SYSTEMS ENGINEERING RESEARCH CENTER | AIRC ACQUISITION INNOVATION RESEARCH CENTER | SERC RESEARCH REVIEW 2026



Integrated Digital Maturity Pathway

WRT-2513

OUSW(R&E), Mission Capabilities (MC), Systems Engineering & Architecture (SE&A)

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Cleared for public release

OLD DOMINION UNIVERSITY

The Research Question

From Digital Maturity to Mission Readiness

SERC WRT-2513

Funded to explore how **AI and user stories** could improve digital maturity and readiness assessment.

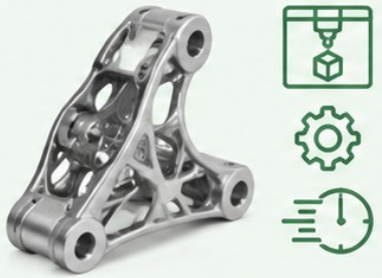
WRT-2513 began with a deceptively simple question:

Can AI-enabled analysis and stakeholder user stories improve how we assess digital maturity and readiness?

We started with **two real operational user stories** in digital manufacturing and digital engineering.

1 Rapid Lightweight Prototyping

How can digital manufacturing enable rapid, low-cost prototyping to accelerate development while managing risk and maintaining required performance?



2 Secure Design Disclosure

How can digital engineering support secure sharing of design information with industry and partners to enable collaboration while protecting sensitive data?



What we learned over the course of the research changed the question.

What the Research Revealed

Maturity asks:

How developed is the capability?

- Technology development
- Process maturity
- Manufacturing capability
- Digital tools and data
- Integration of components

Maturity

Describes development and capability status

≠

Readiness

Determines whether we can accomplish what is required

Readiness asks:

Can it accomplish what is required, under these conditions, with sufficient evidence?

- Operational usefulness
- Evidence of effectiveness
- Risk and constraints
- Human judgment and accountability
- Conditions for success

IDMP asks:
What has to be true before we are ready to act?

1 Rapid Lightweight Prototyping

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Two Original Operational User Stories

2 Secure Design Disclosure

How can digital engineering support secure sharing of design information with industry and partners to enable collaboration while protecting sensitive data?



Stakeholder reviews of both user stories repeatedly surfaced important factors **not contained in the original user story:**

- Assumptions
- Governance
- Decision Authority
- Evidence Requirements
- Organizational Relationships
- Constraints
- Measures of Success

These findings led to the development of Context eXtension —
an empirical research finding that organizational, governance, operational, decision, evidence, and success context must be explicitly considered to produce meaningful readiness analysis.

