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FAST TRACK FACTORY

Using the Engineering Design Process to Improve Efficiency in Mass Production

U.S. National Science Foundation

Engineering & Applied Science
UNIVERSITY OF COLORADO BOULDER

Objectives:

Students will be able to:

- Analyze and simulate a mass production system to identify inefficiencies related to cost and time, using hands-on activities that reflect real-world manufacturing challenges.

- Apply the engineering design process by planning, designing, testing, and refining modifications to improve assembly line performance, supported by data and performance comparisons.

- Demonstrate collaboration, problem-solving, and communication skills by working in teams to develop a final presentation that outlines their design decisions, test results, and a recommended implementation plan.

Phase 1 Research

(Research - Ask - Imagine)

Analyze a mass production system to identify inefficiencies related to cost and time, using hands-on activities that reflect real-world manufacturing challenges.

"Fast Track Factory: Using the Engineering Design Process to Improve Mass Production Efficiency"

The auto industry is booming, but our manufacturing company has hit a speed bump. Our cars are selling fast, but behind the scenes, it's costing *too much time* and *money* to keep up.

That's where you come in!

As elite "efficiency experts", you've been contracted to solve a real-world challenge: take three popular vehicle models and rework the mass production system to make it *faster, leaner, and more profitable* — all while following strict safety and efficiency laws.

When making cars using **craft production**, each engineer designs and builds a product individually.

But our company strives to make hundreds, thousands, or even millions of cars, so we don't have one person build an entire car from scratch. Instead, we follow a **mass production** approach using an assembly line.

One person might be responsible for installing the engine, another for the doors, and another for the tires.

By working together in a system, cars can be made faster, more efficiently, and at a lower cost.

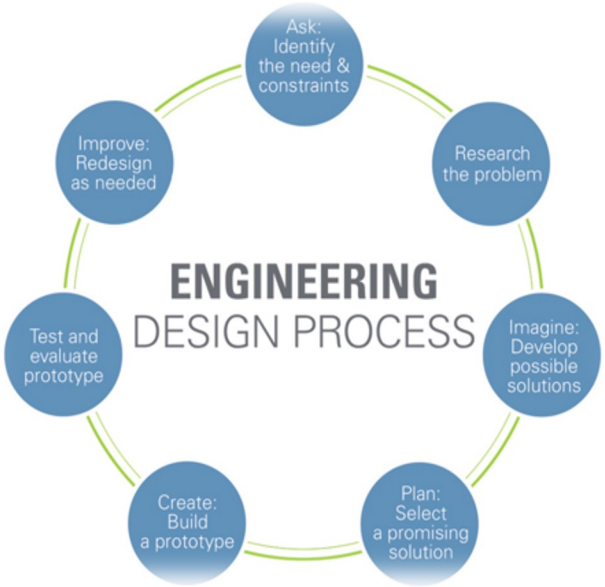
*Pay close attention because this behind-the-scenes look also provides details about how the **engineering design process** drives the world of manufacturing.*

Common Engineering Roles in Manufacturing

There are many **engineers in manufacturing**, but here are a few to think about:

- A **design engineer** designs and often makes plans to improve systems and products based on available materials and requirements.
- A **sourcing engineer** is responsible for finding and purchasing product components and making sure they will meet the needs of the product.
- A **manufacturing engineer** is often responsible for building the process of constructing the product and making sure it goes as efficiently as possible.
- A **quality engineer** is responsible for making sure the product is designed and built to meet all requirements.

Engineering Design Process



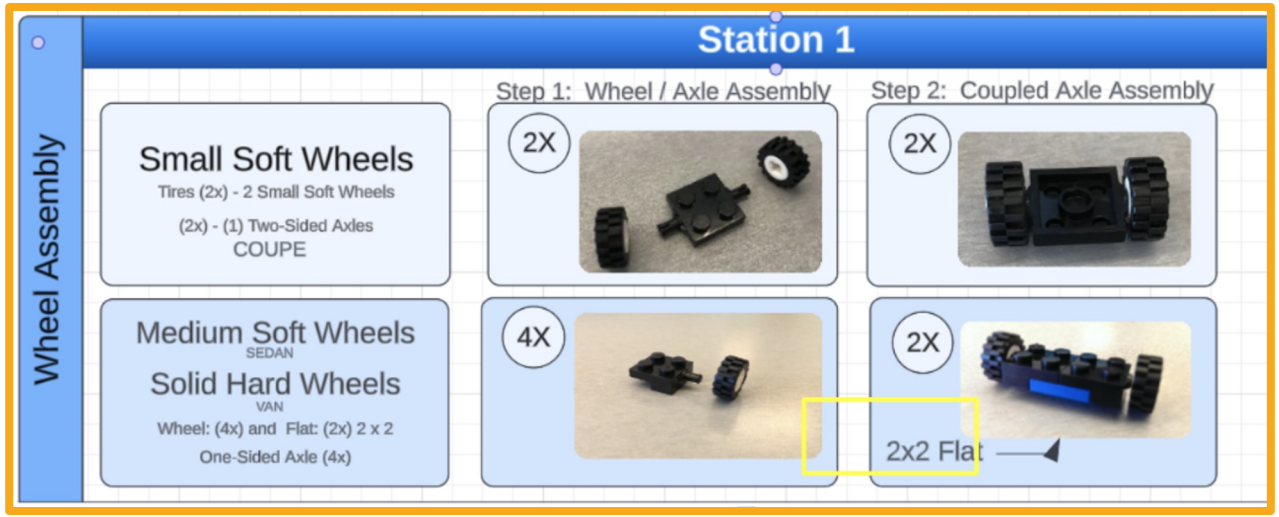
Experience Our Design

You are a team of efficiency experts, and your fresh perspective is just what our company needs!

- We hired you for your reputation as *excellent problem-solvers* for a variety of companies, and we've heard from your previous clients that you had the most success when you were able to dive into the current system first.
- Let's take a moment to walk you through our *three* vehicle designs, the coupe, sedan, and van.

