



Headquarters United States Air Force

**Air Force
Modeling and Simulation Vision
for the 21st Century**

6 July 2010





Air Force Modeling and Simulation (M&S) Vision for the 21st Century

The Department of Defense Militarily Critical Technologies List identifies M&S as an essential subarea that supports advances in the development, production, and use of military capabilities. As we transition into the second decade of the 21st Century, M&S will play an increasingly vital role in the Air Force's ability to train our warfighters, develop new systems, and assess the complexities of a changing battlespace. M&S will also be key to achieving the capabilities and synergies that Joint and Coalition partners add to the full spectrum of military operations.

To meet current and new challenges, we must embrace this vision, which will enhance the way we organize, train, educate, equip, and employ air, space, and cyberspace forces.

A handwritten signature in black ink that reads "William T. Lord". The signature is written in a cursive, flowing style.

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Air Force Modeling and Simulation Vision for the 21st Century

Modeling and simulation (M&S) is a critical and vital enabler across the range of Air Force operations, underpinning the operations of key weapon systems, enhancing command and control, and supporting the preparation and employment of our Airmen. The Post Cold War era and challenging politico-military environment we face today provide new opportunities for M&S to support critical transformation activities, ensuring the Air Force remains in the forefront in defense of our nation, allies, and friends. This vision identifies how M&S will enable the future of our Service as we move beyond the first decade of the 21st Century.

Purpose

This document provides guidance to ensure M&S supports the needs of the Air Force by providing an agile and responsive governance and management structure to oversee M&S applications that support decision-making and skills development. It supports more effective M&S requirements identification; the need for a capable and M&S-savvy workforce that supports the Total Force; and the development of data, tools, services and infrastructure needed to support the Air Force as it moves into the second decade of the 21st Century.

Background

Air Force M&S is a key enabler that accelerates and enhances existing Air Force warfighting capabilities. M&S consists of computer hardware, software, data, networks, tools, and techniques used to create representations of reality for many different activities. The 1995 M&S Vision, described in *Modeling and Simulation: A New Vector*, recognized M&S activities fall into two areas:

- Making better decisions
- Developing better skills

These two major uses have not changed since 1995; however, the Department of Defense (DoD) and Air Force have changed their M&S development and infrastructure strategies. Attempts in the 1990s at joint, monolithic simulations to meet multiple user requirements largely failed, while the ability to link together disparate virtual simulators and integrate constructive simulations to achieve complex mission environments for training, mission rehearsal, acquisition, and testing has grown significantly. This 2010 M&S Vision charts a path forward that capitalizes on our lessons learned and successes.

USAF M&S Vision

*Modeling and simulation capabilities enabling the United States Air Force to organize, train, educate, equip, and employ current and future air, space, and cyberspace forces for the full range of operations.**

Figure 1 depicts the “building blocks” required to implement the M&S Vision. At the top, policy and governance provide senior leadership oversight and guidance for developing M&S requirements and investment strategies that enable current and future activities. To determine Air Force M&S requirements, we must understand what activities the M&S capabilities need to support both now and in the future. These activities are conducted by a broad spectrum of user communities that employ M&S to help make better decisions and develop better skills. These user communities require a trained workforce to use and develop their models, simulations, and simulators, which in turn, need data, tools and other supporting services to be useful. Finally, the foundation provides an infrastructure capable of linking models, simulations, and/or simulators. These “building blocks” are discussed in more detail in subsequent sections.



Figure 1: M&S Vision Implementation Building Blocks

“Range of operations” extends from military engagement, security cooperation, and deterrence activities to crisis response and limited contingency operations and, if necessary, major operations and campaigns and includes but is not limited to military (single service, joint, coalition), interagency, and non-governmental.

Policy and Governance

DoD Directive (DoDD) 5000.59, *DoD Modeling and Simulation Management*, establishes DoD M&S policy, the DoD M&S management structure, and assigns DoD Component responsibilities. Air Force M&S policies and initiatives follow DoDD 5000.59 and other related DoD issuances. The capstone Air Force M&S policy document, AFPD 16-10, *Modeling and Simulation*, assigns key roles and responsibilities and describes Air Force participation in select M&S forums.

Air Force M&S governance, management, and oversight are aligned with DoD M&S governance and are organized by user and cross-cutting communities that include the following:

USER

- Acquisition
- Testing
- Analysis
- Planning
- Experimentation
- Training
- Education and Formal Training

CROSS-CUTTING

- M&S Foundations
- Logistics
- ISR
- Doctrine

Specific definitions of these communities are provided in AFPD 16-10. The Air Force and DoD management structure are explained in more detail in Appendix 1.

User Community Activities Enabled by M&S

Figure 2 depicts examples of various activities enabled by M&S. This list is not intended to be exhaustive, but representative of the activities accomplished by the user communities. Many M&S activities have common characteristics. For example, a capability planning activity may use a campaign and/or mission level simulation to determine capability shortfalls, and a resource allocation activity may use the same or similar simulations to analyze a postulated system to determine the number of systems required to overcome that shortfall and the costs involved.

M&S: An enabler across the entire spectrum of AF activities:

- Acquisition and Logistics
- Science and Technology
- Research, Development, Test & Evaluation
- Experimentation
- Capability Planning
- Resource Allocation
- Force Planning
- Operational Assessment
- Operational Planning
- Educational Wargaming
- Training and Mission Rehearsal

The USAF does two fundamental things with M&S:
(1) Make better decisions
(2) Develop better skills

Figure 2: Sample M&S Activities

Models, Simulations, Simulators, and Users

This section describes the M&S resources-- models, simulations, simulators, and users/workforce-- needed to meet the user communities' requirements.

Models, Simulations, and Simulators. Live, virtual, and constructive (LVC) models and simulations are used individually or together to depict a typical air, space, land, and sea operational environment/scenario. Figure 3 depicts a typical replicated environment. Each M&S user community replicates a wide spectrum of military operations in different functional environments to meet their specific requirements by using various models, simulations, and simulators at different levels of resolution and fidelity. For example:

- Analytic studies employ stand-alone constructive models and simulations that represent anything from a single system or person in the environment up to an entire major campaign operation.
- Activities related to research and development require engineering-level models that may need to interoperate with manned virtual simulators or live systems.
- Education and training applications require a wide variety of models and simulations, from constructive models used for educational wargaming to virtual cockpit simulators.

