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Anchoring to Quality Standards: Achieving ISO 9001 Certification at the Naval Postgraduate School's Department of Defense Management

December 2024

MAJ Siddiq A. Hasan, USA
CPT Derez A. Jones, USA
MAJ Stephen J. Loman, USA

Thesis Advisors: Dr. Eugene P. Paulo, Associate Professor
Dr. Robert F. Mortlock, Professor

Department of Defense Management

Naval Postgraduate School

Prepared for the Naval Postgraduate School, Monterey, CA 93943

ACQUISITION RESEARCH PROGRAM
DEPARTMENT OF DEFENSE MANAGEMENT
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Naval Postgraduate School

ABSTRACT

This capstone project examines the Department of Defense Management (DDM) at the Naval Postgraduate School (NPS) to determine the steps required for achieving ISO 9001:2015 certification. While the DDM adheres to rigorous academic standards and maintains multiple globally recognized accreditations in graduate education and project management, gaps in its Quality Management System (QMS)—notably in areas of process documentation, risk management, and operational consistency—present obstacles to certification. Employing a systems engineering approach, this study deconstructs ISO 9001:2015 requirements, conducts a two-tiered gap analysis, and identifies compliance deficiencies across seven critical areas: context, leadership, planning, support, operations, performance evaluation, and improvement. The findings reveal that the DDM currently meets 82% of ISO 9001:2015 requirements but requires targeted improvements in areas such as procedural standardization, performance metrics, and property accountability. The capstone team developed a detailed assessment of the compliance gaps and offered actionable insights to address identified deficiencies. This project underscores the value of ISO 9001:2015 certification in strengthening the DDM's operational consistency, quality assurance, and alignment with international standards. By systematically addressing areas of non-compliance and prioritizing structured improvements, the DDM is well-positioned to achieve ISO certification.

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ABOUT THE AUTHORS

MAJ Siddiq Hasan is a U.S. Army Acquisition Corps Officer. In 2014, he commissioned through the Reserve Officer Training Corps (ROTC) at Texas A&M University, as a Field Artillery officer. After graduation, he served in several operation assignments – most notably as commander of the 1st Cavalry Division Horse Detachment – before transferring to the Acquisition Corps in 2023. Following graduation from NPS, he will serve as an APM assignment within Missile Defense Agency (MDA).

MAJ Stephen Loman is a U.S. Army Acquisition Corps Officer. In 2009, he commissioned through the Reserve Officer Training Corps (ROTC) at The Citadel in Charleston, SC. After graduation, he served in several operation assignments – most notably in the 82nd Airborne Division and Military Surface Deployment and Distribution Command (SDDC) – before transferring to the Acquisition Corps in 2019. As an acquisition officer, he completed a three-year assignment as an Assistant Product Manager (APM) at PEO Intelligence Electronic Warfare and Sensors (IEW&S). Following graduation from NPS, he will serve in a broadening APM assignment within Missile Defense Agency (MDA).

CPT Derez Jones CPT Derez Jones is a U.S. Army Finance Officer transitioning to the Acquisition Corps. Commissioned through ROTC at Campbell University in 2016, he has served in both conventional and special operations assignments. Currently attending the Naval Postgraduate School, he will graduate in December 2024 and begin a science and technology assignment with DEVCOM and Army North at Joint Base San Antonio, TX

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The authors also express their profound appreciation to Ms. Valentina Palazzetti, Faculty Associate for Assessment and Accreditation at the DDM, for her pivotal support in this capstone project. Ms. Palazzetti provided the team with essential QMS documentation, enabling the completion of two comprehensive gap analyses critical to the project’s success. Her timely assistance and expertise were invaluable in ensuring the accuracy and depth of the research. The authors are deeply grateful for her dedication and collaborative spirit, which significantly contributed to the quality and impact of this work.

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LIST OF ACRONYMS AND ABBREVIATIONS

AACSB	Association to Advance Collegiate Schools of Business
ACs	Academic Chairs
AOL	Assessment of Learning
DDM	Department of Defense Management
DoD	Department of Defense
DSS	Decision Support Systems
GSDM	Graduate School of Defense Management
ISO	International Organization for Standardization
KPIs	Key Performance Indicators
NASA	National Aeronautical Space Administration
NPS	Naval Postgraduate School
PMI	Project Management Institute
PMP	Project Management Professional
QMS	Quality Management System
ROI	Return on Investment
RTM	Requirements Traceability Matrix
SE	Systems Engineering
WASC	Western Association of Schools and Colleges

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EXECUTIVE SUMMARY

PURPOSE

This capstone project was conducted to assess Department of Defense Management (DDM) readiness for International Organization for Standardization (ISO) 9001:2015 certification at the Naval Postgraduate School (NPS). ISO certification represents a rigorous international standard for Quality Management Systems (QMSs), promoting consistency, accountability, and continuous improvement. While the DDM holds academic accreditations, ISO certification would further formalize its operational practices and enhance its reputation by embedding internationally recognized quality standards within the department. The project aims to provide a detailed analysis of current practices, identify areas for improvement, and propose a roadmap for certification, strengthening the DDM's commitment to operational excellence.

METHODS

Employing a systems engineering (SE) approach, the capstone team decomposed ISO 9001:2015 requirements, mapping them to the DDM's existing QMS to identify compliance levels. The capstone team conducted a comprehensive gap analysis, utilizing both qualitative and quantitative data to evaluate the DDM's QMS across the ISO's seven main clauses, including organizational context, leadership, planning, support, operations, performance evaluation, and improvement ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). An ISO 9001:2015 Requirements Traceability Matrix (RTM; see Supplemental 2) was developed to systematically track compliance and guide corrective actions, providing a clear framework for achieving certification readiness.

RESULTS

The findings indicate that the DDM's QMS currently meets approximately 73% of ISO requirements, with strengths in leadership, planning, and support. However, significant gaps exist in documentation practices, resource management, and risk assessment, which impede full compliance. The RTM revealed that, of the 147 specific

ISO requirements analyzed, 82% are met while 18% remain deficient, primarily in areas requiring enhanced process standardization and risk management. Table 1 highlights the requirements that were identified as “not met.”

Table 1. ISO 9001:2015 RTM Not Met Requirements

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
Topic Area #1 – Context of the Organization					
1	Have all that are relevant to your organization's purpose and the achievement of customer satisfaction and the organization's strategic direction been determined?	4.1	1.1	The organization shall identify all external issues relevant to its strategic direction and customer satisfaction.	Not Met
			1.2	The organization shall identify all internal issues relevant to its strategic direction and customer satisfaction.	Not Met
2	Are external and internal issues reviewed and monitored on a regular basis?		2.3	The organization shall update the documentation of these issues regularly.	Not Met
5	Is your QMS established and does it include a description of the processes required and their sequence and interaction?	4.4	5.1	The organization shall establish a QMS that includes a description of the processes required.	Not Met
			5.2	The organization shall describe the sequence and interaction of these processes within the QMS.	Not Met
6	Have the criteria for managing these processes and their interaction been established?		6.1	The organization shall establish criteria for managing processes and their interactions.	Not Met
			6.2	The organization shall document the criteria for process interactions.	Not Met
7	Have all responsibilities, methods, measurements, and related performance indicators needed to ensure the effective operation and control been established?		7.2	The organization shall establish measurements and performance indicators needed for the effective operation and control of processes.	Not Met
			7.3	The organization shall document and regularly review responsibilities, methods, measurements, and performance indicators.	Not Met

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
Topic Area #2 – Leadership					
9	Have the policy and objectives for the QMS which are compatible with the strategic direction of the organization been established and communicated?	5.2	9.2	The organization shall establish QMS objectives that are compatible with the strategic direction of the organization.	Not Met
			9.3	The organization shall communicate the QMS policy and objectives throughout the organization.	Not Met
Topic Area #3 – Planning					
13	Have the risks and opportunities that are relevant to the QMS been established?	6.1	13.1	The organization shall identify risks relevant to the QMS.	Not Met
			13.2	The organization shall identify opportunities relevant to the QMS.	Not Met
			13.3	The organization shall document and regularly review risks and opportunities relevant to the QMS.	Not Met
14	Have the risks and opportunities that need to be addressed to give assurance that the QMS can achieve its intended result(s) been established?		14.1	The organization shall identify the risks that need to be addressed to ensure the QMS can achieve its intended results.	Not Met
			14.2	The organization shall identify the opportunities that need to be addressed to ensure the QMS can achieve its intended results.	Not Met
16	Have the objectives been established at relevant departmental and individual levels within the business?	6.2	16.2	The organization shall establish QMS objectives at relevant individual levels.	Not Met

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
17	Is there a defined process for determining the need for changes to the QMS and managing their implementation?	6.3	17.2	The organization shall establish a process for managing the implementation of changes to the QMS.	Not Met
			17.3	The organization shall document and regularly review the processes for determining and managing changes to the QMS.	Not Met
Topic Area #4 – Support					
22	Has the organization ensured that employees are aware of the quality policy, relevant quality objectives, their contribution to the effectiveness of the QMS, and the implications of not conforming to QMS requirements?	7.3	22.3	The organization shall ensure that employees are informed of the implications of not conforming to QMS requirements.	Not Met
23	Has the organization determined the internal and external communications relevant to the QMS, including what, when, with whom, and how to communicate?	7.4	23.2	The organization shall determine the timing and frequency of internal and external communications related to the QMS.	Not Met
Topic Area #5 – Operation					
27	Is there a defined process for reviewing and communicating with customers in relation to information relating to products and services, enquiries, contracts, or order handling?	8.2	27.3	The organization shall regularly review and update the process for customer communication to ensure its effectiveness.	Not Met
36	Where property belonging to customers or external providers is used in the provision of the product or service, is this controlled effectively?	8.5	36.1	The organization shall establish controls for managing property belonging to customers or external providers used in the provision of products or services.	Not Met

