Paper Title: Forging the Future of Mission-Centric Modeling: Integrating the Integrated Digital Maturity Pathway (IDMP) and User Story Framework into Mission Engineering

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ABSTRACT

As mission complexity and global uncertainty increase, the Department of Defense (DoD) must transform its digital and operational infrastructure to maintain readiness across domains. This paper introduces the Integrated Digital Maturity Pathway (IDMP) and User Story Framework as a novel, mission-centric approach to digital transformation and modeling and simulation (M&S) alignment. Developed to bridge the limitations of static maturity assessments, IDMP operationalizes readiness through the lens of human-in-the-loop decision-making and adaptive mission engineering. The framework captures user narratives, identifies systemic gaps, and provides actionable insights across workforce, technology, and policy dimensions.

This validated approach is currently being integrated with the Manufacturing Readiness Level (MRL) Deskbook revision, led by the MRL Working Group, which incorporates IDMP variables to guide mission-driven readiness evaluations. Recent executive directives, such as Executive Order 14299 on nuclear energy resilience and Executive Order 14192 on procurement reform, underscore the urgency for forward-leaning, right-focused models capable of scaling surge capacity and agile acquisition (U.S. Department of Defense, 2025a, 2025b).

Through case study analysis and application in acquisition planning, this paper demonstrates how IDMP aligns with the DoD Digital Engineering Strategy and Mission Engineering Guide v2.0 to support adaptive systems-of-systems operations. IDMP's integration into mission readiness planning offers scalable benefits for entities such as AFMC, NIWC, NSRP, and NATO ACT. These engagements illustrate how the framework can promote sustainable digital transformation, enhance cross-functional coordination, and prepare organizations to operate effectively under any circumstance.

This session will provide a blueprint for organizations seeking to align digital modernization with operational readiness, leveraging M&S, user-centered narratives, and mission engineering principles to forge the future of defense transformation.

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BACKGROUND

The Department of Defense (DoD) is undergoing a paradigm shift toward mission-centric operations across all domains. The 2022 National Defense Strategy and 2023 National Defense Science and Technology Strategy underscore the need for rapid capability delivery, increased modeling and simulation (M&S) integration, and cross-functional coordination (U.S. Department of Defense, 2022). The DoD Digital Engineering Strategy and Mission Engineering Guide (Office of the Under Secretary of Defense for Research and Engineering, 2023) call for embedding digital engineering principles, lifecycle modeling, and mission-centric analysis in acquisition and sustainment decisions., increased modeling and simulation (M&S) integration, and cross-functional coordination.

The DoD Digital Engineering Strategy and Mission Engineering Guide (v2.0, 2023) call for embedding digital engineering principles, lifecycle modeling, and mission-centric analysis in acquisition and sustainment decisions. Yet, readiness models such as TRL, MRL, and SRL still focus narrowly on component-level maturity. There is a lack of holistic assessment of mission readiness across systems-of-systems (SoS), organizations, and timeframes. To address this challenge, the current revision of the Manufacturing Readiness Level (MRL) Deskbook is being conducted by the MRL Working Group by incorporating the IDMP/User Story Framework into its guidance. This inclusion supports both digital transformation and surge capacity efforts by enabling contextual, mission-driven maturity assessments aligned with operational demands.

Purpose

This paper demonstrates how the IDMP and User Story Framework can bridge this capability gap by linking stakeholder needs with mission-oriented digital maturity. The IDMP supports strategic decision-making by operationalizing maturity across technical, workforce, and organizational domains, while keeping mission impact at the center.

Justification

The IDMP was developed to integrate user narratives into a measurable framework that can be aligned with existing models (APT, MRL, MBSE) while enabling dynamic assessments. The approach allows organizations to capture the voice of the practitioner and to simulate, plan, and act on their digital transformation journey. When integrated into Mission Engineering practices, IDMP provides a unified structure to evaluate readiness across R&D, supply chain, technology deployment, and human capital factors.

As the Department of Defense accelerates its digital transformation goals, including shifts toward software-defined capabilities, distributed operations, and AI-enabled decision-making, the need for forward-leaning and mission-resilient frameworks is urgent (Department of Defense, 2018). IDMP enables this shift by helping stakeholders identify not only current gaps but also anticipate emergent needs across systems-of-systems (SoS).

IDMP also plays a critical role in surge capacity planning—its user story-driven analysis allows programs to simulate rapid increases in production demand, workforce mobilization, and supply chain responsiveness. These capabilities are essential for scenarios requiring resilient scaling to meet operational tempo and contested logistics (Executive Office of the President, 2022).

