

How to prosper in the industrial and systems engineering graduate program

When you arrive, the department chair or the graduate program director will serve as your initial advisor. Your initial advisor will evaluate your background to determine whether or not you need to take supplemental courses. Expertise in statistics and state-of-the-art computer programming is required to do well in the program. If you have not taken complete courses in these two subjects, you will be required to take courses here. If you have taken courses, but your initial advisor is not convinced that you have the necessary expertise, you will be required to take competency tests to determine whether or not you need to take supplemental courses.

Your initial advisor will also help you choose courses for your first semester, and introduce you to the interests of the faculty and the courses that are available. If you are a transfer student, your initial advisor may give a preliminary decision about graduate credit for courses you have taken elsewhere, but the final decision will be made later. If you wish to take courses outside the ISYE department, they must be approved in advance.

There are three possible tracks for the degree. Each begins with a program of courses and culminates with a synthesizing experience, called a capstone. There are three types of capstone experiences – a scholar's paper, a project and a thesis. These are explained later in this handbook. For each of the three tracks, your graduate career will consist of three parts – a beginning, a middle, and an end.

The beginning should last about one and a half semesters. During this period, you should become acquainted with the department faculty, the fundamental areas of industrial engineering, and your fellow students. You can do this by attending seminars, socializing with fellow graduate students, and doing exploratory reading. You should also learn as much as you can about the processes of creating and synthesizing knowledge. You are required to take a one-hour graduate seminar course during this period. This course will show you how to develop ideas, find a focused area of interest, and prepare an organized summary and evaluation of a body of knowledge. If you are an international student, you may also be required to take an English course.

At the end of this initial period, you should have a clear notion of what you are most interested in and you should have paired with a faculty member who will serve as your academic advisor for the rest of your time here. You are required to submit a form to the department identifying your academic advisor

In the middle part of your graduate career, your job is to learn as much as you can about your area of interest. Most of your courses should be directly related to it, or support it in some way. If you take courses outside the department, or wish to transfer courses from another university, your academic advisor will decide whether or not they are relevant and can be included in your program. Approval of a course taken at NIU outside the ISYE department must occur before you enroll in the course.

The middle part of your stay here should terminate with a plan for completing your capstone experience. This plan must be developed with your faculty advisor and formally approved. You must complete an approval form and submit it to the department. The approval process varies for the three possible capstone experiences, and is explained later in this handbook.

The final part of your stay here is doing your capstone experience, with the help of your academic advisor and other faculty members. The procedures for the three different kinds of capstones are given in the rest of this handbook.

Thesis Research

Objectives of Thesis Research

The purpose of a master's thesis is to train the graduate student, under the guidance of a faculty adviser, to conduct independent research. The responsibility for generating the topic of research, performing the work, writing the thesis and defending it is that of the student. The role of the adviser is to suggest ideas, guide, motivate and support the student, evaluate the work and correct errors. A certain degree of originality and significance of contribution are necessary requirements of a master's thesis.

Typical Thesis Objectives

- Predict the performance of a system under given controllable factors and environmental conditions, for example, to investigate the effect of the location or design of a computer keyboard on the likelihood that the operator will develop "carpal tunnel syndrome."
- Optimize the performance of a system, as measured by one or more criteria, by determining the appropriate values of controllable factors; for example, to determine the cutting conditions of a certain tool-part combination that will strike a balance between minimizing surface roughness and maximizing tool life.
- Design a system that will perform one or more functions under given conditions, for example, a protocol for a distributive control system of a computer-integrated manufacturing cell, or an algorithm for scheduling a set of jobs on multiple machines.
- Design a methodology or algorithm for solving a problem which has a broad range of industrial and systems engineering applications, for instance, application of parallel computation to solve the traveling salesman problem.
- Evaluate alternative system designs, methodologies or algorithms.
- Establish theorems or theories which expand the body of knowledge in industrial and systems engineering and furnish a basis for the development of methodologies or algorithms.

Components of a thesis

- A clear statement of the objectives of research and its scope, and a precise definition of the criteria for measuring the attainment of these objectives.
- The background of the problem tackled and a justification of the need for the proposed research.

- A survey of the literature on the subject.
- A description of the model used, with clear definitions of the variables and their notation, and an explanation of the relationships among these variables. Any theoretical analysis of the model must be clearly presented.
- If experimentation is called for, the following elements must be clearly explained: design of experiments, analysis of results, and interpretation. Complete description of experimental conditions and accurate recording and reporting of observations is of prime importance.
- Conclusions and recommendations which establish that a contribution has been made.
- Acknowledgment of the contributions of others.
- Complete citations of referenced material.
- Any appendices or exhibits. Lengthy tables or theorem proofs may be best included in an appendix to not interrupt the flow of presentation in the text.

Characteristics of a good thesis

- It represents an original contribution to the field of industrial and systems engineering. The key here is originality and applicability to industrial and systems engineering problems.
- It differentiates between what is common knowledge, what is quoted from other authors, and what is contributed by the researcher.

