E10
Introduction to Engineering

Industrial and Systems Engineering

Dr. Minnie Patel
Department of Industrial and Systems Engineering
www.engr.sjsu.edu/ise/

Industrial & Systems Engineering
An Introduction via Examples

- What is Industrial Engineering (IE)?
- What is Systems Engineering (SE)?
- An Early and Modern Example about Manufacturing: Car Assembly
- A Modern Example about the Service Industry: Disneyland
- A Modern Example about the truck manufacturing company
- ISE and ISE Curriculum at SJSU
- Current Multidisciplinary Research into Efficient and Safer Large-truck Freight Operations

What is Industrial Engineering?

- Electrical Engineering – to engineer an electrical product or system.
- Computer Engineering – to engineer a computer or a system of networked computers.
- Industrial Engineering?
  - To engineer an industry?? No.
  - To engineer an industrial product or system (efficiently and effectively): for manufactured goods or services, originally
  - To engineer a product or system for industry, the military, government, education, etc.
  - **Efficiency** and **Quality** Engineering!!

What is Systems Engineering?

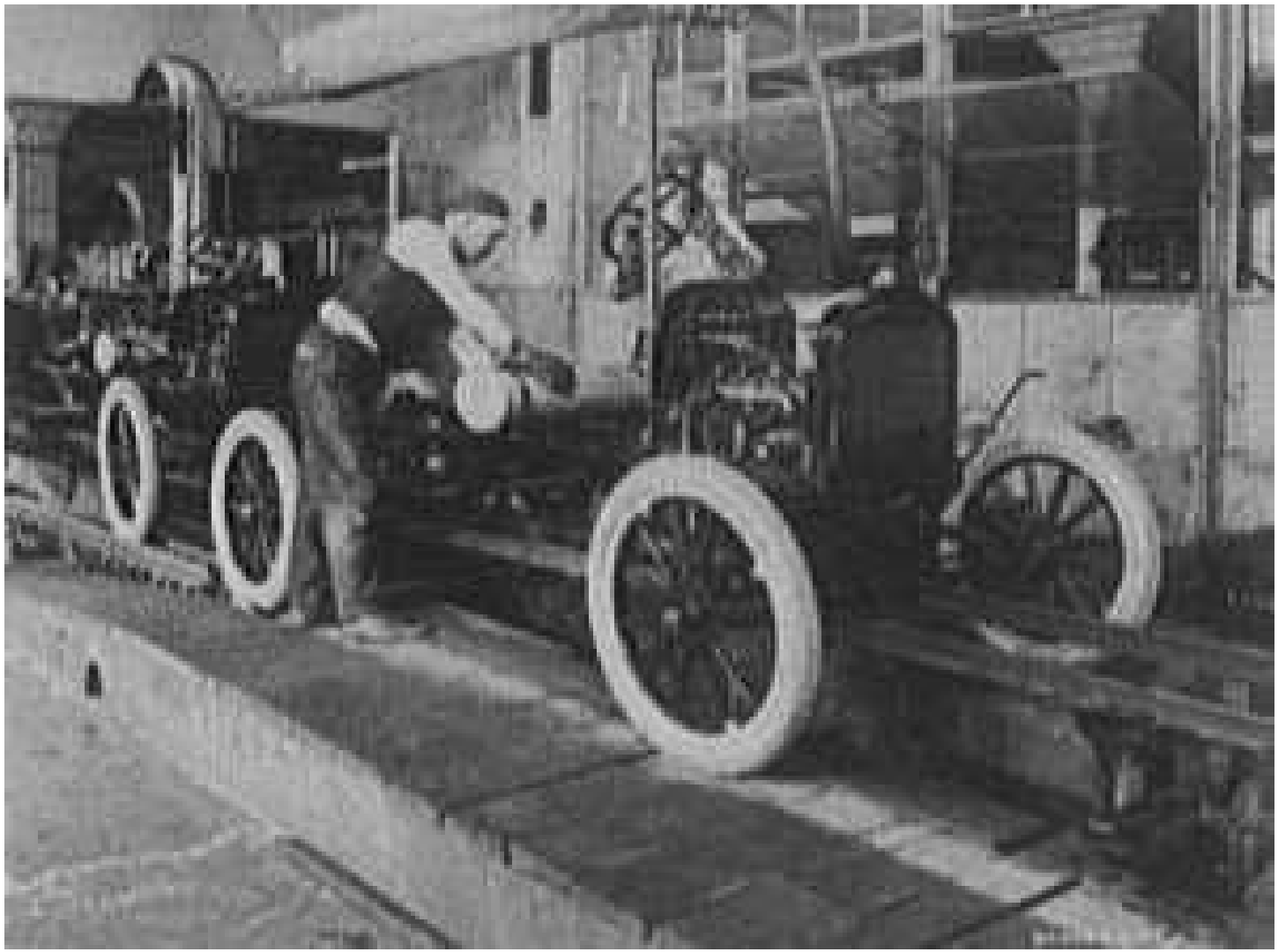
- To engineer a system, with efficiency and quality
- All Types of Systems:
  - Aviation Systems, including Air Traffic Control Systems
  - Telecommunication and Computer Systems
  - Airline Reservation Systems
  - Software and Database systems
  - Highway Systems
  - Manufacturing Systems, e.g., the Toyota Production System (TPS)
  - …..

