

Lean 6 Sigma - AES

Level: 3

Career Cluster: Advanced Manufacturing

Program: Engineering

Pathway: Aerospace Engineering Technician

Aligns with: MTE 2220 Lean Six Sigma

Course Catalog Description

This course introduces Lean Six Sigma principles through aerospace engineering and advanced manufacturing applications. Students use data, quality tools, and structured problem-solving methods to improve aerospace-related processes, support safety and compliance expectations, and prepare for careers in the aerospace engineering technician pathway.

Summary

This course introduces students to Lean Six Sigma principles and their application in engineering and advanced manufacturing contexts, with a specific emphasis on aerospace engineering technician workflows, quality systems, safety expectations, and continuous improvement. Students explore career pathways related to aerospace engineering technician, including workplace expectations, professionalism, ethics, laws, certifications, and postsecondary opportunities in Colorado. Through hands-on analysis of aerospace-related systems and workflows, students learn to define engineering problems, map processes, collect and interpret data, identify root causes, and develop evidence-based solutions using tools such as DMAIC, SIPOC, flowcharts, value stream maps, fishbone diagrams, and basic statistical displays. The course also emphasizes collaboration, technical communication, safe and responsible practices, and the ethical use of data as students design, test, monitor, and sustain process improvements in contexts such as component production, assembly flow, inspection, maintenance support, and documentation control. By the end of the course, students synthesize their learning in a capstone-style aerospace improvement project that connects Lean Six Sigma methods to real-world aerospace engineering applications and career readiness.

Notes

This revised version preserves the core Lean Six Sigma sequence of defining problems, measuring performance, analyzing causes, improving processes, and sustaining results, but it broadens the original course in several important ways. Most notably, the updated course places Lean Six Sigma within an aerospace engineering technician context, giving students more direct exposure to industry-relevant workflows, safety expectations, quality standards, and technical communication practices. It also adds stronger emphasis on professionalism, ethics, leadership, and work-based learning so that students are not only learning improvement methods, but also applying them in ways that reflect current workplace expectations and career readiness goals. In addition, the revised document strengthens connections to Colorado postsecondary pathways and the broader Aerospace Engineering Technician pathway, making the course more clearly aligned to current CTE priorities while still maintaining the original methodological foundation.

Student Learning Outcomes

1. Career Exploration and Postsecondary Opportunities

Objective: *Students will explore and analyze career pathways related to aerospace engineering technician by examining professional roles, tools, work environments, ethical and legal responsibilities, certifications, professional organizations, and Colorado postsecondary education options in order to make informed academic and career decisions*

- 1) Identify employment opportunities in various fields with a focus in the area of aerospace engineering technician
 - a. Recognize the work typically performed, tools and technology used, and nature of work environments
 - b. Identify potential certifications within the careers
 - c. Find membership organizations associated with the careers
 - d. Understand the necessary education associated within the careers
- 2) Define professionalism within the context of aerospace engineering technician
 - a. Criticism and evaluation
 - b. Presentation
 - c. Assessment
- 3) Recognize laws, regulations, and ethics significant to the fields of aerospace engineering technician
- 4) Identify postsecondary opportunities offered in the state of Colorado
 - a. Technical college, community college, 4-year institutions
 - b. Certificates, associates, bachelor, and advanced degree opportunities

2. Foundations of Lean Six Sigma in Aerospace Engineering

Objective: *Students will understand Lean Six Sigma concepts and explain how continuous improvement supports quality, efficiency, safety, compliance, and ethical decision-making in aerospace engineering systems.*

- 5) Define key Lean Six Sigma terms, including waste, variation, quality, and customer value.
- 6) Differentiate between Lean and Six Sigma approaches.
- 7) Describe DMAIC, PDCA, Kaizen, and 8D problem-solving frameworks.
- 8) Identify the eight types of waste in real-world processes.
- 9) Explain how continuous improvement impacts engineering productivity and quality.
- 10) Recognize examples of waste and inefficiency in everyday systems.
- 12) Demonstrate safe and responsible practices when observing aerospace engineering, assembly, inspection, or maintenance-related processes.
- 12) Demonstrate safe and responsible practices when observing engineering processes.
- 13) Explain the ethical use of data and the impact of process improvements on people and systems.

