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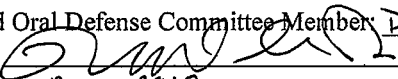
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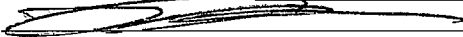
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Executive Summary

Title: Art into Science: Helicopter Fleet Replacement Squadron Operations in a Period of Transition

Author: Major Patrick Lieneweg, United States Marine Corps

Thesis: The interactions in the Marine Corps H-1 training squadron's operations and maintenance departments between 2008 and 2011 were subjected to a variety of misaligned external requirements and asset structure issues while undergoing a transition to new aircraft. The injection of End-to-End Continuous Process Improvement did not result in the desired improvements in pilot production or aircraft readiness due to these influences. Until a standardized training program is implemented, managing this complex system will remain an art, rather than a repeatable scientific process.

Discussion: From 2008 to 2011, the Marine Corps' only Cobra and Huey training squadron began the transition to new aircraft: the UH-1Y and the AH-1Z. During this time, significant manpower fluctuations resulted from a total force increase, and a subsequent reduction following the Force Structure Review Group in 2010. Production requirements at the squadron continued to increase, while student inflow to the squadron fluctuated significantly and aircraft availability decreased. As the squadron struggled to produce the required number of aviators for the fleet, the Marine Corps injected a process improvement initiative under the Naval Air Enterprise AIRSpeed End-to-End program. The program sought to increase aircraft availability and production throughput using Lean and Six Sigma efficiency concepts. The squadron's aircraft readiness and production output continued to decline, however. This study examines the effects of misaligned production goals and resource constraints, and notes how ultimately excessive production requirements overloaded a system in transition.

Conclusion: In light of the significant sources of variance it is not surprising that the squadron's readiness and training throughput suffered. Until the Marine Corps adopts a formal training course for key operations personnel, the relationships between operations and maintenance will continue to retain an ad hoc and personality driven character. The recommendation resulting from this study is the establishment of proper training courses for operations personnel, because only with the right training can the "art" of squadron operations be converted to a repeatable, scientific process.

Preface

This paper is the culmination of many months of both direct involvement in the process of training aviators, and of later study from afar. My conclusions are informed greatly by bottom-up perspectives by other participants in the process, as well as personal observations from three years of work within the maintenance and operations departments of the subject squadron. I tried to focus on constraints and hindrances that stood in the squadron's way in producing whatever number of helicopter pilots the Marine Corps needed in a given year. This study may hopefully inform future students of operations management and production processes by providing a unique insight into a specific system about which not much is written.

I am indebted to, and wish to acknowledge the hard work of the operations and maintenance professionals of HMLAT-303, Major Terry Milner, the Current Readiness Officers at MAG-39, and the AIRSpeed team for their invaluable contributions to this study and Marine Rotary Wing Aviation. I wish to also extend my heartfelt gratitude to Dr. Gelpi, Dr. Wineman, Dr. Swanson, Col Fitzpatrick, and the Command & Staff faculty who guided my research and tested its value. Above all, I wish to thank Carrie and Aubrey for continuing to bear the burdens of my many absences.

Introduction

In the spring of 2008, Marine Light Attack Helicopter Training Squadron 303 (HMLAT-303) took delivery of the first Bell UH-1Y *Venom* helicopter, a long-awaited upgrade to the aging UH-1N *Iroquois*, also known as the Huey. Colloquially, the two Huey variants became known as “Yankees” and “Novembers” respectively. This was the first delivery of these aircraft to an operational end user, as only test pilots had flown the UH-1Y until this time. The event was an initial milestone of a Marine Corps-wide, phased replacement of the 30-year-old UH-1N fleet, a change over that began with the seeding of a self-sustaining training process at HMLAT-303 with aircraft and pilots.

Although beloved by its crews and periodically updated with newer sensors, weapons, and other improvements, the Huey fleet was at the end of its useful lifespan. Of mid-1970s manufacture, the twin-engine UH-1N was under-powered, its aging components suffering from the effects of decades of vibration, corrosion, dirt, and hard use.¹ Although configurable for up to 14 passengers, an armed, fully fueled UH-1N’s passenger load was realistically limited to about four combat-loaded Marines, and a combat radius of about 50 miles.² That capacity further degraded as air density decreased, such as in the high temperatures of the Middle East, or in the mountainous terrain of Afghanistan.

The new UH-1Y featured state-of-the art fiber composite structural components, four-blade main and tail rotors, powerful engines, flight control computers, “glass” cockpits, digital self-diagnostic systems, heads up displays, and other modern helicopter features. The new aircraft were faster and more robust, could carry greater loads over longer distances (the UH-1Y approximately doubled the combat assault capabilities of the UH-1N), and were designed for

ease of maintenance.³ They were also significantly different enough from the UH-1N to warrant a months-long training program for pilots, crew chiefs, and maintainers.

The task of training Marines to operate the new aircraft fell to Marine Light Attack Helicopter Training Squadron 303 (HMLAT-303) as the designated H-1 Fleet Replacement Squadron (FRS). Over the next three years, between one and three UH-1Ys were delivered from the factory each month, first to HMLAT-303, and then to the rest of the fleet. The squadron continued to train concurrently in UH-1Ns until mid-2011, as the fleet still required replacement legacy aircrews and maintainers. These factors created significant operational challenges, as the squadron sought to train its own UH-1Y instructor cadre along with new and transitioning fleet pilots, all with limited manpower and aircraft readiness, and all under real-world time constraints required to support the fleet's operational deployment cycle with replacement pilots and crew chiefs. As the upgraded aircraft gradually replaced legacy models at the FRS and in the fleet, HMLAT-303 sought to develop and improve efficiencies in maintaining aircraft and training aircrews. At the leading edge of the Marine Corps-wide UH-1Y and AH-1Z transition, the squadron also underwent a concurrent transformation in the coordination of air operations and aircraft maintenance execution in order to maximize training throughput and improve aircraft maintenance processes.

From Art to Science

This paper examines activities and interactions in the Marine Corps H-1 training squadron's operations and maintenance departments between 2008 and 2011, which were subjected to a variety of misaligned external requirements and asset structure issues while undergoing a transition to new aircraft. In an attempt to make the squadron operate more efficiently, the squadron consulted a group of subject matter experts from the Navy's AIRSpeed

program. The squadron adopted many of the group's recommended procedures; however, these did not bring about the desired levels of improvement in pilot production or aircraft readiness. The Marine Corps has since made great strides to align resources and mission requirements, and the squadron has progressed toward a more scientific approach to operations management.

