

*Corrosion Prevention and Control  
Integrated Product Team*

# Cost of Corrosion to DoD



**SOLE Lunch**

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The background of the slide is a stylized, wavy American flag. The stars are white on a blue field, and the stripes are red and white, curving across the page.

## ***Corrosion –***

**The deterioration of a material or its properties due to a reaction of that material with its chemical environment**

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The background of the slide is a stylized, grayscale American flag with stars and stripes. The stars are in the upper left, and the stripes flow across the rest of the page.

# Outline

- Background – Results summary
- Top down and bottom up approach
- Data conversion process
- Data structure and database
- Slice and dice
- Guidebook
- Next steps

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# Background - Results of Studies to Date

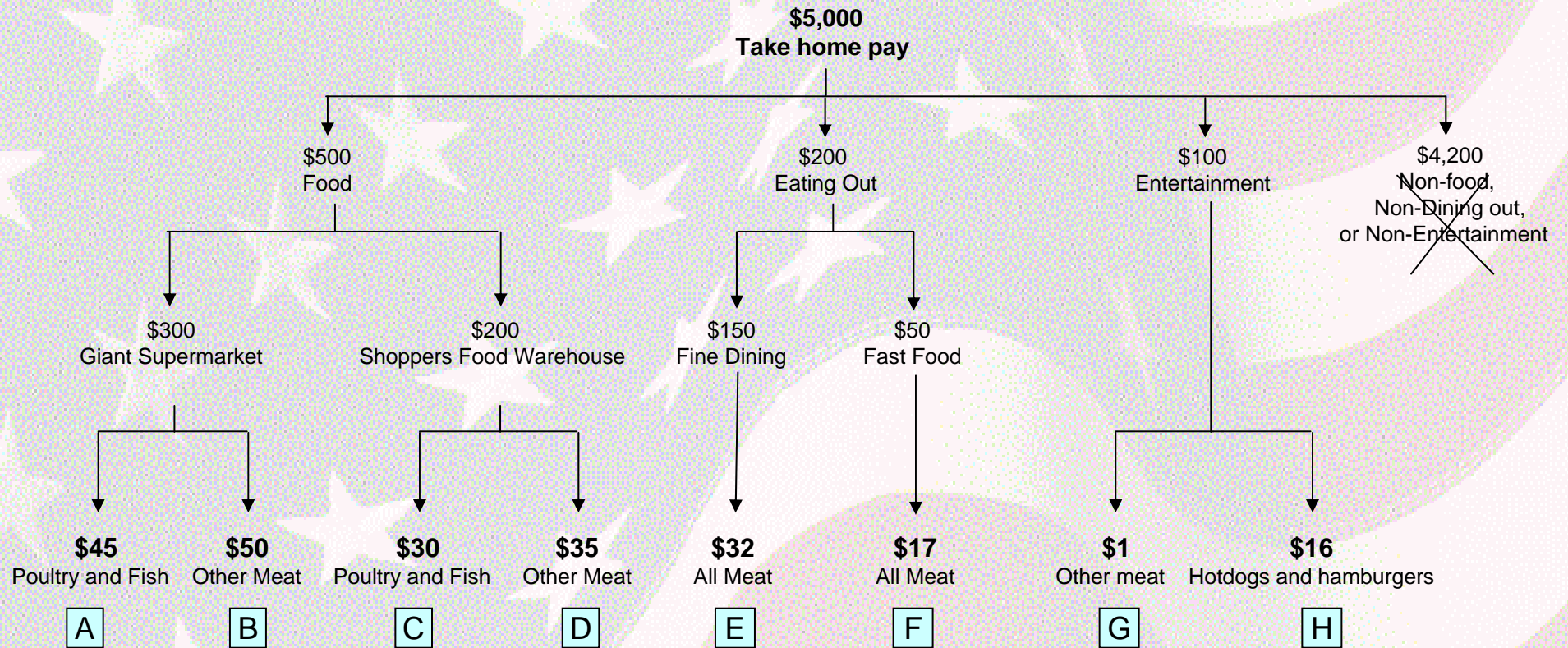
Study Year	Study Segment	Annual Cost of Corrosion	Corrosion as a Percentage of Maintenance	Data Baseline
2005-2006	Army Ground Vehicles	\$2.0 billion	14.8%	FY2004
2005-2006	Navy Ships	\$2.4 billion	19.8%	FY2004
2006-2007	DoD Infrastructure	\$1.8 billion	15.1%	FY2005
2006-2007	Army Aviation/Missiles	\$1.6 billion	18.6%	FY2005
2006-2007	Marine Corps Ground Vehicles	\$0.7 billion	20.8%	FY2005
2007-2008	Navy and Marine Corps Aviation	\$3.0 billion	31.5%	FY2006
2007-2008	Coast Guard Aviation and Vessels	\$0.3 billion	25.5%	FY2006
2008-2009	Air Force	\$5.4 billion	32.2%	FY2007
2008-2009	Army Ground Vehicles	\$2.4 billion	14.3%	FY2007
2008-2009	Navy Ships	Pending	Pending	FY2007
2008-2009	Unmeasured segments of DoD	\$5.1 billion	22.1%	FY2006

