MTAPP
Taking Manufacturing to New Heights

MTAPP POSITION PAPER

Addressing Diminishing Manufacturing Sources and Material Shortages (DMSMS) and Sustainment Challenges

Small Business Reverse Engineering Opportunities and Requirements

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Why MTAPP covers this topic?

MTAPP is in a unique positioning of examining the supply chain landscape from the perspective of the end users, buyers, and producers of the goods. MTAPP has strategic relationships across the DOD including representatives from the armed forces, the DLA, major prime contractors, and the commodity councils.

MTAPP uses a needs driven approach to find opportunities where agile small business can solve major supply issues within the DOD while simultaneous growing and becoming more competitive.

The paper will provide data analysis, synthesis, and conclusion that should aid small businesses in positioning themselves in the competitive market. The ultimate goal of this paper is provide small businesses with a framework in which to understand what drives government needs and to provide businesses with a detailed view on the highlighted issues.

What this report presents?

This report has been written to provide MTAPP Member suppliers with an accurate status report on the efforts and policies of the top organizations that represent the MTAPP customer base. This report does not make the case to pursue the report's respective findings. Instead, this report should give businesses insight into each subject area and the potential to position themselves for future sales.

SB Reverse Engineering Opportunities and Requirements

What MTAPP found:

- Addressing Diminishing Manufacturing Sources and Material Shortages (DMSMS) challenges is a key need area within the Department of Defense where small business can excel.
- Proactive management of DMS include the following areas:
  - Sourcing from the existing source of supply at a higher unit cost;
  - Conducting lot buys based on a future forecast;
  - Developing alternative source of supply;
  - Substituting the product while ensuring compliance with form, fit, and function;
  - Looking at aftermarket sources (non-OEM suppliers) when available;
  - Redesigning and reverse engineering the part.
- Proactive management of DMS has saved the DOD over $500 million.
- Reverse engineering efforts and teaming with other small business suppliers would provide a strong platform for the maintenance and support of the Air Force's legacy aircraft.
- Issues facing successful reverse engineering efforts include:
  - Lack of a qualified source;
  - Lack of Technology and Development programs (TDPs);
  - Small lot sizes;
  - Administrative and production lead times.
- MTAPP can address these challenges through collaboration and a Small Business Sustainment Solution Center approach.

INTRODUCTION

Through a broad based research effort into areas of need within the Air Force and Department of Defense (DoD) supply chains, MTAPP has analyzed the impact of DoD transformation on small business manufacturers and made recommendations on how these businesses should prepare themselves for the changes presented by the transformation. The MTAPP Research Study Update concluded that the persistent and systemic challenge of diminishing manufacturing sources (DMSMS) and parts obsolescence presents an opportunity for capable small business manufacturers to position themselves for continued direct-to-government contract awards. One critical capability gap within the DMSMS problem is the inability of the DoD to efficiently define the requirements for and identify suppliers to provide reverse engineering solutions to areas facing the loss or impending loss of the last known manufacturer or supplier of raw material, production parts, or repair parts. Other issues are part shortages due to lack of technical data packages and replacement of parts that we never intended to be replaced. Reverse engineering has been identified as a critical capability sought by the Defense Logistics Agency (DLA) that is mandated to procure and replace these parts. Addressing both needs will lead to improvements in the lead times, part and system availability, and the associated costs incurred to address DMSMS issues in the Air Force and DoD supply chain.

MTAPP research efforts into small business opportunity areas included a broad-based situational analysis of the current and future (transformed) DoD supply chain. Analysis of evolving support structures and the information requirements within the supply chain showed that there is a need for MTAPP to create a solution that is flexible and agile to address these needs. Our research identified this as one of the new core capabilities required to maintain small business participation. We received input from multiple interrelated stakeholders including the following: Air Force Materiel Command, US Army Materiel Command, Air Logistic Centers, Defense Logistics Agency, and various Prime Contractors and their large sub-contractors.