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
			36.2	The organization shall implement controls for managing property belonging to customers or external providers used in the provision of products or services.	Not Met
36			36.3	The organization shall regularly review and update controls for managing property belonging to customers or external providers used in the provision of products or services.	Not Met
Topic Area #6 – Performance Evaluation					
45	Has an approach to perform management reviews been established and implemented?	9.3	45.2	The organization shall implement the established approach to ensure that management reviews are conducted effectively and align with QMS objectives.	Not Met

CONCLUSIONS AND RECOMMENDATIONS

ISO 9001:2015 certification presents a substantial opportunity for the DDM to refine its QMS, aligning with international standards that would reinforce the DDM's operational consistency, accountability, and stakeholder trust. By addressing the identified deficiencies, the DDM is well-positioned to advance toward ISO compliance, establishing a quality management framework that supports long-term performance and continuous improvement. In addition, the capstone team suggests areas for future research, including a cost–benefit analysis and longitudinal studies on the impact of ISO certification to further support the DDM's ongoing quality enhancement efforts.

References

"International Standard: ISO 9001 Quality Management Systems-Requirements." ISO, September 15, 2015. https://www.iso.org/standard/62085.html.

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I. INTRODUCTION

The NPS's DDM has earned multiple accreditations recognizing the quality of the university and the department. It lacks a certification that exemplifies the quality management system used to ensure continual improvement of the programs and processes for all stakeholders. The sponsor of this study challenged the researchers to identify what is required for the DDM to gain ISO 9001:2015 certification. The following work provides a foundation for the DDM to continue pursuing ISO certification.

A. PROBLEM STATEMENT AND SUMMARY

The Naval Postgraduate School's Department of Defense Management's Quality Management System is not certified to the International Organization for Standardization 9001:2015 standard.

The lack of ISO 9001:2015 certification for the NPS's DDM QMS indicates significant gaps in the current quality management processes. These gaps could lead to inefficiencies, inconsistencies, and potential quality issues in the department's operations. Without certification, the DDM may struggle to meet international quality standards, which could impact its credibility and effectiveness ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015).

The primary questions this capstone project aims to answer are how can applying SE principles identify and address gaps within the current DDM QMS? Can a comprehensive process map for the DDM's QMS be developed to achieve ISO 9001:2015 certification? Additionally,

The ISO capstone team has the following specific objectives:

1. Decompose ISO 9001:2015 requirements and conduct a gap analysis by identifying deficiencies within the current DDM QMS relative to these standards.
2. Provide recommended updates to the QMS to address the deficiencies, fill the identified gaps, and ensure compliance with ISO 9001:2015 standards.

The ISO capstone team seeks to provide detailed recommendations to the DDM's associate chair for acquisition science to fill the identified gaps found in the program. These recommendations to meet the ISO 9001:2015 requirements are a key component to

the DDM achieving ISO 9001:2015 compliance, enhancing the department's operational efficiency and credibility.

B. SCOPE AND LIMITATIONS

The scope of this project focuses on analyzing the ISO 9001:2015 standards and assessing how they align with the DDM's QMS through a detailed breakdown of each standard. This includes conducting a thorough gap analysis to identify current deficiencies and proposing recommendations to bring the QMS into compliance with ISO standards. A primary deliverable of this project is a comprehensive list of requirements needed to meet the ISO standards. Additionally, the capstone team will provide the results of the gap analysis conducted outlining whether the requirements are 'met' or 'not met'.

Areas of interest that lie outside the scope of this project are things such as obtaining final ISO certification, conducting external audits, and implementing long-term improvements. Additionally, post-certification maintenance, cost estimation, and training of DDM personnel are beyond the project's timeframe and focus.

C. METHODOLOGY

The approach for researching this project adopts a SE approach structured to evaluate the DDM's readiness for ISO 9001:2015 certification. The capstone team decomposed the ISO requirements and mapped them onto the existing DDM QMS to establish a baseline for compliance. Using the SE framework, the capstone team performed a gap analysis identifying specific areas where the current QMS does not meet ISO standards. This analysis combined qualitative insights from feedback for accreditation assessments and quantitative data from document reviews to thoroughly assess the QMS. The SE-based methodology ensures that all facets of ISO compliance are addressed systematically, with close attention to the unique operational needs of the DDM.

In the following chapters, the capstone team provides the necessary background context for the project and the significance of the ISO 9001:2015 certification to the DDM and NPS. Next, the literature review examines the foundational theories and best

practices in ISO standards and SE, focusing on how quality management system frameworks have been applies in similar academic environments. After the literature review, the methodology for applying the SE process to develop requirements based on the seven ISO clauses is laid out. The 144 requirements generated were utilized to conduct the gap analysis, identifying areas needing improvement. The results of the gap analysis paired with the recommendations for correcting gaps are addressed in the findings and recommendations chapter. Finally, the conclusion chapter closes the study with suggested areas for continued research to support ongoing quality improvement within the DDM.

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II. BACKGROUND

The DDM and NPS focus on providing advanced graduate education in defense management, including contracting, logistics, and program management for Department of Defense (DoD) personnel. Despite its high academic standards, the DDM's QMS is not certified by the ISO 9001:2015 standard, the globally recognized benchmark for quality management ("ISO 9001 Certification – Quality Management Standard | NQA," n.d.). The associate chair for acquisition science has tasked the ISO capstone team with this project to elevate the department's operational quality and credibility by providing a detailed recommendation to achieve ISO 9001:2015 certification. The ISO 9001:2015 certification represents the highest internationally recognized standard for process quality. ISO standards require an organization to establish, maintain, and continuously improve its QMS across seven internal topic areas: organizational context, leadership, planning, support, operation, performance evaluation, and improvement (ISO 9001:2015).

The DDM's current QMS relies on a mixture of traditional academic oversight and internal quality controls. These practices include periodic reviews, internal audits, and adherence to academic accreditation standards such as those set by the Western Association of Schools and Colleges (WASC) and the Association to Advance Collegiate Schools of Business (AACSB). However, the DDM's current method of managing its QMS and academic accreditation processes is not documented per ISO 9001:2015 standards for process improvement, risk management, and resource optimization, leading to inefficiencies and gaps in quality assurance.

The primary challenge for the ISO capstone team lies in decomposing the ISO 9001:2015 requirements and overlaying them with the DDM's current QMS to identify gaps and deficiencies. This task involves analyzing internal processes, aligning them with ISO standards, and developing a comprehensive action plan to address any identified issues. The goal of the ISO capstone team is to provide a clear, executable process map that the DDM can follow to achieve ISO 9001:2015 certification.

The context of this project includes both internal and external factors that impact the DDM's ability to achieve ISO 9001:2015 certification. Externally, factors such as funding, defense acquisition policies, and academic accreditation standards may constrain the resources and time available for pursuing ISO certification. Internally, misaligning resources and organizational structure with the QMS requirements may necessitate substantial revisions. Additionally, internal and external factors contribute to the risk of the project, including potential objections from DDM staff, especially administrative staff, in accepting organizational and process changes. Addressing these risks will be crucial to the successful implementation of modifications to the department's QMS.

D. STAKEHOLDERS

Table 1 outlines the roles and the needs considerations for project stakeholders to achieve ISO 9001:2015 Certification.

Table 1. Project Stakeholders

STAKEHOLDER	ROLE	NEEDS
Associate Chair for Acquisition Science, DDM	The associate chair for acquisition science is the project sponsor and key decision-maker responsible for overseeing the implementation of the ISO 9001:2015 certification process within the DDM.	The associate chair requires a detailed, executable process map that identifies gaps, recommends actionable steps, and allocates resources effectively to achieve ISO 9001:2015 certification. This plan must be realistic and feasible within the constraints of the department's resources and timeline.
Provost, NPS	The provost oversees the academic operations and ensures that all departments, including the DDM, maintain high standards of educational quality and compliance.	The provost requires assurance that the DDM is operating at an optimal quality level, adhering to internationally recognized standards, which in turn enhances the overall reputation and credibility of NPS.
Department Chair, DDM	The department chair is responsible for the overall leadership and administration of the DDM, including academic programs, faculty, and staff.	The department chair needs a comprehensive plan to elevate the department's QMS to meet ISO 9001:2015 standards, ensuring consistent and high-quality educational delivery and administrative processes.
Faculty and Staff, DDM	Faculty and staff are involved in the daily operations, educational delivery, and administration within the DDM.	Faculty and staff need clarity on process improvements and training on new procedures to ensure compliance with ISO

STAKEHOLDER	ROLE	NEEDS
		9001:2015 standards. They also require support in integrating these new processes into their daily routines to enhance operational efficiency and educational quality.
Graduate Students, NPS	Students are the primary beneficiaries of the educational programs offered by the DDM.	Students need assurance that the education they receive meets high-quality standards, which are validated through ISO 9001:2015 certification. This certification ensures that the educational programs are consistent, well-structured, and continuously improved, enhancing their learning experience and future career prospects.
Other Academic Institutions with Graduate Defense-Focused Curriculums	Institutions with similar graduate programs in defense management and related fields.	These institutions need insights into best practices for achieving ISO 9001:2015 certification in a defense-focused academic setting, as well as access to the process map and findings to potentially replicate successful strategies and enhance their own QMS.

