Improve Aircraft Readiness

Applying the theory of constraints

by Maj Drew Bossart, Capt Jeffrey Simonton, CWO2 Johnathan Hassell, MGySgt Douglas Jordan & MSgt Timothy Eustace

>Maj Bossart is a 7532 MV-22 Pilot currently serving as the Aircraft Maintenance Officer with VMM-166 (Rein), 13th MEU.

>>Capt Simonton is a 6002 Aviation Maintenance Officer currently serving as the Material Control Officer with VMM-166 (Rein), 13th MEU.

>>>CWO2 Hassell is a 6004 Aircraft Maintenance Engineering Officer currently serving as the Maintenance Material Control Officer with VMM-166 (Rein), 13th MEU.

>>>>MGySgt Jordan is a 6019 Aircraft Maintenance Chief currently serving as the Squadron Maintenance Chief with VMM-166 (Rein), 13th MEU.

>>>>>MSgt Eustace is a 6019 Aircraft Maintenance Chief currently serving as the Maintenance Control Chief with VMM-166 (Rein), 13th MEU.

Poor aircraft readiness has been a mainstay across Marine aviation for several years. Low readiness is generally attributed to a lack of funding for parts, aging aircraft, high operational tempo, and retention issues that drain talent from the maintenance department. While these factors will always impact readiness, they are not a barrier to success. Steps must be taken by leaders at the squadron level to substantially increase readiness while fostering a positive work environment and reducing work hours, despite the routinely cited causes of poor readiness. This article discusses the implementation of the Theory of Constraints (TOC) in an MV-22B maintenance department that resulted in a 40 percent increase in readiness while slashing the time that Marines spent at work. Many factors within the squadron affect maintenance readiness; however, this article focuses primarily on what maintenance leadership can control at their level.

The TOC is a management process developed by Dr. Eliyahu Goldratt and first introduced in his seminal book, *The Goal*, which aims to improve processes in the manufacturing industry. The TOC provides tools to identify a system's constraint, or "bottleneck," and then optimize the bottleneck to increase productivity.[1] The TOC assists leaders with identifying what to change, what to change it to, and how to cause the change.[2] Every system or organization has constraints that prevent it from achieving unlimited success toward its goal, whether the goal is profit margin in manufacturing or maintaining the safety of flight aircraft in a squadron.[3]

Osprey taking off. ***(Photo by SSgt Joshua Jackson, 13th MEU.)***

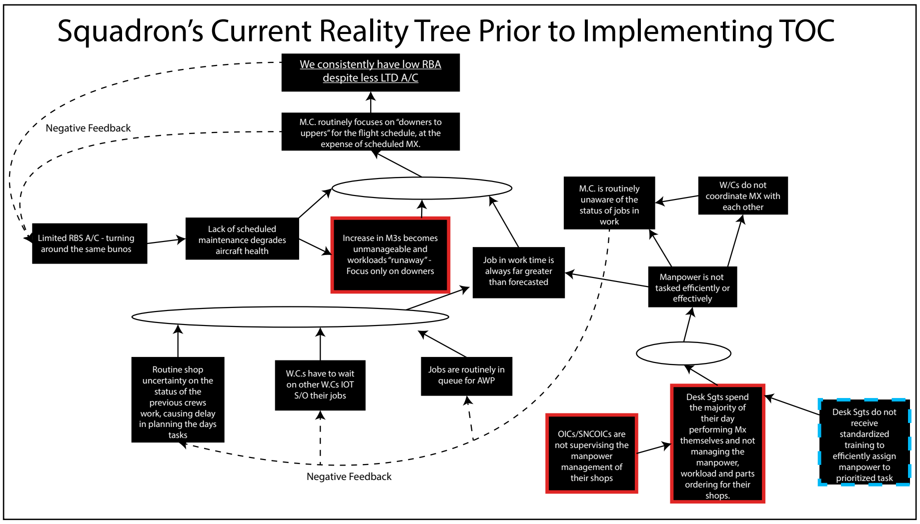

Figure 1. The maintenance department's reality tree prior to implementing the TOC. ***(Figure provided by author.)***

An aviation maintenance department operates similarly to a manufacturing plant, thus similar processes can be applied to increase efficiency in both. Companies from various industries who implemented the TOC had an average increase of 82 percent profit margins, and maintenance departments can likewise achieve comparable gains in aircraft readiness.[4]

