



The MITRE AI Maturity Model and Organizational Assessment Tool Guide: **A Path to Successful AI Adoption**

Eric E. Bloedorn, Ph.D., Diane M. Kotras, Peter J. Schwartz, Ph.D., Clyneice Chaney, Clareice Chaney, and Jim Patsis
November 2023

TABLE OF CONTENTS

EXECUTIVE SUMMARY III

INTRODUCTION 1

 Purpose 1

 Target Audience 2

 Value Proposition 2

CHAPTER 1. AI MATURITY MODEL 3

CHAPTER 2. AI MATURITY MODEL PILLARS AND DIMENSIONS. 6

 PILLAR 1: ETHICAL, EQUITABLE, AND RESPONSIBLE USE. 6

 Responsible, Governable, and Contestable. 7

 Transparency 8

 Human-Centric, Fair, and Equitable 9

 PILLAR 2: STRATEGY AND RESOURCES. 10

 AI Strategic Plan. 10

 Partnerships. 11

 Governance 12

 PILLAR 3: ORGANIZATION 13

 Culture 13

 Organizational Structure. 14

 Workforce Development 15

 PILLAR 4: TECHNOLOGY ENABLERS 16

 AI Innovation 16

 Test and Evaluation 17

 AI Platforms 18

 PILLAR 5: DATA. 19

 Architecture 19

 Security and Privacy 20

 AI Data Governance 21

 Accessibility. 22

 PILLAR 6: PERFORMANCE AND APPLICATION. 23

 Usage and Adoption 23

 Solution Monitoring 24

 Robust and Reliable 25

 User Trust 26

CHAPTER 3. AI MATURITY ASSESSMENT PROCESS 27

 Prepare for the Assessment 27

 Identify the Assessment Team 27

 Answer the Questions in the AI AT 27

 Develop a Plan to Increase AI Maturity. 28

 Repeat the Assessment Periodically to Measure Progress 28

CHAPTER 4. MOVING TO DIFFERENT LEVELS 29

 Level 1 to 2 29

 Level 2 to 3 29

 Level 3 to 4 30

 Level 4 to 5 30

 Level 5. 30

 Maturing the Ethical, Equitable, and Responsible Use Pillar 31

 Maturing the Strategy and Resources Pillar 31

 Maturing the Organization Pillar 31

 Maturing the Technology Enablers Pillar 32

 Maturing the Data Pillar 32

 Maturing the Performance and Application Pillar 32

GLOSSARY OF TERMS 33

BIBLIOGRAPHY 36

APPENDIX A. MITRE AI MATURITY MODEL LEVELS. 37

APPENDIX B. AI MATURITY MODEL PRINTABLE DIAGRAM 38

EXECUTIVE SUMMARY

The MITRE Artificial Intelligence (AI) Maturity Model (MM) and corresponding organizational Assessment Tool (AT) are designed to measure an organization's progress in AI maturity as it becomes increasingly adept at incorporating AI technologies and best practices into its work environment. The AI MM and AT focus special attention on workforce and enterprise goals. Fundamental to effective and purposeful AI utilization is early buy-in from this workforce community. Whether at the executive, mid-level management, administrative, or junior staff level, AI is meant to be experiential with the goal that all levels of an organization embrace and implement it. Effective and compelling communication is critical to achieving this, as is senior leadership commitment. This demonstrates the value proposition of AI to all, regardless of their roles in the organization, and is fundamental to effecting cultural changes. It is also necessary for establishing a data-literate organization, which is critical to AI adoption maturity. Enhanced data literacy is expected to be a correlate to an organization's business value as a result of its prominence in over 80% of organizational data and analytics strategies [1]. Leadership plays a key role in this by being exemplars of effective and progressive AI adoption measures. They serve as champions for AI adoption with the potential to inspire and incentivize their workforce.

The MITRE AI MM can be viewed as a methodology to provide guidance and recommendations for building a foundation for successful AI implementation across an

organization. It was developed based on a systematic review of commercial AI MMs extant throughout the private sector as well as an assessment of both the Capability Maturity Model Integration (CMMI) appraisal processes developed by Carnegie Mellon University and the National Institute of Standards and Technology's AI Standards [2] [3]. The AI MM (Figure E1) is organized according to six pillars that industry considers major aspects of maturity that are key to successful AI adoption: Ethical, Equitable, and Responsible Use; Strategy and Resources; Organization; Technology Enablers; Data; and Performance and Application. Each pillar has either three or four dimensions (20 total) describing specific actions and activities that demonstrate advancing mastery of AI maturity for that dimension. These pillars and dimensions are assessed across five readiness levels that qualitatively describe different approaches to AI adoption. They are juxtaposed with five assessment levels intended to describe hierarchical and scalable progress throughout AI adoption: Initial, Adopted, Defined, Managed, and Optimized. These are depicted in Figure E1.

While the AI MM's pillars and readiness levels give structure and distinctness to the model, the 20 dimensions provide metrics by which an organization can qualitatively determine its progress in AI adoption. These dimensions provide a comprehensive framework for qualitatively guiding an organization's evaluation of AI adoption and mature

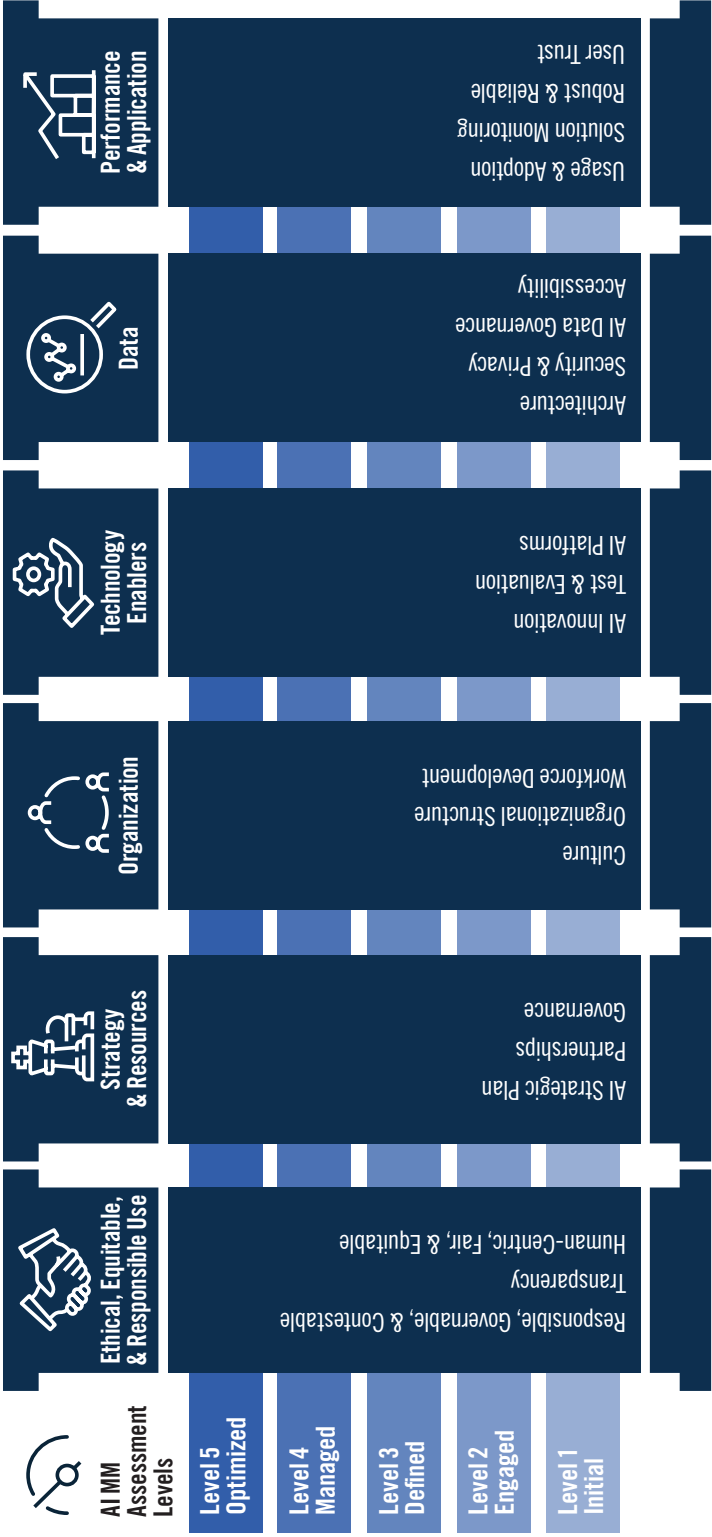


Figure E1. AI MM Overview: Pillars, Dimensions, and Assessment Levels

The MITRE AI Maturity Model and Organizational Assessment Tool Guide:

A Path to Successful AI Adoption

practices. Advancement to the next level in AI maturity is based on an organization's ability to have successfully achieved the benchmarks described at the previous level.

The target maturity level for an organization is a function of its mission and business practices, which influence the organization's determination of maturity that is appropriate for its needs.

The AI MM is accompanied by an AI AT that provides a means to qualitatively assess an organization's AI maturity and help determine if the critical resources, processes, communication, and technology are in place for success. The AI AT consists of a series of multiple-choice questions—one for each dimension of the AI MM. There is only one answer that can be selected for each question, and the chosen response determines the level of maturity within that dimension. When all questions are answered, the AI AT generates a score and graphical visualization of results.

Evidence used to determine a level of maturity is the final component of the model. Each piece of sample evidence is a potential source of information that can be used to help an organization understand if it has satisfied the

key aspects of a pillar's level. The maturity of a previous level should be attained in order to progress to the next level. This evidence will help an organization achieve realistic results from an assessment that can hold up to scrutiny. It is important to note that an organization establishes its own courses of action by targeting appropriate maturity levels specific to its enterprise and business practices. The highest maturity level in all dimensions may not be practicable or relevant.

The combined MITRE AI MM and AT provide a systematic and transformational path to success and a valuable means to guide organizations as they plan to adopt and implement a significant transformative technology. Both constructs allow for the development of a cohesive framework for understanding the evolution of AI adoption across an organization and a corresponding roadmap for accomplishment. Together, they allow an organization to chronicle its advancement in AI and plan for greater adoption success.

For additional information on the AI MM and AT, please contact us at: AIMM@mitre.org



INTRODUCTION

Artificial intelligence (AI) and machine learning (ML) are advanced technologies whose application can elevate and enhance the value proposition associated with business process improvements and strategic goals. Though many enterprises initiate AI projects, results often fall short of expectations, highlighting a need for organizations to prepare for AI initiatives. According to a major study released in 2020 by MIT Sloan Management Review, BCG GAMMA, and BCG Henderson Institute—despite increased investment and activity, only 10% of organizations are achieving significant financial benefits with AI [4]. The study highlights the often-underestimated role of mutual learning between humans and machines in generating value from AI. Those companies that draw on multiple types of interaction and feedback between humans and AI are six times more likely to amplify their success with AI. The study also highlights the following investments organizations make to maximize value:

- Building foundational capabilities—AI infrastructure, talent, and strategy—increases the likelihood of achieving significant benefits by 19%.
- Scaling AI across different use cases and going beyond automation increases the likelihood by another 18%.

