



# TeachEngineering

STEM Curriculum for K-12

Phase 2: Design to Deliver: Optimizing Craft Production for Efficiency, Profit, and Purpose



Subscribe to our newsletter at [TeachEngineering.org](https://TeachEngineering.org) to stay up-to-date on everything TE!

Brought to you by



# Objectives for Phase 2

## Students will:

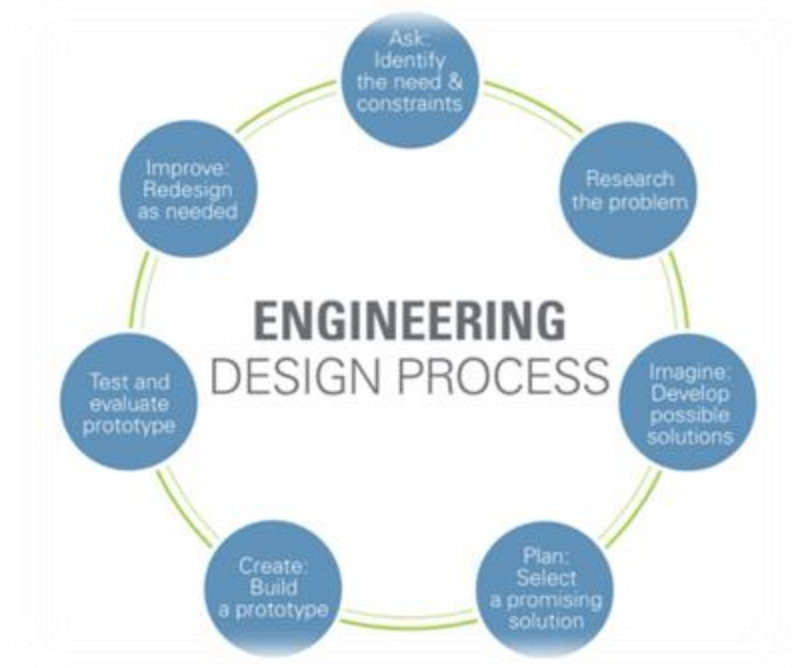
- Design and implement a vehicle production system that integrates principles associated with craft manufacturing concepts and engineering roles.
- Analyze performance data to evaluate their production system, then design and implement revisions to maximize the number of vehicles and profit they can build within the allotted time.

# Recall from Previous Activity

The main idea of **craft manufacturing** is that a highly skilled person, or a group of skilled people, produces a unique item, one at a time, according to a customer's directions.



# Engineering Design Process



# Recall Engineering Roles



## Design Engineers

Design the vehicle, selecting unique colors & features for each Lego component.



## Manufacturing Engineers

Put the plastic bricks together, making sure every piece fits just right.



## Sourcing Engineers

Find rare & high-quality bricks that fit the designer's vision.



## Quality Engineers

Test the vehicle to make sure it is how the customer wants it and meets specifications for safety and durability.

# Create your own Production Line



Mr. Otto Mobile's eyes are on you and your competition!

Keep in mind your goal is to make a higher number of quality cars than your competitors AND make the most profit.

## Create your own Production Line

Plan and create a diagram of the production area for your factory.

Include the following:

- Locations of each station.
- Locations of any engineers who will be placed at various stations.
- Material flow (designing - gathering parts - building).
- How the team will handle quality control or testing of the vehicles.
- A specific location within your plan for required materials, including the supply source (plastic brick kit), completed Bill of Materials sheets from the previous activity, and Customer Order Forms with a die.

Since we don't have an unlimited supply of building materials, once a completed car has passed all quality tests, it must be disassembled, and the parts must be replaced in the supply area.

# Craft Customer Order Form

## Craft\_Customer Order Form

COMPANY NAME: \_\_\_\_\_

ENGINEERS SECTION TO FILL OUT


- DESIGN ENGINEER
- SOURCING ENGINEER (SUPPLIER)
- MANUFACTURING ENGINEER (BUILDER)
- QUALITY ENGINEER (TESTER)

### 1 VEHICLE / CAR Information


CAR Number # \_\_\_\_\_

### 2 SUPPLY LIST FOR VEHICLE

Create Supply List based upon the Design Options and / or Proposed Design

Type	Size	Weight	Price	Quantity	Total Price	Type	Size	Weight	Price	Quantity	Total Price
	1x1	0.45	\$0.07				Big	1.4	0.29		
	1x2	0.8	\$0.11				Small One Side	0.95	\$0.18		
	1x3	1.15	\$0.12				Small Two Sided	0.7	\$0.15		
							Sm 1-Sided				
							Sm 2-Sided				

