Author Request (To be completed by applicant) - The following author(s) request authority to disclose the following presentation in the MORSS Final Report, for inclusion on the MORSS CD and/or posting on the MORS web site.

Principal Briefer’s Organization and address

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Original title on 712 A/B: The Long Term effect of Equipment Usage in the GWOT on Equipment Readiness

Revised title: N/A

Presented in: (WG 21, CG___, Special Session ___, Poster, Demo, or Tutorial):

This presentation is believed to be:
UNCLASSIFIED AND APPROVED FOR PUBLIC RELEASE
The Long Term effect of Equipment Usage in the GWOT on Equipment Readiness

The Long Term effect of Equipment Usage in the GWOT on Equipment Readiness

<table>
<thead>
<tr>
<th>MAJ Dave Sanders</th>
<th>MAJ John Ferguson</th>
<th>Mr Matthew Woodward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Army PAED</td>
<td>ASA FM&amp;C</td>
<td>OSD PA&amp;E</td>
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<tr>
<td>Deputy Chief of Staff G-8</td>
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<td>703-695-3785</td>
<td>FAX: 703-693-6993</td>
<td><a href="mailto:john.ferguson@us.army.mil">john.ferguson@us.army.mil</a></td>
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<td><a href="mailto:david.m.sanders@us.army.mil">david.m.sanders@us.army.mil</a></td>
<td></td>
<td></td>
</tr>
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</table>
Problem Identification…

Oct, 03: Mr Tison (Deputy G-8): We need to ensure we fix the equipment as a result of GWOT, otherwise we will have to divert funding in future years to do this, when it should be done now.

1030 hrs, 10 Mar 04: BG Durbin, Deputy PAED “Bring down the slide that shows how much more our systems have aged because of Iraq. I need it by 1400.”

SECDEF, 26 Mar 04: “Typically, the cost of operations is funded with supplemental appropriations. I therefore would like to ensure that, in developing the next supplemental request, we are properly covering the cost of using equipment at higher than expected rates.”

“…effort is needed to understand more clearly how operations are contributing to greater wear and tear on equipment, and what the implications are for future supplemental appropriation requests. The study will determine the additional depot maintenance needed to repair and replace systems, tally the equipment lost in combat operations, and identify which items might have to be replaced sooner than anticipated.”

Major players: Army, OSD, OMB, Congress, USMC, Air Force/Navy
Background

Density of Equipment Currently in Theater

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Number of Vehicles/Aircraft</th>
<th>Fleet Size (PB05)</th>
<th>Percentage of Fleet in Use</th>
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</thead>
<tbody>
<tr>
<td><strong>Wheeled Vehicles</strong></td>
<td></td>
<td></td>
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<tr>
<td>Light Tactical Vehicles</td>
<td>36,665</td>
<td>116,979</td>
<td>31</td>
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<tr>
<td>Medium Tactical Vehicles</td>
<td>6,498</td>
<td>71,163</td>
<td>9</td>
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<tr>
<td>Heavy Tactical Vehicles</td>
<td>5,537</td>
<td>25,041</td>
<td>22</td>
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<tr>
<td><strong>Totals</strong></td>
<td>48,700</td>
<td>213,183</td>
<td>23</td>
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<td><strong>Combat Vehicles</strong></td>
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<td>M1 Fleet</td>
<td>819</td>
<td>4,392</td>
<td>19</td>
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<tr>
<td>M2/M3 Fleet</td>
<td>884</td>
<td>3,719</td>
<td>24</td>
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<tr>
<td>M113</td>
<td>1,287</td>
<td>13,387</td>
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<tr>
<td>Stryker</td>
<td>311</td>
<td>930</td>
<td>33</td>
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<tr>
<td><strong>Totals</strong></td>
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<td>22,428</td>
<td>15</td>
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<tr>
<td><strong>Aviation</strong></td>
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<tr>
<td>Light Reconnaissance</td>
<td>96</td>
<td>352</td>
<td>27</td>
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<tr>
<td>Utility</td>
<td>238</td>
<td>1,619</td>
<td>15</td>
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<td>Cargo</td>
<td>66</td>
<td>459</td>
<td>14</td>
</tr>
<tr>
<td>Attack</td>
<td>86</td>
<td>713</td>
<td>12</td>
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<tr>
<td><strong>Totals</strong></td>
<td>486</td>
<td>3,143</td>
<td>15</td>
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*Reflects vehicle and aircraft deployments in OIF as of September 2004.

