
ACQ

UISITION STRATEGY:

Technology is the KEY

Technology, especially MBE technology, will play an important role in government program management's development of an acquisition strategy—one that creates and sustains a competitive environment from program inception through sustainment.

By Mitzi Whittenburg and Roy Whittenburg


Technology resources are transforming the acquisition landscape in the United States. Everything from manufacturing and engineering to acquiring products and services and the communication between government and industry is being drastically transformed by incorporating digital technology into how we do business.

Earlier this year, President Barack Obama announced the Digital Manufacturing and Design Innovation (DMDI) Institute. The purpose of this $175 million institute can best be summarized by the following excerpt from the White House press release announcing it:

> The United States stands on the edge of a new frontier in manufacturing—a frontier in which high-tech products are designed and tested largely within a virtual environment and individually tailored for performance. Much like the Internet has transformed the way we approach commerce, digital design is transforming manufacturing.[1]

Furthermore, engineering no longer begins on a draftsman's table, where hand-generated sketches are turned into physical prototypes that are modified and tested multiple times to get it right. As a result of the increasing complexity of manufactured systems and the requirement for low-volume production to meet highly customized needs, growing opportunity exists to expand capabilities in digital manufacturing and design.

However, along with this growing opportunity, there are also significant challenges to integrate this "digital thread" across different manufactured technologies and across the supply chain. These challenges include:

- Establishing true interoperability,
- Managing intellectual property interests in an effective and balanced manner,
- Maintaining network technology and security,
- Workforce skills, and
- New organizational cultures that embrace and leverage a digital tapestry.

The government has made an unprecedented commitment in the form of the DMDI Institute to address these challenges and to take advantage of the opportunities presented. One of the ways it plans to do this is through a transformational approach called the "Model-Based Enterprise" (MBE).

The Model-Based Enterprise

An MBE is a fully integrated and collaborative environment founded on 3D product definition that is detailed and shared across the enterprise to enable rapid, seamless, and affordable deployment of products from concept to disposal. The foundational elements of an MBE are a single digital master data set that contains the 3D model and all needed product data in a managed, secure, and controlled environment—one that supports maximum data reuse for all aspects of acquisition, maintenance, and operations.

Let's take a look at the basis for the digital thread that is used in computer-aided design (CAD) to aid acquisitions in an MBE. CAD is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. Manufacturers typically design using CAD software, which is used to increase the productivity of the designer, improve the quality of design, improve communication through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for 3D printing, machining, or other manufacturing operations. Thus, the solid model is typically already in a 3D format eliminating the extra step of converting into a 2D deliverable. This in turn offsets any cost of documenting the model with "product manufacturing information" for use by non-CAD users. CAD has become an especially important technology within the scope of an MBE, encompassing benefits such as lower product development costs and a greatly shortened design cycle.

Historically, the government has used "Level 3" drawings to communicate requirements for manufacturing parts used in weapon systems. Meanwhile, industry has moved from the use of drawings to a reliance on technology to design, price, and manufacture items in a world in which digital information is king. Using a 3D annotated model as part of a technical data package (TDP) enables the design engineer to formalize the design intent, using geometry

