Special Feature

An e-RA is an online, real-time, dynamic auction between a buying organization and a group of suppliers who compete against each other to win the business.

Perhaps no other term has invaded the vernacular and imagination of today's maintenance community more than *high velocity*. The very idea of accelerating processes and pushing aircraft through maintenance activities is at the heart of many of the key initiatives that are in work today.

Thinking about logistics

Electronic Reverse Auctions—Removing Barriers to Unleash Savings in Federal Procurement

High-Velocity Maintenance—Air Force Organic PDM: Assessing Backshop Priorities and Support

This edition of the Journal presents two featured articles: "Electronic Reverse Auctions—Removing Barriers to Unleash Savings in Federal Procurement" and "High-Velocity Maintenance—Air Force Organic PDM: Assessing Backshop Priorities and Support."

In "Electronic Reverse Auctions—Removing Barriers to Unleash Savings in Federal Procurement," the authors present a case study that explores the first and only electronic reverse auction (e-RA) conducted by the United States Air Force in Kuwait and addresses gaps in e-RA application within the Department of Defense (DoD). The research examines procedures DoD contracting officers could follow to use e-RAs for stateside and contingency procurements—and expected savings from doing so. A spend analysis of fiscal years 2007 and 2008 Air Force procurement transactions, extrapolated across the DoD, suggests the DoD is leaving billions of dollars on the table by not using e-RAs. Drawing on the results, implications for practice and recommendations are made at the conclusion of the article.

The second featured article examines high-velocity maintenance and its implementation at the depot level. Major Branson notes that there is one primary factor affecting proper execution of aircraft programmed depot maintenance orchestrated under the high-velocity maintenance (HVM) construct—scheduling chaos. The capacity to overcome unforeseen maintenance requirements is critical for HVM as the compressed time line makes such occurrences much more acute. Branson makes the point that, given the rigidity resident in the HVM process, the capacity to address such events may reside within the depot's supporting backshops.

Introduction

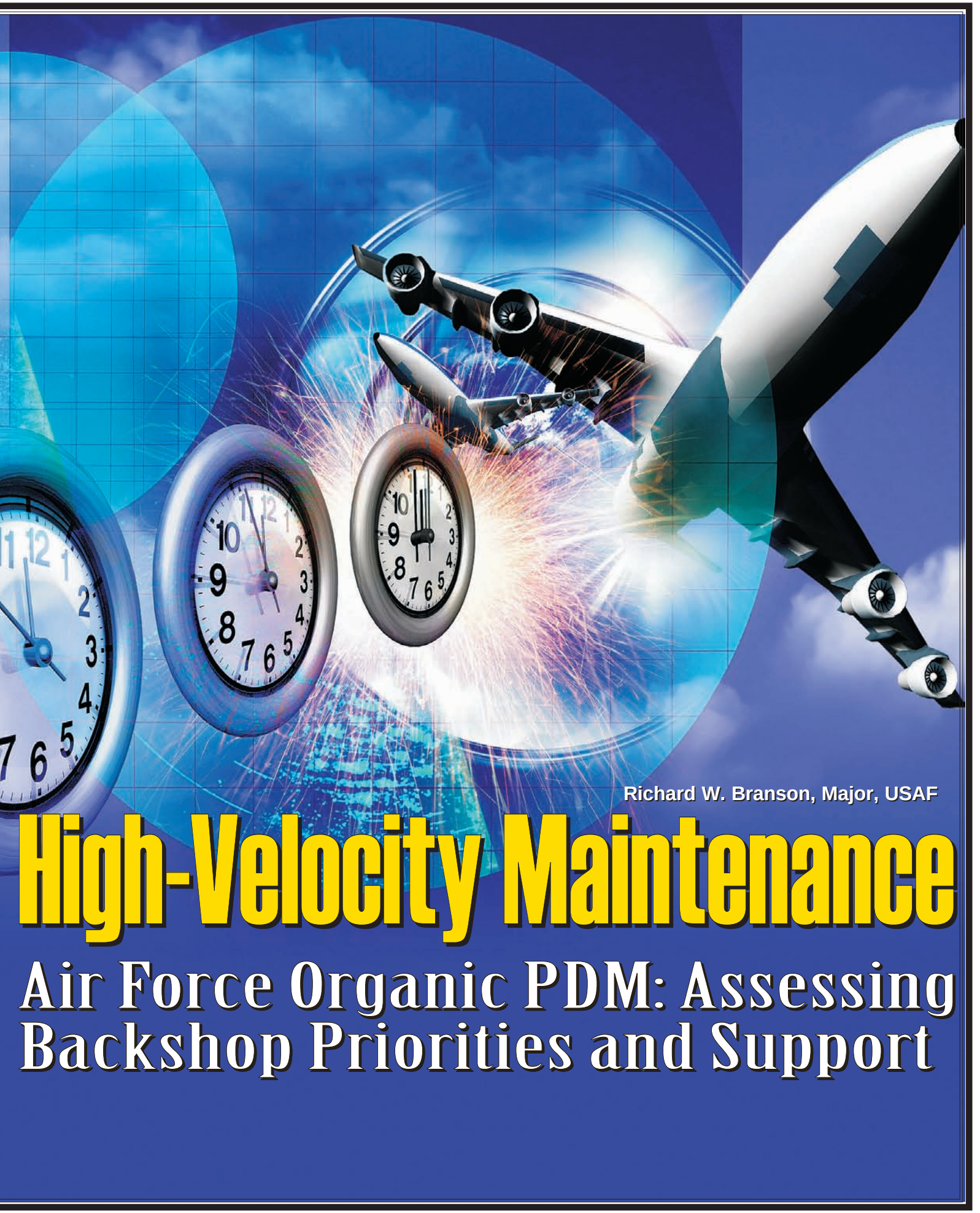
Continuous process improvement has become the primary means for addressing the myriad of constraints that Airmen face. The idea of doing more with less has slowly given way to doing the right amount of work with the finite capacity available. The elimination of nonvalue added work, waste, and processes redundancies has enabled workers with the ability to right-size workloads to the resources available. The latest innovation along this vein is the high-velocity maintenance (HVM) concept being tested in a pilot program at Warner Robins Air Logistics Center (ALC). This program holds great promise, but its success is dependent upon factors outside of direct program control. One such factor is depot backshop support. The responsiveness and capability of the backshop will be critical in enabling HVM to deliver the anticipated gains. The case for change, development of HVM and its principles, and overview of the depot backshop workload prioritization process will provide the framework for determining feasibility and areas of concern for mitigating backshop lag that may negatively impact HVM operations.

