarded for doing so.

Award-winning Results

The AIR*Speed* journey was not a simple straightforward course from A to B and many lessons were learned along the way. Some obstacles arose from the fundamental concepts of the methodologies themselves and through AGI's leadership, the team of TOC and LSS experts resolved each of those conflicts to create a truly coherent, integrated TOCLSS solution. Other obstacles were common to any major organizational or procedural change that requires education, training, experience, leadership and success to overcome. Nonetheless, as the training and implementations progressed, the Enterprise AIR*Speed* culture continued to spread in breadth and depth. In 2007, the NAVAIR Commander's National Award in the Logistics and Industrial Category was presented to the Maintenance and Supply Integration Performance Improvement Team. The award cited the training and mentoring "to strategically implement the Theory of Constraints and tactically focus on Lean and Six Sigma events to increase throughput and decrease inventory and operating expenses."

Why VELOCITY Makes a Difference

Efforts to make dramatic improvement are not new. Over the years, many of the units and organizations involved in Enterprise AIR*Speed* have had a long history of diligent, well-executed, good-intentioned efforts to improve performance and quality, cut expenses, or both. What makes the current approach different? How have these newest AIR*Speed* efforts achieved a higher degree of success?

One could argue the TOCLSS integration just takes the best from each methodology and applies the tools where they are best suited, but that would ignore the vital impact of the system perspective and strategic direction.

The ***VELOCITY*** approach is more than just a combination of tools and methods—it's an approach that requires the system perspective of constraint-based thinking and TOC design principles to stabilize the system's performance towards achieving a determined goal AND incorporates the best TOC and LSS practices into a tightly-intertwined improvement process that focuses on the issues that matter the most. With Enterprise AIR*Speed*, the NAE leadership focused on speed with direction; the velocity of their results is inspiring and creating a new breed in their workforce engaged in genuine transformation.

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442 Orange Street
New Haven, CT 06511 USA
Tel: +1-203-624-9026

Goldratt Institute™ Focused System Improvement
www.goldratt.com

Penthouse Level, Suntec Tower Three
8 Temask Blvd, SINGAPORE 038988
Tel: +65-97468450