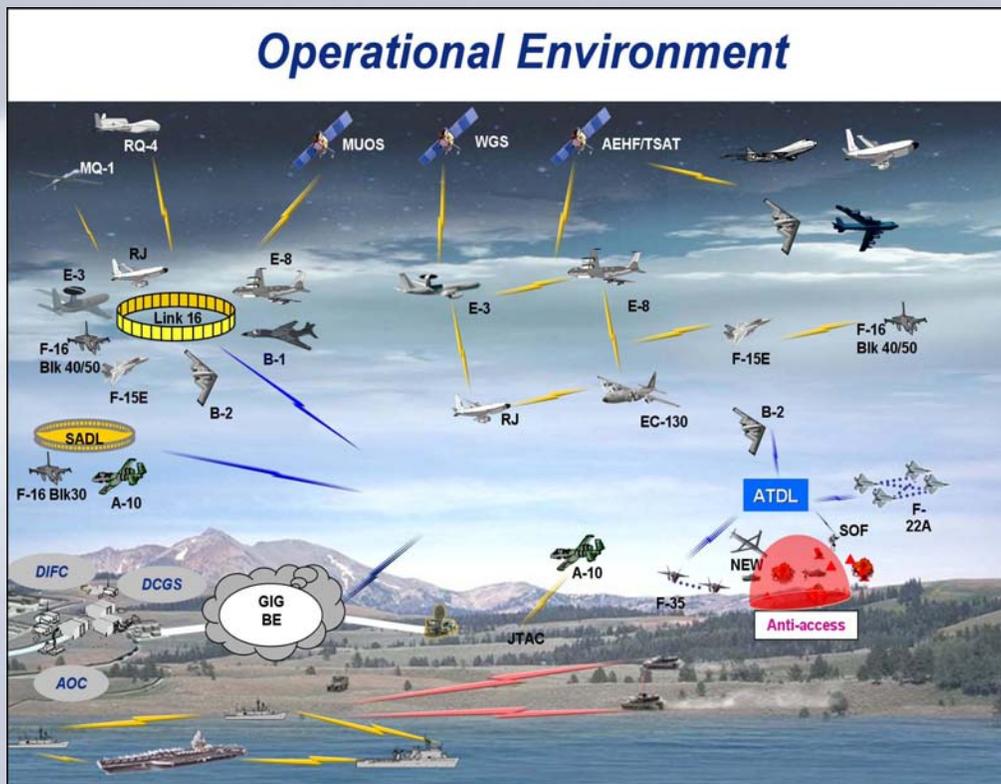


Figure 3: Typical Replicated Environment

- For testing and training applications, the only affordable way to represent the required environment is to introduce simulated systems into live cockpits or with a synthetic, immersive environment due to limitations in physical range space and the number of physical assets available to represent realistic friendly and threat force densities. In some cases, M&S environments can be used to assess test issues that cannot be easily addressed in the real-world environment due to financial, operational security, and/or environmental considerations. Creating augmented live training and synthetic environments for training and exercises also promises to reduce operation tempos while still allowing realistic training at home stations and reducing the wear and tear on valuable equipment.
- Joint warfighting experimentation uses analyses, simulations, wargames, experiments, technology demonstrations, and joint exercises conducted in virtual environments.

M&S environments need to accommodate the insertion of emerging and future capabilities (e.g. non-kinetic weapons, hypersonic platforms, cyberspace operations, information assurance, irregular warfare, directed energy) and the modeling of non-traditional aspects of warfare (e.g. human behaviors and social networks) and effects from the natural environment. M&S environments must support rapid innovation of both materiel and non-materiel solutions that provide Airmen an edge on the battlefield and keep the enemy off balance and on the run. M&S environments must also enable joint interdependence, unifying and integrating the military Services into a powerful, flexible team.

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**M&S environments enable us to organize, train, educate, equip
and employ our forces as we intend to fight!**

Few activities require replication of the entire operational environment, but the entire set of components within the environment must be available so they can be readily assembled as needed. Components may be single or multiple live assets, virtual simulators, or constructive models and simulations. The resolution and fidelity of the components may vary across applications. However, the components should be consistent and compatible with each other and developed using common data sets to ease verification, validation and accreditation (VV&A) and interoperability. The philosophy of “build once, replicate many” is endorsed to reduce M&S cost and redundancy. Additionally, we must make models more accessible and discoverable, and ensure the tools are transparent and built to be integrated into existing or new applications. Assembling a distributed LVC environment should be akin to scheduling resources on a range – seamless, integrated, scalable, supportable, and tailored to specific M&S user requirements.

In addition, Air Force M&S must be compatible with Army, Marine Corps, and Navy M&S. Representations of other Service forces should be integrable into the Air Force environment; likewise, Air Force components, if required, should also be integrable into other Service environments and joint/coalition environments. Designing models and simulations for integration will require joint adoption of standards.

M&S Workforce Development.

The Air Force requires a Total Force workforce that understands how to use M&S efficiently and effectively. In order to implement the vision articulated in this document, the Air Force must establish a common set of M&S workforce requirements for our Airmen and government civilians. For example, senior-decision makers require a broad awareness and general appreciation of the capabilities and benefits achieved through the proper application of M&S. Program managers, on the other hand, must understand how specific M&S tools and services can enable them to achieve their organization or program goals and objectives in a cost effective manner with an acceptable level of risk. Finally, M&S users must learn how to leverage the environments where LVC simulations replicate our weapon system performances and human behaviors. Indeed, an educated M&S workforce can significantly enhance our ability to fly, fight, and win while at the same time saving valuable resources.

Data, Tools and Services

Modeling, simulations, and simulators require data to function. On the front end, data are used to develop and drive M&S; on the back end, data are produced for analysis or as an input to another function. However, there are several areas of caution surrounding data, including, but

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not limited to, validation and classification. Models and simulations require validated and authoritative data to ensure accurate representations. These sources drive friendly and threat systems, as well as scenarios and environmental data. Additionally, data are needed at multiple levels of classification. This creates unique security policy challenges.

Tools are hardware and/or software items that are used to develop, maintain, or execute models within the simulation environment. Tools are distinct from models, simulation, and simulators because they do not provide part of the simulation environment, but they are essential to supporting and executing viable M&S.

Similarly, M&S services are support activities by individuals or organizations that deliver technical assistance. These specialized services are typically needed throughout M&S development and execution.

