Weapon System Readiness- Metrics, Analysis, and Management

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Achieving, sustaining and employing combat readiness is the goal of aviation squadrons and companies. Aircrew readiness and weapon system readiness are basic elements. This article will discuss the constituent parts of weapon system readiness, how it is measured, analyzed, managed and provide insight for improvements.

Measurements- *"Show me how you measure a system and I'll show you how it behaves."* [1]

Current Weapon System Readiness (WSR) measurements do not account for the sum of the parts. The metrics do not allow for a holistic evaluation and analysis. The result is a symptomatic approach vice a systematic approach to weapon system readiness.

The primary measurements of weapon system readiness are Mission Capable (MC) and Full Mission Capable (FMC) rates. These high level metrics are valuable in a limited fashion but are meaningless as it relates to determining how many aircraft are available for operational tasking. Additional readiness sub-metrics accompany requirement documents and are evaluated during test. These sub-metrics usually include Mean Time Between Failure (MTBF), Mean Time Between Repair (MTBR), Mean Time Between Abort (MTBA), Mean Time between False Alarm (MTBFA) and Maintenance Man-Hours/Flight Hour. These sub-metrics are used by Reliability Centered Maintenance (RCM)/ Conditional Based Maintenance (CBM) engineers and stovepipe systems competencies but are rarely incorporated in organizational level analysis.

When we consider the entire system that is responsible for weapon system readiness, we are able to identify which organizations are responsible for each variable of the Mission Ready (MR) equation and dependent relations can be established. Figure 1 suggests a new metric of MR that identifies when an aircraft is available for operational tasking. Changes in the measurement should change the behavior of the system. The MR metric identifies the organizational level as the responsible organization for Non Mission Capable Maintenance (NMCM) & Partial Mission Capable Maintenance (PMCM), the intermediate level/OEM is responsible for Non Mission Capable Supply (NMCS) & Partial Mission Capable Supply (PMCS), and Systems Commands/ engineering are responsible for Functional Check Flight (FCF) & scheduled maintenance requirements.

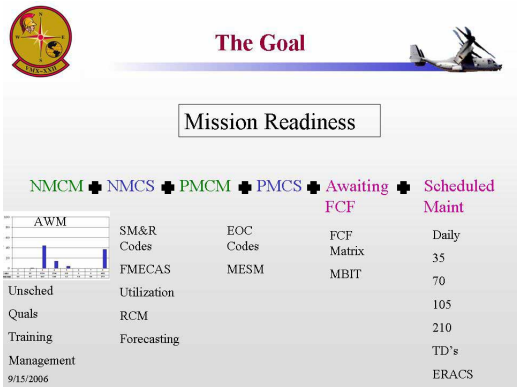


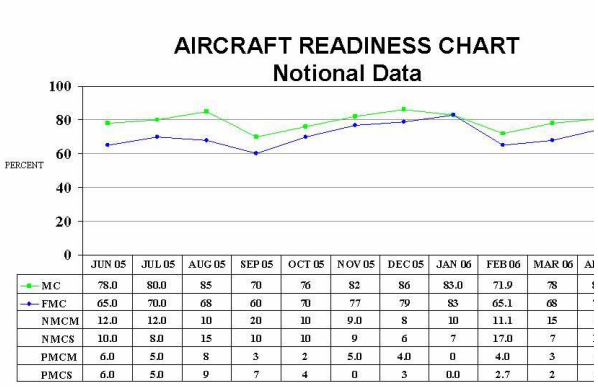
Figure-1

NMCM/PMCM

Maintenance, Material, and Manpower (3M) summaries are topical presentations of Maintenance 1-6 reports. The maintenance reports themselves present surface level metrics. The 3M presentation Fig 2 displays MC/FMC and breaks it down by NMC Maintenance/Supply (NMCM/S) times/percentages. Fig 3 shows the NMC Awaiting Maintenance (AWM) codes of which only M3 (backlog maintenance), M5 (other) and M8 (Awaiting other shops) are under the control of the organizational level maintenance dept. When PMCM is considered M7 (awaiting flight) can be added.

