ACAP

Automated Calibration Procedure Development

ELECOMP Capstone Design Project 2026-2027

Sponsoring Company:

DEWETRON Inc.
2850 South County Trail, East Greenwich, RI 02818
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Company Overview:

DEWETRON develops high-precision, synchronized data acquisition and measurement systems that help engineers and scientists turn complex test data into actionable insight. Its modular hardware and intuitive OXYGEN measurement software support automotive and mobility, aerospace and aviation, renewable and green energy, and manufacturing and industrial applications. DEWETRON is part of the Anritsu Group and combines configurable measurement solutions, technical expertise, and a commitment to precision, reliability, and continuous improvement.

Technical Director(s):

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Project Motivation:

DEWETRON is transitioning to a new Fluke calibration platform and needs replacement automated calibration procedures for selected DEWETRON measurement modules. The existing procedures and historical practices provide a starting point, but the new station requires procedures that are compatible with the available calibrator, digital multimeter, communications interfaces, and the MET/TEAM and MET/CAL environment. A structured capstone project gives students a real-world opportunity to combine metrology, instrumentation, communications, and software automation while delivering reusable procedures for DEWETRON's U.S. calibration laboratory.

Anticipated Best Outcome:

A validated set of automated, user-guided calibration procedures that operates with the new Fluke calibration station, controls the required instruments, records results, and provides an unambiguous pass/fail determination aligned with approved calibration requirements. The final package should be repeatable, maintainable, and ready for controlled review and implementation by DEWETRON personnel.

Project Details:

Overall System Concept:

The student team will work with DEWETRON's U.S. and Austrian calibration representatives to identify the selected module types, approved calibration points, required accuracies, and instrument configurations. The team will translate those requirements into automated procedures within MET/CAL, with asset, result, and workflow support through MET/TEAM as available. Procedures will communicate with the calibrator, digital multimeter, and other approved instruments using GPIB or another interface confirmed by the Technical Directors. Testing will be performed on equipment in the DEWETRON laboratory.

Primary Objectives:

- Document the current calibration workflow and define the replacement procedure requirements for the selected DEWETRON module or module family.
- Develop a modular procedure architecture with clear prompts, instrument setup, measurement points, tolerances, calculations, decision logic, and result recording.
- Automate instrument control and data exchange so the operator can complete the calibration consistently with minimal manual intervention.
- Validate accuracy, repeatability, error handling, and pass/fail behavior using representative hardware and known test conditions.
- Provide controlled documentation, source files, configuration information, and training materials so DEWETRON can maintain the procedures after project completion.

System Interfaces and Data Flow:

Element	Project Role	Expected Output
DEWETRON module	Device under test; channels and ranges selected by Technical Directors	Stable readings and traceable test results
Fluke calibrator	Generates approved electrical stimuli for procedure steps	Known source values and status
Digital multimeter	Independent verification or supporting measurement where required	Measured reference values

Element	Project Role	Expected Output
GPIB / approved interface	Command, query, status, and error communication between instruments	Reliable automated control
MET/CAL	Procedure execution, calculations, prompts, limits, and pass/fail logic	Automated calibration record
MET/TEAM	Asset, workflow, and result management as configured by DEWETRON	Controlled records and retrieval

Scope Boundaries:

The capstone team will develop and demonstrate procedures for the module types and test points formally selected at project kickoff. Production release, laboratory approval, accreditation decisions, cybersecurity approval, and authorization to place a procedure into operational service remain the responsibility of DEWETRON. Work outside the agreed module list or requiring additional specialized standards is subject to Technical Director approval.

Success Criteria:

- The procedure executes from start to finish on the designated station without unintended manual workarounds.
- Instrument commands, prompts, calculations, tolerances, and recorded results match the approved procedure requirements.
- Known passing and failing conditions produce the expected results, including clear handling of communication or setup errors.
- Repeat trials demonstrate consistent operation within the acceptance limits defined by the Technical Directors.
- DEWETRON receives source files, revision history, validation evidence, setup instructions, and operator guidance.

