Industrial Engineering

Teacher Workshop
Jan 29, 2016

Otto

Born: Helsinki, Finland

Education: Hollyrood Elementary (Portland, OR)
ACCESS (Portland, OR)
Grant High School (Portland, OR)

Fun Fact: A college application criteria was NOT engineering

Aspirations: Engineer business ventures, create jobs

Admires: Innovative companies creatively disrupting the status quo business environment by utilizing IE principles.

Amanda

Born: Portland, OR

Education: Community Christian (Tualatin, O
Jesuit High School (Beav

Graduation: March 2016

Favorite Subject in Middle School: Math

Favorite Animal: Panda

Brandon

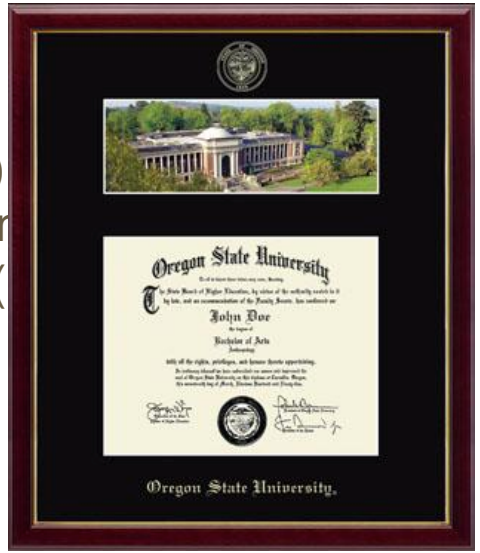
Born: Portland, OR

Education: Sexton Mountain (Beaverton, OR)
Highland Park (Beaverton
Southridge High School (

Graduation: March 2016

Original Major: Business

Interests: Sports, health & fitness, outdoors



What is Industrial Engineering?

Find out now!

-Where can we work? **Any place that involves a process**

-What do we do? **Optimize, reduce waste, analyze, etc.**

-What do we focus on? **Efficiency and quality**

-Why teach IE principles to middle and high school students?

Why Industrial Engineering?

Learn to model, manage, and optimize processes and systems by isolating and eliminating inefficiencies, while adding quality, productivity, and value

Trains the mind for systematic and complex problem solving utilizing an interdisciplinary skillset applicable to a range of industries

Provides understanding of business organizations and supply chains, preparing individuals for careers in operations management

Empowers one to improve the current state and impact the status quo!


Industrial Engineering
Finance, Banking, & Service Industry
Defense & Aerospace
Information Technology
Healthcare
Supply Chain
Education & Research
Management
Technical Sales & Marketing
Military & Homeland Security
Energy
Public Service
Manufacturing

Our Project

Task: Revise existing IME SMILE lessons and create a new module

-Simplicity for teachers (formatting, readability, etc.)

-Relate IE to real-world applications

End Product: Educational module with 4 lessons covering IME topics and kit to include all necessary materials

-Optimization

-Facility Design

-Just-in-time Manufacturing

-Standard Work

Main Objectives of Our Project

-Awareness of IE

-Connecting IE to real world applications (middle/high school)

-IE careers

Group Discussion Question

Get into groups of 2-3

-Compare “old” vs “new” lesson plan

-What do you like about the new lesson plan?

-What would you like to see changed?

-General comments

Discuss answers with table group and have one person report out

IME Lesson 1

Network Optimization

Levels:
Grades 6-12

NGSS:
Practices
- Planning / carrying out investigations
- Analyzing / interpreting data
- Constructing explanations / design solutions
- Engaging in argument from evidence
- Obtaining / evaluate / communicate

Crosscutting Concepts
- Patterns

Lesson Time:
Prep time - 15 minutes
Intro and Activity - 45 minutes

Objectives:
- Students will develop an understanding of what optimization is and how it is used in industrial engineering.
- Students will apply creative thinking to optimize a real world example.
- Students will understand what a network model is and how it can be used for optimizing cost.

Contact:
SMILE Program
Oregon State University
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Web: smile.oregonstate.edu

Description:
In this lesson, students will be introduced to the concept of optimization. Students will explore the benefits of the network model through a shortest path problem. Additionally, they will gain critical thinking skills by coming up with alternative answers and justifying their team's decisions.

Using This Lesson:
This lesson should be performed in groups of 2-4 students, depending on classroom size. Each group should also be given an adequate amount of workspace in order to collaborate effectively.