The subject squadron implemented the TOC over a significant period and subsequently increased its monthly mission-capable rating from 42 to 83 percent and its ready basic aircraft (RBA) from 35 to 76 percent. During the previous fiscal year, the squadron averaged 25 percent mission-capable readiness, with only three of their twelve aircraft available on any day. After returning from its previous MEU deployment, five aircraft were simultaneously inducted into in-service repair for window-sill corrosion, and throughout the year, each aircraft entered into a long-term-down (LTD) status for an average of one month for in-service repairs. The limited number of available aircraft resulted in the squadron under-flying its fiscal year flight hours by over 400 hours. This translated to flight-hour waivers for nearly half of the pilots in the ready room who did not attain their 100-hour fiscal year minimums. The squadron was operating in crisis mode, and its maintainers focused on "downers to uppers" on a daily basis in order to fly the few available aircraft. Understanding how work was being processed in the maintenance department was the first step to distilling clarity on the failing situation.

When operating in crisis mode, an organization will rely on its best individuals to complete the mission because there is no desire for anyone except the "A-Team" to complete the job. The A-Team in each of the squadron's work centers encompassed one or two individuals who did everything, to include running the desk while also spending their entire day on the flightline performing and signing off on maintenance. The work centers simply put their best man or woman on the job in order to make miracles happen and get the aircraft back up for the day's flight schedule. Throughout the year, aircraft started returning from an LTD status, but the squadron's readiness did not markedly improve. The A-Team continued to be exploited on a daily basis with no real improvement in readiness—despite less LTD aircraft. Like Alex Rogo's failing manufacturing plant in *The Goal*, the maintenance department continued to "expedite" its work orders while barely producing the minimum requirement for the flight schedule and routinely falling short.[5] In this situation, no amount of extended work hours could resolve the maintenance department's problems without first identifying the root cause of its continued failure.

The TOC thinking process enables leaders to dissect the barriers to success in an organization and identify the root cause or bottleneck in the system, which must be fixed before any improvement in performance can be realized. The current reality tree in the TOC thinking process allows management to sketch out and link associated issues together until the core issue is identified.[6] In *The Goal*, Alex Rogo's plant is losing money and continuously playing catch-up by expediting one job after another. Alex's plant is swamped with excess material inventory awaiting processing behind his unrecognized bottleneck.[7] Once he identifies the bottleneck, which is a particular processing machine, he optimizes it by changing its schedule to only work on its primary task and perform that task continuously. Alex controls the workload to the bottleneck by subjugating all of the machines in the manufacturing line below the bottleneck machine, causing inventory to process at a faster rate and creating greater "throughput" for the plant.[8] Alex's problems were initially recognized because he was failing to meet his goal, a large profit margin. The squadron's maintenance department was also not meeting its goal because it consistently had a low number of RBA, despite less LTD aircraft on its roles. For the maintenance department, the bottleneck was not a particular machine or work center, instead it was the management of its workload, specifically the desk sergeants and the maintenance controllers. The desk sergeants were not performing their primary job because they were also the A-Team and spent the majority of their day performing maintenance on the flightline instead of managing their manpower and workloads. While consumed with work on the flight-line, they were not screening their workloads, developing integrated plans to process the workloads across departments, ordering parts to facilitate their plan, or communicating the plan with maintenance control. Dysfunction was obvious because maintenance control rarely knew the status of jobs.

The desk sergeant's primary job is to continuously groom and refine his plan for processing inventory—maintenance action forms (MAFs)—from his workload. In aviation maintenance, a small workload is indicative of large throughput. The byproduct of desk sergeants not performing their primary jobs is an enormous amount of M3 (backlog) MAFS, which peaked at a 117-page workload for 13 aircraft, or 50 to 80 MAFs per V-22 in the subject squadron. It became obvious to maintenance leadership that the desk sergeant billet was the constraint that was stifling throughput in the system.

