LEADER'S PRIMER TO:

A GUIDE TO DIGITAL TRANSFORMATION

Adoption of Model-Based Definition in the Defense Industrial Base

INTRODUCTION

Today small and medium-sized manufacturers (SMM) face rapid changes in the technology that is available to them and that can best deliver success for the business. Adoption of Industry 4.0 is a challenge faced by all manufacturers. Through **A Guide to Digital Transformation**, a path is created for understanding the implementation of Model-Based Definition within the manufacturer. This Primer will prepare you for the journey and give you background to start your company on a digital transformation.

THE DIGITAL MODEL INITIATIVE

The Department of Defense's (DoD) Office of Local Defense Community Cooperation (OLDCC) initiated a Defense Manufacturing Community Support Program to strengthen national security by aiding defense manufacturing. Connecticut, with its wealth of defense contractors, is part of that program and has implemented the Digital Model Initiative (DMI), a pilot program to identify and capture lessons learned and best practices for SMM in the defense industrial base. **A Guide to Digital Transformation** supports manufacturers as they adopt Model-Based Definition (MBD) processes, related technologies, and workforce strategies.

INDUSTRY 4.0 – DEFINITION

Industry 4.0 refers to the fourth industrial revolution, which connects machines, people, and physical assets into an integrated digital ecosystem that seamlessly generates, analyzes and communicates data, and sometimes takes action based on that data without the need for human intervention.[1]

As part of a "digital transformation" towards an Industry 4.0 manufacturing operation, companies strive to leverage the benefits of the 6 enabling principles of Industry 4.0 – including the use of virtual digital models that can be shared between interoperable systems.

01 Interoperability

02 Virtualization

03 Decentralization

04 Real-Time Capabilities

05 Service Orientation

06 Modularity

1. Source: PwC's Insights, *Capital efficiency meets Industry 4.0*

The Digital Model Initiative captured the experiences of manufacturers as they started a digital transformation journey. Those experiences show the best practices of MBD adoption and implementation paths, with examples to highlight problems, their solutions, and recommendations on next steps.

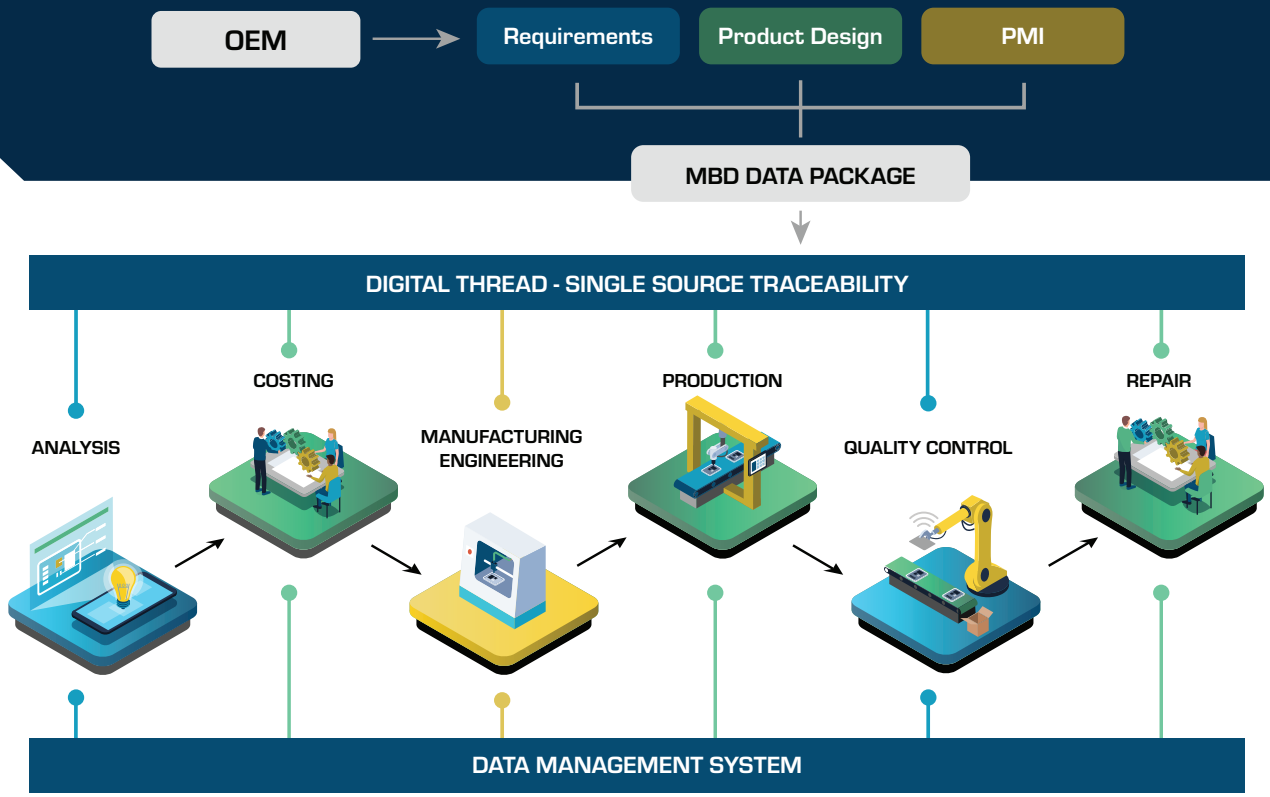
Moving to a digital thread implementation follows a general pattern:

- Assessment of the organization's readiness,
- Creation of a roadmap toward implementation, and
- Parallel workstreams for technical implementation and workforce development.

DIGITAL DATA – DEFINITION

A Model-Based Enterprise (MBE) uses a 3D model format annotated with digital data containing everything needed to design, model, simulate, manufacture, test, and support a product throughout its lifecycle. This digital thread connects every phase of the product and fosters improved communication and understanding between OEMs and their suppliers.

Digital data has other uses, including the simulation, analysis, and field support of end products, but this guide is focused on using digital data to manufacture a product and ensure the required quality. Streamlined access to the data for quoting, scheduling, and inspection ensure a successful exchange and can prevent costly errors and supply chain disruptions.



BENEFITS OF MODEL-BASED

Why is the DoD pushing for defense manufacturers to implement MBD? Besides simplifying and securing the exchange of data between OEMs and suppliers, there are other business benefits:

Data Reuse – Digital models create a digital thread useful for both manufacturing and quality control as well as business processes. Model-based definition provides needed data directly to electronic work instructions, CNC machining, CMM inspection, and service manuals.

Reduced Effort – Since it is not required to specify every dimension within a design, the effort of documenting is reduced.

Error Reduction – A significant source of errors result from drawings not matching the dimensions in the model.

Clarity – 2D drawings require interpretation. 3D annotations are associative which means the annotations are connected to the 3D geometry on the CAD data.

Validation – The models can be automatically validated for comprehensive and clear definition.

Change Comparison – Versions of the model can readily be compared for both geometry and PMI changes.

DIGITAL TRANSFORMATION READINESS ASSESSMENT

Before beginning any transformation, a manufacturer should assess their current state and develop a roadmap for a future state based on their business needs. The assessment platform selected for the DMI project is an independent model that helps companies assess their readiness for digital transformation and incorporates financial and performance data to help them prioritize their next steps and create a roadmap for improvement. The assessments provided some useful insight into where MBD solutions can significantly impact manufacturers' activities.

The three core elements are:

PROCESS:

Identify inefficient and error-prone processes in the exchange of PMI with OEMs

Highlight opportunities to improve efficiency and quality by incorporating MBD tools into internal operations and supply base interface

TECHNOLOGY:

Highlight areas where machine-readable PMI can assist the programming of CNC and metrology systems

Incorporate 3D models and other data to create augmented reality environments and streamline value-add assembly capabilities

ORGANIZATION:

Identify skill sets and roles vital to successfully use MBD

Gauge how to use MBD for increased collaboration and enhanced workforce training and development

The assessment reveals key findings about the driving forces to support a company's transformation, using key performance indicators (KPIs) and cost factors to identify the areas where they can see significant impacts with advanced technology and MBD practices.

