DMEA

Defense MicroElectronics Activity

SUPPLEMENTAL REPORT

RESOLUTION COST METRICS FOR DIMINISHING MANUFACTURING SOURCES AND MATERIAL SHORTAGES

December 2001

Prepared for
Defense MicroElectronics Activity (DMEA)
4234 54th Street, Bldg. 620
McClellan AFB, CA 95652-1521

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by

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SUPPLEMENTAL REPORT

RESOLUTION COST METRICS FOR DIMINISHING MANUFACTURING SOURCES AND MATERIAL SHORTAGES (DMSMS)

December 31, 2001

1.0 BACKGROUND

The Deputy Under Secretary of Defense for Logistics & Material Readiness (DUSD (L&MR)) recognized the need to determine cost metrics for DMSMS resolutions. The cost metrics will allow DoD programs to uniformly report DMSMS cost avoidance associated with implementing the best resolution in line with program requirements and cost constraints, and will be used by the DMSMS Teaming Group to report cost avoidance metrics to the Government Industry Data Exchange Program (GIDEP). DUSD (L) requested the Defense MicroElectronics Activity (DMEA) to develop cost metrics for all DoD programs to uniformly report cost avoidance associated with their DMSMS programs. In 1999 DMEA awarded ARINC a contract to develop these metrics.

This supplemental report provides an update to the 1999 report[*] "Resolution Cost Factors for Diminishing Manufacturing Sources and Material Shortages". No significant data were obtained to justify changing the 1999 values. However many members of the DoD DMSMS Teaming Group and others associated with DMSMS in the DoD and industry made three general comments:

1. Provide 90% confidence bounds to reduce the range between low and high

2. Escalate the factors for the years 2002 – 2006 and provide summary tables

3. Round the numbers to remove the level of significance and precision implied for the estimated cost metrics

In addition to those three comments, this update will also correct a typographical error in the DMEA Cost Avoidance Methodology Table 3-3 from the original 1999 report.

[*] The 1999 report incorrectly used the term "factors". A better term to define the non-recurring engineering values is metric.

2.0 GROUND RULES

ARINC established the following ground rules and assumptions and coordinated them with DMEA at a technical interchange meeting (TIM) on December 6, 2001:

- Costs will be escalated from the original constant fiscal year 1999 dollars.
- Cost metrics are determined for the DMSMS resolutions agreed upon at the January 12, 1999, TIM with DMEA.
- Cost metrics are updated for nonrecurring engineering (NRE). (Cost factors for recurring engineering were provided in the 1999 report for reference only.)
- NRE cost factors do not include procurement and administrative labor hours (time to identify sources of supply).
- NRE cost factors do not include costs associated with developing new microcircuits using state-of-the-art technologies.
- Additional cost elements identified are addressed separately from the NRE cost factors and are not updated.

3.0 NONRECURRING COST METRICS

Nonrecurring cost metrics are provided for the following resolutions:

- Reclamation
- Alternate
- Substitute
- Aftermarket
- Emulation
- Redesign

The definitions, required activities, explanation of the low versus high costs, and notes are detailed in the 1999 report *(Table 2-3)*. The 1999 cost factors are provided in Table 1. The 90% confidence interval for the average values are provided in Table 2.

Table 1. NRE Resolution Cost Metrics (1999)

Resolution	Low	Average	High
Existing Stock	$ 0	$ 0	$ 0
Reclamation	629	1,884	3,249
Alternate	2,750	6,384	16,500
Substitute	5,000	18,111	50,276
Aftermarket	15,390	47,360	114,882
Emulation	17,000	68,012	150,000
Redesign—Minor	22,400	111,034	250,000
Redesign—Major	200,000	410,152	770,000

Table 2. 90% Confidence Interval Cost Metrics (1999)

Resolution	90 % Low	Average	90% High
Existing Stock	$ 0	$ 0	$ 0
Reclamation	637	1,884	3,131
Alternate	4,000	6,384	8,769
Substitute	13,844	18,111	22,379
Aftermarket	38,382	47,360	56,338
Emulation	51,649	68,012	84,375
Redesign—Minor	77,270	111,034	144,797
Redesign—Major	341,833	410,152	478,470

