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Introduction to Industrial Engineering: Team Tower

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IE 150 Fall 1999	Class Exercise 6: Inspecting Quality

OBJECTIVE

One of the key areas of Industrial Engineering is *quality control*. Quality control is concerned with testing and inspecting a product to confirm that it meets production and customer specifications. To understand some of the basics of quality control, let's consider the production of M&M candies.

"M&Ms"® begin their lives as liquid chocolate -- made with all-natural ingredients like whole milk, cocoa butter, sugar and chocolate liquor (which comes from grinding cocoa beans).

The chocolate is poured into tiny molds to create the M&M's chocolate centers. After they harden, they're moved on a conveyor belt to have their candy shells applied. The chocolates are rotated in large containers as the liquid candy is sprayed onto them. They get several coatings to ensure a complete and even coating on every piece. As the liquid dries, it turns into "M&Ms" famous crunchy shell.

The single-colored batches of candy are combined into mixtures of red, yellow, blue, green, brown and orange. They're sifted to eliminate misshapen pieces, and then transported to the machine that will put the "m's" on their shells. A special conveyor belt moves the pieces along, each in its own little indentation, past rubber etch rollers that gently touch each candy, printing that distinctive "m" on its shell.

A special packaging machine then weighs the "M&Ms", pours the proper amount into each bag, and heat-seals each package to ensure product safety and freshness. The finished packages are moved along a conveyor belt to a machine that assembles the shipping cartons, fills them with the right number of packages, and seals the cartons closed. The cartons are then loaded into trucks and transported to distribution centers, and then to stores across the country!

Here is a picture:

Task 1 *Defining the Quality Team*

For our class exercise, each team must have an employee for each of the following roles: *product designer* (responsible for developing new M&M candies and deciding how it is produced), *production manager* (responsible for the operations of the M&M production facility), *machine operator* (responsible for running the machines and conveyors on the M&M production line), and a *quality inspector* (responsible for inspecting M&M during the manufacturing process). Record this information for your team:

Team Member	Position in Company

Task 2 *Defining Quality*

The first task for your team is to define quality. Be specific about the attributes that your team requires of each of the following general categories:

- condition of package

- coating of M&Ms

- stamping of "m" on M&Ms

What other quality characteristics does your team think are important?

Task 3 *Defining Acceptable Quality Levels*

Given your team's definition of quality, what is your acceptable quality level (AQL)? An AQL measures the allowable percent of nonconforming (*i.e.*, does not meet quality specifications) product. For example, an AQL level of 2% would allow 2% of the product to be nonconforming. What is the *desired* AQL level for each of your respective positions and your final consensus AQL level:

Position in Company	Desired AQL Level	Factors Impacting Your Reason
product designer		
production manager		
machine operator		
quality inspector		

Record your team's consensus AQL level: _____

Another Approach: Consider Motorola, one of the first organizations to introduce the six-sigma concept into their manufacturing operations. Imagine a system that requires 99% accuracy (has an AQL of 1%). For one million parts, 10,000 defective parts would be expected. Under a six-sigma policy, only 6 defective parts per million are expected.

Task 4 *Where Should Inspection Occur?*

The goal of a quality inspection plan is to inspect the product to determine whether it meets specifications. Given the description of how M&M candies are manufactured, where should inspection occur in the process and how should it occur?

Task 5 ***Inspection Costs*** (your team has 8 minutes to complete this task)

Any inspection plan incurs costs. The following are four cost categories for costs. Your team is determine some example costs for each of the categories:

[1] **Internal failure costs:** These are costs associated with defects (errors, nonconformance) that are found prior to shipment (transfer) of the M&Ms to the customer. The following costs would disappear if no defects existed in the M&Ms before shipment.

Examples:

[2] **External failure costs:** These are the costs associated with defects that are found after the product is shipped to the customer:

Examples:

[3] **Appraisal costs:** These are the costs incurred in determining the degree of conformance to quality requirements:

Examples:

[4] **Prevention costs:** These are costs incurred in keeping failure and appraisal costs to a minimum.

Examples:

Task 6 *Inspection*

Your team has been given a sample of 8 to 10 packages of M&Ms. Use the following quality categories for your inspection:

- condition of package (conforming or nonconforming)
- coating of M&Ms (conforming or nonconforming)
- stamping of "m" on M&Ms (conforming or nonconforming)

Before you eat the M&Ms (or open the bag), inspect, classify, and record the quality information for your teams sample (based on your criteria defined in Task 4). Let **C** = conforming and **NC** = nonconforming.

	Package Condition		**Coating of M&Ms**		**Stamping of "m"**		Total Number of M&Ms	# Brown	# Green	# Red	# Yellow	# Blue	# Orange
	C	**NC**	**C**	**NC**	**C**	**NC**							
Package 1													
Package 2													
Package 3													
Package 4													
Package 5													
Package 6													
Package 7													
Package 8													
Total													

Task 7	***Inspection Results*** (your team has 10 minutes to complete this task)

Did your team meet the AQL requirements? If not, why not?

How can each of your positions in the company implement changes to the process for you to be able to meet improve the AQL level?

Should the AQL level change (increase, decrease, stay the same)?

Task 8	***Exercise Objective***

What has your team learned about quality control?