Experience our Design ⟹ Graphic Assembly Guide

Your team now has access to the **Fast Track Factory: Graphic Assembly Guide**. Use it to take a close look at how each of our three vehicles—**coupe**, **sedan**, and **van**—are currently being built. This guide will give you the inside scoop on the steps, parts, and time involved in producing each model.



Practice construction for the coupe, sedan and van

Using plastic building bricks & the assembly guide, please build each of the three vehicle models—**coupe**, **sedan**, and **van.**

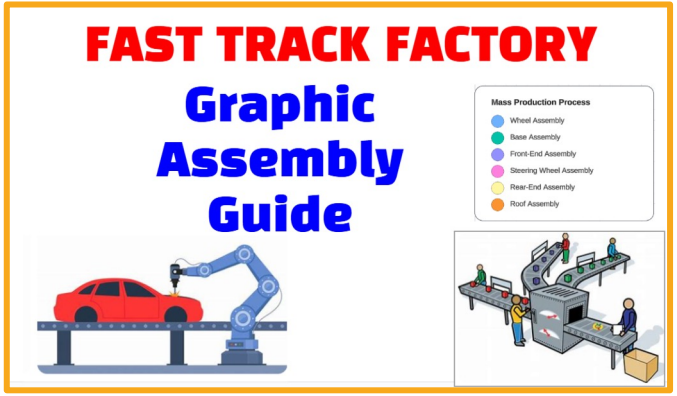
Ask questions.

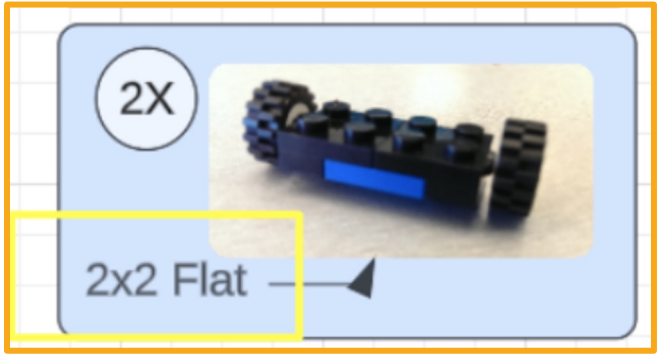
Take notes.

How are parts fitting together?

What works well?

What could be better?





Use this as a guide for specific details

Our Coupe, Sedan & Van

Coupe	FAST TRACK SAFETY - ALL VEHICLES
(a) Vehicle must have four tires (with axles), wind shield, steering wheel, and roof. (b) All tires must be small soft. (c) Vehicle base width and length are 4 dots and 6 dots, respectively. (d) Vehicle weight between 20 and 30 grams. (e) Vehicle height must fit a sitting driver. (f) Maximum different colors of the car is 5 (including color of tires and steering). (g) Car price is $9.	(a) The vehicle must be able to travel and stay on the ramp in order to cross the finish line fully intact during ramp test. (b) Vehicle must remain intact following a 2 foot drop from drop test (c) Minimum of 4 blocks high for driver height is required.

"Fast Track Factory" Safety & Efficiency Guidelines

Raw Material Inventory

Part Name		# per Standard Kit	Weight per Part	Cost per Part	
Brick	B1x1	100	0.45	$0.07	
	B1x2	100	0.80	$0.11	
	B1x3	40	1.15	$0.12	
	B1x4	40	1.50	$0.15	
	B2x2	24	1.15	$0.14	
Plate	P2x2	60	0.60	$0.11	
	P2x6	20	1.70	$0.19	
	P2x8	30	2.25	$0.25	
	P2x10			$0.25	
	P4x6			$0.43	
	P4x10	2	3.40	$0.54	

Weight & Cost Sheet

- What suggestions do you have for design changes we should make to each model?
- Revised models must meet safety and efficiency standards required by law.
- The raw material parts must also cost less than the sales price. Our marketing team has provided us with the highest prices customers are willing to pay.

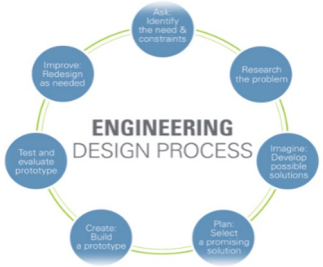
Time for Your Expert Opinions!

Discuss with your fellow experts changes that you believe should be made using the resources provided.

- Please open a blank document and record your proposed revisions to our current vehicle models using the two resources provided for greater efficiency and cost effectiveness.

- Please include pictures with your documentation throughout the activities.

- Which steps of the **engineering design process** are being used most effectively during today's activity, and reflect how the steps of the EDP help to guide your team to improve your team's final vehicle designs?



Phase 2
Physical Simulations

(Plan - Create - Test - Improve)

Apply the engineering design process by proposing, testing, and refining modifications to improve assembly line performance, supported by data and performance comparisons.

Thank you so much for the expertise you've offered for our vehicle design process!

- Now we would like to show you how we bring our vehicle designs to life through our assembly line process using the engineering design process.

- As you get hands-on experience with our system, please keep in mind we want you to make suggestions for improvement, so don't hesitate to speak up. It's why we brought you on board!

Designate Engineering Roles for Your Team

Please designate within your group who will take on each of the roles that are currently required to make our assembly line work.