Total Annual Cost of Corrosion to DoD – \$22.5 billion

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# Combined Top-down/Bottom-up Methodology

(Example – Determining Monthly Expenses for Meat)

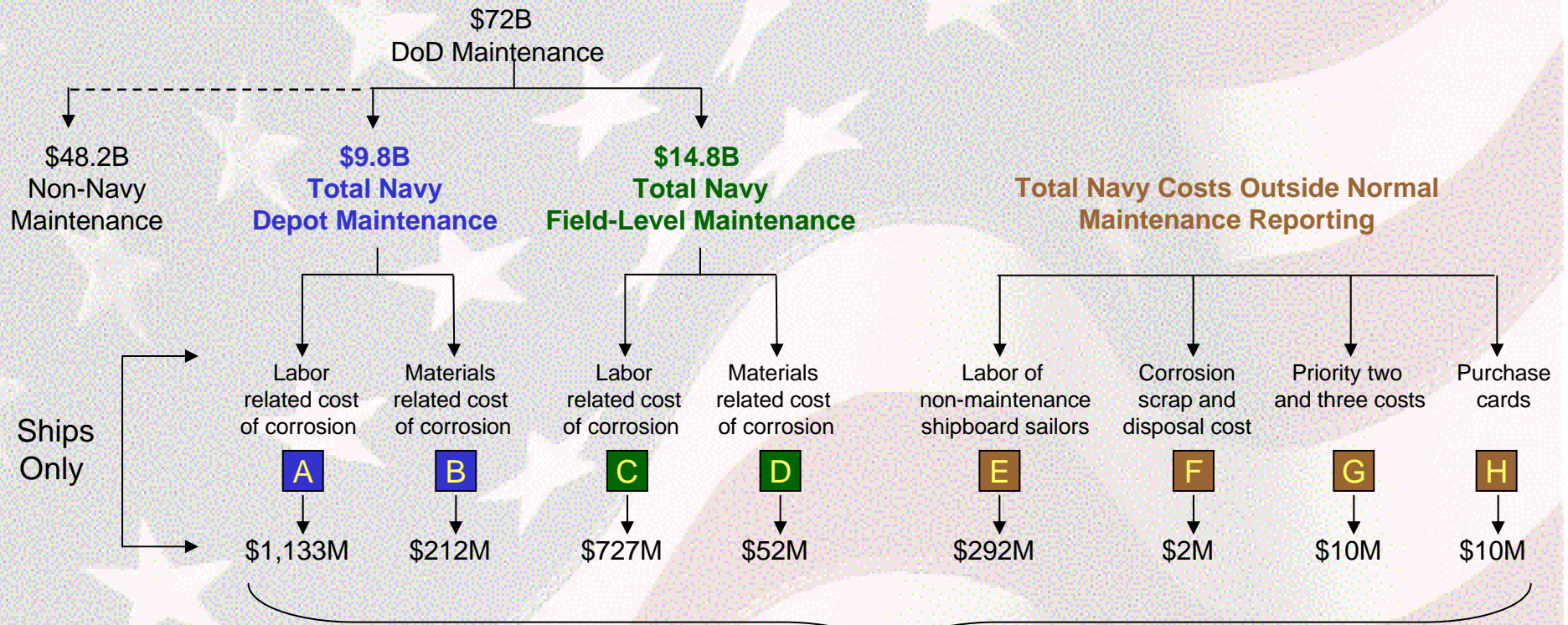


Must use grocery and restaurant receipts to determine meat expenses

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# Top-down Cost Tree Example – Navy Ships