- Achieving organizational learning with AI (drawing on multiple interaction modes between humans and machines) and building feedback loops between humans and AI increases that likelihood by another 34%.

As with other newly implemented technologies, careful management is required to maximize the efficiency and effectiveness of AI. Maturity models have been used successfully by organizations to determine readiness or to validate progress when effecting major changes. Maturity models are tools that define objective evaluation criteria to help organizations assess their current effectiveness and identify next steps to improve performance. Improvement is achieved by taking the actions necessary to grow processes and technologies within an organization to reach the next level of maturity. The MITRE AI Maturity Model (AI MM) can be viewed as a methodology to provide guidance and recommendations for enabling a foundation for successful AI implementations across an organization.

Purpose

The MITRE AI MM and its associated Organizational Assessment Tool (AT) provide a way to assess and guide an organization's readiness, adoption, and use of AI. The AI MM defines dimensions and levels of AI maturity and provides a foundation for an assessment utilizing

The MITRE AI Maturity Model and Organizational Assessment Tool Guide:

A Path to Successful AI Adoption

the AT. The AT operationalizes the maturity model to provide organizational awareness and insight into key areas necessary to support development and advancement of AI technologies. Based on the results of the AT, an organization will be able to understand its capabilities and competencies in areas key to successfully implementing AI solutions. The organization can then implement decisions regarding how to increase its level of AI maturity in the areas that need improvement and plan specific actions required to reach its goals.

Target Audience

The AI MM is intended for use by any organization interested in understanding its current AI adoption maturity and how to advance AI initiatives more successfully. The model is designed for organizations with the authority and autonomy to

direct change across their business enterprise; however, it can also be tailored for use by smaller organizational components and/or project teams seeking to enhance or improve their AI adoption approach or strategy.

Value Proposition

Operationalizing AI is not an easy task. Organizations may fail to anticipate problems or focus only on a single dimension. The combined MITRE AI MM and AT provide a systematic path to success and a valuable means to support organizations as they plan to implement a significant transformational technology. Together, both tools can provide the framework for facilitating AI adoption across an organization and define a roadmap for success.

CHAPTER 1.
AI MATURITY MODEL

The AI MM (Figure 1) is organized according to six pillars representing major aspects of maturity recognized by industry as key to successful AI adoption: Ethical, Equitable, and Responsible Use; Strategy and Resources; Organization; Technology Enablers; Data; and Performance and Application. Each pillar has either three or four dimensions (20 total) describing specific actions and activities that demonstrate advancing mastery of AI maturity for that dimension. The model defines five levels of maturity: Initial, Engaged, Defined, Managed, and Optimized. The AI MM assessment levels are summarized in Figure 1.

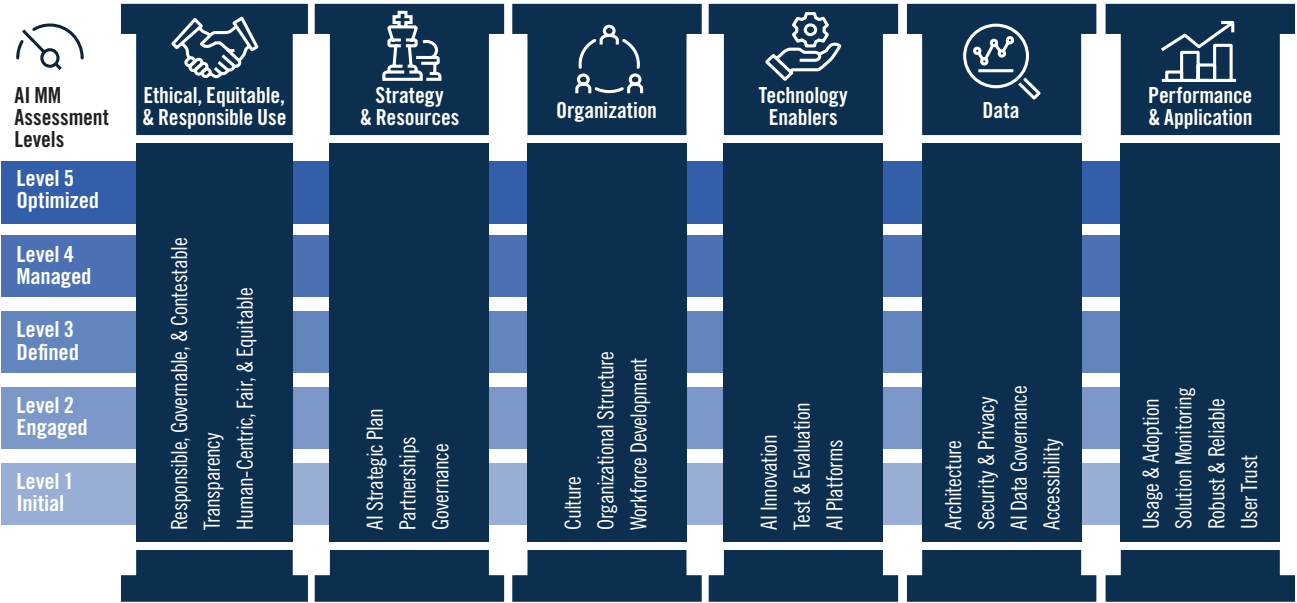


Figure 1. AI MM Overview: Pillars, Dimensions, and Assessment Levels

Level 1: Initial

- Nascent AI efforts lack senior management leadership, governance, strategy, and direction for key areas necessary for adoption.
- Project and organizational leadership are seeking to understand the definition of AI, its applicability across a broad category of scenarios and capabilities, and how others are using AI.
- No AI sponsor or champion is designated to mature AI capability and tools.
- AI exploration may be occurring; however, if individuals or teams do initiate AI pilot projects, enterprise-level AI strategies, processes, and technology are not present.

The MITRE AI Maturity Model and Organizational Assessment Tool Guide:

A Path to Successful AI Adoption

Level 1 projects may demonstrate one or more of the following characteristics:

- Project teams and leaders have little or no information about AI and insufficient training to coach employees through the path of AI development.
- AI projects are isolated, AI information is not centralized, and each new project “re-learns” the basic skills; there is no common approach to AI solution development and AI information.
- AI executive support is evident through funding authorization and resource allocation but lacks visible sponsorship and enthusiastic championship.

Level 2: Engaged

- There is a more organized approach to AI with emphasis on establishing champions, team building, governance, and strategies for successful adoption.
- AI pilots are initiated, and project-level processes, procedures, and technology are being defined; solutions are still decentralized.
- Cultural changes are being implemented, some successful initiatives are occurring, and evaluation of tools and standards is being considered.

Level 2 projects may demonstrate one or more of the following characteristics:

- The existing AI framework is rudimentary, with initial governance, policies, and practices beginning to be investigated and considered.
- A common approach for introducing AI methodology does not yet exist, so variations of AI project practices exist, with many different approaches applied sporadically throughout the organization; some projects may be designing AI solutions effectively, while others are not.

- Managers and supervisors do not have sufficient AI training to coach employees through changes anticipated.

Level 3: Defined

- Approved enterprise-wide approaches, resources, and processes are documented for AI projects, initiatives, and adoption efforts.
- AI governance, culture, strategies, and leadership are in place, empowering technology and leading to mature, defined internal policies that guide the use of tools, software, data, and procedures.
- Plans for the continued monitoring, retraining, and evaluation of AI models are under development.
- Senior leadership and AI sponsors take on a more active role in sponsoring change, but now a formal company-wide program exists to train project leaders, managers, or coaches on AI and govern AI solution development.

Level 3 AI projects may demonstrate one or more of the following characteristics:

- Standardized AI requirements and approaches are used by multiple projects; pockets of excellence in AI may co-exist with projects that have only minimal use.
- AI projects are aligned to enterprise-wide plans, technologies, and approaches with approved performance outcomes and allocated resources.
- There are elements of a rudimentary process to collect AI-specific data, measures, and metrics at an enterprise-wide level.

Level 4: Managed

- AI initiatives follow policy, governance, and technical standards. Outcomes and supporting metrics are collected, analyzed, and utilized to determine impact.
- Multiple projects exist and utilize standard technologies and approaches; outcomes are informed by supporting metrics.
- Leadership is making decisions by analyzing data against defined and captured metrics to determine enterprise-wide impact.

Level 4 AI projects may demonstrate one or more of the following characteristics:

- AI project teams are capturing metrics and documenting best practices and tools to achieve strategic outcomes.
- There is enterprise-wide AI data collection, training, and acknowledgment of AI and the importance of following defined standards for project success.
- Individuals, groups, or administrative positions are dedicated to supporting AI solution development efforts and building AI competence.
- AI adoption is high; project teams regularly use and apply AI tools, resources, standards, and practices.

Level 5: Optimized

- The enterprise produces high-level AI work by continually improving and innovating its AI projects.
- Leadership is updating policies and procedures by analyzing data against defined and captured metrics to optimize enterprise-wide impact.
- Strategically, operationally, and tactically, the enterprise has broken down silos to integrate data and resources more effectively, thereby realizing enhanced AI.

Level 5 AI projects may demonstrate one or more of the following characteristics:

- The organization produces high-level AI work by continually improving and innovating its AI projects.
- Leadership is updating policies and procedures by analyzing data against defined and captured metrics to optimize enterprise-wide impact.
- Project teams are capturing best practices and lessons learned to share with each other.
- Strategically, operationally, and tactically, the organization has broken down silos to integrate data and resources effectively, thereby realizing enhanced AI across its enterprise.

CHAPTER 2.

AI MATURITY MODEL PILLARS AND DIMENSIONS

The six pillars (Figure 2) represent major aspects of AI maturity. Each pillar has either three or four dimensions (20 total) describing specific actions and activities that demonstrate advancing mastery of AI maturity for that dimension.

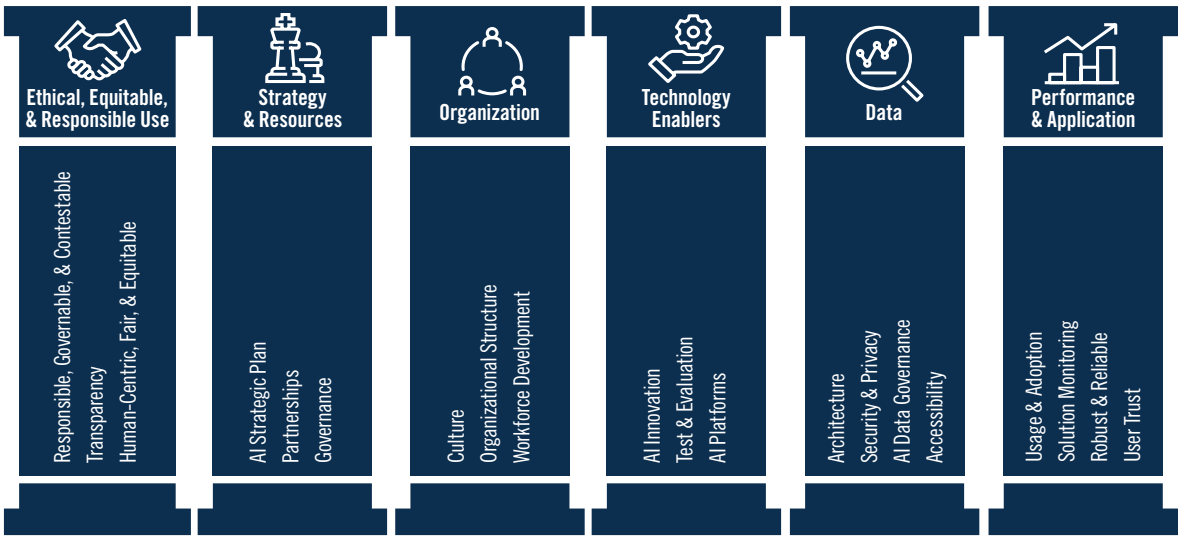


Figure 2. MITRE AI MM Pillars and Dimensions

PILLAR 1: ETHICAL, EQUITABLE, AND RESPONSIBLE USE

Objective: Establish expectations, requirements, and governance to mitigate risks of negative or unintended consequences of AI initiatives.

Performance Outcome: AI solutions are designed, evaluated, and monitored for effective, responsible, ethical, and equitable impacts on individuals and society.

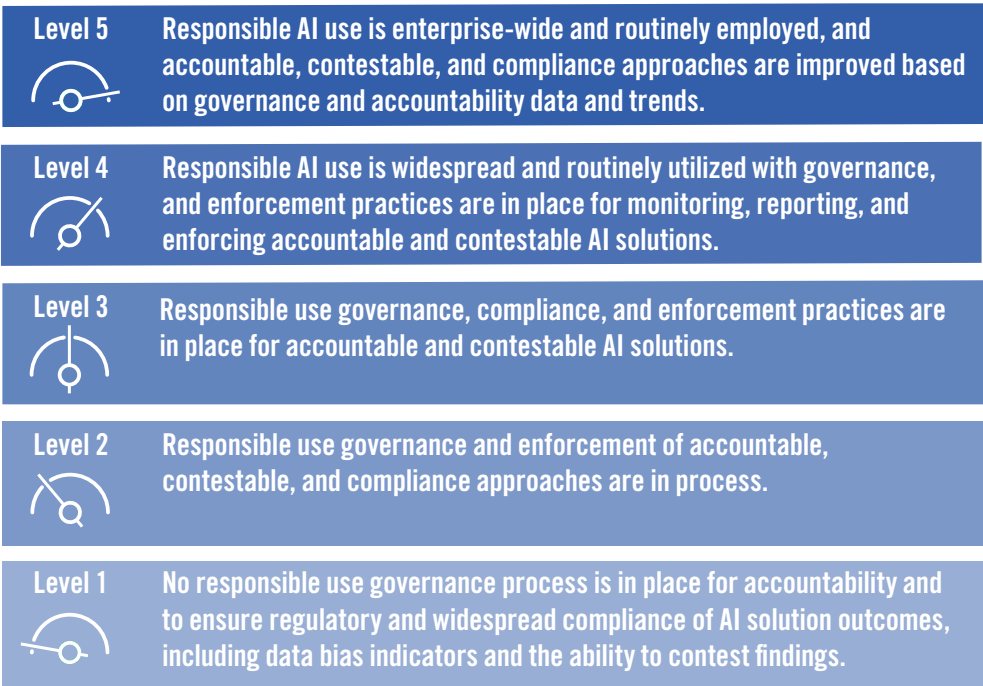
Key Performance Indicators: Percentage or number of AI solutions meeting expected responsible use requirements.

The Ethical, Equitable, and Responsible Use Pillar encompasses three dimensions:

1. Responsible, Governable, and Contestable
2. Transparency
3. Human-Centric, Fair, and Equitable

Responsible, Governable, and Contestable

Oversight and governance are in place to enforce regulatory and enterprise-wide compliance of AI system development and outcomes, including timely processes for accountability and to allow challenges to use and outputs.








Supporting Evidence:

- Framework for Easy Identification of Regulatory and Organizational Responsible Use Standards and Policies
- Policy/Framework for Identifying Decisions and Operations that Should Never Be Delegated to AI
- Process for Contesting/Questioning/Appealing AI Solution Outcomes, Bias, etc.
- Responsible Use Enforcement/Adherence and Accountability Processes, Data, or Algorithms Used in Developing AI Systems

Transparency

AI systems decisions, outputs, and outcomes are explainable, justifiable, and transparent to users and those impacted by them.






Level 5 	Enterprise-based AI approaches for transparency in AI solution outcomes and outputs are routinely utilized and improved through data-trend analysis and performance improvement.
Level 4 	Enterprise-based AI approaches that enforce transparency and justification of outcomes and outputs of AI solutions exist; compliance audits, checks and balances are monitored and measured.
Level 3 	An approved approach to trace, explain, and justify outputs and outcomes to AI solutions is in place and utilized. Ideally, it describes how to ensure that the people affected by the outcomes of AI-based decisions are included in the discussion about the design and use of AI from the beginning of the project and throughout its lifecycle.
Level 2 	A standardized methodology to trace, explain, justify, and make transparent AI solutions and outcomes is in process.
Level 1 	No standardized approaches exist that enable clear traceability for AI outputs/outcomes enabling transparency and the ability to explain and justify results.

Supporting Evidence:

- Technical Standards
- Blueprints
- Design Guidance for Transparency and Explainability
- Transparency Policies
- Standardized Approach to Deciding Who, What, When, Where, and How for Personnel, Hardware, Data, or Algorithms Used in Developing AI Systems
- Policy Designating Operations and Decisions that Should Never Be Delegated to AI

Human-Centric, Fair, and Equitable

AI systems are designed to accommodate human rights, diversity, and well-being through use of deliberate steps to avoid bias and unfair and/or unintended discrimination or inequitable consequences.

	Level 5 Enterprise-based AI policies, standards, and approaches that ensure ethical practices and adherence to responsible use guidelines, and to human rights assessments of fairness and equitability, are optimized using data-trend analysis and performance improvement.
	Level 4 Enterprise-based AI policies, standards, and approaches that ensure ethical practices and adherence to the responsible use policies and human rights assessments of fairness and equitability (qualitative metrics) are monitored, measured, and reported.
	Level 3 An approved set of AI policies, standards, and approaches that ensure responsible use, fairness, and equitability of AI solutions are defined, documented, and approved.
	Level 2 AI policies, standards, and approaches that ensure responsible use, fairness, and equitability of AI solutions are being considered.
	Level 1 No clear policies, standards, and approaches to ensure responsible use of AI through respect of human rights, diversity, well-being, fairness, and equitability.

Supporting Evidence:

- Responsible Use Policy
- Bias Evaluation Standards and Guidelines
- Data and Measures from Governance and Audits
- Bias Strategy and Evaluation Tools

PILLAR 2: STRATEGY AND RESOURCES

Objective: To ensure the availability of AI solution strategic plans governance model and needed resources.

Performance Outcomes: Short- and long-term strategies and governance entity are in place.

Key Performance Indicators: Plans for actual results are available to gauge progress on meeting AI and strategic and resource goals, partnership activity, and governance and audit results.

The Strategy and Resources Pillar encompasses three dimensions:

- 1. AI Strategic Plan
- 2. Partnerships
- 3. Governance

AI Strategic Plan

Formal documents/artifacts that support a plan for achieving defined AI mission, vision, policies, and standards.



Supporting Evidence:

- Organizational AI Strategy/Plan
- AI Communications Strategy
- AI Employee Surveys

Partnerships

AI partnerships between government, private enterprises, academic institutions, and/or federally funded research and development centers (FFRDCs) are available to collaborate with and ensure a variety of perspectives to represent different stakeholder populations while building responsible AI capabilities and competencies.

<div>Level 5</div> 	Collaborative partnerships within academia, industry, and government communities are improving outcomes, and there is a process in place for identifying, initiating, and executing new partnerships to improve AI initiatives.
<div>Level 4</div> 	Information from academic, industry, and agency partnerships is being applied to inform and enhance AI initiatives.
<div>Level 3</div> 	AI partnership(s) with industry, academia, or other agencies are in place. Ethical responsible-use practices are included in partnership agreements.
<div>Level 2</div> 	AI partnership(s) with industry, academia, or other agencies are being formed.
<div>Level 1</div> 	No AI partnership(s) with industry, academia, or other agencies exist.

Supporting Evidence:

- AI Strategy Partnership with Private Industry, Academia, and Government

The MITRE AI Maturity Model and Organizational Assessment Tool Guide:

A Path to Successful AI Adoption

Governance

AI governance structures, standardized processes, policies, and audits are available to promote conformance with the entity's ethics, regulations, and policies.

Level 5 	AI governance is actively engaged in improving AI solution development and utilization by re-evaluation of existing standards, processes, policies, and procedures.
Level 4 	AI governance is routinely carried out, and participation is representative of the organizational entity. Metrics are consistently collected and inform adherence to defined standards.
Level 3 	AI governance and processes are established, accountable executives are identified, and audits are in place and utilized.
Level 2 	AI governance and processes to guide and oversee how AI is developed and used are initiated.
Level 1 	No AI governance structure, audits, processes, and standards are in place.

Supporting Evidence:

- AI Data, Responsible Use, and Audit Results
- Governance Meeting Records
- Published (Multi-Channel) AI Governance Results and Performance Data (Fairness, Privacy, and Security)
- Legal and Regulatory Communications
- Expert Review Board

PILLAR 3: ORGANIZATION

Objective: Ensure AI that is embraced at an enterprise level includes culture, roles and responsibilities, and workforce development to enable effective AI solutions.

Performance Outcomes: AI-centric culture, structure, and workforce development plans enable AI solution success.