The background information in this lesson has been written so it can also be used as reading material for the students. However, the time for reading is not included in the lesson plan length. There is also an example problem for the teacher to reference to better understand the concepts.

The PowerPoint presentation provides background information. It should first be reviewed by the teacher and then presented to the students prior to starting the activity. The last slide of the PowerPoint includes the problem students will be solving and should be left up for them to reference during the activity.

The student *Wrap-Up Worksheet* should be administered to the students following the completion of the activity to promote the understanding of key ideas and assess the students' comprehension of the lesson objectives.

Activity Directions:
1. Hand out the empty network diagram (last page in the student handout) to have the students fill the network based on the travel options Anna has. This requires 5-10 minutes.
2. Ask a group or a student to share how they completed their network diagrams. Project their solution on a white board.
3. Ask students to calculate the cost and time of all possible routes the family can take using the network diagram. This required roughly 15 minutes.
4. Have each group present their best solution for saving the family money (do not discuss time at this point). Per the solution handout, the lowest cost option should be Portland->Las Vegas->Los Angeles.
5. Have each group present their best solution for saving the family time. Per the solution handout, the lowest time option should be Portland->Salt Lake City ->Los Angeles.
6. Once the routes for minimizing cost and time have been discussed, have the calculation for both of the routes up on the board and ask students which route is the best solution for the family

Activity Questions:
After the activity is completed, ask student the following questions to lead discussion and promote critical thinking.
1. How did the optimization network model help the family explore their travel options?
2. What things are you "optimizing" in this problem?
3. Are you maximizing or minimizing these things? Why?
4. Which route saves the family the most money?
5. Which route saves the family the most time? Is it a different route that saves the most money?
6. What are the differences between these two routes (cost vs. time solutions)?
7. What is the best solution (which option should the family choose)?

Materials:
- 1 Student handout per team
- 1 Calculator per team
- 1 Pencil per student

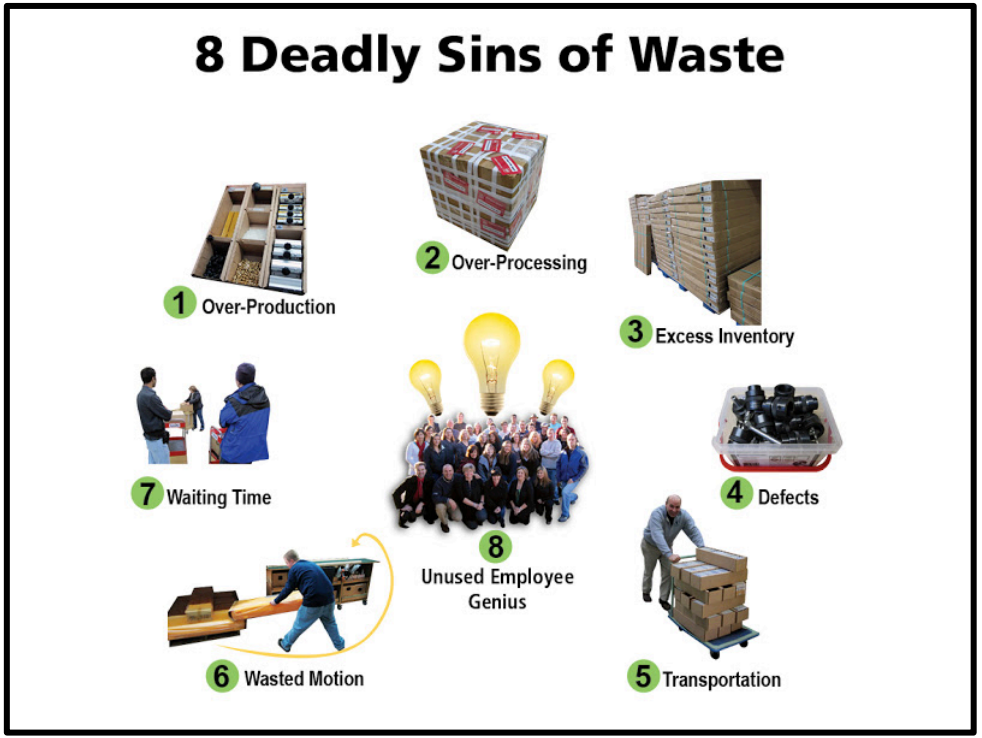
Elaborate:
More advanced students can solve more complicated problems with the network optimization model. The example problem included in this lesson is a good problem to use. The problem looks at distance instead of cost. It can be made more challenging by adding time to each route. Students should evaluate the following questions.
1. How many possible solutions are there?
2. How many optimal distance solutions are there?
3. Is one of these better than the other?
4. How do things change when a second variable (time) is introduced?
5. After introducing time, what is the optimal solution?
6. Realistically, what other variables would affect an engineer's decision in choosing a route?