- In FY 03, little funding provided to support RESET
- In FY 04, $3B provided for RESET, but requirement was $4.4B – with very little procurement
- In FY 05, ~ 10B provided in procurement, with $3.2 going towards RECAP and replacement of losses
- We expect increased requirements for a minimum of two years after hostilities end, and the backlog is growing...

Overall, roughly 40% of Army Equipment has been deployed to OIF/OEF by the end of FY 05
RESET Definitions

RESET is a series of actions to restore units to a desired level of combat capability commensurate with mission requirements and availability of resources. It consists of:

(1) Repairing IAW Technical Manuals (TM), to include Delayed Desert Damage (3D) and Aviation Special Technical Inspection and Repair (STIR), at both the National and Field levels.

(2) Recapitalization where sensible/affordable, implementing lessons learned.

(3) Replacement of battle losses and washed out equipment.

(4) Reorganizing resetting units to a modular design in support of ACP.

Added in FY 05 – repairs damage, implements lessons learned through critical upgrades, replaces lost and washed out equipment which is not “replaceable”
Army Readiness Trends

Current Operations are impacting on readiness:
• Combat operations
• Harsh environment
• Increased OPTEMPO (above expected peacetime level)

Trend since 9/11:

Total Fleet OR Trends are declining.

OR rates are falling behind in CONUS. Home-station units are paying the price to keep Theater OR rates up.

Increase in USAGE exacerbates damage.

While intuitively it is obvious that the increased usage has an effect on the decreased useful life of the vehicle, impacting both operating costs and readiness, data is elusive…
**Relationship between Equipment Age and Readiness**

- **Other Factors effecting relationship:**
  - **Location**
    - variance in maintenance practices
    - Availability of organic depots / GS facilities
  - **System Sustainment planning**
    - Sustainment Systems Technical support (SSTS)
    - Upgrade programs for weapon system – which includes Systems Technical Support (STS)
    - Depot Maintenance Programs and past funding levels

![Graph showing the relationship between HMMWV OR rate and age](image)

\[ y = -0.0003x^2 - 0.0006x + 0.9758 \]

\[ R^2 = 0.8258 \]
Relationship between Equipment Age and Readiness

Why? (a hypothesis only)

- upgrade programs exist – so STS dollars impacted sustainment because of high commonality of secondary items)
- Aggressive DM overhaul programs existed – mid-life rejuvenation occurred
Elements that effect “Age”

\[ \text{Aging} = f(\text{time, mileage, terrain, environment}) \]

Conceptually:

Increased USAGE decreases the useful life remaining – thus “increasing” age.

Estimating the impact:

\[
\text{Aging in AOR} = \left( \frac{\text{COST}}{\text{Terrain Factor}} \times \frac{\text{COST}}{\text{Environment Factor}} \times \left( \frac{\text{OPTEMPO Factor}}{\text{GWOT Factor}} \times \frac{\text{GWOT}}{\text{OPTEMPO}} \right) \right) + \text{Time factor}
\]
Potential approaches to determining Mileage / Time relationship of effective Aging

- **Depreciation**
  - IAW commonly accepted accounting methods
    - Government standards exist IAW OMB Circular A-076 which outlines life expectancy and salvage value
  - Value in commercial sector

- **Comparison to government travel Reimbursement**

- **Data based analysis**
  - current data as compared to historical baselines of
    - Failure rates
    - Operational Readiness
    - O&S costs

Similar to a report by CBO which estimated the percentage of the acquisition cost of the vehicle for the excess usage.
Aging Analysis Concept # 1

Commercial Vehicle Model Based on Kelly Bluebook®

<table>
<thead>
<tr>
<th>Model</th>
<th>Invoice Value $</th>
<th>Equiv age for additional 15K miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dodge Dakota</td>
<td>16,949</td>
<td>18.6%</td>
</tr>
<tr>
<td>Isuzu Rodeo</td>
<td>19,261</td>
<td>20.8%</td>
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<tr>
<td>Ford F150</td>
<td>20,342</td>
<td>24.7%</td>
</tr>
<tr>
<td>GMC Sonoma</td>
<td>23,695</td>
<td>21.4%</td>
</tr>
<tr>
<td>Nissan Pathfinder</td>
<td>25,530</td>
<td>28.4%</td>
</tr>
<tr>
<td>Chevy Suburban</td>
<td>37,688</td>
<td>32.5%</td>
</tr>
<tr>
<td>Range Rover</td>
<td>67,144</td>
<td>19.6%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>67,144</strong></td>
<td><strong>24.9%</strong></td>
</tr>
</tbody>
</table>

The decrease in commercial value due to incremental mileage increase is 25%.