Hardware/Electrical Tasks:

- Review the selected DEWETRON module signal types, ranges, connectors, and calibration requirements.
- Configure and safely interconnect the new Fluke calibrator, digital multimeter, device under test, and laboratory computer.
- Confirm cabling, shielding, grounding, warm-up, connection sequencing, and protection requirements.
- Create wiring diagrams, connection tables, instrument identification lists, and station setup documentation.

- Execute controlled tests, troubleshoot unexpected readings, and support repeatability and uncertainty reviews.

Firmware/Software/Computer Tasks:

- Learn the relevant MET/CAL procedure language, MET/TEAM workflow, and approved instrument command sets.
- Develop user-guided automated procedures with setup prompts, range selection, loops, calculations, tolerance limits, decisions, and result storage.
- Implement GPIB or other approved communications, including instrument discovery, command responses, timeouts, and error recovery.
- Use version control and meaningful revision notes for source code, procedure files, instrument configuration, and documentation.
- Create test cases for nominal, boundary, failure, interrupted, and communication-error conditions.
- Prepare operator instructions and a handoff package that enables DEWETRON personnel to run, review, and maintain the work.

Expected Deliverables:

- Approved requirements matrix identifying modules, ranges, test points, standards, instruments, interfaces, and acceptance criteria.
- System block diagram, wiring diagram, connection table, and station setup checklist.
- MET/CAL source procedures and associated configuration files for the agreed scope.
- Version-controlled test plan, test data, traceability matrix, anomaly log, and validation report.
- Operator work instruction covering startup, connections, execution, expected prompts, pass/fail review, shutdown, and fault recovery.
- Final design report, technical presentation, live demonstration, and transfer package for DEWETRON.

Project Plan, Reviews, and Risk Controls:

Phase	Key Activities	Review / Evidence
1. Define	Confirm module scope, stakeholders, requirements, station configuration, records, and AI/data restrictions.	Requirements review and approved scope.
2. Design	Create architecture, instrument interface plan, procedure flow, test strategy, and documentation outline.	Preliminary design review.

Phase	Key Activities	Review / Evidence
3. Develop	Build procedure components, prompts, communications, calculations, limits, and record handling.	Incremental demonstrations and code reviews.
4. Integrate	Connect station hardware and execute end-to-end procedures on representative modules.	Integration test results and anomaly log.
5. Validate	Run nominal, boundary, repeatability, failure, recovery, and usability tests.	Validation report and acceptance review.
6. Transfer	Finalize source, revision history, operator instructions, training, presentation, and handoff.	Final demonstration and deliverable checklist.

Key Risks and Controls:

- Incomplete or changing requirements: use a signed requirements matrix and Technical Director approval for scope changes.
- Instrument availability or communication issues: confirm equipment, interfaces, drivers, command documentation, and backup test windows early.
- Incorrect limits or calculations: require independent review of specifications, units, conversions, tolerances, and pass/fail logic.
- Damage to equipment or unsafe connections: use approved diagrams, current/voltage limits, connection checks, and supervised laboratory testing.
- Uncontrolled data or source revisions: use approved storage, version control, change notes, access restrictions, and defined release ownership.
- Overreliance on AI-generated content: follow Appendix A, prohibit restricted information entry, and require student and Technical Director verification.

Composition of Team:

One Electrical Engineering student and one Computer Engineering student. Both students are expected to participate in requirements definition, integration, testing, documentation, and formal design reviews.

Skills Required:

Electrical Engineering Skills Required:

- Electrical and metrology fundamentals: A/D conversion, voltage, current, resistance, temperature, signal integrity, and measurement uncertainty.

- Ability to interpret specifications, tolerances, percentages, statistics, calibration points, and pass/fail limits.
- Safe use of calibrators, multimeters, laboratory equipment, cabling, grounding, shielding, and protection practices.