(\$ - FY2004)



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# Data Conversion - Navy

Main <b>Depot</b> Data Sources	Data Value	Main <b>Field-Level</b> Data Sources	Data Value	Main " <b>Outside Normal Reporting</b> " Data Sources	Data Value
1307 report	Top-Down	DDMC	Top-Down	Survey	Top-Down
50-50 Reporting	Top-Down	VAMOSC	Bottom-up	DDMC	Top-Down
DDMC	Top-Down	<b>3M/OARS</b>	<b>Bottom-Up</b>	Purchase Card Records	Bottom-Up
SYMIS/AIM	Bottom-Up	Haystack	Bottom-up	DRMO	Bottom-Up
NMD	Bottom-Up			HAZMAT Centers	Bottom-Up
MRS	Bottom-Up				
VAMOSC	Bottom-Up				
CCIMS	Bottom-Up				

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# Bottom-up Data Conversion - Navy

MAINT_L LEVEL	SHIP_CATEGORY	SHIP_HULL	3DIGIT_WBS	WBS	JOB_ORDER_NUM	FAULT_DESCRIPTION	NATURE_OF_COST	TOT_MAINT_ COSTS	TOT_CORR_ COSTS	STRUCTURE	PART
FIELD LEVEL	Amphibious	LCC 20			20001DA01P163	REPLACE PRC DECK COVERING	OTHER	\$418.45			
FIELD LEVEL	Amphibious	LCC 20			20001DA01Z006	MASTS - INSP	PREVENTIVE	\$418.45	\$139.34		
FIELD LEVEL	Amphibious	LCC 20	665	66511	20001DA020242	WORN NYLON NETS	OTHER	\$4,572.29			
FIELD LEVEL	Amphibious	LCC 20	665	66511	20001DA020243	DETERIORATED VENT DUCTING	CORRECTIVE	\$418.45	\$418.45	YES	
FIELD LEVEL	Amphibious	LCC 20	634	63411	20001DA020244	WORN NON-SKID	CORRECTIVE	\$418.45	\$418.45	YES	
FIELD LEVEL	Amphibious	LCC 20	074	07400	20001DA020245	DETERIORATED STUFFING TUBES	CORRECTIVE	\$2,908.71	\$2,908.71		
FIELD LEVEL	Amphibious	LCC 20	654	65400	20001NN011939	RUSTED HAND RAILS ON O-3 LEVEL	CORRECTIVE	\$1,297.57	\$1,297.57	YES	
FIELD LEVEL	Amphibious	LCC 20	665	66511	20001DA020250	VENT SCREENS DETERIORATED	CORRECTIVE	\$418.45	\$418.45	YES	
FIELD LEVEL	Amphibious	LCC 20	511	51111	20001EA014031	6-52-4-A INSTALL ISOLATION VLV	OTHER	\$622.57			YES
FIELD LEVEL	Amphibious	LCC 20			20001DA01Z002	7-40-1-J CLEAN & GAS FREE	PREVENTIVE	\$418.45	\$418.45		
FIELD LEVEL	Amphibious	LCC 20	654	65400	20001DA013168	REFURBISH FANROOM 1-38-2-Q	OTHER	\$1,245.13			
FIELD LEVEL	Amphibious	LCC 20	167	16711	20001DA01P151	QAWTS 1-73-2 WORN HARDWARE	OTHER	\$622.57		YES	

ship_type _hull	uic	jcn	issue_date	niin	quantity	unit_price	total_price
LCC 20	20001	20001NN011939	07-Jul-04	002785350	609	0.65	395.85

Corrosion Materials Cost Information

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# Data Structure

Ship 256 Age 27 years		Cost	Percent of total			
Ship 125 Age 5 years		Cost	Percent of total			
Ship 001 Age 12 years		Cost	Percent of total	Labor	Materials	ESWBS
Corrective corrosion costs						
Preventive corrosion costs						
Depot maintenance corrosion costs						
Field maintenance corrosion costs						
Outside normal reporting costs						
Structure direct corrosion costs						
Parts direct corrosion costs						