Special Feature

Driving Towards Improved Aircraft Availability

Today's Air Force has a significant aircraft availability dilemma that impacts almost every weapon system in the fleet. This problem is especially troublesome in the high-demand or low-density aircraft fleets. The increasing age of aircraft, high operational demands, reduced manpower, and overall lack of fiscal resources further compound the problem to the extent that previous solutions provided to address aircraft availability shortfalls have been found insufficient. It is within this framework that the logistics community has embraced process improvement. Given earlier successes, the community continues to build upon and stretch for even further gains as evidenced in the initial Expeditionary Logistics for the 21st Century (eLog21) goals. These goals include a 20 percent increase across the board in aircraft availability by year 2013, with a corresponding reduction of operation and maintenance costs by 10 percent.[1] Although the availability goals have since been modified to reflect actual improvements required of each weapon system, the road ahead remains challenging for all those in the logistics business.[2]

Within the logistics enterprise, the maintenance community holds the most potential for providing the greatest gains toward achieving the eLog21 availability goals. Utilizing a myriad of AFSO21 tools from Lean to value stream mapping, maintainers have already provided incremental success that span all levels of the Air Force. At the unit level, gains are being made little by little, and perpetuated throughout the Air Force. MacDill Air Force Base's 6th Maintenance Group is an example where initiatives implemented locally reduced each KC-135 aircraft turn time by 30 minutes, freeing up an estimated three to four aircraft per week for additional missions.[3] Other initiatives have gone well beyond base level and have altered the entire outlook of an aircraft fleet. Air Mobility Command's regionalization of



Richard W. Branson, Major, USAF

High-Velocity Maintenance

Air Force Organic PDM: Assessing Backshop Priorities and Support

Article Highlights

Today's Air Force has a significant aircraft availability dilemma that impacts almost every weapon system in the fleet. This problem is especially troublesome in the high-demand or low-density aircraft fleets. The increasing age of aircraft, high operational demands, reduced manpower, and overall lack of fiscal resources further compound the problem to the extent that previous solutions provided to address aircraft availability shortfalls have been found insufficient.

Continuous process improvement is considered by many as the best means for addressing the problem of meeting seemingly unlimited demands with finite resources. As the idea has matured within the Air Force, it has taken on a personality of its own in becoming AFSO21. Even with its formalization, the myriad of process improvement initiatives being undertaken throughout the Air Force remain mostly localized and limited in scope. One of the few examples of process improvement that strives to break out from mainstream is the high-velocity maintenance (HVM) pilot program that is being adapted to programmed depot maintenance operations at the Warner Robins Air Logistics Center. The success of this concept will rely heavily on factors currently outside of the center's control as well as difficult adjustments within its own organizations. If proven, the concept will serve as a good example of how process improvement can be accomplished on a vastly larger scale and may serve as an informative case study on process reengineering organic operations.

There is one primary factor affecting proper execution of aircraft programmed depot maintenance orchestrated under the high-velocity maintenance construct—scheduling chaos. The capacity to overcome unforeseen maintenance requirements is critical for HVM as the compressed time line makes such C-5 isochronal inspections is one such success story where productivity, quality, preventive maintenance, economy of scale, and aircraft availability all trended in positive directions. The bottom line on the efforts was the dramatic reduction of the maintenance cycle from an average of 25 days to 14 directly resulting in 407 additional days of C-5 availability per year.[4] Even broader is the Repair Network Enterprise program which seeks to leverage global visibility of all repairable assets, centralized funds management, and strategic sourcing and partnerships with industry to provide optimum logistical support for equipment spares Air Force-wide.[5] The initiatives presented here are examples of the incremental successes being attained throughout the maintenance community every day. That said, perhaps no other area of the maintenance complex has taken process improvement further, or holds more promise for the future, than the ALC's depot maintenance organizations.

It should come as no surprise that the ALC's depot maintenance organizations are accomplishing tremendous things in terms of process improvement. It is within this Air Force community that the idea began. In 1999, well before AFSO21 came into the lexicon of Airmen, the Warner Robins ALC piloted the first continuous process improvement project utilizing an adapted form of the Toyota Production System known as Lean.[6] Very few could have imagined the gains that would continue to be made over the next decade—and it all started with that limited effort in the F-15 wing shop. At Warner Robins ALC alone, aircraft depot maintenance due date performance improved from 83 percent to 96 percent while simultaneously reducing schedule changes by 85 percent.[7] These gains have had a direct effect on aircraft availability by reducing the number of depot possessed aircraft. C-5 aircraft have dropped from 15 in 2003 to 7 in 2007, and F-15 aircraft from 44 to 28 over the same period, giving 8 and 16 aircraft back to the warfighter respectively.[8] The extent of the success at Warner Robins is further evidenced by it being the first-ever public industry to win the Shingo Prize for Excellence in Manufacturing—a feat it has accomplished three more times.[9] Given the incredible accomplishments Warner Robins has had in its approach to improving its maintenance practices, it is no surprise that another ground breaking initiative is coming from this ALC that aims to revolutionize aircraft depot maintenance and provide yet another opportunity to improve aircraft availability to the warfighter. This new concept is high-velocity maintenance.

High-Velocity Maintenance (HVM)

Perhaps no other term has invaded the vernacular and imagination of today's maintenance community more than *high velocity*. The very idea of accelerating processes and pushing aircraft through maintenance activities is at the very heart of many of the key initiatives that are in work today. As it relates to depot activities, HVM is much more than accomplishing inspection and repair requirements more quickly. It is a fundamental change in the Air Force's approach to programmed depot maintenance (PDM).

