

USAWC STRATEGY RESEARCH PROJECT

**THINKING INSIDE THE BOX: GROWING AN AVIATION MAINTENANCE SOLUTION  
FOR THE JOINT FORCE FIGHT**

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## ABSTRACT

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The Department of Defense's (DOD) aviation maintenance structure is an inefficient and marginally effective relic of the Cold War. DOD and Army maintenance structures have implemented a patchwork series of reforms since the 1980s that have been partially applied, insufficiently integrated and marginally effective. Military aviation organic and support maintenance performance has slowly declined over the past twenty years. While various services continue to espouse a desire to increase joint operations and interoperability, the majority of changes within their respective aviation maintenance communities have been parochial. They optimize service unique portions of the maintenance system. Future budgetary and operational realities will demand that the services operate their expensive aviation operations more efficiently and effectively.

Each service in the military creates its own maintenance requirements, contract specifications, and competes individually for all support services. Each service and agency sub-optimizes their procurement, maintenance, overhaul and sustainment operations for their perceived needs. The result is a hodgepodge of organic as well as contract support organizations and procedures that is cumbersome and inefficient. Aviation maintenance should be integrated and consolidated in order to maximize overall systemic efficiency and effectiveness.



## THINKING INSIDE THE BOX: GROWING AN AVIATION MAINTENANCE SOLUTION FOR THE JOINT FORCE FIGHT

The Army's and the Department of Defense's (DOD) aviation maintenance structure is an inefficient and marginally effective relic of the Cold War. DOD and Army maintenance structures have implemented a patchwork series of reforms since the 1980s that have been partially applied, insufficiently integrated and marginally effective. Army aviation organic and support maintenance performance has slowly declined over the past twenty years.<sup>1</sup> Similarly, the Air Force has faced readiness challenges across its fleets as Operational Tempo (OPTEMPO) and deployments continue to press against institutional structural limitations.<sup>2</sup> While various services continue to espouse a desire to increase joint operations and interoperability, the majority of changes within their respective aviation maintenance communities have been parochial. They optimize service unique portions of the maintenance system. Future budgetary and operational realities will demand that the services operate their expensive aviation operations more efficiently and effectively.

The key to the success of applying reforms to the aviation sustainment community is to understand the complexities and uniqueness of aviation businesses and to apply realistic and constructive reforms to the realities faced by aviation maintainers and operators. Modern business practices and functional consolidation across the services will improve the efficiency and effectiveness of military aviation support operations throughout the world.

Each service in the military creates its own maintenance requirements, contract specifications, and competes individually for all support services. In the limited world of aviation support services not only are the maintenance requirements uncoordinated, they often compete with one another on pricing, manpower, parts and other sustainment issues. Each service and agency sub-optimizes their procurement, maintenance, overhaul and sustainment operations for their perceived needs. The result is a hodgepodge of organic as well as contract support organizations and procedures that is cumbersome and inefficient. Aviation maintenance should be integrated and consolidated in order to maximize overall systemic efficiency and effectiveness.

### Methodology

This study proposes to examine the mechanisms of aviation maintenance across the DOD against the business model of successfully transformed civilian aviation operations. The analysis will begin by identifying historically where previous attempts at transformation have sub-optimized the current maintenance system.

The study will then lay a foundation for maintenance transformation and integration by examining how successful and profitable cargo and passenger carriers have evolved in the changing aviation environment of the late 20<sup>th</sup> and early 21<sup>st</sup> Centuries. Finally, by applying the lessons learned from past transformation attempts and civilian business models, the study will integrate the maintenance structures of the DOD to the reality faced by the military services today, using the United States Army as the model for integration. Although the Army's aircraft fleet is primarily composed of rotary wing aircraft, maintenance consolidation trends within the civilian industry imply similar structural changes are applicable across the greater rotary and fixed wing aviation communities.

#### Military Maintenance Transformation Since the End of the Cold War:

The end of the Cold War resulted in numerous initiatives to reduce the cost and duplication of efforts throughout DOD and the Government. The Defense Department attempted to streamline operations in many different areas over the past 16 years. Aviation maintenance operations throughout DOD have undergone review and change in a pieced-together, sub-systemic manner since 1989.<sup>3</sup> In most cases, DOD has not holistically implemented aviation maintenance structural changes within the Army, the other military services, or the myriad of governmental departments.

The Army Air Corps' World War II support structure was the basic organizational paradigm used by most civilian airlines and militaries in the aviation business revolution and expansion that occurred after 1945. Although the Army changed staffing to reflect reduced unit aircraft numbers during organizational changes, the maintenance structure of Army aviation has remained essentially unchanged since the end of the WWII.<sup>4</sup> Since the 1980s, the world's civilian aviation maintenance structure has undergone dramatic changes as traditional airlines faced economic challenges from low-cost carriers and package transport services.<sup>5</sup> DOD, in reaction to budgetary pressure to reduce costs in the 1990s, began to examine leading business models and civilian management initiatives in an attempt to reduce costs and increase efficiency.<sup>6</sup>

The Army also experimented with several popular business management strategies to temporarily reduce costs while reducing operational risk.<sup>7</sup> These strategies were implemented haphazardly without regards to the business within which the models operated. Business models that worked well for the automotive sector may not have been appropriate for the services sector. The implementation of sub-optimal changes to the installation and logistics side of Army business sectors did not take into account the impact on the remaining structure of

Army aviation requirements.<sup>8</sup> The Army recognized the changing maintenance paradigm across the civilian transportation sector and applied individual reforms, such as cost banding, without holistic analysis and implementation strategies. Although DOD realized savings from the application of civilian business models and enterprise solutions, the affects of piecemeal applications of efficiencies strained the aviation maintenance system.

At the same time that the services were attempting to squeeze efficiency from their logistics streams, Congress and the executive branch were trying to impose their vision of efficiency on DOD. Many individually sound ideas including Base Re-alignment and Closure (BRAC), National Partnership for Re-inventing Government initiatives, Title 10 reforms such as Depots 50-50 rule and others were imposed in an unintegrated tangle of legalistic and impractical reform that threw the aviation support system into chaos.<sup>9</sup> BRAC and other reforms changed the process and/or system flow of steady state maintenance operations without a top to bottom remapping and analysis of the process. Although these initiatives may have saved money in the short term, they caused systemic interruptions that were often resolved by work-arounds.<sup>10</sup> The organizations of DOD have seen the impacts of the changed maintenance paradigm and have attempted to change accordingly.

Apparently, senior Army leaders in the 1990s recognized three basic courses for reducing aviation costs as they took action in three basic areas. First, under the guise of "Single Stock Fund", repair parts stock and retention procedures were modified to reduce costs. These took the form of reducing Authorized Stockage Levels (ASLs) and Prescribed Load Lists (PLLs) while reducing the depot stocked quantities of repair parts on hand. Next, a series of transportation streamlining and tracking initiatives were implemented. Finally, the maintenance proponent attempted consolidation and reorganization named "Two-Level maintenance" as a potential solution for maintenance reorganization. Two-Level maintenance is an attempt to capture some of the lessons of the transportation sector's changes without an appropriate holistic systemic analysis of the similarities and differences in the civilian aviation sector. Two-Level maintenance is a good start for the restructuring of maintenance across the DOD but does not address the core weaknesses of the current military maintenance structures including mission resource methods, the recognition of the importance of the industrial base, transportation links, and local repair requirements.<sup>11</sup>

The physical act of flying an aircraft is relatively the same in any segment of the industry, however not every airline or package carrier is profitable. In order to maximize the efficiency and effectiveness of military transformation one should leverage the most applicable lessons of civilian business sector leaders. These lessons should not, however, be applied haphazardly or

piecemeal as has been done previously by DOD. Best business practices in both the cargo and passenger sectors of the transportation industry will only transfer successfully when applied to the operational reality and requirements of the Service. As an example, the Air Force cargo fleet could gain much from an examination of FEDEX, but all changes to FEDEX do not immediately translate to the Air Force. Thus, this study proposes examination of the maintenance changes in profitable carriers such as FEDEX and Southwest airlines in the areas of fleet and personnel management, repairables, work loading, and maintenance management. However, the implementation strategy of this examination is proposed to be at the support maintenance level, not the flight line. Although the examples used in this paper are based on the Army's maintenance paradigm, they are practically applicable across the services at the maintenance support level. Although minor flight line changes will occur, the operation of aircraft across services is relatively the same. To facilitate the implementation of an efficient and effective joint aviation maintenance structure, the majority of maintenance efficiencies should focus on business models at the operational support level.

#### Civilian Initiatives Result In Significant Efficiency Gains Without Reducing Performance.

The civilian aviation industry has greatly transformed over the past 30 years. Two major factors for the transformation appear to be increased competition and changing business models.<sup>12</sup> Competition in the freight and passenger service sectors increased as a result of price wars created by fledgling low-cost carriers applied new business models to reduce costs in four critical maintenance areas: man-power employment, airframe efficiency, repair parts outsourcing and maintenance planning. These changes helped to reduce the costs of operating airlines and allowed small start-ups to rapidly gain market share, compete against traditional industry giants, and maintain profitability and responsiveness in dynamic market conditions. The passenger and freight airline service providers achieved their transformation by focusing on personnel and workload restructuring. They applied a comprehensive business plan integrated across the breadth and depth of the organization, implementing the appropriate changes required to achieve their strategic goals.

Workload management and personnel use are critical to aviation businesses. They are key enablers for profitability, success, and capacity generation in the aviation world. Civilian aviation is consolidating skills around the base set of maintenance competencies: Airframe and Power plant (A&P), electrical, and systems (pneudraulics, hydraulics, air).<sup>13</sup> Airlines with in-house maintenance tend to have higher maintenance costs but also rely heavily on certified A&P mechanics. Low cost and package carriers have tended to rely on contract organizations,

known as Part 145 repair stations for Federal Aviation Regulation part 145 which governs their operations, for the majority of their maintenance needs. Because of lower overhead they incur lower maintenance costs. Interestingly enough, most repairs within these facilities are accomplished by uncertified mechanics. "The majority of the workforce for the [traditional] carriers consists of certified A&P mechanics. Non-certificated mechanics that comprise a significant fraction of the workforce at Part 145 repair stations are not paid the same".<sup>14</sup> A Technical Inspector (TI) prior to component or aircraft release for flight verifies work accomplished by both certified and uncertified mechanics. Certified inspectors who advance through the ranks of the aircraft maintenance craft normally accomplish TI. As mechanics rise in seniority and knowledge they often receive specialized technical training and original equipment manufacturer (OEM) or repair and overhaul licensing authorities.<sup>15</sup>

Work load assignment is critical to modern airline operations. Maintenance capacity decisions are made holistically in light of the core competencies the airline chooses to retain.<sup>16</sup> Low cost carriers tend to meet their maintenance requirement needs by using contract and outsource maintenance facilities. Traditional airlines are reorienting their in-house maintenance facilities to the scale of their operations while providing some excess capacity as maintenance clearinghouses.<sup>17</sup> The excess capacity is systemically analyzed as a business process and managed to retain flexibility and in house capability.<sup>18</sup> Successful civilian fleet operations may use out-sourcing heavily. They leverage centers of comparative advantage such as Maintenance Repair Operations (MROs) while high volume, high payoff repairs are conducted in house to ensure maximum return on investment.<sup>19</sup> What is important to derive from this, beyond the growth of outsourcing services around the world, is the industry's strategic and forethought decision to focus on certain core maintenance competencies while divesting non-core tasks to outsourcing. Interestingly, Michael Young from FEDEX aircraft maintenance stated that in some cases, the company will retain price loss repair items that are high demand or low availability in order to ensure the company has flexibility to respond in certain maintenance situations.<sup>20</sup> The lesson to be gleaned from civilian industry, in this case, is that the size, structure and capabilities of the organic maintenance organization must be made with the view of the strategic needs and direction of the entire organization in mind.

As airlines and maintenance repair operations determine their core competencies and work areas, a level of specialization, market segregation, and economies of scale develop. OEM such as engine and auxiliary power unit manufacturers have tended to focus on the repair and overhaul of their components. Regional MROs have specialized in specific airframe overhauls and periodic services, most notably "heavy" diagnostic maintenance.<sup>21</sup> A lucrative niche market

has developed for aviation specific Enterprise Resource Planning (ERP) and document management tools.<sup>22</sup> As MROs establish their core areas of competency, the airlines are able to invest in the education of their workforce in specific areas of need. In either case the unused or excess maintenance capacity that is not a part of an identified desired core competency or required profit center is normally outsourced.<sup>23</sup>

Aviation businesses are limiting aircraft types in use and streamlining supported aircraft models. Southwest, Virgin Blue, West Jet and AirTrans Airways are among the most profitable carriers and have mostly pure-fleeted their operations using varying series of Boeing 737 aircraft.<sup>24</sup> American Airlines is modifying their almost 700 aircraft fleet to pure Boeing jets which share many components and maintenance characteristics. Delta Airlines, which is a major provider of MRO services to other carriers and provides most of its own maintenance services, is in the process of modifying their 578 ship aircraft mix from six aircraft families to three.<sup>25</sup> Air freight operators leverage the passenger carrier fleet divestitures in order to standardize their fleets. For FEDEX that means procuring more MD-11s while reducing their obsolete and low density fleets.<sup>26</sup> Civilian aviation organizations are investing heavily in education and training to provide wide-range expertise across aircraft lines and provide adequate services for aging aircraft lines.

Finally, improved ERP products are allowing improved integration of flight and maintenance operations. This improvement of processes, tracking mechanisms, and integration automation allows for greater centralized planning for mission requirements and reduced aircraft underutilization. This is preferred over localized control as it ensures the most efficient airframe use and allows for effective and efficient maintenance flow planning. An additional benefit of improved ERP is that it frees airlines from the traditional costs of hub operations. Hub operations, much like major Army airfields, had been the center of airline operations, to include scheduling, aircraft changeover, maintenance activities, and bed-down operations through the 1990s. It is also a model that built substantial inefficiency into the airline's models resulting in economic loss.<sup>27</sup>

#### Setting the Conditions for Aviation Maintenance Consolidation.

Many of the lessons learned from the airlines and cargo carriers over the past twenty years are applicable to the management of Army aviation in particular, and DOD's fleets in general. Many of the solutions for the challenges facing the federal government in streamlining their aviation operations could be adapted from civilian airline business models. As in civilian flight operations, these solutions should be implemented across the breadth of the organization

to attain a desired strategic end state. DOD must apply a comprehensive business plan across the organization in order to maintain strategic direction. Personnel specialization, utilization and work-loading improvements must be applied in light of the strategic framework.

The biggest challenge facing DOD may be convincing the federal government to change the established bureaucratic processes required for implementing required changes across the breadth of the organization in order to attain a desired strategic end state. Unlike the civilian business world, which is motivated by shareholder pressure and the reality of bankruptcy, the federal government has little external impetus for efficiency or increased effectiveness. Although there are many arguments for retaining individuality in system support, economies of scale and civilian business models suggest that integrated implementation of aviation support operations across consolidated fleets results in significant savings. The establishment of bureaucratic process change will require an atmosphere and work environment that encourages governmental improvement and accountability to the taxpayer.<sup>28</sup> With the implementation of a government wide strategy, as accomplished for aircraft use and scheduling, and mandatory legislative determination, however, meaningful improvements could be foreseen.<sup>29</sup>

With an eye towards determining strategic responsibilities across DOD for aviation operations and maintenance support, the Army, with the largest rotary wing fleet in the government, should be identified as the executive agent, center of excellence, and process manager for helicopter maintenance operations, integrating all helicopter operations for DOD. The Air Force, as the largest operator of fixed wing aircraft should be identified as the airplane operations center of excellence and process manager to integrate all aircraft practices. Similarly, DOD should identify the Navy or NASA, who have the largest density of experimental aircraft, as the experimental aviation operations center of excellence and process manager. The Joint Staff or another stakeholder could be empowered to determine a strategic direction and requirements for the utilization and maintenance of aircraft across the Department. This step is as critical for the government as a business model and business plan are for the corporate world. In order to maximize the benefits of maintenance system consolidation, program acquisition decisions would be made above the service level to minimize the number of distinct airframes, maximize system component interoperability, and reduce discreet and unique maintenance operations.<sup>30</sup>

The civilian world has reexamined the functions of its maintenance personnel. Likewise, DOD in general and the Army in particular should examine what its mechanics are doing in support of aircraft operations and how they are trained. In tactical units modern crew chiefs and flight engineers operating in the Army and Marine Corps two level maintenance systems

perform few aircraft maintenance tasks. In many organizations they have important flight-related duty responsibilities.<sup>31</sup> Thus, crew chief training at the DOD schoolhouse should focus on broad general maintenance knowledge for the apprentice aircraft mechanic. The graduate crew chief would be extremely knowledgeable in basic maintenance requirements and prepared to perform daily inspections and other services that require no special skill set. This pool of manpower would be available for assignment as either a flight crew chief or a basic apprentice line crew for the integrated support battalion or to a remote site in support of general government flight missions. Subsequent schooling, including integrated distance learning, technical schools and additional civilian training through the grade of E-6, could be pursued to award Airframe and Power-plant or subsystem licensing as required by the government.

Personnel management across the government would need to be standardized in order to meet the requirements of all aircraft users. Since most civilian MROs and fleet line service providers integrate both certified and uncertified mechanics from hundreds of licensing sources, the uniqueness of individual mechanics within the government appears to be an argument of parochialism rather than substance. The FAA, as the government's certifier and inspector of maintenance operations, could be designated as the executive agent for individual and collective maintenance personnel training. Initial entry service members would be trained and viewed as apprentice mechanics. Ultimately, sailors, marines, airmen and soldiers should receive certified and licensed A&P, avionics or auxiliary licenses if they choose to remain in military service. This pool of certified aviation workers, augmented by contract personnel where needed, would form the base-line of support for the integrated fleet management. Service-members would incur a six to eight year commitment after graduation from aviation training.<sup>32</sup> They should go to a unit after graduation and be stabilized for a minimum of five years; assigned to the flying unit for two years with duty at the support level in an Aviation Support Battalion or maintenance squadron for the remainder of their tour. While assigned to the support level, strict training and certification requirements should be required for advancement and retention.

Workload across the government's fleet should be strictly controlled. Distribution of workload should consider available manpower, training base, and core competency limitations. Like the structure outlined in two level maintenance doctrine, most line tasks would focus on removal and installation of components and end items. Additional capability at the support battalion or regional flight support center level would allow minor repair and systems alignment tasks. Like the outsourcing and planning of heavy maintenance in the civilian fleet, work-loading should focus on evacuating or shifting long lead and down time repairs to higher level

maintenance facilities specifically designed and trained with greater knowledge of aircraft systems.<sup>33</sup> Many component repairs should not be allowed below depot or MRO level. This would allow phase consolidation at the regional MRO as identified by the process manager and allow the spreading and shifting of workload. Further, this structure would fully integrate the Reserve and Active Components and provide promotion mobility throughout the services as more skilled and technically trained mechanics would be required to man the regional centers. Finally, tactical and contractor organizations could be created to synergistically meet surge requirements or be stationed at facilities with large mission requirements or areas related to Theater Sustainment Command responsibilities.<sup>34</sup>

This work loading model would require that every opportunity to train the apprentice mechanic is fully leveraged. Currently, most accredited schools require at least 18 months of training and hands on testing prior to awarding Federal Aviation Regulations part 147 certification, commensurate with an associate's degree. Often avionics and systems specialists require an electrical or engineering associate's degree prior to entering into training for their license producing training regimen. This equates to 60 semester classroom hours in addition to the hands-on training the apprentice would gain in the hangar. This prerequisite would require close integration with career progression models. Field training should focus on hands-on application. When aircraft are evacuated to centers of excellence for major repair, every effort should be made to assure the apprentice mechanic accompanies the aircraft and assists in the myriad of tasks associated with heavy maintenance.

Finally, within this new model, major component decisions would be analyzed with the same critical eye as airframes across the government. Component consolidation for repair to "as new" or condition code "A" could be tightly controlled and outlined in National Maintenance Work Requirements (NMWR) or OEM service bulletins and assigned to certified capable repair activities.<sup>35</sup> Workloads could be assigned according to the government's desire to maintain organic core competencies. Implementation of integrated procurement and minimum interoperability standards would allow cross service and cross departmental management and workflow of components. Central management has three immediate benefits for the government; development of facility specialization, establishment of economies of scale and flexibility and responsiveness across the breadth of the government's sustainment structure.

Focusing available workload into areas of desired governmental competencies would have the benefit of allowing specialization across the government's vast depot repair facilities. Organizing the capacity of the depot system along functional lines, regardless of the service owning the depots, would diminish duplication and inefficiency. Similar repair functions across

the government could be merged and streamlined, as necessary, to meet whole fleet requirements. This would facilitate the elimination of redundant excess capacity.<sup>36</sup> Similarly, since workload would be assigned across all government production facilities, input for component repair systems could facilitate the system-wide and central management of both components and airframe overhaul. The high level resolution of requirements would ease workload shifting into depots or contract facilities to maintain optimal work-loading across repair facilities. By managing a larger family of similar components, and ensuring compatibility of those components with major aircraft manufacturers, civilian repair facilities would compliment and reinforce government facilities.<sup>37</sup>

In order to accomplish a complete systemic analysis, one agency must be assigned responsibility and authority. This could be accomplished through the assignment of lead or executive agency, or through the creation of a Defense Aviation Maintenance Agency. However, the ability to examine the whole DOD fleet will reduce the total number of discrete frames, assemblies and components maintained and repaired. Shaping the government's industrial base will help to formulate the operating environment for government aircraft sustainment operations along the successful model used by civilian industry leaders. By focusing personnel recruitment, assessment, use and retention along common industrial lines, the government duplicates the career path and capabilities of civilian air operations while paralleling support mechanisms throughout the government fleet.<sup>38</sup> This allows any maintainer, of an appropriate skill level, to integrate throughout the maintenance structure regardless of local requirements. Finally, workload specialization and management would ensure maximum efficiency within the entire government maintenance system while identifying systemic wide shortages, requirements, and workflow for outsourcing. This provides a benefit for time lining and scheduling of aircraft fleet requirements resource prioritization.<sup>39</sup>

#### Setting the Conditions for DOD Success.

Assuming DOD is capable of executing the systemic changes required to set the conditions for aviation maintenance integration, each executive agent could then modify their specific support structures and rules to benefit the exact airframe type they support. It is critical that DOD establish a mechanism for disinterested oversight and maintenance of the strategic implementation plan. Each executive agency must conduct periodic review and course corrections of integration and implementation actions ensuring that process improvements are integrated and holistic.<sup>40</sup> In this way, optimizing of their area of expertise would not sub-optimize the entire system. The maintenance system, when aligned holistically, could self-reinforce as

necessary, for surge requirements. The implementation of process improvements would be similar across every executive agent but would follow six basic lines of action. First, aircraft would be managed as national assets. Second, maintenance actions would be viewed separately from tactical operations. Third maintenance personnel would be used system wide. Fourth, maintenance procedures should be standardized across fleets. Fifth, repair parts should be centrally managed regardless of experimental, fixed or rotary wing requirements. Finally, repair parts decisions should be made with an eye towards long term maintainability. For purposes of illustration, we will analyze the impact of these principles against the current model of Army aircraft maintenance.

DOD should manage all rotary wing assets, by type, in a fleet wide manner. Aircraft should be viewed as assets that do not belong to the tactical commander, rather are issued to the user as a government asset. Rotary wing aircraft could be maintained at the Army level under the purview of the Army Materiel Command's Aviation and Missile Command. DOD, possibly through the Defense Logistics Agency (DLA), would maintain fleet wide authority to intercede in service differences or direct priorities where national requirements dictate. This would allow fleet decisions to be handled holistically. Furthermore, central management would facilitate the integration of the government aircraft procurement system helping to ensure fleet compatibility and interoperability. Centralized management would increase pressure against establishing organizations with inferior equipment. The cost of maintaining obsolete fleets would surpass the cost of fielding modernized equipment within an enhanced system as exemplified by the procurement decisions in the turn-around plans and business models of United, American and Delta Airlines.<sup>41</sup> Centralized management would allow DOD to adopt the civilian fleet model for aircraft annuals and overhauls. These heavy maintenance actions could be competed among regional contact teams referred to previously, depots, or even civilian organizations with fixed return timelines and penalties for non-compliance. Whole fleet management would allow aircraft to be rotated throughout the services. Finally, whole fleet management would institute the procedure of evacuating aircraft to the best available facility for heavy and time consuming maintenance actions.<sup>42</sup>

The need to reduce the aforementioned tactical friction with maintenance operations drives the imperative for the Army to remove the direct link between aviation maintenance operations and tactical aviation operations. In other words, aircraft should be generated to meet mission requirements rather than the arbitrarily reporting and maintaining fleets to a "ramp availability model" as exemplified by the Army's Unit Status Reporting system focusing on mission readiness rates.<sup>43</sup> A potential solution is for the Army to adopt the Air Force model of

readiness using sortie generation vice the Army focus on continual operability. An aircraft sitting on the ramp is a measure of potential mission satisfaction but not an indicator of actual mission availability. An aircraft reported as Fully Mission Capable (FMC) on the ramp does not equate to an aircraft ready for a mission set. Aircraft can be FMC on paper, but be radically limited by impending maintenance requirements, sub-system limitations or mission incompatibility. Finally, aircraft maintenance operations should be unlinked from the purview of operations. This would allow sortie generation to compete freely with sortie execution for resources. In other words, tactical commanders at every level would know that sortie generation requirements above normal rates would incur a corresponding cost in excess of budgeted operations (reimbursable man-hours, higher parts costs, deferred maintenance costs and lost manpower opportunity costs). Thus, if additional sorties were desirable for the commander, maintenance operations would not be expected to generate blank checks or excessive resources that would cause the whole system to move out of balance.

The Army should change its training perspective ensuring maintenance personnel are capable on interacting throughout the maintenance structure. This would require DOD to revamp their entire aviation maintenance personnel structure along civilian fleet models. Two appreciable implications of the new personnel structure for the Army would be skill consolidation along the lines of systemic aircraft maintenance as outlined previously and experiential growth and progression patterns that would mirror civilian aircraft mechanic career patterns.<sup>44</sup> When these changes are practically applied system-wide across DOD, aviation mechanics from one service could, and by design should, be assigned at any level and for any service.<sup>45</sup> This change would, in effect, create "purple suit" aviation mechanics that could be leveraged on airfields or in the maintenance repair operations (MRO) base for compatible on aircraft or component repair. These maintenance teams would be trained, educated and capable of moving as far forward as necessary to conduct aircraft and component evaluation, heavy maintenance, and aircraft recovery when required by the appropriate operational commander.

The Army should standardize maintenance procedures and practices across the rotary fleet regardless of mission design and series considerations. This will require the synchronization and standardization of both calendar and flight hour inspections. Historically this has been difficult because of flight safety induced considerations and the integration of diverse sub-contractor assemblies into final aircraft designs. Synchronization of maintenance procedures has further been complicated, post aircraft fielding, by aircraft modification and "safety of flight/use" implementations, which have added inspection cycles and procedures, due to component and sub-component failures. The continued development, integration, and fielding

of embedded diagnostics and prognostics for system and subsystem components, could help to reduce this maintenance cycle. Embedded prognostics and diagnostics could facilitate the integration of the Services inspection, repair, replacement, and scheduling activities so that any available capacity can be used by any service to complete standardized repairs. An added benefit to the standardization of maintenance procedures would be to enable DOD to reorganize and relocate repair facilities near centers of operations to minimize travel time between components.

The Army should manage parts supply and repair holistically without regard for source of supply or source of repair. Adoption of the Army and Marine Corps two/three level maintenance models for spares replacement across DOD would enable all the services as well as civilian contract and MRO facilities to compete equally for repair and overhaul business. A standardized NMWR and/or DMWR standard, established by the Defense Department or the OEM would provide control for the operational user by ensuring that all repair facilities meet minimum quality criteria. It would be essential that the Army's warranty program be reinvigorated to support the defined minimum standard. A workable and strongly enforced warranty program would increase operator confidence in the revised maintenance system and provide legal recourse and insurance against sub-optimal service providers. This model would also leverage the revised personnel structure previously discussed by ensuring that all major and "critical for flight" components return to the "manufacturing base" for repair, thus reducing the stress on the young apprentice mechanic as he learns his craft by focusing on the removal and replacement of components and the general inspection and preparation of aircraft for missions.

In order to ensure that supply procedures are integrated into a long term maintenance structure of the services and supports the strategic plan for the military, DOD could integrate aviation maintenance oversight functions into DLA. Repair parts flow could then be optimally time-lined and stream-lined to meet the operational requirements and priorities of the Defense strategic plan in an integrated and synchronized manner. Finally, the Army should adopt the civilian industry model for component repair as demonstrated by Federal Express and Southwest airlines.<sup>46</sup> The Army should assist the Defense Department and Congress, as appropriate, to determine which areas of the aviation maintenance mission are desired as core competencies. These areas would be divided among the depots/arsenals system according to capability. Current return on investment trends, sunk cost considerations, and low civilian expertise or requirement for security issues could be applied to remaining maintenance functions to determine what capacity should be maintained close-in to the maintenance system.<sup>47</sup> The application of this paradigm should result in DOD directing the Army to repair

some components for themselves or other services regardless of their application, the Army and other Services deciding to repair additional components due to their comparative advantage, and the remaining items, managed by all sources, delivered to the MRO or OEM market based on their comparative advantage or capacity. Certain items, identified as “high demand and high return on investment” would be fixed at multiple centralized locations, even if accomplished as a work displacement repair, because of their identification as critical repairs. In every case, however, large dollar, high use components would be fixed at depots, MROs or OEMs with the proven capability to meet NMWR and DMWR standards.<sup>48</sup>

Although this model was developed using the Army maintenance structure, it is equally applicable to the problem set facing each service. The challenges facing the services are similar and are a function of sub-optimally applied business and management initiatives across the subsets of the larger military aviation and sustainment communities. The individual services have many capabilities and strengths that could be effectively leveraged for the benefit of the entire Defense Department. Current initiatives to increase Joint interoperability, coupled with the services working more closely in a practical manner, provides a unique opportunity to holistically examine aviation maintenance practices and procedures and improve them for the benefit of all the services. Although this model offers extensive opportunity for streamlining the military’s maintenance structure, its applicability to the greater community of non-DOD agencies should be examined. Currently the federal government has numerous “air forces”, each with their own policies and procedures. Each DOD component has its own rotary and fixed wing aircraft fleet.<sup>49</sup> Additionally, the Departments of Energy, Interior, State, Homeland Security, Agriculture, Transportation, and Justice, as well as separate reporting agencies NASA and TVA maintain fleets of helicopters.<sup>50</sup> Analysis of which major repairables offer the maximum return on investment and hold the greatest strategic importance for the government should be analyzed before the Defense Base Operating and Working Capital Funds work-loading plans are developed. Resource of initial stockages, service core repair competency and manpower division of labor between the services will have to be studied in detail to ensure support responsibilities across DOD and, if determined effective, the larger aviation community of the government, are sufficiently resourced against expected flying hour programs.

### Conclusion

The civilian aviation industry has suffered through numerous changes in the past twenty years and has demonstrated a viable course of action to improve both the efficiency and effectiveness of their maintenance operations. In order for DOD to realize efficiency in its

aviation maintenance operations it must rationally apply the lessons learned from civilian industries, facing similar challenges. The Defense Department should adopt a comprehensive, strategic plan for their aviation operations, to include the assignment of executive agents for each business process, across the breadth of their aviation operations. They should then apply a comprehensive personnel recruitment and utilization plan. Finally, work-load improvements must be undertaken across the breadth of the aviation maintenance system, most importantly in the areas of reparable management and maintenance management. If successfully managed, this Joint aviation maintenance model could be used across the breadth of the government's large and diverse aircraft fleet operations and provide a template for efficient and effective integrated maintenance operations.