Thesis Research Guidelines

- A student must select a thesis adviser as soon as possible and decide on an area of research for the thesis. The student must also register for the appropriate number of credit hours for the thesis, ISYE 699A, in the semester(s) during which work on the thesis is in progress.
- After deciding on a particular research topic, the student must prepare a formal thesis proposal detailing the research problem to be solved, the proposed approach, and the potential contributions of the research. The proposal must also include a list of tasks and the corresponding estimated completion dates. The student must review the existing literature thoroughly on the chosen research area before preparing the proposal. The proposal must be submitted to the thesis adviser for initial approval.
- After the thesis adviser has approved the proposal, the student must form a thesis committee consisting of the thesis adviser and at least two other faculty members with expertise related to the thesis topic. A majority of the committee members should be from the Department of Industrial and Systems Engineering. A majority must also be members of the graduate faculty.
- The student must submit the proposal to the committee members and present it in a meeting of the committee for formal approval. The thesis proposal along with the cover sheet containing the approval of the committee members must be submitted to the department. The fully approved proposal will stand as an official contract between the student and the thesis committee, and will help the student avoid having to make drastic changes after the thesis has been completed. If a need arises for a major change in thesis direction, the student must prepare a new proposal to be subject to the same process of approval. **The proposal must be presented and approved no later than the end of the semester preceding the semester in which the student plans to complete the thesis.**
- While working on the thesis, the student must regularly schedule appointments with the thesis adviser and report the progress of the thesis. If the student encounters any major hurdles to the research while working on the thesis, he/she must request a meeting of the committee members and discuss the possible remedies to overcome the hurdles. Any changes made to the previously approved proposal must be amended and approved by the committee.
- After completing the written report of the thesis, the student must obtain an initial approval of the report from the thesis adviser. Then the student must make copies of the report and distribute them to the committee members. **The committee members must be given at least two weeks to read the report.** The student is also

required to follow the thesis format requirements of the Graduate School.

- **To graduate in a particular semester, the student must schedule the thesis defense at least two weeks before the deadline for submission to the Graduate School in that semester.** This will give the student adequate time to make the necessary changes suggested during the defense and resubmit the thesis to the committee members for final approval.
- During the thesis defense, the student will be asked to give a presentation on the thesis research. The student will then be questioned on the work. After this, the thesis committee will evaluate the work in a closed meeting and decide whether to approve the thesis or require any changes or additional work.
- After the student has implemented the suggested changes, if any, and resubmitted the thesis to the committee for final approval, the committee will decide on a satisfactory/unsatisfactory grade for the thesis. If it is found to be satisfactory, the student must submit the thesis to the Graduate School, according to procedures established by the Graduate School.
- If the student wishes to replace either the thesis advisor or a member of the thesis committee, the student must submit a formal petition to the committee stating the reasons for requesting the change and how it will help the student's progress. The petition, along with the recommendations of the existing and proposed committees, must be submitted to the department chair for final decision. Any change in the adviser or the committee must not violate the professional rights of the former adviser, members of the committee, or the student.

Graduate Project

Objectives of Graduate Project Work

A student who chooses the graduate project (non-thesis) option of the program leading to the degree of Master of Science with a major in industrial and systems engineering must complete three hours of project work under ISYE 699B, Graduate Project, with a grade of satisfactory.

The purpose of the graduate project is to train the graduate student, under a faculty adviser, to conduct independent study aimed to solve a real engineering or management system problem with the application of industrial and systems engineering principles, concepts and techniques.

The responsibility for identifying the problem, formulating it, collecting data, choosing the appropriate model and technique, solving the problem, reporting it and presenting it is that of the student. The role of the adviser is to suggest ideas, guide, motivate and support the student.

Emphasis in conducting a graduate project is placed on the application of industrial and systems engineering concepts and techniques to the solution of contemporary real world problems.

Typical Project Objectives

- Design a system that meets given functional, physical, environmental, performance and cost requirements; for example, a manufacturing cell for the production of specified parts, in given quantities, at predefined quality levels.
- Evaluate alternative proposals for the design of a system; for example, alternative plant layouts for a manufacturing line.
- Evaluate the impact of proposed changes in an existing system; for example, investigate the effect on a manufacturing system of converting from production to stock to just-in-time production.
- Create a tool for the analysis, planning or control of system operation; for example, a software for scheduling jobs on machines.

Components of a project report

- A clear statement of the objectives of the project and its scope.
- A description of the system investigated and the background of the problem addressed, and a formal statement of the problem.
- A survey of the literature related to the type of problem addressed.
- A description of the procedure followed in solving the problem.
- Explanation of the data collection procedure. If experimentation is called for, the following elements must be clearly explained: design of experiments, analysis of results,

and interpretation. Complete description of experimental conditions and accurate recording and reporting of observations is of prime importance.

- Conclusions and recommendations
- References
- Any appendices or exhibits. Lengthy tables or attachments may be best included in an appendix to not interrupt the flow of presentation in the text.