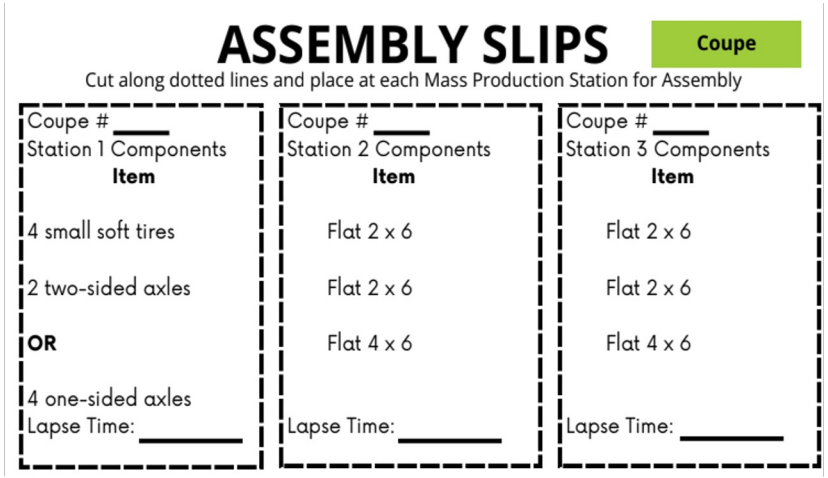
- Sourcing Engineer(s) (Suppliers) - Gathers the parts required for each assembly station, makes sure each station remains fully stocked, and puts recycled building materials back into the supply area.
- Manufacturing Engineers (Builders) - Constructs each portion of the car, according to the graphic assembly guide instructions.
- Quality Engineer(s) (Testers) - Verifies that each vehicle is built correctly, according to the provided specifications and passes the ramp and drop tests.

Round 1: Setting the Stage for the “Initial” Simulation

Your team will use Pages 1–3 of the Assembly Specification Slips.

- Cut along the dotted lines and use the slips to load the correct parts into the supply bins at each station. Be sure to prepare enough materials to build at least two cars. Place slips at your station.
- The Quality Testing Slips can be found at the bottom of Pages 1–3. Place at the Quality Station.

Time to Help Set up The Line!
All Hands On Deck!



ASSEMBLY SLIPS Coupe

Cut along dotted lines and place at each Mass Production Station for Assembly

Coupe # ____ Station 1 Components **Item**	Coupe # ____ Station 2 Components **Item**	Coupe # ____ Station 3 Components **Item**
4 small soft tires	Flat 2 x 6	Flat 2 x 6
2 two-sided axles	Flat 2 x 6	Flat 2 x 6
OR	Flat 4 x 6	Flat 4 x 6
4 one-sided axles Lapse Time: _____	Lapse Time: _____	Lapse Time: _____

Round 1: Setting the Stage for the “Initial” Simulation

- Each engineer will take the assembly slips for their station and gather enough parts for TWO of each model.
- Label cup with station number.
- Pick up a stopwatch.
- Add the Station Activity Place Card (if applicable) at the correct station.

Example of the Wheel Assembly or Station 1

Round 1: Setting the Stage for the “Initial” Simulation

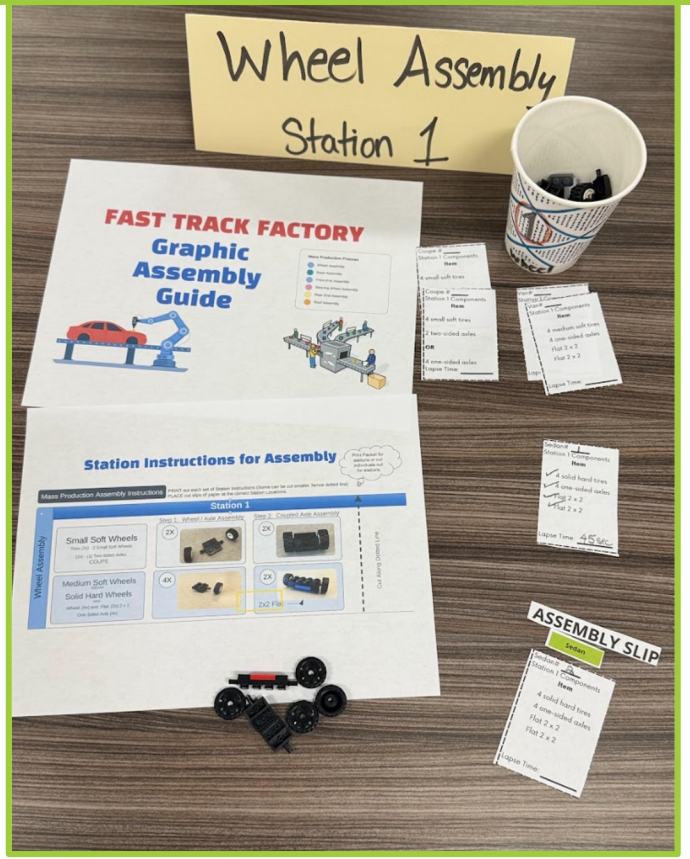
Sourcing Engineer(s)

- Verify your station has the plastic brick supply kit.
- Have a copy of the Graphic Assembly Guide.
- Have a full copy of the Assembly Specification Slips for each car model (coupe, sedan & van) *(1 full set of Pages 1-3)*.

Round 1: Setting the Stage for the “Initial” Simulation

Builders/Manufacturing Engineers

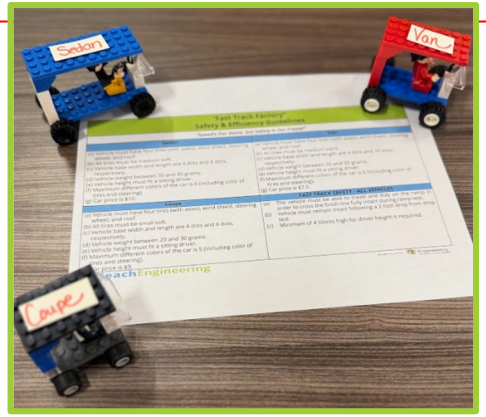
- Verify your stations have the necessary parts of the *Graphic Assembly Guide*.
- Have a stack of *Assembly Slips* for your stations.
- Have the correct supply bins loaded with the correct materials for each car model.