Much like the adaptation of the Toyota Production System, HVM owes its beginnings to industry practices resident in the commercial market and the compelling need for process improvement. A group of subject matter experts at Warner Robins formed a high-performance team that was chartered to investigate current state PDM processes and industry best practices and develop an implementable HVM concept.[10] Their

work laid the foundation for a spiral development effort that culminates in a process that will enable continuous monitoring of aircraft condition—a mechanic-centric focus; a single Air Force-wide maintenance cycle; point-of use-parts, tools, data and equipment; standard work and processes; and information-enabled planning and execution.[11]

The initial review of the current state of PDM operations identified several aspects of the process that inhibited effective completion. First, aircraft are received into the process with limited understanding of the platform's overall condition. This gap between field and depot maintenance activities creates a situation where unanticipated damage and repair actions drive perturbations into the overall schedule.[12] Second, the long-established depot maintenance interval, based on original manufacturer's recommendations, drives a *must fix now* mentality that increases maintenance activities during the depot process. In a system where aircraft do not return to the depot for approximately 60 months on average, a strong emphasis is placed on fixing all discrepancies, even those with slight potential risk for failure, prior to returning to the end user.[13] This has the unintended effect of *gold plating* aircraft depot maintenance activities. Third, there are inherent inefficiencies within the depot work environment itself. Examples that directly impact schedule execution include technicians completing nonvalue added work, such as gathering tools, equipment, and supplies and the lack of kits designed to support maintenance operations that are accurate and complete.[14]

In seeking out potential solutions to overcoming these issues, the team visited a number of commercial sites including American Airlines, Cascade Aerospace, and TIMCO. Three common aspects stood out across all of the companies visited. First, touch labor rates of up to four to five times that of the ALCs were standard business and expected.[15] The high touch labor rates fostered an environment where technicians were focused directly on repair activities and nonvalue added work was diminished. Second, maintenance intervals were significantly shorter for commercial repair organizations.[16] The increase in visits that aircraft made through the repair cycles provided closer monitoring of aircraft conditions and fostered better forecasting for repair and materiel requirements. Lastly, heavy emphasis was placed on detailed, reiterative work planning. Most importantly, such planning incorporates lessons learned from both aircraft repair and task completion in the previous cycle.[17] The combination of increased maintenance intervals (fosters better forecasting) with the detailed work planning proved to be a powerful means for achieving the high labor rates desired (see Figure 1).[18]

The information gathered provided the background necessary to work towards the HVM goals. The team began a pilot program to validate HVM concepts utilizing Air Force Special Operations Command C-130s. The initial work focuses on dissecting the current PDM package into four smaller packages that can be accomplished in shorter intervals, approximately every 18 months.[19] This strategy strives to improve insight into materiel requirements by accomplishing evaluations for the next maintenance cycle at the completion of the current one. This enables the production support planning required to create an integrated, mechanic-centric plan that strives to apply the right resources, at the right time and place, to achieve the desired high touch labor rates throughout the aircraft depot maintenance process.[20] Additionally, the plan goes further by integrating field-level isochronal (ISO) and phased inspection (HSC) requirements into

Article Highlights

occurrences much more acute. Given the rigidity resident in the HVM process, the capacity to address such events may reside within the depot's supporting backshops. This transfer of flexibility is not without constraints, however, as the backshop's competing priorities and materiel availability must be acknowledged and mitigation strategies developed that best support execution of HVM operations. Given the size of the organic depot enterprise and the limited scope of HVM, such strategies are further constrained in that they should be enacted in a manner that does not negatively affect traditional aircraft depot maintenance operations. The ability of depot backshops to reach a balance between traditional and HVM PDM constructs—and to deliver the responsiveness HVM requires—may be the biggest challenge to realizing the anticipated benefits of this shift in depot-level maintenance.

The future of HVM shows great promise. As operational demands remain high, this tool may provide another avenue for squeezing even more out of the Air Force's high-demand, low-density fleets within today's fiscally constrained environment. It is yet another example of the kind of ideas that our innovative and outstanding Airmen, civilian and military alike, develop every day to tackle the difficult challenges we face.

Article Acronyms

AFMC – Air Force Materiel Command
ALC – Air Logistics Center
eLog21 – Expeditionary Logistics for the 21st Century
EPP – EXPRESS Prioritization Processor
EXPRESS – Execution and Prioritization of Repair Support System
HSC – Home Station Check
HVM – High-Velocity Maintenance
ISO – Isochronal
PARS – Prioritization of Aircraft Repairables
PDM – Programmed Depot Maintenance
SPRS – Spares Priority Release Sequence
UMMIPS – Uniform Military Movement Issue and Priority system