This position paper includes a presentation of data analysis, syntheses, and conclusions that result in a position statement regarding the stated supply need. The objective of this document is to provide the readers and key stakeholders most impacted by the identified need a succinct view of the issues and its interrelated system components. The paper also proposes an action plan for MTAPP to participate in addressing these requirements. This document will be used for online knowledge sharing and elicit feedback from individual stakeholders, contributors, and MTAPP companies.

Demand Drivers for Reverse Engineering Capability

Removing DMSMS Supply Chain Constraints

Diminishing Manufacturing Sources and Material Shortage (DMSMS) are situations where there is a loss or impending loss of the last known manufacturer or supplier of an item or the shortage of raw materials needed to support a weapon system. This may be attributable to discontinued production by one or more manufacturers, or by manufacturers exiting the business. DMSMS limits operational readiness and is driven by technology turnover and an inadequate supply base. When a part is no longer economical for the manufacturer to make, the Air Force can either pay a premium for the part, or look to new sources. The Air Force cites the following drivers of this problem that work against overall sustainment efforts:

1. Diminished Overall Demand:
    - Military customers "require" specialized parts (i.e., temp, voltage)
    - Commercial microcircuit users (computers, cell phones, etc.) now constitute—by far the largest share of the market
    - Declining military share of the overall electronics market:
        - 1975: 17% 1985: 7% 2003: ~0.1%
2. Extended Support Periods:
    - Microcircuit life cycles average ~18 months (much less for memories)
    - DoD has long design-to-acquisition lead times
    - Extension of the service lives of systems

- Support requirements for military systems outlast those of parts
    - Commercial electronic systems: 4 – 7 years
    - Military electronic systems: 25 – 30 years

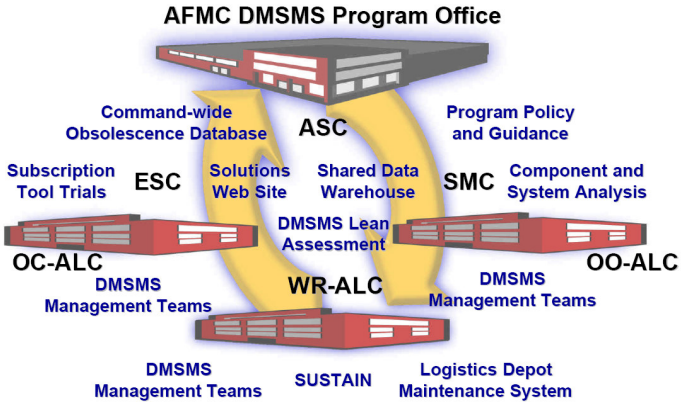
Data on the root causes of such situations show that this problem is most persistent within Avionics: (**Exhibit 1**)

EXHIBIT 1 Root Causes of the Obsolescence Problem

Root Cause Analysis	Age	Obs	Vndr	Dsgn	Log	New Item	Maint Plan
Avionics	27.5%	45.0%	1.3%	8.1%	8.1%	9.4%	0.6%
Dynamic Component	61.0%	0.0%	7.3%	3.7%	11.0%	12.2%	4.9%
Electrical/Power	40.6%	4.7%	6.3%	37.5%	3.1%	3.1%	4.7%
Engine Cold	64.2%	0.0%	0.0%	0.0%	7.7%	28.2%	0.0%
Engine Hot	86.2%	0.0%	0.0%	0.0%	0.0%	10.3%	3.4%
Engine Other	46.7%	8.3%	0.0%	23.3%	20.0%	1.7%	0.0%
Structures	76.7%	3.3%	0.0%	13.3%	0.0%	3.3%	3.3%
Sub Systems	52.9%	5.9%	4.4%	10.3%	14.7%	10.3%	1.5%

To address these challenges the Air Force has created a program office in charge of addressing DMSMS problems, collecting data, and identifying proactive solutions. AFMC established a program office at AFRL Manufacturing Technology Division (AFRL/MLM) to provide tools and assistance to program offices dealing with DMSMS issues. (**Exhibit 2**)

EXHIBIT 2 Air Force DMSMS Program Structure



The office provides support such as data, lesson learned, and available best practices to ensure the most timely and cost effective solutions AFRL/MLM works on the proactive management of DMS. Some proactive solutions for solving DMSMS are as follows:

1. Sourcing from the existing source of supply at a higher unit cost
2. Doing a lot buy based on a future forecast
3. Develop an alternative source of supply
4. Substitute the product while ensuring compliance with form, fit, and function
5. Look at aftermarket sources (non-OEM suppliers) when available
6. Redesign and reverse engineering of the part

The data on DMSMS shows that this program office is achieving significant cost avoidance.

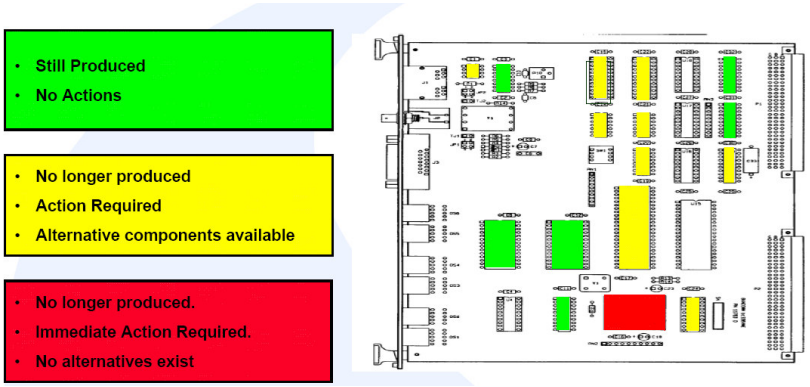
EXHIBIT 3 Air Force DMSMS Cost Avoidance

Year	AFMC DMSMS Solution Types and Number of Occurrences									AFMC Cost Avoidance (NRE and Recurring)*
	Existing Source	Reclamation	LOT Buy	Alternate	Substitute	Aftermarket	Emulation	Minor Redesign	Major Redesign	
FY 02	16	0	1,371	290	331	70	879	7	0	$ 198M
FY 03	3,019	214	1,612	181	695	951	32	36	2	$ 169M
FY 04**	8,007	1,864	984	1,500	1,062	11,171	0	26	2	$ 437M
Total	**11,042**	**2,078**	**3,967**	**1,971**	**2,088**	**12,192**	**911**	**69**	**4**	**$ 804M**

While this data shows that the program is currently achieving cost avoidance, what is not shown is the additional benefit to not having to invest the administrative time to accomplish columns 2-5 or the reasons that these are so prevalent? A major factor to this is the availability of data.

As an example of a typical DMSMS reverse engineering opportunity within electronics, the following graphic shows a printed circuit board (PCB) and the challenges faced at the micro level by DoD DMSMS teams (**Exhibit 4**).

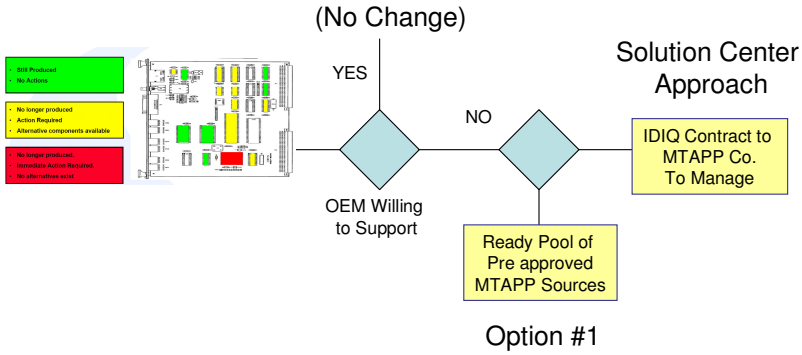
EXHIBIT 4 COTS Challenges at the Micro Level



This level of data is just know being aggregated to levels where cross service PCB comparisons can get the necessary volumes of procurement opportunities to make a reverse engineering activity feasible. The current solution involves one or more engineers at a Depot or within the DLA spending 2-3 weeks of administrative time to identify capable suppliers and then source the part through contracting.