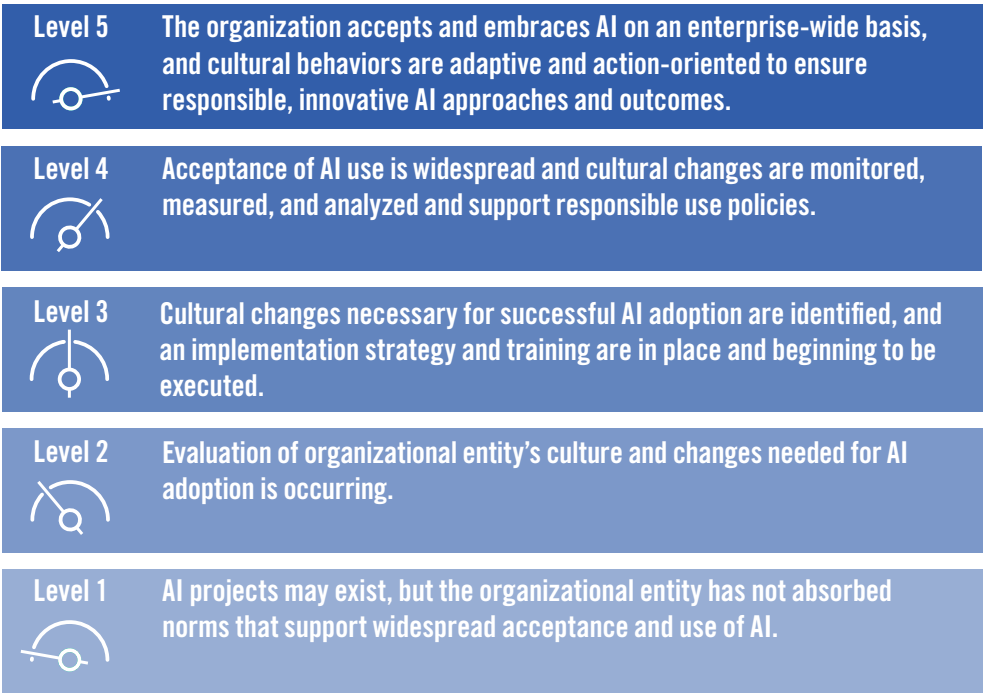
Key Performance Indicators: AI culture and workforce development measures reflect alignment with enterprise/program goals and targets.

The Organization Pillar contains three dimensions:

- 1. Culture
- 2. Organizational Structure
- 3. Workforce Development

Culture

The organizational norms and values support an adaptive and risk-tolerant culture that is ready to accept the types of changes that AI might entail.



Supporting Evidence:

- Enterprise AI Cultural Strategy/Plan
- AI Employee Surveys
- Address How Norms such as Responsible Use, Beliefs, and Values Will Be Transmitted

Organizational Structure

AI structures, roles, and processes are defined, documented, and executed within the enterprise.






	Level 5 Enterprise-based AI structures, roles, and processes are defined, documented, and measured. Metrics are utilized to improve activities and implement best practices.
	Level 4 Enterprise-based AI structures, roles, and processes are enabled, and resources are applied to monitor and measure performance.
	Level 3 AI structures, roles, and processes are defined for the entity.
	Level 2 Enterprise-based AI structures are rudimentary but functional. Roles and processes are present but limited in definition and documentation.
	Level 1 The organizational entity does not have AI-specific structures, roles, and processes defined and documented.

Supporting Evidence:

- AI Organizational Strategy Objectives
- Published AI Roles and Defined Responsibilities
- Published AI Standard Operating Procedures (SOPs)
- AI/ML Organizational Chart, AI Cultural Strategy/Plan (How Norms such as Responsible Use, Beliefs, and Values Will Be Transmitted)
- AI Employee Surveys

Workforce Development

Processes are in place for diverse AI teams’ training, recruitment, and career impact awareness to develop and reshape an AI organizational workforce.

<div>Level 5</div> 	Enterprise-based AI structures, roles, and processes are defined, documented, and measured. Metrics are utilized to improve activities and implement best practices.
<div>Level 4</div> 	An AI workforce development plan is meeting current expectations and capturing metrics to define current and future workforce needs within an expanding portfolio of initiatives.
<div>Level 3</div> 	An AI workforce development plan is in place and implemented to impact resource needs within existing initiatives. Workshops and certifications required for team members are occurring.
<div>Level 2</div> 	An AI workforce development plan is in process.
<div>Level 1</div> 	No solution or workforce plan is in place for AI workforce development.

Supporting Evidence:

- AI Workforce Strategy
- Displacement Strategy/Guidance
- AI Training Plans and Results
- AI Workforce Data

PILLAR 4: TECHNOLOGY ENABLERS

Objective: Ensure the establishment of technology enablers, including innovation, testing, and infrastructure to produce AI solutions.

Performance Outcomes: Availability of effective AI infrastructure, testing methods, and innovation activities enable improved AI solutions.

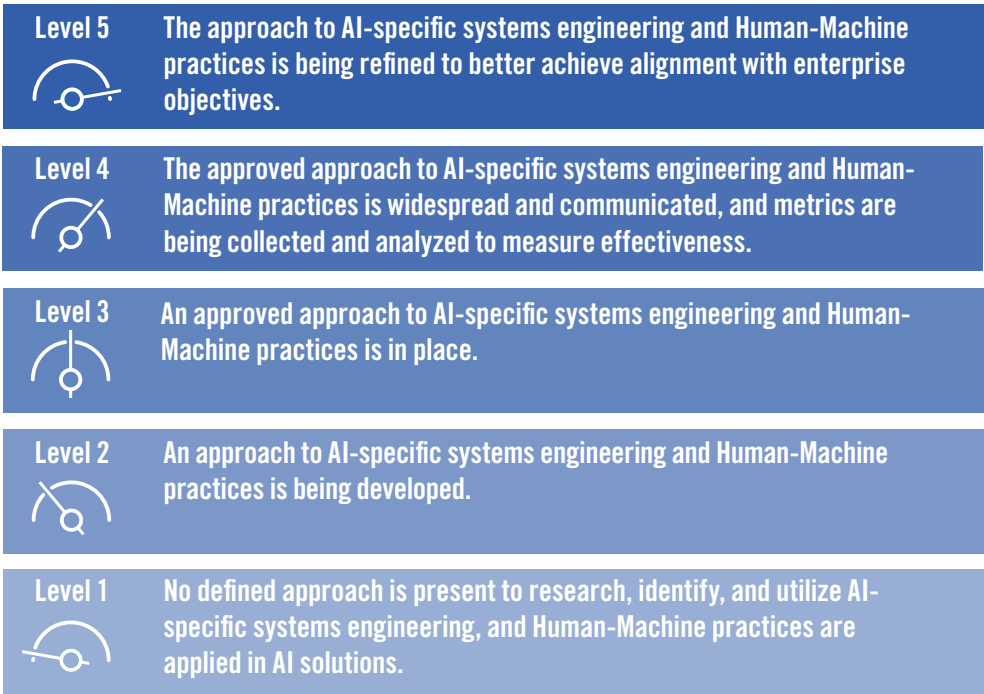
Key Performance Indicators: Indicators include measures of innovation activities, implementation and utilization of testing and evaluation (T&E) techniques, and tool platform capability.

The Technology Enablers Pillar has three dimensions:

- 1. AI Innovation
- 2. Test and Evaluation
- 3. AI Platforms

AI Innovation

Process whereby research, systems engineering, and human-machine design principles and best practices integrate AI into business operations.



Supporting Evidence:

- Innovation Strategy
- AI R&D Project Plans
- AI Systems Engineering Approaches
- Human-Machine Design Principles
- AI Initiatives Documents
- AI Initiative/Innovation Data

Test and Evaluation (T&E)

AI-specific T&E standards ensure that solution requirements are verified and validated to meet all identified requirements.

<div>Level 5</div> <div></div>	AI T&E standards and processes are enterprise-based; improvement through continual testing and development trend analysis is facilitating product solution outcomes.
<div>Level 4</div> <div></div>	AI programs have integrated AI T&E standards into acquisition and operations processes; AI solution test results are audited; measures are collected to ensure solutions meet quality targets and acceptance criteria.
<div>Level 3</div> <div></div>	AI-specialized test approaches, such as data sensitivity and residual analysis, benchmark models, discrimination testing, and security audits, are defined and standardized.
<div>Level 2</div> <div></div>	AI-specific techniques, such as data processing, optimization, training code unit tests, AI-specific integration strategies, basic model debugging, bias, and human-centric validation techniques, are being utilized.
<div>Level 1</div> <div></div>	No guidelines and approaches for AI-specific T&E standards are in place. AI solutions are tested using traditional unit, integration, security, etc., approaches.

Supporting Evidence:

- AI Test Strategies including Specific Test Standards, Guidebooks, SOPs, and Tools
- Results including Verification of Responsible Use, Security, Privacy, and Reliability
- Training Data
- Test Tools
- Bias Evaluation

AI Platforms

A defined set of enabling architecture, standards, computer networking, hardware, and software tools are designed to support development, integration, and operation of AI solutions.



Supporting Evidence:

- Architecture Design and Standards
- AI Tools/Platform Strategy and Contracts
- AI Architecture and Development and Test Platform
- Access Logs

PILLAR 5: DATA

Objective: Ensure that AI initiatives have the needed data for effective and successful implementation.

Performance Outcomes: Data is available, accessible, and secure for the development and operation of AI capabilities.

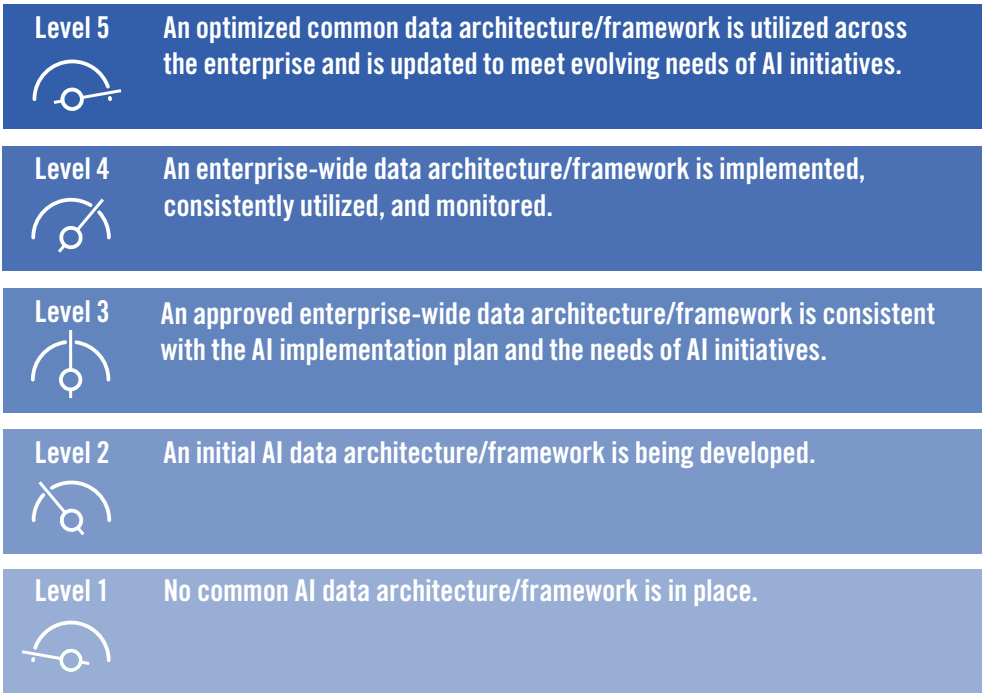
Key Performance Indicators: Indicators are measures for AI data security, volume, governance, accessibility, variety, velocity, and veracity.