E. RESEARCH METHOD

The ISO capstone team employs a mixed-methods approach, incorporating systems analysis to thoroughly investigate the DDM's current QMS and its alignment with ISO 9001:2015 standards. This approach integrates both qualitative and quantitative methodologies to offer a comprehensive analysis of existing processes and identify areas for improvement. Case studies are reviewed and analyzed to understand how similar academic organizations have successfully achieved ISO 9001:2015 certification. These insights are applied to solve the DDM's specific challenges. Quantitative data, in the form of checklist items that align with ISO 9001:2015 clauses, are used as a foundation for evaluating existing processes within the department (through the analysis of department policies and other documentation). This combination of methods provides a robust framework for identifying gaps and developing actionable recommendations. Additionally, the educational domain of SE is explored through literature reviews, expert consultations, and the utilization of educational resources.

The chosen research approach is expected to be successful for the following reasons:

Comprehensive Analysis: The mixed-methods approach ensures that both qualitative insights and quantitative data are considered, providing a well-rounded understanding of the DDM's QMS.

Stakeholder Engagement: By involving stakeholders, the project ensures that the perspectives and expertise of those directly impacted by the QMS are integrated into the analysis and recommendations.

Evidence-Based Recommendations: The use of quantitative data allows for objective assessment and benchmarking, ensuring that recommendations are grounded in evidence and aligned with best practices.

Systematic Framework: Grounded theory and case studies provide a structured methodology for identifying root causes of deficiencies and developing targeted solutions, which can significantly improve the current QMS practices.

Overall, the ISO capstone team seeks to employ a holistic approach to analyzing and documenting the DDM QMS to identify the requirements for achieving certification. The stakeholders and the ISO capstone team seek to utilize DDM as a proof of concept that can be scaled throughout NPS. Therefore, the foundation work employed in this capstone will be integral in future policies and processes.

Currently, the DDM's QMS supports high academic standards but lacks the formalized structure required by ISO standards. Achieving certification would not only align the DDM's processes with ISO but also foster a culture of continuous improvement, directly enhancing stakeholder confidence. This context underpins the project objectives, from assessing current practices to developing the foundation for certification readiness. The following literature review explores the underpinnings of ISO 9001:2015, systems engineering approaches, and best practices in quality management, providing a foundational understanding for the subsequent analysis and recommendations.

III. LITERATURE REVIEW

The NPS DDM QMS is not certified by ISO 9001:2015. DDM is a defense-focused graduate academic department that focuses on contracting, logistics, and program management topics for DoD students. In the early planning stage of the capstone project, the sponsor, DDM's associate chair for acquisition science, hosted a strategy meeting with the authors, the *ISO capstone team*. In this meeting, the sponsor conveyed the problem and six specific goals he sought to meet by achieving ISO 9001:2015 accreditation:

1. *Quality Assurance*: ISO 9001:2015 certification demonstrates the DDM's commitment to high education, research, and administration standards.
2. *Improved Processes*: Achieving certification necessitates a thorough examination and documentation of processes, leading to enhanced workflow efficiency and resource utilization.
3. *Compliance and Risk Management*: ISO certification fosters systematic risk management, compliance with regulations, and increased operational resilience for the DDM.
4. *Consistency*: ISO 9001:2015 standards help ensure that DDM's operations consistently meet educational and management expectations.
5. *Enhanced Credibility and Reputation*: An ISO 9001:2015 certification boosts the DDM's reputation in military and educational circles, attracting top-tier faculty and students.
6. *Continuous Improvement*: The certification encourages continuous improvement, which is vital for adapting to technological changes and strategic defense acquisition environments.

The ISO capstone team reviewed and provided recommendations on the DDM QMS to meet ISO 9001:2015 standards by applying an SE approach. This approach provides a distinctive perspective from traditional methods and illuminates unique avenues for refining quality management practices. Additionally, the ISO capstone team followed the sponsor's guidance to explore potential avenues for achieving ISO 9001:2015 certification and began researching scholarly content related to the topic areas. In this work, the ISO capstone team presents a comprehensive literature review that seeks to fill a notable void in contemporary research by applying an SE approach to requirements decomposition and applying ISO 9001:2015 requirements for DDM's QMS.

This literature review surveyed research on risk-based thinking, gap analysis, and holistic thinking, which has demonstrated their usefulness in identifying requirements. Additionally, this review analyzes academic and defense-oriented organizations similar to DDM that have successfully implemented ISO 9001:2015 standards. This analysis provides insights into how these organizations identify and utilize key performance indicators (KPIs) to benchmark QMS activities and implement decision support systems (DSS) to improve organizational processes and compliance with regulatory requirements.

F. INCLUDED/EXCLUDED LITERATURE TOPICS

For this literature review, the ISO capstone team employed a methodology centered on recency, relevance, and source diversity of research topic selection. The ISO capstone team prioritizes sources published within the last decade, including the current ISO 9001:2015 standard and ISO 9001 documents, and examines these sources to trace the evolution of these standards over time. The relevance criteria expanded on topics directly associated with process improvement principles, performance indicators, quality management, and cost–benefit analyses related to ISO implementation.

Research materials were sourced using scholarly search engines and industry-specific websites. Conditions were established to ensure a broad spectrum of source types were included by using a broad vocabulary of keywords and industry-specific terminology to minimize research bias. Additionally, scholarly journal articles, past capstone projects and thesis reports, and DoD doctrine and publications were thoroughly reviewed to direct and better inform the team's research scope.

This literature review primarily includes studies and methodologies on implementing ISO 9001 standards within academic environments, particularly those integrating QMSs in military and government educational settings similar to NPS. Special consideration is given to scenarios highlighting process improvement, performance indicator identification and application, and the utilization of systems thinking or SE practices in the context of ISO 9001:2015 certification.

To ensure the utilization of the latest revision of the ISO standard, the ISO capstone team prioritizes sources that detail the implementation of the current ISO 9001:2015 version. Any content discussing previous iterations of ISO 9001:2015

provides historical context to the research; however, methods from earlier versions are only referenced, with priority given to the current ISO 9001:2015 standard. Additionally, sources that discuss the return on investment (ROI) associated with ISO implementation warrant inclusion in this literature review.

This review excludes literature on implementing ISO 9001:2015 in manufacturing or production-oriented environments, as these do not directly correlate with the academic- and defense-focused applications intended for this study. Discussions centered around leadership and executive stakeholder engagement are also omitted, given that the DDM's leadership is committed and actively directing the ISO capstone team to research this certification effort. This review does not include research on implementing ISO 9001:2015 QMS management within the healthcare sector. Though these sources may help glean historical process improvement best practices, medical ISO 9001:2015 implementation efforts do not directly apply to the academic utilization sought by this research.

G. SE APPROACH TO ISO 9001 IMPLEMENTATION

The ISO capstone team will apply the *Define Systema Requirements* and *Allocate System Functions to Subsystem* steps of the SE process. This allowed the team to identify the requirements the sponsor's problem statement needs to address. This is highlighted by the SE "Vee" Process Model created by Blanchard and Fabrycky (Blanchard and Fabrycky 2014), depicted in Figure 1. For this project, only two critical steps of the Vee model were examined: *Define System Requirements* and *Allocate System Functions to Subsystems*.

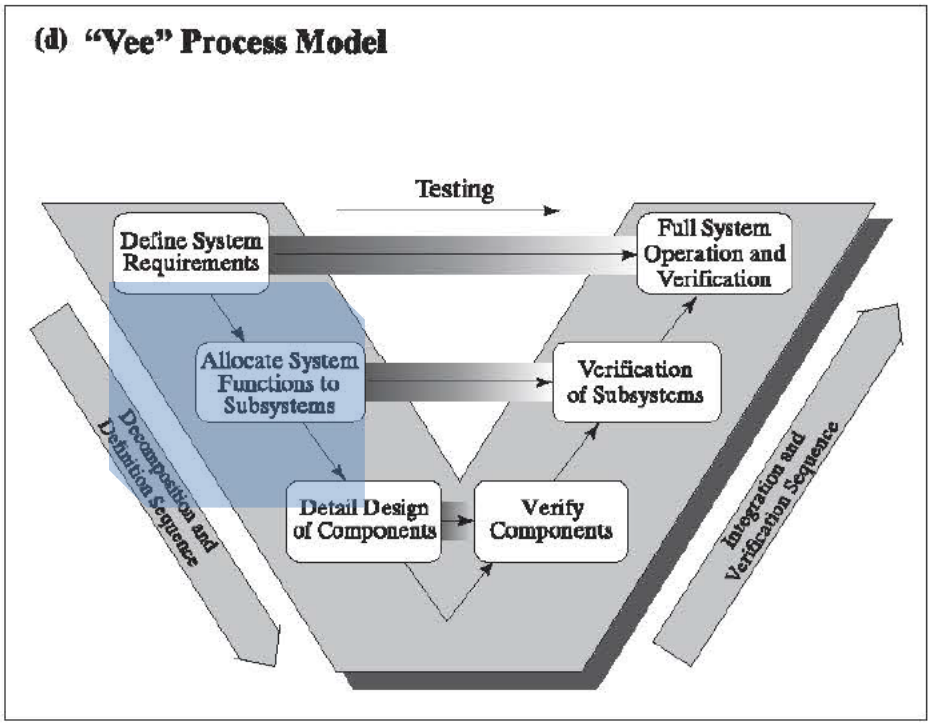

Figure 1. System Engineering "Vee" Process Model. Source: Blanchard and Fabrycky (2014).

