TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

A3FABE and NCMBE Tech Transfer

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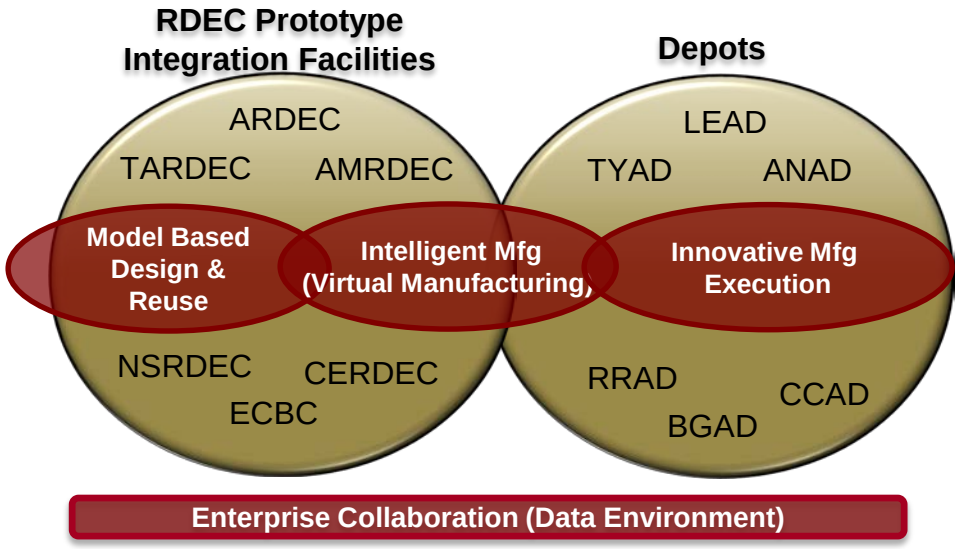
Purpose

To socialize existing Army Mantech MBE related Projects that are available for re-use*.

*Some of the re-usable projects may be restricted to DoD only.

Accelerated & Adaptive Army Fabrication Enterprise (A³FABE)



Purpose:

The A3FABE program provides advances in organic business process efficiency through Model Based Enterprise (MBE) technology demonstrations that improve the Army's organic manufacturing capability to better support our program managers, reduce time to field solutions, reduce up front risk and reduce lifecycle cost for Army materiel solutions.

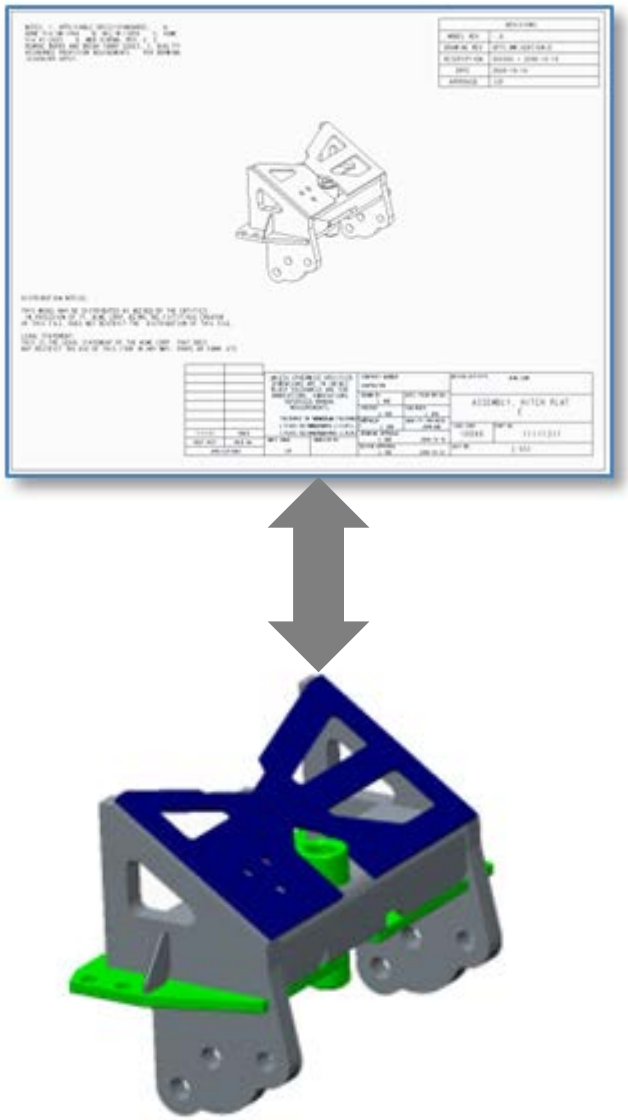
Products:

- *Demonstration of Manufacturing Execution System (JobBOSS – Production and Quality modules) - ARDEC (FY14)*
- *Demonstration of Distributed Numerical Control (DNC) and Manufacturing Data Collection (MDC) via MTConnect Standard and Predator Solution - ARDEC PIF and Watervliet Arsenal (FY14)*
- *Demonstrate DARPA Digitally Dynamic Tooling Library – ARDEC (FY16)*
- *Review and reassess Model Based Enterprise capabilities for RDECOM's Prototype Integration Facilities (PIF), via a guided survey (FY16)*
- *Demonstrate Manufacturing Knowledge Base with model based CAM tools ESPRIT and Pro-NC (FY16)*
- *Demonstrate business case for MDC at ARDEC PIF (FY16)*
- *Large scale demonstration of PIF to PIF Enterprise Product Data Management interoperability (FY16)*

Payoff:

- *Time-to-field cycle is reduced; Warfighter obtains products faster*
- *Reduction in overall production cost*
- *Increased production throughput*
- *Capture and reuse of manufacturing knowledge*
- *ROI = 10.2:1 based on FY14 cost analysis*

Net-Centric Model Based Enterprise (NCMBE)



Purpose:

This program seeks to define, develop, and demonstrate Model Based Enterprise (MBE) technologies and processes within the Army's organic manufacturing base and private industry to reduce acquisition costs, risks, and lead times by utilizing fully annotated models as the 3D product master and maximizing their use throughout the lifecycle. Examples of products coming from these efforts include fully annotated 3D Technical Data Packages (TDP), virtual manufacturing process planning, and 3D work instructions for repair and maintenance of weapon systems.

Products:

- ***Developed a standard schema for creating fully-annotated Computer-Aided Design (CAD) models and published in MIL-STD-31000A***
- ***Developed and documented MBE processes for major***
- ***CAD tools including Pro-E, Creo, and SolidWorks***
- ***Developed contract language for 3DTDP acquisition for***
- ***Program Manager (PM)-Ground Combat Vehicle***
- ***Developed and documented process for creating Digital***
- ***Work Instructions from pre-existing 3D models***
- ***Developed SOP for Digital Work Instructions; Demonstrated with TOW-GPK***
- ***Provided 3D fixture designs and animated manufacturing***
- ***work instructions for the MaxxPro Dash Protection Roller***
- ***Interface Bracket to PM-Close Combat Systems***
- ***Provided 3DTDP of M2A1 Quick Change Barrel to PM-SW***
- ***Standardized 3DTDP Contract Language: Finalized MIL-STD-31000 and established boiler-plate RFP language for acquiring Instructions.***
- ***Provide training for Anniston Army Depot personnel to use Digital Work***

Payoff:

- ***Best practices available to tech data users***
- ***Military and commercial standards in place***
- ***Holders of tech data will have tested set of processes to transmit data***
- ***Increased reuse of model data throughout the lifecycle***

MBE Capability Index

Purpose/Scope

The MBE Capability Index served as the driving tool behind two ManTech efforts. In the A3FABE program, the Capability Index was used annually to quantify MBE tool and process adoption at each RDECOM PIF. A3FABE also funded and managed a new revision of the Capability Index to improve ease of use for organizations to perform self-assessments.

A3FABE scored each PIF against the MBE Capability Index on an annual basis from 2013 to 2016.