An Early and Modern Example about Manufacturing:

Car Assembly

- The original “work cell” assembly method
- Henry Ford’s idea of assembly line, following the efficiency innovations in cattle slaughtering
- Many innovations for higher efficiency and better quality, including robotics
- The Toyota Production System (TPS), practiced at The New United Motor Manufacturing Incorporated (NUMMI) in Fremont, California (and elsewhere)

Early Moving Assembly Line at Ford



A Glimpse of a Car Assembly Line

Robots at Work in Car Assembly

Robots at Work in Car Assembly

A Modern Car “Assembly Line” VW Phaeton in Dresden

A Modern Example about the Service Industry: Disneyland

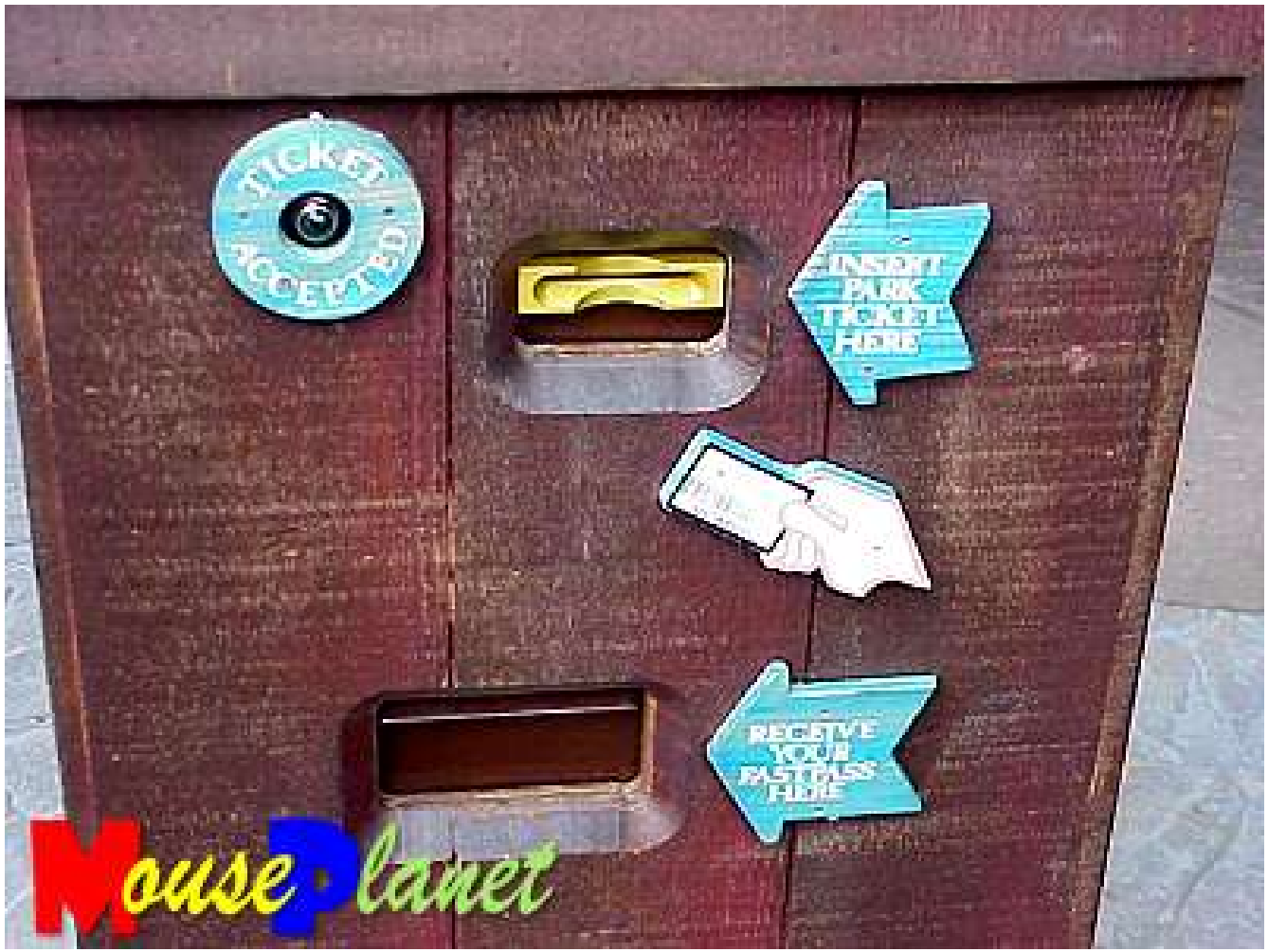
- Simple “Take-a-Number” virtual waiting lines at a hospital, to avoid patience discomfort or enable rest
- The recent implementation of “Take-a-Number” virtual lines at California’s DMVs and recent acceptance of appointments via the Internet
- Why can’t Disneyland use this simple idea? What may be the unintended consequences?