This model visually represents the SE method, providing a structured framework for developing and implementing complex systems (Blanchard and Fabrycky 2014). The authors explain that the development and downward slope of the SE Vee begins with defining the system's requirements and ends when a detailed design of the system's components is complete. The system then moves upward along the right side of the SE Vee, where it is incrementally verified at the component, subsystem, and complete system. According to the same source, the final step is delivering a fully operational system meeting the requirements. This model offers a comprehensive roadmap from system conception to delivery, emphasizing the importance of verification and validation at each stage (Blanchard and Fabrycky 2014). The *SE Vee* provides organizations with a linear and interconnected approach to problem-solving and offers a foundation for the ISO capstone team's research approach.

H. ISO 9001:2015 RUBRIC

Sato (2024a) notes that the ISO 9001 standard was first introduced in 1987 with the inaugural edition, ISO 9001:1987. Historically, the ISO standard has been updated every 5 to 8 years, with the latest iteration, ISO 9001:2015, representing the fifth and

currently implemented version. A revision is underway, with an anticipated release of the new edition in 2026 (Sato 2024a). Given this timeline, the 2015 edition remains the most recent iteration of the ISO 9001 standard, and the ISO capstone team uses it for analysis.

Per the official ISO 9001:2015 webpage, the current standard provides a comprehensive framework for designing, maintaining, and continually improving an organization's QMS ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). This standard covers various aspects essential to ensuring organizational efficiency and consistency. The following seven mandatory topic areas are quoted directly from the ISO 9001:2015 requirements webpage and form the overarching structure that will be applied to the DDM QMS:

1. *Context of the organization*: ISO 9001 requires organizations to determine the external and internal factors that affect their ability to achieve the intended results of their quality management system.
2. *Leadership*: The Standard emphasizes the importance of leadership in implementing and maintaining a quality management system.
3. *Planning*: The quality management system must include measures designed to achieve an organization's quality objectives and continuously improve the system's effectiveness.
4. *Support*: ISO 9001 addresses resources, competence, awareness, communication, and documented information.
5. *Operation*: The processes necessary to meet customer requirements and increase customer satisfaction must be planned, implemented, and controlled.
6. *Performance evaluation*: The Standard requires organizations to monitor, measure, analyze, and evaluate the performance and effectiveness of their quality management system.
7. *Improvement*: ISO 9001 emphasizes the importance of continuously increasing the effectiveness of the quality management system based on the results of performance evaluation and other data sources. (ISO, 2015)

Ultimately, these seven topic areas will be integrated into the DDM's QMS framework to validate that the system meets ISO 9001:2015 standards. By thoroughly assessing each area, the ISO capstone team identifies gaps, recommends targeted improvements, and ensures compliance with international quality management standards. This comprehensive evaluation will empower the DDM to establish a robust and resilient QMS, fostering continuous improvement and supporting its strategic objectives in

education, research, and administration. Achieving ISO 9001:2015 certification will reinforce the DDM's commitment to excellence and provide a competitive edge in attracting top-tier faculty and students while adhering to international best practices in quality management.

Additionally, approaching the goal of waste elimination is a key component of ISO 9001:2015. Waste presents itself in many forms, including personnel time and energy, raw material, space, and financial waste. Authors (Alieva and von Haartman 2020a) suggested that organizations must consider digital waste as a new form of waste. Digital waste refers to the vast accumulation of disorganized, outdated, or unnecessary data resulting from digital transactions produced by Internet of Things devices (Alieva and von Haartman 2020a). While DDM does not manufacture vehicles using the perfected waste management of the Toyota Production System, DDM can still learn from its practices by ensuring that it develops, captures, measures, and discusses valuable data metrics as inputs to obtain valid results. ISO 9001:2015 requires that documents be updated and available to all stakeholders (ISO, 2015). Therefore, once the later discussed DSS architecture is designed and developed, DDM must determine or expound on secure communication methods available to their key population of stakeholders that will satisfy ISO 9001:2015 requirements while striking a balance between producing positive results and eliminating digital waste.

I. SE INTEGRATION

The ISO capstone team aims to expand the available literature on the benefits of applying a SE or systems thinking methodology to achieve ISO 9001:2015 in higher education institutions. Bashan and Kordova's (Bashan and Kordova 2021) article on integrating global quality and systems thinking highlights some of the benefits mentioned when using Mizikaci's holistic approach was used. While the ISO capstone team is focusing on applying systems thinking to the education realm, Bashan and Kordova's 2021 work is applicable for inclusion because the NPS and the DDM educate and employ global stakeholders. The increasing globalization of education encourages the use of the international standard for documented quality in the program of interest to continue the attraction of global students and instructors.

Systems thinking holistic characteristics offer a better approach to understanding the interrelatedness of the QMS clauses in the ISO 9001:2015 to improve the QMS compared to other methodologies. Individually decomposing each of the seven requirements from the ISO 9001:2015 for analysis, planning, and requirements generation allows for a useful understanding of the interrelatedness of each requirement. This understanding permits the generation and execution of a testable, scalable process. The SE methodology promotes traceability so that it can more easily document and achieve continuous improvement as new data become available.

Systems thinking forces the organizational members to develop a plan to address the problem from several perspectives and identify how they are all connected to make a better product as a whole. Bashan and Kordova (2021, 3) stated, "The whole emerges from the interactions among the components and consequently gives meaning to the parts" (p. 3). Considering the several components that make up the ISO 9001:2015 standard, coupled with the quality work already completed by the DDM and the future identification of gaps, Richmond (Richmond 2000a) suggested that looking at the issue "from 10,000m rather than focusing on local trees" and "considering how the system influences systems on the other side of the line and how these latter systems influence the former system." Therefore, as Bashan and Kordova (2021) stated, continued and varied studies in the application of the systems perspective in education and other disciplines are needed to improve the adoption of QMSs (2021, 4).

Research on applying systems thinking to achieve ISO 9001:2015 in higher education institutions is crucial for improving the DDM QMSs and achieving ISO 9001:2015 certification. Other methodologies fall short in addressing some of the seven requirements outlined by the international standard. Systems thinking incorporates a holistic nature by providing a better understanding of the standards' interrelatedness and offers a comprehensive perspective for continuous improvement.

J. BENCHMARKING

The ISO capstone team selected Freeman et al.'s 2012 work, *Using Technology to Improve Peer Review and Collaborative Conversations to Benchmark Academic Standards*, as this study focused on the use of electronic communication mediums to

facilitate benchmarking practices within an academic organization. The authors investigated the effectiveness of using technology to enhance peer review processes and collaborative discussions among academics to establish standards across educational departments and universities. Freeman et al.(Freeman et al. 2012a) utilized a mixed-methods approach, combining qualitative data from focus group discussions and quantitative data from surveys. They found that technology-supported peer review processes helped to standardize the understanding of academic benchmarks and improved the clarity and consistency of identified standards. Additionally, the authors reported that digital communication and data storage made accessing and sharing benchmarked information much easier compared to other methods. Freeman et al.'s comprehensive methodology—which successfully standardized academic benchmarks through collaborative efforts and technology—demonstrates how organizational performance can be enhanced by aligning internal expectations with external benchmarks. This approach promotes a comprehensive and cohesive quality management strategy.

K. CONTINUOUS IMPROVEMENT

Once requirements are established and customized to meet the specific needs of the DDM's QMS, it becomes crucial for management to concentrate their efforts on continuous improvement. Continuous QMS process improvement is a fundamental tenet within the requirements of ISO 9001:2015 (ISO, 2015). Continual enhancement yields substantial benefits within the educational sector beyond merely being a requirement for ISO certification. Given the dynamic nature of academic environments and the ever-evolving standards of quality education, the pursuit of process improvement is indispensable in this context.

To further research process improvement practices and their implementation within the DDM's QMS, the ISO capstone team selected Moturi and Mbithi's (Moturi and Mbithi 2015) study, *ISO 9001:2008 Implementation and Impact on the University of Nairobi: A Case Study*. In this work, the authors note that the University of Nairobi's implementation of ISO 9001:2015 standards led to significant improvements in the institution's QMS and, once established, continual process improvement. The authors sought to understand better how ISO 9001:2015 requirements could enhance service

delivery and operational performance at the University of Nairobi, an academic institution with many similarities to the DDM. Moturi and Mbithi utilized a case study design, employing a robust qualitative approach to analyze data collected from internal audit reports, internal surveys, surveillance audits, and external rankings over 7 years. Due to the academic context of their work, the insights from Moturi and Mbithi's study are highly relevant to the DDM. The authors' findings regarding the leadership challenges in implementing continual improvement are detailed in the following sections. These challenges highlight potential friction points that may be encountered by the DDM's management while seeking ISO 9001:2015 certification, including issues related to *people*, *resources*, *documentation*, and *communication.*

1. People

One of the main challenges is the insufficient engagement and commitment from faculty and staff. Moturi and Mbithi (Moturi and Mbithi 2015) discovered that some staff focused more on satisfying audit requirements than integrating the QMS into their daily activities. They found that staff would complete tasks just to check off items on a checklist rather than consider how to simplify tasks to improve the overall process. Instances like this can lead to a superficial compliance culture rather than one that genuinely values process improvement. It is crucial to foster a culture where all staff understand the benefits of the QMS and are committed to its principles. This can be achieved by holding regular training sessions and workshops and by creating a sense of ownership among the staff. Recognizing and rewarding contributions to improving KPIs—and, by extension, the QMS—can also enhance commitment and involvement (Moturi and Mbithi 2015).

2. Resources

Another significant challenge is the availability of resources, facilities, and physical infrastructure. At the University of Nairobi, Moturi and Mbithi (2015) found that resources were generally stretched, which hindered the full implementation and improvement of the QMS. Ensuring that adequate resources are allocated for the implementation and maintenance of the QMS is essential. This includes investing in the

necessary technology, infrastructure, and personnel to support the QMS processes. To achieve this, department budgeting and resource planning should prioritize QMS needs to avoid these bottlenecks. Additionally, the department should focus on staff training to enhance their skills and efficiency, ensuring that the current workforce can effectively manage and improve QMS processes without requiring additional hires. Leveraging existing technology, such as digital platforms for communication and data management, should also be considered to maximize efficiency and reduce costs associated with new investments. By adopting a flexible and resourceful approach, significant strides can be made in QMS implementation and maintenance, even within financial constraints (Moturi and Mbithi, 2015).

3. Documentation

Management and access to reference documents, as well as maintaining complete records, are essential for the QMS (Moturi and Mbithi 2015). The University of Nairobi faced challenges in this area, which led to inefficiencies and gaps in ISO 9001 compliance. Implementing a robust documentation management system is vital. This system should ensure that all documents are easily accessible, regularly updated, and properly maintained. Digital solutions for document management can enhance accessibility and control, reducing the risk of errors and omissions (Mbithi and Moturi, 2015).

4. Communication

Effective communication is critical for the success of the QMS. The University of Nairobi struggled with inadequate communication, even with internal stakeholders. Establishing a comprehensive communication strategy is essential. This strategy should ensure that all stakeholders are informed about the QMS processes, their roles, and the benefits of the QMS. Regular updates, feedback mechanisms, and open channels of communication can help in creating a transparent and inclusive QMS environment (Moturi and Mbithi, 2015).

In conclusion, while the implementation of ISO 9001:2015 standards and continuous QMS improvement can bring significant benefits to an organization, it is

essential to address the challenges proactively. By learning from the experiences of the University of Nairobi, strategies can be developed to enhance involvement, allocate adequate resources, manage documentation effectively, build robust structures, and improve communication. This comprehensive approach ensures that a QMS not only meets ISO 9001:2015 standards but also drives continuous improvement and excellence in the operations of the organization to which it belongs.

L. CONCLUSION

This literature review highlights the substantial benefits and unique challenges of implementing ISO 9001 certification within the DDM at NPS. The insights gained from the studies examined provide a comprehensive understanding of the complexities involved, particularly the innovative application of SE processes to decompose requirements and enhance QMS adherence. Notably, there is a distinct lack of research in utilizing the SE approach to refine QMS for ISO 9001:2015 certification in higher education institutions. This gap presents a significant opportunity for the ISO capstone team to pioneer a unique methodology. By leveraging SE principles, the team can systematically identify and address requirements and gaps within the DDM's current QMS, ensuring that the department is prepared to achieve ISO 9001:2015 standards. This approach not only emphasizes the interconnectivity of various processes and their contributions to overall system performance but also ensures that improvements are holistic and sustainable.

The SE process, exemplified by the "Vee" model, offers a structured framework for developing and implementing complex systems. Applying this model to the DDM's QMS enables a thorough examination of requirements, verification at each stage, and a comprehensive roadmap from system conception to delivery. This rigorous approach suits the DDM's defense-oriented academic environment, where precision, reliability, and continuous improvement are paramount. Incorporating benchmarking, requirement identification, and a thorough gap analysis of the QMS further strengthens the system's quality. Benchmarking against best practices and standards helps set realistic and aspirational goals. Identifying requirements ensures that the correct performance is measured and managed effectively. Identifying existing gaps in the QMS aids in

evaluating deficiencies, making informed decisions, and fostering a culture of continuous improvement.

Ultimately, the ISO capstone team's efforts to integrate SE processes into the DDM's pursuit of ISO 9001:2015 certification represent a groundbreaking approach in the academic sector. This methodology not only addresses the unique challenges faced by the DDM but also sets a precedent for other departments within NPS and other defense-focused educational institutions aiming to enhance their QMS and achieve ISO 9001:2015 certification.

IV. METHODOLOGY

The methodology section serves as a structured guide, detailing the processes and tools the ISO capstone team applied to initiate the ISO 9001:2015 certification process at the DDM. The capstone team adopted an SE approach, specifically utilizing the Vee model, as outlined by Blanchard and Fabrycki (2014; see Figure 1). For this project, only two critical steps of the Vee model were examined: Define System Requirements and Allocate System Functions to Subsystems. These initial steps ensure the ISO 9001:2015 requirements are systematically identified, dissected, and correctly aligned with the department's current processes and procedures to identify areas that may already meet the requirement and those that do not.

M. REQUIREMENTS GENERATION

First, the Define System Requirements phase focused on pinpointing the exact expectations and standards set by ISO 9001:2015. The seven key clauses, identified from the official ISO 9001:2015 webpage ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015), provided a clear structure for the areas that must be addressed within the DDM's QMS. Each clause encompasses specific requirements for maintaining a robust quality management system, covering everything from organizational leadership to continuous process improvement. These clauses include the following subject areas:

1. Context of the Organization
2. Leadership
3. Planning
4. Support
5. Operation
6. Performance Evaluation
7. Improvement

To further define the system's requirements and work toward their application, the ISO capstone team utilized the *ISO 9001:2015 Gap Analysis Checklist* (see Supplemental 1 for full checklist); this checklist, available through Vanguard Management Systems (n.d.), a United Kingdom–based ISO certification consulting firm

("Free ISO 9001:2015 Templates," n.d.), served as a tailorable self-assessment tool that guided the initial survey of the DDM's existing QMS. The checklist is broken down into seven sections, corresponding to each of the seven ISO 9001:2015 subject areas. The checklist is 44 lines in length, with each line detailing a specific requirement, or set of requirements, necessary for ISO 9001:2015 compliance.

N. GAP ANALYSIS OVERVIEW

Next, the ISO capstone team utilized the second step of the SE Vee model, Allocate System Functions to Subsystems via a gap analysis. A gap analysis is a systematic approach used to evaluate the differences between an organization's current state and a desired standard, typically focusing on specific requirements or goals. In the context of ISO 9001:2015 certification, the gap analysis serves as a tool to assess how well the existing processes, policies, and documentation align with the standards outlined in the requirements. The analysis identifies areas of compliance as well as gaps that need to be addressed to achieve certification (Syahrullah et al. 2022, 69).

The gap analysis aims to provide a clear understanding of where the organization stands relative to the ISO 9001:2015 requirements. By identifying gaps early in the process, institutions can focus resources, streamline efforts, and prioritize the necessary changes to meet certification standards. The gap analysis also helps in creating an action plan to close identified gaps, ensuring that compliance efforts are efficient and targeted.

In this project, the gap analysis served as a foundational step, offering a structured, data-driven method to compare the DDM's existing QMS against the ISO 9001:2015 standards. The initial, high-level assessment paved the way for a more detailed second gap analysis, helping the capstone team determine which areas already meet compliance and which require further development, leading into the detailed review in the subsequent section.

O. INITIAL QMS GAP ANALYSIS

To verify the DDM's compliance with the checklist, the capstone team requested a copy of all department documents that could be useful in determining ISO compliance for each of the 44 requirements. The DDM's faculty associate for assessment and

accreditation provided six documents; each is detailed next with a brief description of its publication date, purpose, and any other relevant information.

1. *Department of Defense Management Continuous Improvement Review Report* (Department of Defense Management 2019)

Publication Date: December 2019

Purpose: This report outlines continuous improvement efforts by the Graduate School of Defense Management (GSDM; the previous title for the DDM) over five years (2015–2019). It evaluates progress on academic and operational initiatives aimed at enhancing education and research outcomes, including curriculum development and faculty engagement.

Relevant Information: This document aligns with the ISO 9001:2015 clauses on Performance Evaluation and Improvement, emphasizing strategic planning and faculty development efforts.

See Supplemental 5: DDM Continuous Improvement Review for complete report.

2. *Department of Defense Management Program Assessment Policy (Draft)* (Department of Defense Management 2024a)

Publication Date: Scheduled for late 2024

Purpose: This draft policy provides the framework for assessing program competencies and objectives within the DDM. It ensures proper evaluation of learning outcomes for continuous program improvement and accreditation compliance.

Relevant Information: The policy ensures compliance with Western Association of Schools and Colleges (WASC) and AACSB standards, relevant to the ISO 9001:2015 Support and Planning clauses.

See Supplemental 4: Department of Defense Management Program Assessment Policy (Draft) for complete document.

3. *Naval Postgraduate School President's 2024 Intent* (Rondeau 2024)

Publication Date: 2024

Purpose: This document outlines the NPS president's strategic goals for the institution, focusing on education, research, and organizational transformation for 2024. It details key priorities such as improving staff engagement, resource management, and wargaming capabilities.