Infrastructure

DoD defines M&S infrastructure as consisting “... of M&S systems and applications, communications, networks, standards and protocols, and information resource repositories.” As M&S usage becomes more prevalent in the Air Force and across DoD, demands for computing, data storage, and networking increase. M&S infrastructure requirements are driven by the models, simulations, and simulators required by the various M&S user communities. For example, high fidelity, complex simulations require increased speeds in computing hardware, to include parallel processing and high-performance computing assets. As the operational environment becomes more complex (e.g., system of systems interoperability, net-centric operations), simulation environments will also increase in complexity, creating the need for greater bandwidth and decreased latency.

M&S Requirements Development

To determine Air Force M&S requirements, we must be prepared to assess capabilities across the full range of operations that M&S needs to support now and in the future. A good way to capture these requirements is through a set of frameworks that depict how we use and plan to use M&S to support Air Force goals. Two frameworks accomplish this, one to support each of the two major activities enabled by M&S: (1) making better decisions, and (2) developing better skills. Figure 4 depicts the two frameworks. The framework elements answer the questions of who, what, when, where, and how. The frameworks are also supported by an integrating architecture that provides compatible and consistent M&S data, service, infrastructure, and best practices where applicable.

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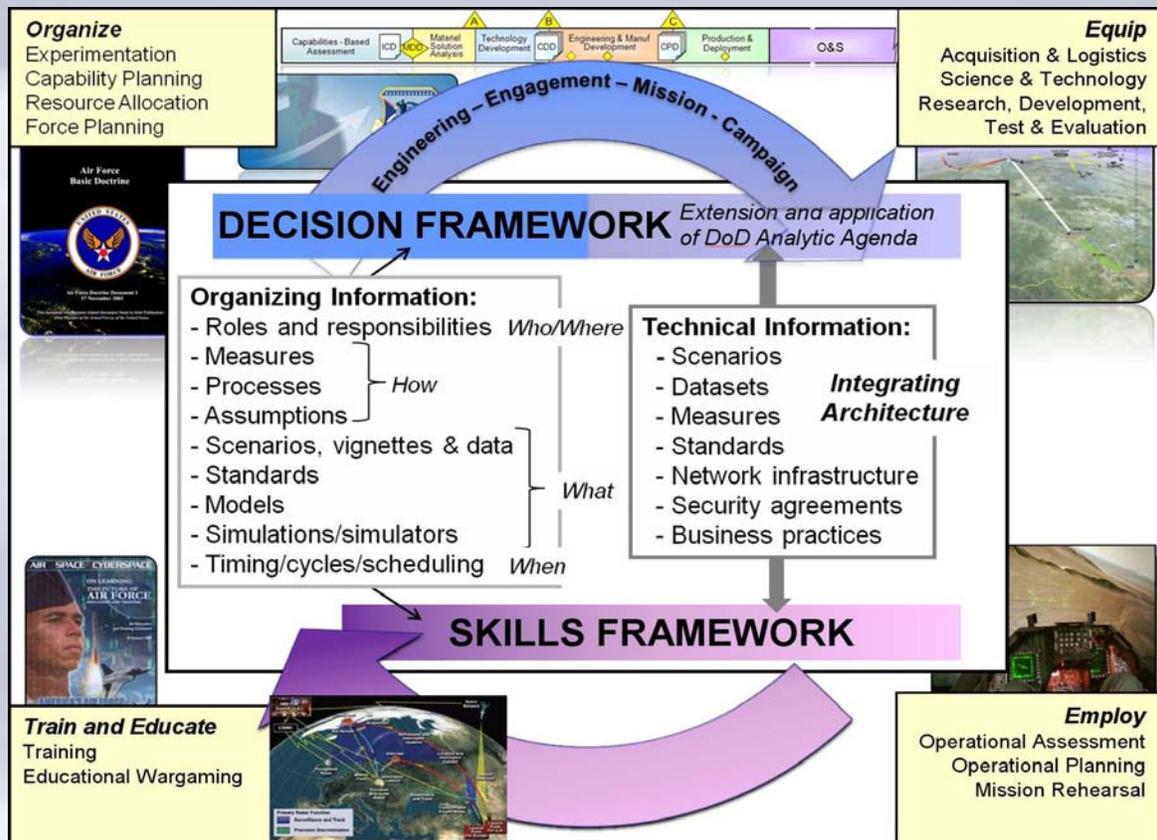


Figure 4: M&S Frameworks

Current State of Air Force M&S

Making Better Decisions: The M&S technologies available for “making better decisions” are primarily, but not exclusively, used by the Acquisition, Analysis, Planning, Testing, and Experimentation Communities. These communities use M&S to frame and scope problems, examine alternatives, and provide insight and solutions for Air Force decision makers. The DoD Analytic Agenda can be used as a framework to provide a common set of accepted scenarios, M&S tools and authoritative data. Current challenges include:

- Many M&S tools used today were designed to support a system-based acquisition process for only Air Force, not joint requirements.
- Many M&S tools lack scalability and extensibility necessary to address complex joint interoperability issues.
- Many models and simulations are proprietary and not interoperable with other tools.
- Limited ability to do exploratory analysis with quick running models.

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- Limited M&S tools to support complex problem-solving.
- Limited M&S tools to manage large data sets.
- Limited use of M&S to augment actual testing for assessment of complex system of systems, within dense threat environments that may not be fully achievable on the range.
- Limited use of M&S throughout the Acquisition Life Cycle, partly due to many PMs not knowing what M&S tools exist and are available for use in specific scenarios.
- Availability of data to perform verification and validation on M&S tools.
- Lack of a centralized repository for VV&A documentation to identify M&S application validation appropriate to intended activities.
- Lack of M&S capability to analyze Irregular and Non-kinetic Warfare operations or Mission Support Activities

Developing Better Skills: The M&S technologies available for “developing better skills” are primarily, but not exclusively, used by the Training and Education and Formal Training Communities. The Training Community uses M&S to enhance the warfighter’s ability to train and conduct mission rehearsal in realistic LVC environments. The Education and Formal Training Community uses M&S to deliver unrivaled air, space, and cyberspace education and formal training. Current challenges include:

- Training and education policies do not maximize the use of LVC environments enabled by M&S technologies.
- Current and future weapons systems and weapons capabilities often outpace existing LVC training capabilities and facilities.
- Database fidelity is often insufficient to support required synthetic environments.
- High fidelity simulators are expensive to develop and maintain.
- Most exercise architectures are non-persistent.
- Achieving interoperability in joint and coalition environments.
- Current network security and information assurance policies, along with technology limitations, make it difficult to achieve multilevel security (MLS) and cross-domain solutions (CDS).
- Information Assurance policies may impede rapid review of capabilities.

