Transforming Information Assurance and IT Service Management Through Digital Engineering

Dissertation Proposal Defense

John James Darth Vader Bonar
john.bonar@trojans.dsu.edu

The Beacom College of Computer & Cyber Sciences
Dakota State University
Madison, South Dakota, United States

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Dissertation Committee

Committee Chair

Dr. Patrick Engebretson, PhD

Committee Member

Dr. David Kenley, PhD

Committee Member

Dr. Matthew Kelso, EdD

/whois John Bonar

- Seven Degrees and Certifications from Dakota State University
- Senior Manager Solution Engineering & Architecture, Program Work Environments, Digital Technology at Collins Aerospace (RTX)
- Daily experience with high-compliance environments: DAAG, JSIG, CNSS, CSFC, CDS
- Research Focus: Systems Engineering for IT and Information Assurance
- First Computer: Commodore 64K
- First computer job: 1994 CCS Computers Burlington, Iowa
- Caught a 30 day ban from Ames Lab at age 15 for locking up a Cray YMP2E with a massive ray tracing simulation
- Is Darth Vader, legally

Research Abstract

Digital Engineering has transformed how the Department of War, NASA, and the aerospace industry design, develop, and sustain complex systems. Its four pillars—MBSE, digital threads, digital twin, and Product Lifecycle Management—have delivered measurable improvements in mission assurance, configuration management, and lifecycle governance.

Despite this proven operational value, these methods remain virtually untested within enterprise IT and information assurance domains, where expanding compliance obligations—including the NIST Risk Management Framework and the Cybersecurity Maturity Model Certification—impose documentation, traceability, and verification demands that current practices fail to sustain. This study employs quantitative survey methodology to establish baseline empirical data regarding professional awareness and perceived value.

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Presentation Agenda I

1. Problem Statement and Research Context
2. Expanding Compliance Landscape
3. Research Questions
4. Digital Engineering Foundations (Chapter 1)
5. Literature Review: Analytical Synthesis (Chapter 2)
6. Research Methodology (Chapter 3)
7. Survey Design and Instrument
8. Analytical Approach and Rigor
9. Timeline and Schedule
10. Expected Contributions
11. Questions and Discussion

The Visibility Crisis: A Real-World Scenario I

Federal Incident Response: Late 2023

When a vulnerability surfaced within federal information systems, security teams raced to identify every affected component. Weeks passed while agencies struggled to map the blast radius of potential compromise.

The Core Problem: Existing documentation bore no faithful resemblance to actual infrastructure configurations. Defenders challenged with tracing cascading impacts while adversaries retained the initiative.

Current State of Information System Management I

Environmental Complexity

Organizations operate within relentless technological evolution: cloud computing, microservices, IoT devices, and operational technology have spawned intricate webs of interdependencies.

Documentation Velocity Mismatch

Static documentation approaches designed for quarterly or annual update cycles cannot maintain accuracy when systems change hourly. The structural mismatch creates systematic failures that compound over time.

Information Assurance Practice Challenges I

Key Frameworks

NIST SP 800-37 Rev 2: Risk Management Framework
ISO 31000: Risk Management
NIST Cybersecurity Framework 2.0

Critical Challenge: The RMF continuous monitoring requirement exposes limitations of document-centric approaches most directly. Organizations attempting continuous monitoring through manual processes discover the labor exceeds available resources.

The Expanding Compliance Landscape I

NIST Cybersecurity Framework 2.0 (February 2024)

Added Govern Function addressing leadership engagement and risk strategy. Broadened scope beyond critical infrastructure to all organizations. Maps to SP 800-53 controls through Informative References.

SP 800-171 Revision 3 (May 2024)

Protects Controlled Unclassified Information in nonfederal systems. Restructured from fourteen to seventeen security requirement families. 97 requirements encompassing 266 individual control items and 49 Organization-Defined Parameters.

SP 800-172: Enhanced Security Requirements

Thirty-five enhanced requirements against Advanced Persistent Threats. Three-pillar defense: penetration-resistant architecture, damage-limiting operations, and cyber resiliency.

The Expanding Compliance Landscape II

CMMC 2.0 (December 2024)

Three-tiered certification: Level 1 self-assessment, Level 2 third-party assessment (SP 800-171), Level 3 government assessment (SP 800-172). Shifts from self-attestation to verified compliance. Full implementation expected by November 2028.