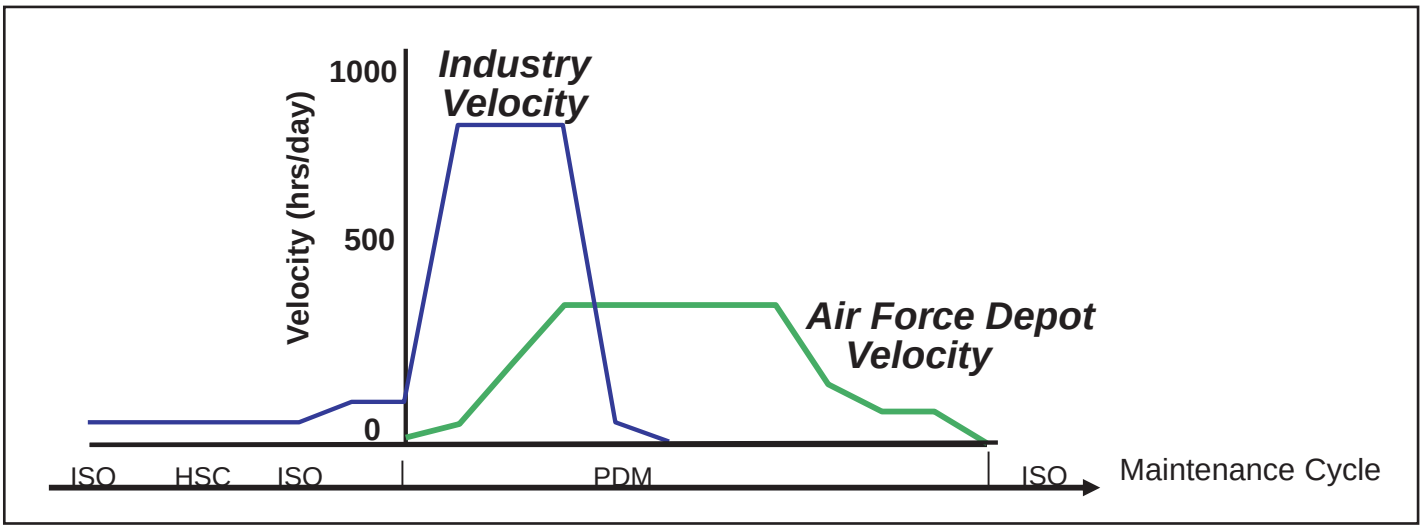


Figure 1. Notional Touch Labor Rate Comparison

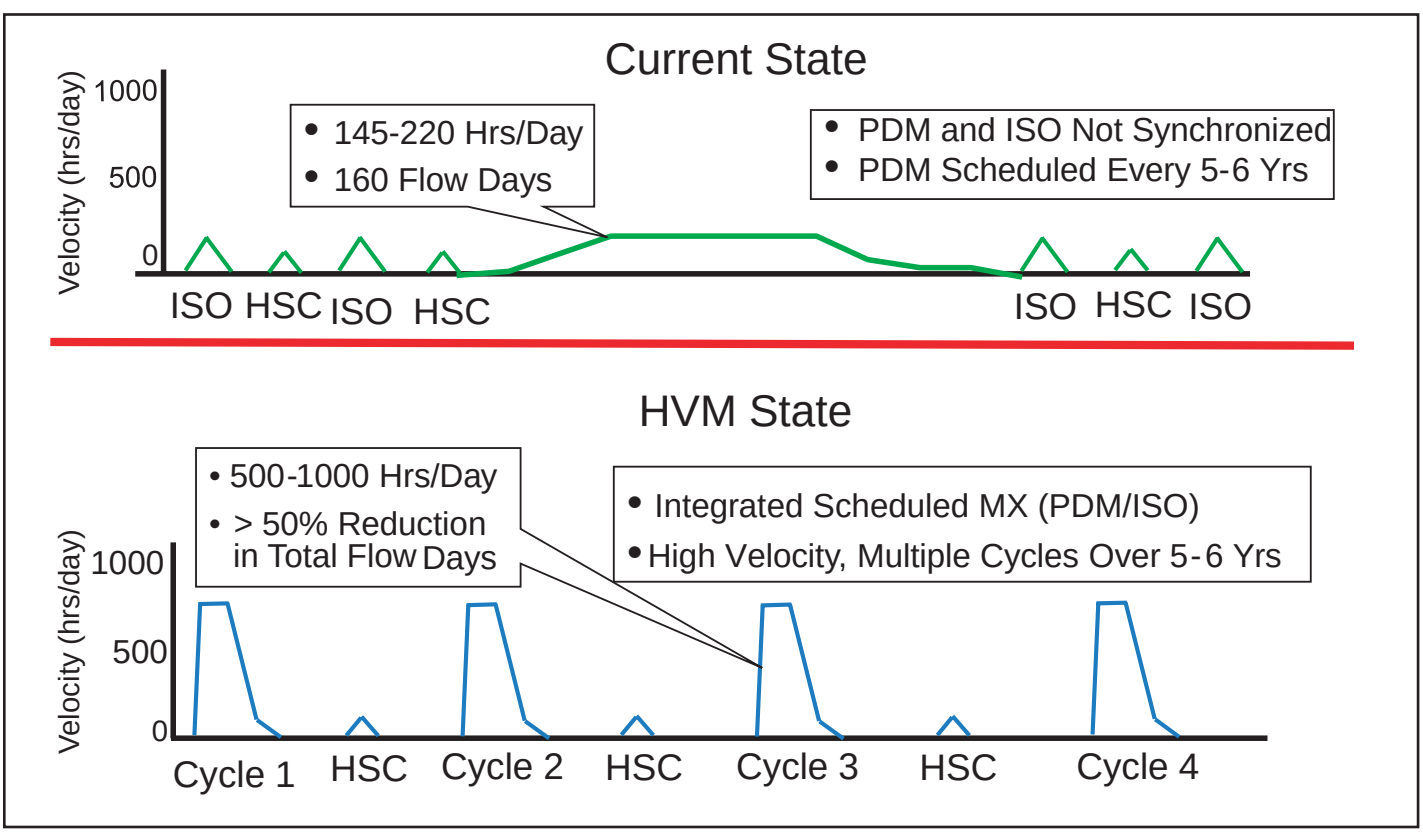


Figure 2. Current and Future State Depot Maintenance Cycles

the depot process. Accomplishing this will reduce scheduled aircraft maintenance downtime in the operational environment.[21] Last, it addresses two systemic issues inherent in the current depot process: unanticipated maintenance requirements and the compelling need to conduct unnecessary repairs based on long periods between PDM cycles. A notional chart of current and future state depot processes is illustrated in Figure 2.[22]

The impact of forecasting requirements and aligning materiel support for long lead-time items cannot be overstated. In order to achieve the pace desired, the detailed maintenance plan will need to be finely orchestrated in such a manner as to place manpower, materiel, and requirements at finite points along the process in order to facilitate the high touch labor rates desired. This approach to PDM necessitates a level of rigidity in execution that will not be capable of tolerating a large amount of unanticipated and unscheduled repair requirements. Although such events should be limited due to increased visibility of aircraft conditions evaluated during the prior PDM, it is unreasonable to expect that such conditions will not exist at all. One area that will be key to sustaining the time-critical flow of HVM depot operations will be the depot backshops. Understanding the process with which depot backshops prioritize and schedule requirements will determine how effectively they can integrate HVM demands into existing processes.

