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DEPARTMENT OF DEFENSE HANDBOOK

SYSTEMS REQUIREMENTS DOCUMENT GUIDANCE

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FOREWORD

This handbook is approved for use by the Department of the Air Force and is available for use by all departments and agencies of the Department of Defense.

Comments, suggestions, or questions on this document should be addressed to ASC/ENRS, 2530 Loop Road W., Wright-Patterson AFB OH 45433-7101, or emailed to Engineering.Standards@wpafb.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil.

Pertinent data for improving this handbook may be addressed to HQ AFMC/ENS, 4375 Chidlaw Rd., Wright-Patterson AFB OH 45433-5006, or emailed to afmc.ens.workflow@wpafb.af.mil.

This handbook was prepared through the Continuous Capability Planning Integrated Product Team (CCP IPT) under Develop and Sustain Warfighting Systems (D&SWS) Process, Acquisition Improvement Plan (AIP) 2.1: Requirements Maturation Core Process. This core process is part of Secretary of the Air Force (SECAF) and Chief of Staff, Air Force (CSAF) directed transformation effort to define Air Force core processes within the AF Smart Operations for the 21st Century (AFSO21) program.

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EXECUTIVE SUMMARY

A guidance document/handbook or template for developing a System/Subsystem Requirements Document never existed. It was Department of Defense (DoD) best practice to use the System/Subsystem Specification DID and MIL-STD-961 as a reference point for establishing a SRD and subsequent system and subsystem specifications. After development of the Joint Services Specification Guides (JSSGs), under now defunct Joint Aeronautical Commander's Group (JACG), it served as a convenient template for a SRD at the system or subsystem level.

Data Item Description (DID) DI-IPSC-81431A, *System/Subsystem Specification*; and MIL-STD-961, *Department of Defense Standard Practice Defense and Program-Unique Specifications Format and Content*, coupled with several different Systems Engineering (SE) guides, formed the framework for this System Requirements Document (SRD) handbook. While no longer used by the United States Air Force (USAF) DI-IPSC-81431A is still in use by the United States Navy (USN). Since Acquisition Reform of the early 1990's, DoD Programs have relied upon industry best practices and contractor formatted specification documents that continue to reflect the intent of this DID. As this document was once a stalwart of the DoD specification process, the SRD Team has chosen to use it as the baseline for this handbook. Any deviations from the latest DID version will become update recommendations for future versions.

This SRD handbook includes a generic SRD template and format, and contains template examples representative of major weapon systems, e.g., Aircraft, Air Armament, Command & Control (C2), Nuclear Systems, and Space Systems. It is meant to be used as a guide to translate warfighter Capability Based Requirements (CBR), or other user/customer requirements, into performance based acquisition requirements, e.g., system requirements, for a system or subsystem in any program Milestone (MS) or phase. The handbook focus is on requirements analysis as related to SRD development, and is not intended to be a complete Systems Engineering Handbook or a repository for "System Requirements." Reference documents were used extensively in creating this handbook and were updated herein to current DoD policy and processes. Please refer to cited footnote references for further reading. One drawback to citing reference documents is that references change over time and it could be a challenge to keep current. With regulations and instructions, the latest is the one that should be followed. However, advantages outweigh drawbacks and this document will provide detailed background for anyone desiring a more in depth research into the subject. This handbook will be reviewed periodically for updates and will attempt to remain current.

A dedicated team of SE professionals across the AF assisted in drafting and editing this handbook. While it was prepared in an AF centric manner, the principles documented herein are equally applicable for any DoD program. The next version will remove all AF centricity if there is a DoD wide demand for this guidance. Core team members and major contributors are listed below. I welcome your comments and suggestions for future improvement.

//*SIGNED*//
Jeffery L. Pesler
SRD Team Lead and Principal Author

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ACKNOWLEDGMENTS

This work was conducted under the overall direction of Mr. Jeffery L. Pesler, Hq AFMC/ENS. Thanks and expressed appreciation is extended to the many individuals who contributed material, reviewed various drafts, or otherwise provided valuable input to this handbook.

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Final Edit and Publication	1.0	20100304

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1. SCOPE

1.1 Scope.

This handbook contains guidance for preparation of a System Requirements Document (SRD) using established Systems Engineering (SE) processes. It contains a generic SRD template with guidance, a standard SRD format, and contains sample templates representative of major weapon systems. It is meant to be used as a guide to translate warfighter Capability Based Requirements (CBR) into performance based acquisition requirements for a system or subsystem in any program Milestone (MS) or phase. The SE processes and principles found in this guidance are equally applicable to any DoD program/project.

2. APPLICABLE DOCUMENTS

2.1 General.

Documents listed below are not necessarily all documents referenced herein, but are those needed to understand information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks.

The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-961	–	Department of Defense Standard Practice Defense and Program-Unique Specifications Format and Content

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-61	–	Configuration Management Guidance
MIL-HDBK-881	–	Work Breakdown Structures for Defense Materiel Items

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications.

The following other Government documents, drawings, and publications form a part of this document to the extent specified herein.

AIR FORCE INSTRUCTIONS

AFI10-601	–	Capabilities Based Requirements Development
AFI10-604	–	Capabilities Based Planning
AFI61-204	–	Disseminating Scientific and Technical Information

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AFI63-101	–	Acquisition and Sustainment Life Cycle Management
AFI63-1201	–	Life Cycle Systems Engineering
AFI99-103	–	Capabilities Based Test and Evaluation
AFMCI 99-103	–	Test Management

(Copies of these documents are available online at http://www.e-publishing.af.mil/.)

CHAIRMAN OF THE JOINT CHIEFS OF STAFF INSTRUCTION

CJCSI 3170.01	–	Joint Capabilities Integration and Development System
JCIDS Manual	–	Manual for the Joint Capabilities Integration and Development System

(Copies of this document are available online at http://www.dtic.mil/cjcs_directives/cjcs/instructions.htm.)

DATA ITEM DESCRIPTION (DID)

DI-IPSC-81431	–	System/Subsystem Specification (SSS)

(Copies of this document are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

DEPARTMENT OF DEFENSE DIRECTIVES AND INSTRUCTIONS

DoDD 5000.01	–	The Defense Acquisition System
DoDI 5000.02	–	Operation of the Defense Acquisition System
DoD 5200.1-PH	–	DoD Guide to Marking Classified Documents
DoD 5200.1R	–	Information Security Program
DoDD 5230.34	–	Distribution Statements on Technical Documents
DoDD 5230.35	–	Withholding of Unclassified Technical Data from Public Disclosure
DoDD 8320.02	–	Data Sharing in a Net Centric Department of Defense
DoDD 8500.01	–	Information Assurance (IA)
DoDI 8500.2	–	Information Assurance (IA) Implementation

(Copies of these documents are available online at http://www.dtic.mil/whs/directives/.)

2.3 Non-Government publications.
The following documents form a part of this document to the extent specified herein.

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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE STD 610.12	–	Standard Glossary of Software Engineering Terminology
IEEE STD 1220-2005	–	(ISO/IEC 26702), Application and Management of the Systems Engineering Process
IEEE STD 1471-2000	–	Systems and Software Engineering - Recommended Practice for Architectural Description of Software Intensive Systems

(Application for copies should be addressed to the IEEE Service Center, P.O. Box 1331, 445 Hoes Lane, Piscataway, NJ 08855-1331, or online at http://www.ieee.org/portal/site.)

3. PURPOSE

3.1 Introduction.

This SRD handbook supports AFI10-601, *Capabilities Based Requirements Development;* AFI10-604, *Capabilities Based Planning;* and AFI63-101, *Acquisition and Sustainment Life Cycle Management,* by providing a bridge between warfighter and acquisition communities. It has been developed to standardize and formalize the requirements analysis process to translate warfighter CBR into acquisition requirements using Data Item Description (DID) DI-IPSC-81431A, *System/Subsystem Specification,* and MIL-STD-961, *Department of Defense Standard Practice Defense and Program-Unique Specifications Format and Content,* as the framework. It is intended to guide SRD preparation for all programs during Request for Proposal (RFP) development, pre contract award, and Engineering Change Proposal (ECP) or Contract Change Proposal (CCP) development after contract award, or any other application requiring translation of warfighter CBR into acquisition requirements. It may be used by any DoD component or acquisition organization. Guidance is meant to be generic enough to be used in support of all program MSs and phases, and has been written to encompass system as well as subsystem development, modification, or update. Detailed templates are provided to illustrate template tailoring for different types of weapon systems, e.g., Aircraft Systems, Command and Control (C2) Systems, Air Armament Systems, Nuclear Weapon Systems, and Space Systems. This handbook offers maximum flexibility in creating a SRD and accommodates any given set of warfighter CBR. Requirements analysis processes are transparent to a program's MS or phase, and supports early acquisition programs through mature programs undergoing modification or update. Development of a SRD is a critical part of Life Cycle Systems Engineering (LCSE) processes described in AFI63-1201, *Life Cycle Systems Engineering*.