#### Endnotes

<sup>1</sup> Marvin N. Russell, *Is the Current Army Aviation Maintenance Strategy Efficient or Effective In The Post Cold War, Non-Linear Battlefield Era of Expeditionary Force Projection*, Strategy Research Project, (Carlisle Barracks: US Army War College, 16 June 2004), 6-8. COL Russell lists the extreme amount of deferred maintenance and operational mission compromises required by inadequate maintenance capability in units since the implementation of "J" series Tables of Organization and Equipment and increased mission requirements due to Operational Tempo.

<sup>2</sup> Carl Conetta and Charles Knight, "The Readiness Crisis of the U.S. Air Force: A Review and Diagnosis", *Project on Defense Alternatives*, 22 April 1999. The authors index the steady decline of Air Force readiness as requirements increased and funding decreased. Interestingly, this mirrors the recent Air Force decision to reduce manning and retire older and harder to maintain airframes in order to continue research and development of aircraft procurement programs.

<sup>3</sup> Aviation maintenance changes have focused significantly on manning reduction, the integration of contract maintenance personnel, and parts stockage and repair experiments (like velocity management, dollar cost banding of ASL and PLL levels), and source of supply and repair manipulation.

<sup>4</sup> Russell, pp.1-3, crew chief numbers in assigned to individual units changed periodically as the Army experimented with fewer aircraft per unit and pure aircraft units. However, the relative number of mechanics to airframe (including required contractor support to peacetime operations) remained relatively unchanged.

<sup>5</sup> Traditional airline revenue streams consisted of two major components; passenger and package traffic. With the onset of package transport services such as UPS, DHL, Tiger and FEDEX, the lucrative package and postal transport service was stripped away from the airlines. Margins for passenger traffic were undercut by low cost carrier business plans that, for large part, leveraged the FEDEX business model to reduce passenger airline costs.

<sup>6</sup> Many portions of the Federal bureaucracy underwent downsizing and cost reduction during the 1990s under the Clinton Administrations "re-invention of government" initiatives. The purpose of focusing on the DOD in this case is two-fold. First, because of the "peace-dividend", the DOD experienced the most significant drop in funding (in real dollars). Second, the non-integrated manner of governmental business decisions undertaken by the DOD highlight the problems that occur when systems are sub-optimized for efficiency without regard to their systemic effects overall. As an example, while the Army was experimenting with management initiatives to generate cost savings, the Air Force and Navy underwent similar cost savings initiatives. Not only were the initiatives poorly coordinated within the sustainment arms of each Service, they were not coordinated cross-service for efficiency and effectiveness needs.

<sup>7</sup> The Army alternately experimented with Enterprise Business solutions, Six Sigma (and its current hybrid: Lean Six Sigma), Total Qualitative Management (TQM), outsourcing non-core skills, activity based costing (ABC) and ISO certifications at the wholesale levels, and velocity management, dollar cost banding and Just In Time (JIT) at the retail level. Each "business solution" reaped critical resources for the Army, but placed a great burden on the user level to maintain readiness. Many of these strategies fell out of favor with the business community and were rejected. The impact of the wholesale solutions to the Depots was damaging.

<sup>8</sup> Logistics support is a three -legged triad consisting of supply and services, maintenance and repair, and transportation. The complexity of Army operations requires that logistics support operations are coordinated in all three areas. Such that "Just in Time" (JIT) solutions imply a transportation solution, but have significant supply, maintenance and repair components that must be integrated (not wished away) for the solution to be viable.

<sup>9</sup> Perhaps no example better illustrates the resultant state of aviation maintenance than the Unit Level Logistics Support System-Aviation (ULLS-A) fielding of the mid-late 1990s. The Army, under pressure to meet the automation initiatives, fielded ULLS-A to users with several functions that were inoperable or semi-operable. Training for soldiers in the field was minimal. The system was plagued with errors and failures. Contrary to Army Regulation and Senior Officer pressure, many tactical units simply refused to continue using the system.

<sup>10</sup> An excellent example of the impact of base closing is the study of the AN-ALQ 144 main bearing and similar supply constraints, which were caused by the closing, and liquidation of stocks at certain depots during the base closure process of the 1990s.

<sup>11</sup> Almost every discussion of Army versus other service readiness and maintenance eventually turns to the topic of the Service difference in Aircraft readiness reporting and missioning. The Air Force and Navy focus on a sortie generation model for aircraft readiness. The Army and Marine Corps focus on a unit mission generation model. Neither of these models is significantly different in its generation of aircraft for mission accomplishment. I propose that the discussion, while academically interesting, is irrelevant to the discussion of maintenance operations. The relevant issue is maintenance resourcing and the application or utilization of those resources.

<sup>12</sup> Increased competition amongst the airlines has driven a recurring search for efficiencies. Similarly, new business models as represented by FEDEX and the low cost carrier models of People's Express, Southwest and Virgin. Additional information on FedEx's business model can be found at <http://www.fedex.com/us/about/today/companies/express/a380faqs.html>:

<sup>13</sup> Francis Fiorino, "FAA's 'Stock' in Safety The agency looks to cultural change and teaming with industry to enter an 'absolute safety' zone", *Aviation Week and Space Technology*, Jul 14, 2003. Vol. 159, Iss. 2; pg. 48.

<sup>14</sup> "Oversight of Maintenance and repair Facility Practices Under Examination", *Air Safety Week*, Sept. 6, 1999, p. 4. It is important to note that certain repairs, identified as "flight critical" are required to be accomplished by A&P mechanics. Therefore, not all repairs can be accomplished by unlicensed mechanics.

<sup>15</sup> William Morris, aircraft mechanic and A&P, TIMCO, Destin, FL, telephone interview with author, 3 Oct 2005. Part 145 operations often hire non-certified mechanics with the stipulation that they continue their education and progression towards A&P certification. The traditional carriers tend to advance their personnel along "trade skills" lines such that the apprentice A&P spends several years applying the trade, then advances to a higher level (traditionally journeyman, craftsmen, master craftsmen but more commonly Level 2, 3 etc). With each level advanced, additional skills are required to be learned through company or self-funded schooling and used on the aircraft fleet.

<sup>16</sup> Micheline Maynard, "Well-Laid Plan Kept Northwest Flying in Strike" *The New York Times*, Aug 22, 2005, Late Edition, p.A-1. The author examines how airline maintenance capacity could be maintained even though the the limited resource of flight line mechanics' union (AFMA) walked off the job during their strike.