Depot Backshop Support

ALC depot backshops are vital resources that have an impact well beyond traditional depot maintenance operations. The unique repair capabilities that reside in the capital equipment and an experienced workforce are in high demand throughout the Air Force repair enterprise. In contrast to commercial aircraft maintenance and repair organizations, depot backshops are not solely dedicated to a particular weapons system, product line, or ALC in which they reside. This distinction highlights the complexity of managing a diverse workload originating from several different sources and meeting the demands in a manner that satisfies customer needs without adversely impacting other customers. HVM operations will not only be another customer competing for these limited services, but one that will require them at an accelerated pace. The responsiveness required to ensure zero lag in the HVM process requires its inputs to be considered at a higher priority than its traditional counterparts. Understanding the system that the backshops use to schedule workload, its prioritization logic, and methods for addressing shortfalls and limitations within the existing framework is critical to determining the impact HVM and backshops will have on one another. This understanding will be key in developing adaptable and effective mitigation strategies for future use.

Aligning Depot Backshop Workload

The primary tool utilized to make backshop repair decisions is the Execution and Prioritization of Repair Support System (EXPRESS). EXPRESS merged and integrated several initiatives for identifying and prioritizing depot repair requirements based on weapon system operating requirements and readiness targets with the aim of aiding maintenance managers in decisionmaking in a resource-constrained environment.[23] On a daily basis, the system compares operational and organic depot repair requirements to global inventory levels and depot repair capacity.[24] By combining this information the automated system produces time-horizon based repair priorities for Air Force Materiel Command (AFMC) managed items based on the depot's ability to support the repair actions. The EXPRESS system is comprised of three functional modules that work together in deriving workload requirements.

- Prioritization of Aircraft Repairables (PARS)
- EXPRESS Prioritization Processor
- The Supportability Module

The PARS system is the first stop in establishing daily workload requirements for each backshop. The module takes into account base flying activity, asset position, and aircraft availability goals, then attempts to fill system demands by the most expedient means available.[25] Once requirement data has been gathered, the system will utilize one of two methods for forecasting demand in order to establish priorities. The first method—the preparation process—bases future demands on operational flying activity. The second method—the computation process—is based on existing stock levels.[26] The outcome of this process is a prioritized list of Air Force-centric required repair actions that are best aligned to meet overall weapon system availability goals. This completed list will then feed into the second module of EXPRESS.

The second module, EXPRESS Prioritization Processor (EPP), applies a daily single prioritization across weapon systems algorithms to PARS. EPP ensures an even distribution of support across weapon systems and produces a rank ordered list of repair requirements. EPP then adds non-PAR repair demands to this product, such as foreign military sales and other Service requisitions, and integrates these requirements within the prioritized list based on priority code and document date.[27] Once all demands have been established, EPP produces a single integrated list of all repair priorities for each repair shop. The process flow from PARS through EPP is depicted in Figure 3. It is this integrated list that provides the source document for the Supportability Module.

EXPRESS accomplishes an initial feasibility check of all repair requirements through its Supportability Module. The module provides an automated validation of repair viability based on four criteria. Each requirement is checked for the availability of a repairable carcass, parts required to support the repair, funds availability, and backshop capacity.[28] Requirements that fail any of these four criteria are identified at the shop level, where workload managers have the opportunity to resolve constraints. There are certain limitations that impact the module's effectiveness, especially as it relates to support of HVM PDM operations. Inaccuracies in bench stock inventories and bills of materiel drive inaccuracies into the supportability logic and indirect parts and materiel are automatically excluded.[29] These issues may cause items to appear supportable even when materiel support is not available. One positive aspect to depot operations, however, is that carcass and funding constraints will not be significant challenges with the aircraft being on site and funding centrally managed by AFMC.

Prioritization Methodology

EXPRESS uses the combination of PARS and EPP to produce an integrated list of repair requirements. The first step in prioritizing this list is applying the spares priority release sequence (SPRS)

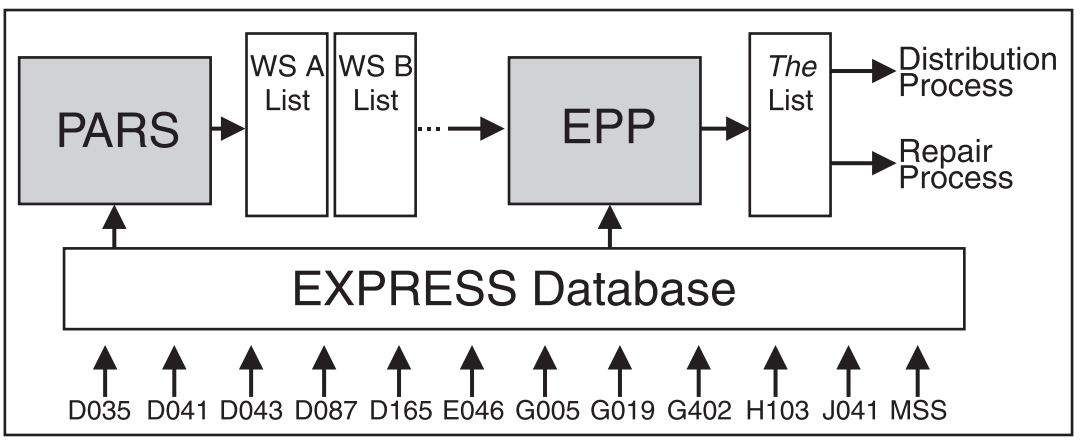


Figure 3. Prioritization of EXPRESS Flow

rules to the requirements. SPRS rules were developed and approved by major command commanders during the June 1999 Corona and implemented the following February.[30] The rules define Air Force needs based on importance and assign SPRS sequence numbers that give precedence to those units located at the forefront of operational needs. Table 1 provides an overview of the release sequence where repair requirements are staged by priority, then by needs within these groupings, giving preference to JCS mission capability requirements.[31] Given its operational focus, depot requirements are not considered during this phase of the prioritization scheme and may even be delayed due to pressing SPRS requirements.