**CRAFT Production**  
**Roll Dice**



Option A = 1  
Option B = 2  
Option C = 3  
Option D = 4  
Roll Again if 5 or 6





# BOM and Craft Customer Order Form

Option C

## Bill of Materials (BOM)

Type	Size	Weight	Price	Quantity	Total Price	Type	Size	Weight	Price	Quantity	Total Price	
Brick	1x1	0.45	\$0.07	7	\$0.25	Axle	Large	1.4	\$0.29	4	\$1.16	
	1x2	0.8	\$0.11	1	\$0.11		Small	0.95	\$0.18	4	\$0.72	
	1x3	1.15	\$0.12				One Sided	0.7	\$0.15			
	1x4	1.5	\$0.15				Small Two Sided	1.55	\$0.30			
Plate	2x2	1.15	\$0.14	2	\$0.28	Rim	Large	0.7	\$0.25			
	2x2	0.6	\$0.11				Medium	0.25	\$0.20			
	2x6	1.7	\$0.19				Small	0.6	\$0.29	1	\$0.29	
	2x8	2.25	\$0.25				Wind Shield	2x4	2.5	\$0.38	1	\$0.38
Tire	2x10	2.8	\$0.25			Slope	1x2	0.65	\$0.11	2	\$0.22	
	4x6	3.25	\$0.43	2	\$0.86		1x2 open	0.7	\$0.11			
	4x10	5.4	\$0.54				2x2	1.05	\$0.14			
	Large Solid Hard	5.45	\$0.61				# of color components	3	Pass or Fail	Pass		
Med Soft	2.6	\$0.29			Total Overall Weight:							
	Small	0.65	\$0.15	4		\$0.60						
Total Overall Cost: \$3.77												

Weight 21.6g  
Cost \$3.77

## Craft Customer Order Form

COMPANY NAME: Vroom Vroom!

ENGINEERING SECTION TO FILL OUT

- DESIGN ENGINEER
- SOURCING ENGINEER (SUPPLIERS)
- MANUFACTURING ENGINEER (BUILDERS)
- QUALITY ENGINEER (TESTERS)

VEHICLE / CAR Information  
CAR Number: 12

SUPPLY LIST FOR VEHICLE  
Consider Supply List based upon the Design Options and / or Proposed Design

Type	Size	Weight	Price	Quantity	Total Price	Type	Size	Weight	Price	Quantity	Total Price	
Brick	1x1	0.45	\$0.07	7	\$0.25	Axle	Large	1.4	\$0.29	4	\$1.16	
	1x2	0.8	\$0.11	1	\$0.11		Small	0.95	\$0.18	4	\$0.72	
	1x3	1.15	\$0.12				One Sided	0.7	\$0.15			
	1x4	1.5	\$0.15				Small Two Sided	1.55	\$0.30			
Plate	2x2	1.15	\$0.14	2	\$0.28	Rim	Large	0.7	\$0.25			
	2x2	0.6	\$0.11				Medium	0.25	\$0.20			
	2x6	1.7	\$0.19				Small	0.6	\$0.29	1	\$0.29	
	2x8	2.25	\$0.25				Wind Shield	2x4	2.5	\$0.38	1	\$0.38
Tire	2x10	2.8	\$0.25			Slope	1x2	0.65	\$0.11	2	\$0.22	
	4x6	3.25	\$0.43	2	\$0.86		1x2 open	0.7	\$0.11			
	4x10	5.4	\$0.54				2x2	1.05	\$0.14			
	Large Solid Hard	5.45	\$0.61				# of color components	3	Pass or Fail	Pass		
Med Soft	2.6	\$0.29			Total Overall Weight:							
	Small	0.65	\$0.15	4		\$0.60						
Total Overall Cost: \$3.77												

Weight 21.6g  
Cost \$3.77

3 SOURCING ENGINEER Provide Builder with requested components. SUPPLIER ✓

4 MANUFACTURING ENGINEER Verify supplier delivery and begin build. BUILDER ✓

5 QUALITY ENGINEER Inspect the Vehicle and perform Quality Testing. TESTER

INSPECTION OF VEHICLE  
Appearance match the design?

Accept ☒ Pass ☒  
Reject ☐ Fail ☐

FUNCTIONAL TESTING  
RAMP TESTING DROP TESTING  
Pass ☒ Pass ☒  
Fail ☐ Fail ☐

# Production Setup

You will have 10-15 minutes to get your production line set up, using your diagram.

Be sure to establish team roles and arrange your resources.

# Trial Run of Production Line

Because this is a practice trial run, Mr. Otto Mobile will not be using the results to determine which team will work for Porsche. This is your team's opportunity to identify any issues that might prevent you from making the largest number of quality cars while also earning the largest overall profit.



30:00



# Production has ended!!

How did your team's production line perform during its first trial run?

- Did your team produce the largest number of cars that passed all quality checks?
- Did your team earn the highest profit during its first trial run?
- What were some of your group's successes?
- What were some of your group's challenges?
- Were there any issues that diminished your group's efficiency or profit?
- What changes could improve your production line?
- RECORD YOUR RESPONSES in the document you have already created.

# Porsche Production Line

Mr. Otto Mobile will now be using the results to determine which team will work for Porsche.

**30:00**



**AND the WINNER is..... EVERYONE who engaged in the engineering design process!!!**