3. Defining Engineering Problems and Mapping Processes

Objective: *Students will apply process-mapping tools to define aerospace engineering problems and organize system components, handoffs, and workflows.*

- 14) Construct a project charter defining a process problem.
- 15) Describe a measurable and bounded problem statement.
- 16) Identify customers, suppliers, inputs, outputs, and process steps (SIPOC).
- 17) Create flowcharts and process maps.
- 18) Develop value stream maps for simple systems.
- 19) Classify steps as value-added or non-value-added.
- 20) Compare mapping tools (flowcharts, spaghetti diagrams, affinity diagrams).
- 21) Collaborate effectively in teams to document processes.
- 22) Organize observations using an engineering notebook or structured documentation.
- 23) Communicate process information clearly using visual and written formats.

3. Measuring Process Performance and Visualizing Data

Objective: *Students will measure and represent aerospace process performance using data and visual tools to establish a baseline for improvement.*

- 24) Collect quantitative and qualitative process data.
- 25) Measure performance metrics such as cycle time, defects, and variation.
- 26) Create graphs including trend charts, Pareto charts, and histograms.
- 27) Interpret patterns and meaning from visual data displays.
- 28) Distinguish between variation and trends in data.
- 29) Calculate basic statistics (average, frequency, range).
- 30) Use data diagrams to communicate baseline conditions.
- 31) Record data accurately and ethically.
- 32) Evaluate the reliability and completeness of collected data.
- 33) Communicate data findings clearly through charts and technical explanations.

4. Analyzing Root Causes of Problems

Objective: *Students will analyze aerospace process data to identify root causes and justify conclusions using evidence-based reasoning.*

- 34) Analyze process data to identify causes of inefficiency or defects.
- 35) Construct cause-and-effect (fishbone) diagrams.
- 36) Apply the 5 Whys and 2 Hows techniques.
- 37) Interpret scatter plots and relationships between variables.
- 38) Examine simple FMEA models to identify risks.
- 39) Differentiate between root causes and symptoms.
- 40) Justify conclusions using data and evidence.
- 41) Evaluate multiple possible causes before selecting the most likely.
- 42) Communicate findings using technical language and evidence.
- 43) Reflect on errors in reasoning and revise conclusions as needed.

5. Designing and Testing Improvements

Objective: *Students will develop, test, and refine solutions that improve aerospace engineering processes while considering feasibility, safety, compliance, and operational impact.*

- 44) Generate potential solutions through brainstorming.

- 45) Compare solutions using criteria such as cost, time, and effectiveness.
- 46) Apply benchmarking techniques.
- 47) Explain push vs. pull systems.
- 48) Identify error-proofing (poka-yoke) and efficiency tools.
- 49) Design a solution plan for process improvement.
- 50) Test solutions using prototypes or simulations.
- 51) Evaluate whether improvements are successful.
- 52) Revise solutions based on results and feedback.
- 53) Defend solution choices using engineering reasoning.
- 54) Collaborate effectively during solution design and testing.
- 55) Consider safety, ethical, and real-world impacts of proposed solutions.

6. Controlling and Sustaining Improvement

Objective: *Students will implement control strategies to sustain aerospace process improvements and monitor long-term process performance.*

- 56) Explain the purpose of control plans.
- 57) Develop a control plan to maintain improvements.
- 58) Use charts or monitoring tools to track performance.
- 59) Apply 5S principles for organization and efficiency.
- 60) Explain the role of visual controls.
- 61) Describe the function of TPM and standardized work.
- 62) Create simple standard operating procedures.
- 63) Demonstrate the use of Kanban or workflow systems.
- 64) Monitor process performance and identify drift.
- 65) Recommend corrective actions when performance declines.
- 66) Document process improvements using professional engineering formats.
- 67) Communicate process changes clearly to stakeholders.