A Modern Example about the Service Industry: Disneyland (Cont'd)

- Disneyland first estimated wait time for the customers and displayed it at each attraction.
- Disneyland then displayed the estimated wait times at the entrance and other strategic locations, for better planning by the customers.
- Disneyland recently implemented its version of the "Take-a-Number" system: the "FastPass".
- Better customer satisfaction, and higher revenue too, at the restaurants and gift shops, etc.!

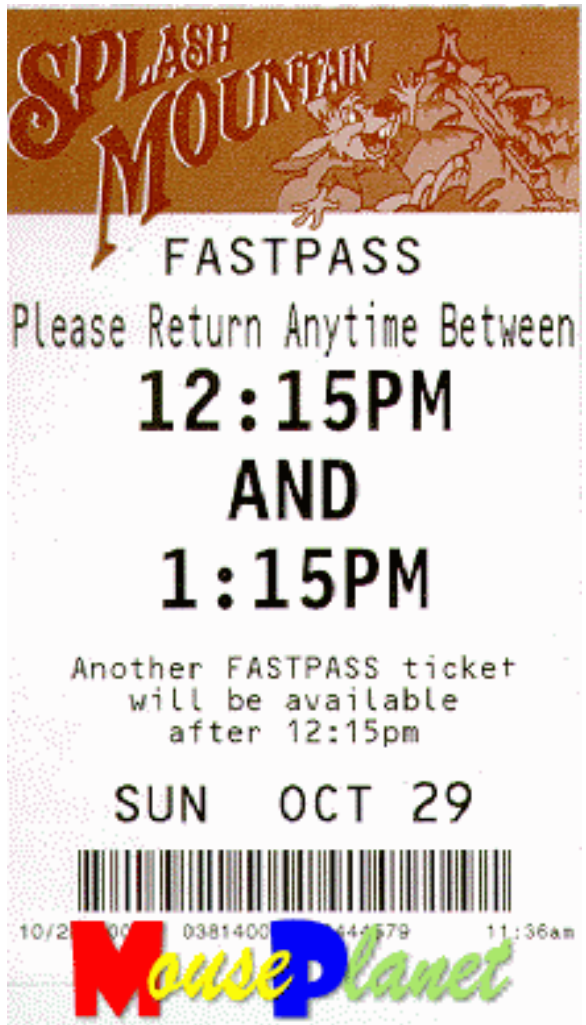
FastPass
Disneyland – Splash Mountain

FastPass Machine
Disneyland – Splash Mountain



FastPass Ticket

Disneyland – Splash Mountain



A Leading Truck Manufacturing Plant in U.S.