Source: Kelly Blue Book Guide for Used Cars
http://www.kbb.com/kb/ki.dll/ke.kb.sp?kbb.VA;032042;VA059;&22079'suv+r&usedCars;slp
Comparison of Aging Models

From this analysis, recommend using Kelly Blue Book model:

- Scaleable
- Conservative
- Reasonable

- but…commercial value of vehicles is also based on other factors, not solely on the useful life of the vehicle
  - preferences and perceptions of vehicles
  - perceptions of potential for resale
  - location
  - state of the economy
Potential approaches to determining Mileage / Time relationship of effective Aging

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Aging Analysis Concept #2

Build a failure rate to age relationship model for a few key parts

RAND Study

• Rand analysis compared mean time between failure to age of Abrams tank, broken out by work breakdown structure.
• “low cost items” showed aging to the largest extent

• “low cost” items have a great impact because though they are not cost drivers, they cause NMC rates to increase.

Army Analysis Concept:
- Compare failure data in OIF on cohorts of same aged systems to determine if aging can be observed in deployed fleets
Analysis of RECAP Increases

• Data was broken down by WBS, & binned into 8 age groups for each WBS
• Resulting data set was regressed to determine relationship between age and failure rate per 1000 miles

\[
\text{Aging} = f(\text{time}, \text{mileage}, \text{terrain}, \text{environment})
\]

\[
\text{Aging in AOR} = \left( \frac{\text{COST}}{\text{Terrain Factor}} \times \frac{\text{COST}}{\text{Environment Factor}} \times \left( \frac{\text{Mileage} \times \text{GWOT}}{\text{Factor} \times \text{OPTEMPO}} \right) \right) + \text{Time Factor}
\]

(1 – mileage factor)

After a year in GWOT, a 13 year old HMMWV shows the characteristics of an 18 year old HMMWV.

<table>
<thead>
<tr>
<th>HMMWV</th>
<th>&quot;Mileage Factor&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Analysis</td>
<td>25.0%</td>
</tr>
<tr>
<td>Failure rate Analysis</td>
<td>39.5%</td>
</tr>
<tr>
<td>Actual Utilized</td>
<td>9.7%</td>
</tr>
</tbody>
</table>
Fixing the Problem

Develop relationship between higher OPTEMPO and "aging" of equipment

\[
\text{Aging} = f(\text{time, mileage, terrain, environment})
\]

Aging = \left( \frac{\text{COST}_{\text{Terrain Factor}} \times \text{COST}_{\text{Environment Factor}} \times \frac{1}{4} \text{GWOT}}{\text{OPTEMPO}} \right) + 0.75

Increased "aging" of fleet due to density in OIF

RECAPS 465/862 required in FY 05

RECAPS 711/1309 required by '07

Develop RECAP recommendation based on:
- fleet strategy and constraints
- SEED assets
- National Maintenance Capacity
- parts availability
- time limitations of supplemental funding

Request Supplemental funding for executable, prioritized requirements

Translate to Fleet Average Age and calculate requirement to "buy back" increased aging

RECAPS 465/862 required in FY 05
RECAPS 711/1309 required by '07

5.66 yr increase in aging effects

HET OIF Stress Impact

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RECAPS 711/1309 required by '07

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HET OIF Stress Impact
## RECAP / Modifications

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<th>Non-Executable QTY</th>
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<td><strong>11,479</strong></td>
<td><strong>5,535</strong></td>
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FY 05 SUPP: $2.6B
Future Work

• Continue to evaluate “Effective Aging”
  
  – Assess effects of new “National Level RESET” programs, particularly Abrams/Bradley, Stryker, and Aviation systems to determine if problems still exist

• Explore relationships between SSTS and Maintenance polices on Readiness; use in assessment of Army POM

• Develop FY 06 required / feasible level of effort to address issues
Questions
BACKUP
National and Field Level RESET

**National level** Reset is defined as work performed to correct equipment faults that are above the Field level of maintenance (that is, above ORG and DS), as laid out in Technical Manual Maintenance Allocation Charts. National level Reset is orchestrated by AMC, performed to a National standard that AMC is responsible for defining, and could be done in the Army Materiel Command, by contractor, by installation DOL maintenance activities, or any combination of the three. It is conducted in depots, arsenals and forward on or near installations where the equipment is stationed. The AMC life cycle management centers (LCMCs) develop strategies for National Level maintenance ICW their PEO/PM partners and IMA (for work done by DOLs). National level Reset is also conducted on pieces of equipment which exceed Field level Reset capability because of the quantity of work to be performed. Certain types of equipment, due to its inherent complexity, will automatically be done at the National level of maintenance. Aviation STIR and the Generator Reset program are examples. AMC has published a list of equipment which is treated in this manner.