<sup>17</sup> Barry Rosenberg, "Everybody's Doing It; Airline Maintenance strategies are diverse, but all include an element of outsourcing", *Aviation Week & Space Technology*. New York, Apr 19, 2004, Iss. 16; p.68. "Some airlines such as American are up to their elbows in heavy D checks, while others such as Southwest can do little more than line maintenance. Still others, such as United have outsourced their airframe maintenance, while Lufthansa Technik scours the world looking to that type of work. Then there are carriers such as Delta that have turned their maintenance operations into profit centers, while Continental wants nothing to do with aircraft not its own".

<sup>18</sup> Ibid. The author discusses the Lufthansa Technik and Delta maintenance models as profit centers for the airlines.

<sup>19</sup> Michael L. Young, Senior Manager, MEM Aircraft Line Maintenance, FEDEX hub operations, Memphis, Tennessee, interview with author, Sept 2004 . Mr. Young was my host during a research visit while we discussed maintenance differences between the Army Materiel Command (AMC) and FEDEX. His boss hosted GEN Kern at the Memphis FEDEX main hub facility.

<sup>20</sup> Ibid

<sup>21</sup> Heavy diagnostic maintenance (a.k.a. heavy D) refers to labor and time intensive inspection and overhaul cycles that occur on a periodic (flight hour or calendar) basis as specified by aircraft manufacturers or the FAA. They are commonly known as heavy phases in the Army and annuals, "multis" or overhauls in the civilian world.

<sup>22</sup> Michael Mecham, "Enterprise One brings Boeing Into MRO Services", *Aviation Week & Space Technology*. New York, Apr 2, 2001. Vol. 154, Iss. 14; p.102.

<sup>23</sup> Rosenberg, p.69, "A decade ago, 1/3 of air carrier work was outsourced; last year it was 50% and it will approach 65% by the end of the decade. . . I expect carriers will continue to focus their in-house efforts around operationally oriented maintenance such as line support and low level checks. Strategic maintenance, largely overhaul of components, engines and heavy airframe checks will increasingly become the province of MRO specialists" (p. 69). It is critical to note that fleet operators recognize the need to maintain some loss generating operations for efficient business operations. FEDEX, for example, maintains several component repair lines specifically to maintain flexibility although it would be cheaper to buy from an OEM or MRO.

<sup>24</sup> "The Secret Behind High Profits at Low-Fare Airlines", Jun 14, 2002, Seattle, pp.1-4. <http://www.boeing.com/commercial/news/feature/profit.html> ,

<sup>25</sup> Edward H. Phillips, "U.S. Airlines Brace for Market Turbulence; Carrier Officials expect to increase capacity but will keep a watchful eye on the economy" *Aviation Week & Space Technology*. New York: Nov 16, 1998. Vol. 149, Iss. 20; p.44.

<sup>26</sup> Ibid

<sup>27</sup> Tom Hanson, Dr. Jurgen Ringbeck, and Dr. Markus Franke, "Airlines: A New Operating Model; Providing Service and Coverage Without the Cost Penalty", Booz, Allen, Hamilton Inc., 2004, pp.1-10. As an aside, the package and freight carriers use regional hubs significantly, specifically for sorting the large volume of packages they transport and to efficiently load aircraft for regional distribution.

<sup>28</sup> The re-invention of Government initiatives executed by Vice President Gore were well conceived, but they were not holistically integrated. As noted previously, the many attempts to glean savings were focused on sub-optimization of sub-systems without consideration of the impact of actions on the greater governmental support system. In the absence of centralized guidance, individual agencies sought their perceived "best deal" neglecting the impact on the remainder of the governmental system. This is best exemplified by PACOM's purchase of Apple computers and Word Perfect office suite in 1994, while the rest of the DOD negotiated a Windows and Microsoft Office 95 standard. Similarly, procurement decisions have been made to maintain two types of attack, utility and cargo helicopters within the DOD structure and several light helicopters across the government structure.

<sup>29</sup> Richard Darman, Circular No. A-126, "Improving the Management and Use of Government Aircraft", Office of Management and Budget, May 22, 1992.

<sup>30</sup> Essentially the Federal Government, through the GSA or other impartial agency, would select aircraft types for the subordinate government mission sets. Additionally, aircraft procurement would be required to meet certain minimum interoperability requirements. Common components, such as glass cockpits, small, medium and large class engines, avionics, common hardware, and subcomponent assemblies would be standardized within defined parameters. This eases ordering, stock and, re-supply requirements, and reduces training workloads on journeymen and craftsmen level mechanics.

<sup>31</sup> Utility and Cargo helicopter crew- chiefs and flight engineers, while traditionally holding maintenance Military Occupational Skill Identifiers (MOS), are trained as flight crew members with significant training requirements. Two-level maintenance will reduce line maintenance tasks

shifting the onus for most repair and replacement tasks to the integrated Aviation Support Battalion.

<sup>32</sup> Army enlistees choosing aviation maintenance skills currently incur service obligations as long as eight years total. However, some maintenance specialties allow active duty commitments as low as 15 months with the balance served in the reserves or National Guard. [http://www.army.com/news/articles/aarticle\\_051905\\_02.html](http://www.army.com/news/articles/aarticle_051905_02.html)

<sup>33</sup> COL S. Remaly, "Maintenance Transformation" briefing slides for the Worldwide Aviation Conference, Redstone Arsenal, Alabama, March 2005. MG Pillsbury, the AMCOM commander, has proposed establishing Theater Aviation Sustainment Maintenance Groups, built around the traditional Aviation Classification and Repair Activity Depot (AVCRAD) Commands that, if augmented with several mobile contact and maintenance teams, could perform "heavy maintenance" like phases and damage repair across the breadth of the operational area. This additional construct is not part of MG Pillsbury's briefing but is a natural extension of integrated aviation maintenance operations for the Federal Government. Regional support would establish "repair MROs" in general areas much like the current MRO structure used by the civilian air fleet operators.

<sup>34</sup> Fort Rucker and Campbell, because of their high density of assigned aircraft, provide excellent examples of potential staging bases for the integrated contractor and military components of MRO support organizations. During traditional and peacetime operations, the military components would be available to provide additional support to flight operations throughout the region. Upon deployment, the military component could deploy as the contact and support teams of the AVCRAD to sustain flight operations.

<sup>35</sup> The Department of Defense often has specific parts performance or waiver requirements that are outlined in Defense Maintenance Work Requirements (DMWR) standards. When the primary customer is a Defense activity, DMWR standards could be substituted for OEM or NMWR standards subject to adjudication to the executive agency for core charge reimbursement.