Key Insight: Escalating documentation, traceability, and verification demands that Digital Engineering capabilities are designed to address.

IT Service Management Practice Challenges I

ITIL Framework Dependencies

Service Strategy — Service Design — Service Transition — Service Operation — Continual Service Improvement

Critical Challenge: Configuration Management Database implementations depend upon accuracy and currency of underlying information—accuracy that organizations consistently fail to achieve. Change management processes suffer when impact assessments rely upon incomplete dependency information.

Evidence: Visibility and Documentation Failures I

Finding	Statistic	Source
Visibility Gap Metrics		
IT environment monitorable	66%	IDC/Exabeam 2023
Security teams lacking device visibility	63%	Ponemon Institute 2023
High confidence in device discovery	15%	SANS Institute 2023
Organizations with security/IT silos	55%	Ivanti 2025
Configuration Management Failures		
CMDB implementation failure rate	80%	Gartner Research
Outages from configuration issues	64%	Uptime Institute 2023
Misconfigurations from parameter errors	70-85%	Yin et al. 2011
Unplanned outages from ill-planned changes	80%	IT Process Institute

Evidence: Security Impact Metrics I

Finding	Statistic	Source
Shadow IT and Undocumented Assets		
Shadow IT as percentage of IT spend	30-40%	Gartner Research
Employees using shadow IT (2022)	41%	Gartner Research
Cloud services vs. IT estimates	15-22x higher	Cisco 2016
Projected shadow IT usage (2027)	75%	Gartner Research
Security Impact Metrics		
Mean time to identify breach	204 days	IBM/Ponemon 2024
Breaches involving shadow data	35%	IBM/Ponemon 2025
Cloud breaches from misconfigurations	82%	Check Point 2024
Organizations with cloud breaches (18 mo)	95%	CSA 2024
Projected preventable cloud breaches (2027)	99%	Gartner Research

The Documentation-Reality Gap I

The persistent gap between documentation and operational reality represents the common thread connecting failures across both domains:

- Security documentation describes control implementations that may not exist as documented
- Configuration databases contain information that no longer reflects system states
- Network diagrams depict architectures that have evolved beyond their documented form

Key Insight: This gap undermines every process that depends upon accurate system information—which includes nearly all Information Assurance and IT Service Management activities. The problem lies not in execution but in inherent limitations of document-centric methodologies.

Research Questions I

RQ1: Awareness

To what extent are information technology and information assurance professionals aware of Digital Engineering capabilities, including Model-Based Systems Engineering, digital threads, digital twin technologies, and Product Lifecycle Management principles?

RQ2: Perceived Value

Do information technology and information assurance professionals perceive Digital Engineering capabilities as potentially valuable or important for their work in information assurance, security compliance, and IT service delivery?

RQ3: Anticipated Benefits

Do information technology and information assurance professionals believe that Digital Engineering practices could help them in performing their jobs, meeting compliance requirements, or enhancing organizational capabilities in information assurance and IT service delivery?

Identified Research Gap I

The Literature Gap

Systematic literature review documents a near-complete absence of academic research applying proven MBSE and Digital Engineering methodologies to enterprise IT infrastructure, IT Service Management, or Information Assurance programs.

Academic applications exist for: Defense systems, aerospace engineering, unmanned aircraft, military system-of-systems design.

Academic applications absent for: Enterprise IT infrastructure, Information Assurance programs, IT Service Management.

Gap Validated: Wooley & Womack (2025) systematic literature review of Digital Engineering adoption, benefits, and challenges explicitly noted the absence of research addressing enterprise IT or Information Assurance applications.

Identified Research Gap II

Awareness Deficit: Henderson, McDermott, & Salado (2024) found that 22% of *systems engineering* professionals cannot clearly define MBSE. If awareness barriers persist within the originating discipline, their magnitude among IT/IA professionals demands empirical measurement.

Digital Engineering: Four Pillars I

Digital Engineering capabilities address the documentation-reality gap through four integrated pillars:

Model-Based Systems Engineering

Executable models as authoritative system representations

Digital Thread

Authoritative traceability across system lifecycle

Digital Twin

Virtual replicas for development, testing, and validation

Product Lifecycle Management

Integrated lifecycle governance and configuration control

Integration among pillars distinguishes Digital Engineering from isolated tool adoption.

Pillar 1: Model-Based Systems Engineering I

Definition

MBSE shifts from document-centric to model-centric approaches. Models become the authoritative representation of system architecture, requirements, behavior, and interfaces using SysML/UML modeling languages.

Standards and Tools:

- SysML v1 $\rightarrow$ v2 evolution with textual notation and API standardization
- Commercial: Cameo Systems Modeler, IBM Rhapsody
- Open Source: Eclipse Papyrus, Capella, SysON

Application to IA/IT:

- Security architectures with explicit control-asset-threat relationships
- Authorization boundaries as executable models rather than static documents
- Configuration item dependencies modeled with inheritance and traceability

Pillar 2: Digital Thread I

Definition

The digital thread provides authoritative traceability—verified, bidirectional connections between requirements, implementations, test results, and operational configurations throughout the system lifecycle.

Policy Foundation:

- DoD DE Strategy (2018) → DoDI 5000.97 (2023): from strategic vision to mandatory requirement
- SERC digital thread research establishes authoritative source of truth concept

Application to IA/IT:

- RMF compliance chains: requirements → controls → implementation → evidence
- ITIL change impact assessment through traced dependencies
- Automated compliance verification through model-based queries

Pillar 3: Digital Twin I

Definition

Digital twins are virtual replicas of physical or logical systems that maintain synchronization with their real-world counterparts through continuous data exchange. Originated from Grieves' PLM concept; now standardized through ISO 23247 and IEC 62832.

Ecosystem:

- Standards: ISO 23247 reference architecture, NIST IR 8356, IETF network digital twin draft
- Open Source: Eclipse Ditto, BaSyx, Twinbase (Gil 2024: 14 frameworks evaluated)

Application to IA/IT:

- Security scenario simulation and defensive measure testing
- Change validation in as-configured virtual environments before deployment
- Capacity planning and performance analysis for IT service delivery

Pillar 4: Product Lifecycle Management I

Definition

PLM provides frameworks and toolsets for managing information, configurations, changes, service history, processes, and resources throughout the entire system lifecycle from conception through retirement.

Application to IA/IT:

- Configuration baseline management aligned with ITIL principles
- Maps to NIST SP 800-53 controls: CM-2 (baselines), CM-3 (change control), CM-5 (access restrictions)
- Security control maintenance throughout operation and decommissioning
- Bridges information assurance and IT operations through shared authoritative data

Institutional Endorsement of Digital Engineering I

Department of War

DE Strategy (2018): Five strategic goals including authoritative source of truth. DoDI 5000.97 (2023) codifies DE as mandatory practice. SE Guidebook (2022) provides implementation guidance.

NASA

HDBK-1004 (2020): DE Acquisition Framework. MBSE Vision document establishes pervasive MBSE adoption path. Independent convergence with DoD validates broad applicability.

INCOSE

Vision 2035: MBSE as dominant paradigm. SE Handbook 5th Ed. (2023). DEIEX Working Group promotes practitioner collaboration.

Institutional Endorsement of Digital Engineering II

SERC / SEBoK / NIST

DECF with 962 KSABs, DE Metrics, and SE Modernization publications. SEBoK defines DE within ISO/IEC/IEEE 15288. NIST CPS Framework (SP 1500-201) addresses systems engineering but not enterprise IT specifically.

Enterprise Architecture: The Unified Architecture Framework I

UAF as Consolidating Standard

ISO/IEC 19540-1:2022 and ISO/IEC 19540-2:2022. Consolidated DoDAF, MODAF, NAF, and commercial frameworks. The specification asserts that 90% of defense framework concepts prove equally applicable in commercial domains.

Comparative Analysis (Bankauskaite 2019)

UAF achieved highest overall rating of 2.8, surpassing TOGAF (2.3), DoDAF (1.9), MODAF (1.8), NAF (1.6), and FEAF (1.2).

Adoption

Endorsed by DoD, NATO (NAF v4), UK MoD. TOGAF complements UAF through joint Open Group-MITRE white paper. SysML integration enables model-based documentation approaches.

Digital Engineering: Measured Evidence I

Return on Investment (Rogers & Mitchell 2021)

Documented 18% improvement in systems engineering efficiency and 9% reduction in defects following MBSE adoption on a complex system-of-systems program. Such measured evidence remains rare but establishes empirical foundation.

Addressing Identified Gaps

- **Authoritative Source of Truth:** Single authoritative model eliminates conflicting documentation
- **Traceability Gap:** Digital thread provides verified connections across lifecycle artifacts
- **Visibility Gap:** Model-based approaches enable comprehensive system visibility
- **Simulation Gap:** Digital twins enable testing without production impact

Digital Engineering: Measured Evidence II

Key Question: Do IT and IA professionals recognize this potential value for their work?

Literature Review: Four Interrelated Arguments I

Chapter 2 examines the research landscape through an analytical synthesis organized around four interrelated arguments:

Argument 1: Disciplinary Silos

Systems engineering, information assurance, cybersecurity, and IT service management evolved along independent academic and professional trajectories, creating structural barriers to cross-disciplinary methodological exchange.

Argument 2: The Evidence Paradox

The evidence base for MBSE value remains disproportionately reliant upon perceived rather than measured outcomes, creating economic uncertainty that discourages adoption beyond established domains.

Argument 3: Perceptions Drive Adoption

Adoption research demonstrates that perceptions—not objective technical merit—drive adoption decisions, yet no empirical data exist on how IT and IA professionals perceive Digital Engineering capabilities.

Literature Review: Four Interrelated Arguments II

Argument 4: Unfulfilled Requirements

Compliance frameworks and ITSM standards explicitly require capabilities that Digital Engineering provides, yet current practices demonstrably fail to deliver them and no research connects these parallel tracks.

Literature Review: Independent Disciplinary Evolution I

Parallel Paths

Each discipline developed its own academic identity, professional communities, curricular standards, and institutional frameworks—despite confronting remarkably similar challenges in documentation, traceability, configuration management, and lifecycle governance.

Literature Review: Independent Disciplinary Evolution II

Key Evidence

- Systems engineering emerged from defense laboratories (Hossain 2020; Honour 2018)
- Information assurance grew from national security policy and computing education (Maconachy 2001; Dark 2006)
- Cybersecurity crystallized as a "meta-discipline" (Parrish 2018; CSEC 2017)
- ITSM developed as a practitioner-driven domain with limited academic theorization (Iden 2013; MacLean 2023)

Consequence: No intellectual infrastructure exists to facilitate cross-disciplinary methodological exchange. Researchers publish in different journals, cite different theorists, and frame problems through different conceptual lenses.

Literature Review: The Evidence Paradox I

Perceived vs. Measured Value (Henderson & Salado 2021)

Approximately two-thirds of claimed MBSE benefits lack empirical measurement and instead rely upon perceived or referenced evidence. Organizations outside systems engineering discover that the literature offers abundant testimony but limited quantified outcomes upon which to build business cases.

Literature Review: The Evidence Paradox II

Measurement Deficit

- Rogers & Mitchell (2021) remains one of only two papers reporting measured MBSE ROI
- Henderson (2023) developed measurement framework—deficit unresolved
- Campo (2023) confirmed persistent gap between beliefs and published evidence
- Wooley & Womack (2025) confirmed absence of enterprise IT/IA research

Implication: Organizations outside systems engineering lack experiential evidence to validate MBSE investment—creating rational hesitation that perception data can help inform.

Literature Review: Perceptions Drive Adoption I

Within Systems Engineering (Call et al. 2024)

Diffusion of Innovations framework applied to MBSE adoption. Perceptions of compatibility, complexity, and trialability mediate adoption decisions among systems engineering professionals. MBSE characterized as a "preventative innovation" whose advantages derive from preventing problems rather than producing visible new benefits.

Organizational Structure (Henderson & Salado 2024)

Organizational flexibility and interconnectedness significantly influence adoption outcomes. Centralization may impede adoption while cross-functional connectivity promotes it.

Literature Review: Perceptions Drive Adoption II

Awareness Deficits (Henderson, McDermott & Salado 2024)

22% of systems engineering professionals cannot clearly define MBSE. Awareness deficits persist even within the originating discipline—raising the question of whether similar or greater barriers exist in domains that have never encountered these methodologies.