**256 Ships**

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# User Database

## NAVY MAINTENANCE CORROSION DATA FILE

*Filter the query's results by making any selections below. After selections have been made, please click on "Query with Above Filters"*

*\*\*Leaving a Field blank returns all values for that criteria\*\**

*Clicking an "ALL" Button will set the field to return all values*

Clear Form

High Maintenance Level:	<input type="text"/>	<input type="button" value="ALL"/>
<b>OR</b>		
Detailed Maintenance Level:	<input type="text"/>	<input type="button" value="ALL"/>
Ship_Category:	<input type="text"/>	<input type="button" value="ALL"/>
Ship_Hull:	<input type="text"/>	<input type="button" value="ALL"/>
Corrosion Related WBS:	<input type="text"/>	<input type="button" value="ALL"/>

QUERY

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Exit Database

# DoD Aviation and Missiles

**Aviation/Missile Corrosion Cost by End Item Type (\$ in millions)**

Rank	Nomenclature	Total maintenance cost	Total corrosion cost	Inventory
1	C-130	\$1,602	\$718	533
2	FA-18	\$1,735	\$601	664
3	Multiple fighters	\$1,625	\$581	Unknown
4	UH-60	\$3,337	\$578	1,447
5	F-16	\$2,070	\$566	1250
6	KC-135	\$1,301	\$451	363
7	F-15	\$1,339	\$444	558
8	C-5	\$1,123	\$431	108
9	SH-60	\$842	\$360	351
10	CH-47	\$1,782	\$352	413

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# DoD Aviation and Missiles

## *Top 20 Aviation/Missile End Item Corrosion Cost Ranking by WUC (\$ in millions)*

Rank	WUC	Description	Corrosion cost
1	11	Airframe	\$1,594
2	03	Inspection	\$821
3	04	Special inspection	\$706
4	46	Fuel systems	\$352
5	13	Alighting/launching system	\$316
6	14	Directional flight	\$302
7	42	Electrical power supplydistribution, andlighting system	\$178
8	09	Shop support	\$146
9	23	Turbojet engines	\$137
10	12	Furnishingsandcompartments	\$125

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# DoD Aviation and Missiles

## *Aviation/Missile Corrective and Preventive Corrosion Cost*

	<b>Category</b>	<b>Corrosion cost (in millions)</b>	<b>Percentage of total maintenance cost</b>
DM	Corrective	\$3,455	69.3%
	Preventive	\$1,533	30.7%
	Total	\$4,988	100.0%
FLM	Corrective	\$1,710	35.4%
	Preventive	\$3,120	64.6%
	Total	\$4,831	100.0%
Total maintenance	Corrective	\$5,166	52.6%
	Preventive	\$4,653	47.4%
	Total	\$9,819	100.0%

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# DoD Ground Vehicles

*Ground Vehicle Corrosion Cost by End Item Type (\$ in millions)*

Rank	Nomenclature	Total maintenance cost	Total corrosion cost	Inventory
1	Truck utility: HMMWV	\$1,087	\$222	60,736
2	Amphibious assault vehicle	\$538	\$176	981
3	Tank combat120MM M1A1	\$758	\$134	4,427
4	Truck cargo: 2-1/2 ton	\$326	\$89	11,812
5	Truck,utility	\$579	\$80	8,986
6	Truck,guided missile	\$404	\$59	8,986
7	Tank,combat,full tracked	\$262	\$58	360
8	Truckcargo: drop side	\$251	\$52	14,898
9	Trailer cargo 1-1/2 ton	\$85	\$50	23,537
10	Truck tractor 5ton 6	\$178	\$49	9,439

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# DoD Ground Vehicles

## *Top 10 Ground Vehicle Subcomponent Corrosion Cost Ranking by WBS (\$ in millions)*

Rank	WBS	Description	Corrosion cost
1	B11	Tactical vehicle hull or body frame	\$268
2	B21	Support vehicle hull or body frame	\$244
3	B13	Tactical vehicle components and accessories	\$146
4	C24	Armored personnel carriers electronic and communications equipment	\$144
5	B12	Tactical vehicle engine	\$103
6	B23	Support vehicle components and accessories	\$97
7	C21	Armored personnel carriers hull or body frame	\$92
8	C11	Tank hull or body frame	\$91
9	C13	Tank components and accessories	\$56
10	B14	Tactical vehicle electronic and communications equipment	\$44