3.2 Functional baseline.

A SRD establishes the basis for an acquisition program functional baseline (FBL). It documents acquisition requirements translated from a warfighter CBR[1] document into an acquisition format used as a baseline for a system or subsystem specification typically prepared by a contractor. It

1. AFI63-101, Acquisition and Sustainment Life Cycle Management, paragraph 3.3, 17 April 2009

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communicates government system or subsystem requirements in a concise, measurable, and understandable fashion. At contract award the SRD is replaced by a documented FBL in a contractor prepared system or subsystem specification. The generic SRD template in this handbook is written in a very broad fashion without documenting specific requirements. It was meant to be used to document acquisition requirements for a range of systems or subsystems that can be passed to a contractor as part of a RFP, ECP, or CCP. The generic SRD template accommodates any MS (e.g., pre MS A, MS A, MS B, MS C) or program phase. As every program is unique with its own set of requirements, so will each respective SRD be unique. There is no one single template or format suitable for all systems and subsystems hence a generic template was developed. Examples of AF Center specific SRDs are provided to illustrate how the generic template can be used to support development of a SRD for a wide range of diverse systems or subsystems.

3.3 SRD guidance applicability.

SRD guidance in this handbook applies to all AF programs, or any DoD program, and also applies to applications that previously used a Technical Requirements Document (TRD). Previously, there was no policy, standard, or handbook to guide preparation of a SRD or TRD. Both documents served the purpose of translating warfighter CBR into acquisition requirements. This handbook provides guidance for development of a standardized SRD for all programs having to translate warfighter CBR into acquisition requirements.

3.4 SRD purpose.

Used during source selection, a SRD is the primary document driving selection of a realistic and affordable solution to the warfighter's CBR. The SRD is prepared early during RFP development and is normally based upon an Air Force Requirements Oversight Council (AFROC) and Joint Requirements Oversight Council (JROC) approved CBR document or an AF alternative CBR[2]. It translates required warfighter CBR into system/subsystem acquisition requirements addressing such concerns as performance; supportability; physical and functional integration; human integration; security, test and evaluation; quality assurance; hardware; software; etc. The SRD will also be used on mature programs to add or modify current capabilities.

3.5 Early systems engineering[3].

Throughout the acquisition process, SE provides the technical foundation for an acquisition program. Particularly in early stages of an acquisition, SE analysis and products are vital to a program office's ability to assess feasibility of addressing warfighter CBR, technology needs of potential solutions, and robust estimates of cost, schedule, and risk, all leading to predictable, disciplined acquisition. With increased emphasis in the new DoD Instruction 5000.02 on Materiel Solution Analysis[4] and Technology Development[5] there is a need for increased

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2. AFI10-601, para. 2.2.2-2.2.8, 31 July 2006

3 United States Air Force Early Systems Engineering Guidebook, 31 Mar 2009, Assistant Secretary of the Air Force for Acquisition (SAF/AQ), Version 1; https://www.my.af.mil/gcss-af/USAF/AFP40/d/1073912418/Files/editorial/Early%20Systems%20Engineering%20Guide%2031Mar2009%20Signed.docx.

4. DoDD 5000.02, *Operation of the Defense Acquisition System*, 8 December 2008, Enc 2, para. 4

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emphasis on SE during these activities. The basis for the United States Air Force Early Systems Engineering Guidebook is a white paper discussing issues of early SE that can be accessed at The National Academies Press website[6].

4. SRD DESCRIPTION

4.1 SRD requirements development.

A primary SE objective is to gain sufficient technical knowledge to develop a program's SRD. The program office engineering team defines system or subsystem level functional and performance requirements derived from warfighter CBR documents, Concept of Operations (CONOPS), Analysis of Alternatives (AOA), system-level performance metrics, mission threads/use cases, and usage environment, which are captured in a program's SRD.

4.2 Performance based SRD.

The program office engineering team defines acquisition requirements in terms of system level attributes, and associated constraints defined by the warfighter. Acquisition requirements are prepared in a performance based fashion. The SRD avoids describing a specific solution unless there is a compelling warfighter CBR need. It should not preclude leasing, commercial, or non-developmental solutions. The SRD should not contain any programmatic or Statement of Work (SOW) or Statement of Objective (SOO) language that belong in other sections of an RFP or ECP. During the subsequent source selection, these requirements, as documented in the offeror's draft system or subsystem specification, are evaluated for cost, performance, schedule, and risk of various candidate solutions resulting in a best value solution. Note: The Defense Acquisition Guidebook[7] (DAG) uses the term "system performance specification" interchangeably with "system specification." System specification is used exclusively throughout this handbook.

4.3 Capabilities-Based Requirements (CBR) documents.

There are three Joint Capabilities Integration and Development System (JCIDS)[8] CBR capability documents used for materiel development: Initial Capability Document (ICD), Capability Development Document (CDD) and Capability Production Document (CPD). Details on use, content, and format of JCIDS documents are located in CJCSI3170.01 and JCIDS Manual. The Joint Capabilities Document (JCD) was rescinded by CJCSI3170.01G, but may still exist on some programs. Additionally, the Air Force has established several alternative means for documenting CBR that are suitable in some situations: Air Force Capabilities Document (AFCD), Combat Capability Document (CCD), and AF Form 1067, Modification Proposal[9].

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5. Ibid, Enc 2, para. 5
6. *Pre-Milestone A and Early-Phase Systems Engineering: A Retrospective Review and Benefits for Future Air Force Acquisition,* National Research Council, 2008, The National Academies Press, http://www.nap.edu/catalog.php?record_id=12065
7. Defense Acquisition Guidebook, https://dag.dau.mil
8. CJCSI 3170.01, Joint Capabilities Integration and Development System, http://www.dtic.mil/cjcs_directives/cdata/unlimit/3170_01.pdf
9. AFI10-601, *Capabilities Based Requirements Development*, 31 July 2006

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4.4 Requirements Correlation Table.

JCIDS, CDD, CPD and AF Form 1067 are required by AFI10-601 to have a Requirements Correlation Table (RCT)[10] for Key Performance Parameters (KPPs), Key System Attributes (KSAs), and Attributes. The RCT lists each capability requirement, associated threshold, objective and rationale/analytical reference. Section 4 of a SRD contains verification provisions for each requirement and Section 5 contains a requirements traceability matrix that traces SRD requirements up to warfighter capability documents, and requirements to verification methodology matrix that shows how each requirement is to be verified. Each SRD KPP and KSA should have an associated threshold and objective. Attributes should include thresholds and objectives as applicable. SRDs will display applicable thresholds and objectives in each paragraph. Individual requirements should be uniquely identified and traceable. Automated tools used for traceability should be capable of supporting required metadata, including rationale/analytical references for each requirement. The RCT metadata should be included for each requirement in a SRD, system/subsystem specification and lower tiered specifications. If an automated tool is not used, provide rational/analytical reference for each requirement as part of the requirements traceability matrix.

4.5 Contract award.

At contract award, the program's FBL is documented in a contractually binding approved system or subsystem specification which now defines requirements an acquisition program intends to achieve. For a mature program, a SRD provides the basis of FBL modifications documented in an approved system or subsystem specification. A system or subsystem specification forms a basis for Test and Evaluation (T&E) of the resultant system or subsystem. Refer to MIL-HDBK-61 for a detailed description of functional and allocated baselines (ABL). The SRD is written at Work Breakdown Structure (WBS) Level I per MIL-HDBK-881, whether prepared for a system or subsystem. The SRD is not a design specification; it contains only top-level performance based requirements for a system or subsystem. While written at WBS Level I, lower WBS elements that have system level requirements are included in a system level SRD, e.g., RADAR integration requirements.

5. APPROVAL

5.1 Signatures and coordination.

Program Manager and Program Chief Engineer sign the SRD certifying the requirements. A revision to AFI63-101 is expected to also require MAJCOM coordination based upon ACAT designation. A guidance memorandum is expected to be issued ahead of AFI63-101 revision.

6. SRD PREPARATION INTRODUCTION

6.1 SRD preparation.

Preparation of a SRD requires a thorough understanding of the requirements analysis process. Requirements analysis is an iterative SE process used to understand warfighter CBR and

10. Ibid

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translate those capabilities into acquisition requirements. With this understanding, and the generic SRD template, an acquisition program office engineering team will be able to create a SRD that is easily translatable into a system or subsystem specification by an offeror or contractor.

6.1.1 Defining acquisition requirements.

An acquisition program office engineering team employs requirements analysis iteratively throughout the SRD development effort to define performance based acquisition requirements for the weapon system. To achieve a complete, balanced system design, acquisition requirements define required attributes for the functional baseline. These attributes will be prioritized as KPPs, KSAs, and Attributes. The functional baseline, as documented in the system/subsystem specification, captures the performance description in terms of performance based requirements and verification methods for each element of a system or subsystem.