Inflation indices are used to escalate the base year FY 1999 cost to then-year cost. Weighted Inflation Indices are used to inflate Base Year Dollars to Then-Year Dollars. Weighted Inflation Indices combine Raw Inflation Indices with Outlay Profiles to account for the time lag between budgeting funds (congressional appropriations), contracting for goods and services, and their receipt (completion). Each service and each major appropriation have distinct inflation indices. Generally the differences are at the third decimal point. For example the indices for converting from Base Year FY 1999 to Then-Year 2002 for Air Force 3400 Operations and Maintenance (O&M) versus 3600 Research, Development, Test, and Evaluation (RDT&E) are 1.0557 and 1.0562 respectively. Indices for Then- Year 2002 through 2006 are shown in Table 3.

Table 3. Weighted Air Force Inflation Indices (Base Year 1999)

Then-Year	Indices	
	O&M	RDT&E
2002	1.056	1.056
2003	1.075	1.075
2004	1.097	1.098
2005	1.120	1.121
2006	1.144	1.144

Because the metrics will be rounded to the nearest thousand, we selected Air Force Weighted RDT&E to use as a basis estimate for the inflation indices. The rates are provided by the USAF Financial Management and Comptroller Office (SAF/FM) and are based on OSD published rates. The 2001 AF Weighted Inflation Indices, 1949-2060 rates may be found at the USAF/FM web site: http://www.saffm.hq.af.mil/FMC/inflation/2001/infl2001.html.

The RDT&E inflation indices were applied for the years 2002—2006 and were rounded to the nearest thousand. These values are provided with the understanding that these can be used as estimated default values when actual documented data do not exist. If a program or program office has documented verifiable actual data, then the actual data should be used. The values for 2002—2006 are provided in Tables 4 through 8.

Table 4. Nonrecurring Engineering Cost Metrics (2002)

Resolution	90 % Low	Average	90% High
Existing Stock	$ 0	$ 0	$ 0
Reclamation	1,000	2,000	3,000
Alternate	4,000	7,000	9,000
Substitute	15,000	19,000	24,000
Aftermarket	41,000	50,000	59,000
Emulation	55,000	72,000	89,000
Redesign—Minor	82,000	117,000	153,000
Redesign—Major	361,000	433,000	505,000

Table 5. Nonrecurring Engineering Cost Metrics (2003)

Resolution	90 % Low	Average	90% High
Existing Stock	$ 0	$ 0	$ 0
Reclamation	1,000	2,000	3,000
Alternate	4,000	7,000	9,000
Substitute	15,000	19,000	24,000
Aftermarket	41,000	51,000	61,000
Emulation	56,000	73,000	91,000
Redesign—Minor	83,000	119,000	156,000
Redesign—Major	367,000	441,000	514,000

Table 6. Nonrecurring Engineering Cost Metrics (2004)

Resolution	90 % Low	Average	90% High
Existing Stock	$ 0	$ 0	$ 0
Reclamation	1,000	2,000	3,000
Alternate	4,000	7,000	10,000
Substitute	15,000	20,000	25,000
Aftermarket	42,000	52,000	62,000
Emulation	57,000	75,000	93,000
Redesign—Minor	85,000	122,000	159,000

Redesign—Major	375,000	450,000	525,000

Table 7. Nonrecurring Engineering Cost Metrics (2005)

Resolution	90 % Low	Average	90% High
Existing Stock	$ 0	$ 0	$ 0
Reclamation	1,000	2,000	4,000
Alternate	4,000	7,000	10,000
Substitute	16,000	20,000	25,000
Aftermarket	43,000	53,000	63,000
Emulation	58,000	76,000	95,000
Redesign—Minor	87,000	124,000	162,000
Redesign—Major	383,000	460,000	536,000

Table 8. Nonrecurring Engineering Cost Metrics (2006)