The Data Pillar has four dimensions:

- 1. Architecture
- 2. Security and Privacy
- 3. AI Data Governance
- 4. Accessibility

Architecture

Process of ingesting, storing, organizing, and maintaining the data created and collected by an organization, including the lexicon and ontology.



Supporting Evidence:

- Documentation
- Data Architecture Enablement Data

Security and Privacy

Protection of privacy rights and data security rights for AI is embedded and upheld by individuals designing, using, and overseeing AI systems to control the safety, specificity, and exchange of personal digital information.

<div>Level 5</div> 	Enterprise-wide, AI-specific privacy and data security rights, approaches, and standards for individual control of safety, specificity, and exchange of digital data are improved and optimized based upon data trends.
<div>Level 4</div> 	Enterprise-wide, AI-specific privacy and data security rights, approaches, and standards for individual control of safety, specificity, and exchange of digital information are managed and monitored.
<div>Level 3</div> 	AI-specific privacy and data security rights, approaches, and standards defined and approved for individual control of safety, specificity, and exchange of digital information.
<div>Level 2</div> 	AI-specific privacy and data security rights, approaches, and standards for individual control of safety, specificity, and exchange of digital information.
<div>Level 1</div> 	No AI-specific privacy and data security rights, approaches, and standards are in place for individual security, control, safety, and specificity in exchange for digital information.

Supporting Evidence:

- AI Shared Data Security Risk and Mitigation Documentation
- AI Security and Risk Monitoring Data

AI Data Governance

Process of managing AI data performance and compliance to guard against data bias and ensure availability, usability, and integrity of data in AI systems.






	Level 5 AI governance is actively engaged in improving AI solution development and utilization by re-evaluation of existing standards, processes, policies, and procedures.
	Level 4 AI governance is routinely carried out, and participation is representative of the organizational entity. Metrics are consistently collected and inform adherence to defined standards.
	Level 3 AI governance and processes are established, accountable executives are identified, and audits are in place and utilized.
	Level 2 AI governance and processes to guide and oversee how AI is developed and used are initiated.
	Level 1 No AI governance structure, audits, processes, and standards are in place.

Supporting Evidence:

- Data Governance Charter and SOPs
- AI Data Governance Entity
- AI Data Audit Results
- AI Data Standards Checklists
- AI Data Quality Check Standards and Process

Accessibility

A systematic approach and structure to address the challenges, legal agreements, and requirements needed for managing trusted and secure data sharing both internally and externally.

	Level 5 An enterprise-wide data-sharing service framework and agreements are improved from collected data analytics and best practices.
	Level 4 A data-sharing framework and agreements are routinely used and verified by metrics to support consistency in data usage.
	Level 3 An approved data-sharing framework and agreements are in place that provide the data availability, accessibility, and quality needed to support AI.
	Level 2 A data-sharing framework is in process to provide common data-sharing agreements and facilitate data cataloging decoupling (freeing data from applications) and eliminating silos.
	Level 1 No data-sharing service framework or agreement is in place.

Supporting Evidence:

- Data Sharing Framework, SOPs, Standards, Terms and Conditions
- Data Standards Legal Agreements
- Data Sharing Framework Results, Automated Tool

PILLAR 6: PERFORMANCE AND APPLICATION

Objective: Ensure the effective and efficient development, deployment, operation, and maintenance of AI-enabled capabilities.

Performance Outcomes: AI solutions are deployed and monitored to meet intended use.

Key Performance Indicators: Deployment, operation, and monitoring capabilities/measures are available as indicators of effective solution usage and performance.

The Performance and Application Pillar has four dimensions:

- 1. Usage and Adoption
- 2. Solution Monitoring
- 3. Robust and Reliable
- 4. User Trust

Usage and Adoption

Identification and documentation of AI business use cases and the application of integrated solutions and processes into workflows result in realized strategic outcomes.








Supporting Evidence:

- AI Business Case Documentation
- AI Business Case Data
- AI Stakeholder Assessment Data (i.e., Who Is Affected, Possible Impact)
- Information Concerning Solutions General Logic or Functioning

Solution Monitoring

A combination of tools and processes that monitor deployed AI solutions to detect any changes in performance, fairness, security, or user trust over time.






<div>Level 5</div> 	Data from post-deployment AI performance anomalies are collected and support continuous improvements of enterprise-wide monitoring, evaluating, and responding activities.
<div>Level 4</div> 	Post-deployment AI initiatives are monitoring results and using performance anomaly results to direct corrective actions to improve outcomes.
<div>Level 3</div> 	A systematic approach and process for monitoring, evaluating, and responding are defined to monitor AI system outputs for inaccuracy, instability, discrimination, leakage of private data, and security vulnerabilities.
<div>Level 2</div> 	AI business use cases and AI solution specific monitoring techniques, such as model decay, fairness, security, and anomaly detection, are in process.
<div>Level 1</div> 	No systematic approach and process are available for monitoring, evaluating, and responding to post-deployment AI performance anomalies and issues.

Supporting Evidence:

- AI Security Documentation
- AI Security Data
- AI Solution Monitoring Results
- AI Model Governance

Robust and Reliable

AI systems are well defined, designed, and tested across the entire lifecycle—including operations—to ensure that they execute in accordance with intended purpose, avoid failures and malfunctions, and meet required quality parameters.






	Level 5 Data from post-deployment AI performance anomalies are collected and support continuous improvements of enterprise-wide monitoring, evaluating, and responding activities.
	Level 4 Post-deployment AI initiatives are monitoring results and using performance anomaly results to direct corrective actions to improve outcomes.
	Level 3 Tested and defined approaches for assuring robust and reliable AI solutions are available and utilized. Test data results and post-deployment monitoring measures are being considered.
	Level 2 AI-specific reliability and robustness approach, models, etc., are being evaluated and tested for viability in determining that AI solutions meet quality requirements and intended use.
	Level 1 No AI-specific reliability and robustness standards/approaches are in place to ensure solutions meet quality requirements and intended use.

Supporting Evidence:

- AI Robustness and Reliability Methodologies, Practices, and Standards

User Trust

Repeatability, traceability, transparency, and explainability are supported by due diligence processes, standards, and techniques to design, measure, and calibrate AI solutions to promote appropriate levels of trust.

	Level 5 Due diligence processes, techniques, and standards are being applied to AI initiatives, and are being improved based on quantitative analysis of incidents.
	Level 4 Due diligence processes, techniques, and standards are present at an enterprise level, and AI initiatives are actively monitoring trust metrics.
	Level 3 Due diligence processes, techniques, standards, and communication mechanisms are defined and approved to measure trust and detect, evaluate, and correct miscalibrations.
	Level 2 Due diligence processes, techniques, and standards are being developed to measure, trust and detect, evaluate, as well as correct miscalibrations and enable stakeholder communication.
	Level 1 No systematic due diligence processes, techniques, and standards are in place to measure and calibrate user trust in AI systems.

Supporting Evidence:

- Communication Efforts (Transparency, Interpretability, Explainability, Contesting, Due Diligence Information)
- AI Due Diligence Process, Standards, and Metrics
- AI Reliability and Trust Metric Data

CHAPTER 3.

AI MATURITY ASSESSMENT PROCESS

The AI MM is accompanied by an AI Assessment Tool (AT) that provides a means to qualitatively assess an organization's AI maturity and help determine if the critical resources, processes, and technology are in place for success. The AI AT consists of 20 multiple-choice questions—one for each dimension of the AI MM. There is only one answer that can be selected for each question, and the chosen response determines the level of maturity within that dimension. As the questions are answered, the AI AT generates a score and graphical visualization of results. The steps to conduct an assessment are summarized below.

Assessment Steps

1. Prepare for the assessment.
2. Identify the assessment team.
3. Answer the questions in the AI AT.
4. Develop a plan to increase AI maturity.
5. Repeat the assessment periodically to measure progress.

Prepare for the Assessment

To assess an organization's AI maturity, begin by preparing for the assessment. Review the AI MM so you are familiar with the dimensions of the model and how the levels are defined. Next, define the assessment scope, including the breadth of the entity to be assessed (which agency, department, project, etc.), as well as which pillars or dimensions should be the focus of the assessment. Then identify any information that could help inform assessment responses, such as AI use cases or relevant strategic documents.

Identify the Assessment Team

Next, identify the assessment team and gather any supporting evidence. Select personnel with the necessary knowledge to answer the AI AT questions that fall within the defined assessment scope. Cross-functional teams that represent the breadth of the dimensions to be assessed are recommended; however, the assessment can be performed by a single knowledgeable individual, particularly if the entity to be assessed is small, such as a single project. It is also important to designate an assessment team lead who will have the authority to make a final determination of the maturity level for each dimension. Finally, have the members of the assessment team gather any relevant information within their area of expertise; refer to the supporting evidence recommendations documented in this guidebook for each dimension.

Answer the Questions in the AI AT

Now the team can perform the AI maturity assessment. Begin by identifying scope of the assessment—which level of the organization, or which specific collection of business units, will be assessed. This should be recorded along with the date of the assessment and who comprised the assessment team. Read each question, consider the evidence gathered by the assessment team, and record the evidence and any related comments; details recorded in the comments can often be very helpful when developing a plan to increase AI maturity. Debate the responses and have the assessment team lead decide the final response.

The assessment team might find that the agency already has documents or processes in place related to a given dimension, but they are defined relative to conventional software and not AI. It is important to consider that the underlying assumptions of AI are different from those of conventional software, so processes developed for conventional software may need to be adjusted for AI.

For example, an agency might already be using a well-defined Data Security policy, but if that policy has not been updated in the context of AI, it might ignore new types of vulnerabilities introduced by AI, such as adversarial machine learning. The assessment team should therefore interpret each question in the AI AT within the specific context of AI, not just conventional software.

It is common for different business units within an organizational entity to have different levels of AI maturity, especially for larger types of organizations such as agencies. Responses to questions in the AI AT should be relative to the entire entity at the level that was identified in the assessment scope. When assessing a larger organization, first identify the business units that are relevant to a given dimension. In some cases, there may be several business units involved; in this case, use the lowest maturity level across the relevant business units since everyone across the agency has achieved at least that level. In other cases, one specialized unit is designated to perform a function for the entire organization. For example, an agency might include several different teams that all develop AI capabilities, but a single team that oversees Test & Evaluation for all of them. As long as it performs the service for anyone across the enterprise, the maturity level of that specialized unit can serve as the maturity level for the entire entity.

It is often helpful to review the initial assessment once complete to ensure that the responses are accurate. If the assessment team meets over a series of sessions to perform the assessment, new information might be discovered, or new team

members might join, bringing new perspectives. The assessment team should also reach out to others across the enterprise to gather additional evidence as needed to achieve consensus.

Develop a Plan to Increase AI Maturity

Based on the assessment, the agency can begin to plan and execute a strategy to grow AI maturity, using the AI MM for guidance. Agency leadership can identify the dimensions of the AI MM that require attention and define a long-term, steady-state maturity level target for each one. Leverage the differences between current and targeted levels of AI maturity (Chapter 2) and guidance for movement between levels (Chapter 4) to inform specific next steps. Assess the level of effort associated with next steps and dependencies between them to develop a budget and timeline.

Repeat the Assessment Periodically to Measure Progress

Plan to repeat the AI maturity assessment process periodically during execution to evaluate progress and adjust course if necessary. Fully reaching the target levels of AI maturity could take years, especially for larger organizations, so an assessment every six to 12 months is likely sufficient in most cases. Continuously update the entity's priorities based on the results of each periodic assessment. As maturity increases in certain dimensions, it is likely that other dimensions become the limiting factor, now making them a higher priority.

CHAPTER 4.

MOVING TO DIFFERENT LEVELS

The results of the AT can tell you where your organization stands today with respect to AI maturity. To develop a plan to increase AI maturity, the differences between levels in the AI MM can indicate what steps are needed to graduate from one level to the next. For each maturity level, this chapter provides a summary of information key to identifying the actions required to reach the next maturity level. Additionally, it provides guidance that is tailored to each pillar of the AI MM.

Level 1 to 2

Movement from Level 1 to Level 2 may take an organization relatively more investment than anticipated from most of the other levels, due to the need to formulate and/or revise policies, procedures, and organizational structure and to build competency. Achieving Level 2 requires a minimum of the following: rudimentary leadership, governance, roadmaps, policy/procedures, and approaches in place, even if modifications are ongoing.

The key objective of achieving Level 2 is a more consistent, less ad hoc approach to AI, which includes people, policies, tools, resources, and governance working toward applicable goals. Steps for building enterprise-based AI competency from Level 1 to Level 2 may include the following activities:

- Identify and document gaps.
- Create a roadmap for moving forward.
- Ensure that a budget is in place to fund AI competency and capacity initiatives.
- Engage consultants.
- Establish and communicate roles, responsibilities, and best practices.

- Focus on both the technical side of AI and culture, ethics, needed organizational changes, and visible leadership support.
- Draft policy, procedures, and governance.
- Obtain and provide applicable training.
- Establish and utilize AI communication plans.
- Establish/utilize an AI-approval process to increase project visibility and encourage use of emerging policies and standards.
- Apply AI solutions/resources to isolated projects and identify ways to help those that are currently experiencing resistance to change.

Level 2 to 3

Movement from Level 2 to Level 3 is a logical follow-on of the capability, capacity, and competency development efforts achieved in Level 2 that have resulted in an established AI framework, including visible leadership, well-communicated policies and procedures, and a working governance structure leading to improved consistency in use of AI tools, resources, and standards.

Enterprise efforts are expended toward rolling out tools, resources, and standards expected by leadership when engaging in AI solution development. The key objectives of achieving Level 3 are approved, well-communicated, and well-utilized policies, standards, and procedures; more consistent use of capabilities; and an increase in enterprise-based AI competencies. Steps to build competency from Level 2 to Level 3 may include the following activities:

- Identify assessment gaps and determine an action plan.
- Enlist executive support for applying AI tools on every project and for building AI competencies at every level in the organizational entity.

The MITRE AI Maturity Model and Organizational Assessment Tool Guide:

A Path to Successful AI Adoption

- Select a common methodology that can have widespread use and begin acquiring the tools and training necessary to implement it.
- Collect and utilize data from Level 2 activities to create a roadmap for moving forward.
- Ensure that a budget is in place to fund AI competency and capacity activities.
- Communicate plans, policies, and procedures.
- Provide training on all approved AI policy, tools, practices, and standards.
- Establish potential measures and metrics to assess progress.

Level 3 to 4

Movement from Level 3 to Level 4 is driven by approved enterprise-based or project practices that are well known, resulting in consistent, well-documented, and well-used approaches for accomplishing AI within a known framework of tools, resources, and standards. The key outcome anticipated in the shift to Level 4 is collection and use of data, measures, and metrics to ensure achievement of AI strategic goals and consistency in applying AI best practices and standards. Potential steps to build AI competency from Level 3 to Level 4 may include the following activities:

- Enterprise efforts are expended toward ensuring that approved tools, resources, and standards are applied consistently when engaging in AI solution development.
- Senior leadership and AI sponsors take on a more active role in sponsoring change and consider this role part of their responsibilities.
- Data is collected, monitored, and used to manage AI development, usage, and implementation effectively.

Level 4 to 5

Movement from Level 4 to Level 5 is dependent upon optimization of AI development and management across the enterprise. The key objective of Level 5 is an enterprise-wide process for AI optimized to the extent that continuous improvement is possible. Potential steps for building Level 5 competency could include the following activities:

- Enterprise-based AI infrastructure and governance is in place and consistently working.
- Formal positions/staff are responsible for AI deployment, training, and improvement of AI competencies and adoption.
- Steps are in place to correct noncompliance and analyze gaps in areas that are not applying the selected methodology.

Level 5

Level 5 AI projects may demonstrate one or more of the following characteristics:

- AI maturity and competency is a common skill set.
- Effective AI is an explicitly stated strategic goal, and executives have made this a priority.
- Employees across the enterprise understand AI, why it is important, and how they play a role in making it successful.
- Standards, practices, and governance are second nature—so commonplace that they are nearly inseparable from initiatives.
- Managers and project teams routinely use AI strategies in the performance of work.
- The organization gathers data to enable continuous improvements to methodologies, tools, and training in the applicable AI dimensions.

- Extensive training exists at all levels of the organization.
- AI standards, policies, and practices are integrated into project management and are viewed as standard practice.

Maturing the Ethical, Equitable, and Responsible Use Pillar

Maturing the Responsible Use Pillar from Level 1 to Level 2 would include visible plans to develop standards, standard operating procedures (SOPs), governance, and accountability activities for each of the key dimension areas. Organizations must understand and define what the concepts of bias/fairness, accountability/remediation, transparency, and interpretability/explainable mean in terms of their organizations and missions. There must be an awareness and understanding of AI's impact on second- and third-order consequences such as human-to-human behavior, environment, civil rights, democracy, societal well-being, automation labor trends, and job loss. This awareness and understanding must be translated in clear policies and defined approaches to ensure that ethics, equality, and responsible use consider the impact on human beings and their rights.

Responsible Use at Level 3 has clearly defined and rolled out responsible use standards, SOPs, governance and accountability activities, evidence of use of responsible use standards through defined measures of achievement, and rules and standards for effective human control over decisions. Organizations/programs will have identified the types of operations that are never delegated to AI solutions, trained all personnel on governance and ethics, established responsible use audit guidelines, and defined basic qualitative metrics. Levels 4 and 5 build upon previous foundations, adding monitoring, trend analysis, and opportunities for continued improvement.

Maturing the Strategy and Resources Pillar

Maturing the Strategy and Resources Pillar from the initial state where a project or entity may be aware of a need to have AI strategic plans and resources but lacks an organizational approach is the essential step to moving from Level 1 to Level 2. Designated roles, responsibilities, and resources are needed to ensure successful AI implementation at more than an individual project level. AI strategic planning should begin at Level 1 and result in a clear, measurable plan that addresses factors such as governance and needed partnership agreements to keep pace with AI innovation.

Level 3 in the Strategy and Resources Pillar demonstrates development and deployment of AI vision, goals, and policies, and prioritization of value-based work processes (use cases). The AI strategy encompasses the diagnosis and mitigation of obstacles for AI implementation and identifies partnerships and their expectations for advancing AI. Resource expectations for personnel and technology are identified and at least partially met, and measurable means of determining the effectiveness of the strategic plan, partnerships, and governance are in full implementation. Movement toward Levels 4 and 5 includes the capability to monitor and track strategy accomplishment and resources, as well as means of identifying and implementing improvements.

Maturing the Organization Pillar

An entity seeking to implement the Organization Pillar moves from awareness and interest at Level 1 to clear planning to address AI needs such as AI culture and enterprise-based AI workforce development requirements. Level 2 activities include initial planning for culture changes and workforce development strategies, as well as

plans for creating and embracing a culture of dialogue, discussion, and constructive critique of AI. Level 3 ensures that standardized approaches span the entire enterprise/program in such areas as defined AI culture change strategy and plans; structured approach to enable key AI activities and ensure effective and safe implementations; and implementing needed workforce development and training. The entity's stance and policies on AI are included in culture and training development, and defined measures to evaluate meeting culture and workforce development objectives exist. Moving to Levels 4 and 5 continues to build on Level 3 actions with trend analysis for effective monitoring as improvement implementations.

Maturing the Technology Enablers Pillar

Maturing the Technology Enablers Pillar from initial awareness and lack of an enterprise-based approach to enabling technology begins with Level 2 planning. Research into and defining AI standards and tools, AI platforms, and T&E standards are key activities for maturation. Level 3 activities include implementation and use of AI-enabling platforms and tools; testing techniques and tools are standardized and available; test strategies, objectives, and practices for evaluating typical AI solution failure points are defined; the testing team is managing data usage; ML training data is well tracked; and tools enable regular hands-on engagements to ensure AI capability effectively fits needs. Movement to Levels 4 and 5 includes trend analysis and opportunities to collect data to improve technology enablers.

Maturing the Data Pillar

Maturing the Data Pillar from the initial awareness to Level 2 includes researching and considering data-related activities such as governance, accessibility, sharing/access controls, architecture, and security, as well as identifying

initial data. By Level 3, the entity should have a defined process for governance and auditing compliance to data standards. Approaches and tools are in place to access, share, and secure needed data; the architecture is defined and utilized; data-focused measures are in place that provide insight and visibility into the effectiveness of data needed for enabling AI solutions; and an enterprise-based data strategy is available. Levels 4 to 5 include performing trend analysis, monitoring, and improvements to data to enable and support AI solutions.

Maturing the Performance and Application Pillar

Entities seeking to move to Level 2 within the Performance and Application Pillar should begin with researching and evaluating needed use cases and potential adoption rates; identifying process and tools to monitor deployed solutions; and identifying key best practices and techniques for building robust, reliable, and trustable solutions.

Moving to Level 3 within this pillar includes aligning business cases with identified use cases; defining and implementing AI solution monitoring tools and processes; and standardizing techniques for evaluating the solution's reliability, trustworthiness, security, and other quality elements. Establish a process to ensure monitoring occurs from development through deployment and post-production. Defined measures and targets for AI solution performance indicators should also be in place, as well as ML learning operations technology and practices used to provide a scalable and governed means to deploy and manage machine learning models in production environments. Levels 4 and 5 build upon activities set up in Level 3 by performing trend analysis and improvement activities.

GLOSSARY OF TERMS

TERM	DEFINITION
AI Adoption	Pursuit by organizations and/or individuals to commit to investing in, employing, and deriving continued value from AI capabilities.
AI Data Governance	Dedicated management of AI data performance and compliance to guard against data bias and ensure ethical and responsible use, availability, usability, integrity, privacy, and security of data in AI systems.
AI Due Diligence	Careful and persistent use of requisite AI and machine learning (ML) tools and resources to achieve the best possible outcomes while mitigating risk.
AI Innovation	Process whereby research, systems engineering, human-machine design principles, and best practices integrate AI into transformational, cutting-edge business applications.
AI Maturity Model	A methodology that is designed to advance AI adoption by organizations. It provides a framework for identifying AI's potential strategic business impact; assessing an organization's current AI capabilities; and prioritizing investments toward AI technologies, skills, and processes that are needed to facilitate AI readiness. It is a qualitative measurement and benchmarking tool designed to guide AI maturity.
AI Platforms	Defined set of hardware, software, networking tools, and services designed to support the development, adoption, use, and management of AI across an organization.
AI Strategic Partnerships	Documented relationships between government, private enterprises, academic institutions, and FFRDCs to effect collaboration and increase AI capabilities and competencies.
AI Strategic Plan	A document used by leadership to communicate business goals, measures, implementation approaches, timelines, and resources for AI initiatives.
Artificial Intelligence (AI)	Pursuant to the DoD AI Strategy, AI is "the ability of machines to perform tasks that normally require human intelligence."
Assessment Levels	Defined levels of progress improvement (maturity) within AI adoption processes. As part of the AI Maturity Model, assessment levels include: Initial, Engaged, Defined, Managed, and Optimized.
Bias Evaluation Standards and Guidelines	Measures designed to evaluate and mitigate general classes of bias and reduce risk in the development and employment of AI systems, including examination of algorithmic biases, flawed training data, and unfair human influence and error.
Bias Strategy	Strategy that establishes the organization's approaches, principles, techniques, and methodologies used to prevent or reduce bias in its AI solutions.
Business Use Case	Documented business practices and anecdotal event steps that define successful and efficient ways to maximize the value of employing AI at scale to achieve organizational goals and objectives.
Culture	An organization's customs, practices, shared conventions, values, and artifacts that support and enable AI adoption.
Data	A collection of facts, figures, visuals, statistics, and/or other observed and generated types of information for computing, calculating, and analysis.
Data Analytics	The scientific process of analyzing raw data to discover patterns, relationships, detailed understanding, and insight from large sets of data.
Data Architecture Framework	Infrastructure for collecting, housing, organizing, and maintaining data created by an organization. It is informed by corresponding standards on lexicon, ontology, security, privacy, and ethics.
Data Security & Risk Mitigation	Process and methodologies for identifying and mitigating risks to data security, particularly as they are impacted by AI initiatives.

The MITRE AI Maturity Model and Organizational Assessment Tool Guide:

A Path to Successful AI Adoption

Data Sharing Framework	A guidance document that outlines key ethical, legal, and organizational concerns to define and achieve effective data sharing among mutually agreed upon data providers and data consumers.
Data Standard Legal Agreements	Documentation that defines guidelines and safeguards for data sharing, data content, and syntax standards.
Dimensions	Functional and measurable features that are foundational to successful AI adoption and that describe specific focus areas critical to AI adoption maturity.
Enterprise AI Culture Strategy	A document used by an organization's leadership to identify and promote the cultural aspects they consider important to successful AI use (e.g., continuous learning, data-driven, experimental).
Equitable	An equitable solution is designed to provide fair and equal treatment across diverse populations.
Ethical AI	Ethical AI is a focus area that examines ways to ensure AI systems and their human operators adhere to well-defined ethical guidelines regarding fundamental values, including individual rights, privacy, non-discrimination, and non-manipulation. Ethical AI places fundamental importance on ethical considerations in determining both the legitimate and illegitimate applications of AI. Organizations that apply ethical AI have clearly stated policies and well-defined review processes to ensure universal understanding and commitment to these guidelines.
Explainable	Explainable AI is the extent to which the mechanics and performance of an AI system can be explained in human terms and clearly understood.
Federally Funded Research and Development Center (FFRDC)	Federally funded research and development centers (FFRDCs) are a special class of research centers dedicated to providing Federal agencies with research and development capabilities that cannot be met by the Federal government or private industries.
Governance	Conduct of ensuring and overseeing performance and compliance of AI policies, ethics, accountability to responsible use, technical standards, and change management practices in a fair manner.
Governance Structure	Framework that describes managerial roles, responsibilities, and authorities as they relate to AI adoption and practice in an organization. It establishes rules, procedures, and policy guidelines for dedicated use of AI.
Human-Centric	A design approach for information technology systems that is characterized by humanistic values and observance of human welfare. When applied to AI, this approach emphasizes the importance of user needs and desires. Design decisions are predicated on human necessities, wants, and requirements.
Human-Machine Design Principles	Principles founded on the need to establish clear guidance and structure for humans and machines to interact in support of achieving successful outcomes.
Infrastructure	Components that are fundamental for AI systems/services. These usually include computer and networking hardware and facilities as well as software and network components.
Key Performance Indicators	Quantifiable measures used to evaluate the success of an organization or various projects, initiatives, and/or programs.
Metrics/Measures	Quantifiable measures used to assess the status of a specific process and/or initiative.
Mission	Statement or written documentation that details organizational objectives to effectively achieve future AI outcomes.
Organization	An organized body of people with a shared purpose and/or mission objective.
Organizational Change	The process by which an organizational entity modifies, redirects, or reforms its operational methods, strategies, and infrastructure to achieve common business objectives.

The MITRE AI Maturity Model and Organizational Assessment Tool Guide:

A Path to Successful AI Adoption

Performance & Application	Identification and documentation of relevant AI business use cases and the application of integrated solutions and processes into workflows that, when combined, result in implementing AI at scale and actualizing strategic and effective outcomes.
Pillars	Structured group of related functional areas (dimensions) that are important factors in successful AI adoption.
Project	A specific plan, venture, or actualized concept with defined goals and objectives designed to achieve a specific mission objective.
Recruitment	Action of identifying new people and skill sets required to support advancements in AI.
Research & Development	Specific activities by which the organization pursues innovative solutions, products, and/or services to obtain and utilize new and enhanced AI knowledge and technology.
Responsible Use Policy	A document describing the way an organization addresses the challenges of AI adoption and practice from both an ethical and a legal perspective.
Skill Sets	The spectrum of expertise and capabilities required to implement AI projects or initiatives.
Strategy & Resources	Formal plans of action outlining goals and methods as well as timelines for achieving objectives and corresponding organizational authorities, roles, responsibilities, and requisite funding allocations.
Structure	The foundational design and architecture that outlines how AI activities are implemented to achieve organizational objectives.
Technology Enablers	Tools and methodologies utilized by organizations to advance technology adoption and maturity in order to achieve and sustain enduring technological progress and growth within their business enterprise.
Test & Evaluation	Process by which AI systems or components are compared against requirements and specifications through testing to assess adequacy of design and progress in performance.
Test Standards	A set of AI-specific standards to guide and ensure that initiatives/solutions are evaluated against their requirements to produce desired outcomes.
Training Data	Actual data required to train the planned AI model to perform desired various actions.
Transparency	Quality of AI that allows for ease of explanation and understanding.
Trustworthiness	Ability of an AI solution to produce human confidence throughout its performance, through demonstrated accuracy, reliability, explainability, security, and safety.
Vision	A defined end-state of an initiative or strategy.

BIBLIOGRAPHY

- [1] M. Rollings, D. Allen and V. Logan, 10 Ways CDOs Can Succeed in Forging a Data-Driven Organization, Gartner, 2020, pp. 1-2.
- [2] CMMI Institute, Capability Maturity Model Integration (CMMI) At-A-Glance, pp. 6-33.
- [3] National Institute of Standards and Technology, U.S. Leadership in AI: A Plan for Federal Engagement in Developing Technical Standards and Related Tools, U.S. Department of Commerce, 2019.
- [4] Boston Consulting Group, Annual MIT Sloan Management Review—Boston Consulting Group Study Finds Significant Financial Benefits with AI Are Noticeably Amplified When Organizations Develop Multiple Effective Ways for Humans and AI to Learn Together, Cambridge, MA, 2020.
- [5] C. Alemany and A. Gurumurthy, “Governance of Data and Artificial Intelligence (Extract from the Civil Society Report “Spotlight on Sustainable Development 2019”),” 2018.
- [6] Build the AI Business Case, Gartner, 2018.
- [7] Blogauthor, “How to Test AI Systems?,” 9 January 2019. [Online]. Available: www.v2soft.com/blogs/how-to-test-AI-systems.
- [8] Carahsoft, “The Next Phase of AI in Government,” March 2020. [Online]. Available: <https://www.carahsoft.com/innovation/innovation-resources/fcw-report-government-artificial-intelligence>.
- [9] J. Jordan, Effective Testing for Machine Learning Systems, 2020.
- [10] A. Linden, F. Choudhary and P. den Hamer, Top Organizational Pitfalls of Machine Learning Initiatives, 2019.
- [11] K. Malone and S. Seabold, The CIVIS Guide to Analytical Maturity: How to Make the Right Decisions about How to Make Decisions, CIVIS ANALYTICS, 2018.
- [12] K. Radmarkrishnan and C. Chantry, AI from Exploring to Transforming: Introducing the AI Maturity Framework White Paper A Strategic Guide to Operationalize and Scale Enterprise AI Solutions, Element AI, 2020.
- [13] T. Ramsøy, Why Data Ownership Matters in the Age of AI, 2018.
- [14] B. Getty, How to QA Test Software That Uses AI and Machine Learning, 2020.
- [15] SOGETI, Testing of Artificial Intelligence: AI Quality Engineering Skills - An Introduction.
- [16] D. Schatsky, The Rise of Data and AI Ethics: Managing the Ethical Complexities of the Age of Big Data, Delloite, 2019.
- [17] Wipro Holmes, Testing of AI/ML Based Systems.
- [18] R. Burkhardt, N. Hohn and C. Wigley, Leading Your Organization to Responsible AI, McKinsey & Company, McKinsey Analytics, 2019.
- [19] M. Jones, “Why Companies Will Need to Create an AI Culture to Achieve Success,” Forbes Technology Council, 2018.
- [20] M. Minevich, “5 Steps to Get Digital Enterprises Ready for AI Adoption,” 2020.
- [21] Gartner, “Barriers to AI Adoption; Smarter with Gartner,” 2019.