Computer Engineering Skills Required:

- Programming or scripting fundamentals and the ability to learn MET/CAL procedure development.
- Hardware/software integration, instrument communication, GPIB concepts, data handling, timeout logic, and debugging.
- Structured software testing, version control, documentation, user prompts, and maintainable procedure design.

AI Usage:

The AI Use Policy for this project is defined in Appendix A at the end of this proposal. The Technical Directors have completed the checklist in Appendix A to indicate which AI uses are permitted on this project. Any item left unchecked is not allowed.

Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

Successful procedures can reduce repetitive manual setup and calculation effort, improve consistency between operators, and shorten the time required to calibrate supported modules. Standardized prompts, automated instrument control, and electronic result capture can also reduce avoidable errors and support clearer review of calibration records. Reusable program structures may lower the effort needed to develop additional procedures for related modules, subject to separate validation and approval.

Broader Implications of the Best Outcome on the Company's Industry:

The project demonstrates how metrology knowledge and software automation can be combined to improve repeatability, traceability, and usability in a modern calibration laboratory. The same engineering disciplines apply broadly to aerospace, automotive, energy, manufacturing, and other regulated or quality-critical environments in which measurement decisions depend on controlled procedures and reliable data.

Items to Confirm Before Student Kickoff:

- Exact DEWETRON module models, ranges, channels, and number of procedures included in scope.

- Specific Fluke calibrator and digital multimeter model numbers, options, drivers, and available GPIB hardware.
- Current approved specifications, test points, tolerances, uncertainty expectations, and reference procedure sources.
- MET/CAL and MET/TEAM versions, licensing, development environment, user access, and approved source repository.
- Laboratory access, safety training, supervision, hardware availability, and rules for remote work.
- Formal acceptance authority, validation sample size, document templates, naming conventions, and ownership of final intellectual property.

Appendix A: AI Use Policy - Automated Calibration Procedure Development

Allowed

- Students may use AI tools for
  - ☒ brainstorming support
  - ☐ concept development
  - ☒ literature and publicly available documentation review
  - ☐ software development
  - ☐ debugging
  - ☒ data analysis
  - ☐ test development
  - ☒ non-proprietary paragraph editing
  - ☒ non-proprietary single-slide formatting
  - ☒ preparation of project deliverables
  - ☒ note taking or transcription of meetings
  - ☐ Others: ____________________________

Not Allowed

- Using AI in violation of university policies, applicable laws, course-specific rules identified by the capstone instruction team, or project-specific rules identified by the Technical Directors.
- Entering proprietary, confidential, personally identifiable, security-sensitive, controlled, or otherwise restricted information into an AI system without authorization.
- Submitting AI-assisted work without understanding, reviewing, verifying, and appropriately disclosing its use.
- Submitting entire documents or presentations to an AI system for editing or formatting.
- Any unchecked item from the allowed-use list above.

Requirements

- AI tools may only enhance, not replace, students' technical reasoning, engineering judgment, and understanding. Students must be able to explain, justify, and defend all submitted designs, code, analyses, test results, documentation, and conclusions.
- During the first two weeks, the student team and Technical Directors shall identify proprietary or confidential information; determine what may be shared with AI systems; identify approved tools, models, accounts, and configurations; and document project-specific restrictions or approval requirements.

- Students shall transparently document AI use using the URI CYPHER AI Usage Marking guidelines (https://web.uri.edu/cypher/ai-marking/) and comply with any capstone instruction provided by URI.
- Students retain full professional responsibility for all design decisions, analyses, implementations, testing, documentation, presentations, and final deliverables, regardless of whether AI tools contributed to the work.

Project-Specific Data Handling Note

Calibration procedure source code, unpublished specifications, customer or asset information, credentials, network details, instrument configuration files, calibration records, and other non-public DEWETRON information shall not be entered into an AI system unless the Technical Directors provide explicit authorization and an approved environment.