Resolution	90 % Low	Average	90% High
Existing Stock	$ 0	$ 0	$ 0
Reclamation	1,000	2,000	4,000
Alternate	5,000	7,000	10,000
Substitute	16,000	21,000	26,000
Aftermarket	44,000	54,000	64,000
Emulation	59,000	78,000	97,000
Redesign—Minor	88,000	127,000	166,000
Redesign—Major	391,000	469,000	547,000

The cost metrics in Tables 4—8 are for NRE only and do not include procurement and administrative labor costs (time to identify existing sources of supply—estimated as 1 to 32 hours of labor). Under certain circumstances, the resolutions identified may require any of the following actions: qualifying new sources, conducting radiation-hardening tests, conducting special tests for plastic-encapsulated microcircuits (PEMs), or program specific tests such as flight testing. The following should be considered and when applicable should be escalated using the indices from Table 3:

- New source qualification could increase cost; however, no standard value could be obtained because vendors typically amortize this as part of recurring cost.

- If radiation-hardening testing is required, the cost metrics presented in Tables 4—8 could increase an additional $5,000 (dose rate only) to $52,000 (dose rate, total dose, and single-event upset) and possibly as much as $82,000 for microprocessors.

- If qualification testing for PEMs are required, each cost metric could increase from $600 (acoustic microscopy only) to $47,340 (full qualification of a 100-piece lot).

- Program-specific test costs (e.g., flight test, aircraft ground test) are also not included and no standard value could be obtained.

4.0 DMEA COST AVOIDANCE METHODOLOGY

The DMEA cost avoidance methodology ranks each resolution from lowest cost to highest cost. Cost avoidance is determined by subtracting the cost of a resolution (Table 9) from that of the next-higher-cost resolution. Table 10 lists the resulting average values.

Table 9. Average NRE Resolution Cost Metrics (1999)

Resolution	Average
Existing Stock	$ 0
Reclamation	1,884
Alternate	6,384
Substitute	18,111
LOT Buy[†]	43,684
Aftermarket	47,360
Emulation	68,012
Redesign—Minor	111,034
Redesign—Major	410,152

Table 10. DMEA Cost Avoidance Values

Resolution	Average
Existing Stock	$ 1,884
Reclamation	4,500
Alternate	11,727
Substitute	29,249
LOT Buy	3,676
Aftermarket	20,652
Emulation	43,022
Redesign—Minor	299,118
Redesign—Major	0

ARINC analyzed resolution data from the JTIDS program from 1997 - 1999. The data provide the number of times a resolution was used for a total of 181 obsolete parts. Using the average cost avoidance values from Table 10 and the JTIDS data, we determined the data summarized in Table 11 (Replacement for Table 3-3 in the 1999 report).

To determine estimated cost avoidance resulting from a DMSMS program for JTIDS, we subtracted the cost of the DMSMS program from the total value of $2,553,725. If the DMSMS program cost were $100,000 per year for three years, the resultant cost avoidance for this example would be $2,253,725. There are two situations in which adjustments to the cost avoidance calculation would be required:

[†] LOT Buy data was based on a MIL-SPEC integrated circuit with an estimated unit cost of $40.00

- In some instances, the next-higher-cost resolution may not be technically feasible; for example, emulation may not be a viable alternative for a complex ASIC.

- A redesign may resolve DMSMS problems for more than one (often five) components at once.

Table 11. Cost Avoidance Estimate for JTIDS Using DMEA Methodology

Resolution	Probability of Occurrence (%)	Number of Occurrences	Average Delta	Cost Avoidance
Existing Stock	4.5	8	1,884	15,345
Reclamation	0.0	0	4,500	0
Alternate	68.0	123	11,727	1,443,324
Substitute	7.0	13	25,573	324,009
LOT Buy	12.0	22	3,676	79,837
Aftermarket	5.0	9	20,652	186,898
Emulation	3.0	5	43,022	233,610
Redesign—Minor	0.5	1	299,118	270,702
Redesign—Major	0.0	0	0	0
Total	100.0	181		$2,553,725