Questionnaire

Activity

What is Lean Manufacturing?

Management philosophy that adds value by eliminating waste in a process -



Batch vs. One-Piece Flow

Batch Processing:

Completing multiple jobs before moving to the next process

One-Piece Flow:

Completing one job at a time

Finding a balance that fits for the company

WASTES: Over production, Excess WIP Inventory

Get into groups of 5!

Give everyone a number (1-5) and get in a line

Processing (1-3)

1: Take caps off the markers and place on the bottom

2: Spin in a circle and place the cap back on

3: Remove cap; Draw a circle with each marker on paper; Replace cap

4: *Quality Control* Remove cap; Draw a star next to the circle of the same color; Replace cap

5: *Shipping* Roll makers with paper and secure with rubber band

Rules

-Each round will be timed

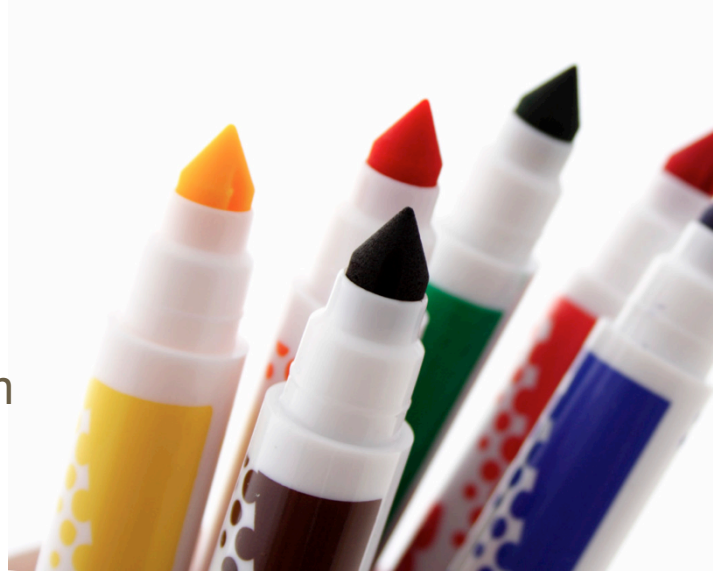
-Stand in numerical order (1-5)

-You cannot pass your markers to the next person if they still have markers

-You cannot set down the markers until they are ready to be “shipped”

Batch Processing

Tasks 1-5



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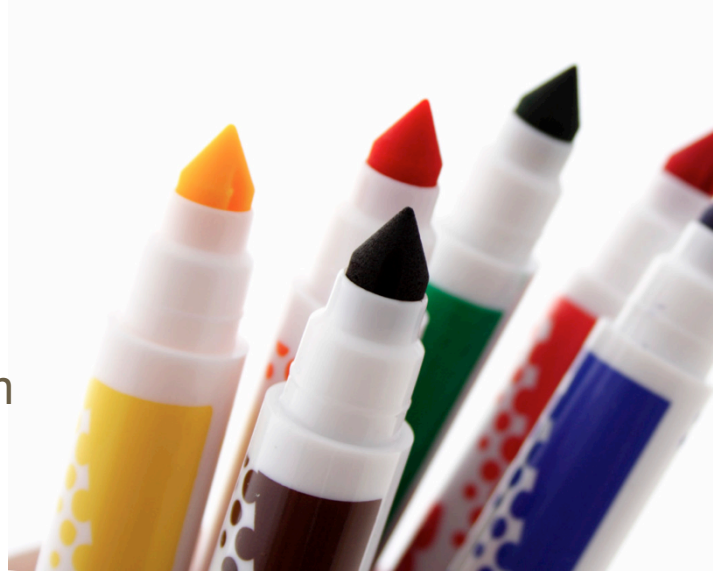
One-Piece Flow

Tasks 1-5



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End of Activity Discussion

-Did batch processing or one-piece flow work better?

-What kind of production would one-piece flow work better?

-What kind of production would batch processing work better?

Thank you!

These slides will be available on the SMILE website for your use.