

Student Names

Points: 20

Period

①

Date:

Due:

## PLTW ENGINEERING

### Project 3.9

# Manufacturing a Box

## Introduction

In the past, artisans who produced one item at a time built most products. Today, industry uses **mass production** to build many of the same items more efficiently. *Assembly lines* can benefit mass production. An assembly line is an arrangement of machines, tools, and workers that build a product in steps. Each station of the line is equipped to perform a specific task. Assembly-line production can usually manufacture a product in less time and at lower cost. Mass production can also improve the **quality** of the product.

What is quality? How is quality determined? Some would say that the product designer determines quality. The designer creates specifications. Those specifications dictate the quality of the product. However, poor manufacturing processes may also affect the quality of a final product. The use of inferior materials or components can also reduce quality.

**Quality control**, or QC, is a system used to verify the quality of a product. By testing important product features and comparing the resulting **data** to the previously established specifications, you can identify product defects. *Quality assurance*, QA, attempts to adjust the manufacturing process to improve and stabilize the quality of the product. We use **statistics** to help us determine and control quality. This is often the responsibility of quality control engineers.

In this project, you will work in teams to design, test, and improve a manufacturing process to build boxes. Collectively you will build a box for each student in your class. As part of the process, you will test the quality of the boxes using statistics. Note that your box will become part of your design for Problem 8.2 Automata Design Challenge. Quality matters!

## Equipment

- Sand Paper (180 grit)
- Student Box Kit
- Quick-dry Tacky Glue
- Computer with spreadsheet capabilities
- Protractor
- Ruler or Dial Caliper
- Stopwatch
- Miter Box (Optional)
- Saw (Optional)

		Cost
Box Kit - 1 piece 1/4" x 4" x 4 1/2" wood - 2 pieces 1/4" x 4" x 5" wood - 2 pieces 1/4" x 4" x 4" wood	\$4.25	
Student Time (research your state minimum wage per hour and write in)	State minimum wage: \$ _____ /hour	
Teacher Consultation Time	\$0.65/minute	
Testing Time	\$0.12/second	
Fine for misrepresenting COG	Amount over real COG x 150%	

- o What is your estimated COG for a single box?
  - o Based on the estimated COG, what revisions can be made to your manufacturing process flow to reduce the cost by reducing time or materials?
6. Have your teacher approve your manufacturing process flow before you move on to the next step. Your teacher should initial and date your process flow chart in your notebook.
  7. Set up the assembly line to build one prototype box.
  8. When all supplies and team members are ready, start the stopwatch and construct one box through the assembly-line process. Members of the team should document the test in their PLTW Engineering Notebooks, and when not directly involved in the manufacturing process, they should note flaws and mistakes. Include suggestions for process improvement. Stop the clock when the box is complete. Record the time it took to construct one box in your notebook. Be sure to specifically describe the quantity that you are recording. "Time to manufacture ONE box per the above process flow = \_\_\_\_\_."
- Estimate the time required to construct all the boxes. Remember that multiple workers can each work on separate boxes while the assembly line is running. Justify your estimate in a few sentences in your notebook.
9. As a team, assess the quality of the prototype based on the quality control standards you developed in step 3. Identify, discuss, and record (in your notebooks) the steps in the assembly line that resulted in an inefficient use of time or poor quality construction.
  10. Devise and document in your notebook a plan to improve the process to address each inefficiency or quality issue.
  11. Update your manufacturing process flow to reflect your planned improvements to the assembly line. Have your teacher approve and initial your revised process flow before you move on to the next step.
  12. Set up the assembly line for mass production. After all supplies and team members are set up,

8

1. Did you meet your estimated time to complete all the boxes? Why or why not?
2. List two advantages and two disadvantages of assembly-line manufacturing.
3. How does quality control and quality assurance fit into the design process of the product?
4. How can statistics of a product's dimensions be used to assess the quality of the product?
5. Did you class produce boxes more accurately than the comparison class? Explain your answer.
6. Did you class produce boxes that are more precise than the comparison class? Explain your answer.