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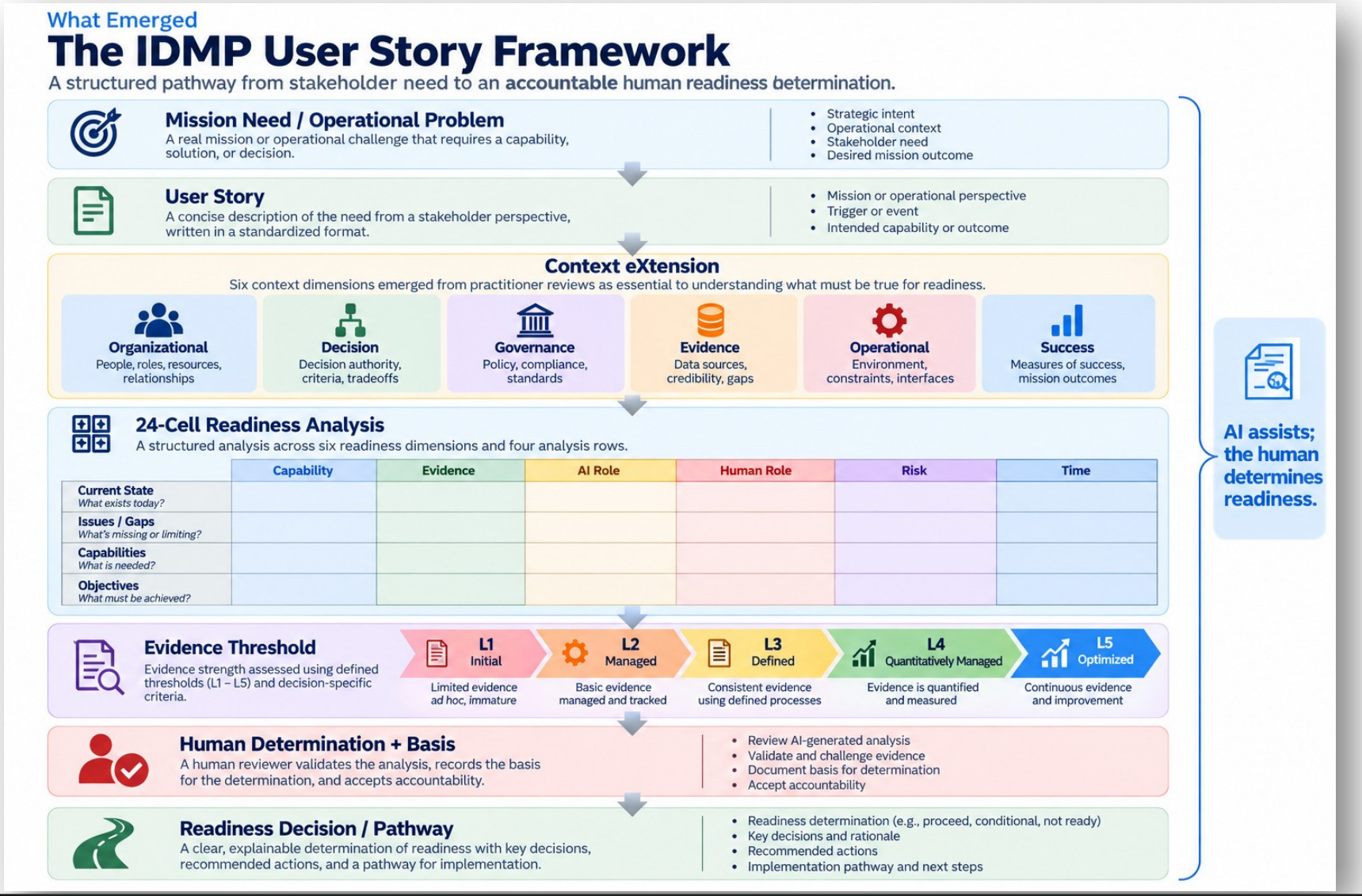

What Emerged
The IDMP User Story Framework
A structured pathway from stakeholder need to an accountable human readiness determination.
Mission Need / Operational Problem
A real mission or operational challenge that requires a capability, solution, or decision.
Strategic intent
Operational context
Stakeholder need
Desired mission outcome
User Story
A concise description of the need from a stakeholder perspective, written in a standardized format.
Mission or operational perspective
Trigger or event
Intended capability or outcome
Context eXtension
Six context dimensions emerged from practitioner reviews as essential to understanding what must be true for readiness.
Organizational
People, roles, resources, relationships
Decision
Decision authority, criteria, tradeoffs
Governance
Policy, compliance, standards
Evidence
Data sources, credibility, gaps
Operational
Environment, constraints, interfaces
Success
Measures of success, mission outcomes
24-Cell Readiness Analysis
A structured analysis across six readiness dimensions and four analysis rows.
Capability
Evidence
AI Role
Human Role
Risk
Time
Current State
What exists today?
Issues / Gaps
What's missing or limiting?
Capabilities
What is needed?
Objectives
What must be achieved?
Evidence Threshold
Evidence strength assessed using defined thresholds (L1 – L5) and decision-specific criteria.
L1 Initial
Limited evidence ad hoc, immature
L2 Managed
Basic evidence managed and tracked
L3 Defined
Consistent evidence using defined processes
L4 Quantitatively Managed
Evidence is quantified and measured
L5 Optimized
Continuous evidence and improvement
Human Determination + Basis
A human reviewer validates the analysis, records the basis for the determination, and accepts accountability.
Review AI-generated analysis
Validate and challenge evidence
Document basis for determination
Accept accountability
Readiness Decision / Pathway
A clear, explainable determination of readiness with key decisions, recommended actions, and a pathway for implementation.
Readiness determination (e.g., proceed, conditional, not ready)
Key decisions and rationale
Recommended actions
Implementation pathway and next steps
AI assists; the human determines readiness.