**Field level** Reset is defined as work performed to correct equipment faults within the Field level of maintenance (that is, work that is done by soldier mechanics at what we know today as ORG and DS level maintenance), as laid out in Technical Manual Maintenance Allocation Charts for their echelon of maintenance. Field level Reset work is executed by the MACOMs, and is done with soldier labor, augmented by contractor labor as required. This work is performed on the installation where the equipment is stationed. The scope of work at this level involves bringing a piece of equipment back to TM 10/20 standards, eliminating the effects of 3D, and performing services required.
Mileage effects on aging

### Multiple Regression Analysis

**Ford 150 Kelly Bluebook**

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<td>milage yrs</td>
<td>-0.0133</td>
<td>-14.3070</td>
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% of devaluation from each additional year of mileage = 24.73%

### Multiple Regression Analysis

**Chevy Suburban Kelly Bluebook**

<table>
<thead>
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<td>Observations</td>
<td>47,000</td>
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<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Significance F</th>
</tr>
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<tbody>
<tr>
<td>Regression</td>
<td>2</td>
<td>0.007393777</td>
<td>0.15686839</td>
<td>316.223866</td>
<td>0.00062E-27</td>
</tr>
<tr>
<td>Residual</td>
<td>44</td>
<td>0.021446911</td>
<td>0.00049739</td>
<td>0.236716449</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
<td>0.007833589</td>
<td></td>
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<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Intercept</td>
<td>0.000314</td>
<td>-37.0234</td>
<td>4.48E-52</td>
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<tr>
<td>age</td>
<td>0.000111</td>
<td>-37.0234</td>
<td>4.48E-52</td>
</tr>
<tr>
<td>milage yrs</td>
<td>-0.0133</td>
<td>-14.3070</td>
<td>4.18E-17</td>
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</tbody>
</table>

% of devaluation from each additional year of mileage = 26.02%
Why RECAP?

Recapitalization (RECAP) is the rebuild and/or systemic upgrade of currently fielded systems to ensure operational readiness and a zero time/zero mile system. Objectives include

- extending service life
- reducing O&S costs
- improving system reliability
- enhancing capability

RECAP can be further subdivided into rebuild programs, which do not enhance capability, and upgrade programs, where capability is enhanced. RECAP occurs at the National level of Maintenance

Current Operations are impacting on readiness:

- Combat operations
- Harsh environment
- Increased OPTEMPO (above expected peacetime level)
Alternative Modeling Methodology: Commercial truck costing Model

Either of these factors would greatly increase the “aging” factor

<table>
<thead>
<tr>
<th>Type</th>
<th>Manufacturer</th>
<th>MSRP</th>
<th>Age equiv of 1 more year of Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Haul</td>
<td>Freightliner</td>
<td>$115,880</td>
<td>1.12</td>
</tr>
<tr>
<td>Local Haul</td>
<td>Freightliner</td>
<td>$108,705</td>
<td>0.48</td>
</tr>
<tr>
<td>severe duty</td>
<td>Freightliner</td>
<td>$105,308</td>
<td>0.27</td>
</tr>
<tr>
<td>Average:</td>
<td></td>
<td></td>
<td>0.63</td>
</tr>
</tbody>
</table>

Aging in AOR = \( \left( \frac{COST}{Terrain \ Factor} \times \frac{COST}{Environment \ Factor} \times \left( \frac{1}{4} \ GWOT \ OPTEMPO \right) \right) + 0.75 \)

Alternative Modeling Methodology: 
Tractor Age vs Condition

• Commercial tractor methodology does not have a factor we could use based on increased mileage, only on condition.

• Tractor Model would increase “aging” of Abrams by 3.4-3.66 yrs – Kelly bluebook Truck model would increase “Aging” by 3.77 yrs.
  - But no variance for lesser or greater used vehicles.
  All fleets would age by this amount.