Desired End State of Air Force M&S

Ultimately, Air Force M&S should meet user requirements across all Air Force activities. When possible, M&S should be open-source, government-owned, and designed for use with multiple applications. For example, the M&S representations for a particular system might include a high-resolution, engineering-level version suitable for test and evaluation, a medium-resolution version suitable for Tactics, Techniques, and Procedures (TTP) development, and a low-resolution version suitable for CONOPS development and future trade-space screening. All model versions should be validated using test data, operational data, or higher-resolution/fidelity models. To validate model versions using another model will require established credibility with the intended users for their particular purposes.

Many of today's users require LVC capabilities to meet their needs. The integration of LVC provides challenges, but also provides great potential benefit to achieve the Vision. Users determine which M&S assets should be available for use in distributed LVC environments suitable for research, testing, training, and mission rehearsal applications (to name a few). These models will require additional characteristics, such as the ability to be readily integrated in a seamless environment supported by acceptable cross-domain security solutions, rule sets and operational procedures. Where possible, the M&S should be the same or consistent across all activities. Assembling a distributed LVC environment should be like scheduling resources on a range – seamless, integrated, scalable, and capable of meeting user requirements. Furthermore, rapid data generation capabilities allow for discovery of appropriate resources from available models, simulations, simulator facilities, and datasets for quick assembly of particular applications. Making better decisions and developing better skills will lead to improved Joint Force Commander air, space, and cyberspace power employment.

Making Better Decisions: The framework for making better decisions requires the following:

- A systems engineering approach to maintain and share M&S tools, data, and assumptions used to support program/system (or other study) decisions and make the information available to support or inform future decisions.
- M&S tool improvement and data generation requirements driven by and derived from the need to support decision making and operations.
- As appropriate, standards that require consistent M&S capability representations and data be developed and maintained throughout the life cycle of AF systems.
- A common set of M&S tools and data (e.g., forces, CONOPS, system characteristics and performance data) available and readily accessible to support all AF M&S user communities (leverage and influence Analytic Agenda products).
- M&S that supports system of systems and/or net-centric requirements as part of a capability-based development and acquisition process.

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- Quick-running models useful to rapidly explore capabilities of systems under development and test.
- Virtual M&S to mitigate live test limitations while increasing opportunities to emulate the operational environment for assessing system of systems and/or net-centric performance requirements.

Developing Better Skills: The framework for developing better skills requires the following:

- Virtual network support to link Airmen together in collaborative educational and training environments—from enlistment to retirement.
- Unclassified scenarios supported with multi-use databases. The ability for geographically separated units to conduct horizontally and vertically integrated full-spectrum training, mission rehearsal, and operations in a Joint/Coalition force environment against realistic threats.
- On-demand, integrated, immersive, and operational environments able to accommodate multiple and varying warfighting teams at appropriate levels of detail.
- Leveraging of private-sector practices and technology, including extensive use of online gaming to train diverse audiences in a wide variety of individual and collective skills.
- Personnel trained as experts in M&S to serve as educators and trainers.

Shared Desired End State: The Integrating Architecture shall support:

- A common, cross-community methodology to identify and prioritize AF/DoD corporate and cross-cutting M&S and data requirements based on the “value-added” contribution to the M&S end-user.
- M&S based on a coherent set of government-owned data.
- Discoverability and accessibility of M&S tools and data.
- Verified and validated M&S that is reusable from one community to another.
- M&S that represents joint warfighting capabilities at varying levels of fidelity and resolution.
- Compliance with standardized architectures and interoperable databases.
- Multilevel Security (MLS)/Cross Domain Solutions (CDS)/Multi-National Information Sharing (MNIS) solutions, including full MLS/CDS for individual weapons/weapons systems, allowing full protection and ability to participate in full-spectrum, immersive environments.
- Affordable, efficient, composable, scalable, and schedulable M&S.

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- Standardized, robust environmental and analytical scenarios available across simulation domains.
- Model management standards and best practices, including adopting industry accepted software development practices and standards, to ensure software is maintainable throughout its lifecycle.
- Conduct of system testing and/or experimentation within a training event where the objectives of each event can be effectively merged.

Implementing the Vision

Implementing the vision requires defining the frameworks, determining required M&S capabilities, identifying gaps in current M&S capabilities based on those requirements, determining solutions to those gaps, and developing an M&S Integrated Capability Roadmap to support the development and fielding of required capabilities. Multiple initiatives are already underway that contribute to the vision's implementation, and these initiatives must be leveraged and integrated into this effort.

Figure 5 depicts the conceptual and planning documentation required to achieve the vision. The

