

IE Awesome Mini Airplane Activity

Objectives

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- Develop an understanding of what cost management is and why and how it is used in industrial engineering.
- Understand the definition of cost management.
- Understand the difference between cost leadership and differentiation strategies
- Understand how to apply cost management techniques in a real world example.

Skill Level: This activity is targeted for middle school students with extension for high school students

Prep time: 15 Minutes
Class time: [45minutes]

Materials

- (1) Set of Legos
- (1) Pencil for each student
- (1) Activity sheet per team
- (1) Calculator per team

Standards

Disciplinary Core Idea:

ETS1.C: Optimizing Design Solutions

Performance Expectations:

MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Practices

- ☐ Asking questions / defining problems
- ☐ Developing / using models
- ☒ Planning / carrying out investigations
- ☒ Analyzing / interpreting data
- ☐ Math / computational thinking

Crosscutting Concepts

- ☒ Patterns
- ☐ Cause and effect: Mechanism / explanation
- ☐ Scale, proportion, and quantity
- ☐ Systems and system models
- ☐ Energy / matter: Flows, cycles, conservation

- ☒ Constructing explanations / design solutions
- ☒ Engaging in argument from evidence
- ☒ Obtaining / evaluate / communicate

- ☒ Structure and function
- ☒ Stability and change

Background Information

Introduction:

Industrial and Manufacturing is a field of engineering that determines the most effective ways to use the basic factors of production including people, machine, materials, money, and other resources in order to provide products or services. This activity will focus on money to demonstrate the concept of resource management to students. The method used by industrial engineers in order to save money for their organizations and find strategies to compete with competitors in the markets is cost management. Cost management is a process of effectively planning and controlling the manufacturing costs of businesses.

Background information:

There are two common techniques in cost management that industrial engineers use to gain an advantage over competitors in the market. The two business techniques are **cost leadership** and **differentiation**. **Cost leadership** is the business strategy of gaining a competitive advantage by having the lowest prices in the market. **Differentiation** is the technique of selling unique products that fulfill customers' needs but are hard for competitors to copy. However, this activity will focus only on cost leadership.

Differentiation

Apple is an excellent example of using a differentiation strategy. As we can see, all the Apple products are unique and attractive to customers. Apple uses their own operating system for their laptops, Macintosh, unlike other companies such as Dell or Sony which use Windows. Moreover, everything you purchase from Apple such as music from iTunes, or games from the Apple Store, can be used only with Apple products. By creating something unique, different and exclusive than the rest of the market, Apple has placed itself in an authority to sell products at higher prices due to high demand of their products.

Cost leadership

The supermarket industry is a good example of cost leadership. For example, Fred Meyer and Safeway always compete each other with food prices. As we can see they always have discounts for specific items. The reason is to attract customers and gain profits from that. However, it requires the company to consider their costs as well before they give the discounts. They need to ensure that they still earn profits after giving discounts.

Example of cost management

There is a sandwich company called Yummy Sandwich who has been doing this business for almost two years. The company sells only one kind of sandwich which is a turkey sandwich at \$6. One day, another sandwich company called Delicious Sandwich opens just two blocks from Yummy Sandwich. Delicious Sandwich sells the same food items as Yummy Sandwich but at a cheaper price, \$4. Due to the cheaper prices of sandwiches, Delicious sandwich attracts a lot of customers including customers from Yummy Sandwich.

- What strategy should Yummy Sandwich uses to compete with Delicious Sandwich?
- How can Yummy Sandwich use this strategy to achieve it?

The table below provides the current costs of each item that Yummy Sandwich uses to make one sandwich as well as alternates costs that they can use.

Yummy Sandwich's cost

	Cost (\$)
Bread	\$1
Meat	\$2
Veggie	\$1
Total cost	\$4 (\$1+\$2+\$1)
Sell	\$6
Profit	\$2 (\$6-\$4)

Alternate suppliers (assume that they offer all the same kind and quality)

Bread	Price
Supplier A	\$0.5
Supplier B	\$1

Meat	Price
Supplier C	\$1.5
Supplier D	\$2

Veggies	Price
Supplier E	\$1.5
Supplier F	\$1

Solution

The answer for the first question is to use cost leadership strategy because Delicious Sandwich sells the same food item with Yummy Sandwich but Delicious Sandwich sells at the cheaper price. Therefore, Yummy Sandwich should reduce the price of the sandwich to compete with Delicious

Sandwich.

As you can see if Yummy Sandwich reduces the price of the turkey sandwich to sell at \$4, they will get no profit. And if they reduce the price to be below \$4, then they will lose money.

Therefore, Yummy should find ways to reduce their cost in order to sell their sandwiches at the cheaper price.

