

FINAL PROJECT BRIEFING

Integrating Engineering and Aviation Standards in Higher Education Curriculum

National Institute of Standards and Technology, United States Department of Commerce
Standards Coordination Office Curricula Development Cooperative Agreement Program

FEDERAL AWARD

70NANB23H240

FEDERAL SHARE

150,000 dollars

PERIOD OF PERFORMANCE

September 15, 2023 to September 14, 2026

Embry-Riddle Aeronautical University, Worldwide and Daytona Beach Campuses

Presented by Dr. Leila Halawi, Principal Investigator

September 10, 2026, 11:00-11:30 AM Eastern Time.

Project Team

Three faculty carried this award across two campuses and two disciplines



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chair, program chair, and course instructors

Advisory board: curriculum

Agenda

Twenty-five minutes of content, followed by five minutes for discussion

1

Why Standards Literacy

The gap between what students learn and what employers require

2

Objectives and Alignment

Three commitments and how they matched sponsor priorities

3

Outcomes and Deliverables

What we promised set beside what we delivered

4

Evaluation and Results

Methodology, survey findings, and an honest reading of the evidence

5

Findings and Lessons Learned

What worked, what tested us, and how we responded

6

Adoption Beyond One University

The transferable framework and how to obtain it

7

Publications, Thanks, and Questions

Dissemination record and acknowledgments

The Gap We Set Out to Close

September 2023: a problem easy to name and hard to fix

Aviation and engineering run on standards.

Safety, quality, risk, and environmental performance all rest on documents authored by bodies such as ISO, SAE, ASHRAE, ANSI, and NIST.

Yet most students never open one.

They graduate without tracing how a standard is written or applying one to a working decision.

They arrive fluent in theory and silent in the language their employers actually speak.

THE PREMISE

If standards govern how the aviation and aerospace workforce designs, builds, maintains, and operates, then students should meet those standards inside the classroom rather than for the first time on the job.

3

Courses redesigned across two disciplines

2

Campuses, Worldwide and Daytona Beach

36

Months of performance, fully delivered

Three Objectives, Built in Sequence

Creation, then validation, then transfer, which is the natural arc of a curriculum meant to outlast its funding

1

Create

Customizable educational modules for three targeted courses, two undergraduate engineering and one graduate aeronautics, adaptable across institutions.

WHAT WE COMMITTED TO

Instructional strategies that promote active learning, critical thinking, and problem solving.

2

Evaluate

Student learning outcomes assessed through multiple stakeholders, including the university advisory and industry board and subject matter experts.

WHAT WE COMMITTED TO

Anonymous module surveys and student performance measures, reporting strengths and areas for improvement.

3

Transfer

A model curriculum other colleges and universities can adopt, with a path toward student recognition for mastery.

WHAT WE COMMITTED TO

A model curriculum document and adoption guidelines other institutions could follow.

Each objective carried measurable commitments and named deliverables, not aspirations.

Where We Placed the Work

Three courses chosen to reach students at three stages of learning

CIV 222

Introduction to Environmental Engineering

Daytona Beach, lower division

INTRODUCE

Standards literacy and ISO 14001

CIV 417

Fundamentals of Air Pollution

Daytona Beach, upper division

PRACTICE

ASHRAE and National Ambient Air Quality Standards

ASCI 693

Current Research Problems in Aviation and Aerospace

Worldwide, graduate online

MASTERY

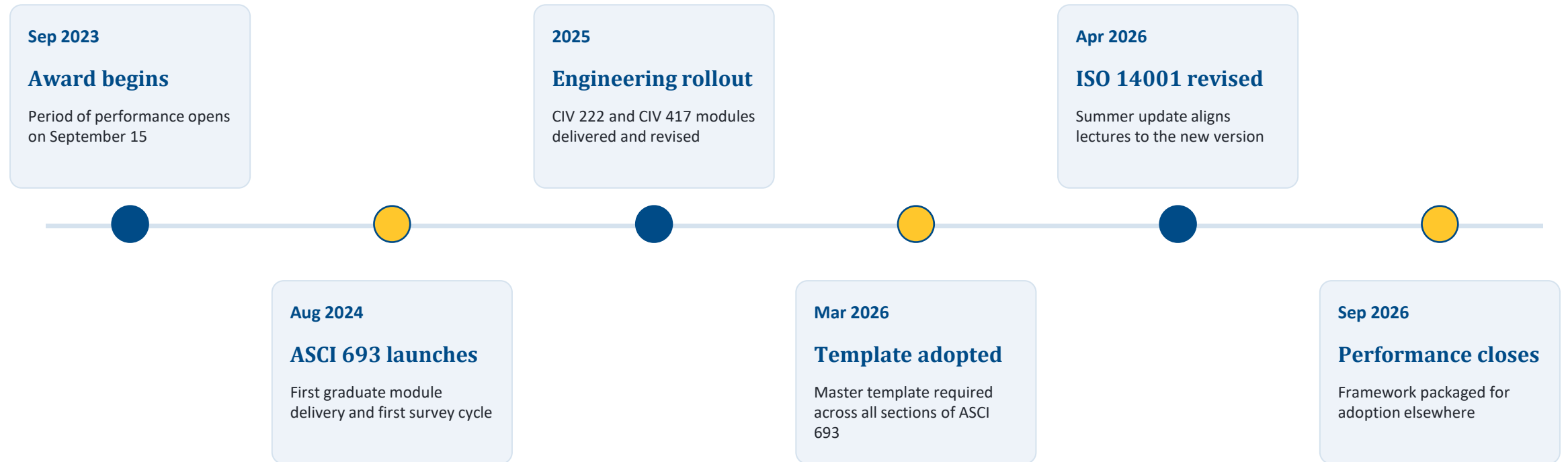
ISO 31000 and SAE AS9100 moving to IA9100

WHY THE GRADUATE PLACEMENT MATTERED

ASCI 693 sits in the core of the Master of Science in Aeronautics, one of the largest international aviation master's programs in the world, with more than eleven hundred enrolled students and accreditation recognized by the Royal Aeronautical Society. Engineering revisions reached roughly fifty students each semester. Aviation revisions reached roughly three hundred seventy-five students each year.

The Three-Year Arc

From an identified curriculum gap to a durable, transferable framework



Across this arc the courses absorbed hurricanes, faculty illness, conference travel, and the departure of a lead instructor without losing continuity.

Promised Beside Delivered

A grant is a promise, and the fairest way to judge one is to set the two side by side

Course	Promised	Delivered	Standards Integrated
ASCI 693 Graduate Aeronautics, Worldwide	2 modules	approximately 4.5 modules	ISO 31000, SAE AS9100 moving to IA9100, NIST Cybersecurity Framework, standards ethics
CIV 222 Environmental Engineering, Daytona Beach	2 modules	3 modules	ISO 14001, ISO 9001, Plan Do Check Act
CIV 417 Fundamentals of Air Pollution, Daytona Beach	2 modules	3 modules	ASHRAE 62.1 and 62.2, National Ambient Air Quality Standards, atmospheric data analysis

Every expansion answered a documented need. Advisory board recommendations produced the ethics lecture. Instructor feedback produced the spaced repetition flashcards. Student confusion produced the redesigned terminology section. Nothing was added as padding.

Inside ASCI 693: Listening Turned Into Content

Each addition traces back to a specific voice

1

Ethics lecture

Driven by Advisory board

The industry move toward IA9100 placed new emphasis on ethics, product safety, and cybersecurity, so we added a dedicated lecture.

2

Spaced repetition flashcards

Driven by Instructor feedback

An interactive flashcard system was built to strengthen retention of difficult standards terminology.

3

Terminology redesign

Driven by Student confusion

We rebuilt the section around aviation specific examples to distinguish standards, codes, regulations, frameworks, and guidelines.

4

Spoiler alert previews

Driven by Standards in motion

Preview sections prepared students for coming revisions to ISO 9001 and the future IA9100 they will meet in practice.

Inside CIV 222 and CIV 417

Two engineering courses that moved students from awareness to applied practice

CIV 222

Introduction to Environmental Engineering

- Shared foundational module on standards literacy
- ISO 14001 environmental management systems
- Real problem solving through the United Nations Sustainable Development Goals and a Plan Do Check Act exercise
- Third module on ISO 9001 quality management
- **Major summer update after the revised ISO 14001 released in April 2026**

CIV 417

Fundamentals of Air Pollution

- ASHRAE 62.1 and 62.2 indoor air quality foundations
- National Ambient Air Quality Standards applied to real conditions
- Atmospheric data analysis using EPA data and the Air Quality Index
- **Surveys measured whether students could articulate the professional and career relevance of each standard**

When the revised ISO 14001 arrived in April 2026, the team updated lectures and activities that same summer. That is the living, current curriculum this project set out to create.