Relevant Information: The emphasis on institutional development aligns with the Leadership and Context of the Organization clauses of ISO 9001:2015.

See Supplemental 6: Naval Postgraduate School President's 2024 Intent for complete intent.

4. *Global Accreditation Center-Project Management Institute Self-Assessment Report* (Department of Defense Management 2024b)

Publication Date: March 2024

Purpose: This self-assessment report was submitted to the Global Accreditation Center (GAC) for the accreditation of the Master of Science in Program Management (MSPM) and Defense Program Management programs. It evaluates the alignment of these programs with GAC standards, including curricula, faculty qualifications, and student support.

Relevant Information: This document supports compliance with the Operation and Support clauses of ISO 9001:2015 by providing insights into program structure, resources, and staff competencies.

See Supplemental 3: Global Accreditation Center-Project Management Institute Self-Assessment for full report.

5. *Western Association of Schools and Colleges (WASC) Naval Postgraduate School Thematic Pathway for Reaffirmation Institutional Report* (Naval Postgraduate School 2020)

Publication Date: 2020

Purpose: This report was submitted to WASC as part of NPS's reaffirmation process for institutional accreditation. It covers a range of topics, including curriculum redesign, faculty recruitment, and student success initiatives.

Relevant Information: The report helps address the Context of the Organization and Leadership clauses, providing a comprehensive evaluation of NPS's academic programs and organizational alignment.

See Supplemental 7: WASC NPS Thematic Pathway for Reaffirmation Institutional Report for complete report.

6. *Western Association of Schools and Colleges Naval Postgraduate School Thematic Pathway for Reaffirmation Compliance Worksheet* (Naval Postgraduate School 2020)

Publication Date: June 2020

Purpose: This worksheet ensures that NPS complies with WASC standards and federal requirements. It summarizes NPS's efforts to align with accreditation criteria and provides evidence of compliance with institutional goals.

Relevant Information: The worksheet is critical for aligning with the Performance Evaluation and Improvement clauses of ISO 9001:2015, particularly in tracking educational effectiveness and compliance.

See Supplemental 8: WASC NPS Thematic Pathway for Reaffirmation Compliance Worksheet for full documentation.

The capstone team then proceeded with a detailed review of the DDM's QMS by applying the 44-line ISO 9001:2015 Gap Analysis Checklist. Figure 2 provides a sample of the complete ISO 9001:2015 Gap Analysis Checklist found in Supplemental 1 of the same name; a high-level overview of the results is listed next. This checklist, structured to align with the seven key clauses of the ISO 9001:2015 standard, was used as a step-by-step guide to verify compliance across the seven topic areas. Each line within the checklist represents specific compliance requirements, and the team systematically cross-referenced the DDM's available documentation against these lines to evaluate conformity.

Planning

Ref	Gap Analysis Question	Finding					
		Yes	No	ISO Clause	Process Owner	Primary Evidence	Action Needed
15	Have the risks and opportunities that need to be addressed to give assurance that the QMS can achieve its intended result(s) been established?	X		6.1.1 (Page 4)		WASC_2020.07.29 NPS TPR Institutional Report: Page 8, "E4S Strategy": Discusses the identification and assessment of risks and opportunities related to achieving the intended results of the QMS Page 10, "Review and Assessment Program (RAP)": Addresses the assessment of risks and opportunities in the context of the QMS	

Figure 2. Sample of DDM ISO 9001:2015 Gap Analysis Checklist from Supplemental 1

For each item on the checklist, the team categorized findings as either "Met" or "Not Met." This process enabled the team to identify both compliant and non-compliant areas, allowing for a granular view of the department's current alignment with ISO standards.

1. High-Level Results

Met: 32 of 44 requirements (approximately 73%) were deemed compliant with the ISO 9001:2015 standard.

Not Met: 12 of 44 requirements (approximately 27%) were identified as not yet meeting compliance.

2. Breakdown by Topic Area

1. Context of the Organization: 4 of 6 items met (67%)
2. Leadership: 6 of 7 items met (86%)
3. Planning: 3 of 3 items met (100%)
4. Support: 7 of 8 items met (88%)
5. Operation: 4 of 7 items met (57%)
6. Performance Evaluation: 5 of 6 items met (83%)
7. Improvement: 3 of 4 items met (75%)

The identified gaps are primarily related to procedural documentation and operational controls. However, a more detailed review of the findings, including the

specific gaps and recommended corrective actions, are captured in the Findings and Recommendations chapter of the capstone report. At this stage, the primary focus of the gap analysis was to provide an initial assessment of the DDM's alignment with ISO 9001:2015 requirements.

P. SECOND QMS GAP ANALYSIS

After completing the initial gap analysis, the capstone team determined that a more detailed evaluation of the DDM's QMS was necessary. The team found that the initial 44-line ISO 9001:2015 Gap Analysis Checklist provided valuable insights but did not fully capture the complexity of ISO 9001:2015 requirements and a more granular assessment was required. To address this, the team further refined the analysis by decomposing the existing checklist into a more robust, and longer, set of requirements. This process was guided by the National Aeronautics and Space Administration (NASA; 2019) document, "How to Write a Good Requirement" from Supplemental 9.

Using NASA's methodology, the ISO capstone team systematically broke down each of the 44 original checklist lines into detailed, measurable requirements. This approach ensured that each broad ISO requirement was translated into specific, actionable items for more effective assessment. Typically, each requirement was decomposed into three to five additional sub-requirements, following a process of identifying, monitoring, and documenting compliance. The resulting requirements were organized into a comprehensive Requirements Traceability Matrix (RTM), which provided a clearer and more in-depth evaluation of the DDM's ISO 9001:2015 compliance. Figure 3 is a sample of Supplemental 2 for contextual purposes.

Line Number	Gap Analysis Question	ISO Clause	leq. No	Req. Description	Status: Met or Not M	Referenced Document and Citation
Topic Area #1 - Context of the Organization						
1	Have all that are relevant to your organization's purpose and the achievement of customer satisfaction and the organization's strategic direction been determined?	4.1 Understanding the organization and its context	1.1	The organization shall identify all external issues relevant to its strategic direction and customer satisfaction.	Not Met	NPS President's 2024 Intent - Get Real, Get Even Better (p. 1 -3); Identifies areas of focus that impacts the strategic vision for NPS and stakeholders. The areas discussed include people, funding, and assessing "internal and external" mission related requirements. DDM's policy: DDM Policy Statement 2024-002 Assurance of Learning (p.2) aims to bring external advisors to discuss "external perspective on trends and challenges". However, the policy lacks details on the specific process or tools to capture and implement the goal of identifying external issues. Recommend business rules and a formal policy signed and implemented.
			1.2	The organization shall identify all internal issues relevant to its strategic direction and customer satisfaction.	Not Met	A repository that list all NPS or DDM internal issues has not been provided. Recommend a dash board or internal process to track and report statuses. There has been many third- party documents highlight current issues however, the CAPSTONE team has not been provided a method to assess if the issues are resolved. Recommend an issue log started to capture and monitor statuses of the issues.
			1.3	The organization shall document and review these issues regularly.	Met	The DDM Program Assessment Policy discusses integrating assessment findings into continuous program improvement on a quarterly basics to include key roles of faculty members.

Figure 3. Sample of ISO 9001:2015 RTM from Supplemental 2

The result was a total of 147 individual requirements, which afforded a more precise view of the DDM's current alignment with the certification standards. The RTM served as the baseline for the second phase of the gap analysis, during which the team evaluated each requirement against the documentation and processes in place at the DDM. Results from the second gap analysis follow next.

1. High-Level Results

Met: 120 of 147 requirements (approximately 82%) were deemed compliant with the ISO 9001:2015 standard.

Not Met: 27 of 147 requirements (approximately 18%) were identified as not yet meeting compliance.

2. Breakdown by Topic Area

1. Context of the Organization: 3 of 6 items met (50%)
2. Leadership: 5 of 7 items met (71%)
3. Planning: 3 of 4 items met (75%)
4. Support: 6 of 9 items met (67%)
5. Operation: 7 of 16 items met (44%)
6. Performance Evaluation: 6 of 6 items met (100%)
7. Improvement: 2 of 5 items met (40%)

This more in-depth gap analysis revealed that 120 of the 147 requirements (82%) were, by the ISO capstone team's assessment, already in compliance with ISO 9001:2015 standards. However, 27 requirements (18%) were identified as Not Met, particularly in the Operation and Improvement categories, where further development and

documentation are required. This second gap analysis provided a more detailed picture of the DDM's readiness for ISO 9001:2015 certification, highlighting specific areas that need to be addressed. The identified gaps serve as the foundation for corrective actions and are thoroughly explored in the Findings and Recommendations chapter of this report. By decomposing the requirements and conducting this detailed assessment, the team has created a solid foundation for moving forward with the ISO certification process.

In summary, the ISO capstone team's application of systems engineering principles and gap analysis provided a comprehensive understanding of the DDM's current alignment with ISO 9001:2015 standards. The initial and secondary assessments revealed that while significant progress has been made, key topic areas, particularly in Operation and Improvement, still require attention. The second gap analysis, which utilized a more detailed RTM, highlighted both strengths and critical gaps.