The first thing to consider is the alternate suppliers in order to reduce costs. By looking at the tables, we can conclude that in order to reduce cost, the company should order bread from Supplier A, meat from Supplier C, and veggies from Supplier F.

	Cost (\$)
Bread from Supplier A	\$0.5
Meat from Supplier C	\$1.5
Veggies from Supplier F	\$1
Total cost	\$3

This would allow Yummy Sandwich to sell the turkey sandwich at \$4, with \$1 in profit for each sandwich. They can also sell at \$3.50 if they want but it will reduce their profits to be \$0.5 for each sandwich.

Engage

Students will explore the benefits of cost management techniques through the Lego activity. Additionally, they will gain creative thinking by coming up with new designs and justifying their team decisions. In order to engage students into this activity, the following example can provide students with scenarios in which cost management techniques may be important to their everyday lives.

Example:

Imagine you want to hold a party at your home with a few of your best friends. You have a budget of around \$60. You want to buy as many snacks and soda as you can. How are you going to do it?

What do you need to consider?

Students can answer a number of things such as a list of snacks or soda that their friends like and the costs of food.

How can you satisfy all of your friends with the budget you have?

One way is to have a list of your friends' favorite snacks. Then you will need to find what brand offers the cheapest price for each snack.

A second example:

Assume that your mom gives you \$20 to go grocery shopping and tells you that you can keep the money that is left over from the purchase.

In order to get as much of money left from the purchase as possible, it is wise to choose the brand that has the cheapest price for each item

Note: See PowerPoint with visual aids.

Explore

Experiment Questions:

Students will be examining the following questions in this activity:

What is cost leadership?

Cost leadership is the business strategy of gaining a competitive advantage by having the lowest

prices in the market.

What is a differentiation?

Differentiation is the technique of selling unique products that fulfill customers' needs but are hard for competitors to copy.

Can you give an example of a company using the cost leadership strategy?

Safeway is giving discounts in order to compete the prices with Fred Myer.

Can you give an example of a company using the differentiation strategy?

Apple invents many unique products that other companies cannot copy.

Procedure:

Set Up:

- Students should be split into teams of 3-4 depending on the classroom size. Each team should have enough workspace to collaborate
- Each team should be provided all the materials listed in the materials section
- Once all the teams have been provided the materials, review the PowerPoint presentation to introduce the topic of cost management
- The last slide on the PowerPoint has the problem students will be solving and should be left up for them to reference.

Run the activity:

- Go through and explain the sheet that provides all of the Lego piece prices to students. Confirm that they understand the prices.
 - It may be helpful to go through every Lego pieces with its own price
- Ask students to build the mini airplane Lego based on the instruction that given.
- Allow students to create a new design of a mini airplane Lego by using cost leadership strategy. Give them around 10-15 minutes.
- Once time is up, ask a group to calculate the total cost for their own designs.
 - It may be helpful to stop by each group and make sure they calculate it correctly.
- Have each group present their own designs for the mini airplane Lego.
 - Ask them how much they are going to sell their product for.
 - How much profits they will gain after reducing the cost.

Explain

The following questions should be asked to the students once they have had time to completely finish the activity

1. What are the benefits of using cost leadership in real life?
 - a. It helps you to reduce expenses in your daily life.
 - b. It helps you manage your accounts efficiently.
2. What are the benefits of using differentiation in real life?
 - a. It helps you to think outside of the box.
 - b. It helps you to practice your creativity to create something unique.

Elaborate

More advanced students can solve more complicated problems that involve additional types of costs. Instead of using only material costs, some fixed costs can be added to the problem such as salary expenses. Therefore it will be more challenging for students to calculate the overall cost for their own design.

Assume that you have 10 employees in your company and they all get the same salaries at \$10 per hour. Each of them works 8 hours per day. Moreover, it requires 28 days to complete your mini airplane.

- 1) How much for the material costs for your mini airplane.
 - a. Students will answer the total cost of their mini airplanes designs.
- 2) How much for the total salary expenses?
 - a. Total salary expenses per month =
 $(10 \text{ employees}) * (\$10/\text{hour}) * (8 \text{ hours/day}) * (28 \text{ days}) = \$22,400$
- 3) How much for the total cost including both material costs and salary expenses
 - a. Students will simply sum up the answers from question number 1 and 2. That will be the total cost.

Resources

Additional Resources:

<http://whatis.techtarget.com/definition/cost-management>

http://catalog.flatworldknowledge.com/bookhub/reader/3085?e=kitchen_1.0-ch05_s04

<http://smallbusiness.chron.com/examples-cost-leadership-strategy-marketing-12259.html>

Resources Used:

<http://www.techopedia.com/definition/13878/cost-management>

http://www.mindtools.com/pages/article/newSTR_82.htm

<http://www.albany.edu/faculty/es8949/bmgt481/lecture4.html>