Leaders for Global Operations (LGO)
Engineering Department Content Guidelines
(last revised 22-Aug 2023)

This document is intended to inform LGO Partner Companies about the general scope requirements for a Masters Thesis submitted to an engineering department at MIT. Each engineering department has its own expectations in terms of technical content and appropriate methodologies. Within this document, links to each department's relevant research areas has been provided to illustrate topical areas of interest. The engineering departments described in this document include:

- Aeronautical and Astronautical Engineering
- Chemical Engineering
- Civil and Environmental Engineering
- Electrical Engineering and Computer Science
- Mechanical Engineering
- Nuclear Science Engineering
- Operations Research Center

As the work completed by an LGO intern at their host company forms the basis of the intern's Masters Thesis, the project scope must align with the intern's respective engineering department. If Partner Companies are expecting to offer internships to students in a particular engineering department, they should take note of the guidelines for that department to ensure the project scope (as defined in the Internship Proposal Input form) is aligned.

After receiving project proposals from the Partner Companies, the LGO staff review the content to determine which engineering departments are eligible. In most cases, multiple engineering departments are eligible for a single project. Students can only interview for projects that have been approved for their department. In some cases, the staff may contact the proposal authors to discuss revisions to the project scope to better align with departmental guidelines.

The guidelines are relatively broad and, as research is always evolving, cannot be highly prescriptive. Proposal authors should use the information in this document as a guide only. Questions about a specific project or department can always be directed to the LGO staff.

Content Guidelines for LGO Internship Projects in the Department of Aeronautical and Astronautical (AeroAstro) Engineering

AeroAstro Engineering [Research Areas](#):
- Autonomous Systems & Decision-making
- Computational Science & Engineering
- Earth & Space Sciences
- Human-System Collaboration
- Systems Design & Engineering
- Transportation & Exploration
- Vehicle Design & Engineering

Projects that are NOT appropriate for AeroAstro Engineering:
- Supply chain optimization outside of the Aerospace industry
- Transportation and logistics outside the Aerospace industry
- Strategic sourcing and supplier management outside the Aerospace industry
- SKU complexity management outside the Aerospace industry

Example project research topics:
- Aerospace product design and development
- Evaluation of drone technology in commercial environments
- Impact analysis of aerospace product feature trade-offs
- Aerospace product life-cycle analysis
- Aerospace manufacturing processes and flows
- Evaluation of material properties for aerospace applications
- Evaluation of robotic use in aerospace manufacturing processes
- Design-of-experiments for root cause analysis in aerospace applications
- Design of future aerospace factories for improved productivity and profitability
- Satellite design, manufacturing, and operational use scenarios

Past project examples with good AeroAstro Engineering content:
- On Demand Mobility – Bell Flight
- Identifying Opportunities and Implementing Additive Manufacturing within Engineering and Design Organizations - AIP
- Drone-Assisted Damage Assessment – National Grid
- Additive 3D Printing of Metal structures associated with Advanced Missile Integration – Raytheon RMS
- Production System Safety - Boeing
- Exploration Upper Stage Program, Space Launch System – Boeing
- Demand Stabilization and Line Balancing of Satellite Production - Boeing

Content Guidelines for LGO Internship Projects in the Department of Chemical Engineering

Chemical Engineering [Research Areas](#):
- Biomedical and Biotechnology
- Catalysis and Reaction Engineering
- Energy
- Environment and Sustainability
- Materials
- Math and Computational Systems
- Transport and Thermodynamics

Projects that are NOT appropriate for Chemical Engineering:
- Does not relate to a physical system or process

Example project research topics:
- Process Optimization of drug development
- Electrochemical energy storage
- Digital-twin models for process simulation

Past Projects Examples with good Chemical Engineering content:
- Data-driven Predictive Modeling for Cell Line Selection in Biopharmaceutical Production -Amgen
- Computation and predictive modeling to increase efficiency and performance in cell line and bioprocess development – Amgen
- Product Management Framework for the Development of Automation Solutions for Biologics Drug Substance Manufacturing – Amgen
- Process Intensification of Spodoptera frugiperda (Sf) Cell Growth via Multi-Parallel Bioreactor System – Sanofi
- Technology Implementation Roadmap for Next-Generation Cell Culture Harvest - Amgen

Content Guidelines for LGO Internship Projects in the Department Civil and Environmental Engineering

Civil and Environmental [Research Areas](#):
- Climate, Environment, and Life Sciences
- Sustainable Materials and Infrastructure
- Food and Water Security
- Resilient Systems and Mobility

Projects that are NOT appropriate for Civil and Environmental Engineering:
- Does not relate to the research areas above and does not address a systems problem

Example project research topics:
- supply chain optimization and management
- service operation optimization
- transportation and logistics systems analysis
- strategic sourcing and supplier management
- complex network analysis
- data analytics for improved operations
- infrastructure analysis based on environmental conditions

Past Project examples with good Civil and Environmental Engineering content:
- A Systematic Approach for Assessing Next Generation Technologies and Solutions in Biomanufacturing - Amgen
- Workflow Evaluation of Key Work Packages in Drug Product Technologies - AstraZeneca
- Assessing Sales Floor Capacity and Replenishment Strategy - Amazon
- E-Commerce data integration in distribution – Inditex (Zara)
- Using Analytics to Improve Delivery Performance - Nike
- Value of Distribution-Level Reactive Power for Combined Heat and Power Systems – National Grid
- Forecasting Linehaul Transit Times & On Time Delivery Probability Using Quantile Regression Forests - Amazon
- Big Data Analysis Interrogating Raw Material Variability and the Impact on Process Performance -Amgen
- Inventory Modeling for Active Pharmaceutical Ingredient Supply Chains - AstraZeneca

Content Guidelines for LGO Internship Projects in the Department Electrical Engineering and Computer Science

MIT has one department for EECS because of the interdisciplinary nature of hardware and software systems. The department is large and diverse.