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V. FINDINGS AND RECOMMENDATIONS

The overarching theme and findings are that the DDM has developed policies, procedures, and concepts to accomplish ISO certification. However, the capstone team cannot fully state that the DDM is ready for an external audit that would result in certification. The capstone team's assessment of the DDM reveals several key areas that require improvement to align with ISO 9001 standards and NPS's strategic objectives. To address the key concerns and ensure alignment with ISO 9001 standards, the capstone team has provided several recommendations for implementation across various topic areas. In terms of Context of the Organization, the DDM must formally document its QMS system, establish key objectives and metrics, and develop a digital record-keeping system to ensure traceability and stakeholder access. For Leadership, a communication plan and requirement-traceability matrix should be created to align NPS and DDM strategic goals. Under Planning, the DDM should develop a risk management plan, task organization chart, and a documented change control process to monitor and mitigate risks effectively. In Support, establishing business policies, administrative counseling statements, and a formal training plan will ensure employees understand the importance of QMS compliance. For Operations, the creation of a communication plan and property accountability process is essential for managing customer interactions and external property. Finally, for Performance Evaluation, the DDM should implement a formalized process to document meetings and management reviews to support continuous improvement and ISO 9001 audit requirements. These steps will enhance operational efficiency and alignment with both ISO 9001, project management best practices, and organizational objectives. The following sections expound on the key findings that support further improvements necessary for the DDM to become ISO-certified.

Q. TOPIC AREA: CONTEXT OF THE ORGANIZATION

Recommended action: Formally document in writing the interworking of the DDM QMS system. Publish key objectives, metrics, and an information radiator that is accessible to all stakeholders. Furthermore, develop a digital record keeping management system.

Internal and external issues that are relevant to the strategic direction for customer satisfaction have not met the ISO 9001 requirement ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). DDM policy: DDM Policy Statement 2024–002 Assurance of Learning aims to bring external advisors to discuss "external perspective on trends and challenges" (Department of Defense Management 2024a). However, the policy lacks details on the specific process or tools to capture and implement the goal of identifying external issues. Therefore, the capstone team recommends establishing business rules that detail focus areas, key objectives, metrics, and traceability verification aspects to ensure all issues are properly identified and addressed. In addition, the development of an assessable record-keeping system would benefit the department as faculty and leadership transition into and out of the department. This is in support of requirements 1.1, 1.2, and 2.3 listed in Table 2.

A quality management system must include a written description of the processes required, their logical sequence, and the interactions of processes, and the system must be regularly reviewed and updated ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). At this moment, the capstone team has not received a process document, program, or plan to verify that a QMS and its processes are functioning correctly. The DDM Program Assessment Policy does discuss integrating assessment findings into continuous program improvement quarterly to include key roles of faculty members. Thus, the capstone team recommends the development of a process chart that visually displays how the QMS system interacts, along with a written standard operating procedure for internal and external stakeholders to reference as a best practice handbook when conducting organizational business. This is in support of requirements 5.1 and 5.2 listed in Table 2.

The organization shall establish criteria and monitor processes and their interactions ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). Once the DDM establishes a logical and written description of its QMS, ensuring criteria for managing the applicable processes must be established. The capstone team recommends leveraging the DDM's board of advisors and key personnel to develop a checks-and-balances process that reviews and approves changes (like a change control board). If this recommendation is implemented, it must be formally

documented to communicate ISO 9001 compliance. This is in support of requirements 6.1 and 6. 2 listed in Table 2.

The DDM shall establish measurements and performance indicators needed for the effective operation and control of processes ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). The DDM empowers its faculty to develop and adjust course syllabi, which establishes measurements and performance indicators needed for the effective operation and control of classroom processes. While this is a strength of the DDM within the classroom, the capstone team recommends consolidating course performance objectives to determine if all departmental objectives are being met. Quantifiable metrics and analysis and adjustment of the course of actions as needed would greatly benefit the department. Furthermore, a dashboard or information radiator would benefit the department to ensure information is regularly updated and documented. This is in support of requirements 7.2 and 7.3 listed in Table 2.

Table 2. ISO 9001:2015 RTM Not Met Requirements (Context of the Organization)

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
Topic Area #1 – Context of the Organization					
1	Have all that are relevant to your organization's purpose and the achievement of customer satisfaction and the organization's strategic direction been determined?	4.1	1.1	The organization shall identify all external issues relevant to its strategic direction and customer satisfaction.	Not Met
			1.2	The organization shall identify all internal issues relevant to its strategic direction and customer satisfaction.	Not Met
2	Are external and internal issues reviewed and monitored on a regular basis?		2.3	The organization shall update the documentation of these issues regularly.	Not Met
5	Is your QMS established and does it include a description of the processes required and their sequence and interaction?	4.4	5.1	The organization shall establish a QMS that includes a description of the processes required.	Not Met
			5.2	The organization shall describe the sequence and interaction of these processes within the QMS.	Not Met
6	Have the criteria for managing these processes and their interaction been established?		6.1	The organization shall establish criteria for managing processes and their interactions.	Not Met
			6.2	The organization shall document the criteria for process interactions.	Not Met
7	Have all responsibilities, methods, measurements, and related performance indicators needed to ensure the effective operation and control been established?		7.2	The organization shall establish measurements and performance indicators needed for the effective operation and control of processes.	Not Met
			7.3	The organization shall document and regularly review responsibilities, methods, measurements, and performance indicators.	Not Met

R. TOPIC AREA: LEADERSHIP

Recommended action: Develop a communication plan and a DDM requirement and objective traceability matrix to ensure alignment and clear communication of NPS and DDM strategic objectives.

The DDM Program Assessment Policy discusses integrating assessment findings into continuous program improvement every quarter, ensuring that actions taken in response to risks and opportunities are incorporated into program processes. However, the document does not list specific objectives and how they support NPS's overall strategic objective. Furthermore, the policy does not communicate how actions are documented and presented to NPS senior leadership. Thus, the capstone team recommends developing a matrix that maps to NPS strategic objectives and how DDM is facilitating those objectives within its policies, processes, and offerings. This is in support of requirements 9.2 and 9.3 listed in Table 3.

Table 3. ISO 9001:2015 RTM Not Met Requirements (Leadership)

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
Topic Area #2 – Leadership					
9	Have the policy and objectives for the QMS which are compatible with the strategic direction of the organization been established and communicated?	5.2	9.2	The organization shall establish QMS objectives that are compatible with the strategic direction of the organization.	Not Met
			9.3	The organization shall communicate the QMS policy and objectives throughout the organization.	Not Met

S. TOPIC AREA: PLANNING

Recommended action: Development of a DDM risk management plan, task organization chart, and a documented change control process.

The NPS President 2024 intent established ongoing risks inherent to the university's transformation to meet its objectives (Rondeau 2024). Yet, the DDM has not published or provided documentation on its risk or opportunities to support the overall objectives of NPS. Thus, the capstone team recommends developing a visual risk matrix chart and a risk and issue log that highlights the associated risk for the DDM. Therefore, as time progresses, risks and opportunities can be monitored and mitigated. This is in support of requirements 13.1, 13.2, 13.3, 14.1, and 14.2 listed in Table 4.

ISO 9001 requires the organization to establish objectives at the departmental and individual levels. The DDM Program Assessment Policy outlines specific roles for faculty and staff in managing and accessing academic programs. While these are not framed as individual QMS objectives, they do reflect the delegation of responsibilities that could be seen as relevant individual-level objectives. The capstone team recommends developing a task organization chart with tailored roles. This is in support of requirement 16.2 listed in Table 4.

The organization shall establish a process for managing the implementation of changes to the QMS and a manner of reviewing those changes. The capstone team recommends including a change process and approval chain based on the specifics of the request. This is in support of requirements 17.2 and 17.3 listed in Table 4.

Table 4. ISO 9001:2015 RTM Not Met Requirements (Planning)

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
Topic Area #3 – Planning					
13	Have the risks and opportunities that are relevant to the QMS been established?	6.1	13.1	The organization shall identify risks relevant to the QMS.	Not Met
			13.2	The organization shall identify opportunities relevant to the QMS.	Not Met
			13.3	The organization shall document and regularly review risks and opportunities relevant to the QMS.	Not Met
14	Have the risks and opportunities that need to be addressed to give assurance that the QMS can achieve its intended result(s) been established?		14.1	The organization shall identify the risks that need to be addressed to ensure the QMS can achieve its intended results.	Not Met
			14.2	The organization shall identify the opportunities that need to be addressed to ensure the QMS can achieve its intended results.	Not Met
16	Have the objectives been established at relevant departmental and individual levels within the business?	6.2	16.2	The organization shall establish QMS objectives at relevant individual levels.	Not Met
17	Is there a defined process for determining the need for changes to the QMS and managing their implementation?	6.3	17.2	The organization shall establish a process for managing the implementation of changes to the QMS.	Not Met
			17.3	The organization shall document and regularly review the processes for determining and managing changes to the QMS.	Not Met

T. TOPIC AREA: SUPPORT

Recommended action: Document formal communication and training plans for implementing and reviewing the QMS.

The organization shall ensure that employees are informed of the implications of not conforming to QMS requirements ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). The capstone team recommends establishing business policies and administrative counseling statements to ensure proper implementation. In addition, annual position descriptions and new hire duty descriptions must communicate the importance of facilitating success. Lastly, ensuring training and oversight is established to ensure compliance is vital to its existence. This is in support of requirement 22.3 listed in Table 5.