How the Modules Were Built

A deliberate pedagogical foundation, not a content dump

Six Teaching Models

Social constructivism, resource-based learning, collaborative learning, problem-based learning, narrative-based teaching, and students as partners, all sequenced through the Backward Design Model so activities and assessments were built backward from intended outcomes.

Professional Instructional Tools

H5P, Adobe Rise, Yellowdig, and the Canvas learning management system carried interactive components, embedded knowledge checks, real problems drawn from practice, and an end of module survey that fed every revision.

A DESIGN DECISION WORTH EXPLAINING

We built from modular, interactive, text based components rather than recorded video. With ISO 14001, ISO 9001, and the shift from AS9100 to IA9100 all under active revision, recorded video would have dated quickly and grown costly to reshoot. Assets built in H5P and Adobe Rise let us revise a lecture or a standard reference in minutes rather than rerecording a studio session. The absence of video is not a gap in rigor. It is the choice that keeps the content current and inexpensive for adopting institutions to maintain.

Curriculum Evaluation Methodology

Evaluate, adjust, improve, then repeat, which is the discipline the standards themselves teach

1

Formative and summative

Continuous assessment through each teaching term paired with summative review at defined milestones.

2

External expert review

A subject matter expert who also works as an industry practitioner reviewed the modules at two committed stages.

3

Module surveys

Anonymous seven point scale instruments tailored to each module, measuring perception, knowledge, confidence, and career relevance.

4

Triangulation

Faculty observation, industry partner feedback, and student performance measures layered on top of survey data.

5

Monthly governance

An advisory board of the curriculum chair, program chair, and course instructors vetted components and recommended changes.

6

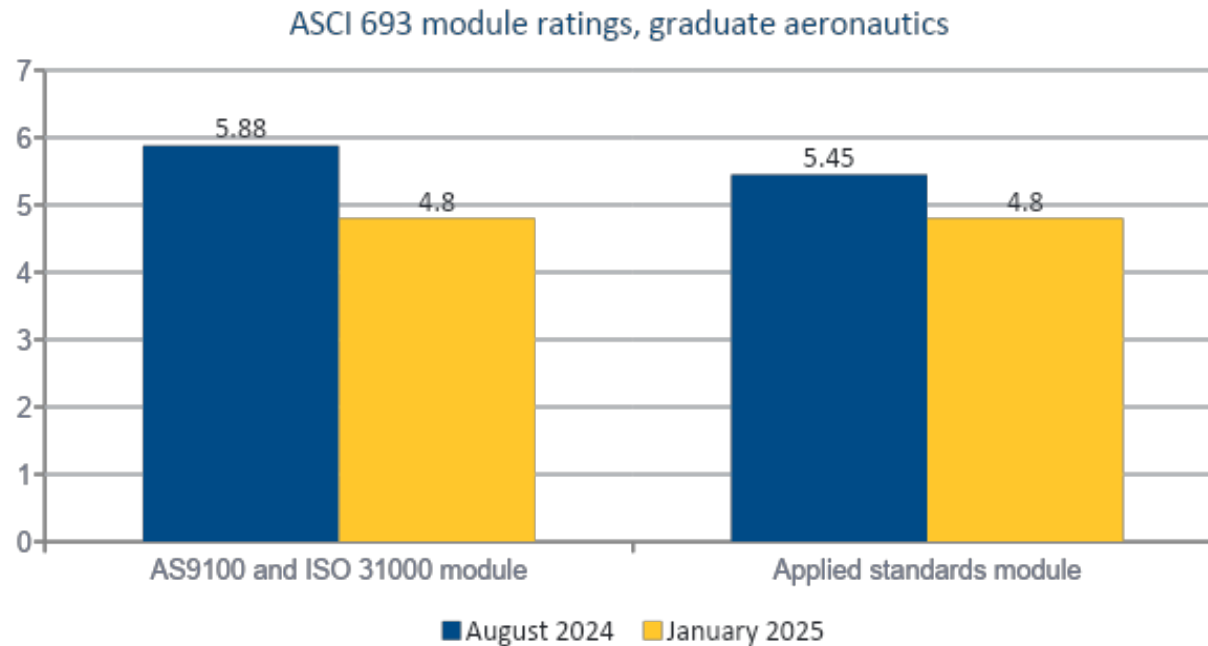
Repetition across faculty

Modules were taught across several cycles, by different instructors, on different platforms, and revised each time.

Scope note: the funding notice excluded research with human subjects, so we deliberately confined collection to anonymous, course embedded surveys and faculty observation.

What Students Told Us

Seven-point scale, collected at the close of every module



CIV 222

Twenty six students, undergraduate engineering

Ratings clustered near the scale midpoint.

- Strongest marks: whether the module clarified the distinctions among standards, codes, and regulations.
- Lowest marks: self rated readiness to apply standards independently.

Awareness was landing. Confidence in application needed more hands-on practice, which is exactly what later revisions targeted.

READING THE EVIDENCE HONESTLY

Individual section sizes were modest, so we treat these results as formative and directional rather than as inferential claims. Their power lies in the honest, repeated signal they gave us term after term, and in the discipline of acting on that signal. The January 2025 dip did not discourage us. It produced the ethics lecture, the terminology redesign, and the authentic problem scenarios.

Student Feedback: What Was Working

Open response comments from ASCI 693, Modules 1 and 2, on AS9100 and ISO 31000

Practical Application

"AS9100 and ISO 31000 made the course feel more practical because they turn qualitative findings into structured, usable improvements."

Balanced and Engaging Content

"The content is perfect, very balanced and engaging. Engaging in a way that is better than small micro learn activities."

Clear Outcomes

"This module was informative and clearly communicated outcomes and expectations."

Real World Relevance

"Gaining a better perspective of the usefulness of ISO 31000 and AS9100D and how they apply to the traditional Safety Management System."

Forward Looking Mindset

"Moving forward, I will use these standards to keep my research grounded in real aviation quality and risk management instead of just descriptive themes."

The Language Students Used

Term frequency across all open response feedback from ASCI 693, Modules 1 and 2



Practical, standards, research, and management dominate. Students described the modules in the vocabulary of the workplace, not the vocabulary of a course.

What Worked

The findings that held across all three courses

1

Authentic problems over definitions

Students engaged far more deeply when abstract standards were tied to real aviation, aerospace, and environmental challenges. They stopped treating standards as trivia and started connecting them to their own professional experience.

2

Retention tools that earned their place

The spaced repetition flashcard system helped students retain difficult terminology, and the redesigned terminology section cleared up long standing confusion about standards, codes, regulations, frameworks, and guidelines.

3

Modular asynchronous design as resilience

Hurricanes, faculty illness, conference travel, and the departure of a lead instructor were absorbed without losing continuity, because content could be completed independently and delivered online.

4

Meeting instructors where they are

Offering the course on two platforms, one using Yellowdig and one using Canvas discussion boards, let faculty adopt the material with tools they already trusted. Adoption depends on this as much as on content quality.

Standards are learned best in context, through application, not through definition alone.

What Tested Us, and How We Responded

A credible project reports its friction

Challenge	Our Response
Online adaptation of CIV 417 lagged its in person version and required more quality assurance time than scheduled.	Architected content for residential, hybrid, or online delivery so the curriculum could survive the loss of any single instructor.
Two Co Principal Investigator transitions, including a departure in February 2026 where a consulting arrangement could not be secured.	Notified NIST, secured approvals, and the Principal Investigator assumed direct oversight. Distributed leadership and working ahead of schedule protected every deliverable.
The in person NIST workshops in Gaithersburg, Maryland were never held, leaving budgeted funds in question.	Sought guidance from our NIST director, requested a budget reallocation, and redirected effort to dissemination at Decision Sciences Institute, the Society for Standardization Professionals, and SAE Aerotech.
The standards themselves moved. ISO 14001 was revised, ISO 9001 entered revision, and AS9100 began its transition to IA9100.	Conducted summer updates, added spoiler alert previews, and gave students independent tracking resources. We built the movement into the curriculum.
A unified course catalog requires identical outcomes across campuses, so some scenarios stayed optional rather than required.	Designed rigorously within the constraint and documented the boundary so adopting institutions can anticipate the same governance reality.

