

Tactical Vehicle Cons & Reps Cost Estimating Relationship (CER) Tool



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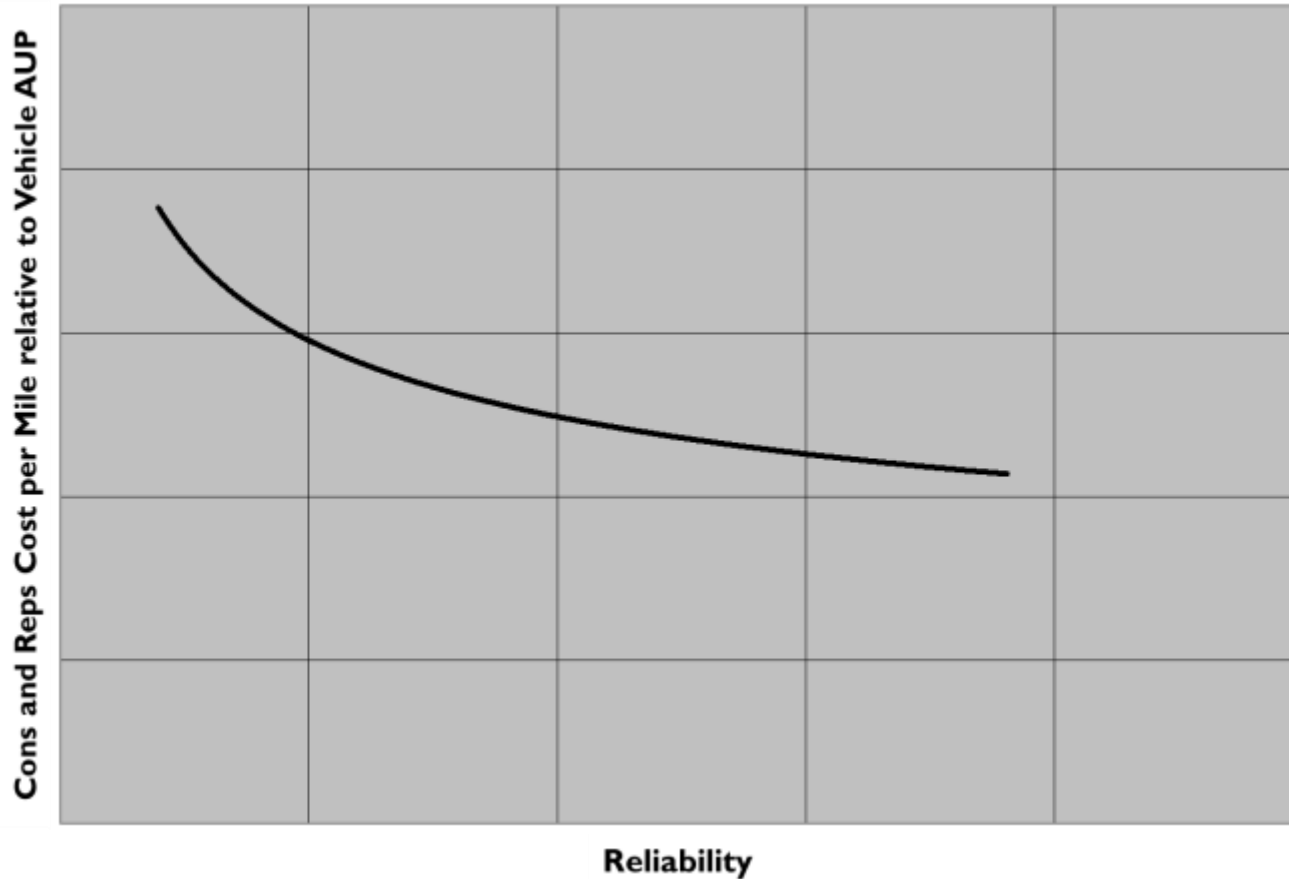
Objective/Purpose

- Developing a single consumables and reparables parts cost estimating relationship (CER) for the Army's Tactical Vehicle fleet is a significant challenge. This study sought an Excel-based tool that would allow analysts to select data relevant to their specific vehicles, efficiently and comprehensively compare multiple relationships, and choose the CER most relevant to their programs. This paper will discuss challenges and detail the process for quantifying the relationship between tactical vehicle reliability and parts cost.

Previous Studies

- Two predecessor tasks to the current study
- Completed for the Office of the Deputy Assistant Secretary of the Army for Cost and Economics (ODASA-CE)
- Same objectives as current study: to develop a methodology to support consumables and reparable (Cons and Reps) parts cost estimating for tactical vehicles
- Two operating hypotheses led the studies to seek Cons and Reps cost ratio plots against reliability:
 - 1) Cons and Reps per mile varies inversely with reliability (i.e., Cons and Reps cost decreases as vehicle reliability increases)
 - 2) Cons and Reps per mile varies directly with vehicle price (i.e., Cons and Reps cost increases with vehicle average unit price (AUP))

Theoretical Cost Ratio



Theoretical Cost Ratio of (Cons and Reps per Mile) / (Vehicle AUP) vs. Reliability

Previous Studies

- 2008 Vehicle Study
 - Vehicle AUP data from varied sources
 - Reliability metrics not consistent
 - Mean miles between operational mission failure (MMBOMF), mean miles between system abort (MMBSA), mean miles between hardware mission failure (MMBHMF)
 - Captured during different stages in the lifecycle of the vehicle (e.g., Developmental Test (DT), Operation Test (OT), Limited User Test (LUT))
 - Cons and Reps costs and activity (miles) based on OSMIS data
- 2012 Tactical Vehicle Study
 - Vehicle AUP data all from the Wheeled and Tracked Vehicle (WTV) Automated Cost Database (ACDB)
 - Reliability metrics all from Army Materiel Systems Analysis Activity (AMSAA) Sample Data Collection (SDC)
 - Cons and Reps costs and miles all from AMSAA SDC

Current Study – Hypotheses Revisited

- Same Two Operating Hypotheses:
 - 1) Cons and Reps costs (per mile) vary inversely with reliability
 - Cons and Reps costs decrease as reliability increases
 - 2) Cons and Reps costs (per mile) vary directly with vehicle cost
 - Cons and Reps costs increase as vehicle AUP increases
- Using hypotheses 1 and 2 above, aimed to create similar Cons and Reps cost ratio plot against reliability
 - $(\text{Cons and Reps per Mile}) / (\text{Vehicle AUP})$ vs. Reliability
 - And explore other alternatives
 - Two variable case, Cons and Reps per mile = $f(\text{Reliability}, \text{AUP})$
 - Three variable case, Cons and Reps = $f(\text{Reliability}, \text{AUP}, \text{Miles})$
 - Cons modeled separately; Reps modeled separately

Current Study – Data Definition

- Wheeled and Tracked Vehicle (WTV) Automated Cost Database (ACDB)
 - Army’s primary source of contract acquisition price
 - Data housed in WTV ACDB used to calculate vehicle variant AUP
- Army Materiel Systems Analysis Activity (AMSAA) Sample Data Collection (SDC)
 - Army source of consistent CONUS and field exercise data
 - Served as the study’s source of reliability data
- Army Operating and Support Management Information System (OSMIS)
 - Army’s primary source of O&S phase costs
 - Served as the source of Cons and Reps parts cost, miles driven (activity), and inventory (density)

Current Study – Data Collection

- Compiled list of tactical vehicles with contract and Cost Data Summary Report (CDSR) production data in WTV ACDB
- Obtained peacetime reliability metrics from AMSAA
 - Mean miles between non-mission-capable visits (MMB NMC Visits)
- Compiled list of vehicles for which data was available both within the WTV ACDB and AMSAA SDC
- Where possible, extracted Class IX Summary (cons and reps costs, miles, and inventory) data for aforementioned list of vehicles from OSMIS:
 - Due to differing surcharge applications, data was pulled for both of the following:
 - Base Year (BY) 2012
 - Then Year (TY) and escalated to BY12 via Army OMA indices
 - Peacetime costs (Without CONOPS)
 - Provided years individually and averaged, the latter done in an effort to level-out fluctuations in the data

Current Study – Data Collection

- Compiled a list of vehicles for which all three data sources were available, resulting in a list of 93 vehicles
- Completed “Pareto-Plus” analysis to reduce sample size to a manageable number of systems based on the following criteria:
 - Included vehicles that comprised top 95% of total inventory, and
 - Included vehicles that comprised top 95% of total miles driven
- Extracted contracts and CDSRs from the WTV ACDB for the resulting list of 52 vehicles
- Utilized Total Price and Quantity as well as OPA inflation indices to obtain vehicle AUP in BY2012
- Per customer direction, MRAP M-ATV (MI240) and ASV (MI117) added to data set in later iteration
- Developed Visual Analysis Tool (VAT) to develop CERs for these **54 vehicles** across 12 series (the list of vehicles is shown on the next slide)

Current Study – Data Collection

Vehicle Series	Vehicle Variant		Vehicle Series	Vehicle Variant		Vehicle Series	Vehicle Variant		Vehicle Series	Vehicle Variant
HMMWV	M998		FMTV	MI078A1-6343		M939 Series	M923A2		HEMTT	M978-7672
HMMWV	MI025		FMTV	MI083A1-3890		M939 Series	M923		HEMTT	M984A1
HMMWV	MI097A2		FMTV	MI088A1-3893		M939 Series	M931A2		HEMTT	M977-6426
HMMWV	MI114		FMTV	MI078A1P2-8577		M939 Series	M931		HEMTT	M985-7673
HMMWV	M997-2274		FMTV	MI083A1P2-8610		M939 Series	M925		HEMTT	MI120A2
HMMWV	MI113		FMTV	MI088A1P2-7759		M939 Series	M925A2		HEMTT	MI120A2R1
HMMWV	MI038		FMTV	MI078A1-3888		M939 Series	M929A2		HEMTT	M978A2-8215
HMMWV	MI037		FMTV	MI083A1-3884		M939 Series	M929		HEMTT	M977-0260
HMMWV	MI026		FMTV	MI089A1-3892		M915 Series	M915A3-4847		HEMTT	M984A2
HMMWV	M966		FMTV	MI078A1P2		M915 Series	M915A1		PLS	MI075
HMMWV	MI025A2		M-35 Series	M35A2-1617		M915 Series	M915A2		PLS	MI074
HMMWV	MI152		M-35 Series	M35A2C-0873		M915 Series	M915		M809 Series	M818-8984
HET	MI070		M916 Series	M916		M915 Series	M920		M809 Series	M813A1-8913
MRAP	MI240		ASV	MI117						

Vehicle Series and Variants for Tactical Vehicle Cons and Reps CER Tool

Current Study - Analysis

- Desired CER and results differ depending on the subset of tactical wheeled vehicles of interest
- Differing results due to inherent variations in Cons and Reps data as well as large variations in data depending on the vehicle of interest (weight, mission, etc.)
- Created Excel-based VAT
 - Robust tool that enables the user to select desired data subset, regression form, and variables
 - Outputs graphs, statistics, CER (in both fit and unit space), residual analysis, and data for effective analysis
 - Analyst able to analyze multiple relationships in a short period of time, enabling more efficient and comprehensive analyses

Current Study - Results

- Recommend summing MACOMs (i.e., selecting Total from the MACOM dropdown within the Tool)
 - Individual MACOMs produce varying results for which no significant relationships were identified to warrant use
- Recommend utilizing average across the years
 - Statistics suffer when utilizing all years individually
 - Large annual variance when utilizing all years vice average
 - May have 8 years of data for one vehicle and 2 years for another; skews results
- Recommend two variable power model, $f(\text{Reliability, AUP})$, when assessing the dataset as a whole
 - Power model makes most sense when considering asymptotic trends
 - R^2 improves when compared to the one variable relationship
 - Results in cost per mile estimate, the Army's preferred output

Current Study - Results

WTV - TACTICAL VEHICLE RELIABILITY

CV: R2: Adj R2:

40.4% 58.3% 53.1%

Unit Space Summary

User Guide

Acronyms

***OSMIS DATA PULL METHOD

BY12 TY -> BY12

AXES CONTROLS

X-Var: 1
 X-Axis: MMB NMC Visit
 Y-Axis: Cons&Reps per Mile AUP
 MACOM: Total
 Average Years

TRENDLINE

OFF
 Linear
 Exponential
 Logarithmic
 Power

STATS

RESIDUAL ANALYSIS

DATA

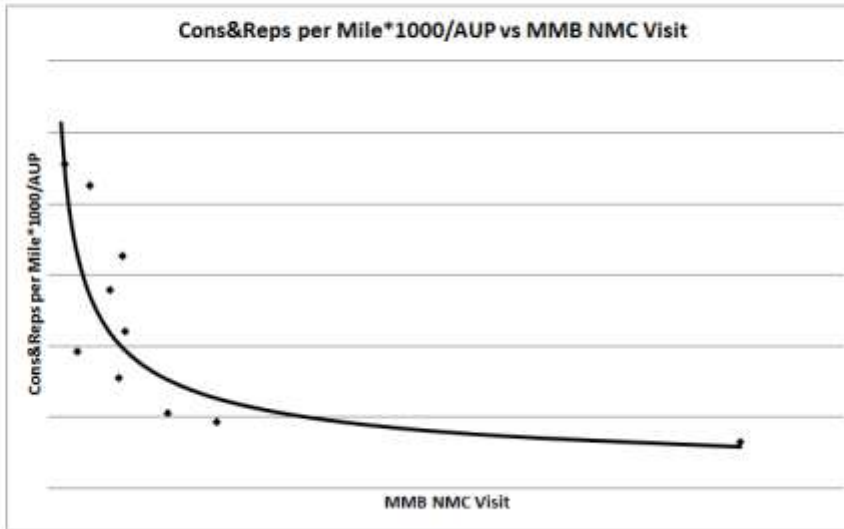
AXES CONSTRAINTS

	Min	Max
Y		
X		

TRENDLINE CONTROLS

	Min	Max
Y-Axis		
X-Axis		

***Note: Consumables and Repairables costs were pulled from the Army OSMIS system in two manners:
 1. Dollars pulled in BY12S for all years and all systems (BY12 option).
 2. Dollars pulled in TYS for all years and all systems then converted to BY12S via the Army OMA Inflation table (TY -> BY12 option).



ABS(Std. Residual)

POTENTIAL OUTLIER

2

Toggle

Avg Series

- | | | |
|--|---|--|
| <input checked="" type="checkbox"/> HMMWV SERIES | <input checked="" type="checkbox"/> M915 SERIES | <input type="checkbox"/> STRYKER SERIES |
| <input checked="" type="checkbox"/> M998 | <input checked="" type="checkbox"/> M915A3-4847 | <input type="checkbox"/> M1126 |
| <input checked="" type="checkbox"/> M1025 | <input checked="" type="checkbox"/> M915A1 | <input type="checkbox"/> M1127 |
| <input checked="" type="checkbox"/> M1097A2 | <input checked="" type="checkbox"/> M915A2 | <input type="checkbox"/> M1128 |
| <input checked="" type="checkbox"/> M1114 | <input type="checkbox"/> M915 | <input type="checkbox"/> M1129 |
| <input checked="" type="checkbox"/> M997-2274 | <input type="checkbox"/> M920 | <input type="checkbox"/> M1130 |
| <input checked="" type="checkbox"/> M1113 | <input checked="" type="checkbox"/> Average_M915 | <input type="checkbox"/> M1131 |
| <input checked="" type="checkbox"/> M1038 | | <input type="checkbox"/> M1132 |
| <input checked="" type="checkbox"/> M1037 | | <input type="checkbox"/> M1133 |
| <input checked="" type="checkbox"/> M1026 | <input checked="" type="checkbox"/> PLS SERIES | <input type="checkbox"/> M1134 |
| <input checked="" type="checkbox"/> M966 | <input checked="" type="checkbox"/> M1075 | <input type="checkbox"/> M1135 |
| <input checked="" type="checkbox"/> M1025A2 | <input checked="" type="checkbox"/> M1074 | <input type="checkbox"/> Average_STRYKER |
| <input checked="" type="checkbox"/> M1152 | <input checked="" type="checkbox"/> Average_PLS | <input type="checkbox"/> Include Add-Ons |
| <input checked="" type="checkbox"/> Average_HMMWV | <input checked="" type="checkbox"/> M809 SERIES | <input checked="" type="checkbox"/> MRAP M-ATV |
| <input checked="" type="checkbox"/> M35 SERIES | <input checked="" type="checkbox"/> M818-8984 | <input type="checkbox"/> M1240 |
| <input checked="" type="checkbox"/> M35A2-1617 | <input checked="" type="checkbox"/> M813A1-8913 | <input type="checkbox"/> ASV |
| <input checked="" type="checkbox"/> M35A2C-0873 | <input checked="" type="checkbox"/> Average_M809 | <input type="checkbox"/> M1117 |
| <input checked="" type="checkbox"/> Average_M35 | <input checked="" type="checkbox"/> HEMTT SERIES | |
| <input checked="" type="checkbox"/> FMTV SERIES | <input checked="" type="checkbox"/> M978-7672 | |
| <input checked="" type="checkbox"/> M1078A1-6343 | <input checked="" type="checkbox"/> M984A1 | |
| <input checked="" type="checkbox"/> M1083A1-3890 | <input checked="" type="checkbox"/> M977-6426 | |
| <input checked="" type="checkbox"/> M1088A1-3893 | <input checked="" type="checkbox"/> M985-7673 | |
| <input checked="" type="checkbox"/> M1078A1P2-8577 | <input checked="" type="checkbox"/> M1120A2 | |
| <input checked="" type="checkbox"/> M1083A1P2-8610 | <input checked="" type="checkbox"/> M1120A2R1 | |
| <input checked="" type="checkbox"/> M1088A1P2-7759 | <input checked="" type="checkbox"/> M978A2-8215 | |
| <input checked="" type="checkbox"/> M1078A1-3888 | <input checked="" type="checkbox"/> M977-0260 | |
| <input checked="" type="checkbox"/> M1083A1-3884 | <input checked="" type="checkbox"/> M984A2 | |
| <input checked="" type="checkbox"/> M1089A1-3892 | <input checked="" type="checkbox"/> Average_HEMTT | |
| <input checked="" type="checkbox"/> M1078A1P2 | <input checked="" type="checkbox"/> M939 SERIES | |
| <input checked="" type="checkbox"/> Average_FMTV | <input checked="" type="checkbox"/> M923A2 | |
| <input type="checkbox"/> HET | <input checked="" type="checkbox"/> M923 | |
| <input checked="" type="checkbox"/> M1070 | <input checked="" type="checkbox"/> M931A2 | |
| <input checked="" type="checkbox"/> M916 SERIES | <input checked="" type="checkbox"/> M931 | |
| <input checked="" type="checkbox"/> M916 | <input checked="" type="checkbox"/> M925 | |
| | <input checked="" type="checkbox"/> M925A2 | |
| | <input checked="" type="checkbox"/> M929A2 | |
| | <input checked="" type="checkbox"/> M929 | |
| | <input checked="" type="checkbox"/> Average_M939 | |

Tactical Vehicle Cons and Reps Cost Estimating Tool

Current Study - Conclusions

- Specific CER utilized depends on analysis
- Do not recommend a single CER for all cases
- Recommend summing MACOMs (selecting Total from the MACOM dropdown)
- Recommend utilizing average across years
- Tactical Vehicle Cons & Reps CER Tool enables users to assess the level of fit for various relationships efficiently and comprehensively
 - More in-depth analyses in order to determine the relationship that makes most sense for current estimation needs
 - Analysts have control over and insight into the relationships being built when using this tool
 - All necessary information is provided to the analyst so that he/she may make the best CER selection

Tactical Vehicle Cons and Reps CER Tool Demo

Learn More and Contact Us

Tactical Vehicle Cons and Reps CER Tool

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