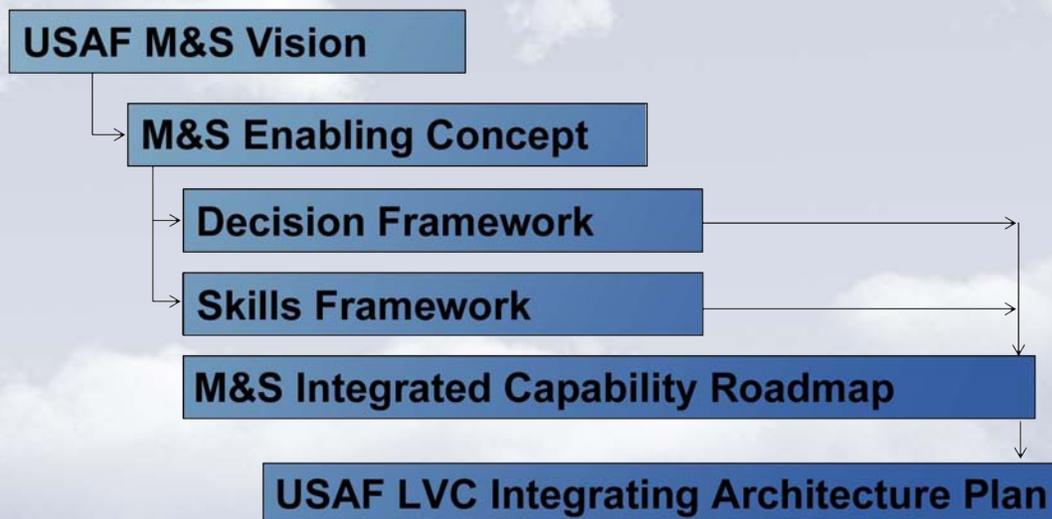


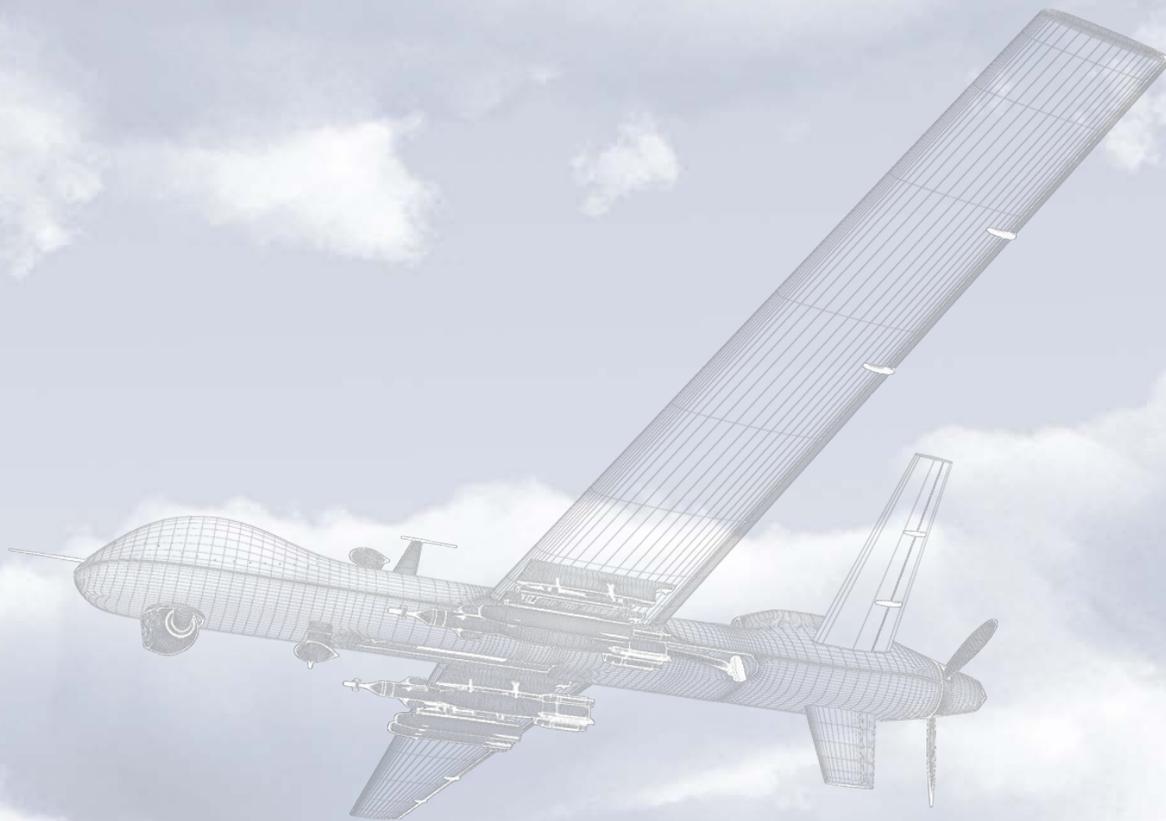
Figure 5: Hierarchy of Documents

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goal is to implement the vision and ensure adequate resources are available across the user communities.

Summary

This vision for Air Force M&S builds on the foundations of past and present lessons learned and accomplishments. Our goal is to ensure that M&S enables all user communities across the broad spectrum of Air Force activities and operations. The Enabling Concept, Frameworks, Integrating Architecture, and Integrated Capability Roadmap called for in this document provide the building blocks the Air Force needs to best employ M&S as a transformational capability. An agile and responsive governance and management structure, along with policies that foster and enable user communities supported by the right models, simulations, simulators, and highly qualified people with the right data, tools, and services will provide the robust infrastructure to meet the user's M&S requirements and to achieve this vision.



APPENDIX 1 – USAF and DoD Modeling and Simulation Governance

USAF M&S Governance

The new USAF M&S governance structure, depicted in Figure 6, closely aligns with the DoD M&S governance as defined in DoDD 5000.59. One exception is the AF Training community specifically refers to Operational training, and the AF Education and Formal Training community refers to education and basic training. Together, they align with the DoD Training community. In addition, the USAF more explicitly identifies cross-cutting tools, data and services across the functional areas of M&S Foundations; logistics; intelligence, surveillance, and reconnaissance; and doctrine. The M&S in the cross-cutting areas is intended to encompass both M&S to support those communities (e.g., a model used to support intelligence analysis) and M&S or data produced by those communities to support the other communities (e.g., a threat model to support an engagement level model or a logistics model or data set to support a campaign model). Additionally, the USAF uses cross-cutting data, tools, and services provided by DoD when necessary to support an activity; for example, data, tools, and services from air, space, ocean, and terrain providers.

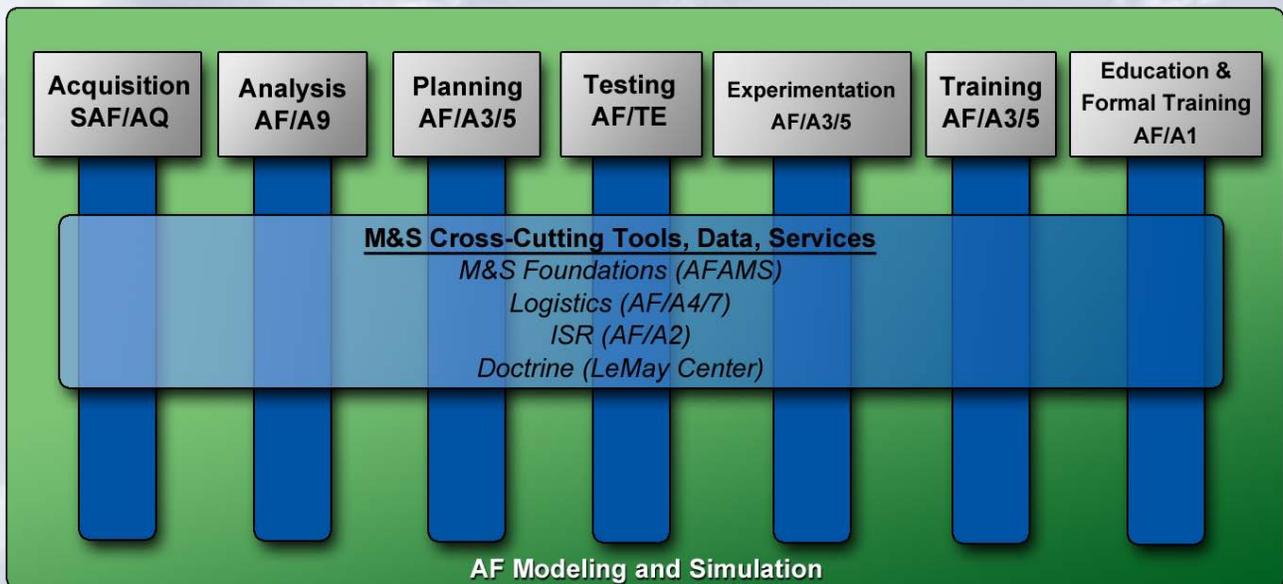


Figure 6: AF M&S Communities

The purpose of the AF M&S governance structure, and its associated forums, is to support the MAJCOMS by championing AF M&S capabilities, advocating for those capabilities within the established Air Force Corporate Structure, and strengthening the Live, Virtual, and Constructive representations of air, space and cyberspace capabilities in all Air Force, Joint, Inter-agency and