One gap we report openly: when the CIV 417 instructor departed, the window to collect student survey data there closed. The module remains complete and ready for delivery.

Built to Travel: The Two-Layer Design

Reusability was a governing principle, not an afterthought

LAYER ONE DISCIPLINE NEUTRAL

Foundational Standards Literacy

What a standard is, how standards are written and revised, how they differ from codes and regulations, and how to locate authoritative standards through library and agency resources. This layer works as readily in civil engineering as in aviation, business, or information systems, because every technical field depends on standards even when it never names them.

Adopting institutions keep Layer One intact and swap Layer Two for the standards that matter to their own programs.

LAYER TWO

Environmental Engineering

ISO 14001 and ISO 9001

LAYER TWO

Air Pollution

ASHRAE and the National Ambient Air Quality Standards

LAYER TWO

Graduate Aeronautics

AS9100, ISO 31000, and the NIST Cybersecurity Framework

We proved transfer inside our own walls first: across two disciplines, two campuses with different cultures, and two academic levels. A model that moves cleanly among such different settings in one university is prepared to move among universities.

Removing the Barriers to Adoption

The specific mechanisms that turn a local project into a shared national resource

Public facing NIST library guide

The original guide required a university login. We partnered with the library to build a public version accessible to educators everywhere.

guides.erau.edu/asci693-nist

Consistent NIST award branding

Attribution travels with the content when others reuse it, so the sponsor is credited wherever the modules land.

Award 70NANB23H240

Dual platform options

One pathway using Yellowdig and one using Canvas discussion boards, because adopting faculty arrive with different tools and comfort levels.

Yellowdig and Canvas

Self enroll Canvas course

All modules are being consolidated into a single course any instructor or student can join voluntarily with a university email login.

[ENROLLMENT LINK PENDING]

Open source repository

Groundwork laid to house the materials for adoption by other institutions and professors.

In preparation

Master template adopted

Refined ASCI 693 content became required content across all sections beginning March 2026.

Universal faculty standard

Alignment Institutions Already Own

The curriculum does not ask a program to invent new outcomes

ABET Student Outcomes

Two hundred level, introduce. CIV 222 introduced standards through ISO 14001 and the Plan Do Check Act cycle.

Four hundred level, practice. CIV 417 applied ASHRAE indoor air quality requirements and the National Ambient Air Quality Standards.

AABI Program Outcomes

Graduate level, mastery. ASCI 693 integrated SAE AS9100 and ISO 31000 into a course already in the core of the Master of Science in Aeronautics.

That program measures learning against the twelve graduate program outcomes of the Aviation Accreditation Board International, so our standards content reinforced a framework the program was already accountable to.

WHY THIS LOWERS THE COST OF ADOPTION

Any institution accountable to ABET, to AABI, or to a comparable accreditation framework will find that these modules slot into obligations it already carries. The curriculum helps a program meet outcomes it is already committed to, which lowers both the cost and the risk of adopting it.

A Complete Adoption Guide, Ready to Hand Over

Adopting the Standards Integration Model Curriculum: Documentation and Guidelines for Colleges and Universities

WHAT THIS DOCUMENT IS

A field-tested operating manual for any college or university that wants to bring standards literacy into courses it already teaches. Fourteen sections, publicly releasable, containing no personal or proprietary information, so it can travel freely.

An adopting institution does not need a NIST award, our discipline mix, or our campus structure to use it.

It also serves, in condensed form, as the Suitability and Potential for Adoption at Other United States Institutions section of the final summary paper.

WHAT AN ADOPTER SUPPLIES

A committed faculty owner, lawful access to the relevant standards, and the willingness to pilot, evaluate, and refine. In exchange the institution gains graduates who read the standards their professions run on, and a curriculum resilient enough to endure.