It is doubtful that the Marine Corps has ever introduced a new airframe into the fleet without some difficulty. In the case of the current transition to upgrade UH-1Y and AH-1Z in an ongoing production process without pause, in fact while increasing overall production, made this challenge even more difficult. While this situation may have been unique, to hope that similar circumstances will never happen again may not be realistic. There are a number of plausible scenarios currently on the horizon that could pose challenges similar to those covered in this examination. For example, as budget and force drawdown initiatives come to bear in the near future, new constraints in flight hours and manpower will almost certainly be introduced to this system. The ability to manage production capacity correctly and efficiently will be of paramount importance in maintaining adequate fleet manpower levels and combat readiness.

A near-total comprehension of the system and its tributaries will be required at the squadron level to inform manpower and budgeting decisions among the various stake-holding agencies, and to help align the process. Without this knowledge, communications between the departments will likely be ineffective, and maximized efficiency in the entire production process will remain elusive. The complex requirements of this task cannot be taught via an outdated desktop procedure binder and on-the-job training. A formal training program must be implemented for training squadron operations officers. Until this occurs, managing this complex system will remain subject to individualism and skill, rather than a repeatable scientific process, and will likely retain inefficiency as a result.

Training

Although HMLAT-303 trains all Marine Corps H-1 pilots and crew chiefs, this study will focus on UH-1Y and AH-1W pilot training. This includes Replacement Pilots (also referred to by the misnomer of Replacement Air Crew, or RACs), qualified UH-1N pilots undergoing basic conversion to the UH-1Y (“Series Conversions”), pilots returning to flying assignments after long absence (“Refreshers”), and FRS Instructor (FRSI) training.⁴ While AH-1Z, UH-1N, and crew chief training were also an important part of the H-1 FRS mission, the aforementioned population represented the main challenge from an operations perspective.

Marine aviation training is prescribed in detail in the NAVMC 3500.14C Aviation Training and Readiness Program Manual, and its accompanying, platform-specific volumes. Known collectively as the T&R, these manuals codify the squadron structure of pilots, qualifications, and aircraft assets, and serve as the foundational reference for all flight training at the squadron. What the T&Rs do not contain is a prescription for the “art” of balancing training requirements with training asset management, i.e. how to maximize production without causing reduced readiness through improper or excessive scheduling. In fact, as of this study there was no document or training course for FRS operations officers that prescribed these concepts. The following example of UH-1Y training serves to illustrate the general requirements common across the platforms.

While a T&R for the UH-1Y existed in draft form at the start of the UH-1Y upgrade transition in 2008, the pilot training syllabus generally followed the same lines as the UH-1N syllabus, with some additions to accommodate for the operation of new systems. The basic UH-1Y pilot training syllabus consisted of several stages of various familiarization flights in day, night, and instrument flight conditions. It included aircraft systems knowledge, basic flight procedures, emergency procedures practice, visual navigation, low-level terrain flight, basic

conventional weapons delivery, confined area operations, external load lifting, and night vision device training among other things. The T&R prescribed the duration of the syllabus for “Category One” (CAT-I) pilots as 22 weeks. The syllabus to convert a qualified UH-1N pilot to the UH-1Y distilled the CAT-I syllabus to focus only on differences between the old and new series, and lasted approximately 2-3 months. This produced only the most basic qualification in the aircraft. The remaining training fell to the pilot’s fleet squadron.⁵ A full UH-1N FRSI conversion to UH-1Y FRSI was prescribed as 17 weeks, but realistically required approximately 5-6 months, and took place entirely at HMLAT-303.⁶

On average, between 5-15 UH-1Y pilots were under instruction at any one time between 2008 and 2011.⁷ The UH-1Y instructor pool grew from 5 in 2008 to 10 in 2011.⁶ The annual RAC training requirement, as dictated by the office of Aviation Production Management (APM), grew from 12 in 2008 to 26 in 2011.⁸ Additionally, HMLAT-303 began the series conversion of all west coast UH-1N fleet pilots in 2008 to keep up with aircraft deliveries and meet fleet conversion and deployment timelines.

Squadron Operations

In the period under study, HMLAT-303’s operations department employed 2-3 flight officers per aircraft type, who oversaw and directed the syllabus progression of the student population in accordance with T&R requirements, produced daily flight schedules, coordinated ordnance and ranges, and oversaw a student staff of about 10-12 lieutenants. Future operations, such as squadron detachments for training (DFTs), were planned and coordinated by a Future Operations officer, who shared an office with the Assistant Operations Officer (AOPSO). The AOPSO supervised several flight scheduling officers, supervised the enlisted operations clerks and the ground training chief, and tended to administrative matters. The Operations Officer

(OPSO) oversaw the entire department, coordinated with MAG-39 and various external stakeholding agencies, and directed and supervised the execution of the flight hour program. In 2011, the operations department (S-3) was divided into Current Operations (COPS) and Future Operations (FOPS) departments, which divided up the responsibilities for short and long-term operational planning. A Student Control (STUCON) department was created as a separate staff division to coordinate with external agencies, forecast and manage student inflow, and oversee the completion of syllabus prerequisites before students commenced training flights in the aircraft. Collocated with STUCON was a civilian Naval Aviation Production Plan (NAPP) analyst, who collected data on squadron production and assisted STUCON with production throughput modeling.⁹

Electronic Training Management

A central STUCON function was to forecast, monitor, and report student throughput, based on instructor and aircraft assignments, utilizing an assigned Naval Aviation Production Process (NAPP) analyst and the web-based Production Planning Factor (WebPPF) training modeling program.¹⁰ WebPPF replaced a manual, formula-based method to determine FRS training capacity in 2007. During the period under study, the NAPP process remained in the data collection stage, and actionable operational analysis was not yet available. In the interim, WebPPF facilitated long-term production planning, and could be used to predict training throughput capacity. The WebPPF tool was used by squadron, MAG-39, and Transition Task Force staffs to forecast and justify manpower and aircraft allocations during the transition period.¹¹

The “Marine Sierra Hotel Aviation Readiness Program” (M-SHARP), implemented by Training and Education Command’s Aviation Training Division (ATD), was the squadron’s

web-based training management tool. The M-SHARP program enabled electronic flight scheduling, flight logging (the program incorporated the Naval Flight Information Record System NAVFLIRS), and tracking of all training events in accordance with the rules of the T&R, and enabled automated reports generation for oversight. The program came with a 532-page manual, and required a two-week training course to understand, but was not fully implemented at HMLAT-303 during the UH-1Y transition.¹²

The squadron operations staff may have benefited from wider familiarity in the use of these training management tools. While only one officer was required to receive formal training in these programs, the majority of the staff only had a limited working knowledge. As of this writing, no formal training management course existed for Marine Corps squadron operations officers, pilot training officers, flight schedulers, or student control personnel. The “art” of balancing squadron production against resource constraints was learned on the job, and remained more improvisational and reactive than scientific and predictable. This was a significant problem, which persisted as an organizational inefficiency throughout the period under study.

Sources of Variance

Marine Corps Aviation production requirements are based on various external agencies interpretation of fleet demand, which are independent of FRS production capacity.¹³ Although OPNAVINST 3500.31G clearly delineates responsibilities for assessing and incorporating FRS capacity in the creation of Training Requirements Letters, these considerations appear to have fallen away in the drive to build the “202k” force. It was not until 2011 that the Marine Corps brought all the production agencies back into alignment.¹⁴ One of the most significant production challenges during this period was the externally caused fluctuation in student populations. During the period under study, HQMC’s initiative to clear out “pools,” where a number of

students could be placed to await the start of their 20-week syllabus, meant that arriving students had to begin training immediately, regardless of how many students were already in the pipeline. With limited throughput capacity, a decrease in velocity (i.e. increased Time To Train, or TTT) naturally followed.

During the transition, the Marine Corps was also in a state of change- first programming new HMLA squadrons for the projected “202k” force, and then cutting that structure back following the 2010 Force Structure Review Group (FSRG).¹⁵ The increased number of students fed into the 2-year aviation training pipeline at Pensacola was programmed to support the growth of additional squadrons. When this structure was reduced in 2010, an excess of student aviators remained in the pipeline, which continued to flow through the FRS. The HMLAT-303 Pilot Training Requirement (PTR) remained at pre-FSRG levels to clear these students out of the pipeline. The excess of students was further exacerbated by the Marine Corps’ decision to accelerate the “sundown” of the UH-1N to 2011.¹⁶ This created an additional population of students that had been programmed to fly UH-1Ns, which APM reassigned to fly either AH-1Ws or UH-1Ys. The outcome of these manpower decisions was a 24% increase in the squadron’s total throughput requirement in 2009, which then remained at those levels through 2011.¹⁷

Other input variances were the result of budget constraints. In the first half of FY11, a funding freeze halted cross-country military personnel transfers, and with it student inflow to HMLAT-303 for several months. Not only was there an excess of students to be trained, the backlog arrived en masse at the FRS, once funding returned. While this also occurred in 2010, the greatest impact on student production was in 2011 (see Figures 4 and 6), causing a significant shortfall in both AH-1W and UH-1Y.

In June 2011, ASM finally codified the routine by which naval aviator production would be managed among the various stake-holding agencies.¹⁸ In defining and aligning more closely the various organizational roles and responsibilities, the identification and communication of manpower and training requirements was facilitated, as well as the provision of timely and accurate feedback. The effects of this organizational realignment on FRS production remain to be seen, but appear to address many of the problems outlined here.

Training Asset Variance

In 2011, the T&R listed HMLAT-303's asset structure as 14 UH-1s, which still reflected the requirement to produce the pilots needed for the "202k" fleet. The actual number of assigned aircraft fluctuated monthly, as aircraft were shuffled between squadrons during the transition. Permanently Assigned Aircraft (PAA) varied from as much as 10 Yankees at the start of 2009 to 6 by the 3rd quarter, and leveling off at 8 in 2011. Not only were too few aircraft assigned to create the capacity to meet the TRL, the mechanical health of these few UH-1Y helicopters remained poor, with less than half of the assigned aircraft generally ready to fly (see Appendix, Figure 5).¹⁹

The low number of aircraft assigned meant that in order to complete the sorties required to train the growing number of students, healthy aircraft were flown continuously for long periods, with returning crews hot-seating, or switching seats with the outbound crews with the aircraft still running. Hot-seating cut down the number of aircraft required to support the flight schedule, which reduced the immediate maintenance effort, but did not reduce the high overall utilization rates. The high usage exceeded the rates programmed in the H-1 Weapons System Planning Document (WSPD), and caused accelerated parts consumption, which affected readiness.

Moreover, certain existing parts continued to fail sooner in their lifecycles than advertised, which increased the parts demand further.²⁰

The aviation supply system was not able to quickly adjust to the increased demand for parts, especially on the new upgrades aircraft. Often replacement parts had not yet been manufactured, or required repair by the manufacturer, which frequently resulted in weeks of maintenance delays. Many times parts were pulled from the Bell assembly line and shipped directly to the squadron. As the fleet squadrons began to fly the UH-1Y in Afghanistan, these squadrons naturally had priority for these parts. To compensate, parts were often “cannibalized” at HMLAT-303 from aircraft awaiting maintenance action for other issues, resulting in some aircraft remaining in an un-flyable status for months on end. This, in turn, led to fewer aircraft flying even more hours, as the squadron fought to continue the same student throughput.²¹

Exacerbating the parts supply problem was an understandable lack of upgrades experience among the squadron’s maintenance personnel. The volumes of technical publications and manuals required to properly maintain the new aircraft were sometimes inadequate or occasionally even incorrect. Despite the maintenance department’s concerted efforts to bridge experience gaps with smart, hard-working people and technical advice from on-site technical representatives, from time to time human errors caused additional damage to aircraft. More than once an incorrectly applied troubleshooting procedure resulted in catastrophic damage to major airframe components due to maintainer inexperience. Major replacement components were still being manufactured, and some aircraft sat unusable for up to a year awaiting replacement parts.²² A detailed analysis of HMLAT-303 aircraft readiness rates follows later in this study.

Manpower

In 2009 there were only eight UH-1Y instructor pilots present at HMLAT-303. In 2011 there were ten, although the squadron's mission really required thirteen, according to WebPPF modeling.²³ Training new instructors was a challenge to student production in itself, because due to constrained resources, the squadron could only train instructors by displacing student training sorties. In other words, any instructor training directly impacted student training because there was no excess capacity in the system. Accordingly, the time required to convert a single UH-1N instructor to the UH-1Y grew to over 6 months.²⁴

As the UH-1Y student training requirement continued to grow from twelve students in 2009 to twenty-six in 2011, the squadron's instructor manning requirement increased also, as did the flight hour requirement.²⁵ The squadron assigned more UH-1N instructors to the conversion syllabus, and MAG-39 assigned additional aircraft to the squadron as well.²⁶ Nonetheless, the challenge of unhealthy aircraft and competition for resources continued along the same lines as before, and was reflected by continued poor aircraft readiness rates.

In 2010, as the fleet squadrons began receiving their UH-1Ys, HMLAT-303 pilots provided the initial familiarization training to convert fleet pilots to the UH-1Y. At the same time the FRS continued to meet the growing CAT-1 training requirement and also continued internal efforts to train more UH-1Y instructors. The conversion process continued for each of the remaining squadrons through 2011, driven by unit deployment dates promulgated in the Marine Corps Aviation Plan.²⁷ These requirements undercut FRSI and RAC production, and resulted in reduced output efficiency.

End-to-End and Continuous Process Improvement

In September 2009, HMLAT-303 received an E2E AIRSpeed team, whose purpose served to implement the Naval Aviation Enterprise (NAE) “End-to-End” continuous process improvement concept, also known as E2E AIRSpeed, or simply “E2E”.²⁸ The purpose of E2E is described on the NAE website:

End-to-End (E2E) AIRSpeed incorporates the tools and methodologies of continuous process improvement (Theory of Constraints, Lean and Six Sigma) in a collaborative endeavor among squadron maintenance, supply, ordnance, operations and other aspects of logistics system across the Naval Aviation Enterprise to align and create reliable throughput so that the appropriate levels of readiness of both aircraft and personnel are maintained.²⁹

The E2E team analyzed HMLAT-303’s production process across all relevant lines of operation, maintenance, supply, and management with the purpose of mitigating organizational inefficiencies, improving communications, and facilitating management through improved visibility of asset and manpower status.³⁰ The team worked concurrently with the Marine Aviation Logistics Squadron (MAL-39) to streamline and align supply functions with operational demands. The team traveled to Camp Pendleton monthly to work with HMLAT-303 departmental representatives to improve the squadron’s production process. The main objective of E2E implementation at HMLAT-303 was increased annual throughput by reducing Time-to-Train for CAT-1 pilots. The main supporting objective was increased daily aircraft availability (RBA/RFT), which would naturally translate to improved training throughput. The E2E effort was to culminate with the creation of new Standard Operating Procedures (SOP), which implemented these improvements.

Previous to the application of E2E Continuous Process Improvement (CPI), the interaction between the operations and maintenance departments was not specifically codified. In a standard year, the HMLAT-303 operations department created an annual production plan, based on the

annual Training Requirement Letter (TRL) and allocated flight hours. While the FRS optimally would have communicated its throughput capacity to ASM in order to inform TRL decisions, the many variance factors in the period under study made this assessment difficult. Normally, as the production year progressed, execution usually diverged from the plan as flights were canceled due to various factors. In the period under study, the operations department resorted to short-term, reactive planning to try to “get back on track” to meet production goals, but was often disrupted by the factors discussed previously.³¹

While the T&R, the TRL, and the Commanding Officer’s directions limited the departments’ activities, there was no written guideline on how the planning and execution process was supposed to cope with mid-stream changes. While a production planning order existed, the formulas were based on static resource quantities. In the period under study, the operations department’s aircraft requirements were presented to the maintenance department on a weekly basis, and were subject to interpretation, negotiation, personal influence, and other non-empirical methods between the departments. E2E sought to codify that relationship, and reduce the variance and performance fluctuations inherent in the HMLAT-303 system.³²

A central theory of E2E revolved around the key concept of reducing “variance” in the system. Variance, from an operations standpoint, meant increases and reductions in scheduled flight hours, driven by responses to deviation from programmed annual flight hours and student production goals. For example, cancelled flights on a Wednesday would mean additional flights on the following days in order to stay on track for the week. Multiple cancellations had to be met with surge days later on, which created variance in aircraft utilization.

The variance in demand for aircraft was unsynchronized with, and exacerbated variances in aircraft readiness and availability from the maintenance perspective. The un-programmed

increases in demand for aircraft affected overall aircraft readiness due to breakage or decreased intervals in required periodic maintenance. The reactions to these demand and supply fluctuations were usually subjective nature, and were a product of the judgment and personalities of more-or-less experienced key players in the departments. The E2E process purported to develop and implement systemic changes that mitigated variance in a scientific and predictable way, and also to facilitate greater oversight and simplify management of critical resources.³³

The E2E process codified, and implemented the concept of “buffer” management, in terms of flight hours and available aircraft. Operational plans were developed to include a certain percentage of flight hours on top of the base requirement, to “protect for” a normal percentage of canceled flights. The maintenance plan also included an aircraft buffer, which meant that extra aircraft were kept ready daily, to protect for a certain percentage of aircraft breakdown. Through automated reports, each department recorded and reviewed utilization of their buffers at scheduled intervals, and over time adjusted these buffers to create a more stable and predictable system of aircraft asset allocation and utilization. At HMLAT-303 the practice of buffering was not unfamiliar, but the degrees of definition and standardization that E2E introduced were certainly an improvement. Also new was a codified standard response by each department to various degrees of buffer utilization, all set forth in a command SOP.³⁴

E2E Analysis & Evaluation

As with any attempt at organizational change, the E2E effort was initially met with some skepticism by squadron members. The requirement for long meetings to identify nuanced problems and resolve systemic changes cut into a great deal of valuable time in the squadron’s high operational tempo environment. Additionally, the commitment to implement these changes

and teach the process to the rest of the squadron was essentially self-driven. The final outcome at the end of two years of CPI efforts at the squadron was debatable, and perhaps predictably so.

Some of the E2E process improvements implemented at HMLAT-303 included:

- a. Standardized rules of engagement between operations and maintenance departments (the SOP remained in draft form, but the ROE were followed in practice)
- b. Development of monthly training forecasts, and promulgation at Planning Boards.
- c. Improved documentation of flight completions and cancellations.
- d. Functional Check Flight procedures changed to reduce maintenance-related flight hour overhead.
- e. Improved reporting and monthly maintenance trend analysis to inform decisions on flight scheduling and execution.
- f. Reduced lengths and “gold plating” of aircraft phase inspections, i.e. reducing the level of attention to detail and performing only the required actions.³⁵

Conversations with members of the operations and maintenance departments in 2011 revealed perceptions that the effects of E2E were minimal- in essence much talk and turmoil resulting in few real results.³⁶ The statistical evidence provided by the squadron in 2012 appears to confirm no significant improvement in student throughput or aircraft readiness in the wake of E2E. Readiness metrics continued to lag well behind expectations through 2011, and CAT-1 production goals remained behind schedule (see Appendix figures 1-6).³⁷ The SOP that was supposed to maximize efficiency in the squadron remained unpublished as of this study. The E2E team has since moved on to other projects, and many key squadron personnel involved in the process have moved on to other assignments.