Characteristics of a good project

- It addresses a meaningful and significant real world problem, the solution of which requires the tools and techniques of industrial and systems engineering learned at the graduate level.
- It follows a rigorous, systematic procedure with verifiable documentation. Originality in applying industrial and systems engineering concepts and techniques is an added merit.
- It presents sound conclusions and realistic recommendations that can be applied in practice.

Project Guidelines

- A student must select a graduate project adviser as soon as possible and decide on a problem area for the project. The student must also register for the appropriate number of credit hours for the graduate project, ISYE 699B, in the semester(s) during which work on the project is in progress.
- The student must identify, with the help of the adviser, an appropriate problem for the project. The problem may be one that exists in a manufacturing, service, government or any kind of organization. After gathering some initial data, the student must submit a brief pre-proposal to the adviser which contains a tentative problem definition, the objectives of the project, and the anticipated benefits.
- Upon agreement with the adviser about the project idea the student must collect further data and submit a formal proposal to the adviser which contains the objectives and scope of the project, the approach and procedure to be followed with a time table of the activities involved, anticipated deliverables, and estimated costs and benefits to the organization.
- After the project adviser has approved the proposal, the student must form a project committee consisting of the project adviser and at least two other faculty members with expertise related to the project topic. A majority of the committee members should be from the Department of Industrial and Systems Engineering. The project proposal along with the cover sheet containing the approval of the committee members must be submitted to the department. The fully approved proposal will stand as an official contract between the student and the project committee, and will help the student avoid having to make drastic changes after the project has been completed. If a need arises for a major change in project direction, the student must prepare a new proposal to be subject to the same process of approval.
- While working on the project, the student must regularly schedule appointments with the project adviser and report the progress of the project. If the student encounters any major hurdles while working on the project, he/she must discuss the possible remedies to overcome the hurdles with the adviser. Any changes made to the previously approved proposal must be amended and approved by the adviser.
- After completing work on the project, the student must submit to the adviser a final draft of the report which contains the components listed above.
- The advisor's approval of the final report should be at least three weeks before the final examination week. After securing the adviser's approval of the final report, the student must schedule a **public** presentation of the project in the presence of the project committee. **To graduate in a particular semester, the student must schedule**

this presentation no later than the week proceeding the final examination week.

- The student must submit one copy of the final project report to the adviser and one to the department office.

Graduate Paper

Objectives of the Graduate Paper

The purpose of the graduate paper is to investigate and integrate an area of industrial and systems engineering, with the guidance of a faculty adviser. The responsibility for identifying the topic, researching it, collecting literature, reporting it and presenting it is that of the student. The role of the adviser is to suggest ideas, guide, motivate and support the student.

A student who chooses the graduate paper (non-thesis) option of the program leading to the degree of Master of Science with a major in industrial and systems engineering must prepare and submit a scholarly report in the form of a journal paper. The student will register for ISYE 698 (1-3 semester hours) to meet this requirement.

Typical Graduate Paper

A detailed overview of a specific topic within the field of industrial and systems engineering. The goal is comprehensive coverage of current knowledge in a prescribed domain. This could be, for example, a new framework in which to understand and evaluate the subject matter; original comparisons between different sources or methods; focus on new key ideas or concepts. The paper cannot be simply a transcription of course notes or a summary of several articles or books. The paper should be written in the style of a typical Industrial and Systems Engineering journal paper or review article.

Graduate Paper Guidelines

- The student must determine a topic and graduate paper adviser as soon as possible. Upon agreement with the adviser about the topic, the student must collect further data and/or literature and submit a formal proposal to the adviser that contains the objectives and scope of the paper and a plan for completion.
- While working on the project, the student must regularly schedule appointments with the paper adviser and report the progress. If the student encounters any major hurdles while working on the paper, he/she must discuss the possible remedies to overcome the hurdles with the adviser.
- The student must register for the appropriate number of credit hours for the master's paper, ISYE 698, in the semester during which the paper is completed.
- The advisor's approval of the final report should be at least three weeks before the final examination week.
- The student must submit one copy of the final paper report to the adviser and one to the department office.

IMPORTANT THINGS TO REMEMBER

- **All supplemental courses must be taken as soon as possible. You will not be allowed to begin your capstone project before you have completed them.**
- **You will not be allowed to begin your capstone project before you have completed the graduate seminar.**
- **You must request credit for transfer credit by filling out the appropriate form. Your academic advisor will decide whether or not the credit can be granted.**
- **You must request credit for non-ISYE courses in advance by filling out the appropriate form. Your academic advisor will decide whether or not the credit can be granted.**
- **Before you have completed 18 hours of graduate credit, you must find an academic advisor and notify the department using the appropriate form. If you change advisors, this form must be resubmitted.**
- **The deadlines for completing the stages in the production of a thesis or project will be strictly enforced. No exceptions will be made.**
- **Your academic advisor is the ultimate authority for the approval or disapproval of transfer courses and non-ISYE courses.**