7. Aerospace Lean Six Sigma Engineering Project

Objective: *Students will synthesize Lean Six Sigma knowledge to complete and present a full aerospace engineering improvement project.*

- 68) Select a process improvement problem.
- 69) Apply the DMAIC process to a full project.
- 70) Compile project documentation (charts, maps, data).
- 71) Create a formal technical presentation.
- 72) Defend project conclusions using evidence.
- 73) Evaluate the success and limitations of the project.
- 74) Reflect on teamwork and problem-solving growth.
- 75) Propose next steps for continued improvement.
- 76) Demonstrate professional communication skills in written and oral formats.
- 77) Connect project outcomes to real-world engineering and career applications.

8. Leadership

Objective: *Students will develop leadership skills by demonstrating responsibility, collaboration, initiative, ethical decision-making, and effective communication in aerospace engineering and continuous improvement contexts.*

- 78) Demonstrate responsibility, accountability, and reliability in individual and team-based aerospace engineering tasks.
- 79) Collaborate effectively with peers to plan, complete, and evaluate process-improvement activities.
- 80) Apply ethical decision-making and professional communication when leading discussions, solving problems, and presenting ideas.
- 81) Demonstrate initiative, adaptability, and constructive leadership during continuous improvement projects and workplace simulations.

9. Work-Based Learning

Objective: *Students will engage in work-based learning experiences to apply Lean Six Sigma and aerospace engineering knowledge in authentic settings, strengthen career readiness, and connect classroom learning to industry expectations.*

- 82) Apply Lean Six Sigma and aerospace engineering knowledge in authentic workplace settings.
- 83) Demonstrate workplace readiness skills such as punctuality, professionalism, teamwork, and task completion.
- 84) Analyze how industry expectations, safety practices, and quality standards influence workplace performance.
- 85) Reflect on work-based learning experiences to identify strengths, growth areas, and career connections in aerospace engineering technician pathways.

10. Career and Technical Student Organizations

Objective: *Using the [CTSO Resource Document](#), chapter activities will provide some of the best opportunities CTSO members will have to learn by doing. A successful [program of work](#) creates a positive learning atmosphere in the classroom. CTSO members learn how to accept responsibility, work as a team, manage a budget, and handle success and failure. Per the CTE Admin Handbook, CTSOs are embedded into curriculum.*

Professional Development

Prepare each member for entry into the workforce and provide a foundation for success in a career. Becoming a professional does not stop with acquiring a skill, but involves an increased awareness of the meaning of good citizenship and the importance of labor and management in the world of work.

Community Service

Promote and improve goodwill and understanding among all segments of the community through services donated by CTSO chapters, and to instill in its members a lifetime commitment to community service.

Business and Industry Connections

Increase awareness of quality job practices and attitudes, and increase the opportunities for employer engagement and eventual employment.

Financial Leadership

Plan and participate in activities to allow all members to carry out the chapter's projects. Educate members on their own personal finance for current and future success.

Public Relations

Make the general public aware of the good work that students in career and technical education are doing to better themselves and their community, state, nation, and world.

Social Activities

To increase cooperation in the school and community through activities that allow CTSO members to get to know each other in something other than a business or classroom setting.

Academic Standards Alignment

Colorado CTE courses are required to integrate academic and essential skills into course content. The following academic standards have been identified as aligned to this course and should be integrated throughout instruction.

[CO CTE Academic Standards Resources](#) (Rubrics, integration strategies, etc)
[CDE Colorado Academic Standards Online](#) (Online standards lookup tool)

Note: Mathematics and Science standards will be added in the future. Visit the [Colorado Academic Standards](#) page for the most current version.