On the other hand, opinions also prevailed in the squadron that participation in the process itself had stimulated more scientific interaction and discussion between the maintenance and operations departments that had not existed before.³⁸ The codified aircraft and flight hour buffer

concepts introduced by the E2E team appeared to have gained credibility, and the command implemented a significant departmental reorganization to facilitate long-term planning. These follow-on efforts remained under development as of this study.

The concept of deploying a highly trained process analysis team to build efficiency through proven systems likely bears merit, as evident from the significant results a KC-130J Hercules testbed squadron had managed to realize.³⁹ However, these were single-platform squadrons of constant size and throughput, and not subject to the greater variety of variance seen at HMLAT-303. Also, there was no special selection of exceptional people to man 303's departments. The population, especially enlisted maintenance personnel, was constantly subject to reassignment, which likely resulted in experience and quality norming, instead of growth.

Most importantly, although the FRS received much attention from outside agencies and higher headquarters, that scrutiny was focused on throughput metrics, and not process improvement mechanisms. The squadron's operations and maintenance representatives attempted to develop efficiencies in the presence of the E2E team, without much outside information- for instance, there was no cross talk between HMLAT-303 and other squadrons that had realized benefits from E2E. The team, which brought great expertise to problem articulation and documentation, did less to provide techniques and solutions that could be leveraged to implement systemic change.⁴⁰ The outcome was that the HMLAT-303 system remained essentially what it was- as efficient as possible, given its limited resources and the effects of externally driven variance.

Aircraft Readiness Rates

The aircraft readiness data set examined in this study to assess the efficiency of the operations/maintenance interaction covers a 3-year period from November 2008 to December

2011. The aircraft data provided by the HMLAT-303 maintenance department and the MAG-39 Current Readiness office in 2012 have been broken down and are represented by four graphs provided in Appendix 1. While UH-1N and AH-1Z are represented for information, the analysis focused exclusively on AH-1W and UH-1Y Ready Basic Aircraft (RBA). The trend analysis of these data showed that aircraft readiness remained well below goals set by MAG-39 in the years of the upgrades transition, and that E2E Continuous Process Improvement did not measurably raise readiness rates to the desired levels.⁴¹

Figure 1 represents average monthly RBA percentages with colored lines against a backdrop of the 75% readiness goal set by the Aviation Logistics Support Branch at Headquarters Marine Corps (ALS-2).⁴² Two polynomial trend lines are superimposed to represent trends for AH-1Ws and UH-1Ys. Also included were other notable events across the period, to include E2E design and implementation periods, and arrivals and departures of AH-1Z and UH-1N. These two platforms did not appear to influence the trends of the other two, and were disregarded in the analysis.

Figure 1 displays a decline in total readiness across 2009, starting at around 75-80% in January, and dropping to a low average of around 40% for UH-1Ys and 50-60% for the Cobras in the following years. 2010 shows an initial surge, followed by a steep drop for UH-1Ys to their lowest recorded RBA in May. A slow recovery follows for the next 18 months, followed by another steep 5-month drop in the fall of 2011. The Cobras vary, but generally level off between 60-70% RBA in 2010 and 2011. AH-1Z and UH-1N were disregarded for purposes of this study, due to the large fluctuations caused by small numbers and unusual circumstances during the stand-up and sundown events of these platforms.

Figure 2 shows the number and type of aircraft permanently assigned to the squadron (PAA) across the period. There appears to be no simple correlation between PAA and RBA *percentages*, as fluctuations continued to present in both UH-1Y and AH-1W after the last UH-1N departed in March 2011. Figures 3 and 5 show the relationships between PAA and aircraft in reporting (IR) status, and the numbers of RBA and “Ready For Training” (RFT) aircraft. RFT aircraft had functioning subsystems required for specific syllabus flights (for example, a working gun system on a Cobra for an ordnance training flight). Again, polynomial trend lines were included to illustrate trends in readiness, and the difference between PAA and RFT.

As depicted in Figure 3, the Cobras had high readiness rates at the beginning of 2009, followed by a slight drop across the second half of 2009. At the end of 2011, there was a divergence between RBA and RFT numbers for both aircraft. RBA numbers went up, but RFT remained constant, likely indicating a problem with certain aircraft subsystems. RFT trends improved slightly after September 2009, but remained nearly constant for a year and a half. In Figure 4, the Yankees showed a gradual divergence of PAA and RFT trends across the entire period, starting around 2 and ending with a difference of 4 aircraft. There was a significant amount of fluctuation in PAA until November 2011, after which RBA increased, but RFT remained completely flat. In the second half of the study, these trends to appear to converge slightly, indicating a very small increase in readiness over the course of two years.

The analysis reveals that in these three years, there was no discernible correlational effect of reducing or increasing aircraft quantity on relative readiness for both AH-1W and UH-1Y. This tends to discredit the theory that this particular bit of variance had negative effects on the overall system. However, further analysis shows that the relationship between aircraft quantities and production requirement was not optimally aligned. In FY08, the squadron had an average of

18.7 Cobras assigned. In FY09 the number of assigned Cobras decreased to 16.5, and in FY10 to 15.0. The squadron had an average of 7.7 UH-1Ys in FY09, 6.5 in FY10, and 7.9 in FY11.⁴³ During this time, aggregate student production requirement in FY09 increased nearly 20% over FY08, and remained at that high level in FY10 and FY11.⁴⁴ This means that while the squadron had less AH-1Ws and UH-1Ys assigned in 2009 and 2010, it was simultaneously tasked to increase student production, resulting in a higher training sortie requirement- with a negative impact on readiness.

Student Throughput

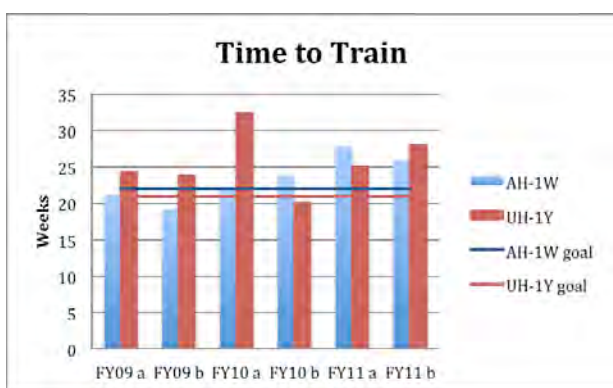


Figure 1

The T&R manuals in 2011 prescribed the FRS syllabus length as 26 weeks for AH-1W, and 22 weeks for UH-1Y pilots.⁴⁵ Two central E2E strategic objectives were to reduce Time-to-Train at HMLAT-303 for each platform to 22 and 21 weeks

respectively. Individual student TTT records from the STUCON department have been grouped here into first and second halves of FY09-11. Figure 1 shows that AH-1W TTT trended upward since the first half of FY10, exceeding the E2E objectives, though remaining within T&R standards. UH-1Y TTT trended upward also, exceeding even T&R parameters, with the exception of an outlier in the second half of FY10.⁴⁶ This overview suggests that no gains toward TTT reduction resulted from E2E process improvement strategies, however, this look does not provide much detail on causality.