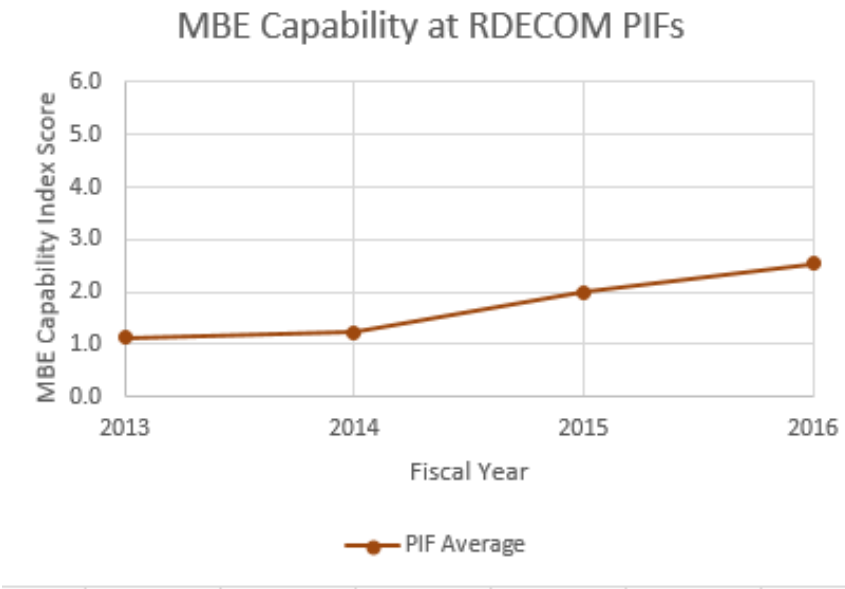
Available Tools/Artifacts

- MBE Capability Index Tool.
- Model Based Enterprise Capability Index – Technical Report

Both artifacts are publically released.

Background

The Capability Index was originally created in 2007 and last updated in 2015 as a response to the need for a common method to measure MBE tool and process adoption within an organization or enterprise. A group of government and industry organizations collaborated to produce the original index - BAE Systems, Boeing, U.S. Army RDECOM, National Institute of Standards and Technology (NIST), Defense Advanced Research Projects Agency (DARPA), Joint Defense Manufacturing Technology Panel (JDMTP), and DoD Engineering Drawing and modeling Working Group (DEDMWG).



MBD Training: CREO and Solidworks

ISSUE

Currently RDECOM manufacturing centers (PIFs and depots) rely on 2D drawings and paper printouts to manufacture orders and track their completion. Technical data packages (TDPs) contain complex 2D drawings which take a long time to interpret before production can begin with a complete manufacturing plan. Reliance on 2D drawings is in conflict with the RDECOM S&T community and OEMs which work almost exclusively with 3D models. The drawings are easy to misinterpret causing inaccurate manufacturing quotes and subsequent contract modifications. Drawings are also no longer the primary design document for engineers – 3D models are generated first and the drawings are merely derivatives that present the models in two dimensions. Two files must be collectively maintained to perform correct configuration control.

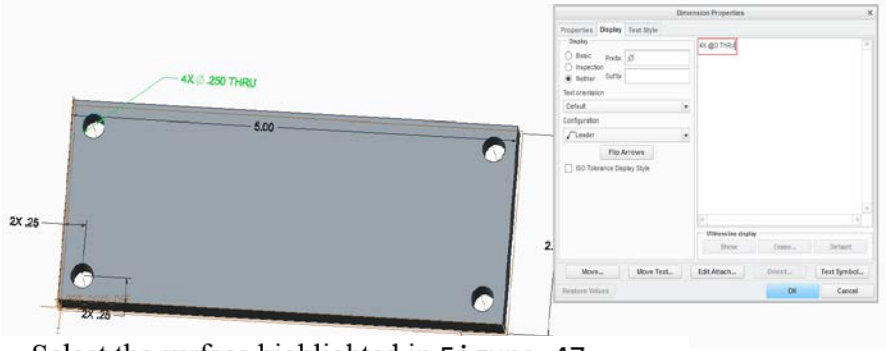
Available Resources

- SOPs for Solidworks and CREO 2.
- Associated models for the SOPs along with completed models for reference.

SOLUTION

Step-by-step SOPs were developed for PTC Creo, PTC Pro-Engineer Wildfire 5, and SolidWorks 2015. These SOPs are in use at ARDEC M&PT and ARDEC PIF. The same processes are being taught to ARDEC engineers taking the 3D TDP Standards course through its Armament University.

The SOPs are cleared for unlimited distribution.