APPENDIX A. MITRE AI MATURITY MODEL LEVELS

Level	Description	Project Characteristics	Activities to Reach the Next Level
1: Initial	<ul style="list-style-type: none">• AI lacks senior management leadership, governance, strategy, and direction for key areas necessary for adoption.• Project and organizational leadership are seeking to understand the definition of AI; its applicability across a broad category of scenarios and capabilities; and how others are using AI.• No AI sponsor or champion is designated to mature AI capability and tools.• AI exploration may be occurring; however, if individuals or teams do initiate AI pilot projects, enterprise-level AI strategies, processes, and technology are not present.	<ul style="list-style-type: none">• Project teams and leaders have little or no information about AI and insufficient training to coach employees through the impact of AI development.• AI projects are isolated. AI information is not centralized, and each new project "relearns" the basic skills; there is no common approach to AI solution development and AI information.• AI executive support is evident through funding authorization and resource allocation but lacks visible sponsorship.	<ul style="list-style-type: none">• Identify and document gaps.• Create a roadmap for moving forward.• Focus on both the technical side of AI and culture, ethics, needed organizational changes, and visible leadership support.• Obtain and provide applicable training.• Establish and utilize AI communication plans.• Establish/Utilize an AI approval process to increase project visibility and encourage use of emerging policies and standards.• Apply AI solutions/resources to isolated projects and identify ways to help those that are currently experiencing resistance to change.
2: Engaged	<ul style="list-style-type: none">• There is a more organized approach to AI with emphasis on establishing champions, team building, governance, and strategies for successful adoption.• AI pilots are initiated, and project-level processes, procedures, and technology are being defined; solutions are still decentralized.• Cultural changes are being implemented, some successful initiatives are occurring, and evaluation of tools and standards is being considered.	<ul style="list-style-type: none">• The existing AI framework is rudimentary, with initial governance, policies, and practices beginning to be investigated.• A common approach for introducing AI methodology does not yet exist, so variations of AI project practices exist, with many different approaches applied sporadically throughout the organization; some projects may be designing AI solutions effectively while others are not.• Managers and supervisors do not have sufficient AI training to coach employees through changes anticipated.	<ul style="list-style-type: none">• Identify assessment gaps and determine an action plan.• Enlist executive support for applying AI tools on every project and for building AI competencies at every level in the organizational entity.• Select a common methodology that can have widespread use and begin acquiring the tools and training necessary to implement it.• Collect and utilize data from Level 2 activities to create a roadmap for moving forward.• Ensure that a budget is in place to fund AI competency and capacity activities.• Communicate plans, policies, and procedures.• Establish potential measures and metrics to assess progress.
3: Defined	<ul style="list-style-type: none">• Approved enterprise-wide approaches, resources, and processes are documented for AI projects, initiatives, and adoption efforts.• AI governance, culture, strategies, and leadership are in place, empowering technology and leading to mature, defined internal policies that guide the use of tools, software, data, and procedures.• Plans for the continued monitoring, retraining, and evaluation of AI models are under development.• Senior leadership and AI sponsors take on a more active role in sponsoring change, but now a formal company-wide program exists to train project leaders, managers, or coaches on AI and govern AI solution development.	<ul style="list-style-type: none">• Standardized AI requirements and approaches are used by multiple projects; pockets of excellence in AI may co-exist with projects that have only minimal use.• AI projects are aligned to enterprise-wide plans, technologies, and approaches with approved performance outcomes and allocated resources.• There are elements of a rudimentary process to collect AI-specific data, measures, and metrics at an enterprise-wide level.	<ul style="list-style-type: none">• Enterprise efforts are expended toward ensuring that approved tools, resources, and standards are applied consistently when engaging in AI solution development.• Senior leadership and AI sponsors take on a more active role in sponsoring change and consider this role part of their responsibilities.• Data is collected, monitored, and used to manage AI development, usage, and implementation effectively.
4: Managed	<ul style="list-style-type: none">• AI initiatives follow policy, governance, and technical standards. Outcomes and supporting metrics are collected, analyzed, and utilized to determine impact.• Multiple projects exist and utilize standard technologies and approaches; outcomes are informed by supporting metrics.• Leadership is making decisions by analyzing data against defined and captured metrics to determine enterprise-wide impact.	<ul style="list-style-type: none">• AI project teams are capturing metrics and documenting best practices and tools to achieve strategic outcomes.• There is enterprise-wide AI data collection, training, and acknowledgment of AI and the importance of following defined standards for project success.• Individuals, groups, or administrative positions are dedicated to supporting AI solution development efforts and building AI competence.• AI adoption is high; project teams regularly use and apply AI tools, resources, standards, and practices.	<ul style="list-style-type: none">• Enterprise-based AI infrastructure and governance is in place and consistently working.• Formal positions/staff are responsible for AI deployment, training, and improvement of AI competencies and adoption.• Steps are in place to correct noncompliance and analyze gaps in areas that are not applying the selected methodology.
5: Optimized	<ul style="list-style-type: none">• The enterprise produces high-level AI work by continually improving and innovating its AI projects.• Leadership is updating policies and procedures by analyzing data against defined and captured metrics to optimize enterprise-wide impact.• Strategically, operationally, and tactically, the enterprise has broken down silos to integrate data and resources more effectively, thereby realizing enhanced AI.	<ul style="list-style-type: none">• Project teams are capturing best practices and lessons learned to share with each other.	

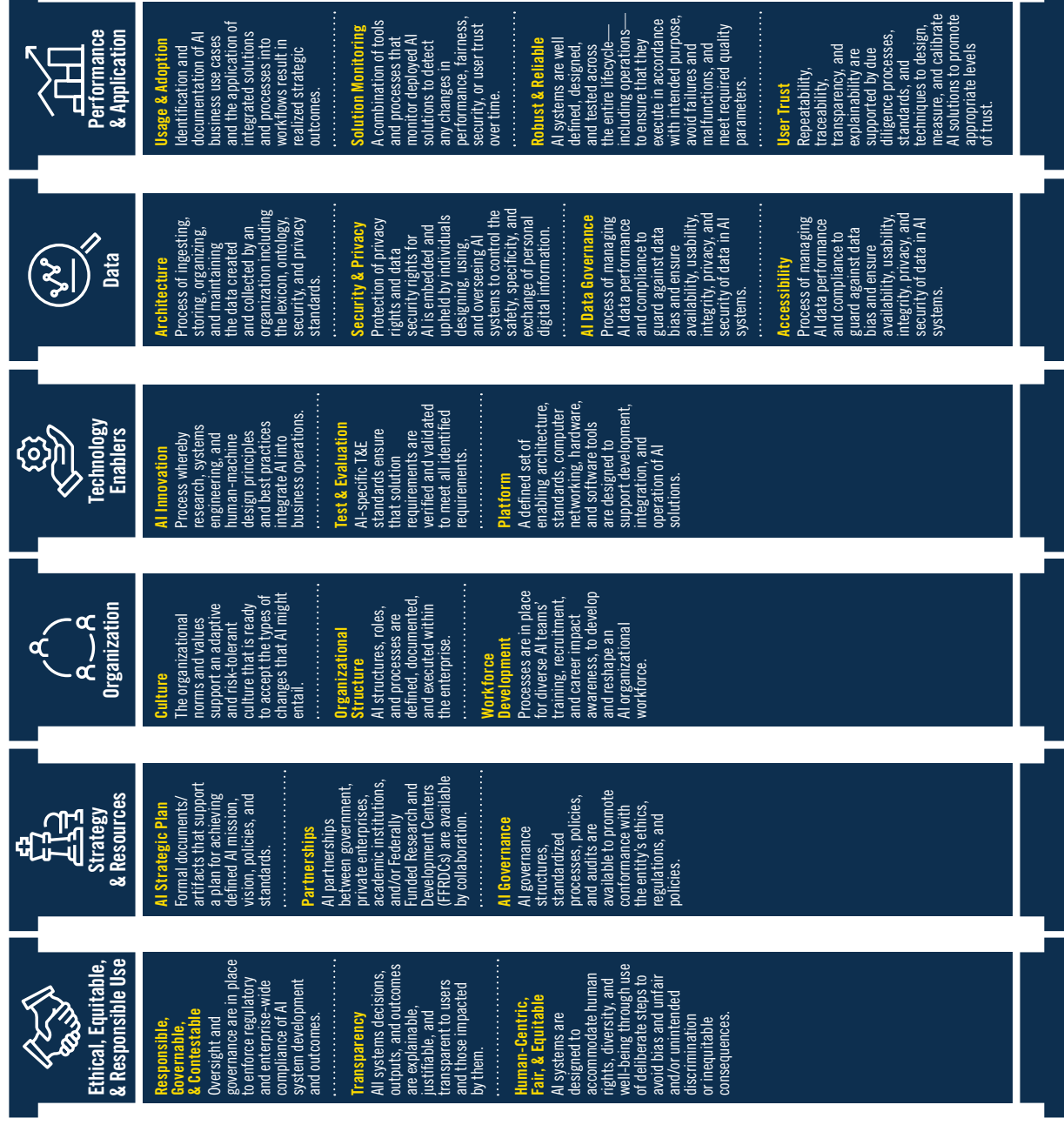
APPENDIX B.

AI MATURITY MODEL PRINTABLE DIAGRAM

The AI MM defines five levels of maturity: Initial, Engaged, Defined, Managed, and Optimized.

The model is organized according to six pillars representing major aspects of maturity recognized by industry as key to successful AI adoption:

1. Ethical, Equitable, & Responsible Use
 2. Strategy & Resources
 3. Organization
 4. Technology Enablers
 5. Data
 6. Performance & Application
- Each pillar has either three or four dimensions (20 total) describing specific actions and activities that demonstrate advancing mastery of AI maturity for that dimension.



The MITRE AI Maturity Model and Organizational Assessment Tool Guide:

A Path to Successful AI Adoption

About MITRE

MITRE's mission-driven teams are dedicated to solving problems for a safer world. Through our public-private partnerships and federally funded R&D centers, we work across government and in partnership with industry to tackle challenges to the safety, stability, and well-being of our nation.

The views, opinions, and/or findings contained herein are those of the author(s) and should not be construed as an official government position, policy, or decision unless designated by other documentation.