A closer examination of output is provided in a graphed summary of AH-1W and UH-1Y student production data from 2008 to 2011 (see Appendix, Figures 4 and 6).⁴⁷ The AH-1W data

in Figure 4 shows a fairly consistent production rate of approximately 5 CAT-1 students per month, with little correlation to aircraft availability or TRL. This reflects the scheduling priority of CAT-1 students that the operations department gave these students in order to meet annual production goals. It is interesting to compare the rise in production goals (tan areas) and Students in Training (red line) to the decrease in aircraft assets (Fig. 3) across the period, decreasing from approximately 14 RFT aircraft in 2009 to an average of 9 in 2010 and 2011. Notably, one of the E2E strategic objectives was to achieve improved student throughput with only 15 assigned aircraft. If any increase in efficiency can be noted in the wake of E2E, it may be found in the consistency of aggregate production despite the decrease in training assets, particularly in FY 10, and perhaps also in the slight narrowing of the average gap between aircraft In Reporting (IR) and Ready For Training (RFT) in 2010 and 2011. In any case, production goals were missed from 2009 to 2011, and aircraft readiness rates remained below the 75% RBA goal discussed previously.

On the UH-1Y side, the operations department balanced student production between CAT-2 series conversions to meet fleet demand during the upgrades transition, and CAT-1 production to fulfill rising TRL goals. The strategic E2E goal was to reduce TTT with 8 aircraft assigned.⁴⁸ Students in Training (SIT) varied widely, due to steep fluctuations in RAC inflow, but generally the department was able to call in CAT-2 SC students from the fleet on short notice to maximize production in times of low CAT-1 inflow. In comparing production to aircraft availability, SIT populations happened to decrease during times of low aircraft availability so no significant conclusions can be drawn. However, as readiness improved from 2010 to 2011 a slight overall rise in monthly production can be determined, and although aggregate production topped out at 20 CAT-1s, this number still exceeded previous years' production goals. The higher RFT rates

seem to have contributed to high production early in the year. Still, as with the AH-1W, readiness rates did not meet the 75% RBA goal across the period under study, and this critical resource constraint ultimately limited production. In 2011, the only year where production failed to achieve TRL goals, the halt in student inflow mid-year due to fiscal constraints masked any efficiencies gained in process improvement.⁴⁹

Conclusions

Did the scientifically improved and standardized business practices between the departments result in improved aircraft readiness and training throughput? The short answer is this squadron did not implement sustained E2E Continuous Process Improvement in the period under study with the level of success that some other squadrons experienced. However, while readiness percentages did not appreciably improve, this outcome cannot be concretely interpreted as a conclusive indictment of E2E. The expectation of significant readiness and throughput results, as intimated by E2E and Marine Corps leadership, were not realized in the required time frame, but the research has not revealed that the process did not have merit. While the production system at HMLAT-303 was simply overwhelmed by excessive mission requirements, the system operated with a new awareness of the variance factors affecting readiness and throughput. The result was that the squadron actually implemented small, self-invented adaptations, even though a fully codified system of efficiencies had not emerged as of 2011.

This study finds that the squadron was subject to a variety of misaligned external requirements and asset structure issues while undergoing a transition to new aircraft. The HMLAT-303 system was too unstable. While the E2E process had the potential to improve squadron operations and maintenance practices, it probably came at the wrong time. In another time, perhaps 3 or 4 years before or after the dual upheavals of Upgrade Transition and Force

Restructuring, CPI may have had more clearly discernible results, however it did not meet the stated objectives in the three-year period under study.

After 2011, aircraft readiness remained below minimum RBA goals, while the squadron continued to struggle to meet an inflated TRL mission for both AH-1W and UH-1Y. Self-discovered efficiencies that kept the training mission afloat before E2E CPI remained in practice, and as of this writing the operations staff had begun to vet and codify these in a separate effort.⁵⁰ The operations department reorganized, and shifted to more proactive planning in concert with the maintenance department, and began to implement changes to support a less volatile and more long-term operational plan. The command's reorganization of the operations department and the creation of a separate student control division in 2011 have increased variance management capabilities, though the results on CAT-1 production will not likely be evident until the other variance sources have evened out. The previously mentioned organizational realignments implemented in the naval aviation production process in 2011 can be expected to contribute greatly to a reduction of external variance.

In 2012, interviews with key maintenance and operations personnel in the squadron showed concurring opinions, in that while E2E may have had merit, the process did not bring significant efficiencies to the squadron. The 70-page E2E SOP of 2011 remained in draft form a year after the conclusion of the E2E policy development phase. Key personnel, from MAG and squadron commanders through operations and maintenance staffs had long since concluded their tours and departed. Some personnel continuity remained in the departments, but for the most part, commitment to the process had faded out.⁵¹

In times of high operational tempo and friction, it is often easier for organizations to revert to tried and trusted methods. In light of the significant sources of variance such as new aircraft,

new training syllabi, new maintenance procedures, limited parts supply, accelerated fleet transition schedules, fiscal constraints, fluctuating and uncoordinated external production requirements, implementation of web-based training management, departmental reorganization, manpower fluctuations, etc., it is not surprising that the readiness and throughput statistics suffered. The operations and maintenance interface remained staffed with well-intentioned, hard working, and intelligent people who continued to build relationships as best they knew how. Until the Marine Corps adopts a formal training course for these key personnel, these relationships will continue to retain an ad hoc and personality driven character.

Recommendations

In this renewed age of fiscal constraint, it will be ever more important that squadron operations officers understand how to accomplish their missions in the most efficient way possible. More manpower fluctuations are looming in the next decade. Decreases in flight hour and maintenance contract funding must be expected as a matter of course. An efficiency-oriented mindset must take root at every level of production. In order to lay the groundwork for successful operations management, formal training for operations personnel must be implemented. More specifically, based upon the challenges faced by HMLAT-303, a solution to the challenges examined in this study calls for the establishment of an aviation operations officer course.

