



USING COST OF CORROSION DATA FOR MAINTENANCE DECISIONS IN AIR FORCE AEROSPACE

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Outline



- **LMI Studies**
- **AF use of OSD Data Warehouse**
- **AF CCPE Survey – “How Are You Measuring Corrosion?”**
- **Customer Doesn’t Feel the Pain**
- **Bottom Level Effort: CMCM**
- **The Way Forward/Summary**



AF Use of OSD (LMI) Data Warehouse



- Involved since initiation with Army and Navy in 2004 data
- Mandated every five years: Air Force years 2009 and 2012
- Began looking at corrosion as a percent of maintenance cost
- 2010 began including non-availability statistics
- Warehouse uses REMIS
 - Break down by prevention/correction
- When our third report is completed, will start trend analysis
- Established paradigm of what corrosion really costs
- AF management viewed as a top down funding drill, not enough fidelity



**Assessment of Weapon System A₀
is The Motivation!**

AF CCPE proposed AF
set a cost reduction
goal & is looking for an
appropriate #



C-130 CPAB



- **LMI accomplished corrosion cost and maintenance data analysis for FYs 2006 – 2010 on AF C-130 fleet**
- **Results**
 - The average annual corrosion-related **field-level** maintenance cost **decreased** by **\$76M**
 - The annual corrosion-related **depot-level** maintenance cost **increased** by approximately **\$111M**
 - Estimated average annual cost of corrosion - \$610M
 - Ranged from a low of \$599 M in FY 2006 to a high of \$634M in FY2010
 - This is roughly an average of 37% of all C-130 maintenance cost during the period



Corrosion Cost



**Table II-4. Aviation/Missiles with Highest Average per Item and Total Corrosion Costs
(\$ in millions)**

Priority	Nomenclature	Average corrosion cost per item	Rank in top 20: Corrosion cost per item	Total corrosion cost	Rank in top 20: Total corrosion cost	Combined rank
1	C-130	\$1.3	8	\$718	1	9
2	C-5	\$4.0	2	\$431	8	10
3	KC-135	\$1.2	9	\$451	6	15
4	FA-18	\$0.9	13	\$601	2	15
5	B-1	\$3.7	3	\$251	12	15
6	EA-6	\$4.2	1	\$193	15	16
7	B-52	\$2.6	6	\$240	13	19
8	F-15	\$0.8	17	\$444	7	24
9	CH-47	\$0.9	14	\$352	10	24
10	C-17	\$0.8	16	\$137	19	35



C-130 Tracks Cost to Subsystems



Table 2-5. 10 Most Costly C-130 WUCs in Terms of Corrosion and Maintenance (FY2006–FY2010)

WUC	WUC description	Corrosion cost (in millions)	Maintenance cost (in millions)	Corrosion as a percentage of maintenance
115	Airframe—wings and nacelles	\$334	\$809	41.4%
114	Airframe—fuselage	\$264	\$538	49.1%
461	Fuel systems—tanks	\$195	\$403	48.5%
041	Special inspections	\$128	\$352	36.5%
010	Ground handling, servicing, and related tasks	\$113	\$338	33.5%
037	Scheduled inspection or maintenance—storage	\$111	\$492	22.7%
110	Airframe	\$94	\$181	51.8%
112	Airframe—doors (hydraulic)	\$92	\$211	43.4%
032	Scheduled inspection or maintenance—thruflight inspection	\$90	\$243	37.0%
090	Shop support general code (includes fabrication or local manufacture)	\$66	\$113	58.7%



AF CCPE Survey



“How Are You Measuring Corrosion?”

- **CCPE sent question to AF CPCWG**
- **Who do you go to for answers?**
 - AFCPCO, CTIO, AFRL, SPO, MAJCOMs, NASA, SMEs, OEMs
- **Other resources?**
 - NACE, SSPC, past collaborators, Google, AFCPCO website, AFIs, TOs, CPABs, OEMs, Technical Meetings
- **Most important AF CPC?**
 - AFCPCO, maintainer, TOs, CPCP, SMEs, IPTs, Wing Corrosion Mgr
- **Most important shortfall?**
 - Training, strategic guidance, ID and reporting, fragmentation of system, resources diminishing, lack standardized scoring system, enforcement, funding
- **How measure?**
 - Site visits, inspections, AFCPCO surveys, deficiency reports, depends, not, not quantified for subsystems
- **Useful metrics?**
 - Fidelity, engineering designs, root cause analysis, cost by control, prevention, current status, utilization, cost/benefit analysis