<sup>36</sup> Excess capacity is not necessarily an undesirable attribute. Most "for profit" corporations do not habitually operate at 100% productivity. Retained excess capacity would be determined by governmental agency review in order to retain "surge" or wartime capacity within the Defense Base Operating Fund and Depots programs.

<sup>37</sup> There must be one significant caution sounded on the use of civilian MROs. Systems managers must make holistic decisions for the designation of depot core competencies in two areas. First, *Aviation Week and Space Technology* has published several articles since 2001 noting the rise of Asian and Latin American MRO operations. American cargo and passenger carriers are leveraging these facilities increasingly due to their lower labor and total operations cost. Many critical items may be retained within the government's repair system for National Security reasons. Second, excess organic national repair capacity must be retained during peacetime to ensure that wartime high OPTEMPO requirements will be met.

<sup>38</sup> A significant counter-argument that I have heard for the past 20 years as an aviation maintainer is that the civilian business model is different from the Army mission generation model, which is also different from the Air Force Sortie generation model of resourcing aircraft requirements. Thus, the argument continues, no single maintenance solution can fit all cases.

This argument is an attempt to over-complicate and specialize aviation maintenance requirements. Aircraft are resourced for an availability model. This is true for all uses, both civilian and military. The long term utilization of that availability is the responsibility of the operational manager or commander, while maintainers simply marshal and apply repair resources as efficiently and effectively as possible to meet the operational requirements. Civilian air fleets are limited in their availability as much as military fleets. They are simply managed differently based on perceived needs and perceived surge requirements.

<sup>39</sup> These improvements also imply another benefit; lack of competitive bidding by governmental sub-components. Since maintenance requirements will be centrally managed and identified, the Department of Interior will not bid against the Department of Justice for aircraft parts and services thus driving up costs.

<sup>40</sup> Mike George, Dave Rowlands and Bill Kastle, *What is Lean Six Sigma?*, McGraw-Hill, New York, 2004. The authors offer a simple procedure for Lean Six –Sigma implementation that could be extremely useful for tracking the complex integration of aircraft sustainment operations across the DOD. Lean Six Sigma has been implemented in several large commercial corporations and has been proven effective in both maintenance and transactional processes of sustainment operation improvements for the Army's Materiel Command. The use of continual process review, assessment and improvement would ensure that systemic modification does not drift into irrelevance.

<sup>41</sup> Phillips , pp.44-45.

<sup>42</sup> The Army experimented with evacuation of aircraft to depots and contact teams after Desert Storm (a.k.a. STIR program) and between rotations of Operation Iraqi Freedom. Although the evacuations for maintenance have been widely successful, organizational friction has been significant in certain units as tactical commanders have not wanted to "lose their aircraft" for extended periods of time.

<sup>43</sup> Army Regulation 220-1 requires units to report aircraft readiness based on system and subsystem operability. Aircraft are reported as "Fully Mission Capable, Partially Mission Capable, or "Not Mission Capable" on a continuous clock basis throughout a cyclical month. This methodology favors short term maintenance solutions in pursuit of maintenance goals as opposed to flexing aircraft for actual mission requirements. Mission requirement metrics, such as Fort Rucker's fleet "sortie generation" or the Air Force "sortie completion" models are fundamentally different metrics which provide the tactical commander significant planning flexibility while allowing maintainers to make better long-term decisions.

<sup>44</sup> The Army and other Services have attempted several iterations of MOS consolidation and streamlining. These reorganizations have been sub-optimal attempts to glean spaces for other reorganizations without regard for the complete needs of the Defense Department's aviation structure. When the system is integrated, however, obvious "strategic advantages" may be identified throughout the Department as a whole. For example, it may be advantageous for the services to procure "power by the hour" from auxiliary power unit OEMs to focus on airframe and power plant mechanics. By leveraging excess capability and determining critical core competencies across the DOD, the critical resource of manpower availability could be managed more effectively.

<sup>45</sup> An excellent example of this could be in the area of avionics, electrical, hydraulic and pneudraulics repairs. System components and diagnostic and test equipment for these areas are similar throughout the civilian aircraft fleet. Procedures can be designed to be followed by any generally competent mechanic. The replacement of pitot tubing for a light helicopter is essentially the same as for a heavy bomber. Similarly, if avionics are standardized across fleets, there will be little need for a system specific repairer.

<sup>46</sup> Edward H. Phillips. "Cargo Carriers Seek Stronger Ties with MRO providers", *Aviation Week & Space Technology*, New York: Aug 27, 2001. Vol. 155, Iss. 9; p.61. The author quotes FEDEX vice president Mike Cukor as stating: "the company has had long term relationships with contract maintenance and repair operations" and will continue to do so in the future.

<sup>47</sup> Certain aircraft specific items such as Aviation Survivability equipment and avionics require personnel with Secret or Top Secret clearances to accomplish repair. This requirement should not be the only consideration when evaluating a component for outsourcing, however, these requirements may significantly increase the cost or repair and overhaul.

<sup>48</sup> This would end the practice of DLR repair at the unit or organizational level. This is required in order to prolong the serviceability of end items and ensure the continued high quality of repair parts. In this way, the period between repetitive maintenance actions on the same component, assembly or airframe should be extended. This will reduce the line mechanics' "touches" on the aircraft.

<sup>49</sup> The Department of Defense has the largest aircraft fleet by far in the federal government. Although numbers vary significantly by source, Army Materiel Command tracked 3598 aircraft in the Army in 2004 (from the Army Equipping Conference data dated 31 March 2005 by ADC-S, G-8). The Air Force and Air Force Reserve totaled 4941 aircraft including 197 helicopters (OPR: AF/XPPE, 2003). The Navy and Marine Corps have significant quantities of fixed and rotary wing aircraft. The Coast Guard, a component of the Department of Homeland Security, but not reported under DHS, has 162 rotary and 59 fixed wing aircraft currently in their inventory.

<sup>50</sup> The General Services Administration (GSA) "Report on the Status of Federal Government Aircraft" from the Federal Aviation Interactive Reporting System (FAIRS) , FY 2004, dated 31 March 2005 lists a total of 1464 directly owned government aircraft in the service of the Federal Government. These aircraft, by type and quantity can be found in appendix 1. This total does not include aircraft under long term government lease or contract. Although many of the aircraft are fixed wing, a significant number a non-complex rotary wing compatible with types operated by the Department of Defense. Although the paradigm I am forwarding is designed around Army core competencies with rotary wing aircraft, there are sufficient parallels between aircraft maintenance requirements to extrapolate the logic of consolidating the government's fixed wing fleet under an organization with a fixed wing core competency (Air Force or Naval Aviation).