6.1.2 Core SE process.

Requirements analysis is a core SE process that begins with definition of the warfighter's CBR. The acquisition community should be involved during development of the warfighter's CBR documents and the warfighter should be a participant on the SRD development team. This will ensure complete understanding of the warfighters CBR and capabilities/requirements will be developed using characteristics of good requirements listed in paragraph 7.4.

7. REQUIREMENTS ANALYSIS PROCESS[11,12]

7.1 Introduction.

This section follows requirements analysis described in System Engineering Fundamentals, Chapter Four. Another good discussion of requirements analysis can be found in IEEE STD 1220-2005.

7.2 Process inputs[13].

Typical inputs to the SE requirements analysis process include but are not limited to: warfighter needs, objectives and operational requirements in the form of CBR, missions, Measures of Effectiveness/Measures of Suitability/Measures of Performance (MOE/MOS/MOP), environments, KPPs, KSAs, attributes, technology base, output requirements from prior application of SE process, program decision requirements, suitability requirements, and project constraints. Capability based requirements, or simply capabilities, relate directly to desired performance characteristics of the system. They are stated life-cycle warfighter CBR needs and

11. Systems Engineering Fundamentals, January 2001, Chapter 4, Defense Acquisition University Press, Ft Belvoir Va, 22060. Available from Acquisition Community Connection: (http://www.dau.mil/pubscats/Pages/sys_eng_fund.aspx)
12. IEEE 1220-2005 (ISO/IEC 26702), Application and Management of the Systems Engineering Process, 15 July 2007
13. Systems Engineering Fundamentals, January 2001, Chapter 4, Defense Acquisition University Press, Ft Belvoir Va, 22060. Available from Acquisition Community Connection: (http://www.dau.mil/pubscats/Pages/sys_eng_fund.aspx)

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objectives for the system, and they relate to how well the system will work in its intended environment over its service life.

Input requirements should be comprehensive and defined for both system products and system processes such as development, manufacturing, verification, deployment, operations, support, training and disposal (eight primary functions).

7.2.1 Constraints.

Constraints are conditions that exist because of limitations imposed by cost, schedule, external interfaces, project support, need for standardization/commonality, technology, or life cycle support systems. Constraints limit development teams' design opportunities and should be used selectively.

7.2.2 System technical requirements.

System technical requirements are a primary focus in SE processes because the primary objective is to transform the warfighter's CBR into acquisition requirements used to contract for the system design and development. The SE process develops designs based upon these system technical requirements within a set of constraints and policy. All requirements should be verified to ensure they meet both performance and constraints.

7.3 Types of technical requirements[14].

Technical requirements define system attributes and are categorized in several ways. The following are common categorizations of requirements that relate to technical management. The warfighter's CBR can be in the form of functional, performance, operational or design requirements. These requirements are analyzed using requirements analysis and are further refined by the acquisition team into acquisition requirements documented in the SRD.

7.3.1 Warfighter capability based requirements.

Warfighter CBR are capability based requirement statements and assumptions that define system or subsystem expectations and needs in terms of needed performance capabilities, mission objectives, environment, constraints, measures of MOE/MOS/MOP[15,16]. Capabilities are prioritized as Key Performance Parameters (KPPs), Key Systems Attributes (KSAs), and Attributes.

7.3.2 Functional requirement.

A functional requirement is a necessary task, action or activity that should be accomplished. Functional (what has to be done) requirements identified in requirements analysis will be used as the top level functions for functional analysis at a lower WBS level.

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14. Systems Engineering Fundamentals, January 2001, Chapter 4, Defense Acquisition University Press, Ft Belvoir Va, 22060. Available from Acquisition Community Connection: (http://www.dau.mil/pubscats/Pages/sys_eng_fund.aspx)
15. Ibid, Ch-14
16. Defense Acquisition Acronyms and Terms, 13th Edition, November 2009, http://www.dau.mil/pubscats/Pages/preface.aspx

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7.3.3 Performance requirements.

Extent to which a mission or function should be executed; generally measured in terms of quantity, quality, coverage, timeliness or readiness. During requirements analysis, performance (how well does it have to be done) requirements will be interactively developed across all identified functions based on system life cycle factors; and characterized in terms of degree of certainty in their estimate, degree of criticality to system success, and relationship to other requirements.

7.3.4 Design requirements.

"Build to," "code to," and "buy to" requirements for products and "how to execute" requirements for processes expressed in technical data packages and technical manuals, a warfighter's CBR or the SRD. Design requirements should be used judiciously at the system/subsystem level to avoid placing undue constraints on the design team.

7.3.5 Derived requirements.

Implied or transformed requirements broken out from higher-level requirements, e.g., a requirement for long range or high speed may result in a derived design requirement for low weight.

7.3.6 Allocated requirements.

Allocated requirements are established by dividing or otherwise allocating a high-level requirement into multiple lower-level requirements. Example: A 100-pound item that consists of two subsystems might result in weight requirements of 70 pounds and 30 pounds for the two lower-level items.

7.3.7 Acquisition requirements.

System requirements are derived from the warfighter's CBR and written in performance based terms that further define system or subsystem attributes using the requirements analysis process. Acquisition requirements, prioritized by KPPs, KSAs, and attributes, may use design, derived, and allocated requirements to further define required system attributes. Acquisition requirements are documented in the SRD and facilitate communication of the warfighter's CBR to a contractor or offeror in contractual terms, i.e., each requirement is in its own paragraph and contains a "shall" statement. Once the contractor or offeror further refine acquisition requirements, they become contractually documented in a weapon system or subsystem specification.

7.3.8 Specific design solution.

In special circumstances where there is need for commonality across a System of Systems (SoS) or Family of Systems (FoS) a specific design solution may be necessary. Justification of a specific solution should be provided by the warfighter community and documented in the approved acquisition strategy.

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7.4 Characteristics of good requirements[17].

Good requirements have certain common characteristics that should be strictly adhered to. Characteristics of good requirements include the following:

a. A requirement should be achievable. It should specifically reflect need or objective for which a solution is technically realistic at costs considered affordable.

b. A requirement should be verifiable. It should not be defined by ambiguous words, e.g., excessive, sufficient, resistant, minimal, etc. Expected performance and functional utility should be expressed in a manner that allows verification to be objective, preferably measureable quantitatively.

c. A requirement should be unambiguous. It should have only one possible meaning so it is uniquely testable and verifiable.

d. A requirement should be complete. It should contain all information needed to interpret and verify the requirement, including environmental and/or operational conditions relevant to the requirement.

e. A requirement should be performance based. It should be expressed in terms of need, not solution, i.e., it should address "why" and "what" of a need, not how to do it.

f. A requirement should be consistent with other requirements. Conflicts should be resolved up front prior to release of an RFP or ECP.

g. A requirement should be appropriate for the level of system hierarchy. It should not be too detailed that it constrains solutions for the current level of design, e.g., detailed requirements relating to components would not normally be in a system-level specification.

7.5 Requirements analysis[18].

Requirements analysis begins in support of the warfighter's CBR development. Requirements analysis involves defining warfighter CBR needs and objectives in the context of planned warfighter use, environments, constraints, and identified system characteristics which are then used to develop acquisition requirements documented in a SRD. Any prior analyses are reviewed and updated, refining mission and environment definitions to support system definition (e.g., other system items, performance requirements for identified functions) and verify that people, product, and process solutions (from synthesis) can satisfy the warfighter CBR needs. Requirements analysis is conducted iteratively with functional analysis to optimize performance requirements for identified functions, and to verify that synthesized solutions can satisfy warfighter CBR needs.

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17. Systems Engineering Fundamentals, January 2001, Chapter 4, Defense Acquisition University Press, Ft Belvoir Va, 22060. Available from Acquisition Community Connection: (http://www.dau.mil/pubscats/Pages/sys_eng_fund.aspx)
18. Ibid. Ch-4

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7.5.1 Requirements analysis purpose.

The purpose of requirements analysis is to:

a. Develop warfighter CBR and objectives;

b. Define initial performance capabilities and objectives and refine them into acquisition requirements;

c. Identify and define constraints that limit solutions; and

d. Define functional and performance requirements based on warfighter provided MOE/MOS/MOP.

7.5.2 Requirements analysis result.

In general, requirements analysis should result in a clear understanding of:

a. Functions: what the system has to do;

b. Performance: how well the functions and resultant system or subsystem have to perform;

c. Interfaces: environment in which the system or subsystem will perform; and

d. Other requirements and constraints.

7.5.3 Design basis.

Understanding that comes from requirements analysis establishes a basis for functional and physical designs to follow. Good requirements analysis is fundamental to successful design definition. Requirements analysis is a highly iterative process and is used by the warfighter to create capabilities documents, by an acquisition program office to define acquisition requirements as documented in a SRD, and by developing organization (e.g., offeror, contractor) that produces system/subsystem requirements that form a FBL as basis for all necessary derived and allocated requirements used to design and develop a system/subsystem.