Round 1: Setting the Stage for the “Initial” Simulation

Quality Engineer

- Verify you have a copy of the *Graphic Assembly Guide* for your station.
- Use the Team’s *Safety & Efficiency Guidelines* with prototypes to check off initial inspection.
- Set up ramp and drop testing equipment.
- Have a stack of *Quality Testing Slips* *(located at the bottom of Pages 1-3 from the Assembly Slips)*.



The assembly line starts with a *manufacturing engineer*

The ***manufacturing engineer/builder 1*** will:

1. Confirm with the line that they will build 2 coupes, followed by 2 sedans, 2 vans, 2 coupes, and so forth…
2. Start a stopwatch.
3. Announce the start of production.
4. Move to building station 1 (could also already be at station 1).

Building Stations

Each ***manufacturing engineer (builder)*** will:

1. Start a stopwatch.
2. Fill in the vehicle number on the Assembly Specification Slip.
3. Build their part of the car.
4. Pass on the partially constructed vehicle to the next station *(on a paper plate tray or "conveyor")*.
5. **Stop the stopwatch and fill in the lapse time on the Assembly Specification Slip**.
6. Flip over completed Assembly Specification slip, revealing a blank copy to repeat the process.
7. Reset stopwatch or hit "lap," and begin again for the next car.

Coupe # _____

Station 1 Components

Item

4 small soft tires

2 two-sided axles

OR

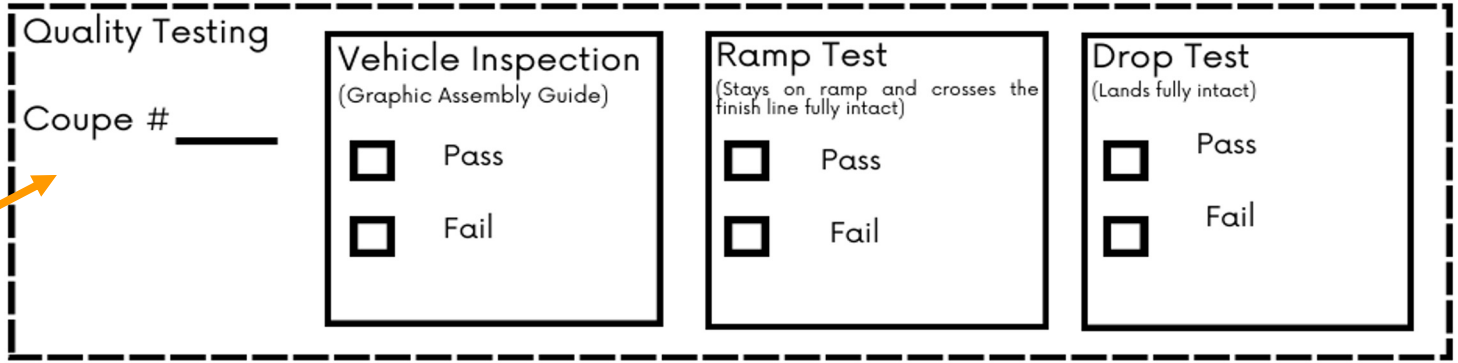
4 one-sided axles

Lapse Time: _____

Paper Plate = Conveyor

Quality Engineer/Tester Instructions

Pay attention to the testing forms. Coupe - Sedan or Van. Make sure you match up correctly.



1. When the last builder finishes, they will hand the completed vehicle to the **quality engineer (tester)**.
2. The **quality engineer** will use the ***Safety & Efficiency Guideline Sheet*** & ***Graphic Assembly Guide*** (*If necessary)* to do the first initial test to check to make sure model is accurately built.
3. Compare the vehicle to the **prototype** for the correct model.
    - If it **does not match**, mark "**Fail**" on the order form and return it to the builder.
    - If it **does match**, mark "**Pass**" on the order form and continue testing.
4. Run two tests: *(check pass or fail)*
    - **Ramp Test**: Does the car roll from top to bottom in one piece?
    - **Drop Test**: Can the car survive a gentle drop without breaking?
5. Record all results. Flip over the Assembly Specification Slip and repeat process with next car.

Sourcing Engineer Again

- A ***sourcing engineer*** will pick up the tested vehicle, take it apart, and return all the components to the supply area.

- The ***manufacturing engineers (builders)*** need to make sure they're stocked with building materials. When they realize they are in need of more, they should call out to the *sourcing engineer* or *supplier* and ask for the parts they require.

- The ***sourcing engineer*** should use the previously completed Assembly Specification Slips as a quick reference to retrieve the required materials from the supply area.

Let's Get to Work! Round 1 Simulation!

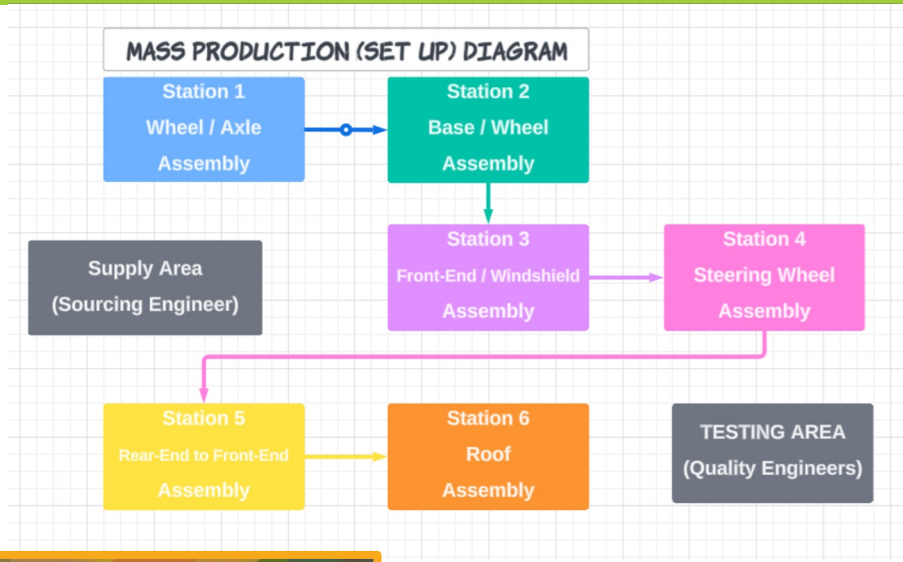
Please take some time to experience our current design by doing a test run of our assembly line.