- **Goal:** Double the amount of truck they manufactured in a day, by optimizing their resources while maintaining excellence in quality
- One of the objectives of the study was
  - To know the precise amount of time spent on non value adding tasks at each truck assembly station, in order to optimize their operation
- Required to evaluate 70 assembly workers

Beyond the Stopwatch

- Work measurement studies often use stop watches to collect task times
- Difficulty
  - Hold the stopwatch and write the information at the same time
  - The results are not accurate
  - Data collection not easy

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ion.


Change Tire
Close door
Install Spare
Get Jack
Install Nuts
Oh Change
Set Jack
Tighten Nuts
Jack-up Car
Lower Jack
Impact Wrench
Set Jack Aside
Delay
Remove Nuts
Park Car
Remove Tire
Obtain Spare

State-of-the-Art Software

- UmtPlus™: The highest quality work measurement tool that leverages handheld computers
- This software developed by Laubrass, facilitates and optimizes the data collection process
- Just need to click on the appropriate icon and your time is logged
- Easy to use
- Truck company customized to suit their needs

Results

- Two hours of training in using UmtPlus to collect the necessary data
- Evaluated 70 workers in just three days
- Once the tasks have been accurately timed on the PDA the results are uploaded to the computer without having to do any data entry
- Employees prefer to see the PDAs rather than a stop watch

Industrial & Systems Engineering

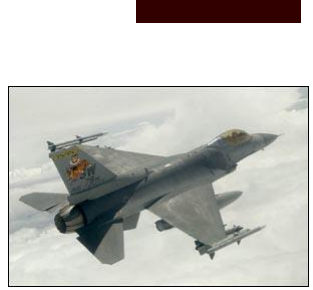
- ISE UG program ranked 3rd in the Nation according to US News
- Approx 55 Undergraduate students
- Very active IIE student chapter
- 165+ Graduate students (MS ISE [110] & MS Human Factors/Ergonomics [55])
- Current FTES 125, and approximately 60-65% graduate FTES
- 4 Full time faculty
  - **Dr. Dessouky → Undergraduate Advisor**
  - **Dr. Tsao → Grad Advisor**
  - **Dr. Freund → HF/E Program Director**
  - **Dr. Minnie Patel → Assessment**
- ISE Faculty experience in manufacturing, healthcare, civil aviation, transportation, supply chain engineering, biometrics, process control
- Research funding from NASA, PATH, MTI, NSF, IBM etc.
- Very good co-op and employment record

ISE empowers its students to better the world…

- ISE students learn how to:
  - improve quality of products and services
  - minimize costs
  - improve security
  - reduce risk of injury
  - minimize delays
  - improve accommodation for the disabled
  - improve quality of work life of employees
  - improve service to customers
  - reduce human errors
  - improve on-time performance

…through innovative applications in many types of organizations:

- Manufacturing
- Computers
- Semiconductors
- Biomedical Device
- Consulting
- Hospitals
- Restaurant chains
- Hotel chains
- Airlines and airports
- Government agencies
- Armed forces
- Worldwide distribution and delivery companies
- Entertainment companies and retail chains



Industrial & Systems Engineering

Management

Products,
Processes,
& Services

The Essential *Linking* Profession

What do ISE's do?

- Production planning and scheduling
- Inventory management
- Supplier reliability management
- Quality improvement
- Facility planning and layout
- Resource planning and scheduling
- Equipment selection
- Minimizing scrap and waste
- Optimization to minimize costs
- Line balancing
- Measure productivity
- Supply Chain Management
- Health Systems design
- Decision Science
- Quality engineering
- Operations research
- Simulation modeling
- Design methods and procedures
- Analyze operations
- Specify automation systems
- Ergonomics / Human Factors
- Work measurement

Where do ISE's work?

Manufacturing
Consulting
Hospitals
Restaurant chains
Hotel chains
Airlines, airports
Government
Armed Forces
Distribution
Entertainment Venues
Retail chains

What are some jobs that ISE's fill?