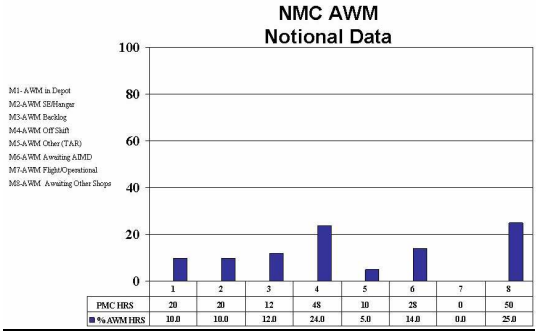
Presented at the American Helicopter Society 63rd Annual Forum, Virginia Beach, VA,May 1-3, 2007.

[1] AIRS*peed* implementation team.



	JUN 05	JUL 05	AUG 05	SEP 05	OCT 05	NOV 05	DEC 05	JAN 06	FEB 06	MAR 06
MC	78.0	80.0	85	70	76	82	86	83.0	71.9	78
FMC	65.0	70.0	68	60	70	77	79	83	65.1	68
NMCM	12.0	12.0	10	20	10	9.0	8	10	11.1	15
NMCS	10.0	8.0	15	10	10	9	6	7	17.0	7
PMCM	6.0	5.0	8	3	2	5.0	4.0	0	4.0	3
PMCS	6.0	5.0	9	7	4	0	3	0.0	2.7	2

Figure-2



	1	2	3	4	5	6	7	8
PMC HRS	20	20	12	48	10	28	0	50
%AWM HRS	10.0	10.0	12.0	24.0	5.0	14.0	0.0	25.0

Figure-3

NMCS- From an organizational level perspective the focus is on accurate documentation of supply requirements and participation in discrepancy reporting. It is the supply, logistic and engineering supporting organizations responsibility to meet, predict, and engineer to the organizational level requirements.

The breadth and depth of the supply posture reflects provisioning based on expected failure rates. These failure rates are developed through an iterative process of Support Analysis and are based on the Failure Mode Effects and Criticality Analysis (FMECA's). A business case analysis is applied to the provisioning process to ensure enough of the right parts are provisioned and reduce the provisioning of the wrong/unused/defective parts. You can't provision for everything. The cost and the logistic footprint would be unattainable.

Supply shortages occur when parts fail before the planned timeframe or we experience unpredicted failures. The FMECAs are the best guess at the time. The process is iterative and is updated as actual data replaces theoretical formulas[2]. This is why system maturity is defined as 60,000 flight hours. Each new technology has its unique challenges and does not have the benefit of a predecessor.

The realization that new technology will fail at unpredicted rates requires a supply posture that can effectively react to new demands on the system. This is a delicate balance of push/pull supply. The introduction of new components/ weapon systems and the current metrics of MC/FMC place an unfair burden of readiness on the contractor. The system and its organizations should be held accountable for their individual metrics.

Analysis-

The design and engineering analysis of components and weapon systems must meet the specified requirement. This analysis is collected in Support Analysis (SA) with supporting FEMECAS. The current method of FEMECA development is based on a work breakdown structure that distorts the way a failure presents itself and presents failure rates at their theoretical maximums. The outcome of the analysis is incorporated into maintenance tasks and sparing models.

Inaccurate analysis will result in degraded WSR that manifests itself in NMCM/S with exaggerated effects (unable to perform the task/ within timelines and delayed delivery of parts). Although this analysis goes through a validation/verification process, the process can not simulate the actual use over time and conditions of use.

A rigorous, well staffed, cross competency RCM/CBM program is essential to continually analyze fleet usage data to verify and update the assumptions in SA and identify investment areas with the highest ROI as it relates to MR aircraft. Currently the metric used for RCM/CBM is LCC. Elevating LCC over MR is analogous to taking the savings before the earnings. Although LCC is an important metric in delivering cost-wise readiness, it should only be considered after appropriate readiness levels have been achieved.