Reading, Writing and Communicating Crosswalk

Course: Lean 6 Sigma

Colorado Academic Standards – Reading, Writing and Communicating

Standard	Prepared Graduate Competency	Description	Course Evidence / Alignment
Standard 1: Oral Expression and Listening	Prepared Graduate 1 – Collaboration	Collaborate effectively as group members or leaders.	Students work in teams to analyze aerospace processes, identify inefficiencies, evaluate peer input, and communicate to achieve shared improvement objectives.
Standard 1: Oral Expression and Listening	Prepared Graduate 2 – Oral Presentations	Deliver effective oral presentations for varied audiences and varied purposes.	Students present problem statements, data findings, and improvement proposals, and defend recommendations verbally using evidence and analysis.
Standard 2: Reading for All Purposes	Prepared Graduate 4 – Informational Texts	Read a wide range of informational texts to build knowledge.	Students read Lean principles, Six Sigma methodologies, aerospace process documentation, case studies, charts, performance data,

			and other technical texts related to quality improvement.
Standard 2: Reading for All Purposes	Prepared Graduate 5 – Language in Context	Understand how language functions in different contexts.	Students use precise process-improvement and statistical terminology, interpret discipline-specific language, and adjust tone for analysis, reporting, and presentations.
Standard 3: Writing and Composition	Prepared Graduate 6 – Craft arguments	Craft arguments using techniques specific to the genre.	Students argue for process changes based on analyzed data, justify improvement strategies using DMAIC evidence, and defend conclusions logically and persuasively.
Standard 3: Writing and Composition	Prepared Graduate 7 – Informational Writing	Craft informational/explanatory texts using techniques specific to the genre.	Students produce problem statements, process maps, improvement reports, and written explanations consistent with aerospace and engineering industry expectations.
Standard 3: Writing and Composition	Prepared Graduate 8 – Narrative Writing	Craft narratives using techniques specific to the genre.	The course emphasizes analytical and professional communication rather than narrative writing.
Standard 3: Writing and Composition	Prepared Graduate 9 – Writing Process	Demonstrate mastery of their own writing process.	Students draft, revise, and refine professional reports and presentations to ensure clarity,

			accuracy, and coherence.
Standard 4: Research Inquiry and Design	Prepared Graduate 10 – Research and Ethics	Gather information from a variety of sources; analyze and evaluate its quality and relevance.	Students gather quantitative and qualitative data, analyze aerospace process performance using statistical tools, and apply research ethically to improve systems, reliability, safety, and decision- making.

Free Resource Links

1. Career Exploration and Postsecondary Opportunities

- Colorado CTE (pathways, program resources, career development in Colorado)
<https://cteincolorado.org/>
- CareerOneStop (career exploration, job outlook, certifications, required education, salary data)
<https://www.careeronestop.org>
- O*NET Online (career profiles, aerospace tools and technology, work environments, skills and tasks)
<https://www.onetonline.org>
- Apprenticeship Colorado (registered apprenticeships, workforce pathways, technical training)
<https://apprenticeship.colorado.gov/>

2. Foundations of Lean Six Sigma in Engineering

- Learn Lean Sigma Guides (DMAIC, Kaizen, 5S, PDCA fundamentals)
<https://www.learnleansigma.com/guides/>
- Kaizen Lean Six Sigma 101 (introduction, Lean vs. Six Sigma, continuous improvement)
<https://kaizen.com/insights/lean-six-sigma-101-a-continuous-improvement-guide/>
- Implementing Lean Six Sigma in Aerospace Operations (aerospace case studies, DMAIC applications, process improvement examples)
<https://www.linkedin.com/pulse/implementing-lean-six-sigma-aerospace-operation-case-studies-joshi-gznb/>
- Lean Design for Six Sigma in Aerospace Manufacturing (defect reduction, process quality, aerospace production case study)
<https://flevy.com/topic/design-for-six-sigma/case-lean-design-six-sigma-aerospace-manufacturing>

3. Defining Problems and Mapping Processes

- SIPOC.info (SIPOC diagrams, process mapping, improvement planning)
<https://sipoc.info/>
- Smartsheet SIPOC Templates (process mapping templates, stakeholder identification)
<https://www.smartsheet.com/content/sipoc-templates>
- ProjectManagers SIPOC Examples (process definition, mapping examples)
<https://projectmanagers.net/15-free-sipoc-template-examples/>
- APQC SIPOC Template (process clarity, process design, performance management)
<https://www.apqc.org/resource-library/resource-listing/process-sipoc-template>