A coordinated effort among maintenance leadership optimized the bottleneck by teaching and enforcing basic management principles to the desk sergeants. The work center's A-Team was taken off the desk and replaced with NCOs who had enough experience and competence to properly screen and manage the work center's workload and manpower. This restructuring freed the A-Team to focus solely on supervising and performing maintenance, which further enhanced throughput. According to the TOC, once the bottleneck is optimized, it then has to be elevated to take priority over everything else in the system.[9] Alex Rogo subjugated all of his machines under the bottleneck machine to create greater throughput in the plant.[10] Conversely, the maintenance department needed to elevate the bottleneck's by processing the bottlenecks runaway stock of inventory: its 117-page workload. Processing through the excess inventory allowed the desk sergeants and maintenance control to develop an executable plan for scheduling predictable maintenance and determining the capability for accomplishing unscheduled maintenance as it arose.[11] Another tenet of the TOC is that an inefficient system works all the time, and the ensuing continuous work further highlighted the gross inefficiencies present in the department.[12]

The department began to "expedite" its excess inventory by working 12 on/off, 6 days a week until the MAF count was down to roughly 20 MAFs per V-22, instead of the 50 to 80 count that it had been previously. This took approximately two months to complete, although—during this time—the squadron became composite and started the MEU work-up cycle. After the first month and a half, readiness increased enough to enable the squadron to fly ten of its twelve aircraft to the first work-up in order to continue processing the workload. The subsequent two weeks of additional 12 on/off during the workup was enough to finish processing the backlogged inventory on the aircraft. Reducing the workload optimized the bottleneck by allowing the desk sergeants to create executable workload plans, enabling more work at a faster rate while unencumbered with a 117-page workload. The resultant system controlled the flow of inventory to the workload by planning for scheduled maintenance, vice focusing exclusively on un-scheduled maintenance, serving the same purpose as controlling material from a non-bottleneck machine to a bottleneck machine in order to maximize throughput in a manufacturing plant.[13] Efficiently managed workloads created an efficient system, and the maintenance department began to realize the personal benefits of maintaining an efficient system.

Marines working on MV-22 nacelle. *(Photo by Sgt Francisco Diaz, Jr., 13th MEU.)*

After excess inventory is processed and everything in the system is subjugated below the bottleneck, the system not only completes work faster but will also have periods of idleness throughout the system—an inefficient system works constantly an efficient system has idle time.[14] After the first work-up period, the maintenance department realized its idle time in the form of returning to regular work shifts and taking 72- and 96-hour liberty passes after each subsequent work-up. Normal shifts were maintained for the duration of the work-up cycle and twelve-hour shifts were not routinely required during the subsequent at-sea periods. Additionally, the health of the aircraft remained extremely high, and the squadron only had one V-22 and one CH-53 go down in the chocks during all of the work-ups; the squadron never executed a bump plan during a mission.

In conclusion, every team survives and succeeds because its people buy into reaching the goal, and despite an efficient process, it requires loyal leaders and the recognition of hard work to create buy-in. There are numerous factors that affect aircraft readiness, and the squadron made many decisions that fell outside of the maintenance department's purview, but the underlying intent of these decisions was to always protect the maintainers from the plethora of external distractions that fall on all Marines preparing to deploy. One simple example is ship taxes, which were sourced almost solely from the battalion landing team to provide the maximum capacity to the ACE for fixing aircraft. The squadron's success with implementing the TOC is not a permanent solution for perpetually achieving the goal, and the TOC is not a magic fix for poor readiness—but it is a proven methodology to begin sound decision making. The TOC is a process of ongoing improvement that requires constant attention and vigilance against new variables that will affect the system and new bottlenecks that will surface.[15] The bottom line for leaders at the squadron level is to understand that there will always be setbacks and barriers to success that are out of their control, but through analysis and the application of existing processes, we can create our own opportunities that fully utilize the most precious resource available to us—the hard work and time spent by our Marines.

Notes

1. "Introduction to the Theory of Constraints by Goldratt," *Theory of Constraints Institute*, (Online: June 2018), available at https://www.tocinstitute.org.

2. Ibid.

3. Ibid.

4. Ibid.

5. Eliyahu M. Goldratt, *The Goal: A Process of Ongoing Improvement*, (New York, NY: Routledge, 2016).

6. Eliyahu M. Goldratt, *It's Not Luck*, (Great Barrington, MA: 1994).

7. *The Goal: A Process of Ongoing Improvement*.

8. Ibid.

9. Ibid.

10. Ibid.

11. Commander, Naval Air Forces Command, *COMNAVAIRFORINST 4790.2C*, *Naval Aviation Maintenance Training Program*, (Patuxent, MD: January 2017). Planning for scheduled maintenance in order to ascertain the leftover capacity for unscheduled maintenance is a core pillar of the Naval Aviation Maintenance Program and is in line with creating an efficient system in the TOC.

12. Ibid.

13. Ibid.

14. Ibid.

15. "Five Focusing Steps, A Process of Ongoing Improvement," *Theory of Constraints Institute*, (Online: June 2018), available at https://www.tocinstitute.org.

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