Organizational level analysis- Current analysis at the organizational level is typically reward looking and topical at best. 3M summaries and maintenance reports only identify the units past performance. Analysis should identify the constraints and understanding of the conditions and environment that created them. Only then can a predictive capability that goes beyond the rule of thumb (intuition) be developed. The current information systems that comprise the Automated Maintenance

[2] Support Analysis (SA) is a selective application of scientific and engineering efforts undertaken as part of the system engineering and design process to assist in optimizing logistical support objectives through an iterative process of definition, synthesis, tradeoff, test and evaluation.

Environment (AME) (Optimized Organizational Maintenance Activity (OOMA), Automated Maintenance Event Ground Station (AMEGS), and the Integrated Electronic Technical Manual (IETM)) provide powerful data collection and reporting capabilities that go largely untapped. Without focused, trained, integrated analysis at all levels combined with enlightened leadership, the result is just numbers and intuition rules the day.

Analysis of MR aircraft must include not only the aircraft provided for operational tasking but its performance as well. Aircraft abort rates broken down to the work order level and what occurred during the impacted time is essential to understanding the dependent relationship between operational availability and scheduling. What exists today is a demand and supply relationship that incorporates many coping mechanisms that produce rule of thumb planning information. Basically the pattern of demand (operational scheduling) is shaped by the potential of the supply (maintenance department)

Management-

Essential to understanding management at the organizational level is that aircraft break at predicted rates (FEMECAs) MTBF, MTBA, MTBFA which require a predicted amount of maintenance using a variety of specialties (MTBR/ MMH/FH). Although captured in MMH/FH but not captured in MC/FMC is scheduled maintenance an FCF requirements. From these assumptions Tables of Organization (T/Os) are established. T/Os are developed to appropriately staff the department to accomplish its mission. These collective assumptions and resources are available to the Maintenance Officer to manage maintenance. The necessary distribution of experience and qualifications is poor assumption that is made. It should be called out in the T/O and stated as a core competent requirement for manpower policy and staffing.

If the analogy of a production factory is applied to the maintenance department, the goal of the maintenance department is to produce MR aircraft in support of operational tasking. It produces widgets called operational flight hours and the measurement of availability is MR aircraft. Its throughput is maintenance man-hours and its inventory is time. Production without safety, quality, and standardization is meaningless. These become necessary conditions. To support these conditions the maintenance department must schedule maintenance actions that do not limit the operational availability and direct maintenance actions to provide the highest return on investment as it relates to mission ready aircraft (Control M3, M5 & M8). Additionally it must ensure enough experience and qualifications are available (training). With this understanding we can score the maintenance department's management functions.

Scheduling- Mission Readiness addresses the supply side of the scheduling process. The demand generator is the operations department and is expressed in the daily flight schedule or the Aviation Tasking Order (ATO). Over time aviation units have developed coping mechanisms that enable the deficiencies in the current WSR metrics to continue. Typically the operations department coordinates with the maintenance department to develop a schedule (demand) based on the maintenance capability (supply). The result is a process that shapes the demand based on the supply.

Sustainment and Performance Based Logistics-

Performance Based Logistics (PBL) provides the opportunity to increase WSR at reduced cost by exploiting industries ability to support a weapon system while reducing governmental overhead and management functions. There is risk associated with any contractor to perform to the support requirements. Currently the government uses established requirements for mission readiness and focuses PBL on supply chain management (NMCS).

The use of the proposed readiness metric (MR) creates an opportunity to expand current PBL requirements to increase WSR. This provides the contractor the ability to use excess capacity or build capacity in engineering and/or analysis functions. The contractor and/or subcontractors should be incentivised to identify and focus on areas that would provide the greatest return on investment in areas like scheduled maintenance, FCF, and portions of NMCM AWM. This could provide a capability where the government is limited in engineering and analysis support. This expansion of PBL would require increased funding but the return on investment would offset the cost as it relates to WSR, Life cycle Cost (LCC), and increase safety.