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# DoD Ground Vehicles

<b>Ground Vehicle Corrective and Preventive Corrosion Cost</b>			
	<b>Category</b>	<b>Corrosion cost (in millions)</b>	<b>Percentage of total maintenance cost</b>
DM	Corrective	\$191	49.4%
	Preventive	\$196	50.6%
	Total	\$387	100.0%
FLM	Corrective	\$956	67.6%
	Preventive	\$458	32.4%
	Total	\$1,414	100.0%
Total maintenance	Corrective	\$1,147	63.7%
	Preventive	\$654	36.3%
	Total	\$1,801	100.0%

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# DoD Vessels

*Ships and Vessels Average Corrosion Cost by Category (\$ in thousands)*

Rank	Nomenclature	Total maintenance cost	Total corrosion cost	Inventory	Average corrosion cost per item	Average maintenance cost per item
1	Carriers	\$2,031,000	\$449,909	12	\$37,492	\$169,250
2	Amphibious	\$2,124,000	\$766,688	37	\$20,721	\$57,405
3	Surface Warfare	\$3,383,000	\$604,559	105	\$5,758	\$32,219
4	Polar Icebreaker	\$50,000	\$15,844	3	\$5,281	\$16,667
5	High Endurance Cutter	\$148,000	\$40,459	12	\$3,372	\$12,333
6	Submarines	\$2,185,000	\$225,738	72	\$3,135	\$30,347
7	Other Vessels	\$482,000	\$77,131	30	\$2,571	\$16,067
8	Medium Endurance Cutter	\$198,000	\$63,089	31	\$2,035	\$6,387
9	Heavy Icebreaker	\$3,332	\$972	1	\$972	\$3,332
10	Bay Class Icebreaker	\$21,000	\$7,278	9	\$809	\$2,333

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# DoD Vessels

**Top 20 Ships and Vessels Subcomponent Corrosion Cost Ranking by ESWBS  
(\$ in millions)**

Rank	ESWBS	Description	Corrosion cost
1	123	Trunks and Enclosures	\$204
2	992	Bilge Cleaning and Gas Freeing	\$182
3	631	Painting	\$166
4	863	Drydocking and Undocking	\$149
5	634	Deck Covering	\$103
6	993	Crane and Rigging Services	\$60
7	251	Combustion Air System	\$57
8	130	Hull Decks	\$55
9	620	Hull Compartmentation	\$41
10	176	Masts, Kingposts and Service Platforms	\$39
11	593	Environmental Pollution Control Systems	\$34
12	864	Care and Preservation	\$24
13	233	Propulsion Internal Combustion	\$21
14	505	General Piping Requirements	\$20
15	551	Compressed Air Systems	\$19
16	514	Air Conditioning System	\$17
17	261	Fuel Service System	\$17
18	150	Deck House Structure	\$15
19	713	Ammunition Stowage	\$15
20	131	Main Decks	\$15

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# DoD Vessels

<i>Ships and Vessels Corrective and Preventive Corrosion Cost</i>			
	<b>Category</b>	<b>Corrosion cost (in millions)</b>	<b>Percentage of total maintenance cost</b>
DM	Corrective	\$421	33.8%
	Preventive	\$822	66.2%
	Total	\$1,243	100.0%
FLM	Corrective	\$568	62.1%
	Preventive	\$347	37.9%
	Total	\$914	100.0%
Total maintenance	Corrective	\$988	45.8%
	Preventive	\$1,169	54.2%
	Total	\$2,157	100.0%

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# DoD Infrastructure and Facilities

**Top 10 Facilities Maintenance Corrosion Costs by FAC (\$ in millions—FY2005)**

<b>FAC</b>	<b>FAC description</b>	<b>Labor corrosion</b>	<b>Materials corrosion</b>	<b>Total corrosion cost</b>	<b>Total maintenance cost</b>
7210	Enlisted Unaccompanied Personnel Housing	47	47	94	603
6100	General Administrative Building	42	33	75	545
7110	Family Housing Dwelling	30	24	54	268
8131	Electrical Power Substation	43	8	51	199
1714	Reserve Training Facility	27	20	48	298
4421	Covered Storage Building, Installation	11	35	46	190
4111	Bulk Liquid Fuel Storage	31	13	44	311
8321	Sewer and Industrial Waste Line	7	28	36	131
2131	Ship Maintenance Dry-dock	30	2	32	73
6102	Large Unit Headquarters Building	10	19	29	161