By emphasizing mission-oriented outcomes and maintaining human-centered decision-making, IDMP bridges the divide between static assessments and dynamic mission needs. It offers a living model of readiness transformation— one that evolves in real time, adapts to context, and guides acquisition and sustainment programs to become more predictive, integrative, and aligned with strategic priorities.

METHODOLOGICAL APPROACH

The Integrated Digital Maturity Pathway (IDMP) leverages five levels of digital maturity defined across core domains, depending on the organization. These domains reflect the interconnected dependencies that shape digital transformation across mission engineering contexts. Each level is activated through user stories, a structured narrative form that grounds the maturity model in operational realities.

The user story framework asks participants to describe (see Figure 1):

- **Current State** – What capabilities, tools, and workflows are currently in use?

- **Issues** – What pain points, gaps, or risks exist that inhibit mission alignment?

- **Capabilities Needed** – What digital tools, data access, or training are required to close those gaps?

- **Objectives** – What outcomes must be achieved for the mission to succeed?

- **Risk Considerations and Key Decisions** – What must be weighed to prioritize investments and decisions?

- **Training and Implementation Requirements** – What human factors or organizational changes are required?
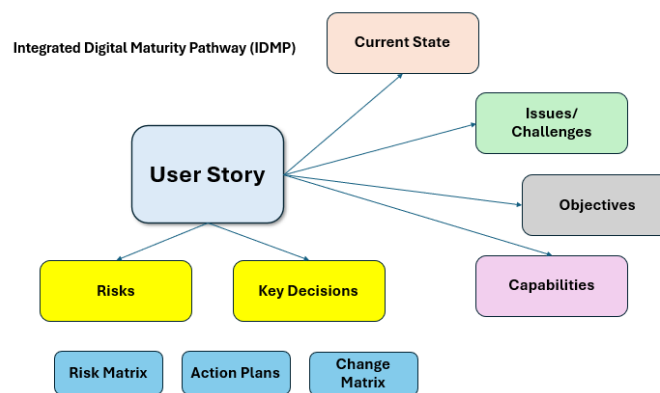

Figure 1: Integrated Digital Maturity Pathway (IDMP) Components (Draper-Amason, 2024)

These user stories are then assessed against the IDMP's structured five-level maturity scale, ranging from ad hoc (Level 1) to optimized (Level 5) digital practices. Each component is scored individually, then aggregated to reveal patterns across domains (Office of the Under Secretary of Defense for Research and Engineering, 2023). The process supports gap analysis, stakeholder alignment, and scenario planning.

The IDMP has also been embedded in digital dashboards and simulation environments that allow for dynamic, real-time modeling of progress. Stakeholders can visualize readiness evolution, benchmark across organizations, and align mission outcomes with transformation efforts. This method makes IDMP both a diagnostic and a planning tool, empowering mission engineering teams to continuously assess, adapt, and operationalize digital transformation strategies.

These user stories can either feed into scenario modeling tools, including the Mission Readiness Model developed by CME or used to operationalize the different decision outputs of the software. This system dynamics-based tool evaluates SoS readiness using mission-centric variables such as supply chain resilience, workforce health, capability alignment, and technology adoption. Digital dashboards present trends and maturity gaps over time.

INTEGRATED DIGITAL MATURITY PATHWAY (IDMP)

The Integrated Digital Maturity Pathway (IDMP) framework provides a structured approach to overcoming digital maturity and interoperability challenges within the Department of Defense (DoD) and Department of Homeland Security (DHS) and its industry partners. By implementing progressive maturity levels, the framework systematically guides organizations through various phases of digital adoption, ensuring a measured and strategic transformation toward a fully integrated and interoperable data environment.

In addition to establishing a digital maturity roadmap, IDMP aligns with key data security standards by integrating cybersecurity principles and VAULTIS (Visible, Accessible, Understandable, Linked, Trustworthy, Interoperable, and Secure) protocols, reinforcing data governance policies and risk mitigation strategies. This structured approach ensures that digital assets remain both accessible and secure against evolving cyber threats, allowing for controlled and compliant data management across different stakeholders.

To further enhance digital transformation efforts, the IDMP framework incorporates additional tools that aid in implementation, sustainability, and scalability. These tools include the Organizational Change Matrix, Risk Matrix, and Action Planning framework, each of which plays a critical role in guiding organizations through the challenges of digital transformation.

The Organizational Change Matrix assists organizations in assessing cultural and operational readiness for digital adoption, identifying potential barriers, change drivers, and necessary interventions to facilitate smooth transitions. By systematically analyzing stakeholder engagement, leadership support, and workforce adaptability, this tool enables organizations to strategically implement digital maturity models while fostering an environment conducive to long-term adoption and growth.

The Risk Matrix provides a structured method for identifying, assessing, and mitigating risks associated with digital transformation efforts. Given the complexities of technical data management, interoperability, and cybersecurity, this tool enables organizations to proactively address potential vulnerabilities, compliance risks, and integration challenges. Through risk prioritization and mitigation strategies, organizations can make informed decisions that minimize operational disruptions and sustainment risks during IDMP implementation.

Additionally, the Action Planning framework serves as a roadmap for execution, ensuring that digital transformation initiatives remain goal-oriented, measurable, and scalable. This structured approach supports milestone tracking, resource allocation, and performance evaluation, enabling organizations to sustain momentum and continuously improve digital capabilities over time. Action planning also helps to align IDMP implementation with broader DoD modernization objectives, ensuring that stakeholder coordination and policy compliance remain integral to digital maturity progress.

To further enhance secure data exchange, IDMP implements standardized, interoperable mechanisms that eliminate data fragmentation and security vulnerabilities. Through structured data-sharing protocols, the DoD and its partners

can streamline access to critical technical data, improve collaboration between defense agencies and contractors, and strengthen supply chain resilience.

IDMP Validation and Use Case Studies

The IDMP was validated through an acquisition research project presented at the Naval Postgraduate School's Acquisition Research Symposium. This study applied the IDMP/User Story Framework to assess readiness challenges in defense acquisition contexts. The National Defense Industrial Association (NDIA) nonprofit organization dedicated to promoting national security by facilitating collaboration among industry, government, and academia. The NDIA Manufacturing Division formed a Digital Manufacturing Working Group (DMWG) in 2024 to address digital transformation effects on manufacturing throughout the life cycle, with an emphasis on technology-enabled changes at the interface between industry and government. To determine member interests, the DMWG captured user stories expressed as "As a (insert role), I want to (insert use of digital data), to achieve (insert benefit)." The initial set of 80 user stories ranged from interests in IP rights and TDP uses, to configuration management, to digital twins for manufacturing and supply chains, and to data analytics for Industry 4.0. These user stories served as the foundation for the working group's application of the IDMP framework. The richness of these cases lies in their ability to highlight both commonalities and nuances, enabling the validation of the IDMP framework and the identification of targeted solutions. Workshop participants clarified user story boundaries, identified problems and mitigation strategies, and identified barriers to the widespread implementation of digital transformation ideas. The research demonstrated that the framework effectively links user-driven needs with structured digital maturity diagnostics, creating a bridge between high-level strategic intent and operational execution, creating a bridge between high-level strategic intent and operational execution.

Currently, the Manufacturing Readiness Level (MRL) Deskbook is being updated by the MRL Working Group to incorporate the IDMP/User Story Framework. This integration aligns IDMP with another enterprise level maturity model that focus on analog manufacturing process assessments, enabling its use in digital transformation initiatives and surge capacity planning across defense manufacturing ecosystems (Executive Office of the President, 2022).

Proposed Use Cases

NIWC Mission Readiness Model. While not yet implemented at the Naval Information Warfare Center (NIWC), the Mission Readiness Model represents an ideal framework for future collaboration. NIWC's focus on complex naval SoS missions, cyber-physical integration, and knowledge management aligns well with IDMP's mission-based and maturity-driven structure.

By applying IDMP variables and user stories, NIWC could simulate the readiness impacts of digital twin adoption, AI-driven operations, and kill web resilience. The Mission Readiness Model would enable NIWC to visualize digital and workforce gaps, evaluate trade-offs among operational decisions, and prioritize investments with greater transparency. This proposed use of IDMP and the Mission Readiness Model positions NIWC to enhance digital transformation while advancing its mission engineering objectives (Department of Defense, 2018).

NSRP/Shipbuilding Readiness. While not yet implemented in collaboration with the National Shipbuilding Research Program (NSRP) and HII-Newport News Shipyard, mission engineering and the IDMP/User Story Framework present promising tools to support shipbuilding readiness across the defense industrial base.

This proposed application would use user stories to uncover bottlenecks in talent acquisition, digital tool adoption, and supply chain alignment—critical to the success of capital shipbuilding programs. By integrating these insights into the CME Mission Readiness Model, stakeholders could simulate readiness scenarios, evaluate policy and infrastructure investments, and strengthen shipyard surge capacity in alignment with national security goals.

NATO ACT. NATO Allied Command Transformation (ACT) presents a strong opportunity to apply the IDMP/User Story Framework and the Mission Readiness Model to multinational readiness challenges. Given ACT's role in force development, training transformation, and multi-national interoperability, the application of mission engineering tools

such as IDMP can aid in identifying digital maturity gaps, capturing coalition-specific user stories, and tailoring readiness simulations across training and operational contexts.

This proposed application would allow ACT to align readiness planning with digital transformation priorities, while also addressing interoperability, scenario-based adaptation, and multinational decision support. Embedding the IDMP framework into ACT's planning and simulation environment could enhance strategic alignment and coalition effectiveness in joint training and operations (U.S. Department of Defense, 2022).

Anticipated Next Steps

The integration of the Integrated Digital Maturity Pathway (IDMP) and User Story Framework with mission readiness modeling represents a significant evolution in how the Department of Defense (DoD) evaluates and anticipates readiness across complex systems-of-systems (SoS). This approach enables transparent and contextualized readiness assessments by bridging the disconnect between static maturity models and the dynamic realities of operational demands. As IDMP is embedded into simulation-based environments, such as the Mission Readiness Decision Support Tool developed at Old Dominion University, it provides actionable data that supports cross-domain mission planning, surge capacity forecasting, and sustainment optimization. These capabilities are especially relevant in the face of contested logistics and the growing demand for rapid responsiveness across global theaters (Executive Office of the President, 2022).

Aligned with key directives such as the DoD Digital Engineering Strategy (Department of Defense, 2018) and the Mission Engineering Guide v2.0 (Office of the Under Secretary of Defense for Research and Engineering, 2023), IDMP ensures that digital modernization efforts remain policy-compliant and outcome-driven. The framework's architecture has also been informed by recent Executive Orders—namely EO 14299 on energy resilience and EO 14192 on procurement reform—which emphasize the need for scalable, mission-focused tools that support agile acquisition and resilient infrastructure (U.S. Department of Defense, 2025a; 2025b).

A defining strength of IDMP is its ability to be tailored across different DoD entities through the User Story Framework. This adaptability allows for localized implementation strategies that reflect specific operational environments, whether across Naval Warfare Centers, Air Force Materiel Command (AFMC) centers, shipyards involved in the National Shipbuilding Research Program (NSRP), or NATO Allied Command Transformation (ACT). By aligning organizational readiness with mission-specific needs, IDMP provides a flexible mechanism for scaling transformation while preserving mission relevance.

Crucially, IDMP does not replace existing maturity models like the Manufacturing Readiness Level (MRL) or the Acquisition Pathway Tool (APT); instead, it enhances them. Its ongoing incorporation into the updated MRL Deskbook by the MRL Working Group demonstrates its compatibility and value in adding granularity, contextual risk analysis, and mission impact layers to traditional assessment structures (Amason & McGrath, 2025).

Finally, coupling IDMP with advanced modeling and simulation tools supports human-in-the-loop decision-making by enabling predictive analytics and scenario-based planning. This integration empowers program managers, engineers, and acquisition leaders to proactively manage risk, model sustainment options, and visualize readiness outcomes—thus reinforcing the DoD's commitment to operational agility and mission assurance in contested and rapidly evolving environments.

CONCLUSIONS

This paper presents the Integrated Digital Maturity Pathway (IDMP) and User Story Framework as foundational elements in a coupled approach with the Mission Readiness Decision Support Tool developed by the Center for Mission Engineering (CME) at Old Dominion University. Together, these tools would enable the Department of Defense (DoD) to align digital transformation with operational outcomes, providing a structured yet flexible way to assess, plan, and improve readiness across systems-of-systems (SoS).

The IDMP framework serves as a diagnostic and planning instrument that captures stakeholder perspectives through user stories and maps them across five levels of maturity in infrastructure, workforce, data, and processes. When integrated with the Mission Engineering Tool, an interactive system dynamics model—IDMP inputs inform mission readiness simulations by representing real-world conditions, technology adoption rates, supply chain responsiveness, and workforce capabilities. This coupling allows leaders to evaluate mission readiness in dynamic, scenario-based environments and supports adaptive planning and surge capacity forecasting.

The paper also details how the IDMP framework is currently being incorporated into the revision of the Manufacturing Readiness Level (MRL) Deskbook by the MRL Working Group. This effort demonstrates how IDMP enhances legacy frameworks like MRL by providing greater granularity and direct mission alignment.

Finally, the paper explores the policy and strategic alignment of this integrated approach, including its relevance to executive orders on energy resilience and acquisition reform, and its applicability to prospective use cases across Naval Warfare Centers, AFMC centers, NATO ACT, and U.S. shipyards. The integration of IDMP with mission engineering tools offers a forward-leaning, data-driven model for achieving measurable, mission-oriented transformation across the defense ecosystem.

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