With the exception of an optional M-SHARP training course, squadron operations officers currently receive no formal training. Marine training and fleet squadrons consist of hundreds of individuals who operate some of the most cutting-edge, expensive, and deadly equipment ever fielded. While the ponderous training requirements for the most mundane administrative functions in other areas are familiar to most Marines, squadron operations officers are expected

to rapidly learn to manage complex training and asset utilization programs from informally kept desktop binders, and transitory information dumps from their predecessors, while also executing their extensive flying duties. This practice requires the acceptance risk that only grows with the introduction of the friction factors discussed in this study. What is needed is a formal training course that will posture squadron operations officers for success.

A formal operations officer course should impart not only a working knowledge of enduring operations management concepts, but also an understanding of electronic training management systems such as M-SHARP, NAPP data analysis capabilities, and standardized production process improvement concepts. This academic foundation would enable operations officers to avoid flawed management strategies and, in their place, adopt practices that are more efficient. Since many of these concepts are applicable to all Marine squadrons, regardless of aircraft type, the cross-pollination achieved during such courses would build corporate knowledge of efficient practices across the aviation fleet. Such a course should be similar in length to the current Aircraft Maintenance Officer (AMO) or Detachment Maintenance Officer (DETMO) courses, and separate course segments should be created for FRS and fleet squadrons, as these training environments encompass significant differences. This course would likely best be taught at quarterly intervals by current, or former operations officers from the aviation community; moreover, this instruction would take place in close proximity to the squadrons in order to mitigate travel costs. Only with the right training can the “art” of operations be converted to an efficient, repeatable, and ultimately easier and less costly scientific process.