EECS [Research Areas](#):
- Electrical Engineering
- Computer Science
- Artificial Intelligence and Decision-Making

Projects that are NOT appropriate for EECS:
- Projects with limited complexity that require only basic modeling or analysis (e.g., using only Excel)

Example project research topics:
- product design and development
- impact analysis of product feature trade-offs
- product life-cycle analysis
- information and decision systems
- energy systems
- optimization and algorithm development
- optimization of systems
- evaluation of robotic use in manufacturing processes
- design-of-experiments for root cause analysis
- design of future factories for improved productivity and profitability
- planning and analysis of multiple plant operations

Past Project Examples with good EECS content:
- Optimization of Amazon Robotics Assets and Outbound Workflows - Amazon
- Advancing Artificial Intelligence in Biomanufacturing Operations - Amgen
- Statistical Forecasting Methodology for Inventory Optimization in a High SKU Mix, Seasonal Business – AIP
- Performance Modeling of Human-Machine Interfaces using Machine Learning- Amazon

Content Guidelines for LGO Internship Projects in the Department of Mechanical Engineering

Mechanical Engineering [Research Areas](#):
- Mechanics
- Design, Manufacturing, & Product Development
- Control, Instrumentation, & Robotics
- Energy Science & Engineering
- Ocean Science & Engineering
- Bioengineering
- Micro & Nano Engineering

Projects that are NOT appropriate for Mechanical Engineering:
- supply chain optimization without factory or plant operations
- service operation optimization without factory or plant operations
- operations strategy for sales and marketing
- transportation and logistics
- strategic sourcing and supplier management
- SKU complexity management

Example project research topics:
- product design and development
- impact analysis of product feature trade-offs
- product life-cycle analysis
- manufacturing processes and flows
- equipment evaluation which can include capital utilization
- evaluation of material properties
- modeling of manufacturing processes
- evaluation of robotic use in manufacturing processes
- design-of-experiments for root cause analysis
- design of future factories for improved productivity and profitability
- planning and analysis of multiple plant operations
- modeling of systems that involve controls and feedback
- evaluation and implementation of energy technologies

Past Project Examples with good Mechanical Engineering content:
- Low Volume High Mix Manufacturing Strategies – LFM Capital
- Using discrete-event simulation to increase system capacity: a case study of an assembly plant - Boeing
- Utilizing Automated Inspection to Identify Surface Quality Defects within the Automotive Body Assembly Process - Nissan
- Additive Manufacturing Applications and Implementation in Aerospace – Bell Flight
- Optimization of Amazon Robotics Assets and Outbound Workflows – Amazon
- Modeling Air Source Heat Pump Adoption Propensity and Simulating the Distribution Level Effects of Large-Scale Adoption– National Grid
- Connected Factory: Real Time Data Analysis for Manufacturing Efficiency - RTX-P&W

Content Guidelines for LGO Internship Projects in the Department of Nuclear Science and Engineering

Nuclear Science and Engineering [Research Areas](#):
- Fission
- Fusion
- Nuclear Security and Policy
- Quantum Engineering
- Advanced Computation, Modeling and Simulation
- Materials in Extreme Environments
- Nuclear Reactions and Radiation

Projects that are NOT suitable for Nuclear Science and Engineering:
- Does not relate to the research areas above

Past Project Examples with good Nuclear Science and Engineering content:
- Technical and Commercial Feasibility Assessment of Nuclear Microreactors as a Clean Energy Source for Data Centers and Mining Sites – Caterpillar
- Optimizing the Maintenance of Nuclear Operations – Commonwealth Fusion Systems

Content Guidelines for LGO Internship Projects in the Department of Operations Research Center

This document outlines the guidelines for engineering content in the department of Operations Research Center. The goal is to identify the projects for which the students may interview and limit their rankings to those that match the appropriate content for their majors.

Operations Research Center [Research Areas](#):
- approximation algorithms
- discrete, continuous, convex, robust, stochastic optimization
- ground and air transportation
- health care
- health care analytics
- machine learning and its interface with optimization
- online algorithms
- personalized medicine
- pricing and revenue management
- social networks
- stochastic modeling
- supply chain management

Projects that are NOT suitable for ORC:
- Projects with limited complexity that require only basic modeling or analysis (e.g., using only Excel)

Past Projects Examples with good ORC content:
- Optimizing Inbound Freight Mode Decisions - Nike
- Improving Prior Knowledge Assessment in Process Characterization - Amgen
- Dynamic Supply-Demand Allocation – Nike
- E-Commerce data integration in distribution – Inditex (Zara)
- Adaptive Learning for Prospective Patient Engagement and Content Targeting - ResMed