ORGANIZATIONAL COMPETENCIES

Adopting a model-based definition approach to managing product manufacturing information is more than purchasing a software package.

The digital transformation can encounter roadblocks in two distinct ways:

1. Leadership and management drive a shift in philosophy and culture in a top-down approach. This can be viewed as unrealistic by employees, who perceive a disconnect between the "real world" of production and the "ivory tower" of leadership.
2. Suggestions originating from initiatives at the employee or "grass roots" level are proposed in a bottom-up approach. This can be perceived by leadership as an unnecessary additional expense, requiring employees to "sell" them on the potential benefits and impacts.

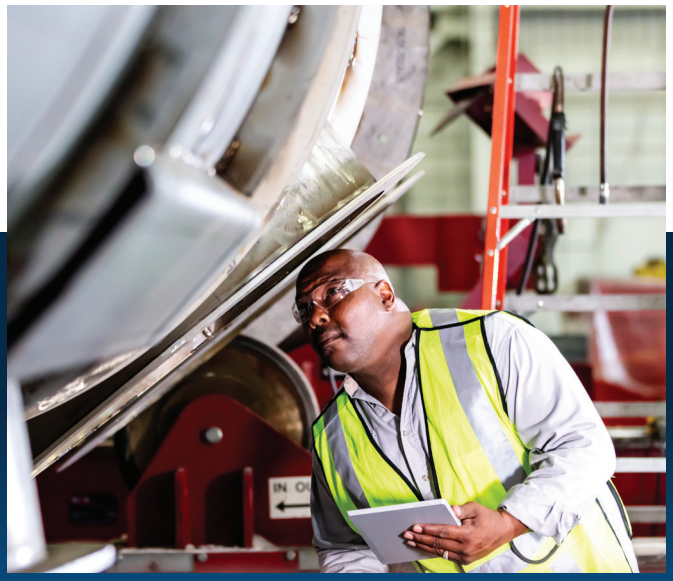
Both scenarios create drains on time and resources to fight the embedded status quo and create the momentum necessary for change. The solution lies in increasing awareness and understanding at both levels.

Leaders and managers must understand the business impact of effective digital transformation: it provides another set of tools to drive efficiency and productivity.

With this understanding, they can integrate digital transformation into their company strategy, promote the benefits, and provide the necessary financial support for initiatives. This will create an organization that can quickly develop and deploy initiatives to fuel growth and long-term success.

At the employee level, competency in the relevant technologies requires additional training and upskilling, as will be addressed in the next section. In addition to the technical skills, it is critical for these employees to be able to identify business needs and map them onto digital solutions. Project proposals need to be framed in terms of their impact to cost factors such as labor and raw materials or key performance indicators, like time-to-delivery or workforce efficiency, to justify the investment of time and resources.

As both leadership and employees gain understanding of Industry 4.0, effective communication and collaboration at all levels of the company must be encouraged. A healthy culture, with shared risks and rewards and enabling teams to have decision-making authority, provides the momentum to take this transformation to Industry 4.0 into a sustaining state.

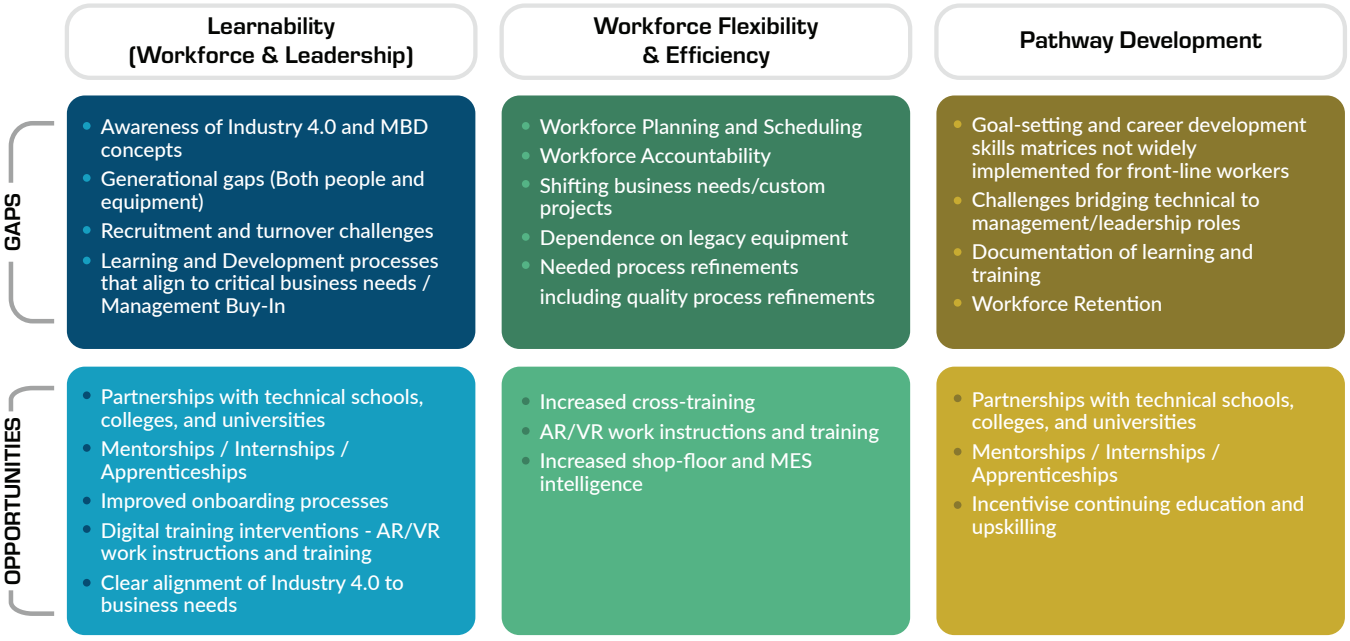


WORKFORCE GAP ANALYSIS

There are workforce challenges across defense manufacturing organizations beyond leadership and frontline management development. Figure 9, below, illustrates three primary categories of critical workforce gaps and opportunities to handle them:

Common Workforce Gaps Across DMI Suppliers

Figure 9



Three primary categories are identified in outlining critical workforce gaps and opportunities:

- **Learnability** concerns the knowledge disparities in embracing Industry 4.0 across supply chains, between existing and new workers, and among organizational leadership. Organizations can respond by building or expanding partnerships with schools, universities, and consultants. Organizations can also expand mentoring through internships and apprenticeships, adopt interactive training approaches with Augmented Reality (AR) and Virtual Reality (VR) technologies, and update business strategies to better incorporate Industry 4.0 and model-based systems.
- **Workforce Flexibility and Efficiency** requires workforce planning and scheduling and better tracking of workforce accountability. Customized projects and orders demand rapid shifts in manufacturing, made more difficult by the widespread dependence upon legacy equipment across the defense supply base. Increased cross-training of workers, using both AR and VR, and MES could help.
- **Workforce Pathway Development** addresses retaining and growing employees, especially front-line workers, through improved training (including in the use of digital records) and defining employment goals and skills required to reach those goals. Building a bridge from technical roles to management and leadership positions would build stronger understanding throughout the organization. These measures respond to the workforce retention challenge experienced by many defense manufacturing suppliers.

Companies that quickly adopt Model-Based Definition will be the leaders in DoD supply chain manufacturing in Connecticut and the country. To ensure that Connecticut maintains our leadership role in supporting the defense of our country, there are resources to support companies implementing their digital transformation. The State of Connecticut will successfully lead our stakeholders in the implementation of MBD across the defense supply chain to ensure the sustainability of our very important defense sector. Failure is not an option.

PAUL LAVOIE

Connecticut's Chief Manufacturing Officer

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