4. Measuring Process Performance and Visualizing Data

- StatSigma Tools (control charts, SPC analysis, process capability)
<https://thestatsigma.com/>
- AirAcad Lean Six Sigma Templates (data collection, histograms, charts, SPC tools)
<https://airacad.com/lean-six-sigma-templates-you-can-use-free-in-excel-and-google-sheets/>

- Learn Lean Sigma Tools (statistics, calculators, process data analysis)
<https://www.learnleansigma.com/>
- Ever-So-Lean Toolbox (data tools, templates, measurement resources)
<https://eversolean.com/toolbox/>

5. Analyzing Root Causes

- DMAIC Suite Resources (fishbone diagrams, Pareto charts, root cause tools)
<https://www.dmaicsuite.com/resources>
- Learn Lean Sigma Guides (5 Whys, root cause analysis, DMAIC tools)
<https://www.learnleansigma.com/guides/>
- Lockheed Martin RCCA Problem Solving Guidebook (8D, corrective action, AS9100-aligned root cause practices)
<https://www.lockheedmartin.com/content/dam/lockheed-martin/uk/documents/suppliers/RCCA-Problem-Solving-Guidebook.pdf>
- Root Cause Analysis Examples in Manufacturing (real scenarios, systemic fixes, corrective actions)
<https://www.learnleansigma.com/problem-solving/root-cause-analysis-examples-manufacturing/>

6. Designing and Testing Improvements

- GoLeanSixSigma Templates (brainstorming, improvement planning, solution testing)
<https://goleansixsigma.com/lean-and-six-sigma-resources/>
- DMAIC Suite Improve Resources (solution design, pilot testing, FMEA)
<https://www.dmaicsuite.com/resources>
- 6SigmaTool Free Training (DMAIC application, improvement implementation)
<https://www.6sigmatool.com/lean-six-sigma-trainings?lang=en>
- Ever-So-Lean Toolbox (Kaizen, improvement tools, benchmarking)
<https://eversolean.com/toolbox/>

7. Controlling and Sustaining Improvement

- StatSigma Control Charts (monitoring, SPC, process control)
<https://thestatsigma.com/>
- Learn Lean Sigma Control Charts (control charts, variation, monitoring)
<https://www.learnleansigma.com/guides/control-charts/>
- Control Plan in Lean Six Sigma (control plans, quality requirements, aerospace manufacturing relevance)
<https://www.6sigma.us/process-improvement/control-plan-lean-six-sigma/>
- Ever-So-Lean Toolbox (5S, visual control, standard work tools)
<https://eversolean.com/toolbox/>

8. Aerospace Lean Six Sigma Engineering Project

- Learn.org Free Courses (project-based learning, certification intro)
<https://learn.org/affordable-degrees/free-six-sigma-courses-certificates>
- LSS Refresh Community (DMAIC lessons, project application, case examples)
<https://www.lssrefresh.com/>

- GoLeanSixSigma Projects (real-world projects, case studies, applications)
<https://goleansixsigma.com/lean-and-six-sigma-resources/>
- KPI Fire Resource Library (project examples, white belt through green belt learning)
<https://www.kpifire.com/blog/best-free-lean-six-sigma-resources/>

9. Leadership

- Leading Teams – Open Textbook (teamwork, leadership, conflict resolution, workplace communication)
<https://pressbooks.usnh.edu/leadingleadingteams/>
- Leadership Lesson Plans (active listening, collaboration, emotional intelligence, meeting facilitation)
<https://involvedliving.osu.edu/leadership-lesson-plans>
- A Practical Guide to Effective Group Work (teamwork, professionalism, accountability, collaboration)
<https://cte.tamu.edu/resources/practical-guide-effective-group-work.html>
- Supporting Effective Group Projects and Teamwork (team projects, shared responsibility, communication, employer-valued skills)
<https://edspace.american.edu/cfe/supporting-effective-group-projects-and-teamwork/>