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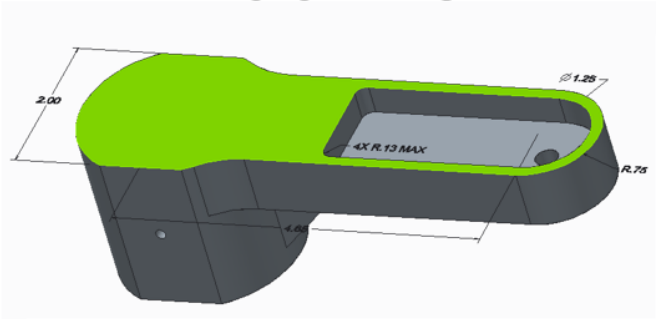


Figure 47

Process Mapping

ISSUE

ARDEC's M&PT had a business process defined in 9 high level steps and some documentation of the staff's roles and responsibilities. The lack of detail left the division's leadership with many uncertainties how to incorporate MBE tools and processes. It was difficult to identify specific process bottlenecks and non-value-added steps.

SOLUTION

Start with the high level (Level 0) process and systematically add detail to develop a level 1 and 2 map. Develop a level 3 process map which identifies "swim lanes" for each software tool used to process tech data.

Available Resources

- Level 1 and 3 Map in Visio or .pdf.

IMPACT

The level 0, level 1 and level 3 maps have been provided to M&PT management for reference. Multiple bottlenecks have been identified where a single or small number of personnel have to process a large amount of data. Steps have been identified as candidates for transition to a MBE process, like eliminating storage of tech data in non-CM controlled file systems.

JobBoss Standardized Libraries

ISSUE

- Data is frequently recreated in the JobBoss Manufacturing Execution System to complete manufacturing quotes and job records.
- Data in JobBoss records is sometimes entered incorrectly or can be misinterpreted by users, causing delays in the purchasing and manufacturing processes.

SOLUTION

Standardize commonly used data that is found in JobBoss library databases, using agreed-on formats and nomenclature. Develop a business process to manage additions and changes to the databases.

Material ID

(Round): (Material)-(Alloy)-(Length)_R
(Tubing): (Material)-(Alloy)-(Diameter)_DIA-(width)
(Rectangular): (Material)-(Alloy)-(Width)-(Height)
(Sheet): (Material)-(Alloy)-(Width)-(Height)-(Length)
(Hardware): (BEARING, CLAMP, SCREW, NUT, WASHER, FOAM, etc)-(size)-(Vendor #)
(Supplies): (up to 25 character description)
(Raw Stock-Round): RS-(Diameter)_DIA-(Material)-(Alloy)
(Raw Stock-Tubing): RS-(Diameter)_DIA-(Length)-(Material)-(Alloy)
(Raw Stock-Rectangular): RS-(Width)-(Height)-(Material)-(Alloy)
(Raw Stock-Sheet): RS-(Width)-(Height)-(Length)-(Material)-(Alloy)

(If placeholder not applicable/available for material, write "**NA**" in its place)

IMPACT

- Clear, unambiguous sets of data available to engineers to build Quotes and Jobs.
- Standardized nomenclatures for materials, hardware, customers and vendors across PIFs using JobBoss.
- Time saved by engineers by avoiding re-entry of existing data or trying to interpret unclear data.

JobBoss Standardized Libraries

Available Resources

- Table for Raw Stock using the Unified Numbering System (UNS).
- Standard table format for: Vendors, Customer and Services.
- Generic form for Production Engineers to request new elements. (Currently found in JobBoss 2016 Database Clean-up Overview. Linking to Pace3 broken.)

Training

*Documents to aid production engineers in how to search for elements and how to request new data. (Currently found in JobBoss 2016 Database Clean-up Overview. Linking to Pace3 broken.)

Lessons Learned - Cultural

- Have a clear Work Statement that defines the purpose of implementing JobBoss
- Provide a robust training program
- Get end users involved early so they feel like they are part of the process
- Trust-Engineers replicated data until they felt comfortable with JobBoss

Lessons Learned - Procedural

- Clear, unambiguous sets of data available to engineers to build Quotes and Jobs.
- Standardized nomenclatures for materials, hardware, customers and vendors across PIFs using JobBoss.
- Time saved by engineers by avoiding re-entry of existing data or trying to interpret unclear data.

MDC Predator Implementation MMDTP

ISSUE

•Shop floor metrics are manually collected and often outdated
•Opportunities for knowledge capture, reuse and lessons learned are lost

Predator MDC

SOLUTION

•Predator MDC is real-time machine monitoring software that automatically collects, reports, charts and processes real-time shop floor manufacturing data including OEE, cycle time, idle time, setup time, teardown time, machine downtime and more. Predator MDC improves manufacturing by supplying accurate shop floor productivity metrics to improve operations and to make better decisions.