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# DoD Infrastructure and Facilities

*Total Maintenance Corrosion Costs by Craft (\$ in millions—FY2005)*

<b>Craft Code</b>	<b>Labor corrosion</b>	<b>Materials corrosion</b>	<b>Total corrosion cost</b>	<b>Total maintenance cost</b>	<b>Corrosion percent</b>
Exterior Plumbing	103	87	190	572	33%
HVAC	203	149	352	1,670	21%
Interior Plumbing	121	57	178	911	19%
General Building Maintenance	278	349	627	3,944	16%
Exterior Electric	44	14	58	442	13%
Interior Electric	54	32	87	1,368	6%
Fuels	6	3	9	140	6%
Roads & Grounds	25	19	44	1,169	4%

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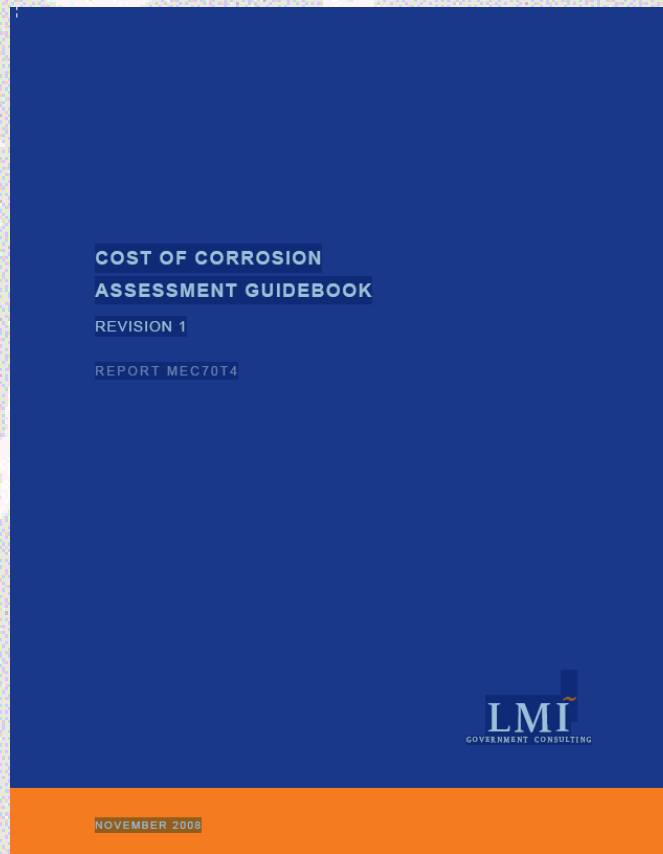
# DoD Infrastructure and Facilities

## *Total Facilities Maintenance Corrosion Costs by Corrective and Preventive Nature (\$ in millions—FY2005)*

TOW/S	Corrective maintenance			Preventive maintenance			Corrective to preventive ratio X to 1
	Corrosion cost	Maintenance cost	Corrosion percent	Corrosion cost	Maintenance cost	Corrosion percent	
τ1N	12	442	3%	44	97	46%	0.3
τ2N	37	664	6%	5	31	16%	7.3
τ2Y	20	223	9%	5	18	24%	4.6
τ3N	324	2,366	14%	101	340	30%	3.2
τ3Y	58	743	8%	36	178	20%	1.6
τ4N	439	2,608	17%	137	362	38%	3.2
τ4Y	119	1,351	9%	154	330	47%	0.8
τ5Y	34	357	9%	22	105	20%	1.6
Total	1,042	8,754	12%	504	1,462	34%	2.1

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# Corrosion Assessment Guidebook



CPC IPT product developed with Service involvement to provide a guide for how to best exploit the cost of corrosion study data.

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# Next Steps

Services exploit cost of corrosion data

Continue schedule of cost of corrosion studies adding more years of data to cover gaps (3 years of data every 3 years)

Develop method to conduct corrosion impact on availability studies

Use combined availability and cost data to help services target corrosion mitigation opportunities with precision

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