8. ROLE OF INTEGRATED TEAMS[19]

Warfighters typically have operational expertise with particular weapon systems but not acquisition, whereas acquisition program office staff members are not necessarily well versed in operational aspects. Typically, a warfighter's CBR need is neither clearly nor completely expressed in a way directly usable by developers. Teamwork between warfighter and acquisition communities is necessary to understand the problem, analyze capability needs, and prepare acquisition requirements. Warfighters often find it easier to describe a system that attempts to solve a problem rather than to describe the problem itself. Although these "solutions" may be workable to some extent, an optimum solution is obtained through a proper technical development effort that balances warfighter mission objectives, functions, MOE/MOS/MOP, and

19. Systems Engineering Fundamentals, January 2001, Chapter 4, Defense Acquisition University Press, Ft Belvoir Va, 22060. Available from Acquisition Community Connection: (http://www.dau.mil/pubscats/Pages/sys_eng_fund.aspx)

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constraints. An integrated approach to capability need and acquisition requirements development will balance the analysis of requirements by providing understanding and accommodation between the warfighter and acquisition communities.

8.1 Continuous Capability Planning (CCP).

CCP integrates MAJCOM led Capabilities-Based Planning (CBP) processes and acquisition led Development Planning (DP) processes. It is designed as a rigorous and iterative high-level activity, and is intended to ensure properly articulated capability needs are met through development of robust concepts, appropriate allocation of requirements, and delivered warfighting systems. Achieving high-confidence programs is a result of systematically moving from capability needs to allocation of system functions. Requirements analysis is at the heart of the CCP process which ensures linkages between system and operational requirements are addressed, understood, and maintained.

8.2 Early SE effort[20].

Capabilities Based Assessment (CBA)/JCIDS scope and trade-space characterization of early SE efforts typically will occur concurrently. The using or sponsoring major command (MAJCOM) owns the CBA/JCIDS process, and leads team efforts supported by acquiring commands and the Air Force Research Laboratory (AFRL) to identify any capability shortfalls. Acquiring commands, led by concept development organizations (typically XR), are responsible for implementing early SE processes involving team efforts supported by the MAJCOM and AFRL to identify candidate solution sets to overcome capability shortfalls. The MAJCOM is responsible for submitting appropriate JCIDS documentation. Acquiring commands are responsible for developing Concept Characterization and Technical Descriptions (CCTD) documentation. For JCIDS and early SE documentation, all team member organizations participate in development of supporting material and in reviews.

8.3 Systems Engineering Working Level IPT (SE-WIPT).

Systems engineering is typically implemented through multidisciplinary teams of subject matter experts (SMEs) (often formally chartered as an Integrated Product Team (IPT)) and through a SE-WIPT[21]. The SE-WIPT translates warfighter-defined CBR into acquisition requirements consistent with cost, schedule, and performance constraints (see DoD Directive 5000.01, and Defense Acquisition Guidebook section 11 discussions of Knowledge-Based Acquisition).

8.3.1 Team interaction.

There should be active participation by the acquisition community early in development of any warfighter, or other user, CBR requiring a materiel solution and the acquisition community should involve active participation of the warfighter, or other user, community in requirements analysis that result in a SRD. It is expected that all other required functional organizations, e.g., Logistics, Test and Evaluation, Intelligence, Safety, etc., will participate in the development of

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20. United States Air Force Early Systems Engineering Guidebook, 31 Mar 2009, Assistant Secretary of the Air Force for Acquisition (SAF/AQ), Version 1; https://www.my.af.mil/gcss-af/USAF/AFP40/d/1073912418/Files/editorial/Early%20Systems%20Engineering%20Guide%2031Mar2009%20Signed.docx.
21. Defense Acquisition Guidebook, https://dag.dau.mil

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the warfighter, or other user, CBR and SRD. The following excerpts are taken from the USAF Early Systems Engineering Guidebook[22], describing roles played by the warfighter, acquisition, and Air Force Research Laboratory communities in early SE processes. A SRD will be prepared any time warfighter CBR are translated into acquisition requirements in order to facilitate a contractual relationship with a development organization.

8.3.2 Leadership transfer.

As JCIDS and trade space characterization processes approach transition to candidate solution sets characterization, a sponsoring MAJCOM will typically turn over leadership to an acquiring command. An XR organization or program office cadre will usually assume leadership, with AFRL providing support. It is still necessary for a MAJCOM to have an active role, as it is the only organization that can interpret warfighter CBR needs and approve changes; it also advises on whether a potential solution can or will be funded. During this stage, the lead acquisition organization is responsible for completing the SRD and preparing for any required reviews.

8.3.3 AF requirements determination/validation.

AF requirements determination/validation is a disciplined process starting with warfighter CBR needs and shortfalls coming out of the JCIDS and Capabilities Review and Risk Assessment (CRRA) process. It involves all operational, materiel command, and supporting stakeholders; and results in materiel solutions being identified, designed, and delivered to meet stated capability needs and shortfalls with speed and credibility.

9. REQUIREMENTS MANAGEMENT[23]

Requirements Management is an important support activity to the warfighter CBR, SRD, and subsequent system/subsystem development: providing configuration control, documentation of decisions, and traceability of all requirements to ensure the pedigree of each requirement. Requirements management provides traceability back to warfighter-defined CBR as documented through either a JCIDS CBR document or other warfighter-defined source, and to other sources of requirements. As the SE process proceeds, requirements are developed to increasing lower levels of design. Requirements traceability is conducted throughout the system life cycle and confirmed at each technical review. Traceability between requirements documents and other related technical planning documents, such as the Test and Evaluation Master Plan (TEMP), should be maintained through a relational data base, numbering standards, or other methods that show relationships and associated metadata[24], (e.g., who, what, when, why). A good requirements management system should allow for traceability from the lowest level component all the way back to the warfighter capability document or other source document from which it was derived. Traceability should be maintained from the SRD to applicable higher level documentation and provides baseline traceability for the resultant system or subsystem

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22. United States Air Force Early Systems Engineering Guidebook, 31 Mar 2009, Assistant Secretary of the Air Force for Acquisition (SAF/AQ), Version 1; https://www.my.af.mil/gcss-af/USAF/AFP40/d/1073912418/Files/editorial/Early%20Systems%20Engineering%20Guide%2031Mar2009%20Signed.docx.
23. Defense Acquisition Guidebook, https://dag.dau.mil
24. (Department of Defense Directive (DoDD) 8320.02, *Data Sharing in a Net Centric Department of Defense*, 23 April 2007); http://metadata.dod.mil/mdr/irs/DDMS/index.html

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specification. After contract award, the SRD is replaced by a system or subsystem specification that is traceable to applicable higher level documentation and required test & verification methodologies and lower level specifications. The program manager should institute requirements management to do the following:

a. Maintain traceability of all requirements and associated test and verification methodologies from capabilities needs through design and test, down to the lowest system/subsystem component throughout the entire life cycle,

b. Document derived requirements and approved changes to requirements, and

c. Record all metadata including rationale for derived requirements and changes.

9.1 Capturing requirements[25].

At the time requirements are written, it is important to capture requirements statements along with metadata associated with each requirement. Metadata is supporting information necessary to help clarify and link requirements, e.g., date created, date changed, POC, approval authority, etc. Method of verification should also be thought through and captured for each requirement when developed. Verification method includes test, inspection, analysis, and demonstration. New or derived requirements uncovered during determination of the verification method should be documented. An example is requiring an additional test port to give visibility to an internal signal during integration and test. If a requirement cannot be verified, then either it should not be a requirement or the requirement statement needs to be rewritten. For example, the requirement to “minimize noise” is vague and cannot be verified. If the requirement is restated as “the noise level of the component X shall remain under Y decibels” then it is clearly verifiable. Examples of the types of metadata are provided in TABLE I.

9.2 Requirements management tools (RMT).

With ever increasing system complexity there is an increased need for RMTs with ever increasing capabilities. Modern RMTs should ensure requirements traceability, and document rationale and heritage of each requirement using metadata. Underlying analysis supporting trade study results and subsequent rationale for any requirement should be retained in the RMT. The analysis should include all relevant conditions and data that would enable analysis recreation if necessary. Metadata is crucial to convey and track the lineage of requirements passed to offerors/contractors. The AF is investigating use of automated RMTs and is in process of implementing a pilot program. The International Council on Systems Engineering (INCOSE) has reviewed many of the RMTs available and has compiled the results on their RMT survey webpage[26].

25. Ibid.
26. International Council on Systems Engineering, (INCOSE), http://www.incose.org/ProductsPubs/products/rmsurvey.aspx

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TABLE I. Sample Requirements Metadata[27].

Item	Function
Requirement ID	Provides a unique numbering system for sorting and tracking.
Rationale	Provides additional information to help clarify the intent of the requirements at the time they were written. (See "Rationale" box below on what should be captured.)
Traced from	Captures the bidirectional traceability between parent requirements and lower level (derived) requirements and the relationships between requirements.
Owner	Person or group responsible for writing, managing, and/or approving changes to this requirement.
Verification method	Captures the method of verification (test, inspection, analysis, demonstration) and should be determined as the requirements are developed.
Verification lead	Person or group assigned responsibility for verifying the requirement.
Verification level	Specifies the level in the hierarchy at which the requirements will be verified (e.g., system, subsystem, element).

Rationale

The rationale should be kept up to date and include the following information:

- **Reason for the Requirement:** Often the reason for the requirement is not obvious, and it may be lost if not recorded as the requirement is being documented. The reason may point to a constraint or concept of operations. If there is a clear parent requirement or trade study that explains the reason, then reference it.
- **Document Assumptions:** If a requirement was written assuming the completion of a technology development program or a successful technology mission, document the assumption.
- **Document Relationships:** The relationships with the product's expected operations (e.g., expectations about how stakeholders will use a product). This may be done with a link to the ConOps.
- **Document Design Constraints:** Imposed by the results from decisions made as the design evolves. If the requirement states a method of implementation, the rationale should state why the decision was made to limit the solution to this one method of implementation.

27. NASA Systems Engineering Handbook, Rev-1, NASA/SP-2007-6105, December 2007, National Aeronautics and Space Administration, NASA Headquarters, Washington DC 20546 http://ntrs.nasa.gov/

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10. NOTES

10.1 Intended use.

This handbook is guidance for the preparation of System Requirements Documents using established Systems Engineering processes. It is meant to be used as a guide to translate warfighter Capability Based Requirements into performance based acquisition requirements for a system or subsystem in any program Milestone or phase.

10.2 Subject term (key word) listing.

Acquisition requirements
Capability based requirements
Generic
Performance based requirements
Requirements analysis
Systems engineering
Template

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Acronyms and Definitions

A.1 ACRONYMS

ABL	Allocated Baseline
AFROC	Air Force Requirements Oversight Council
AFRL	Air Force Research Laboratory
AFSO21	Air Force core processes within the AF Smart Operations for the 21st Century
AIP	Acquisition Improvement Program
C2	Command and Control
CBA	Capability Based Assessment
CBR	Capabilities Based Requirements
CCP	Continuous Capability Planning
CDD	Capability Development Document
CSAF	Chief of Staff of the Air Force
CWBS	Contract Work Breakdown Structure
DAG	Defense Acquisition Guidebook
DCR	DOTMLPF Change Recommendation
DID	Data Item Description
DoD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities
DSP	Defense Standardization Program
D&SWS	Develop and Sustain Warfighting Systems
ECP	Engineering Change Proposal
FBL	Functional Baseline
FOS	Family of Systems
ICD	Initial Capability Document
ISP	Information Support Plan
JACG	Joint Aeronautical Commander’s Group
JCD	Joint Capability Document (Obsolete)
JCIDS	Joint Capabilities Integration and Development System
JROC	Joint Requirements Oversight Council

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JSSGs	Joint Services Specification Guides
KPP	Key Performance Parameter
KSA	Key System Attribute
MAJCOM	Major Command
MOE	Measures of Effectiveness
MOS	Measures of Suitability
MOP	Measures of Performance
MS	Milestone
PWBS	Program Work Breakdown Structure
RCT	Requirements Correlation Table (formerly Requirements Correlation Matrix)
RFP	Request for Proposal
RMT	Requirements Management Tools
SE	Systems Engineering
SECAF	Secretary of the Air Force
SME	Subject Matter Expert
SOS	System of Systems
SRD	System Requirements Document
TEMP	Test and Evaluation Master Plan
TRD	Technical Requirements Document
USAF	United States Air Force
WBS	Work Breakdown Structure

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A.2 DEFINITIONS

Air Force Capabilities Document (AFCD) – AFCD is primarily a planning document, which is normally generated as a result of the Air Force capability-based planning process. Although not recognized by the Joint Staff as a formal JCIDS document, AFCD is capability-based and lays the foundation for additional analysis and development of JCIDS documents. The AFCD defines the capability required, capability gap/shortfall and assigns responsibility for follow-on analyses (AFI10-601, *Capabilities Based Requirements Development*, 31 July 2006).

Allocated Baseline – Definition of the configuration items making up a system, and then how system function and performance requirements are allocated across lower level configuration items (hence the term allocated baseline). It includes all functional and interface characteristics that are allocated from the top level system or higher-level configuration items, derived requirements, interface requirements with other configuration items, design constraints, and the verification required to demonstrate the traceability and achievement of specified functional, performance, and interface characteristics (Defense Acquisition Guidebook, https://dag.dau.mil).

Architecture – The organizational structure of a system or component (IEEE STD 610.12, 28 September 1990). Architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and principles guiding its design and evolution (IEEE STD 1471-2000, 21 September 2000).

Attribute – A quantitative or qualitative characteristic of an element or its actions (CJCSI3170.01G, 1 March 2009).

Capabilities Based Assessment – The CBA is the Joint Capabilities Integration and Development System (JCIDS) analysis process. It defines the mission; identifies capabilities required; determines attributes/standards of the capabilities; identifies gaps; assesses operational risk associated with the gaps; prioritizes gaps; identifies and assesses potential non-materiel solutions; and provides recommendations for addressing the gaps (CJCSI3170.01G, 1 March 2009).

Capabilities Based Requirements – CBR are warfighter generated requirements defined in terms of needed capabilities as documented in the capabilities-based requirements documents.

Capability – Ability to achieve a desired effect under specified standards and conditions through combinations 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. It is defined by an operational warfighter and expressed in broad operational terms in the format of an Initial Capability Document (ICD) or a joint DOTMLPF change recommendation. In the case of materiel proposals/documents, the definition will progressively evolve to DOTMLPF performance attributes identified in the capability development document (CDD) and the capability production document (CPD) (CJCSI3170.01G, 1 March 2009).

Capability Development Document (CDD) – A document that captures information necessary to develop a proposed program(s), normally using an evolutionary acquisition strategy. The CDD

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outlines an affordable increment of militarily useful, logistically supportable, and technically mature capability. The CDD may define multiple increments if there is sufficient definition of the performance attributes (key performance parameters (KPPs), key system attributes (KSAs), and other attributes) to allow approval of multiple increments (CJCSI3170.01G, 1 March 2009).

Capability Production Document (CPD) – A document that addresses the production elements specific to a single increment of an acquisition program. The CPD defines an increment of militarily useful, logistically supportable, and technically mature capability that is ready for a production decision. The CPD defines a single increment of the performance attributes (key performance parameters (KPPs), key system attributes (KSAs), and other attributes) to support a MS C decision. (CJCSI3170.01G, 1 March 2009).

Derived Requirements – Characteristics needed to complete the requirements set for item design that are dependent on the nature of the item solution for their initial identification. These are typically identified during synthesis of preliminary product and process solutions, related trade-off studies and verifications (ASC Systems Engineering Guide, 21 February 2006).

Family of Systems – A set or arrangement of independent systems that can be arranged or interconnected in various ways to provide different capabilities. The mix of systems can be tailored to provide desired capabilities, dependent on the situation. An example of a FoS would be an anti-submarine warfare FoS consisting of submarines, surface ships, aircraft, static and mobile sensor systems and additional systems. Although these systems can independently provide militarily useful capabilities, in collaboration they can more fully satisfy a more complex and challenging capability: to detect, localize, track and engage submarines (Acquisition Community Connection, https://acc.dau.mil/CommunityBrowser.aspx?id=54714).

Function – A task, action, or activity performed to achieve a desired outcome (ref. ASC Systems Engineering Guide, 21 February 2006). Action or actions that an item is designed to perform (MIL-HDBK-61A, 7 February 2001).

Functional Analysis and Allocation – Examination of a defined function to identify all sub-functions necessary to accomplish that function; identification of functional relationships and interfaces (internal and external) and capturing these in a functional architecture; and flow down of upper-level performance requirements and assignment of these to lower-level sub-functions (ASC Systems Engineering Guide, 21 February 2006).

Functional Baseline – Definition of the required system functionality describing functional and interface characteristics of the overall system, and the verification required to demonstrate the achievement of those specified functional characteristics (Defense Acquisition Guidebook, https://dag.dau.mil).

Initial Capability Document (ICD) – Summarizes a CBA and justifies the requirement for a materiel or non-materiel approach, or an approach that is a combination of materiel and non-materiel, to satisfy specific capability gap(s). It identifies required capabilities and defines capability gap(s) in terms of functional area, relevant range of military operations, desired effects, time and doctrine, organization, training, materiel, leadership and education, personnel,

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and facilities (DOTMLPF) and policy implications and constraints. The ICD summarizes results of DOTMLPF and policy analysis and DOTMLPF approaches (materiel and non-materiel) that may deliver the required capability. Outcome of an ICD could be one or more joint DOTMLPF Change Recommendation (DCRs) or recommendations to pursue materiel solutions (CJCSI3170.01G, 1 March 2009).

Key Performance Parameters (KPP) – Those attributes or characteristics of a system that are considered critical or essential to the development of an effective military capability and those attributes that make a significant contribution to the characteristics of the future joint force as defined in the Capstone Concept for Joint Operations. KPPs should be testable to enable feedback from test and evaluation efforts to the requirements process. KPPs are validated by the Joint Requirement Oversight Council (JROC) for JROC interest documents, and by the DOD component for Joint Integration, Joint Information, or Independent documents. Capability development and capability production document KPPs are included verbatim in the acquisition program baseline (ref. CJCSI3170.01G, 1 March 2009).

Key System Attribute (KSA) – An attribute or characteristic considered crucial to achieving a balanced solution/approach to a system, but not critical enough to be designated a KPP. KSAs provide decision makers with an additional level of capability performance characteristics below the KPP level and require a sponsor 4-star, Defense agency commander, or Principal Staff Assistant to change (ref. JCIDS Manual).

Measure of Effectiveness (MOE) – Measure designed to correspond to accomplishment of mission objectives and achievement of desired results. MOEs may be further divided into Measures of Performance (MOPs) and Measures of Suitability (MOEs) (ref. Defense Acquisition Acronyms and Terms, 13th Edition, November 2009).

Measure of Performance (MOP) – Measure of a system's performance expressed as speed, payload, range, time-on-station, frequency, or other distinctly quantifiable performance features. Several MOPs and/or Measures of Suitability (MOSs) may be related to the achievement of a particular Measure of Effectiveness (MOE) (ref. Defense Acquisition Acronyms and Terms, 13th Edition, November 2009).

Measure of Suitability (MOS) – Measure of an item's ability to be supported in its intended operational environment. MOSs typically relate to readiness or operational availability and, hence, reliability, maintainability, and the item's support structure. Several MOSs and/or Measures of Performance (MOPs) may be related to the achievement of a particular Measure of Effectiveness (MOE) (ref. Defense Acquisition Acronyms and Terms, 13th Edition, November 2009).

Metadata – Information describing the characteristics of data; data or information about data; or descriptive information about an entity's data, data activities, systems, and holdings. For example, discovery metadata is a type of metadata that allows data assets to be found using enterprise search capabilities (Department of Defense Directive (DoDD) 8320.02, Data Sharing in a Net Centric Department of Defense, 23 April 2007).

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Metadata Registry – Repository of all metadata related to data structures, models, dictionaries, taxonomies, schema, and other engineering artifacts that are used to support interoperability and understanding through semantic and structural information about the data. A federated metadata registry is one in which multiple registries are joined electronically through a common interface and exchange structure, thereby effecting a common registry (Department of Defense Directive (DoDD) 8320.02, Data Sharing in a Net Centric Department of Defense, 23 April 2007).

Operational Requirements – Are top level system performance attributes or capabilities of the system or subsystem documented in the warfighter's CBR documents.

Performance Based Requirements – Requirements defining the extent to which a mission or function should be executed, generally measured in terms of quantity, quality, coverage, timeliness, or readiness (ASC Systems Engineering Guide, 21 February 2006).

Regulatory Requirements – Requirements directed by military regulations (DoDD 5000.02, Operation of the Defense Acquisition System, 8 December 2008).

Requirements Analysis – Determination of system specific performance and functional characteristics based on analyses of warfighter CBR needs, requirements, and objectives; missions; projected utilization and environments for people, products, and processes; constraints; and measures of effectiveness. Requirements analysis is the bridge between warfighter requirements and system specific acquisition requirements from which solutions can be generated for primary system functions (ASC Systems Engineering Guide, 21 February 2006).

Requirements Correlation Table – A three-part table, specific to Air Force-generated CDDs and CPDs, which provides an audit trail of the performance attributes and desired capabilities identified in the text of these documents. The RCT lists operator-identified performance attributes and capabilities with accompanying thresholds and objectives; identifies operator recommended KPPs; provides supporting rationale justifying each threshold obtained from the AoA or concept studies; and provides a concise summary to ensure decision makers have the necessary data to make informed decisions (AFI10-601, Capabilities Based Requirements Development, 31 July 2006).

Statutory Requirements – Requirements directed by public law (DoDD 5000.02, Operation of the Defense Acquisition System, 8 December 2008).

Subsystem – A grouping of items satisfying a logical group of functions within a particular system (ASC Systems Engineering Guide, 21 February 2006).

Synthesis – Translation of input requirements (including performance, function, and interface) into possible solutions (resources and techniques) satisfying those inputs. Defines a physical architecture of people, product, and process solutions for logical groupings of requirements (performance, function, and interface) and then designs those solutions (ASC Systems Engineering Guide, 21 February 2006).

System – An integrated composite of people, products, and processes that provide a capability to satisfy a stated need or objective (ASC Systems Engineering Guide, 21 February 2006).

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Systems Analysis and Control – Imposition of structure and discipline into system evolution by: measuring progress based on demonstrated performance; identifying, developing, and examining alternatives; making decisions based on cost, schedule, performance, and risk to affect balanced results; documenting evolution and rationale; and controlling resulting configurations (ref. ASC Systems Engineering Guide, 21 February 2006).

Systems Engineering – Systems engineering is an interdisciplinary approach encompassing the entire technical effort to evolve and verify an integrated and total life cycle balanced set of system, people, and process solutions that satisfy customer needs. Systems engineering is the integrating mechanism across the technical efforts related to the development, manufacturing, verification, deployment, operations, support, disposal, and warfighter training for systems and their life cycle processes. Systems engineering develops technical information to support the program management decision-making process (Defense Acquisition Guidebook, https://dag.dau.mil).

Systems of Systems (SoS) – A set or arrangement of interdependent systems that are related or connected to provide a given capability. The loss of any part of the system will degrade the performance or capabilities of the whole. An example of a SoS could be interdependent information systems. While individual systems within the SoS may be developed to satisfy the peculiar needs of a given warfighter group (like a specific service or agency), the information they share is so important that the loss of a single system may deprive other systems of the data needed to achieve even minimal capabilities (Acquisition Community Connection, https://acc.dau.mil/CommunityBrowser.aspx?id=54715).

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System Requirements Document Generic Template Guidance

B.1 SCOPE/INTRODUCTION

This section is divided into the following subparagraphs:

B.1.1 System or subsystem identification.

This paragraph contains a full identification of the system or subsystem and associated software to which this document applies, including as applicable, identification number(s), title(s), abbreviation(s), and release number(s) where known.

B.1.2 System or subsystem overview.

This paragraph briefly states the purpose of the system or subsystem and associated software to which this document applies. It describes the general nature of the system or subsystem and software; summarize history of system development, operation, and maintenance; identify project sponsor, acquirer, warfighter, developer, and support agencies; identify current and planned operating sites; and list other relevant documents.

B.1.3 Document overview.

This paragraph summarizes purpose and contents of this document and describes any security or privacy considerations associated with its use.

B.2 APPLICABLE DOCUMENTS

This section lists number, title, revision, and date of all documents referenced herein. This section also identifies the source for documents not available through normal Government stocking activities.

B.2.1 General.

Provide overview of documentation section. This statement should be placed in all SRD documents and resulting specifications: “Documents listed in this section are specified in sections 3, 4, or 5 of this SRD. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document warfighter’s are cautioned that they should meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.”

B.2.2 Government documentation.

List applicable Government documentation.

B.2.2.1 Government specifications, standards, and handbooks.

List Government specifications, standards, and handbooks. This statement should be placed in all SRD documents and resulting specifications: “The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.”

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INTERNATIONAL STANDARDIZATION AGREEMENTS

DEPARTMENT OF DEFENSE SPECIFICATIONS

DEPARTMENT OF DEFENSE STANDARDS

DEPARTMENT OF DEFENSE HANDBOOKS

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

B.2.2.2 Other Government documents, drawings, and publications.
List other Government documents, drawings, and publications. This statement should be placed in all SRD documents and resulting specifications: "The following other Government documents, drawings, and publications form a part of this SRD to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract."

(Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

B.2.3 Non-Government publications.
List non-Government publications. This statement should be placed in all SRD documents and resulting specifications: "The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract."

(List where copies of these documents can be found.)

B.2.4 Order of precedence.
This statement should be placed in all SRD documents and resulting specifications: "Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained." [The parenthetical phrase "(except for related specification sheets)" is omitted from the paragraph for specifications that do not have related specification sheets.]

B.3 SYSTEM OR SUBSYSTEM REQUIREMENTS

This section identifies basic system or subsystem requirements needed by the warfighter. This section is divided into the following paragraphs to specify system or subsystem requirements,

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e.g., those characteristics of the system or subsystem that are conditions for its acceptance. Each requirement should be assigned a project-unique identifier (to support testing and traceability), and should be stated in such a way that an objective verification can be defined for it. Project unique identifiers should use the Program Work Breakdown Structure (PWBS) pre contract award and the Contract Work Breakdown Structure (CWBS) post contract award. Each requirement should be annotated with associated qualification method(s) (see section 4) and, for subsystems, traceability to system requirements (see section 5.a), if not provided in those sections. The degree of detail to be provided is guided by the following rule: Include those characteristics of the system or subsystem that are conditions for system or subsystem acceptance; defer to design descriptions those characteristics an acquirer is willing to leave up to the developer. If there are no requirements in a given paragraph, the paragraph should so state. If a given requirement fits into more than one paragraph, it may be stated once and referenced from the other paragraphs.

Each SRD KPP and KSA should have an associated threshold and objective. Attributes should include thresholds and objectives as applicable.

The symbols used are:

T	Threshold - Minimum requirement level.
O	Objective - Desired requirement level.
T=O	Threshold and Objective are the same requirement level. No effort will be expended to exceed the Threshold requirement.

Key Performance Parameters (KPPs) and Key System Attributes (KSAs) are indentified in the body of section 3 and provided in a tabular format ranked in order of importance in Appendix B.

B.3.1 Required states and modes.
If a system or subsystem is required to operate in more than one state or mode having requirements distinct from other states or modes, this paragraph identifies and defines each state and mode. Examples of states and modes include: idle, ready, active, training, degraded, emergency, backup, wartime, peacetime. The distinction between states and modes is arbitrary. A system or subsystem may be described in terms of states only, modes only, states within modes, modes within states, or any other scheme that is useful. If no states or modes are required, this paragraph should so state, without the need to create artificial distinctions. If states and/or modes are required, each requirement or group of requirements in this specification should be correlated to the states and modes. The correlation may be indicated by a table or other method in this paragraph, in an appendix referenced from this paragraph or by annotation of the requirements in the paragraphs where they appear.

B.3.2 System or subsystem functional requirements.
This paragraph is divided into subparagraphs to itemize requirements associated with each system or subsystem function. A "function" is defined as a group of related requirements, e.g., avionics subsystem requirements.

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B.3.2.X System or subsystem function.
This paragraph itemizes requirements associated with each system or subsystem function. If the function can be more clearly specified by dividing it into constituent functions, e.g., avionics can be broken down into mission/operational definition, characteristics, design and construction, characteristics of subordinate elements, etc., the constituent functions should be specified in subparagraphs. Paragraph 3.3.x provides a list of topics to be considered when specifying requirements regarding inputs the system accepts and outputs it produces.

B.3.3 System external interface requirements.
This paragraph is divided into subparagraphs to specify requirements, if any, for the system's or subsystem's external interfaces. This paragraph may reference one or more Interface Requirements Specifications (IRSs) or other documents containing these requirements.

B.3.3.1 Interface identification and diagrams.
This paragraph identifies required external system or subsystem interfaces. Identification of each interface includes a project unique identifier and designates interfacing entities (systems, configuration items, warfighter's, etc.) by name, number, version, and documentation references, as applicable. The identification states which entities have fixed interface characteristics (and therefore impose interface requirements on interfacing entities) and which are being developed or modified (thus having interface requirements imposed on them). One or more interface diagrams are provided to depict the interfaces.

B.3.3.X Project-unique identifier of interface.
This paragraph (beginning with 3.3.2) identifies a system or subsystem external interface by project-unique identifier, identifies interfacing entities, and is divided into subparagraphs as needed to state requirements imposed on the system or subsystem to achieve the interface. Interface characteristics of other entities involved in the interface are stated as assumptions or as "When [the entity not covered] does this, the system shall .... ," not as requirements on the other entities. This paragraph may reference other documents (e.g., data dictionaries, standards for communication protocols, and standards for warfighter interfaces) in place of stating the information here. Requirements include the following, as applicable, presented in any order suited to the requirements, and notes any differences in these characteristics from the point of view of the interfacing entities (e.g., different expectations about size, frequency, or other characteristics of data elements): Note: Detailed external interface elements may not be known during SRD development, in which case external interface requirements will be in broader, performance based terms. Also, external interfaces will be described in more detail in the architecture diagrams and Information Support Plan (ISP). In many instances, interface requirements are known in great detail as they are associated with current operational systems. Net Ready KPP requirements are also addressed herein.

a. Priority the system assigns to the interface.

b. Requirements on type of interface (e.g., real-time data transfer, storage-and retrieval of data, etc.) to be implemented.

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c. Provide required commercial or Government external interface standards for data information transfer.

d. Provide required external communication links.

B.3.4 System internal interface requirements.
This paragraph specifies requirements, if any, imposed on interfaces internal to the system or subsystem. If all internal interfaces are left to the design or to requirement specifications for system or subsystem components, this fact is so stated. If such requirements are to be imposed, paragraph 3.3 of this DID provide a list of topics to be considered.

B.3.5 System internal data requirements.
This paragraph specifies requirements, if any, imposed on data internal to the system or subsystem. Included are requirements, if any, on databases and data files to be included in the system. If all decisions about internal data are left to the design or to requirements specifications for system or subsystem components, this fact is so stated. If such requirements are to be imposed, paragraphs 3.3.x.c and 3.3.x.d of this DID provide a list of topics to be considered.

B.3.6 Adaptation requirements.
This paragraph specifies requirements, if any, concerning installation-dependent data that the system or subsystem is required to provide (e.g., site dependent latitude and longitude) and operational parameters that the system is required to use that may vary according to operational needs (e.g., parameters indicating operation-dependent targeting constants or data recording).

B.3.7 Safety requirements.
This paragraph specifies system or subsystem requirements, if any, concerned with preventing or minimizing unintended hazards to personnel, property, and the physical environment. Examples include restricting use of dangerous materials; classifying explosives for purposes of shipping, handling, and storing; abort/escape provisions from enclosures; gas detection and warning devices; grounding of electrical systems; decontamination; and explosion proofing. This paragraph includes system or subsystem requirements, if any, for nuclear components, including, as applicable, requirements for component design, prevention of inadvertent detonation, and compliance with nuclear safety rules.

B.3.8 Security and privacy requirements.
This section specifies system or subsystem requirements, if any, concerned with maintaining security and privacy. The requirements include, as applicable, security/privacy environment in which the system or subsystem should operate, type and degree of security or privacy to be provided, security/privacy risks the system or subsystem should withstand, required safeguards to reduce those risks, security/privacy policy, security/privacy accountability the system or subsystem provides, and criteria for security/privacy certification/accreditation. Paragraphs should be included for IA requirements IAW DoDD 8500.01, *Information Assurance (IA)*; and DoDI 8500.2, *Information Assurance (IA) Implementation* as required.

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B.3.9 System environment requirements.
This paragraph specifies requirements, if any, regarding the environment in which the system or subsystem operates. Examples for a software system or subsystem are computer hardware and operating system on which the software runs. (Additional requirements concerning computer resources are given in the next paragraph). Examples for a hardware-software system include environmental conditions that the system or subsystem withstands during transportation, storage, and operation, e.g., conditions in the natural environment (wind, rain, temperature, geographic location), induced environment (motion, shock, noise, electromagnetic radiation), and environments due to enemy action (explosions, radiation).

B.3.10 Computer resource requirements.
This paragraph is divided into the following subparagraphs. Depending upon the nature of the system or subsystem, computer resources covered in these subparagraphs may constitute the environment of the system or subsystem (as for a software system) or components of the system (as for a hardware-software system).

B.3.10.1 Computer hardware requirements.
This paragraph specifies requirements, if any, regarding computer hardware that is used by, or incorporated into, the system or subsystem. Requirements include, as applicable, number of each type of equipment, type, size, capacity, and other required characteristics of processors, memory, input/output devices, auxiliary storage, communications/network equipment, and other required equipment.

B.3.10.2 Computer hardware resource utilization requirements.
This paragraph specifies the requirements, if any, on the system's or subsystem's computer hardware resource utilization, e.g., maximum allowable use of processor capacity, memory capacity, input/output device capacity, auxiliary storage device capacity, and communications/network equipment capacity. Requirements (stated, for example, as percentages of the capacity of each computer hardware resource) include conditions, if any, under which the resource utilization is to be measured.

B.3.10.3 Computer software requirements.
This paragraph specifies requirements, if any, regarding computer software that is used by, or incorporated into, the system or subsystem. Examples include operating systems, database management systems, communications/network software, utility software, input and equipment simulators, test software, and manufacturing software. The correct nomenclature, version, and documentation references of each such software item are provided.

B.3.10.4 Computer communications requirements.
This paragraph specifies additional requirements, if any, concerning computer communications that is used by, or incorporated into, the system or subsystem. Examples include geographic locations to be linked; configuration and network topology; transmission techniques; data transfer rates; gateways; required system use times; type and volume of data to be transmitted/received; time boundaries for transmission/reception/response; peak volumes of data; and diagnostic features.

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B.3.11 System quality factors.
This paragraph specifies requirements, if any, pertaining to system or subsystem quality factors. Examples include quantitative requirements concerning system functionality (ability to perform required functions), reliability (ability to perform with correct, consistent results, e.g., mean time between failure for equipment), maintainability (ability to be easily serviced, repaired, or corrected), availability (ability to be accessed and operated when needed), flexibility (ability to be easily adapted to changing requirements), portability of software (ability to be easily modified for a new environment), reusability (ability to be used in multiple applications), testability (ability to be easily and thoroughly tested), usability (ability to be easily learned and used), and other attributes.

B.3.12 Design and construction constraints.
This paragraph specifies requirements, if any, that constrain design and construction of the system or subsystem. For hardware-software systems, this paragraph includes physical requirements imposed on the system or subsystem. These requirements may be specified by reference to appropriate commercial or military standards and specifications. Examples include requirements concerning:

a. Use of a particular system or subsystem architecture or requirements on the architecture, e.g., required subsystems; use of standard, military, or existing components; or use of Government furnished property (equipment, information, or software).

b. Use of particular design or construction standards; use of particular data standards; use of a particular programming language; use of existing software; workmanship requirements and production techniques.

c. Physical characteristics of the system or subsystem (such as weight limits, dimensional limits, color, protective coatings); interchangeability of parts; ability to be transported from one location to another; ability to be carried or set up by one or a given number of people.

d. Materials that can and cannot be used; requirements on handling of toxic materials; limits on electromagnetic radiation that the system is permitted to generate.

e. Use of nameplates, part marking, serial and lot number marking, and other identifying markings.

f. Flexibility and expandability should be provided to support anticipated areas of growth or changes in technology, threat, or mission.

g. Include manufacturing requirements and constraints associated with producing the system or subsystem.

B.3.13 Personnel-related requirements.
This paragraph specifies the system or subsystem requirements, if any, included to accommodate the number, skill levels, duty cycles, training needs, or other information about the personnel

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who will use or support the system. Examples include requirements for the number of workstations to be provided and for built-in help and training features. Also included are human factors engineering requirements, if any, imposed on the system or subsystem. These requirements include, as applicable, considerations for capabilities and limitations of humans, foreseeable human errors under both normal and extreme conditions, and specific areas where effects of human error would be particularly serious. Examples include requirements for adjustable-height workstations, color and duration of error messages, physical placement of critical indicators or buttons, and use of auditory signals.

B.3.14 Training-related requirements.
This paragraph specifies the system or subsystem requirements, if any, pertaining to training. Examples include training devices and training materials to be included in the system.

B.3.15 Logistics-related requirements.
This paragraph specifies the system requirements, if any, concerned with logistics considerations. These considerations may include: system maintenance, software support, system transportation modes, supply-system requirements, impact on existing facilities, and impact on existing equipment.

B.3.16 Other requirements.
This paragraph specifies additional system or subsystem requirements, if any, not covered in the previous paragraphs. Examples include requirements for system or subsystem documentation, e.g., specifications, drawings, technical manuals, test plans and procedures, and installation instruction data, if not covered in other contractual documents.

B.3.17 Packaging requirements.
This section specifies the requirements, if any, for packaging, labeling, and handling the system or subsystem and its components. Applicable military specifications and standards may be referenced if appropriate.

B.3.18 Statutory, regulatory, and certification requirements.

B.3.18.1 Statutory requirements.
This paragraph specifies, if applicable, statutory requirements for the system or subsystem.

B.3.18.2 Regulatory requirements.
This paragraph specifies, if applicable, regulatory requirements for the system or subsystem.

B.3.18.3 Certification requirements.
This paragraph specifies, if applicable, certification requirements for the system or subsystem.

B.3.19 Precedence and criticality of requirements.
This paragraph specifies, if applicable, order of precedence, criticality, or assigned weights indicating relative importance of requirements in this specification. Examples include identifying those requirements deemed critical to safety, to security, or to privacy for purposes of singling them out for special treatment. If all requirements have equal weight, this paragraph so

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states. Key Performance Parameters (KPPs) and Key System Attributes (KSAs) are identified in the body of section 3 and provided in a tabular format ranked in order of importance.

B.3.20 Demilitarization and disposal.
Demilitarization and disposal at the end of a life-cycle include activities necessary to ensure disposal of decommissioned, destroyed, or irreparable system components meets applicable regulations, directives and environmental constraints.

B.4 VERIFICATION PROVISIONS

This section defines a set of verification methods and specifies for each requirement in section 3 the method(s) to be used to ensure the requirement has been met. A table is used to present this information and is documented in Appendix C. The SRD contains verification methods desired by the Government. A contractor may offer alternative verification methods with associated justification.

B.4.1 Verification methods.

B.4.1.1 Demonstration.
Operation of the system, subsystem, or a part of the system that relies on observable functional operation not requiring use of instrumentation, special test equipment, or subsequent analysis.

B.4.1.2 Test.
Operation of the system, subsystem, or a part of the system, using instrumentation or other special test equipment to collect data for later analysis.

B.4.1.3 Analysis.
Processing of accumulated data obtained from other qualification methods. Examples are reduction interpolation, or extrapolation of test results.

B.4.1.4 Inspection.
Visual examination of system components, documentation, etc.

B.4.1.5 Special verification methods.
Special verification methods for the system or subsystem, e.g., special tools, techniques, procedures, facilities, acceptance limits, use of standard samples, preproduction or periodic production samples, pilot models, or pilot lots.

B.5 REQUIREMENTS TRACEABILITY

For a system level SRD, this paragraph includes traceability requirements to a warfighter Capability Document and down to applicable subsystems. For a subsystem level SRD, this paragraph includes traceability to the system specification and down to applicable line replaceable units (LRUs), including software Operational Flight Programs (OFPs) or equivalent. Use of automated tools is highly encouraged and tools that maintain detailed artifacts of each requirement are preferred.

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B.5.1 Traceability to capability document or system specification.
This paragraph contains a description of the traceability to a Capability Document or System Specification. It also defines associated attributes that an automated tool should capture to document each requirement.

B.5.2 Traceability to subsystems requirements.
This paragraph contains a description of traceability to a subsystem or lower tiered requirement document. It also defines associated attributes that an automated tool should capture to document each requirement.

B.6 APPENDIX

B.6.1 Appendix A: Acronyms and Definitions.
This appendix contains acronyms and provides standard definitions for terminology used herein.

B.6.2 Appendix B: Key Performance Parameters/Key System Attributes.
This appendix contains tabularized KPPs, and KSAs, if applicable, listed in prioritized order.

B.6.3 Appendix C: Requirements Traceability Matrices.
This appendix contains tabularized requirements traceability to the source documentation and to the next lower tier documentation where known. If not known, pre contract award, lower tier traceability is to be included in the resultant system or subsystem specification.

B.6.4 Appendix D: Verification Matrices.
This appendix contains tabularized verification method for every system or subsystem requirement. If not known, pre contract award, the verification method is to be included in the resultant system or subsystem specification.

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Systems Requirements Document Format and Generic Template

C.1 PAGE LAYOUT GUIDANCE

Use the following page layout guidance in preparing a SRD.

a. Cover Page: No Page Number, Apply Correct Distribution Statement[28,29,30] and Classification

b. Backside of Cover Page: No Page Number - “This Page is Intentionally Blank”

c. Change History: Page Number i

d. Backside of Change History Page: Page Number ii - “This Page is Intentionally Blank”

e. Contents: Page Number iii

f. 1. Scope: Page Number 1, Start page 1, SCOPE on a right hand page, insert preceding blank page when necessary.

g. Number pages consecutively, Ensure Classification Markings Appear Top & Bottom, Front & Back of Every Page[31,32,33]

28 DoDD 5230-34, Distribution Statements on Technical Documents
29 DoDD 5230.35, Withholding of Unclassified Technical Data From Public Disclosure
30 AFI61-204, Disseminating Scientific and Technical Information
31. DoD 5200.1R, Information Security Program
32. DoD 5200.1-PH, DoD Guide to Marking Classified Documents
33. AFI31-401, Information Security Program Management

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SYSTEM REQUIREMENTS DOCUMENT

SYSTEM NAME and NOMENCLATURE (IF AVAILABLE)

Day Month Year (Ex: 01 January 2010)
Status (Draft or Final)

Prepared for:

Office or Customer
Military Base, State

Prepared by:

Company or Individual Name
Street Address
Mail Stop
City, State (2 ltr abbreviation) Zip Code

***Under:* (Where applicable)**
Contract XXX (Where applicable)
CDRL Item XXX (Where applicable)

Authenticated by: **_____//SIGNED//_____**
First Name MI. Last Name
Chief or Lead Engineer
Day Month Year
(Ex: 01 January 2010)

Approved by: **_____//SIGNED//_____**
First Name MI. Last Name
Program Manager
Day Month Year
(Ex: 01 January 2010)

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