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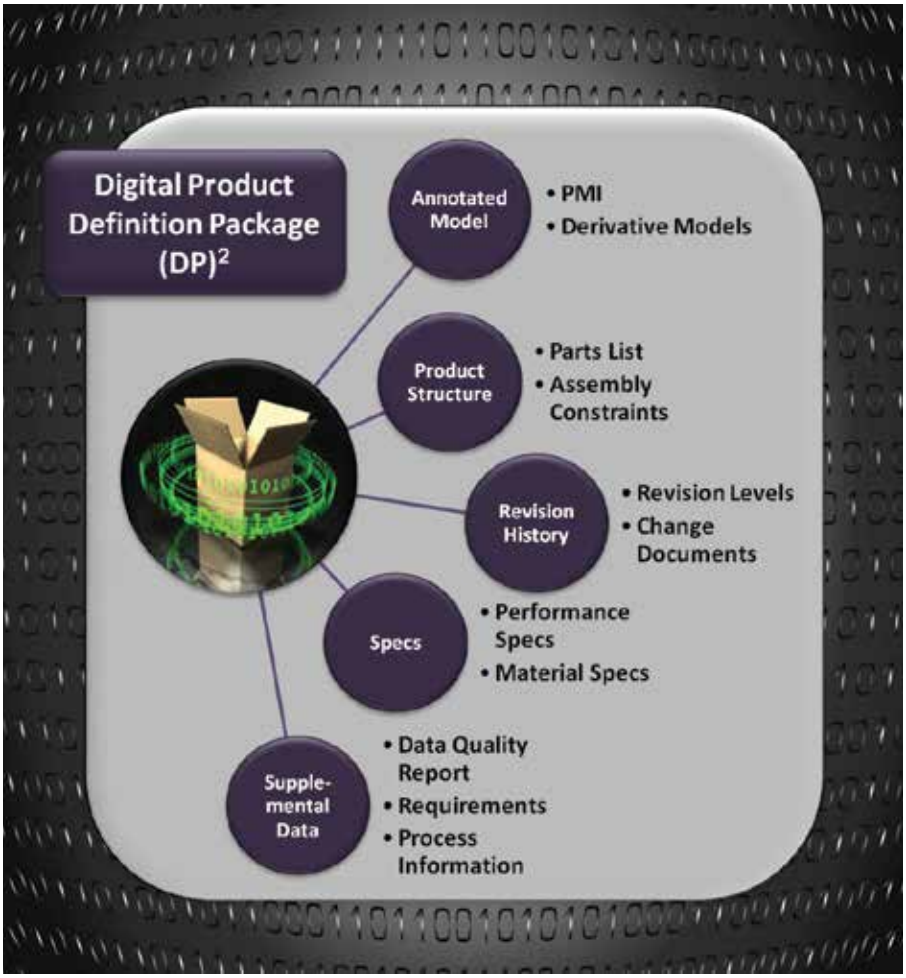

FIGURE 1.

as well as including annotations for specs on dimensions, tolerances, and materials.

A TDP is a technical description of an item adequate for supporting an acquisition, production, engineering, and logistics support (e.g., engineering data for provisioning, training, and technical manuals). The description defines the required design configuration or performance requirements and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, drawings, associated lists, specifications, standards, performance requirements, quality assurance provisions, software documentation, and packaging details. See **FIGURE 1** above.

MBE technology will play an important role in government program management's development of an acquisition strategy to create and sustain a competitive environment from program inception through sustainment. As an incentive to including MBE in acquisition strategy, some of the benefits of applying 3D technology are:

- Reduced cost,
- Reduced time to mission,
- Better quality, and
- Increased professionalism since government will collaborate as a unified team with industry.

Also, as a result of better communication of requirements, technology linked to industry best practices is incorporated, thus increasing competition. Better information equals better competition.

As outlined in the Interim Department of Defense Instruction (DODI) 5000.02, "Operation of the Defense Acquisition System" (released November 25, 2013):

> Decisions made in the early phases of the acquisition process can either improve or reduce program management's ability to maintain a competitive environment throughout the life cycle of a program. Strategies to be considered include: competitive prototyping, dual sourcing, open system architectures that enable competition for upgrades, acquisition of complete technical data packages, and competition at the subsystem level.[2]

See **FIGURE 2** on page 70.

Interim DODI 5000.02 goes on to state:

> Program management must establish and maintain an IP strategy to identify and manage the full spectrum of IP and related issues (e.g., technical data and computer software deliverables, patented technologies, and appropriate license rights) from the inception of a program and throughout the life cycle. The IP strategy will describe, at a minimum, how program management will assess program needs for, and acquire competitively whenever possible, the IP deliverables and associated license rights necessary for competitive and affordable acquisition and sustainment over the entire product life cycle. The IP strategy will be updated throughout the entire product life cycle, summarized in the acquisition strategy, and presented with the life-cycle sustainment plan during the operations and support phase. Program management is also responsible for evaluating and implementing open systems architectures, where cost-effective, and implementing a consistent IP strategy. This approach integrates technical requirements with contracting mechanisms and legal considerations to support continuous availability of multiple competitive alternatives throughout the product life cycle.[3]

