

DEPARTMENT OF MECHANICAL ENGINEERING **SYSTEMS ENGINEERING CERTIFICATE PROGRAM**



Systems Engineering Info Session
August 11, 2021 – 3:00 PM

Why it Matters

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- The median annual salary of **Systems Engineers** is **\$89,000** with a 10% job growth projected from 2019 to 2029 – much faster than average!
 - **Mechanical Engineers**: \$90,160/year and 4% growth – about average.
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- We know what Mechanical Engineers build to make a good salary, but what do **Systems Engineers** produce that is so important to make a salary?



Systems Engineers make nothing!

*Well, kind of.
Let us explain...*

- Systems Engineers don't make the products you enjoy.
We make the products you enjoy better.
 - Faster, cheaper, etc.

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- The **primary goal** of Systems Engineering:

*Improve the productivity of **individuals** and **organizations**.*

- The **core beliefs** of Systems Engineering:

- The world is composed of systems;
- Most systems are inefficient;
- SEs have the tools to improve the system;
- However, the benefit of improving the system may not be worth the effort required to do so.

Mathematical Decision Making

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What happens to a small store if it has **zero inventory**?

VS.



What happens to a small store if it has **50 million units of inventory**?

What is the conclusion here?


The SE Transformation System

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BACK TO THE BASICS

- What is a **system**?
 - A combination of elements that function together to produce the capability required to meet a need.
- Then, what is **Systems Engineering**?
 - (...) a methodical, multi-disciplinary approach for the design, realization, technical management, operations, and retirement of a system.

AS DEFINED BY
OUR FRIENDS AT 

Areas of Systems Engineering

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INDIVIDUALS

- Management teaches how to lead and motivate people.
- Ergonomics studies how people work in their environment.

DATA ANALYSIS

- Statistically analyzing data to develop quality standards and how to measure and monitor these standards.
- Informed decision making – a critical skill for ALL engineers!



Areas of Systems Engineering

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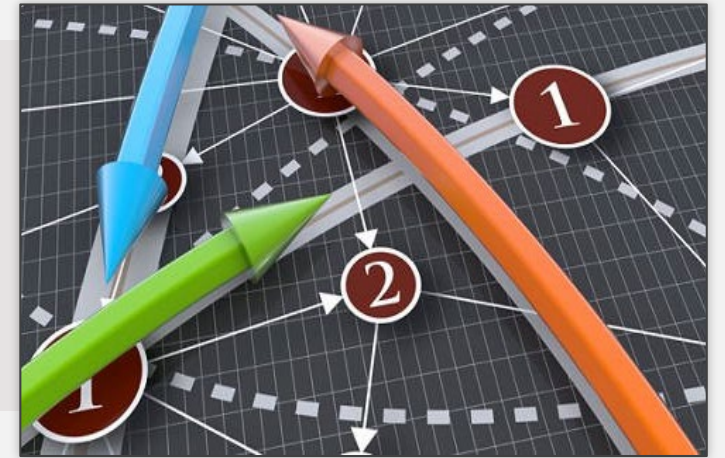


SERVICE AND MANUFACTURING

- How can one supply the customer with a better quality of service?
- How can parts be manufactured faster and cheaper?

OPERATIONS RESEARCH

- Using computers and other tools to find optimal solutions to common operational and strategic problems:
Inventory, vehicle routing, scheduling, finance, oil/gas, energy, etc...



Benefits of Systems Engineering

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- 1 Use tools on a variety of problems.
 - Really, anywhere!
Examples...
- 2 Minimal lab time.
- 3 Most problems have layman's descriptions.
- 4 Over half of all Systems Engineering degrees given in the US are at the graduate level.
- 5 Work with people;
You must be able to convince them!





Courses Now Available

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- **ME EN 5960/6960-006** – Fundamentals of Systems Engineering
- **ME EN 5960/6960-007** – Systems Engineering and Integration
- **ME EN 5960/6960-008** – Production Systems and Operations
- **ME EN 5960/6960-009** – Systems Simulation
- All courses have an online section (030-033)

- **PROGRAM LEADERSHIP**



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New F21 Course: Systems Simulation