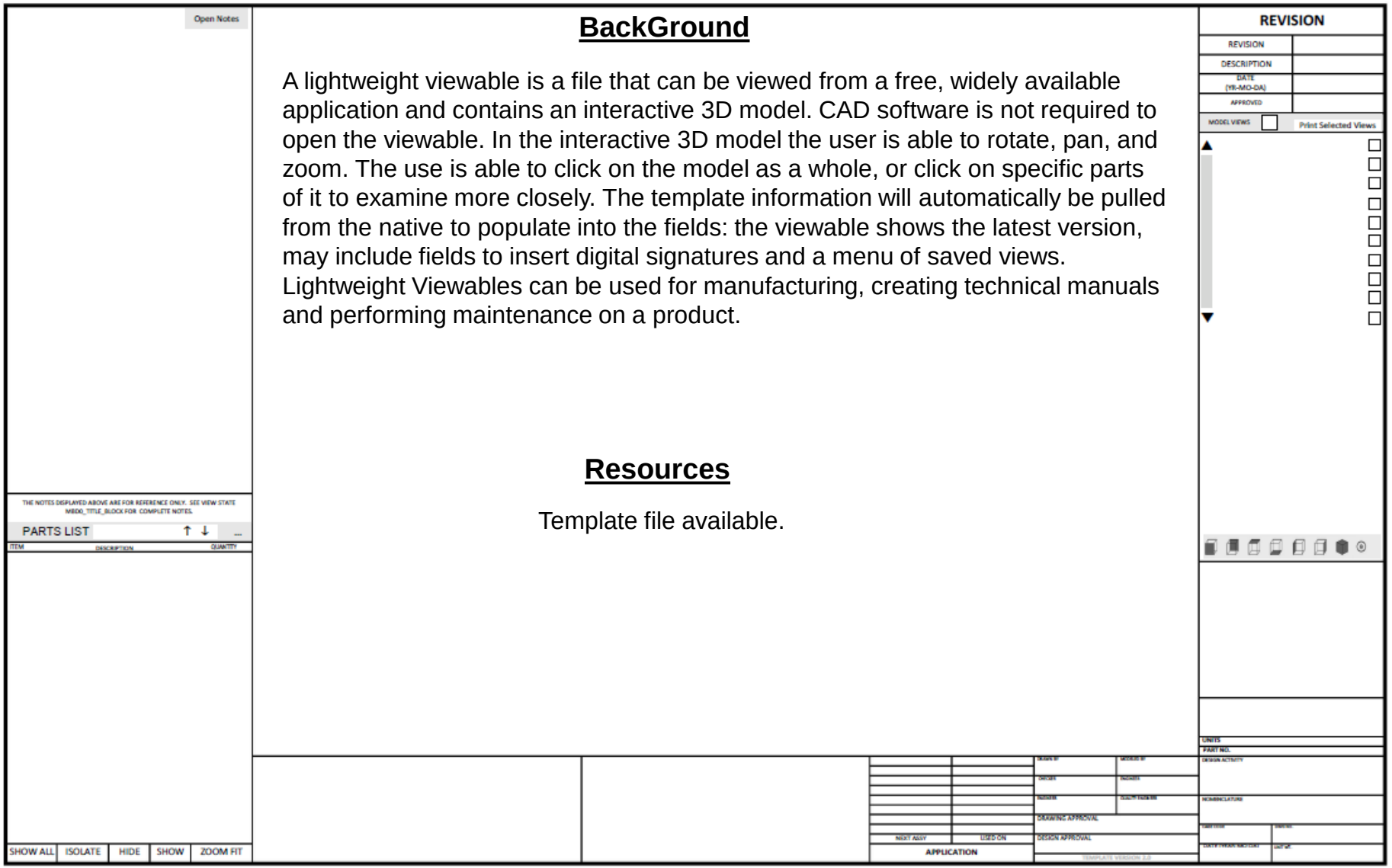
Artifacts

• Design Document with Procedure embedded in document.

IMPACT

•Predator MDC supports automatic, error-free, and unattended machine monitoring for events such as job start and end, setup start and end, cycle start and end, to name a few of the events that can be monitored. For shop floor management

3DPDF Template for Lightweight Viewables: ARDEC Standard



Model Verification

ISSUE

The Army does not use a standard software tool or use a standard process to verify the completeness of 3D models. Some PIFs have experimented with these tools but have found them difficult to configure. Users also find the results difficult to interpret. Manual checking processes are widely used but are time consuming.

SOLUTION

CAD verification tools have been shown in industry to reduce engineering and manufacturing errors, and reduce risks associated with configuration management among multiple offices and organizations. Two software tools were investigated and demonstrated during NC-MBE: PTC's Creo ModelCHECK and ITI's CADIQ. A large portion of the time demonstrating these tools was spent defining an optimal configuration for the needs of the ARDEC M&PT Division. ModelCHECK is a tool within PTC Creo. CADIQ is a third party software that performs similar functions to Model CHECK and in addition can compare multiple CAD files of various formats and revisions and identify differences in a 3DPDF report.

Resources/Artifacts

- CADIQ SOP.
- CADIQ Capabilities Report
- ModelCheck Configuration Files

Results

Configurations were developed and documented for both CADIQ and ModelCHECK.
ModelCHECK is in regular use by a portion of the M&PT engineering staff.

MBD in Prototyping: Business Case Demo at ARDEC PIF

Purpose

To show the feasibility and benefits of using lightweight viewables as a replacement for 2D drawings, especially in manufacturing processes. The expected value is an increased number of bids from small manufacturers, reduced cost, risk and lead times for system acquisition.

Approach

Based on earlier market research the NCMBE team selected the Anark Core software tool to publish 3DPDFs. The tool works by importing a native CAD file, embedding it into a PDF template, and exporting a finalized PDF. The embedding step translates the 3D geometry into an interactive model in the PDF and can also extract metadata from the model and use it to populate set fields in the PDF template. The file cannot be changed once in this state. The manufacturers or other downstream users can review the PDF in any reader available to them, such as Adobe.

Resources

- Generic MBD Process Spreadsheet.
- MBE Business Case for ARDEC

Results

A set of two components were manufactured. The 3DPDF and native Creo model were used to quote the job, schedule the job, program the CNC G-code, and perform 100% inspection. Both components passed inspection. During most steps, printouts of selected view states were used as a reference. Reliance on the 3DPDFs and its printouts did not negatively affect the cost, quality, or schedule of this manufacturing job.

MBD in Prototyping: Business Case Demo at ARDEC PIF

Scope

To demonstrate the current capability of PTC Pro-Engineer CAD software to fully annotate 3D models, and to demonstrate Anark Core's ability to publish 3DPDFs containing all geometry. The complete TDP of the M2A1 QCB was fully annotated and supplemented with 3DPDFs.

Approach

A workflow was developed to provide checks on the models and 3DPDFs at multiple points of the process. ARDEC's PACE3 Windchill system, an Excel spreadsheet and a sequence of emails together were used to maintain configuration control during the process.

Resources

- Lessons Learned document that includes process and workflow information.

Recommendations

Based on success stories like the M9 Bayonet TDP ARDEC has proven that MBD and 3DPDFs are a viable alternative to traditional 2D drawing packages. Training should be made available and promoted to more engineers at ARDEC and other RDECs. To expand beyond mechanical component TDPs, MBD processes should be developed for electrical, composite and shipbuilding CAD tools.

Digital Work Instructions for CNC Machine Setup

Purpose

To demonstrate the capability of DWIs to reduce scrap and cycle time of fixturing workpieces in CNC machines by providing interactive, animated instructions. Once demonstrated, A3FABE transitioned the technology to Watervliet Arsenal.

Problem

Typically fixturing setups are developed by a team of manufacturing technicians and engineers. Setups may be documented as 2D drawings, written instructions, or verbal instructions. Setups for complex or high-precision parts require detailed instructions and existing methods are often insufficient and introduce delays and out-of-spec parts due to confusion and miscommunication.

Resources

- Anark Instructions Document.
- Anark Template.

Approach

The A3FABE team leveraged existing NCMBE knowledge in DWIs and the Anark Core software to develop a set of instructions. In February 2016, staff provided models to Picatinny staff. The initial set of DWIs were developed by June 2016. In parallel Picatinny's Anark SME provided NCMBE's SOP for generating Anark DWIs.

Army POC

For follow-up please contact:

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