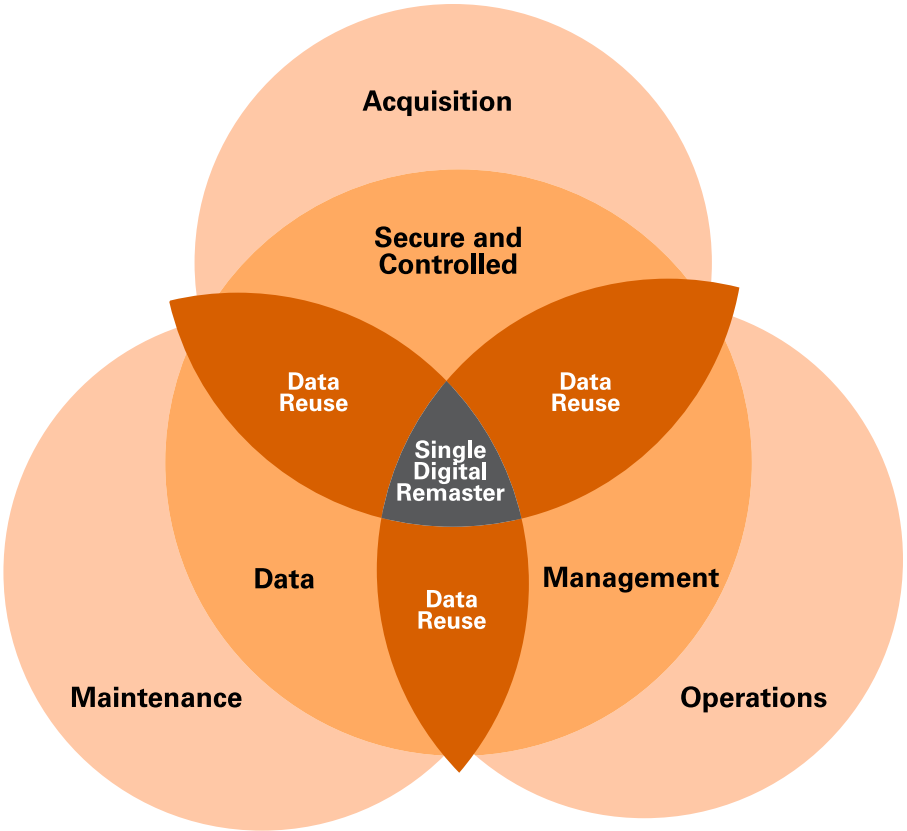

FIGURE 2.

See **FIGURES 3**, **4**, and **5** on pages 71, 72, and 73.

Most defense contractors typically conduct business with both commercial and government customers. Since these contractors probably use 3D models with their commercial customers, it is apparent that they are familiar with doing business in this format. If the government uses technology that is considered to be best industry practice, there would be a better connection between what the government wants to buy and the pricing and delivery they receive from suppliers. When this benefit is utilized by the government, the professionalism of the acquisition team increases because the supplier becomes part of the team rather than the perceived weak link in the supply chain. In an effort to accomplish this outcome, the U.S. Army ManTech Program has supported the Net Centric Manufacturing Program for the past several years, developing foundational technologies and processes needed to support the U.S. Army, the Department of Defense (DOD), and industry.

Nevertheless, once the technology is in place, there needs to be in place a communication plan to educate the many players on the acquisition team. Not only is engineering involved in understanding the use of MBE, it affects the entire acquisition workforce—especially program management, procurement, quality, logistics, and contracting officer representatives.

MBE has a far-reaching impact. Some of the ways that the impact is tied to improving the acquisition strategy are outlined as follows:

- Business: cost estimating—
  - Easier to determine "should" cost through more precise requirements,
  - Fewer processes involved in the short term since product life cycle impacts cost,
  - Identification of short- and long-term cost savings,
  - Development of quantitative "should" cost metrics,
  - Establishing government best practices for determining "should" cost,
  - Accurate "should" cost identifies overspending,
  - Accurate "should" cost provides basis for price evaluation, and
  - Cost for data rights can be considered up front;
- Contracting—
  - Better use of technology to communicate requirements in solicitations,
  - Ability to insert MIL-STD-31000A specifications into solicitations and contracts,
  - Ability to buy data rights upfront and ensure data is received,
  - Risk reduction because of fewer questions from suppliers on vague requirements,
  - Easier scrap rate estimation for suppliers,
  - Evaluation criteria could include incentive for re-use of data,
  - "Real" competition increased through commercial-customer use of technology,
  - Better information provided to contractors—which flows down to subcontractors,
  - Greater achievement of small business goals and subcontracting plans because additional suppliers will likely provide quotes,
  - Ability to negotiate better data rights for the government,

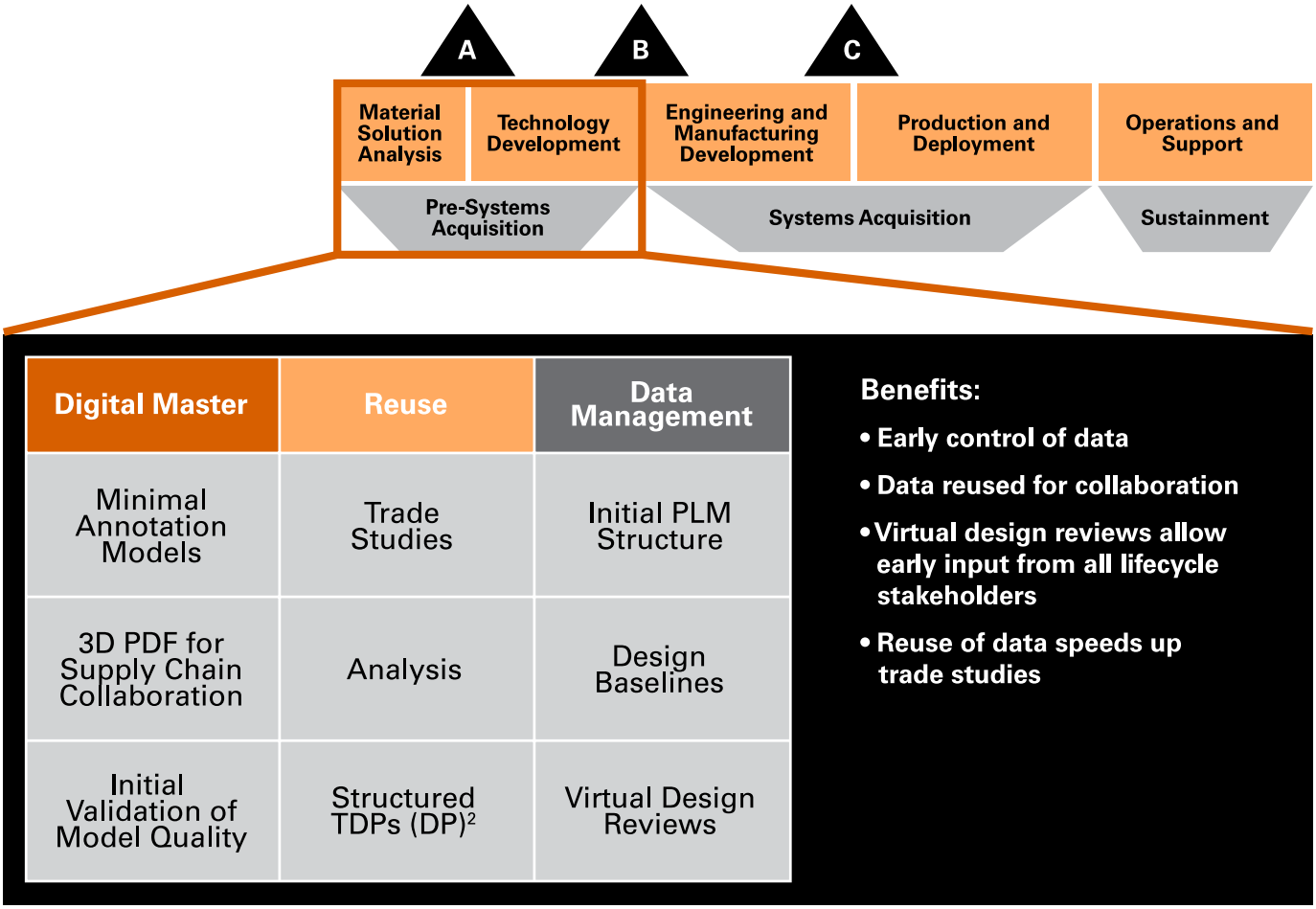

FIGURE 3.

- Better ability to assert data rights,
- Ability to achieve greater competition during all phases of the life cycle,
- Ability to achieve competition at the component level all the way through integration,
- Integration could be facilitated at an organic facility if data rights were asserted,
- Elimination of vendor lock through use of open technology,
- Application of technical advancements in business strategy, and
- Facilitation of the government's goal of becoming a smarter buyer;

▪ Engineering—

- Agreement to beneficial common baseline in practices;
- Better ability to manage information is incorporated;
- Better use of available technology is instituted;
- Expansion of success of U.S. Army ManTech Net Centric project that addresses "above the shop floor" technologies to support integrated weapons systems life cycles;
- Creation of a design team utilizing industry input from the beginning stages;
- Model schema in place;
- Elimination of the need for industry to create a 3D model from a Level 3 drawing;
- Conceptual, design, and production phases instead of Level 1, 2, and 3 drawings;
- Upfront determination of unlimited data rights related to form, fit, and function;

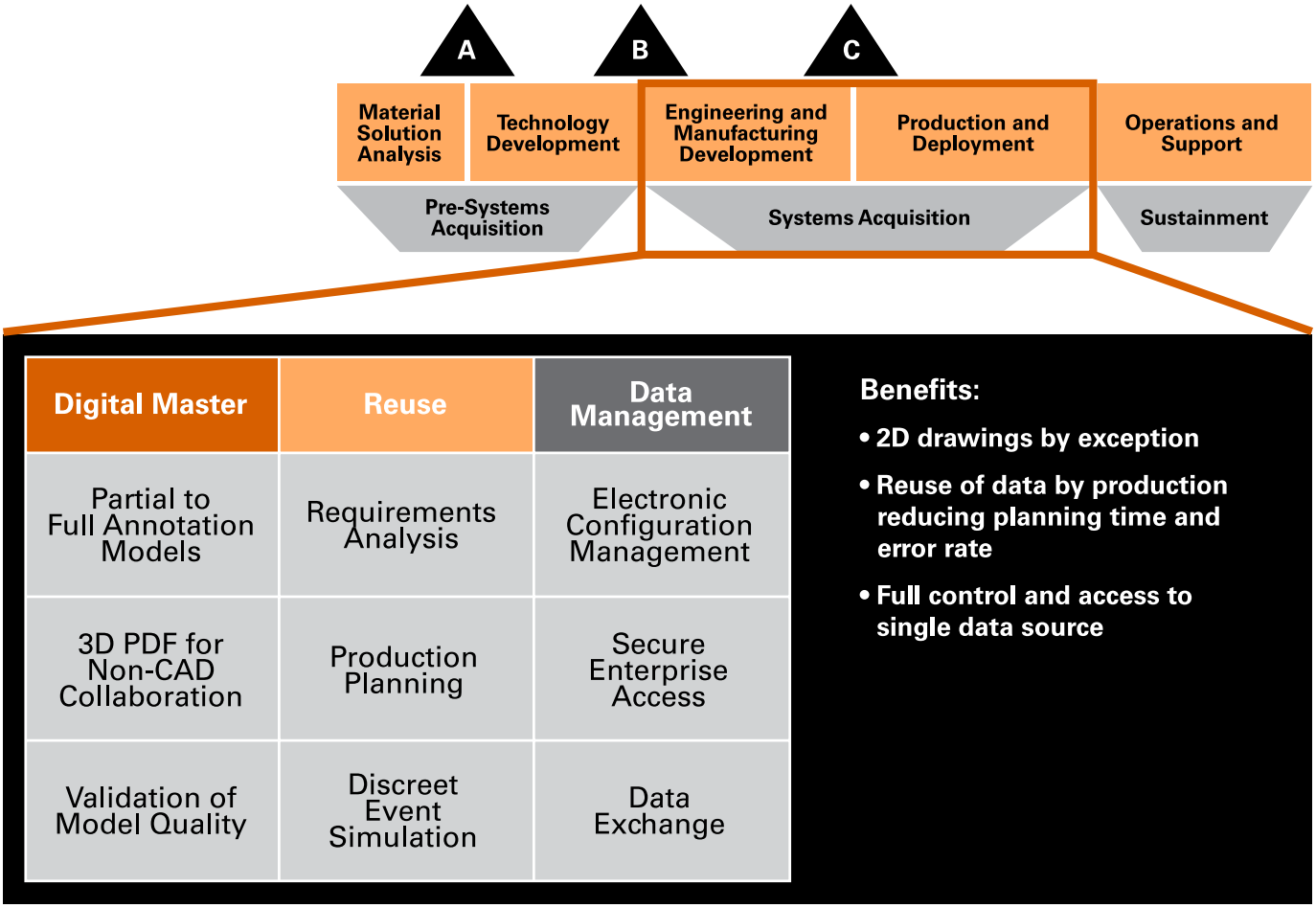

FIGURE 4.

- Upfront determination of unlimited data rights related to operation, maintenance, installation and training; and
- Ability to insert enhanced technical approach and processes into government culture;

- Life cycle logistics—
  - More efficiency in the acquisition life cycle;
  - Increased speed and flexibility in life cycle, causing faster time to mission;
  - Spares can be created when needed and not stored;
  - Models can be used in theater to address both technical publications and rapid acquisition of field-replaceable units;
  - Data can be reused or repurposed, or both, without re-creating it; and
  - Virtual design of custom packaging material before product is on-site;
- Program management—
  - Achievement of cost savings owing to increased competition and more efficient processes;
  - Delivery of a consistent message to industry;
  - Negotiation of better pricing because of increased knowledge available;
  - Taxpayer dollars spent wiser by applying technology to reduce both cost and time to mission;
  - Better stakeholder communication;
  - Lower program risk, especially during transition from the conceptual, developmental, and production phases;
  - Determination if award fee or incentive fee is appropriate for data reusability;
  - Determination if award fee or incentive fee is appropriate for reducing development cycle time;

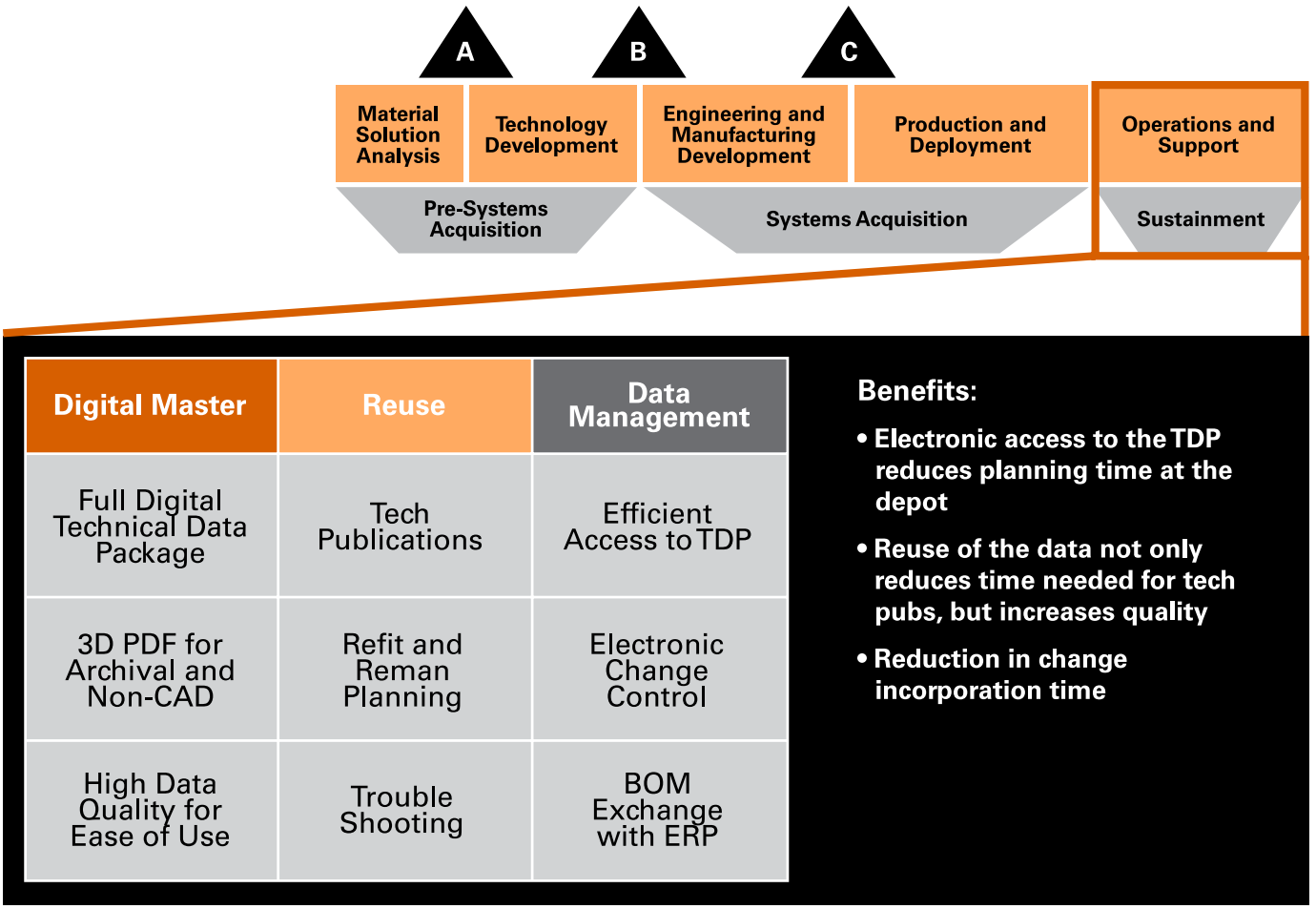

FIGURE 5.

- Agile programs that meet program deadlines by achieving more with less re-work; and
- Aid in rigorous requirements definition;

- Production, quality, and manufacturing—
  - Manufacturing is driven straight from the model, enhancing lean workflow and reducing errors from re-creation;
  - Visualization of production line before manufacturing to eliminate bottlenecks;
  - Easier and better change management tracking;
  - Better quality control through inspection to model;
  - Technical publications can be created earlier in the life cycle; and
  - Depots will not have to reverse-engineer parts to know how to make them; and

- Test and Evaluation—
  - Standardization of processes,
  - Virtual check completed before physical test and evaluation conducted,
  - Verification and validation of 3D models, and
  - Governance of standards by a professional organization.

Everything that is in a Level 3 drawing is in a 3D annotated model. Thus, nothing is missing, but there are enhancements such as additional metadata and the ability to view the part in 3D instead of 2D. This enables the supplier, or an organic facility, to view the part virtually before they manufacture or fix a part to sustain a weapons system. To facilitate better communication, any stakeholder that is unfamiliar with this process change will need to be trained.

To this end, a repository of information is found on the MBE website (**www.model-based-enterprise.org**), including access to the official MBE LinkedIn group, links to other relevant sites, presentations, videos, articles, and success stories all related to MBE.[4]

Now the question is, "How does all of this work?" Will small businesses have to buy certain software to do business with the government? The answer is "no." Whichever CAD tool that they are currently using will work with MBE because native and neutral CAD files are preferred. So one might also simply ask, "What is a 3D TDP?" A 3D TDP is a set of technical data based upon a 3D solid model (also referred to as an "annotated model") that provides the product definition of an item. It replaces a traditional drawing-based TDP, containing many types of related data. The overarching goal for the 3D TDP is to provide a foundation for reuse downstream.

In the past, this TDP was based on 2D Level 3 drawings; however, DOD is now pursuing data in the form of 3D annotated models along with associated detailed TDPs. The colloquial name for this new form of TDP is the "3D TDP." Its main purpose is to provide all downstream users a 3D data set that they can reuse without re-mastering the data. The 3D TDP would be delivered in a neutral format such as an "ISO STEP AP" or PDF format, ensuring a CAD-agnostic solution. For suppliers, this means they will have the ability to drive their computer-aided manufacturing software straight from the model, along with numerous other processes. It also allows for increased collaboration between engineering, procurement, and suppliers, as well as less ambiguity for suppliers when producing the product.

So, now that this is an industry best practice and the government can use similar practices in accordance with government rules and regulations, how does it become part of the government solicitation and the contract? In February 2013, MIL-STD-31000A was approved as an updated version of the standard. This standard paves the way to contract for 3D annotated models, and in some instances 2D drawings, in government acquisitions. A process has been approved to verify and validate the dimensions of the model to ensure that translation from different CAD systems does not affect the validity of the model.

The recently released MIL-STD-31000A defines a TDP and outlines modifications to support a life-cycle productivity transformation from a technical, as well as a contractual standpoint. Other noteworthy results from the release of the new standard are the modernization of the requirements for the deliverable data products associated with a TDP and its related data management products, in addition to an easy-to-use tool to direct the format of contract deliverables for the data product.

The following is a summary of the MIL-STD-31000A provisions:

- Defines what makes up both the 2D and 3D TDPs;
- Provides better alignment between the TDP and the product life cycle to ensure the right data is acquired at the right point in the life cycle:
  - Conceptual Level (Milestone A),
  - Developmental Level (Milestone B), and
  - Production Level (Milestone C);
- Defines a 3D TDP that uses modern data to provide a product definition foundation that can be reused throughout the life cycle;
- Defines a complete up-to-date TDP that can be used to competitively bid the product; and
- Provides a method for both structuring and verifying the quality of a 3D TDP.

MIL-STD-31000A replaces the previous MIL-DTL-31000 for contracts requiring a TDP. Requirements change over time and the TDP will evolve; therefore, MIL-STD-31000A ties the levels to the milestones of the product life cycle. The previous MIL-DTL-31000 used Levels 1, 2, and 3 to describe ascending levels of detail, where a Level 3 would fully define a product (i.e., Level 3 drawing). This revised standard initially applies to major or block upgrades to a legacy system and to the development of new major weapon systems acquisitions. As such, new contracts for substantial mechanical components need to comply with the delivery of a 3D annotated model as part of the TDP—instead of the customary 2D Level 3 drawing package required for government contracts.

Understanding that each contract or program has different needs, MIL-STD-31000A incorporates the "Option Selection Worksheets" in its appendix A. There are two worksheets that allow the user to select which TDP elements are needed for their effort: The first covers the primary TDP elements, and the second is used for commercial products.

Furthermore, MIL-STD-31000A includes a list of updated "data item descriptions" (DIDs) for use in solicitations. The state-

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ment of work must include the fact that the acquisition has been targeted for the use of 3D models and, as such, the new DIDs are required. The use of MIL-STD-31000A must be called out in the solicitation and in the work statement because the requirement is not specified in the *Federal Acquisition Regulation* or the *Defense Federal Acquisition Regulation Supplement*. The "contract data requirements list" will need to list the appropriate DID based on the phase of the acquisition, whether conceptual, developmental, or production.

Tying the levels of a TDP to the life cycle, allowing for several types of TDPs, and providing a tailoring mechanism gives the government tremendous flexibility in how it acquires data. MIL-STD-31000A can ensure a competitive environment from program inception through sustainment by bridging the gap between technology and contracting. It is a perfect example of technical expertise and procurement expertise coming together as a total acquisition team that has a professional acquisition plan and aligned focus to achieve the mission. By modernizing the government TDP to be at the same level, or at least closer to most of industry, there will be fewer conflicts between contractors and the government. With the inclusion of 3D TDP requirements and appendix B, the model organizations schema, MIL-STD-31000A is now on the leading edge of the acquisition of product data. The 3D validation and verification guide in appendix C of the standard is intended not only to provide requirements for data quality but also to inform government personnel on the process.

In summary, new advancements are now available for making technology easier to use for the government to conduct business with industry. These efforts will improve the competitive environment as part of the acquisition strategy, by communicating more precisely and retaining more information to be used in different phases of the life cycle. Once the 3D model has been used to acquire the weapons system, it can certainly make the job of sustainment a lot easier because the 3D model will be retained for use in repairs and maintenance. MBE technology is a winning solution to ensure a competitive environment from program inception through sustainment.

A "culture of communication" is desirable for program management. Effective communication can start with requirements that are verified and validated and are then used repeatedly throughout the program life cycle without the need to re-master throughout the supply chain. It is a new world out there—one that loves its technology. By utilizing technology resources, the void between government and industry communicating virtually together will be dissolved and substantial progress made toward improving acquisition strategy—now and well into the future. **CM**

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Send comments about this article to cm@ncmahq.org.

ENDNOTES

1. "President Obama Announces Two New Public-Private Manufacturing Innovation Institutes and Launches the First of Four New Manufacturing Innovation Institute Competitions," The White House, Office of the Press Secretary (2014).
2. *See* **www.dtic.mil/whs/directives/corres/pdf/500002_interim.pdf**.
3. *Ibid.*
4. Also see "Model-Based Enterprise: An Innovative Technology-Enabled Contract Management Approach" in the September 2012 issue of the *Journal of Contract Management*, as well as "Using MIL-STD-31000A to Support Better Buying Power 2.0" in the October 2013 issue of *Contract Management* Magazine.