The organization shall determine the timing and frequency of internal and external communications related to the QMS ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). The capstone team recommends implementing tailored communication strategies for stakeholders. The capstone team recommends, at minimum, weekly updates and monthly meetings to communicate related QMS knowledge. This is in support of requirement 23.2 listed in Table 5.

Table 5. ISO 9001:2015 RTM Not Met Requirements (Support)

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
Topic Area #4 – Support					
22	Has the organization ensured that employees are aware of the quality policy, relevant quality objectives, their contribution to the effectiveness of the QMS, and the implications of not conforming to QMS requirements?	7.3	22.3	The organization shall ensure that employees are informed of the implications of not conforming to QMS requirements.	Not Met
23	Has the organization determined the internal and external communications relevant to the QMS, including what, when, with whom, and how to communicate?	7.4	23.2	The organization shall determine the timing and frequency of internal and external communications related to the QMS.	Not Met

U. TOPIC AREA: OPERATIONS

Recommended action: Develop a communication plan and document the property accountability process.

The organization shall regularly review and update the process for customer communication to ensure its effectiveness ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). The capstone team recommends developing a formal communication plan that outlines key actions such as methods, frequency, and channels of communication with customers, students, faculty, and stakeholders. These recommendations support the ISO 9001 and align with Project Management Professional (PMP) best practices for establishing a communication management plan. The plan must inform parties of the how, to whom, and by what means (e.g., email, portals, meetings, surveys). This is in support of requirement 27.3 listed in Table 6.

The organization shall establish controls for managing and reviewing property belonging to customers or external providers used in the provision of products or services ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). The DDM Continuous Improvement Review Report "We Do Not Own Our Real Property" (Department of Defense Management 2019) highlights the absent of property accountability. The capstone team recommends that DDM leadership formalize within a memorandum for record how it requests, receives, and accounts for all hand-receipt and expendable items outside of real property. This is in support of requirements 36.1, 36.2, and 36.3 listed in Table 6.

Table 6. ISO 9001:2015 RTM Not Met Requirements (Operations)

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
Topic Area #5 – Operations					
27	Is there a defined process for reviewing and communicating with customers in relation to information relating to products and services, enquiries, contracts, or order handling?	8.2	27.3	The organization shall regularly review and update the process for customer communication to ensure its effectiveness.	Not Met
36	Where property belonging to customers or external providers is used in the provision of the product or service, is this controlled effectively?	8.5	36.1	The organization shall establish controls for managing property belonging to customers or external providers used in the provision of products or services.	Not Met
			36.2	The organization shall implement controls for managing property belonging to customers or external providers used in the provision of products or services.	Not Met
			36.3	The organization shall regularly review and update controls for managing property belonging to customers or external providers used in the provision of products or services.	Not Met

V. TOPIC AREA: PERFORMANCE EVALUATION

Recommended action: Document the implementation process and record meeting minutes.

The organization shall implement the established approach to ensure that management reviews are conducted effectively and align with QMS objectives ("International Standard: ISO 9001 Quality Management Systems-Requirements" 2015). According to the DDM Program Assessment Policy (Department of Defense Management 2024a), "The AoL [Assessment of Learning] Board will implement improvements as necessary and as directed by the ACs [Area Chairs]" (5) (Department of Defense Management 2024a). While this document does include a plan for implementation, it is unclear how the implementation will be conducted since the document is still a draft. The capstone team recommends elaborating on this statement within a formalized memorandum for record. In addition, producing a summary document for historical purposes would support ISO 9001 review and audit requirements. This is in support of requirement 45.2 listed in Table 7.

Table 7. ISO 9001:2015 RTM Not Met Requirements (Performance Evaluation)

Line Number	Gap Analysis Question	ISO Clause	Requirement Number	Requirement Description	Met or Not Met
Topic Area #6 – Performance Evaluation					
45	Has an approach to perform management reviews been established and implemented?	9.3	45.2	The organization shall implement the established approach to ensure that management reviews are conducted effectively and align with QMS objectives.	Not Met

VI. CONCLUSION

This capstone team explored the potential for ISO 9001:2015 certification within the NPS DDM. Achieving this certification promises to enhance quality management practices, instilling a more systematic and resilient approach to academic and administrative processes while enhancing NPS and DDM's accreditations. The capstone team developed requirements through systems engineering principles, addressed current gaps, recommended solutions, and outlined a framework that would guide the DDM in meeting international quality standards. Finally, recommendations for areas of future study are provided to assist the DDM in achieving its goal of ISO 9001:2015 certification.

W. PRIMARY CONCLUSIONS

The methodology for this capstone project involved a mixed-methods approach, integrating both qualitative and quantitative techniques to assess the DDM's readiness for ISO 9001:2015 certification. The research process began with a comprehensive gap analysis, identifying areas where current practices did not meet ISO standards across seven key topic areas: context, leadership, planning, support, operations, performance evaluation, and improvement. A combination of document reviews and case studies of similar institutions provided the data required to assess the existing QMS against the ISO 9001:2015 requirements.

The findings highlighted specific gaps in process standardization, resource management, and documentation procedures. Notably, the analysis revealed that while the DDM adheres to academic accreditation standards, its operational processes lack the consistency and formalized documentation required by ISO standards. Key recommendations included implementing a more systematic approach to process documentation, enhancing risk management practices, and establishing performance metrics to drive continuous improvement. Addressing these findings provides a foundation upon which the DDM can build to achieve ISO certification, aligning operational practices with global quality standards.

X. CERTIFICATION AND ACCREDITATION

Certification and accreditation, while similar, serve different functions in higher education institutions. Certification, such as ISO 9001:2015, focuses on an organization's adherence to specific standards in quality management. In contrast, accreditation, such as that provided by the WASC, emphasizes broader academic standards that evaluate the institution's educational effectiveness and outcomes. Certification can complement accreditation by offering an external, structured approach to quality management that strengthens operational efficiencies and accountability within the institution (Kelechava, 2022). In addition to enhancing reputation, certification also provides a process-driven framework that can lead to improved stakeholder confidence and better alignment with international standards.

Y. AREAS FOR FUTURE RESEARCH

While this project lays the foundation for achieving ISO 9001:2015 certification, further research is recommended in the following areas:

Cost–Benefit Analysis: Conducting an in-depth cost–benefit analysis to assess the financial implications of certification and the return on investment (ROI) it may offer

Steps to Achieve Certification: Conducting additional research of the requirements identified by the capstone team as Not Met that the DDM can use to improve their processes and refine their QMS. This would involve developing detailed project plans, stakeholder engagement strategies, and timelines that ensure the institution is fully prepared for certification.

Market Analysis: Conducting an analysis of third-party vendors offering ISO 9001 certification preparation and certification services that NPS DDM can work with in pursuit of certification

Z. FINAL THOUGHTS

ISO 9001:2015 certification offers a clear framework for establishing a robust QMS that can enhance the DDM's operational effectiveness and academic reputation. The capstone team identified substantial progress toward meeting many of the standard's requirements, indicating a strong alignment with the DDM's current practices in several areas. Specifically, the analysis demonstrated that the DDM already meets core requirements in areas such as leadership, organizational context, and planning, which are

essential foundations for certification. These recognized strengths underscore the DDM's readiness to advance toward an internationally recognized quality standard.

However, gaps in specific requirements, particularly within resource management, documentation practices, and process consistency, were revealed. Addressing these areas will require strategic planning and sustained effort. The identified deficiencies represent areas where targeted improvements are necessary to bridge the gap between current practices and the ISO's rigorous standards. An incremental approach to meeting the remaining requirements will allow the DDM to systematically elevate its processes, ensuring compliance with all aspects of ISO 9001:2015.

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SUPPLEMENTALS

Supplemental 1:	ISO 9001:2015 Gap Analysis Checklist	Public Release

This document presents analysis of where the DDM is in comparison to the ISO clauses.

Supplemental 2:	ISO 9001:2015 RTM Spreadsheet	Public Release

Provides the requirements developed by the capstone team, furthering the gap analysis from supplemental 1.

Supplemental 3:	Global Accreditation Center-PMI Self-Assessment	

DDM self-assessment provided to Project Management Institute (PMI) for program accreditation.

Supplemental 4:	Department of Defense Management Program Assessment Policy (Draft)	Public Release

Documentation for the DDM's planned policy for continuous improvement of the department, curriculum and product delivered.

Supplemental 5:	DDM Continuous Improvement	Public Release

Historical report of the DDM program from 2014–2019 provided to the AACSB accrediting body.

Supplemental 6:	Naval Postgraduate School President's 2024 Intent	Public Release

NPS President's intent for improving the university.

Supplemental 7:	WASC NPS Thematic Pathway for Reaffirmation Institutional Report	Public Release

Historical report provided to the WASC accrediting body from NPS in 2020.

Supplemental 8: WASC NPS Thematic Pathway for Re affirmation Compliance Worksheet — Public Release

Supporting documentation for the historical report provided to the WASC accrediting body from NPS in 2020.

Supplemental 9: How to Write a Good Requirement — Public Release

Annex C from NASA Systems Engineering Handbook that outlines developing SE requirements.

To access the supplemental materials listed here, contact the Dudley Knox Library or, for publicly releasable theses and supplementals only, visit the thesis pages in the library's Calhoun database.

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Acquisition Research Program
Naval Postgraduate School
555 Dyer Road, Ingersoll Hall
Monterey, CA 93943

www.acquisitionresearch.net