Parallel Cybersecurity Adoption Research

Hasani (2023), Alghamdi (2023), and Anthony (2024) independently applied the same adoption theories in cybersecurity contexts—demonstrating theoretical compatibility despite practical isolation between fields.

Literature Review: The Compliance Imperative I

Frameworks Require What Practices Cannot Deliver

SP 800-53 Rev 5 mandates controls requiring enterprise architecture capabilities: PL-2 (security plans), PL-8 (security architecture), PM-7 (enterprise architecture), CM-2 (baselines), CM-8 (component inventory), SA-17 (design specifications). Each demands documentation accuracy that organizations demonstrably lack.

Emerging Compliance Automation

- Santilli (2023): Defined continuous compliance with 13 requirements
- Angermeir (2024): Design science for continuous security compliance
- NIST OSCAL: Machine-readable compliance formats—aligns with DE emphasis on machine-readable documentation

Literature Review: The Compliance Imperative II

Parallel Tracks Without Convergence

Compliance researchers build knowledge graphs and automated verification. DE researchers develop model-based approaches and digital threads. Both address documentation accuracy and traceability. Neither has systematically explored integration.

Literature Review: Digital Twins for Security I

Maturing Research Area

Multiple systematic reviews confirm sufficient research volume to warrant meta-analysis: Alcaraz & López (2022, 300+ citations), El Hajj (2024, 67 papers), Alhumam (2025), Jeremiah (2024), Qureshi (2025).

Security Applications

- SOC analyst training through digital twin-based cyber ranges (Vielberth 2021)
- Enterprise security posture management (Dietz & Pernul 2020)
- Threat modeling across cyber-physical system lifecycles (Erceylan 2025)
- Incident detection and response for critical infrastructure (Kampourakis 2025)

Literature Review: Digital Twins for Security II

Disconnected from Digital Engineering

Research explores digital twins as isolated security tools without embedding them within the integrated DE framework (MBSE + digital threads + PLM). Whether integration produces greater value than isolated implementations remains an open question.

Literature Review: Cross-Disciplinary Transfer I

Barriers to Transfer Beyond Defense/Aerospace

- Platform-centric adoption patterns confine DE to physical systems
- Organizational separation between IT and engineering functions
- Economic factors: no demonstrated ROI outside defense contexts
- Skills gaps: enterprise IT staff lack systems engineering training

Emerging Bridge: DevSecOps Security Assurance

CMU Software Engineering Institute (2023) developed preliminary MBSE reference model for DevSecOps pipeline security—demonstrating technical feasibility for Information Assurance applications, though scope remains narrow.

Literature Review: Cross-Disciplinary Transfer II

Open Source Ecosystem

MBSE (Papyrus, Capella, SysON), digital twins (Eclipse Ditto, BaSyx), and PLM (Aras, OpenPLM) tools exist—but academic research validating enterprise IT application does not.

Literature Review: Research Gaps Summary I

Domain	Gap	Implication
MBSE for Enterprise IT	One study applying MBSE to enterprise IT	Foundation research required
MBSE Adoption Evidence	Adoption studies limited to SE populations	Perception measurement needed
Digital Threads	No research on traceability for IT/IA	Conceptual validation needed
Digital Twin	Security research but no enterprise IT integration	Application studies needed
ITSM Integration	No frameworks integrating DE with ITIL	Integration research required
Compliance Automation	DE and compliance research on parallel tracks	Integration research needed
Professional Perceptions	Unknown awareness among IT/IA professionals	**This research addresses**

Research Design Overview I

Quantitative Cross-Sectional Survey Design

- Survey methodology enables standardized data collection supporting statistical analysis
- Cross-sectional design captures professional perceptions at a single point in time
- Anonymous nature encourages candid responses about knowledge gaps

Systems Engineering Approach

The research methodology itself follows a systems engineering lifecycle, demonstrating application of structured engineering principles to research design while ensuring rigorous traceability.

Methodology Justification I

Why Perceptions Matter

Technology Acceptance Model research demonstrates that perceived value influences adoption decisions regardless of demonstrated actual value. Professionals who do not perceive value will not advocate for adoption.

Why Survey Over Case Study

- Case study findings reflect particular organizational contexts
- Survey enables assessment across broad population of practitioners
- Establishes baseline awareness data before implementation research
- Implementation research presumes perceived value—this study tests that presumption

Systems Engineering Research Lifecycle I

1. **Strategic Phase:** Hypothesis, capabilities, constraints, goals, stakeholders
2. **Requirements Phase:** Derived requirements following ISO 15288:2023 standards
3. **Architecture Phase:** High-level outline and structure for survey
4. **Design Phase:** Survey instrument with complete traceability
5. **Results Phase:** Data capture and analysis with model traceability
6. **Report Phase:** Dissertation chapters traced to requirements

Target Population and Sampling I

Target Population

Professionals actively working in IT and Information Assurance roles: IT service delivery, infrastructure management, security operations, compliance management, security architecture.

Sampling Strategy

Non-probability convenience sampling through multiple channels:

- Professional organizations: ISACA, $(ISC)^2$, ITIL communities
- LinkedIn professional groups
- Industry conferences and professional development events

Sample Size Determination I

Statistical Requirements

Target: 95% confidence level with 5% margin of error

$$n = \frac{Z^2 \times p \times (1-p)}{E^2} = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 384.16$$

Target Sample

- Minimum required: 385 completed responses
- Target with oversampling: 450 completed responses
- Oversampling accommodates 10-15% incomplete response rates
- Requires distribution to approximately 1,500–2,000 professionals

Survey Instrument Structure I

27 Questions Across Six Sections

1. Awareness and Familiarity with Digital Engineering (2 questions)
2. Understanding of Digital Engineering Capabilities (6 questions)
3. Applicability of Digital Engineering (6 questions)
4. Value Assessment for Information Technology (5 questions)
5. Value Assessment for Information Assurance and Cybersecurity (7 questions)
6. Interest and Demographic Information (4 questions)

Estimated Completion Time: Approximately 10 minutes

Question Format and Scale Selection I

Five-Point Likert Scale

Familiarity Scale: Not at all familiar → Extremely familiar

Agreement Scale: Strongly disagree → Strongly agree

Justification

- Likert scales validated since 1932 for measuring attitudes and perceptions
- Five-point format provides optimal discrimination while remaining cognitively manageable
- Consistent with TAM and UTAUT frameworks for technology acceptance research

Likert Scale Analytical Treatment I

The Ordinal–Interval Debate

Longstanding methodological debate regarding whether Likert responses constitute ordinal or interval data. Norman (2010) and subsequent research demonstrate that parametric methods yield valid results with Likert data even when distributional assumptions are violated.

Dual-Reporting Approach

- **Parametric:** Means and standard deviations reported for composite scores and cross-study comparison
- **Non-parametric:** Medians and interquartile ranges reported alongside for individual Likert items
- Enables readers holding either position to evaluate findings against their preferred framework

Survey-to-Research Question Mapping I

Section	Questions	Research Question
Section 1: Awareness	1.1, 1.2	RQ1: Awareness
Section 2: Understanding	2.1–2.6	RQ1: Awareness
Section 3: Applicability	3.1–3.6	RQ2 / RQ3
Section 4: IT Value	4.1–4.5	RQ3: Anticipated Benefits
Section 5: IA Value	5.1–5.7	RQ3: Anticipated Benefits
Section 6: Demographics	6.1–6.4	Subgroup Analysis

Each question maintains explicit traceability to research questions within the systems engineering model.

Data Analysis: Descriptive and Comparative I

Descriptive Statistics

- Central tendency and dispersion for all Likert-scale responses
- Frequency distributions for categorical and binary responses
- Response pattern visualization across survey sections

Comparative Analysis

- Analysis across professional subgroups (IT vs. IA professionals)
- Analysis across experience levels
- Composite score calculation with Cronbach's alpha reliability assessment