1

Understand

Purpose and use, the model at a glance, and the case for adoption

2

Prepare

Readiness preconditions, the phased pathway, module adaptation, and team roles

3

Operate

Institutional constraints, technology and standards access, and evaluation

4

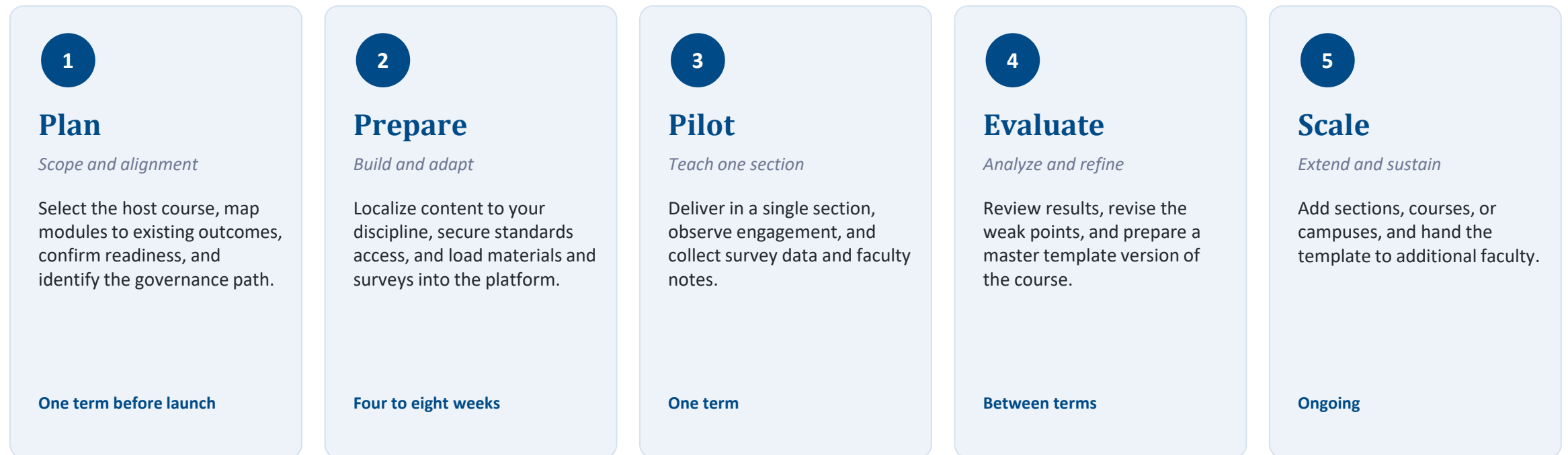
Sustain

Institutionalizing the curriculum, dissemination, and a quick start checklist

Fourteen sections in four working stages an implementation team moves through in order.

The Adoption Pathway in Five Phases

The sequence we actually followed, including the adjustments we made when reality diverged from the plan



SIX READINESS PRECONDITIONS, NONE OF THEM EXPENSIVE

A faculty sponsor who will teach the modules and not merely endorse them, lawful student access to the standards, a learning platform, a host course whose outcomes can absorb a module, a clear governance path, and someone to review survey results each term. The most common gap is standards access. The most common misconception is that faculty must already be standards experts. Neither should stop an adoption.

Beyond the Courses: People and Standards Service

The investments with the longest reach

Two Graduate Research Assistants

- Co authored the Eagles Flight literature review
- Carried standards knowledge into their own research on vehicular electrification, environmental justice, and atmospheric microplastics
- One earned the Florida Air and Waste Management Association Award
- Presented at national venues including the American Association for Aerosol Research annual meeting

A SEAT AT THE STANDARDS TABLE

Sustained Standards Service

- American National Standards Institute, Committee on Education
- United States Technical Advisory Group to ISO Technical Committee 279, Innovation Management

These are not honorary appointments. They are working channels through which the framework can be shared, refined against national practice, and kept current as standards evolve. An adopting institution inherits more than files. It joins a living network.

What started as a curriculum project became a sustained institutional voice in how standards education is shaped nationally.

OUR RECOMMENDATION

A starting point, not the achievement of a single grant.

We began because too many talented graduates entered aviation and engineering having never truly met the standards their careers would demand. We end with a proven, transferable framework that closes that gap: tested across disciplines and delivery modes, cleared of access barriers, aligned to accreditation obligations institutions already hold, and anchored in the national standards community.

The curriculum is ready to travel, and the need it answers belongs to every institution preparing students for a workforce that runs on standards.

Our recommendation is that this model become the starting point for standards literacy across American higher education.

THANK YOU

With gratitude to NIST and to this team.