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Coalition M&S activities. Success is dependent on robust, collaborative and transparent participation of the MAJCOMs and other AF M&S stakeholders across the Air Force. It is not the intent of this vision for all AF M&S capabilities and resources to be controlled at the HQ AF level; MAJCOMs are empowered and have the authority to determine, and resource the specific M&S enabled capabilities required to fulfill their Title 10 responsibilities. However, many aspects of M&S reach across MAJCOMs and require oversight and advocacy at the AF corporate level. Specific roles and responsibilities, along with a description of key M&S forums are documented in AFPD 16-10, *Modeling and Simulation*.

DoD M&S Governance

The DoD M&S governance structure, depicted in Figure 7, along with the DoD M&S vision and supporting goals are summarized below. The Air Force M&S Communities provide representatives to their respective DoD M&S Community forums where cross-Service collaboration occurs. In addition, the Services participate in the DoD M&S management structure where further collaboration occurs.

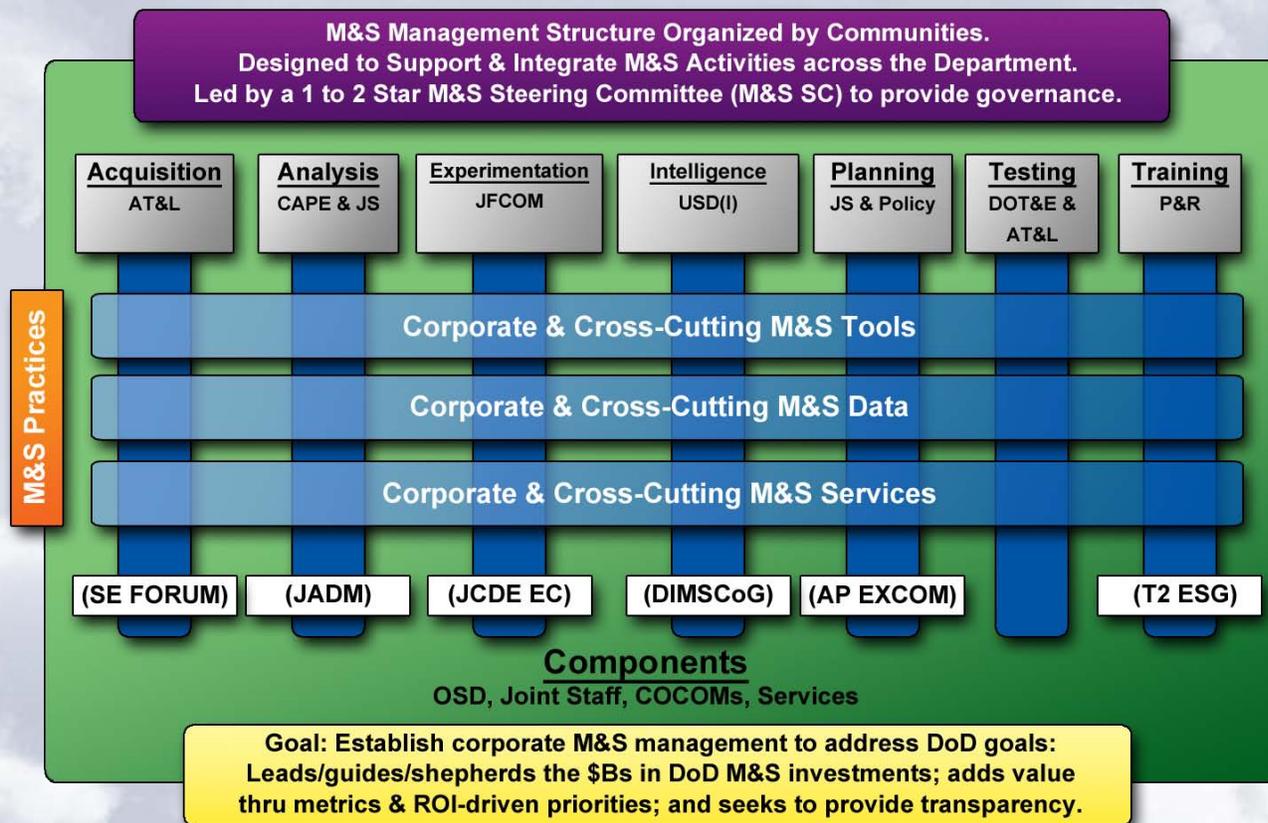


Figure 7: DoD M&S Governance

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DoD Component Responsibilities.

- Implement management processes that provide visibility and access to Component-level M&S programs and activities
- Develop, manage, and provide Component representation data, and support the development of tools and services for DoD Community specified models and simulations
- Maximize the commonality, reuse, interoperability, efficiencies, and effectiveness of Component-specific M&S data, tools, and services

DoD Strategic Vision and Goals[†].

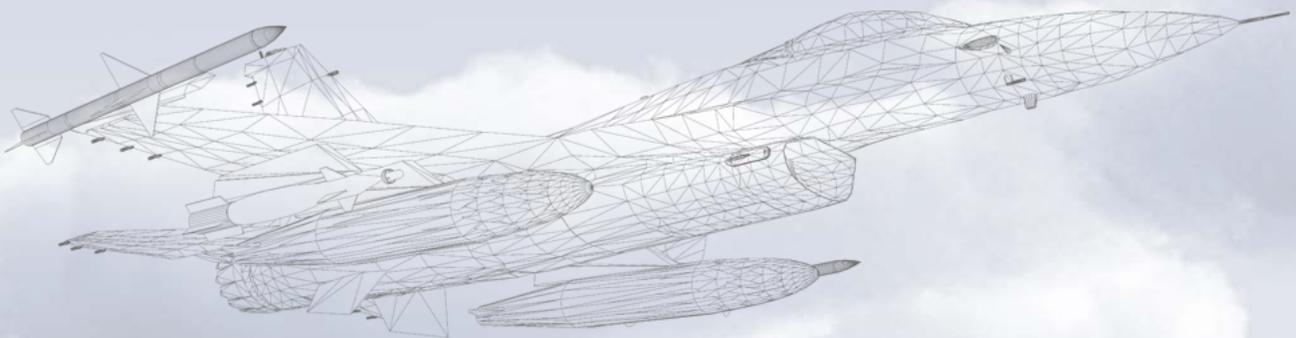
The DoD Strategic M&S Vision is: “Empower DoD with modeling and simulation capabilities that effectively and efficiently support the full spectrum of the Department’s activities and operations.” The DoD M&S Steering Committee identified five goals that support achievement of this vision.

- Standards, architecture, networks and environment that:
 - o Promote the sharing of tools, data, and information across the Enterprise
 - o Foster common formats
 - o Are readily accessible and can be reliably applied by users
- Policies at the enterprise level that:
 - o Promote interoperability and the use of common M&S capabilities
 - o Minimize duplication and encourage reuse of M&S capabilities
 - o Encourage research and development to respond to emerging challenges
 - o Limit the use of models and data encumbered by proprietary restrictions
 - o Leverage M&S capabilities across DoD, other government agencies, international partners, industry, and academia
- Management processes for models, simulations, and data that:
 - o Enable M&S users and developers to easily discover and share M&S capabilities and provide incentives for their use

[†] ODDR&E Memorandum, “Strategic Vision for DoD Modeling and Simulation,” 24 August 2007 (see: http://www.msco.mil/files/Strategic_Vision_Goals.pdf)

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- Facilitate the cost-effective and efficient development and use of M&S systems and capabilities
- Include practical Verification, Validation, and Accreditation (VV&A) guidelines that vary by application area
- Tools in the form of models, simulations, and authoritative data that:
 - Support the full range of DoD interests
 - Provide timely and credible results
 - Make capabilities, limitations, and assumptions easily visible
 - Are useable across communities
- People that:
 - Are well-trained
 - Employ existing models, simulations, and data to support departmental objectives
 - Advance M&S to support emerging departmental challenges



APPENDIX 2 – Acronyms and Glossary

ACRONYMS

CDS—Cross-domain Solutions

CONOPS—Concept of Operations

D, PA&E—Director, Program Analysis and Evaluation

DoD—Department of Defense

DoDD—DoD Directive

DOTMLPF—Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities

DPS—Defense Planning Scenarios

GOSG—General Officer Steering Group

LVC—Live, Virtual, and Constructive

MADL—Multifunction Advanced Data Link

M&S—Modeling and Simulation

MLS—Multilevel Security

MNIS—Multi-National Information Sharing

MSFD—Multi-Service Force Deployment

SADL—Situation Awareness Data Link

TTP—Tactics, Techniques, and Procedures

VV&A—Verification, Validation and Accreditation

GLOSSARY

Air Force Concepts. Describe the ways (sequenced actions) in which we employ military means (capabilities) to accomplish desired ends (effects). Air Force concepts describe how the USAF intends to employ air and space power in support of Joint Operating Concepts and national security and national military objectives. (AFPD 10-28)

Air Force Wargame Strategy. Title 10 and other major Joint and Service wargames are designed to explore new concepts and capabilities; study and refine emerging operational concepts; prevent technological, strategic, and operational surprise; and evaluate the Air Force Strategic Plan and Vision, and assess alternative plans and visions. Such wargames are one tool used to shape military capabilities to best respond to emerging future warfighting environments and National security challenges. These wargames use a range of plausible wargame scenarios addressing military operations other than war through major theater warfare to improve understanding of future challenges and potential responses. These results are also used to guide follow-on studies, analyses, modeling and simulation that are used to address the key warfighting insights, questions and issues. Outputs from mid-term wargames with the associated follow-on supporting studies and analyses are used to advance new technologies and concepts, contribute to the Air Force's Quadrennial Defense Review process, and develop strategies and doctrine for incorporation into experiments, exercises, and other forums for evaluation. Similarly, outputs from far-term wargames are used to influence strategic planning, experimentation, concept development, concepts of operations, future force structure investment streams, and the Air Force Vision. (AFI 10-2305)

Architecture. The structure of components in a program/system, their interrelationships, and the principles and guidelines governing their design and evolution over time. (DoD 5000.59-M)

Capability. The ability to achieve a desired effect under specified standards and conditions through a combination of means and ways across the doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) to perform a set of tasks to execute a specified course of action. (DoDD 7045.20)

Capability Gaps. The inability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks. The gap may be the result of no existing capability, lack of proficiency or sufficiency in existing capability, or the need to replace an existing capability. (CJCSI 3170.01G)

Concept. A notion or statement of an idea -- an expression of how something might be done. (CJCSI 3010.02B)

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Concept of Operations (CONOPS). A verbal or graphic statement, in broad outline, of a commander's assumptions or intent in regard to an operation or series of operations. (AFPD 10-28)

Constructive Simulation – Models and simulations that involve simulated people operating simulated systems. Real people stimulate (make inputs to) such simulations, but are not involved in determining the outcomes. (DoD 5000.59-P)

Cross-Domain Solution (CDS): Information assurance solution that provides the ability to access or transfer information between two or more security domains. (See multilevel security.) (CNSSI No. 4009)

Cyberspace: A global domain within the information environment consisting of the interdependent network of information technology infrastructures, including the Internet, telecommunications networks, computer systems, and embedded processors and controllers. (Joint Publication 1-02)

Cyberspace Operations: The employment of cyber capabilities where the primary purpose is to achieve military objectives or effects in or through cyberspace. Such operations include computer network operations and activities to operate and defend the Global Information Grid. (Joint Publication 1-02)

DoD Analytic Agenda. Under DoD Instruction 8260.01, it is DoD policy to conduct joint and collaborative strategic analyses, synchronized with Planning, Programming, Budgeting, and Execution System cycles to support both known and emerging analytical needs of top leadership. It mandates development, in a joint, transparent, and collaborative manner, appropriate, up-to-date, traceable, and integrated baselines based on CONOPS and forces using approved scenarios. The Analytic Agenda that currently meets these requirements includes Defense Planning Scenarios (DPS) developed by USD(P) as the demand function; the Multi-Service Force Deployment (MSFD) documents developed by CJCS as the representative whole-of-government campaign plan in response to the DPS demands; and the subsequent analysis results of the DPS/MSFDs as approved by the D, PA&E. These analysis results are identified as Analytic Baselines, and these baselines will be made available to the DoD Components. (Guidance for Development of the Force)

Experiment. A technology transition mechanism used to develop and assess concept-based hypotheses to identify and recommend the best value-added solutions for changes to doctrine, organizational structure, training, material, leadership and education, people, and facilities required to achieve significant advances in future joint operational capabilities. (AFPD 10-28)

Information Assurance: Measures that protect and defend information and information systems by ensuring their availability, integrity, authentication, confidentiality, and nonrepudiation.