Data Analysis: Inferential Testing and Error Management I

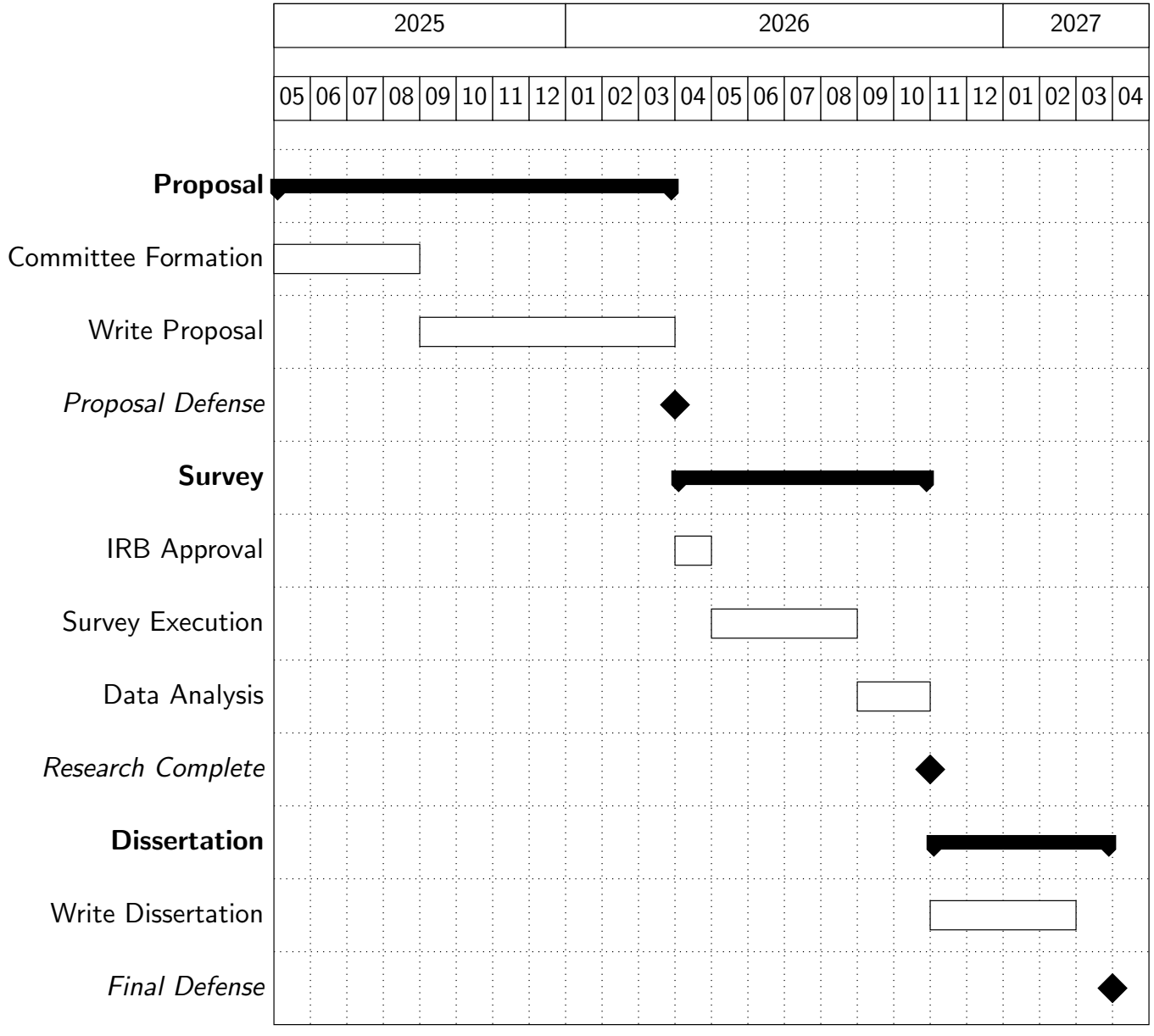
Inferential Statistical Tests

- Parametric (t-tests, ANOVA) or non-parametric alternatives (Mann-Whitney U, Kruskal-Wallis) based on Shapiro-Wilk normality assessment
- Chi-square tests of independence for categorical associations
- Effect sizes reported: Cohen's d for group comparisons, Cramér's V for chi-square

Multiple Comparison Correction

- Holm-Bonferroni sequential correction applied within logical families of related tests
- Effect size assessment ensures observed differences reflect practically meaningful magnitudes

Research Timeline: 22-Month Schedule I



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Timeline Phase Details I

Phase 1–2: Proposal (May 2025 – March 2026)

Committee formation (completed January 2026), proposal development, iterative refinement, proposal defense

Phase 3–4: IRB and Survey Execution (April – August 2026)

IRB approval, platform configuration, recruitment through multiple professional channels, data collection targeting 450 responses

Phase 5–6: Analysis and Writing (September 2026 – March 2027)

Data analysis (September–November), results interpretation, dissertation writing, final defense

Validity and Reliability I

Content Validity

Systematic mapping of survey questions to research questions; alignment with established Digital Engineering frameworks from INCOSE, NASA, and DoD

Construct Validity

Question formats and scale anchors drawn from validated TAM and UTAUT instruments

Reliability

Internal consistency assessed through Cronbach's alpha; standardized question format supports response consistency

Pilot Testing and Instrument Refinement I

Spring 2024 Pilot Study

An earlier version of the instrument was administered to IT and information assurance professionals during the Spring 2024 semester. The pilot study evaluated:

- Question clarity and comprehension among target population representatives
- Completion time and respondent fatigue
- Response distribution across scale points (no floor or ceiling effects observed)

Empirical Contributions to Instrument Design

- Question wording refined to balance context with priming avoidance
- Confirmed substantial variation in Digital Engineering awareness across respondents

Response Bias Mitigation I

Proactive Mitigation Strategies

- **Self-selection bias:** Recruitment messaging encourages participation across the awareness spectrum; no prior Digital Engineering knowledge required
- **Acquiescence bias:** Neutral midpoint option and explicit "No" / "Unsure" options on investment willingness questions
- **Social desirability:** Anonymous design (no PII)

Analytical Safeguards

- Wave analysis comparing early and late respondents to assess non-response bias
- Familiarity-stratified comparison of value perceptions to diagnose potential priming effects from contextual descriptions

Research Limitations I

- Non-probability sampling limits generalizability to broader population
- Self-selection bias may over-represent professionals with existing Digital Engineering awareness
- Social desirability bias may influence perceived value responses
- Self-reported awareness may not reflect actual knowledge
- Cross-sectional design captures single point in time
- Survey measures perceived value rather than actual experienced benefits

Expected Contributions: Academic I

Addressing the Literature Gap

- First empirical investigation of Digital Engineering awareness among IT/IA professionals
- Establishes baseline data for future research in this nascent application domain
- Validates or challenges theoretical framework positing DE value for enterprise contexts

Methodological Contribution

Demonstrates systems engineering approach to research design with traceability between questions, instruments, and analysis

Expected Contributions: Industry I

Industry Benefits

- Informs tool vendor and service provider development priorities
- Guides professional development and training initiatives
- Identifies which DE capabilities professionals recognize as addressing their needs
- Indicates whether adoption initiatives would find receptive audiences

Expected Contributions: Commonwealth and Society I

Commonwealth Benefits

- Enhances protection of government systems and critical infrastructure
- Enables rapid, accurate impact assessment for security incidents affecting federal and national security systems
- Reduces compliance verification burden while improving documentation currency

Societal Benefits

- Potentially enable better security capabilities for organizations serving underserved populations
- Democratize sophisticated documentation capabilities beyond large enterprises
- May reduce compliance burden for resource-constrained organizations serving communities with limited resources

Ethical Considerations I

Human Subjects Protection

- **Anonymity:** No personally identifiable information collected
- **Voluntary:** Participation voluntary with no consequences for non-participation
- **Minimal Risk:** Similar to normal daily internet activity
- **Informed Consent:** Obtained through participation notice
- **Data Protection:** Secure storage with encryption

IRB approval will proceed after successful proposal defense.

Proposal Summary I

Research Purpose

Investigate whether IT and Information Assurance professionals recognize potential value in Digital Engineering capabilities for their work

Approach

Quantitative survey methodology with 27 questions targeting 385–450 IT/IA professionals across multiple sectors

Significance

Establishes empirical foundation for strategic decisions regarding Digital Engineering adoption in enterprise IT and Information Assurance domains

Questions and Discussion

Thank you for attending.

Questions?

Proposal Presentation:
`https://github.com/jbone81/DissertationProposalPresentation`

Thank You

John James Darth Vader Bonar

john.bonar@trojans.dsu.edu

Committee:
Dr. Patrick Engebretson (Chair)
Dr. David Kenley
Dr. Matthew Kelso

The Beacom College of Computer & Cyber Sciences
Dakota State University

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