AFCPCO Conclusions from AF CCPE Survey



- **Lots of AF folks involved in corrosion**
 - Operational side seldom uses corrosion metrics
 - Operational side seldom uses formal trend analysis to identify bad actor
 - Lack of fidelity of data and visibility on the AF corrosion problems

**AF CCPE proposed
AF set a cost
reduction goal & is
looking for an
appropriate #**

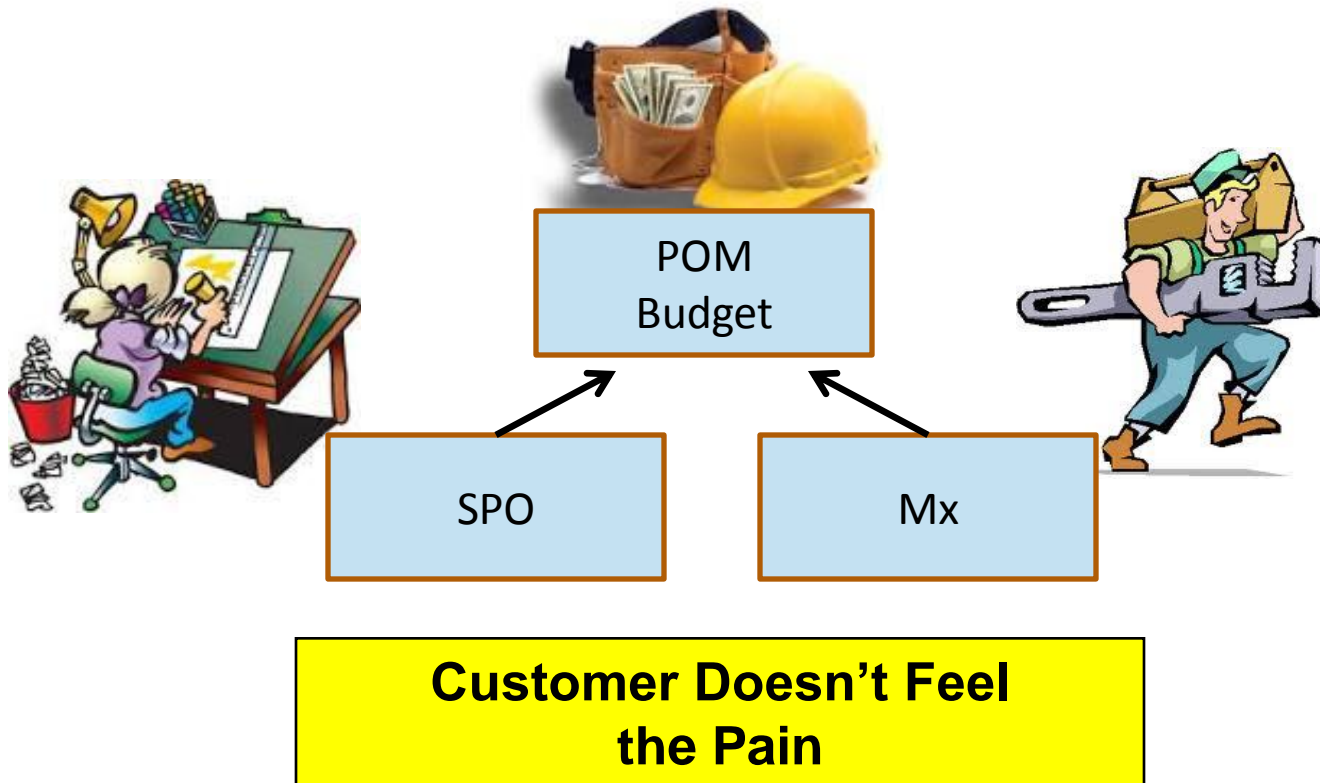




Why Cost of Corrosion is Overlooked in Maintenance Decisions



- Little communication between SPO and Maintenance
- Corrosion seldom linked to safety and availability
- Cost of maintenance events are not accurately tracked
- Input to maintenance databases skewed
- Separate funding paths: i.e. 3400 vs. Mx Working Capital Funding (DMAG)