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These measures include providing for restoration of information systems by incorporating protection, detection, and reaction capabilities. (CNSSI No. 4009)

Interoperability. The ability of systems, units, or forces to provide data, information, materiel, and services to and accept the same from other systems, units, or forces and to use the data, information, materiel, and services so exchanged to enable them to operate effectively together. Information Technology and National Security Systems interoperability includes both the technical exchange of information and the end-to-end operational effectiveness of that exchange of information as required for mission accomplishment. Interoperability is more than just information exchange. It includes systems, processes, procedures, organizations and missions over the life cycle and must be balanced with information assurance. (DoDD 4630.05)

Joint Experimentation. An iterative process for developing and assessing concept-based hypotheses to identify and recommend the best value-added solutions for changes in doctrine, organization, training, materiel, leadership and education, personnel, and facilities and policy required to achieve significant advances in future joint operational capabilities. (CJCSI 3170.01G)

Live Simulation – A simulation involving real people operating real systems. (DoD Publication 5000.59-P)

Major Wargame. An Air Force, Joint or other Service wargame designed to impact future Air Force force structure and employment concepts. (AFI 10-2305)

Model: A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process. (DoD 5000.59-M)

Modeling: Application of a standard, rigorous, structured methodology to create and validate a physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process. (DoD 5000.59-M)

Modeling and Simulation (M&S): The use of models, including emulators, prototypes, simulators, and stimulators, either statically or over time, to develop data as a basis for making managerial or technical decisions. The terms "modeling" and "simulation" are often used interchangeably. (DoD 5000.59-M)

M&S Infrastructure. A M&S infrastructure consists of M&S systems and applications, communications, networks, architectures, standards and protocols, and information resource repositories. (DoD 5000.59-M)

M&S Tools. Software that implements a model or simulation or an adjunct tool, i.e., software and/or hardware that is either used to provide part of a simulation environment (e.g., to manage the execution of the environment) or to transform and manage data used by or produced

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by a model or simulation. Adjunct tools are differentiated from simulation software in that they do not provide a virtual or constructive representation as part of a simulation environment. (DoDD 5000.59)

Multilevel Security (MLS). Concept of processing information with different classifications and categories that simultaneously permits access by users with different security clearances and denies access to users who lack authorization. (See cross-domain solution.) (CNSSI No. 4009)

Multinational Information Sharing (MNIS). MNIS is a net-centric environment based on common agreements and standards enabling enterprise services and dynamic exchange of information with mission partners. It builds upon the DOD's Net-Centric Enterprise Services, Net-Enabled Command Capability, and the Global Information Grid Information Assurance capabilities enabling combined C2. At its foundation, MNIS is a net-centric implementation of our national foreign disclosure policies and international agreements with mission partners enabling the dynamic exchange of information based on the classification and releasability of data vice the physical network separation of information. The MNIS materiel implementation provides an application-based capability synchronizing physical guarding solutions acting on data labeling, identities, and accesses. This capability enables the following MNIS enterprise services:

- Tailorable/User – defined/sharable Common Operational Tactical Picture.
- Event-, Role-, and Content-based sharing.
- Friendly/enemy location/status information sharing.
- Dynamic Communities of Interest. (ICD for MNIS)

Operational Environment – A composite of the conditions, circumstances, and influences that affect the employment of capabilities and bear on the decisions of the commander. (Joint Publication 1-02) It encompasses physical areas and factors (of the air, land, maritime, and space domains) and the information environment. Included within these are the adversary, friendly, and neutral systems that are relevant to a specific joint operation. (Joint Publication 3-0)

Simulation: A method for implementing a model over time. (DoD Directive 5000.59)

Simulator. A) A device, computer program, or system that performs simulation;
B) For training, a device which duplicates the essential features of a task situation and provides for direct human operation. (DoD 5000.59-M)

Tactics, Techniques and Procedures (TTP).

Tactics: The employment and ordered arrangement of forces in relation to each other.

Techniques: Non-prescriptive ways or methods used to perform missions, functions, or tasks.

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Procedures: Standard, detailed steps that prescribe how to perform specific tasks. (Joint Publication 1-02)

Title 10 Wargame. A Service-sponsored wargame, generally supported by participants from Joint Staffs, the Services, and other organizations, which is used to explore futuristic issues impacting doctrine, force structure, and/or employment concepts. (AFI 10-2305)

Total Force. The organizations, units, and individuals that comprise the DoD resources for implementing the National Security Strategy. It includes DoD Active and Reserve Component military personnel, military retired members, DoD civilian personnel (including foreign national direct- and indirect-hire, as well as non-appropriated fund employees), contractors, and host-nation support personnel. (DoDD 5124.02)

Verification, Validation and Accreditation (VV&A):

Verification: The process of determining that a model or simulation implementation accurately represents the developer's conceptual description and specification. Verification also evaluates the extent to which the model or simulation has been developed using sound and established software engineering techniques.

Validation: The process of determining the degree to which a model or simulation is an accurate representation of the real-world from the perspective of the intended uses of the model or simulation.

Accreditation: The official certification that a model or simulation is acceptable for use for a specific purpose. (DoD 5000.59-M)

Virtual Simulation – A simulation involving real people operating simulated systems. Virtual simulations inject human-in-the-loop in a central role by exercising motor control skills (e.g., flying an airplane), decision skills (e.g., committing fire control resources to action), or communication skills (e.g., as members of a C4I team). (DoD 5000.59-P)

Wargame. A simulation, by whatever means, of a military operation involving two or more opposing forces, using rules, data, and procedures designed to depict an actual or assumed real-life situation. (Joint Publication 1-02, 17 October 2008.)

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APPENDIX 3 – References

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