Remember, we brought you here for your feedback, and every detail you provide matters, so observe closely and share your insights!

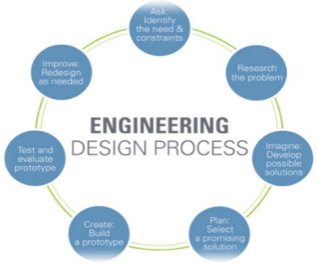
Make notes:

What works well?

What could be better?



Time for Your Expert Opinions - Efficiency and Profit

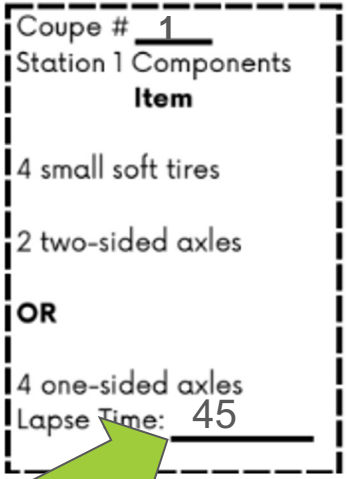


Thank you for giving us your initial thoughts!

To enhance your analysis with hard data, we've provided you with a copy of the *Mass Production Efficiency Data Spreadsheet* we use to calculate the production times and profit of our existing system.

Time for Your Expert Opinions - Efficiency and Profit

Please use the times you have recorded in each assembly slip …



…to fill in the building time required at each station.

*Enter lapse time for manufactured Coupe

COUPE	Station 1				
	Enter Lapse Time in Seconds				
Car #	Initial	1st Revision	2nd Revision	Efficiency Change Initial 1st Revision	Efficiency Change (Initial - 2nd Revision)
1	45			45	45

goes here

Coupe Production Rate | Sedan Production Rate | Van Production Rate

Time for Your Expert Opinions - Efficiency and Profit

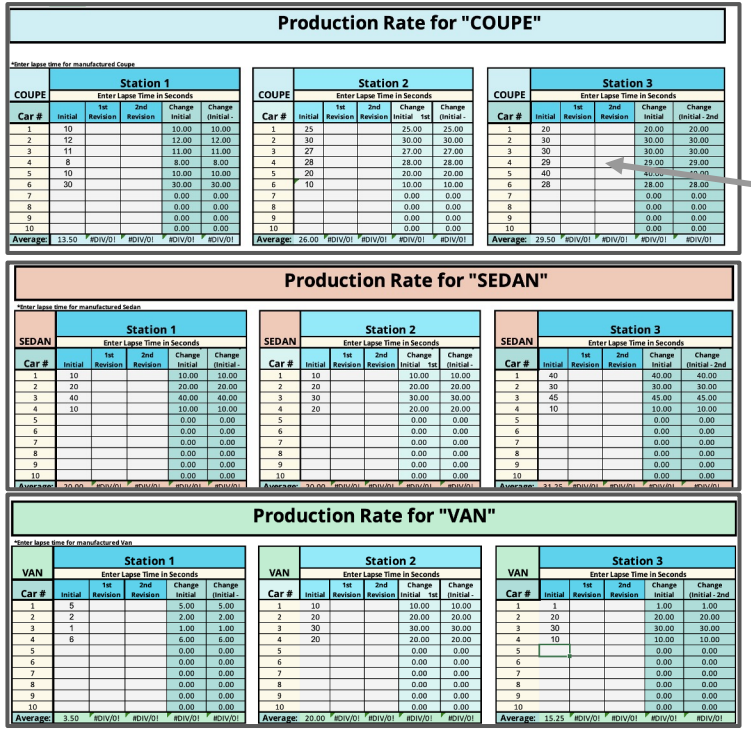
Since this is the first testing round, you should only have data in the column under Initial for each station.

Car #	Initial
1	10
2	12
3	11
4	8
5	10
6	30

Coupe Production Rate ▾ Sedan Production Rate ▾ Van Production Rate ▾

Time for Your Expert Opinions - Efficiency and Profit

- Fill in the time at each building station for the initial test run for each car model, the coupe, sedan, and van.
- Each is on a separate tab of the spreadsheet.
- There are cells in each column for 10 cars, but you will likely not use them all.



Production Rate for "COUPE"

COUPE	Station 1					Station 2					Station 3				
	Enter Lapse Time in Seconds					Enter Lapse Time in Seconds					Enter Lapse Time in Seconds				
Car #	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial 1st	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial - 2nd
1	10			10.00	10.00	25			25.00	25.00	20			20.00	20.00
2	12			12.00	12.00	30			30.00	30.00	30			30.00	30.00
3	11			11.00	11.00	27			27.00	27.00	30			30.00	30.00
4	8			8.00	8.00	28			28.00	28.00	29			29.00	29.00
5	10			10.00	10.00	20			20.00	20.00	40			40.00	40.00
6	30			30.00	30.00	10			10.00	10.00	28			28.00	28.00
7				0.00	0.00				0.00	0.00				0.00	0.00
8				0.00	0.00				0.00	0.00				0.00	0.00
9				0.00	0.00				0.00	0.00				0.00	0.00
10				0.00	0.00				0.00	0.00				0.00	0.00
Average:	13.50	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	26.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	29.50	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Production Rate for "SEDAN"

SEDAN	Station 1					Station 2					Station 3				
	Enter Lapse Time in Seconds					Enter Lapse Time in Seconds					Enter Lapse Time in Seconds				
Car #	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial 1st	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial - 2nd
1	10			10.00	10.00	10			10.00	10.00	40			40.00	40.00
2	20			20.00	20.00	20			20.00	20.00	30			30.00	30.00
3	40			40.00	40.00	30			30.00	30.00	45			45.00	45.00
4	10			10.00	10.00	20			20.00	20.00	10			10.00	10.00
5				0.00	0.00				0.00	0.00				0.00	0.00
6				0.00	0.00				0.00	0.00				0.00	0.00
7				0.00	0.00				0.00	0.00				0.00	0.00
8				0.00	0.00				0.00	0.00				0.00	0.00
9				0.00	0.00				0.00	0.00				0.00	0.00
10				0.00	0.00				0.00	0.00				0.00	0.00
Average:	20.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	20.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	31.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Production Rate for "VAN"

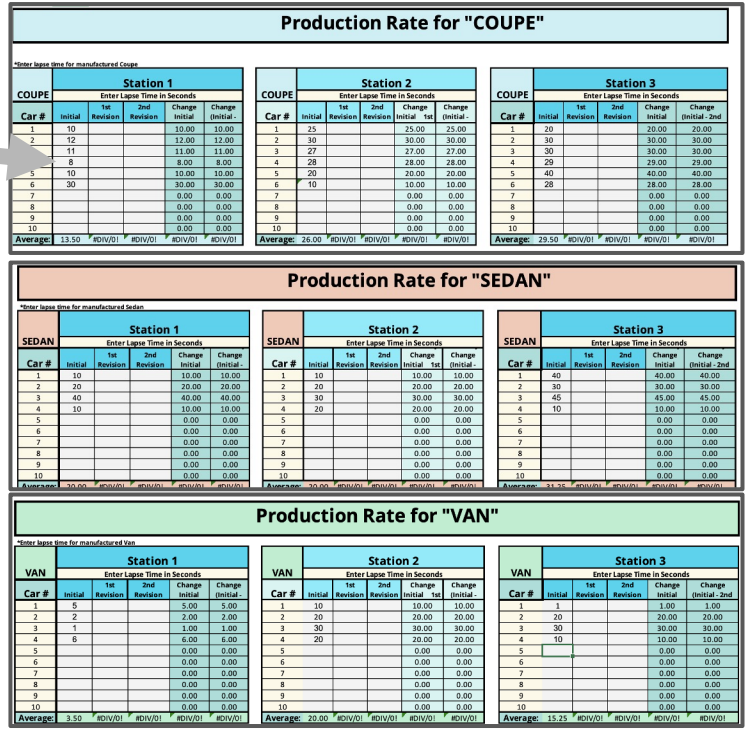
VAN	Station 1					Station 2					Station 3				
	Enter Lapse Time in Seconds					Enter Lapse Time in Seconds					Enter Lapse Time in Seconds				
Car #	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial 1st	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial - 2nd
1	5			5.00	5.00	10			10.00	10.00	1			1.00	1.00
2	2			2.00	2.00	20			20.00	20.00	20			20.00	20.00
3	1			1.00	1.00	30			30.00	30.00	30			30.00	30.00
4	6			6.00	6.00	20			20.00	20.00	10			10.00	10.00
5				0.00	0.00				0.00	0.00				0.00	0.00
6				0.00	0.00				0.00	0.00				0.00	0.00
7				0.00	0.00				0.00	0.00				0.00	0.00
8				0.00	0.00				0.00	0.00				0.00	0.00
9				0.00	0.00				0.00	0.00				0.00	0.00
10				0.00	0.00				0.00	0.00				0.00	0.00
Average:	3.50	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	20.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	15.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Enter data in gray areas only.

Coupe Production Rate ▾ Sedan Production Rate ▾ Van Production Rate ▾

Time for Your Expert Opinions - Efficiency and Profit

- Only enter data in the gray cells.
- The other colored cells contain important formulas that will help with the analysis that you don't want to change.



Production Rate for "COUPE"

*Enter lapse time for manufactured Coupe

COUPE	Station 1					Station 2					Station 3				
	Enter Lapse Time in Seconds					Enter Lapse Time in Seconds					Enter Lapse Time in Seconds				
Car #	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial 1st	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial - 2nd
1	10			10.00	10.00	25			25.00	25.00	20			20.00	20.00
2	12			12.00	12.00	30			30.00	30.00	30			30.00	30.00
3	11			11.00	11.00	27			27.00	27.00	30			30.00	30.00
4	8			8.00	8.00	28			28.00	28.00	29			29.00	29.00
5	10			10.00	10.00	20			20.00	20.00	40			40.00	40.00
6	30			30.00	30.00	10			10.00	10.00	28			28.00	28.00
7				0.00	0.00				0.00	0.00				0.00	0.00
8				0.00	0.00				0.00	0.00				0.00	0.00
9				0.00	0.00				0.00	0.00				0.00	0.00
10				0.00	0.00				0.00	0.00				0.00	0.00
Average:	13.50	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	26.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	29.50	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Production Rate for "SEDAN"

*Enter lapse time for manufactured Sedan

SEDAN	Station 1					Station 2					Station 3				
	Enter Lapse Time in Seconds					Enter Lapse Time in Seconds					Enter Lapse Time in Seconds				
Car #	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial 1st	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial - 2nd
1	10			10.00	10.00	10			10.00	10.00	40			40.00	40.00
2	20			20.00	20.00	20			20.00	20.00	30			30.00	30.00
3	40			40.00	40.00	30			30.00	30.00	45			45.00	45.00
4	10			10.00	10.00	20			20.00	20.00	10			10.00	10.00
5				0.00	0.00				0.00	0.00				0.00	0.00
6				0.00	0.00				0.00	0.00				0.00	0.00
7				0.00	0.00				0.00	0.00				0.00	0.00
8				0.00	0.00				0.00	0.00				0.00	0.00
9				0.00	0.00				0.00	0.00				0.00	0.00
10				0.00	0.00				0.00	0.00				0.00	0.00
Average:	20.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	20.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	31.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Production Rate for "VAN"

*Enter lapse time for manufactured Van

VAN	Station 1					Station 2					Station 3				
	Enter Lapse Time in Seconds					Enter Lapse Time in Seconds					Enter Lapse Time in Seconds				
Car #	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial 1st	Change (Initial -	Initial	1st Revision	2nd Revision	Change Initial	Change (Initial - 2nd
1	5			5.00	5.00	10			10.00	10.00	1			1.00	1.00
2	2			2.00	2.00	20			20.00	20.00	20			20.00	20.00
3	1			1.00	1.00	30			30.00	30.00	30			30.00	30.00
4	6			6.00	6.00	20			20.00	20.00	10			10.00	10.00
5				0.00	0.00				0.00	0.00				0.00	0.00
6				0.00	0.00				0.00	0.00				0.00	0.00
7				0.00	0.00				0.00	0.00				0.00	0.00
8				0.00	0.00				0.00	0.00				0.00	0.00
9				0.00	0.00				0.00	0.00				0.00	0.00
10				0.00	0.00				0.00	0.00				0.00	0.00
Average:	3.50	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	20.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	15.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Coupe Production Rate ▾ Sedan Production Rate ▾ Van Production Rate ▾

Time for Your Expert Opinions - Efficiency and Profit

Also, please fill in the number of employees working at each station on the tab of the spreadsheet.

The quality and supply station employee work times should be the entire length of the test run, in seconds.

Coupe			
	Initial Test Run		
Labor Data by Station	Station	per Station	Work Time,
	Station 1		81
	Station 2		130
	Station 3		177
	Station 4		17
	Station 5		0
	Station 6		0
	Quality Station		
	Supply Station		
	Total Employees	0	

Enter Costs and Sale Price for Each Model

Raw Material Cost per Car (bricks)

Coupe (tires with 2 2-sided axles): $4.08

Coupe (tires with 4 1-sided axles): $4.50

Sedan: $5.40

Van: $6.29

Sales Price:

Coupe: $9.00
Sedan: $10.00
Van: $7.50

Data You Could Consider:

What was the average building time at each station?

Average Work Time at Each Station	15.00

How many total cars were built?

Number of Cars Built	
intial	0

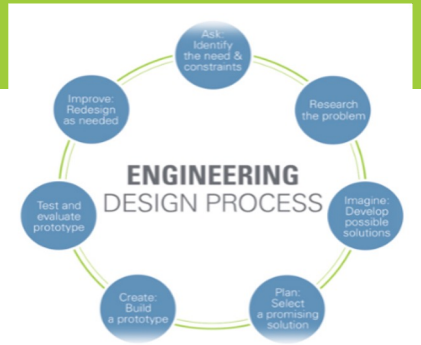
What was the total cost per car?

Total Cost Per Car

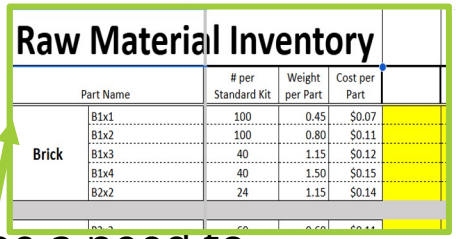
Total Profit per Car Model?

Overall Profit Totals Initial

Time for Your Expert Opinions!



- What do you like about the assembly line?
- What changes might you suggest we try (examples: layout, personnel locations, order of the vehicle types, etc.) ?
- Please open your previous document and record your thoughts and proposals. Don't forget pictures/diagrams!
- Now that you've implemented the assembly line, you MIGHT see a need to revise the car design. If you do, please use our editable Mass Production Weight / Cost Spreadsheet to assure your weight falls into the required safety guidelines and to obtain the total cost of parts for your redesigned vehicle.



Raw Material Inventory

Part Name		# per Standard Kit	Weight per Part	Cost per Part	
Brick	B1x1	100	0.45	$0.07	
	B1x2	100	0.80	$0.11	
	B1x3	40	1.15	$0.12	
	B1x4	40	1.50	$0.15	
	B2x2	24	1.15	$0.14	

Round 2 (1st Revision): Redesign for Speed and Profit

Now that you've experienced the original production run, it's time to *improve the system*!

Your Mission:

Run the Fast Track Factory simulation again, but this time:

Your team will REVISE the manufacturing process to make it more efficient and profitable.

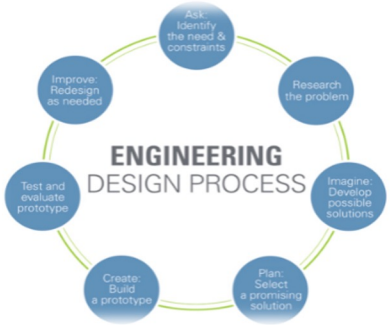
Simulation Round 2 Instructions

Use the engineering design process to make informed, strategic changes.

1. Review the Data

   Look at your build times, test results, and material use from Round 1 (current system). Where did time or materials get wasted?
2. Revise the Process

   As a team, make strategic changes. You can:
   - Simplify vehicle designs while staying within the original constraints.
   - Reduce cost.
   - Reassign roles or tweak your build order for speed.



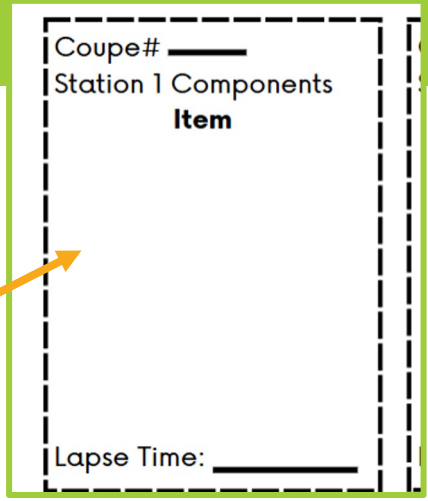
Simulation Round 2 Instructions

Use the engineering design process to make informed, strategic changes.