Once SPRS priorities have been accomplished, the remaining requirements are prioritized using optimization logic. Optimization uses four key inputs in determining order: serviceable stock, allowable holes, wholesale resupply lead time, and depot man-hours needed to complete repair.[32] The first look is at serviceable stock at a particular location or stock that may soon be available for use. Second, shortages are reviewed and prioritized based on impact to aircraft availability goals. If a material shortage does not prevent meeting availability goals, then it is placed behind requirements where such an impact exists. Third, the lead time required to keep forecasted requirements ahead of flying-hour programs, historical failure rates, and historical daily demand rates for assets is considered and the requirements placed into the prioritization (at a point to preclude negatively impacting an organization). Lastly, depot man-hours available to accomplish repair activities are considered a limited resource, and therefore, as a cost variable. They are factored in with the intent on maximizing customer support within the available man-hours. Known aircraft depot maintenance requirements will be considered during this process.

EPP completes the prioritization process. The combined SPRS and optimization logic provided the majority of requirements for repair. However, since PARS data only considers Air Force requirements, those assets required to fill foreign military sales or other Service requirements (Army, Navy) need to be included. EPP does this by applying a placeholder logic for items relative to Air Force requirements based upon the uniform military movement issue and priority system (UMMIPS). For example, if a foreign military sale item is number three on a UMMIPS list of ten like items in demand worldwide, it will be integrated on the EXPRESS listing in the same position during the EPP process. The same approach is used for other Service back orders. Depending on where these demands are inserted, depot maintenance requirements may be delayed due to pressing operational needs or contractual obligations.

SPRS #	Priority	Requirement
08	1	JCS MICAP
07	1	Non-JCS MICAP
06	1	All Others
05	2-15	JCS MICAP
04	2-15	Project Code 700 MICAP
03	2-15	JCS Kit Requirement
02	2-15	Project Code 700 Non-MICAP
01	2-15	Non-JCS MICAP

Table 1. SPRS Release Sequence

Programmed Depot Maintenance Inputs

Traditionally, PDM requirements have remained a low priority when compared to operational needs. The long duration of the aircraft depot maintenance process has enabled it more flexibility in overcoming delays resulting from constraints in the backshop repair process. Workload managers have had the ability to adjust within the traditional depot schedule to accommodate delays or utilize newly induced aircraft with serviceable assets (as a source for cannibalization) to address the lag in the job-routed repair time line. These characteristics of the current PDM environment require rethinking when applied to HVM operations. HVM does not have the luxury of either of these approaches. The responsiveness of backshops in the HVM construct becomes much more significant as a result.

Fortunately, few areas in the backshop environment work job-routed and EXPRESS items concurrently. For those sections that must accommodate such workloads, demands are handled manually by workload managers. The most pressing constraint that a job-routed repair will incur is raw material and consumable supply supportability. Where supportable and operational demands permit, aircraft job-routed items are inserted immediately into the repair process. Although the repair requirements of job-routed items are typically lighter, their inclusion into the backshop's scheduled workload decreases overall efficiency and exaggerates preexisting technician and equipment resource constraints. The optimum solution employed currently is to divide workload and assign a separate team, when available, to accomplish the additional workload independently.

Intervention Framework

There are opportunities to physically intervene and manually alter the prioritization list originating from EXPRESS. However, these options are limited and directly related to specific constraints. They do not specifically increase the velocity of the backshop repair cycle. Workload managers can intervene for any of the following five reasons: interchangeable and substitution issues, erroneous parts data, validated data discrepancies, and equipment and personnel constraints.[33]

The first three intervention causes are data related. For interchangeable and substitution issues, a new stock number may be added but only if there is an offsetting deletion of the stock number that it replaces. Erroneous parts data may be addressed by either enabling repair actions when parts research discovers supportability that EXPRESS did not or by removing an item from repair when parts are not on hand. The final data-driven cause for intervention occurs when data discrepancies are found and validated. In these instances, workload managers determine what the repair requirement and priority should have been and make appropriate adjustments to the prioritized list. Overall, adjustments related to data discrepancies should have minimal impact to HVM operations.

The remaining two causes for intervention are based on shop capacity. EXPRESS bases shop capacity on hours available and does not consider the type and quantity of equipment or workforce skills. Workload managers accomplish a daily review of EXPRESS repair requirements to ensure capacity has not been exceeded. This review adds shop expertise to the supportability module and provides opportunities for workload managers to

optimize repair activity within shops. Adjustments concerning equipment and personnel have the most potential for affecting backshop support but remain limited in overall impact.

Analysis and Recommendations

The relationship between HVM PDM and supporting backshop operations in the long term will improve. As HVM matures within a weapon system, the forecasting of requirements will be enhanced. Such visibility decreases the scheduling risk associated with repair turn time and will enable workload managers to induce requirements in anticipation of the need date required of the HVM process. The improvement of integrating requirements in a scheduled (vice sporadic) manner will serve to improve efficiency, minimize capacity constraints, and optimize workload mix within backshop sections. However, getting to this point requires consideration in the near term of HVM process implementation, prioritization of HVM requirements, materiel availability, and backshop resource mix.

HVM Process Implementation

HVM is in its initial stages of development and implementation, and faces challenges with regard to backshop capability. A vast majority of these hurdles will be caused by inadequate visibility into aircraft condition prior to PDM induction. Over the near term, HVM designers will need to account for potential delays related to unforeseen repair requirements needing backshop support. Managers have the ability to mitigate such risk through initial one-time inspections or anticipation.

As a weapon system initially transitions into an HVM construct, the first pass an aircraft makes through its PDM interval will pose the most risk of unforeseen repairs. Where feasible, initial inspections should be accomplished in order to target potential damage areas associated with the particular phase of HVM. A list of high-failure items based on historical data can be developed and provided to the units. This list can be accomplished as part of depot maintenance preparations being done at the operational unit prior to the aircraft's first inspection under HVM conditions. Another alternative where operational demands make blue-suit inspections untenable is to have these one-time inspections performed by depot personnel. Such inspections would benefit from the specialized skills and experience residing in depot maintenance personnel. Subsequent inspections for the following depot intervals will be accomplished as part of the HVM process itself. Despite the limited scope these inspections would entail, they would provide valuable additional lead time if backshop repairs are required.

The second strategy is to anticipate where backshop-related repair requirements may reside within the HVM process flow. By pre-identifying these points in the process, various courses of action may be developed ahead of time that can lessen the overall impact of an unscheduled repair requirement. Mapping out the components where there is a high probability of failure and the subsequent points in the process where to reintroduce a repaired item provides workload managers more fidelity in matching backshop turn time to schedule. It also gives backshop workload managers more insight into where best to fit depot needs into the overall requirements demand mix. For both organizations, such anticipation provides some measure of flexibility within the rigid HVM framework and limits the impact to workforce efficiency that results from common schedule perturbations.

HVM Workload Prioritization

In time, HVM will dovetail well into the current priority framework that backshops use to align workload. As aircraft condition becomes more certain and the experience gained in accomplishing targeted inspections for each HVM segment grows, requirements for backshop related repairs will be identified well ahead of the necessary lead time. Additionally, the shorter timespan between HVM segments improves the ability of engineers to contrast component life span in a more determinant fashion that may reduce overall repair requirements over time.

In the interim, HVM requirements needing backshop support may actually increase. With more focused inspections in targeted areas, new trends may arise and drive more diverse groups of items into the repair cycle. Strong consideration should be given to ensuring these items are put into work in a manner that precludes any work stoppage in the HVM process. In light of the improvements in aircraft availability that are anticipated by transitioning to HVM, such time-dependent requirements provide a strong case for being placed on par with the operational demands considered in the spares priority release sequence rules. The impact of this shift in priorities to operational customers would most likely be negligible given the limited number of weapon systems currently being considered for HVM. Further, such delayed, time-dependent demands should decline as HVM matures within the weapon system and requirements transition into the existing optimization category of the prioritization process. The ability to mitigate this issue will be a critical factor in determining the successful implementation of HVM depot operations.

Materiel Availability

A key portion of the HVM process design is the development of kits that are aligned to each HVM package. Kitting serves to reduce man-hours and increase efficiency across the depot maintenance process by ensuring the appropriate mix and amount of consumable materiel is available prior to beginning maintenance. Materiel availability can also be a limiting factor in the backshop's ability to accomplish repairs in a timely manner. Two constraints need to be addressed for effective support: carcasses and raw material.

With aircraft in depot maintenance, carcasses should not be a substantial issue unless condemnation rates are significantly high. In such instances, item managers should be consulted and options for increasing serviceable inventories developed. For systemic issues, engineering support may be leveraged to improve component design for reliability and maintainability. The more prevalent but preventable issue is the raw material inventory needed to accomplish repairs. The compressed repair cycle cannot afford delays related to lapses in materiel availability. Where appropriate, it is recommended that additional inventory investments be made that are targeted to HVM-related requirements. Management of such stocks should be done to not only preclude material shortages but also to prevent inventory growth beyond a defined time-determinant level. As HVM matures and repair data indicates, such specialized inventories should be reduced when no longer necessary or the risk has subsided to a manageable level.

Backshop Resource Mix

The backshops will remain constrained in both skilled technicians and high-demand capital equipment. Equipment constraints are relatively known and backshop managers have existing methods for aligning workloads to match up with equipment availability or for accomplishing work by other means. Additionally, it is likely that most job-routed repair requirements resulting from HVM operations will be smaller in scope as compared to overhaul work. It is likely that job-routed repair work will remain mostly accomplished by technicians using standard tools and processes that are not equipment dependent. Therefore, equipment constraints will not be influential in HVM success, but skilled technicians will be.

It can be argued that there are never enough skilled technicians to accommodate the heavy demands placed on depot backshops. Adding the pressure of time-dependent HVM requirements only exasperates the condition by placing more technician-centric demands on the organization. The backshop workforce has shown great flexibility in meeting the increasing demand for some time. Managers may elect to add multiple shifts to an already busy schedule or attempt to address the shortfalls through increased overtime. Neither of these provides a permanent or sustainable solution to the problem. As HVM looks to employ more personnel to achieve the high touch labor rates necessary to meet their time line, a relative percentage of that total increase based on workload should be considered for backshop operations. Additionally, a more versatile workforce that provides managers the flexibility to shift technicians to spikes in workload should be investigated within the guidelines agreed upon with union leadership. Such flexibility between backshop and line operations has the potential to improve overall skill level and working relations throughout the depot repair enterprise. Addressing this aspect of backshop support is important to the overall success of HVM implementation.

Conclusion

In the end, it is all about improving warfighter capability. Maintenance's role in this endeavor is to increase aircraft availability by reducing maintenance related downtime. The community has diligently been working in that direction for over a decade through a myriad of continuous process improvement initiatives. High-velocity maintenance is only the latest iteration along this path but one that holds great promise, especially when applied to the Air Force's high-demand, low-density fleets. But the concept cannot go it alone and will require the depot backshop environment to produce some measure of flexibility to optimize the process rigor that is built into the HVM construct.

As the embodiment of the next evolution in continuous process improvement, HVM represents the transition from doing Lean to being Lean. In its initial development, the Air Force Special Operations C-130s will be the test case. If successful, the migration to the larger C-130 fleet should improve availability by 14 percent.[34] The tangible result is 55 more aircraft at a cost of $1.6B accomplishing missions (not sitting). To the operational maintainer, HVM serves to reduce costs, facility constraints, and workload through the inclusion of ISO inspections into the accelerated time line. For the depot itself, it provides greater insight into aircraft condition, which improves requirements forecasting, and has the potential for reducing scheduling perturbations and the resultant delays. The more mature weapon systems become within the framework of HVM, the more pronounced the benefits will be.

The depot related benefits extend to the supporting backshops, but they will not necessarily be realized until the initial migration of a weapon system into the concept has been completed. In the interim, they will be leveraged in place of the flexibility that is wrung out of the HVM process. The prioritization of HVM demands, backshop material availability, and resource constraints are issues that need to be addressed by workload managers to mitigate scheduling risks that may hinder successful HVM operations. Despite the limited exposure to such risk, their occurrence could hamper HVM operations. Fortunately, the depot backshops have the foundation and capability to overcome these hurdles. In review of their current practices, they appear to pose only a moderate risk to the successful implementation of HVM.