The Most Important Finding
Evidence + Human Accountability
AI can generate analysis. It cannot establish readiness by assertion.
Maturity is not evidence of readiness.
A higher maturity description (e.g., higher MRL, TRL, or IRL) does not mean the condition has been achieved or that the capability is ready to accomplish the intended mission outcome.
Evidence must be explicitly connected to the readiness determination.
Evidence must be relevant, credible, and sufficient for the specific decision.
Human accountability is foundational.
The human determines readiness, records the basis for the determination, and accepts accountability.
1
AI-Generated Analysis
AI retrieves, organizes, compares, identifies, and suggests.
Structured analysis drafted from user story, context, and knowledge sources.
2
Evidence
Assessment evidence gathered and linked to the analysis.
Relevant, credible, and decision-specific evidence (e.g., data, documentation, tests, assessments).
3
Evidence Threshold
Evidence strength assessed against defined thresholds.
L1 Initial
L2 Managed
L3 Defined
L4 Quantitatively Managed
L5 Optimized
4
Human Review
Subject matter experts review, validate, and challenge the analysis and evidence.
Human interpretation, critical questions, and professional judgment.
5
Basis for Determination
Human records the rationale for the readiness determination.
Explicit basis provides transparency, traceability, and auditability.
6
Readiness Decision
A clear, explainable determination of readiness with key decisions, recommended actions, and next steps.
Informs training, implementation, and the pathway to mission effect.
Human-AI Roles in the Framework
AI Role
Retrieve and organize knowledge
Compare information
Identify gaps and risks
Generate initial analysis
Suggest options
Human Role
Interpret results
Challenge assumptions
Validate evidence
Apply professional judgment
Determine readiness
Record the basis for determination
Accept accountability
AI assists; the human determines readiness.
A structured, evidence-grounded, human-in-the-loop process for accountable readiness decisions.

An Unexpected Test of Generalizability

The IDMP readiness construct encountered real-world problems beyond the original pilot context.

These were not WRT-2513 deliverables. They became opportunities to examine whether the research construct made sense outside the original pilot context.

1 Digital Manufacturing

Original research context (WRT-2513)



- Rapid Lightwefight Prototyping (US #1)
- Secure Design Disclosure (US #2)

- Digital manufacturing and digital engineering context
- Initial practitioner validation
- Revealed need for Context eXtension

2 Sustainment / Materiel Readiness



- Readiness degraders and risk analysis
- Evidence requirements
- Human basis for determinations
- Portfolio and §118 reporting considerations

3 Systems-of-Systems Modernization



- Relationships and dependencies
- Continuous evidence and certification
- Digital thread continuity
- Mission-thread traceability for evolving threats
- Practitioner workflow and adoption challenges (e.g., Nick LeGrand)

4 Human / Workforce Readiness



- Practitioner capability and adoption
- Learning readiness as a component of mission readiness
- Training and workflow design
- Human performance and organizational readiness

Evidence of Relevance Across Domains

The same core questions about evidence, context, risk, and human determination emerged across different mission areas, suggesting the construct has broader applicability.

Not Proof of Validation

These applications do not constitute full validation of the IDMP construct across all domains. They do, however, provide evidence that the underlying research questions recur in different mission contexts.

Consistent Analytical Architecture

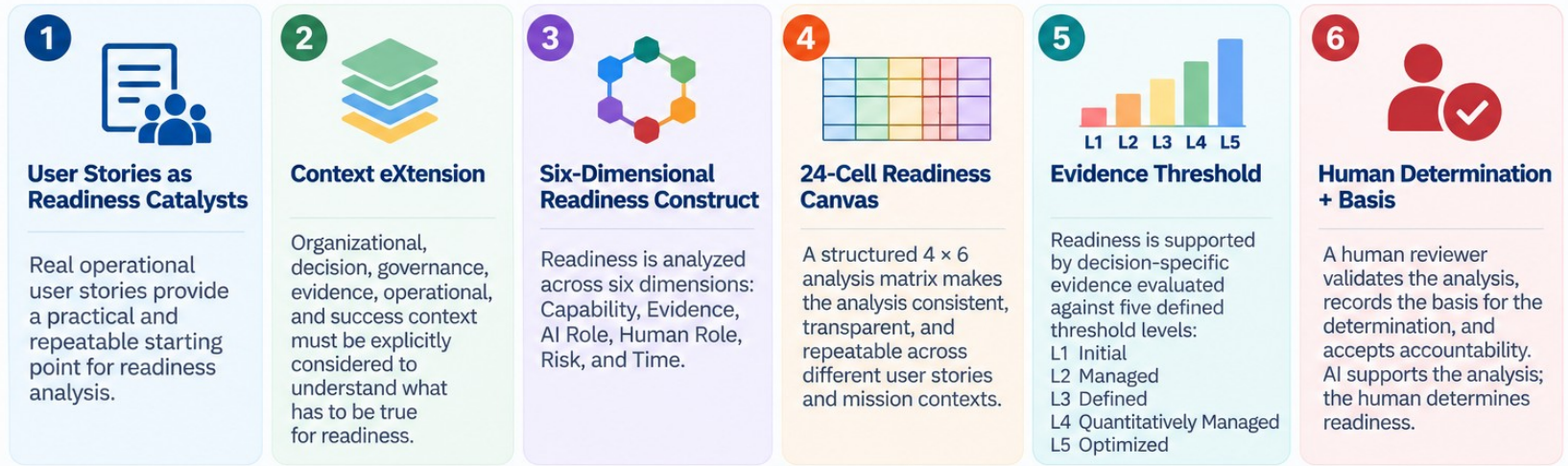
Guidance → Evidence → Analysis → Human Determination

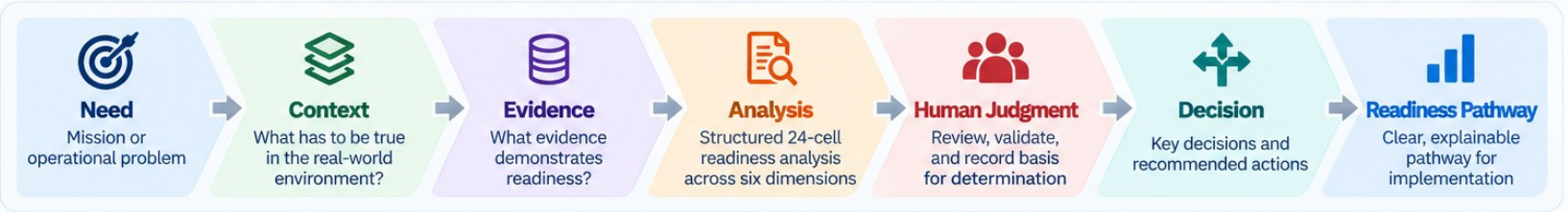
Preserving the human basis for the decision.

Different domains. The same fundamental question: What has to be true before we are ready to act?

What SERC WRT-2513 Actually Contributed

Research contributions from WRT-2513: Integrated Digital Maturity Pathway (IDMP)





WRT-2513 began as research into how AI could improve maturity assessment. It ended by revealing a larger problem: **maturity alone cannot tell a decision-maker whether something is ready.**

IDMP provides a structured pathway from stakeholder need, through context and evidence, to an accountable human readiness determination.

The follow-on applications are now giving us opportunities to test whether the construct generalizes.

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