MTAPP proposes the following process change to facilitate more rapid solutions: (**Exhibit 5**)

EXHIBIT 5 DMSMS Process Improvements



Currently four of the six proactive solutions mentioned above to address DMSMS problems can be done by MTAPP companies. The optimal situations for MTAPP to address are instances where the following occurs:

1. There is a need for specialized test equipment.
2. No tooling can be found or is available.
3. Part is missing data or has an incorrect technical data package.
4. With aging weapons systems, instances of frequent breakdowns resulting in rapid depletion of spares.

Reverse Engineering to Reduce Life-Cycle Sustainment Costs

As a result of the overall DoD transformation and the recently completed BRAC assessments, the DLA will become the single source within the DoD for all depot-level reparable procurement, as well as the majority of hardware consumables not yet managed by the DLA. In addition to the management of depot-level requirements, DLA has taken a leading role in critical initiatives including DMSMS and Business Modernization. The DLA's integrated data environment (IDE) will provide supply chain information linkages and a single point of system access for DoD wide logistics and asset visibility.

Our interviews with the DLA's program managers and engineers from the Air Logistics Centers, MTAPP found ongoing needs for greater small business reverse engineering of parts. The main factor contributing to this need is the lack of technical data packages for critical parts. Due to the aging fleet of aircrafts there are constantly procure parts that were never designed to be replaced. In addition, demand for these parts is quite low to warrant an effort by an outside party. However, a lot of these parts are mission critical and essential for aircraft readiness. When there is a lack of technical data for critical parts, it is sometimes necessary to reverse engineer parts and find sources to procure the parts. Other times, it is necessary to reengineer parts because the current supplier is a company providing the part at an extremely high price.

There are currently 75 parts that are in need of reengineering and production at the DLA. The 75 parts represent about $9MM in annual procurement. Most times, the quantities for these parts are too low for many firms to rationalize the expense of buying the part and then reengineering it. Many times, they will try to recover these costs on the first contract to the government, making the price prohibitive to the DLA. (**Exhibit 6**)

EXHIBIT 6 DLA Reverse Engineering Opportunity

FSC Description	FSC	Annual Revenue	Quantity	Avg Price per Piece
Batteries, Rechargeable	6140	$ 1,450,395.0	3474	$ 417.5
Msl Aircraft Accessories and Components	1680	$ 1,260,938.7	2118	$ 595.3
Radio and TV Comm Equipment, Airborne	5821	$ 813,906.7	144	$ 5,652.1
Airframe Structural Components	1560	$ 762,543.0	1400	$ 544.7
Misc Electric Power & Distribution Eq	6150	$ 757,599.8	1765	$ 429.2
Aircraft Ground Servicing Equipment	1730	$ 713,630.4	207	$ 3,447.5
Cable, Cord, Wire Assemblies: Comm Equip	5995	$ 613,619.9	3013	$ 203.7
Motors, Electrical	6105	$ 605,618.1	715	$ 847.0
Engine Instruments	6620	$ 446,143.8	483	$ 923.7
Engine Fuel System Components, Aircraft & Missile	2915	$ 213,883.2	93	$ 2,299.8
Electrical Control Equipment	6110	$ 198,096.4	582	$ 340.4
Pressure, Temp, & Humidity Meas & Contrling Instru	6685	$ 162,768.0	1238	$ 131.5
Converters, Electrical, Nonrotating	6130	$ 161,036.1	18	$ 8,946.5
Meteorological Instruments and Apparatus	6660	$ 158,991.9	1364	$ 116.6
Gas Turbines and Jet Eng, Non Acft; and Comps	2835	$ 100,138.5	578	$ 173.3
Combination & Miscellaneous Instruments	6695	$ 97,291.1	44	$ 2,211.2
Flight Instruments	6610	$ 95,411.2	348	$ 274.2
Generators and Generator Sets, Electrical	6115	$ 88,305.4	110	$ 802.8
Gas Turbines and Jet Engines, Acft & Comps	2840	$ 54,217.8	136	$ 398.7
Bearings, Plain, Unmounted	3120	$ 52,430.6	313	$ 167.5
Acft Hydraulic, Vacuum & De-icing Sys Comp	1650	$ 42,231.2	80	$ 527.9
Miscellaneous Battery Retaining Fixtures & Liners	6160	$ 36,361.1	62	$ 586.5
Misc Welding, Soldering & Brazing Supply	3439	$ 28,898.6	787	$ 36.7
Miscellaneous Engine Accessories, Aircraft	2995	$ 28,145.7	43	$ 654.6
Total		$ 8,942,602.2	$ 19,115.0	$ 467.8

These components are used in a variety of different weapon systems, ranging from tanks, trucks, aircrafts, and helicopters. Most of the needs remain within the aircraft and helicopter category and make up 52 out of 74 platform. The C-130, F/A 18, F-15, have the largest number of parts that need reengineered parts. The Joint Council on Aging Aircraft (JCAA) cites the following causes for the lack of successful reverse engineering efforts[1]:

1. Lack of a qualified source - OEM no longer produces and an aftermarket sources are not responsive.
2. Lack of technical data/procurement packages - Technical/Production packages were not purchased during the acquisition phase or are not available Procurement/Repair costs.
3. Small lot sizes are required and technical qualification of vendor is cost prohibitive.
4. Administrative and production Lead times cannot support requirements.

MTAPP ACTION PLAN

While small business is particularly challenged by the combination of factors 2 and 3 described above, MTAPP believes that through a combination of teaming and supplier network building, a virtual "Small Business Sustainment Solution Center" could be developed partnering both DoD, SB commercial and major prime commercial contractors, HBCUs, and existing SB support programs such as MEP and PTAC. This center would be

[1] JCAA *National Strategy Summary Document* http://www.jcaa.us/NationalStrategy/JCAANatStrategy.htm

managed by MTAPP with a lead MTAPP member company or team of companies acting as the hub or champion of the initiative.

One critical resource for such an effort could be the JCAA. JCAA and MTAPP have developed the following capabilities requirements template for such a concept:

1. Regulation documentation identification, research and retrieval
2. Re-engineering skills in the manufacture and repair of obsolete parts and systems
3. Qualification of replacement hardware
4. System engineering expertise

This model dovetails with other MTAPP solution center efforts including the Lean Six Sigma and small business agility efforts to address demand surges.

Virtual manufacturing enterprises—integrated, collaborative virtual supply chains that facilitate productive working relationships between small business manufacturers and the large prime contractor. We believe the same model is applicable to addressing both DMSMS and reverse engineering requirements for the DLA. This solution would team a group of manufacturing firms that are available to the DLA and ALCs on an "on call" basis with in-place contract/purchase agreements for quick reaction support. These are teaming arrangements that are enabled by advances in collaboration internet tools.

Participating MTAPP manufacturers would not necessarily play a role in every contract the network is awarded. Participation would be project-driven, with suppliers selected for their project-related capabilities, capacities and strengths. MTAPP can facilitate the formation of the network with one or two of the MTAPP companies as the contract lead and working with one or two prime contractors as sponsors of the network. The concept would minimize overhead costs to the government and would benefit from having suppliers that support other manufacturing programs and are integrated with the re-engineering, test and evaluation core team at the DLA. In solving DMSMS, MTAPP can be long-term source of suppliers that can address DMS issues. The AFRL DMSMS program office tracks potential problems in a predictive database and can provide MTAPP with a list of items that potentially will

become supply issues in the next 12 to 24 months. These items can then be share with the MTAPP virtual manufacturing network.

MTAPP Conclusion

The systemic supply chain problems at the root of the demand for reverse engineering capability are persistent long-term challenges. The solutions being provided by the current Air Force and DoD DMSMS groups are focused on problem avoidance but not on improving the processes by which solutions such as reverse engineering can be provided. A Small Business Sustainment Solution Center that combined existing MTAPP member capabilities and integrated resources including HBCUs, major primes and the engineers at the depots, could streamline these solutions and make them both more cost attractive and more easily applied when avoidance and alternative solutions fall short.