To the National Institute of Standards and Technology and the Standards Coordination Office: Thank you for funding the belief that standards belong in the classroom, and for the guidance that helped us adapt when circumstances changed.

NIST

Our program director and the Standards Coordination Office, for responsive guidance on scope, budget reallocation, and personnel changes.

Faculty and Instructors

Every instructor who taught these modules, revised them against fresh evidence, and adopted the master template.

Advisory Board

The curriculum chair, program chair, and course instructors, whose monthly counsel produced concrete improvements.

Graduate Research Assistants

Two scholars who carried standards knowledge into award winning research of their own.

Hunt Library

For partnering with us to build the public facing NIST guide that removed the access barrier.

University Leadership

The Worldwide Chancellor and the Deans of the Colleges of Aviation and Engineering, for backing that was never ceremonial.

Peer Reviewed Publications

Dissemination record under Award 70NANB23H240, listed in APA style

PEER REVIEWED PROCEEDING

Halawi, L., El Sayed, M., Miller, M., White, S., & Dhakal, S. S. (2024). Eagles flight: A curriculum blend of aviation, engineering, and industry standards. *Collegiate Aviation Review International*, 42(2), 237 to 246.

BOOK CHAPTERS

Halawi, L., Miller, M., & Holley, S. (2024). Beyond the blue skies: A comprehensive guide for risk assessment in aviation [Book chapter]. IntechOpen.

Halawi, L., Miller, M., & Holley, S. (2026). Perspective chapter: An integrated framework of explainable AI, trust, and ethics in aviation. In R. Kimmons (Ed.), *Artificial intelligence ethics, law, and policy*. IntechOpen.

Conference Presentations

Five presentations across national and international venues

- 1 Halawi, L., El Sayed, M., Miller, M., White, S., & Dhakal, S. S. (2024, September 25 to 27). *Eagles flight: A curriculum blend of aviation, engineering, and industry standards* [Conference presentation]. University Aviation Association 2024 Collegiate Aviation Education Conference and Expo, Memphis, TN, United States.
- 2 Halawi, L., Miller, M., White, S., & El Sayed, M. (2025, November 22 to 24). *Bridging academia and industry: A NIST research initiative* [Conference presentation]. Decision Sciences Institute 56th Annual Conference, Orlando, FL, United States.
- 3 Halawi, L., Miller, M., White, S., & El Sayed, M. (2025, November 22 to 24). *Pedagogical models and teaching standards: A framework for higher education curriculum* [Conference presentation]. Decision Sciences Institute 56th Annual Conference, Orlando, FL, United States.
- 4 Halawi, L., Miller, M., & White, S. (2026, June 2 to 4). *Beyond advisory boards, a DACUM approach: How standards professionals can transform aviation, aerospace, and technical education* [Conference presentation]. 2026 Society for Standardization Professionals Annual Conference, Ottawa, Canada.
- 5 Halawi, L., Miller, M., & Holley, S. (2026, June 2 to 4). *Safe skies, clear logic: The AXTENI approach to trustworthy AI* [Conference presentation]. 2026 SAE Aerotech Conference and Exhibition, West Palm Beach, FL, United States.

Dissemination at these three venues was funded through the budget reallocation approved after the Gaithersburg workshops were not held.

Standards Service and Public Resources

What remains available after the award closes

Standards Committee Service

- American National Standards Institute, Committee on Education, Education Group
- United States Technical Advisory Group to ISO Technical Committee 279, Innovation Management

Curriculum Resources

- ASCI 693 NIST Library Guide, public facing guides.erau.edu/asci693-nist
- Integrating Standards Modules, self enroll Canvas course
- [link to the web form to register for course](#)

HOW ANOTHER INSTITUTION CAN BEGIN

1

Open the public library guide and review the foundational standards literacy module.

2

Keep that layer intact and substitute the discipline specific standards your programs require.

3

Choose the platform pathway your faculty already trust, either Yellowdig or Canvas discussion boards.

4

Map the modules to the ABET or AABI outcomes your program already reports.

QUESTIONS AND ANSWERS

Thank you. We welcome your questions.

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Embry-Riddle Aeronautical University, Worldwide Campus

PROJECT OF RECORD

NIST Federal Award 70NANB23H240

Standards Coordination Office

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