Although the risk attributed to depot backshop operations is moderate, it does not lessen the negative perceptions that will be applied to the overall HVM concept when lapses do occur. There will be errors in planning, unforeseen maintenance requirements, and mistakes made across the logistics enterprise in supporting and executing depot operations under the HVM construct. These glitches will predominate the earlier transition phases and lessen over time, but will never completely abate. Therefore, managing the expectations of Air Force leadership, as well as command customers, must be at the forefront of those enterprises championing high-velocity maintenance. Not doing so may result in the snowballing of negative sentiment that has the potential of strangling the infant HVM concept while still in its crib. This truth not only applies to backshop support, but to all facets of HVM.

The future of HVM shows great promise. As operational demands remain high, this tool may provide another avenue for squeezing even more out of the Air Force's high-demand, low-density fleets within today's fiscally constrained environment. Lastly, it is yet another example of the kind of idea that our innovative and outstanding Airmen, civilian and military alike, develop every day to tackle the difficult challenges we face. HVM is today's solution. Tomorrow's most likely will be even greater.

Notes

1. Robert Eardley, "eLog 21: Aircraft Availability Improvement Program," *Exceptional Release*, Winter 2008, 58.
2. Grover Dunn, "Perspectives: In Step with Mr Grover Dunn," *Exceptional Release*, Winter 2008, 24.
3. James Howe and John Creighton, "Reconceptualizing Maintenance Practices," *Air Force Journal of Logistics*, Vol 32, No 2, Summer 2008, 49-50.
4. Dennis Daley, "Aircraft Inspection Regionalization…Just Do It!" *Exceptional Release*, Winter 2008.
5. Expeditionary Logistics for the 21st Century Program Office, *Repair Enterprise 21 Fact Sheet*. Washington, DC, 6 October 2006, [Online] Available: https://acc.dau.mil/CommunityBrowser.aspx?id=32781.
6. Lisa Mathews, "Warner Robins Air Logistics Center and AFSO21: Award Winning Continuing Process Improvement," *Air Force Journal of Logistics*, Vol XXXII, No 2, 22 June 2008, 64.
7. Major General Thomas J. Owen, "Lean/AFSO21 Journey at WR-ALC," briefing, November 2007, 16.
8. Owen, 19, 21.
9. Lisa Mathews, "WR ALC Nets Three Shingo Awards," [Online] Available: http://www.afmc.af.mil\news\story.asp?id=123023739.
10. High Velocity Maintenance Team, "High Velocity Maintenance: An Enterprise-wide Methodology to Increase Availability of USAF Fleets," *Exceptional Release*, Winter 2008, 42.

11. AFMC HVM Program Plan (draft), 5.
12. HVM Team, "HVM: Enterprise-wide Methodology," 42.
13. HVM Team, "HVM: Enterprise-wide Methodology," 43.
14. *Ibid*.
15. *Ibid*.
16. *Ibid*.
17. *Ibid*.
18. Doug Keene, "The Evolution of High Velocity Maintenance," briefing, Shingo Prize Committee, 9 October 2008, 11.
19. HVM Team, "HVM: Enterprise-wide Methodology," 44.
20. AFMC HVM Program Plan (draft), 17.
21. AFMC HVM Program Plan (draft), 16.
22. Keene, 3.
23. LOGTEC, Inc, "Execution and Prioritization of Repair Support System (EXPRESS), Executive Summary," 10 February 2006, 2.
24. AFMCI 21-129, *Depot Maintenance Management; Depot Repair Enhancement Process*, 9 March 2001, 9.4.1.
25. AFMCI 21-129, 9.4.3.1.
26. LOGTEC, Inc, "EXPRESS Exec Summary," 7.
27. LOGTEC, Inc, "EXPRESS Exec Summary," 9.
28. AFMCI 21-129, 9.4.3.3.
29. LOGTEC, Inc, "EXPRESS Exec Summary," 10.
30. LOGTEC, "EXPRESS Exec Summary," 13.
31. "EXPRESS Prioritization Logic," 7.
32. "EXPRESS Prioritization Logic," 8.
33. LOGTEC, Inc, "EXPRESS Information Handbook," 28.
34. HVM Team, "HVM: Enterprise-wide Methodology," 44.

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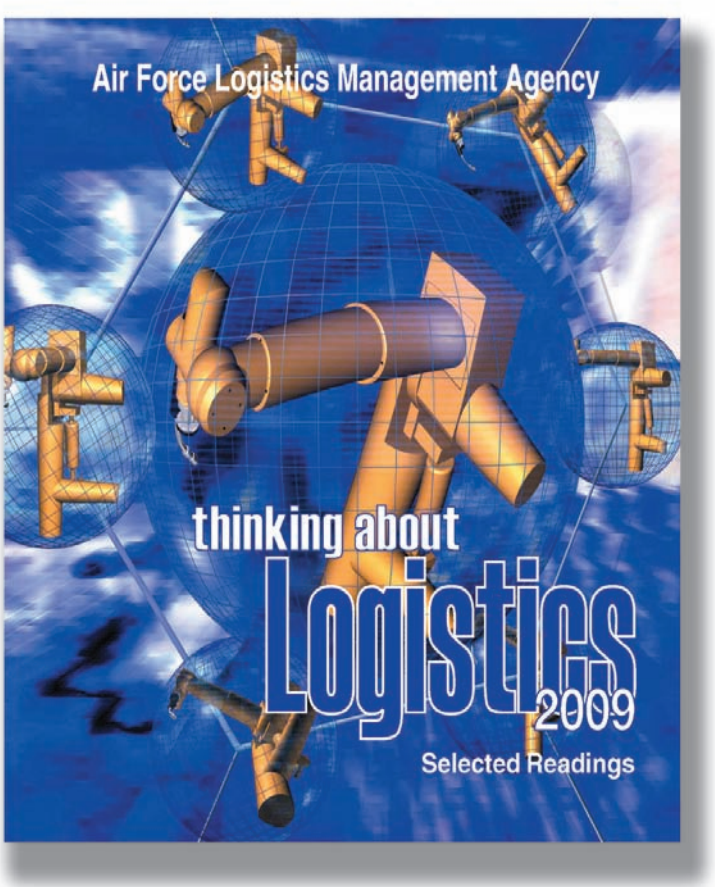

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