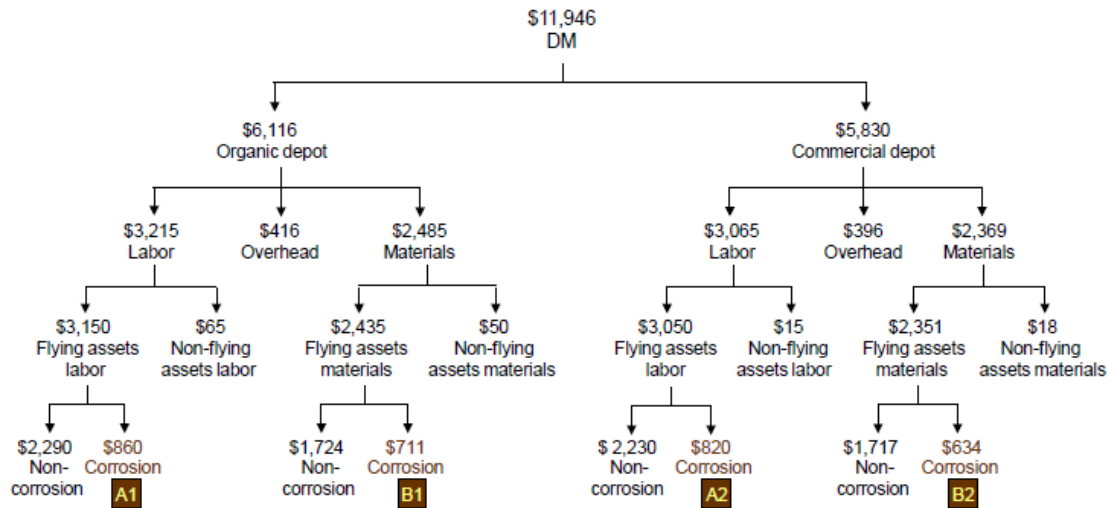




Top Down and Bottom Up Approach



Figure 2-2. Air Force DM Corrosion Costs (\$ in millions)



- LMI collects data from top and bottom
- Data uses a correlation factor for each area
- REMIS data is suspect
- AFCPCO project (CMCM) try to find accurate correlation

Correlation Factors

**CMCM
Accurate Mx Data**

REMIS

**Mx Decision
using corrosion
metrics**



Establishing Fidelity of Data: Corrosion Maintenance Cost Metric (CMCM)



➤ **Current Funded Effort (\$25,000 w/ 6 month POP):**

- For 6 AC's, compare corrosion data recorded in the ICARR-3D database to the corrosion data that was entered into REMIS for the same depot maintenance events
- Determine the level of completeness for the corrosion data entered into REMIS
- Compare corrosion data recorded in the ICARR-3D database to the corrosion trends for the C-130 fleet
- Extrapolate corrosion costs from the 6 AC's as an initial estimate for the C-130 fleet

➤ **Future Unfunded Efforts:**

- Expand the line by line comparison of the ICARR-3D to the REMIS data for the remaining AC's entered in the ICARR-3D database
- Develop corrosion data in ICARR-3D at Ogden for 2 Navy C-130's and compare the findings to USAF C-130's
- Provide recommendations for data parameters to be uploaded into REMIS and Programmed Depot Maintenance Schedule System (PDMSS)

Fidelity Leads to Potential Management Metric/Tool





The Way Forward/Summary



- **Assess impact of potential maintenance actions to corrosion loss**
- **Assess decision of SPO funding on MODs, etc.**
- **Apply to new acquisitions**
- **Optimize**
 - Preventive vs. corrective ratio
 - Depot and field maintenance funding
 - Field funding
- **If Mx cost is accurate, should reduce corrosion cost within AF by:**
 - Identifying bad actors
 - Identifying bad trends
- **Forecast and predict future funding across DoD**
- **CMCM could be game changer**



AFCPCO is an Advocate of Institutionalizing Corrosion Cost in Maintenance Decisions



Contact Info



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Air Force Corrosion Prevention and Control Office
Sustaining the Air Force Fleet for 43 years