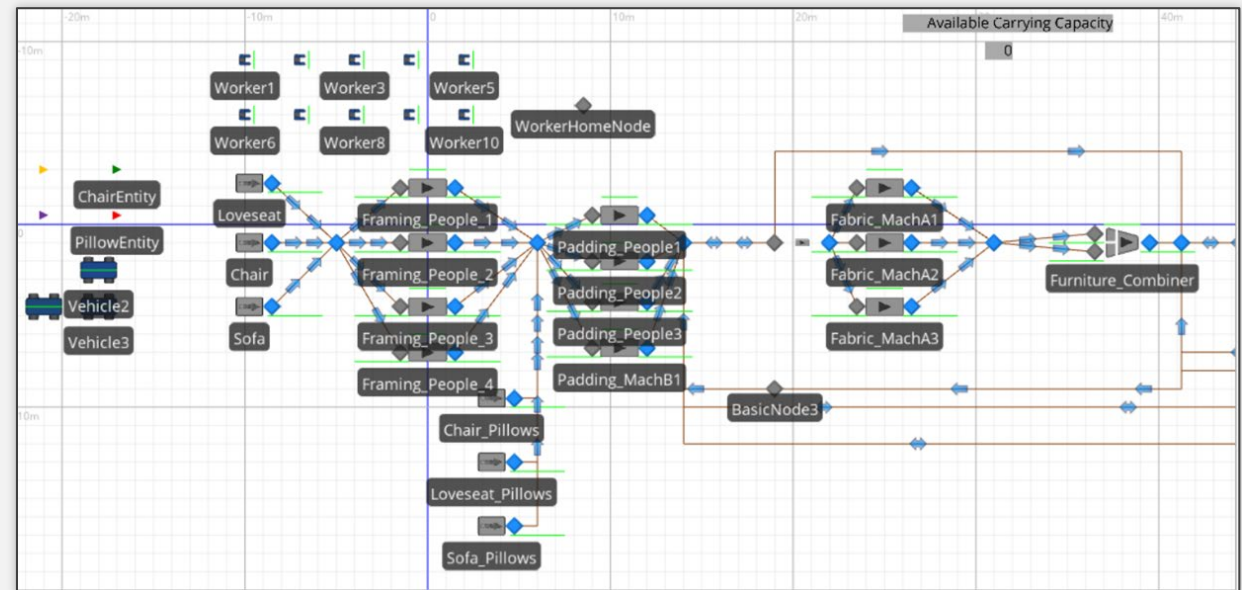
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- Build a system/factory on a computer – the computer uses random events to mimic the performance of the system.
- Move employee and other resources around to improve production or increase profit.

NOW AVAILABLE!

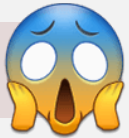
- **Fall 2021** | Open for enrollment as:

ME EN 6960-009 (graduate)
ME EN 5960-009 (undergrad elective)
ME EN 6960-033 (special, distance)



New F21 Course: Production Systems and Operations

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- Develop a **fundamental understanding** of the design process of facilities and logistics networks with emphasis on economic justification, *i.e.*, better **resource utilization** (time, materials, people, money).
- Uncertain demand, limited resource availability, varying cost structures...
 - Variability is **everywhere!** 
 - How can we identify, formulate, and solve problems to mitigate the negative impacts of variability in production and service systems?
- We talk about:
 - Capacity Planning
 - Facility Layout
 - Assembly Line Balancing
 - Facility Location
 - Logistics and Freight Transportation

NOW AVAILABLE!

- **Fall 2021** | Open for enrollment as:

- ME EN 6960-008 (graduate)
- ME EN 5960-008 (undergrad elective)
- ME EN 6960-032 (special, distance)



- WHAT

- A **graduate certificate program** to provide engineers with the knowledge and skills to design and manage complex mechanical and organizational systems.
- Students learn to develop both general system performance **requirements** and quantitative system **metrics** for the management and evaluation of systems.

- WHEN

- Right now!
- Core courses offered regularly during academic semesters and summers, according to demand.



- Upon completing the certificate program, participants will be able to:
 - Apply systems thinking to optimize product design and development
 - Develop innovative approaches for systems design and integration
 - Define cost-effective verification and validation programs
 - Effectively manage cost, schedule, and risk in engineering tasks
-
- **Interested?** The program is open to all CoE graduate students and working professional engineers!
 - BS degree in engineering-related field is required.
 - Can be completed as a non-degree seeking/non-matriculated student.
 - Must fill out a *Program Declaration Form*.
Available on the ME website – <https://mech.utah.edu>

Certificate Requirements

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- 15 credits total:
 - 3 core courses
 - 6 elective hours } minimum **B-** grade
- 3.0 GPA or higher
- Completion of a final project
Part of the *Systems Engineering and Integration* course (see below)

NOTE

Substitutions are possible
for this year only!

See Joy Velarde
to discuss your options

CORE COURSES

Fundamentals of Systems Engineering

- An overview of the science of systems engineering, and an introduction to the systems approach and methodological framework for creation and re-engineering of large-scale systems and processes.

Fall 2021 | ME EN 6960-006

Requirements Engineering & Management

- Covers principles, practices, knowledge, and skills to develop, organize, and distribute systems requirements.
- Analysis of correctness, completeness, consistency, measurability, testability, and clarity of documentation.

Spring 2022

Systems Engineering and Integration

- Systems design/development, test and evaluation, reliability, maintainability, human factors, balancing life-cycle cost, schedule, suitability and performance, risk management, and systems engineering project management and control.

Fall 2021 | ME EN 6960-007

Elective Courses: *Pick Two*

MINIMUM 6 CREDITS TOTAL

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- CVEEN6750 - Engineering Law & Contracts (3)
- CVEEN6730 - Project Management and Contract Administration (3)
- ECON6360 - The Economics of Market Power and Antitrust Law (3)
- ME EN5000 - Engineering Law and Contracts (3)
- ME EN6010 - Principles of Manufacturing Processes (3)
- ME EN6030 - Reliability Engineering (3)
- ME EN6035 - Design of Experiments (3)
- ME EN6100 - Ergonomics (3)
- ME EN7110 - System Safety (3)
- ME EN6210 - State Space Control (3)
- ME EN6810 - Thermal System Design (3)
- ME EN7200 - Nonlinear Controls (3)
- ME EN7210 - Optimal Controls (3)
- ME EN7220 - System Identification for Robotics (3)
- MET E5690 - Process Engineering Statistics (2)
- MST6022 - Production and Operations Management for Scientists (1)
- CMP6371 - Complexity and Systems Thinking (3)
- CH EN6205 - Smart Systems (3)
- **ME EN 6960-009** - Systems Simulation
- **ME EN 6960-008** - Production Systems and Operations

KEEP IN MIND

The “pick two” rule of thumb will not work with courses that award less than 3 credit hours.

RECEIVING THE CERTIFICATE

- Submit a **Certificate Completion Notification Form** on your last semester.
- The graduation office will mail your certificate in the mail.
- The certificate can be awarded on its own or at the same time as an MS or PhD degree.

Certificate vs. Certification

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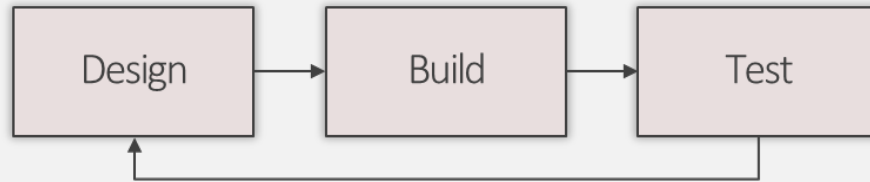
- A graduate certificate is a piece of paper indicating you took courses in a specific area and could be considered an “expert” or “specialist”
 - It is not a license or a professional board certification
- The **Fundamentals of Systems Engineering** course presents a good overview of what is part of a certification offered by INCOSE – International Council on Systems Engineering.
 - Must pass a knowledge exam!
- For more info and certification opportunities, visit:
<https://www.incose.org>



Wrapping Up

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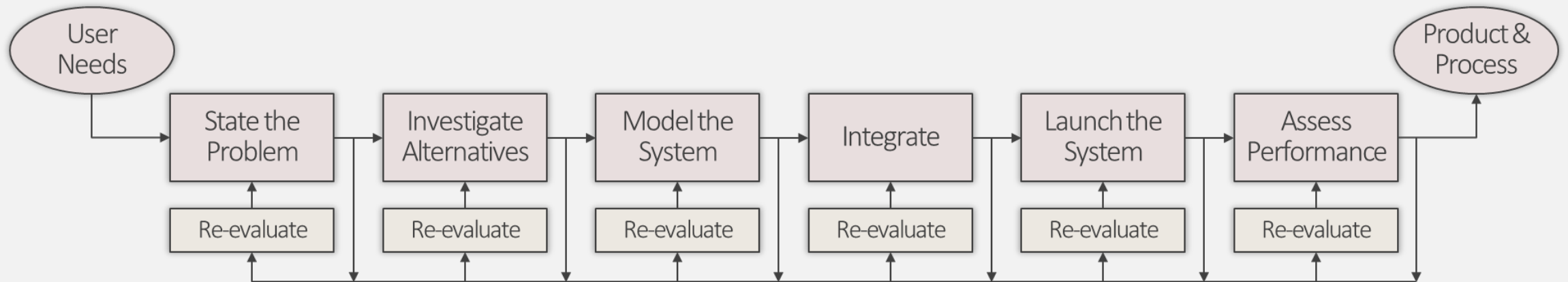
- The historical **trial and error** model:



This is where you are...

- The **Systems Engineering** approach:

This is where you can get!



Thank you!

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- What are your **questions**?
- Contact us:
 - Todd Easton
Associate Professor
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 - Pedro Huebner
Assistant Professor
pedro.huebner@utah.edu
 - Joy Velarde
Outreach and Recruitment Coordinator
joy.velarde@utah.edu



DEPARTMENT OF MECHANICAL ENGINEERING

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Are You a Full-time Engineer Interested in Online Classes?

- No application necessary to enroll
- Register through **continuing education** up until classes start
- \$2500 per course (potential for tuition reimbursement through employer)
- Receive **graduate credit**
- Can complete the certificate without ever applying
- Want to get an **MS degree**? Apply to the Master's program prior to taking your 4th class because only 3 classes taken non-matriculated can count
- 'B' or better required for non-matriculated classes for MS degree



Are You a Full-time Engineer Interested in Online Classes?

- In addition to the **Systems Engineering** courses, 2-3 additional courses offered online each semester based on demand.
- Also available in the **Fall**:
 - ME EN 6130 - Design Implications for Human-Machine Systems
 - ME EN 6150 - Object Oriented Programming for Engineers
- See Joy Velarde (joy.velarde@utah.edu) for more info and registration links.