10. Work-Based Learning

- CareerOneStop Find Training (career readiness, internships, apprenticeships, training pathways)
<https://www.careeronestop.org/findtraining/find-training.aspx>
- Apprenticeships.org (work-based learning, youth apprenticeship, earn-and-learn pathways, employer connections)
<https://apprenticeships.org/>
- Work-Based Learning Career Toolkit (program design, work-readiness competencies, reflection, employer partnerships)
https://ung.edu/center-teaching-learning-leadership/_uploads/files/work-based-learning-career-toolkit-2026-final.pdf
- Career Preparation Toolkit (career competencies, professionalism, teamwork, leadership, communication)
<https://teaching.uoregon.edu/career-preparation-toolkit>



Technology Student Association – National Competitive Events

Data Science and Analytics

Objective: *Students will collect, analyze, visualize, document, and present a data set connected to the annual TSA Data Science and Analytics theme.*

- Research the annual TSA Data Science and Analytics theme and identify a focused topic for investigation.
- Collect or compile a data set of at least 500 rows from credible and relevant sources.
- Analyze data to identify trends, patterns, relationships, limitations, and possible predictions.
- Create a digital scientific poster that communicates the research question, data source, visualizations, analysis, and findings.
- Prepare a documentation portfolio explaining methods, data collection, analysis, conclusions, and resources.
- Present the digital scientific poster within the TSA time limit using clear, evidence-based communication.
- Complete an on-site semifinal challenge by creating a visual representation and brief synopsis from a provided data set.

Resources

- Technology Student Association – Data Science and Analytics competition guidelines
<https://tsaweb.org/competitions-programs/tsa/themes-problems>
- Tableau Public – Data visualization tools
<https://public.tableau.com/>
- Kaggle Datasets – Public data sets for analysis
<https://www.kaggle.com/datasets>
- Google Dataset Search
<https://datasetsearch.research.google.com/>



Technology Student Association – National Competitive Events

Manufacturing Prototype

Objective: *Students will design, document, fabricate, evaluate, and present a manufactured prototype that meets TSA Manufacturing Prototype requirements for production quality, technical documentation, materials, and product communication.*

- Research the annual TSA Manufacturing Prototype challenge and identify the product requirements, constraints, and intended audience.
- Develop a prototype concept using sketches, technical drawings, CAD models, or other design-planning tools.
- Create working drawings, detail drawings, a parts list, and other documentation needed to communicate the design.
- Fabricate a prototype using appropriate manufacturing processes, materials, tools, and equipment.
- Document construction, testing, revisions, strengths, weaknesses, materials, and production decisions in a portfolio.
- Prepare a bill of materials and work log that communicate the manufacturing process.
- Present a sales pitch explaining the product, design decisions, production process, cost considerations, and final prototype.

Resources

- Technology Student Association – Manufacturing Prototype competition guidelines
<https://tsaweb.org/competitions-programs/tsa/themes-problems>
- Autodesk Fusion – CAD/CAM design and manufacturing tools
<https://www.autodesk.com/products/fusion-360/education>
- Xometry – Manufacturing and prototyping process resources
<https://www.xometry.com/resources/>
- Onshape Education – Browser-based CAD and product design tools
<https://www.onshape.com/en/education/>



Technology Student Association – National Competitive Events

Technology Problem Solving

Objective: *Students will work as a team to solve an on-site TSA technology challenge by designing, constructing, testing, and evaluating a solution using limited materials, tools, and time.*

- Analyze an on-site TSA problem and identify the required task, constraints, materials, and scoring criteria.
- Collaborate with a partner to plan and construct a working solution within the competition time limit.
- Use approved materials, tools, adhesives, measuring devices, and safety procedures during construction.
- Apply engineering, manufacturing, and technology concepts to improve the performance of the solution.
- Test the solution using the required objective measure, such as strength, distance, time, accuracy, or task completion.
- Revise the solution based on observed performance and available time.
- Evaluate the final product using TSA criteria for problem solving, construction quality, teamwork, and measurable performance.

Resources

- Technology Student Association – Technology Problem Solving competition guidelines <https://tsaweb.org/competitions-programs/tsa/themes-problems>
- American Society for Quality – Lean Six Sigma resources <https://asq.org/quality-resources/six-sigma>
- TeachEngineering – Hands-on engineering design challenges <https://www.teachengineering.org/>
- Science Buddies – Engineering Design Process <https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps>