Cost Benefit Analysis of Unique Identification (UID)

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The Office of the Under Secretary of Defense for Acquisition Technology & Logistics

REQUIREMENT

Through a series of policy memoranda issued on July 29, 2003, November 26, 2003, December 22, 2003, September 3, 2004 and December 23, 2004, Mr. Michael Wynne, Acting Under Secretary of Defense, Acquisition, Technology & Logistics (AT&L) established and then refined the policy for unique identification and valuation of the Department's tangible personal property. These memoranda, along with implementation details are available on the program website at: www.acq.osd.mil/dpap/uid. The UID policy requirement involves two processes: 1) item marking and 2) delivering data about items as part of the acceptance and delivery process. For most DoD contractors this is an enhancement to existing processes, not a wholesale change.

Unique identification is required for all items delivered to DoD with a unit acquisition value of $5,000 or more, and all embedded subassemblies, components and parts that are serially managed by DoD, mission essential or controlled items. Contractors must ensure that the part mark information applied to each item is globally unique and unambiguous, and they are in control of that process. Industry is responsible for guaranteeing the uniqueness of the serialization approach, so that it can be consistent with commercial practices. Many contractors ensure this practice today, particularly if performance criticality and traceability is important (i.e. aviation engines). Other industries are also adopting UID to ensure unique parts for warranty returns (i.e. Volvo, BMW) and to counteract counterfeit parts.

In addition to assigning a unique item identifier (UII), a correctly formatted 2D data matrix mark must be placed on the item such that it is permanent throughout the item's life. This may be done using a variety of techniques. Where practical, the mark may appear on a data plate or label, provided it can withstand normal wear and tear, including the range of solvents or other chemicals that may come in contact with the mark. The requirement for UID does not determine the method of applying the mark; however, the format of the mark must conform to the requirement of the Defense Federal Acquisition Regulation Supplement (DFARS) clause titled "Unique Item Identification and Valuation" [DFARS Case 2003-D081, published December 30, 2003], and the requirements in the referenced version of MIL STD 130, which references a commercial International Standards Organization (ISO), Aviation and Uniform Code Council standards, widely used in the commercial industry. DoD also endorses several other existing commercial equivalent standards that meet the test of global uniqueness.

BACKGROUND

Unique Identification (UID) of tangible assets, or bar coding, is a commercial practice that has evolved over the last 30 to 40 years, initiated by the grocery industry. In late 1990s the National Aeronautics and Space Administration, in partnership with the bar coding industry, was instrumental in the development of the two dimensional (2D) data matrix, a successor to the traditional linear bar code. The 2D data matrix enables unique identification of items where space is a premium, enabling more data to be

placed on very small items. DoD has several existing policies requiring UID including but not limited to: Serialized Item Tracking, Inventory Management (DoD 5000.64), and Flight Critical Safety Parts. The UID policy expands the requirement for barcoding to a larger number of assets than previously required, to ensure compliance with the 1990 Chief Financial Officer's Act. A machine-readable, unique identifier on assets entering DoD's inventory, enables a common language of business for asset visibility and reliable accountability and accounting practices for asset management.

DoD leveraged existing part marking standards as the foundation in constructing the UID policy. Three international part-marking languages dominate global industry and are managed by EAN/UCC, the Air Transport Association (mandated by the Airlines; used by FAA), and the International Standards Organization. DoD brokered an agreement between the three standards communities that allows for the first time, an interoperable, machine-readable solution to exist internationally. This interoperable part marking standard will also enable common asset traceability for homeland security, spanning multiple commodities. In fact, international support has been so strong that a NATO standard has been drafted by Germany and the United Kingdom to adopt the U.S. interoperable solution.

UID will enable multiple industries and governments to identify assets using one common unique number that stays on the asset through life. Using that single number will then provides the "Key" to discovery and correlation of item, real property and human resource information so that DoD and industry can consistently locate, control and value items in a common consistent manner.

The urgency and significance of unique identification has motivated DoD to require unique identification through policy, contract language, and military standards using ISO/IEC 15434 syntax (i.e. data format) for UID. This is a commonly used and internationally recognized standard for marking items across many business sectors from aircraft parts to golf clubs and even contact lenses. The requirement to use the UID construct including the ISO/IEC 15434 syntax has been included in contracts where the US Department of Defense has no involvement (e.g. the EuroTransporter).

UID marking capability is determined by comparing the characteristics of the item to be marked with the processes, techniques, requirement and knowledge of the manufacturer of the item. The first factor in determining how to mark an item is determined by the nature of the item itself. The item's characteristics, its operational environment, maintenance procedures, and the affect of the mark on the ability of the item to perform its intended function, all factor into the choice of marking method. If the item will be operated and maintained in a protected environment then it is likely that a simple ink-jet printed paper or Mylar label will suffice. As the environments become progressively harsher, it may be necessary to use direct part marking or a data plate marked with laser etching, electro-chemical etching, or dot-peening.

The second factor in UID marking capability is determined by the manufacturer's processes, methods, requirements and technical knowledge of parts marking

techniques. Since the 2-D Data Matrix is compatible with virtually all marking techniques, the UID requirement would rarely require the manufacturer to change their existing marking technique. If a contractor does not serialize or mark items presently, there are many marking vendors that offer services spanning the industry.

DISCUSSION

The Department of Defense (DoD) considered three primary alternatives to implementation of UID marking. The first alternative was to use existing commercial marking approaches, which may or may not serialize uniquely within a part, facility or company, but do not ensure uniqueness outside of these domains. In other words, a tank could have the same part number and serial number combination as a commissary frozen food cooler. This approach did not pass the test for uniqueness and was, therefore, rejected. The second alternative was for DoD to take responsibility for marking all items as they enter the inventory or were inspected and accepted. This was also determined not to be a practical alternative given the diversity of delivery locations, acceptance procedures, marking methods for types of items delivered, costs for redundant infrastructure capabilities at multiple and diverse acceptance points, and the increasing number of direct vendor deliveries. The third and only accepted alternative was to develop a standard marking approach using existing commercial methods and existing item identification data elements. This solution was developed collaboratively with industry in February, 2003 and is reflected in the UID policies subsequently issued and executed through the second interim rule. This final rule seeks to improve the executability of the clause requirements, clarify the prior clause language and to allow exceptions for small businesses, commercial items and for contingency requirements.

A large, medium or small business that currently serializes its items must become knowledgeable in the application of the 2-D Data Matrix, and determine whether internal capabilities to perform the marking exist or whether other alternatives, such as outsourcing the marking activity to a third party, should be considered.

In addition, the contractual requirement to mark items acquired from subcontractors that meet the criteria for unique identification of end items and/or embedded items must be assessed. In some cases the prime and sub-contractor may agree to an alternate arrangement for marking the item, if it is in the best interest of both parties. The subcontractor may assume the responsibility to mark the item either through in-house or outsourced capabilities, or may permit the prime contractor to assume the responsibility. In addition, the proposed changes to the final rule include exceptions to the marking requirement, which were incorporated in response to comments to the interim rule, and allow the government to assume the responsibility for the physical marking of the item, if acquired from a small business or if the item is a commercially available item.

Large manufacturers often outsource some or all of their part marking requirements when they involve labels or data plates. This outsourcing can be as limited as buying the correctly sized base stock with preformatted data already inscribed, or as complete

as purchasing ready to attach data plates pre-marked with all the required UID data and the 2-D Data Matrix.

Several considerations affect the outsourcing decision; a firm must consider cost, timeliness, infrastructure and in-house benefits. If UID is viewed as a cost of doing business from which no internal benefit will be derived then a vendor may outsource the marking process. If, however, UID data and marking are integrated a different decision may be made to control marking in-house.   A 2004 internal study by the Aerospace Engine Division of Rolls Royce identified significant quality improvements and a 4% direct labor savings from the use of UID in conjunction with automated data capture in the manufacturing process. The study could not quantify, but anticipated equally dramatic labor savings in operations and support. A 1999 study at DaimlerChrysler (Airbus) indicated, "Over a period of five years, the Cumulative Net Cash Flow amounts to the sum of 2.25 million DM… without considering the additional 'soft' benefits", for implementing barcoded component tracking in aircraft production.   A 2003 study by ATKearney performed on behalf of UCCnet identified savings in the following areas:

Business Area Affected	Business Impact
Merchandising and Sales time handling data	5% reduction
Customer service time dealing with purchase orders	5+% reduction
Finance time reconciling invoices	5-10% reduction
Inventory	.5-1% reduction
Out-of-stocks	1+% reduction
Logistics costs	1+% reduction
Warehouse and direct store delivery	1000's of hours saved
Speed to market	2 weeks less time on new items
Shelf tag and scan errors	1000's of hours saved
Data Cleansing	$4 saved for every $1 spent

Figure 1 – 2003 Study by ATKearney of Barcoding Business Benefits

Whether the business is small or large, the cost of outsourcing the creation of labels and data plates is a function of volume of parts produced. The number of labels or data plates used may have a significant initial cost, but will ultimately result in a decreasing marginal cost per unit, as quantities rise. Initial setup costs are modest. Medium and large companies often choose to maintain an in-house capability not because of cost, but rather, due to a risk-aversive approach to marking capabilities. In-house capability is likely to provide a more rapid turnaround, but at a higher cost.

Many outsourcing companies are available to satisfy parts marking support that meet the UID requirements. Several of these companies are newly established, independently or in alliance with existing companies, and are themselves small and minority owned businesses. These outsourcing companies provide completed, verified and validated data plates or labels that do not require any additional infrastructure

investments. Companies are also positioned to help medium and small companies introduce fully integrated marking systems that work with receiving, inventory control, manufacturing, shipping and billing systems. The General Services Administration is currently developing a set of schedules that will provide a full range of UID solutions from data plates to data integration. The National Institute of the Blind is also developing a set of proposals to provide UID services to government activities.

Listed in the following tables are real world implementation costs associated with UID implementation

Relative Costs of Outsourced UID Marking Methods

Marking Approach	Method	Outsourced Marking costs (dependent on order quantities with minimum setup charges of $200-$300)	Min. Infrastructure to take advantage of UID and AIDC (optional)
Life-lasting gummed labels	Polyester	$0.10→ $0.50 per label	Readers: $500→ $1000 per reading device
	Metal Foil	$0.20→ $1.00 per label	Readers: $500→ $1000 per reading device
Data Plates	Plastic	$0.50→ $2.00 per plate	Readers: $500→ $1000 per reading device
	Metal	$0.50→ $3.00 per plate	Readers: $500→ $1000 per reading device
Direct Part Marking (DPM)*	Inkjet	$1.00 per mark	All methods (except laser bonding) will require more expensive low-contrast readers costing $1200→ $2500 per reading device
	Chemical Etching	$2.00 per mark	
	Dot Peening	$3.00 per mark	
	Laser Bonding	$2.00 per mark	
	Laser Etching	$2.00 per mark	

* Note: Costs based upon non-complex part geometries and conditions for the part to be marked:

Figure 2 – Internal Market Research: Survey of Representative Sample of Marking Companies

Relative Costs of In-house UID Marking Methods

Marking Approach	Method	In-house Marking costs (very dependent on order quantities)	Min. Infrastructure to take advantage of UID and AIDC (optional)
Life-lasting gummed labels	Polyester	$2000 printer + $700 software + $0.05 per label	Readers: $500→ $1000 per reading device
	Metal Foil	$2000 printer + $700 software + $0.05 per label	Readers: $500→ $1000 per reading device
Data Plates	Plastic	$5000 machine + $0.50 per label (very low volume)	Readers: $500→ $1000 per reading device
	Metal	$20,000 laser + $0.50 per plate	Readers: $500→ $1000 per reading device
Direct Part Marking (DPM)*	Inkjet	$10,000 machine + $0.50 per mark	All methods (except laser bonding) will require more expensive low-contrast readers costing $1200→ $2500 per reading device
	Chemical Etching	$2000 printer + $300 chemetch + $700 software + $0.50 per mark	
	Dot Peening	$10,000 machine + $0.10 per mark	
	Laser Bonding	$15,000 laser + $0.30 per mark	
	Laser Etching	$25,000 laser + $0.20 per mark	

* Note: Costs based upon non-complex part geometries and conditions for the part to be marked:

Figure 3 – Internal Market Research: Survey of Representative Sample of Marking Companies

Beyond the marking requirement there are costs and savings associated with the collection, reporting and registration of UID data. Use of Wide Area Workflow (a digital receipt and acceptance system) to improve payment turnaround has been well received by industry. In addition, companies may access the UID registry data to evaluate the quality and reliability of their manufactured items.

What impact will the UID Policy have on small business? UID is expected to have a minimal impact on the small business base doing business with the DoD.   In FY 2004, DoD purchased Supplies and Equipment from 42,859 small businesses valued at $16.588 Billion on 179,835 contract actions of $25,000 or greater. Analyzing the North

American Industry Classification System (NAICS) codes for each of these actions reveals that only seven NAICS manufacturing categories would have been impacted by UID. These seven manufacturing categories represented $8.967 Billion, or 54 percent, of the total dollars the DoD spent with small businesses in FY 2004 for Supplies and Equipment and 90,597, or 50 percent, of the FY 2004 contract actions awarded to small businesses for Supplies and Equipment. Further, analysis of the Defense Contract Management Agency Mechanization of Contract Administrative Services (MOCAS) database as of March 15, 2005 reveals that there were 4,946 small businesses with items greater than $5,000 out of a total of 11,131 vendors in the MOCAS database. The total line items in MOCAS greater than $5,000 were 22,970 out of 353,274, or 6.5 percent. Also, of the 3,710,573 National Stock Numbers managed by the Defense Logistics Agency, only 59,754 (1.61 percent) have a manufacturing unit cost equal to or greater than $5,000.

The small businesses in the NAICS manufacturing categories normally use some form of product identification already, i.e., bar coding, as part of their commercial business practices. The UID Program Office is unaware of any small business that cannot comply with the UID policy. In fact, there is an increase in the number of small businesses providing marking/UID data services to industry and the DoD. We anticipate that most small vendors will be able to comply using labels and data plates readily and inexpensively available in the commercial market. A small business can order labels and data plates from a wide array of vendors at a cost of $0.10 to $3.00 per item. No specific investment need be made by a small business.

DoD issued policy guidance regarding contract pricing and cost accounting associated with UID compliance, dated July 9, 2004, in recognition that in some cases there is a cost of compliance that can be justified and submitted as an allowable cost.   Indications are that this cost is significantly less when the mark is applied during the manufacturing process prior to packaging and shipping. The cost of marking items in route (i.e., unpacking, marking and repacking) or at its destination is typically greater due to the increased handling and labor costs. In addition, marking in route is less efficient and may result in items being overlooked during the manual application of a label or data plate.   Should this happen, and the item inadvertently be deployed, traceability of the item is lost and the goal of a clean audit opinion would be significantly compromised, or it would result in additional expense to locate, retrieve and subsequently mark the item.

How can the acquisition community benefit? For the acquisition community within DoD and where Contractor Logistics Support is provided, the 2D mark enables an automated approach to data capture and a means for traceability throughout the life of an item. As the data capture occurs and is linked to in-service data sources users will have access to a broad range of reliable data for engineering analysis, logistics support decision making, valuation and even operational decision making. It will also mean fewer errors should occur in the acceptance and reorder processes.

Doesn't the operator/maintainer bear a large burden of UID? It is true that operational and maintenance processes need to be modified to conform to an automated data

capture capability, but only where those processes are not in use today. Most all maintenance systems, whether in the government or a contractor, rely on serially tracked items to ensure proper maintenance and to track reliability. It is also true that we already capture much of the product identification data today by writing data on forms and typing data into computers – usually maintaining redundant processes for the same transaction! The difference is the speed (10x$\rightarrow$ 100 xs faster) and accuracy (10x$\rightarrow$ 100,000 xs more accurate) with which the data is captured. There is also the benefit of eliminating the cost of producing, populating, editing, transcribing, correcting and storing paper forms. Today the operator/maintainer has to read and write down product data that may have been vibro-etched or stenciled onto a part and then enter it manually into a data system. By the implementation of a standard data structure and mark, the operator/maintainer will use an image capture device which is pointed at the 2-D Data Matrix and the data can either be stored or transmitted to the database. This reduces human error, resulting in accurate and fast data capture.

What is the future of UID? In the short-term, marking items and electronically submitting the data on deliverables through Wide Area Workflow (WAWF) will allow both industry and the government to improve data quality. Concurrently, the use of UID data within and across the acquisition, finance and logistics communities will enable UID marking and data capture to contribute to functional processes. In the long-term UID will become a key factor in all accountability and accounting systems.

Some possible applications either enabled or enhanced by the use of the UID include:

- ✓ Failure Reporting/Analysis & Targeted Repair (Reactive and Predictive)
- ✓ Recall or Latent Defect Resolution
- ✓ Warranty enforcement
- ✓ Maximizing Capability While Minimizing Logistics
  - ▫ Reliability studies to determine best equipment available
  - ▫ Tracking and redirecting as necessary in route
- ✓ Planned Maintenance
- ✓ Repair
- ✓ Supplier Performance
  - ▫ Parts (end items and spares)
  - ▫ Logistics support
- ✓ Optimized lift models

The insight provided through this basic, but effective means of uniquely and unambiguously identifying parts is only limited by the ingenuity of smart people with creative ideas and our combined ability to recognize its value.