Appendix A

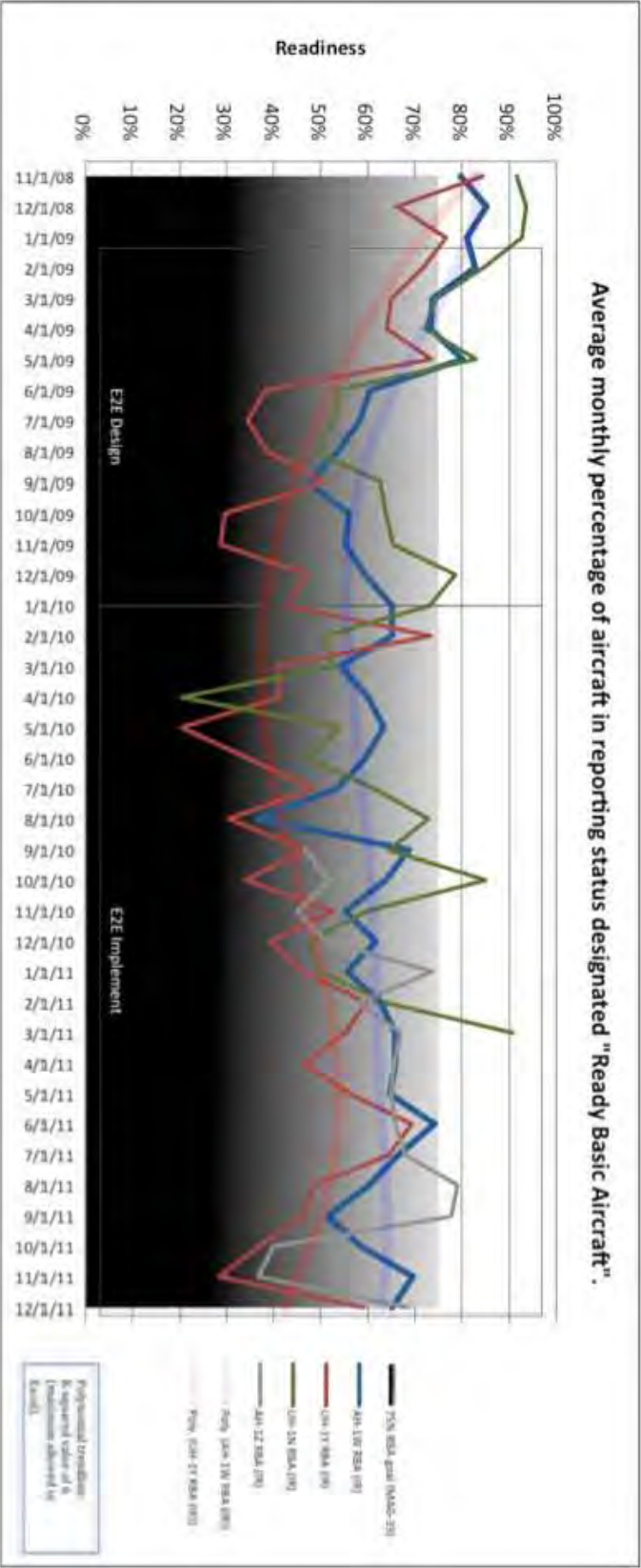


Figure 1

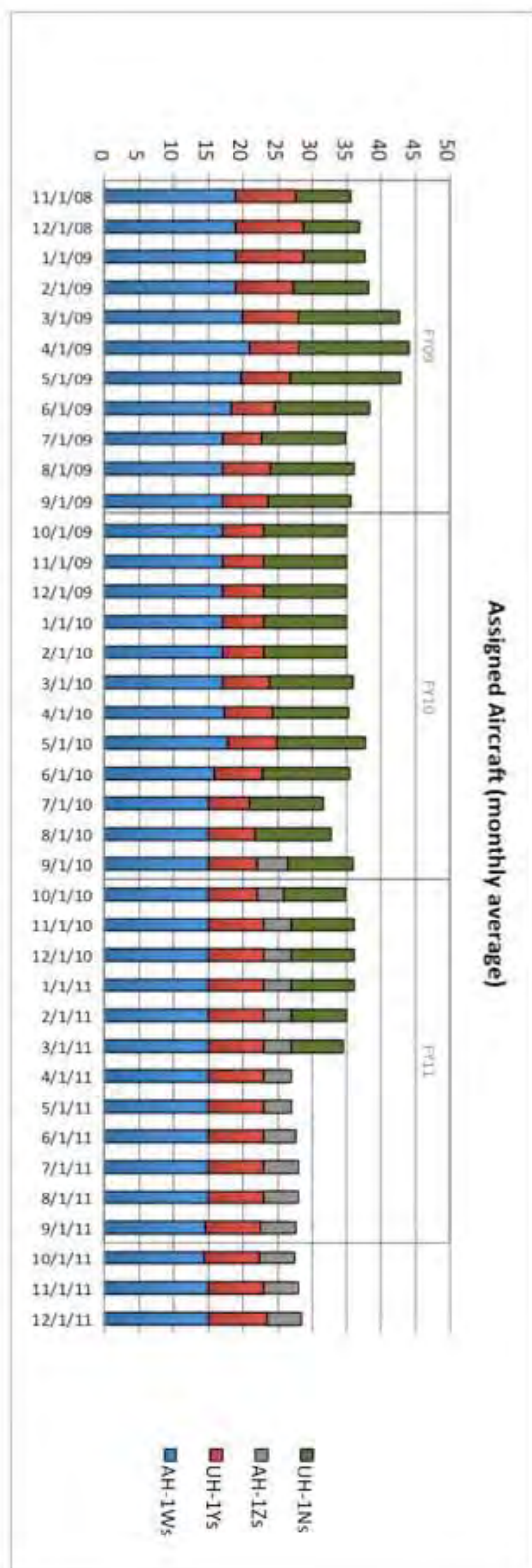


Figure 2

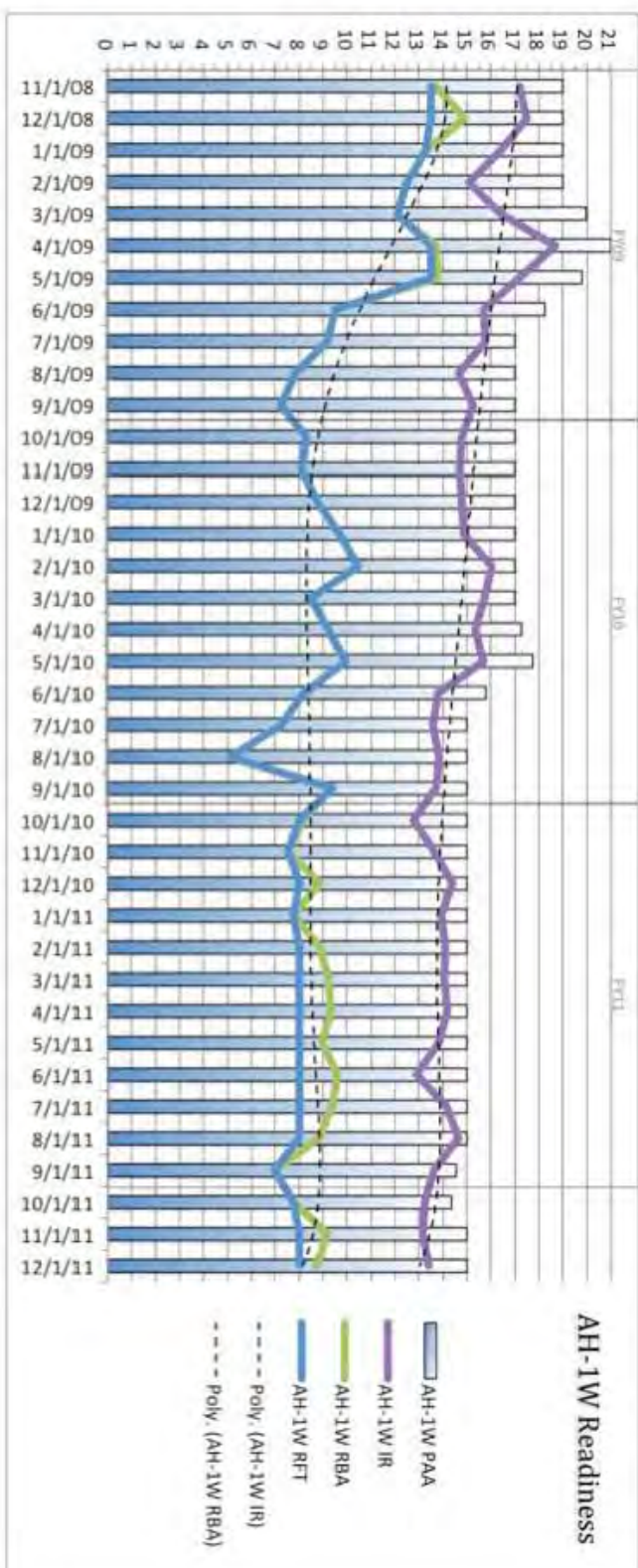


Figure 3



Figure 4

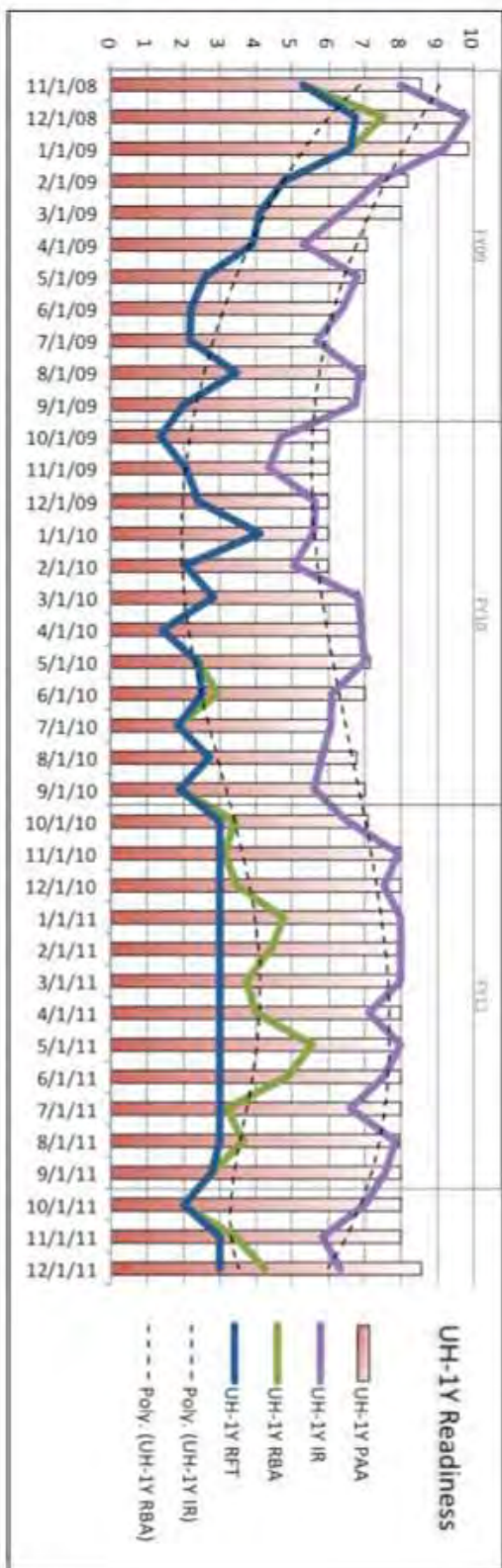


Figure 5

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