- Industrial Engineer
- Systems Engineer
- Management Engineer
- Quality Engineer
- Production Engineer
- Logistics Planner
- Supply Chain Manager
- Plant Manager
- VP Manufacturing
- Director of Planning
- Process Engineer
- Product Manager
- Manufacturing Engineer
- Management Consultant
- Ergonomist
- Human Factors Engineer
- Reliability Engineer
- Methods Engineer

Coordinator of Process Improvement
Director of Engineering

Find out more about how you can become an Essential Link!
Visit the SJSU ISE Department web site at: www.engr.sjsu.edu/ise
Watch the streaming video, and find out more about
Industrial and Systems Engineering in your future
or, contact the ISE Department at San Jose State University today: (408) 924-3301
or email to: ise@ email.sjsu.edu

San José State
UNIVERSITY

ISE Undergraduate Curriculum

Ranked 3rd in the USA* 2009-10

Enterprise Operations

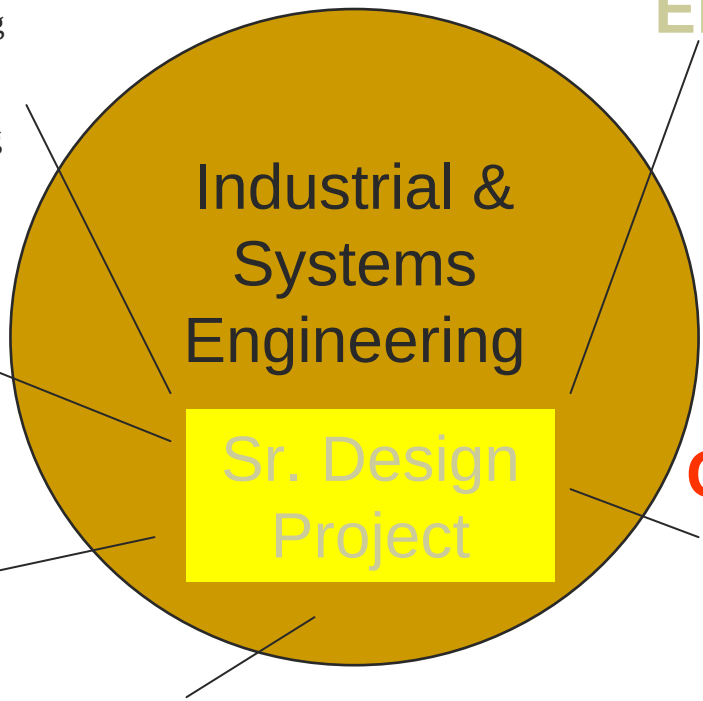
ISE 155 Supply Chain Engineering
ISE 140 Opns Plng & Control
ISE 142 Services Engineering
ISE 115 Computer Integrated Mfg

Eng. Breadth

Engr 10 Problem Solving
ME 20 Design & Graphics
CmpE 30
MatE 25 Intro to Materials
EE 98 Circuits
Cmp E 131 Software Engrg

Eng. Management

ISE 105 Intr Systems Engrg
ISE 102 Engrg Economics
ISE 151 Engrg Mgmt



Math Modeling

ISE 130 Statistics
ISE 167 Simulation
ISE 170 Operations Research

Quality Control

ISE 131 Quality Control
ISE 135 Design of Expts
ISE 196R Reliability

Human Component

ISE 112 Occ Hlth Engrg
ISE 114 Safety Engineering
ISE 120 Work Methods & Measurement
ISE 164 Human Computer Interaction

***U.S. NEWS among colleges and Universities without doctoral degrees.**

Multidisciplinary Research: Efficient and Safer Large-truck Operations

- Proven US oil reserve: 22 billion barrels
- Daily US consumption: 21 million barrels
- “Desperate” need for fuel efficiency
- Public transportation for passengers, but how about freight transportation?
- Longer Combination Vehicles (LCVs) for higher fuel efficiency: 5.4 MPG for a 40,000-lb “straight truck” and 4.6 MPG for a 140,000-lb “turnpike double”


Franz
The Good Breads
LONG LOAD
Snyder's
The Good Bread
Steve Johnson Collection

Efficient and Safer Large-truck Operations

- LCV for higher productivity: tractor utilization, driver utilization and speed of freight movement
- But, only 20 states allow such operations.
- California does not allow them. Why?
- Safety hazard and damage to roadway
- A major source: “off-tracking”
- Innovative concept: Automated Trailer Steering, for virtual elimination of off-tracking [Rangavajhula & Tsao]
- Multidisciplinary research: mechanical engineering, electrical engineering, electrical engineering, industrial engineering, economics, public policy, etc.

Industrial & Systems Engineering

- Questions?
- Comments? You are the customer, and the product too.