1. Open a blank document and create your own revised copy of the Graphic Assembly guide, with pictures.

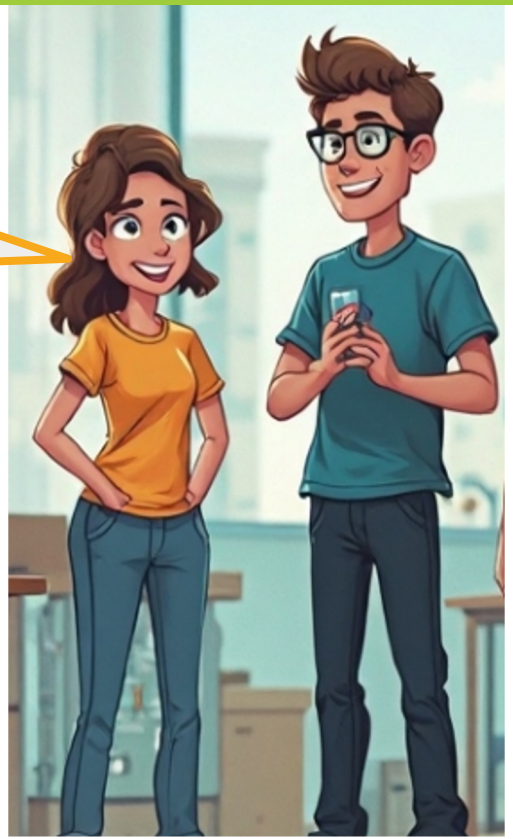
2. Update Assembly Specification Slips *(Pages 4-6 provide blank or editable templates for your team).*

3. Reflect your changes clearly so your team can follow the new process during the next simulation.



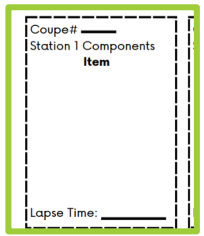
Round 2: 1st Revision of the Assembly Line (Your Station Setup & Simulation)

Time to test out your “efficiency” in the production process your team created.
Be ready to make some important notes.



End of 1st Revision Testing - Recording Results

Please open the *Mass Production Efficiency spreadsheet* we use used earlier and record the data from your slips/this testing round.



1st Revision (Round 2)			
Labor Data by Station	Station	Employees per Station	Employee Work Time, per Station
	Station 1		0
	Station 2		11
	Station 3		15
	Station 4		20
	Station 5		70
	Station 6		40
	Quality Station		156
	Supply Station		156
	Total Employees	0	

here

*Enter lapse time for manufactured Coupe

COUPE	Station 1				
	Enter Lapse Time in Seconds				
Car #	Initial	1st Revision	2nd Revision	Efficiency Change Initial 1st Revision	Efficiency Change (Initial - 2nd Revision)
1				45	45

here

CostProfit

Coupe Production Rate | Sedan Production Rate | Van Production Rate

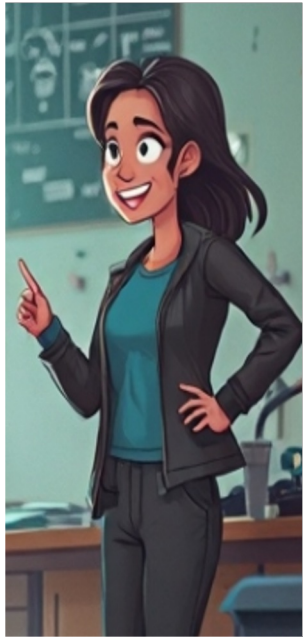
Post Mass Simulation Reflections

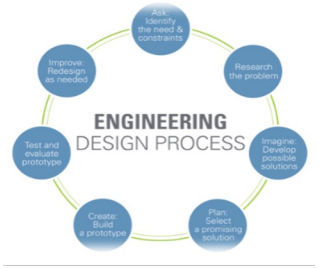
- Did your new process improve build time? By how much?
- **How did your material usage change in Round 2?**

  (Did you use fewer plastic bricks? Did the new design require less?)
- Was your final product still successful in the quality tests?
- What trade-offs did you encounter?

Post Mass Simulation Reflections

- How did your team's collaboration and communication change between rounds?
- Did your revised plan result in higher profit or efficiency overall? Explain.
- If you had one more round, what would you change next? Why?
- How does this process reflect the real-world engineering design process?
- What lesson from this simulation can apply to real manufacturing or engineering careers?





Round 3: 2nd Revision of the Assembly Line (Your Station Setup & Simulation)

Now it’s time to level up!

Take everything you’ve learned and revise your Fast Track Factory system one more time to make it even faster, leaner, and more efficient—can your team outdo your last run?

Let’s find out!

30:00

Phase 3

(Evaluate - Improve)

Demonstrate collaboration, problem-solving, and communication skills by working in teams to develop a final report that outlines design decisions, test results, and a potential implementation plan.

Get Ready for the “Fast Track Huddle”

Our Company Meeting with Executives

"Where efficiency meets innovation!"

Time to put your thinking caps (*hard hats*) on!

Use your data sheets to spot traffic jams in our production, shift gears with smart solutions, and steer the company toward success using the engineering design process.

You will need to:

- Spot those bottlenecks.
- Brainstorm brilliant fixes.
- Compare and contrast your data from the 1st simulation to the final revision simulation(s).

Time to impress the company executives!

You've got this, “Efficiency Experts!”

Open Your Mass Production Efficiency Data Spreadsheet

Analyze your data

What specific problems or bottlenecks did you encounter during initial production?

How could simplifying the vehicle design improve production efficiency?

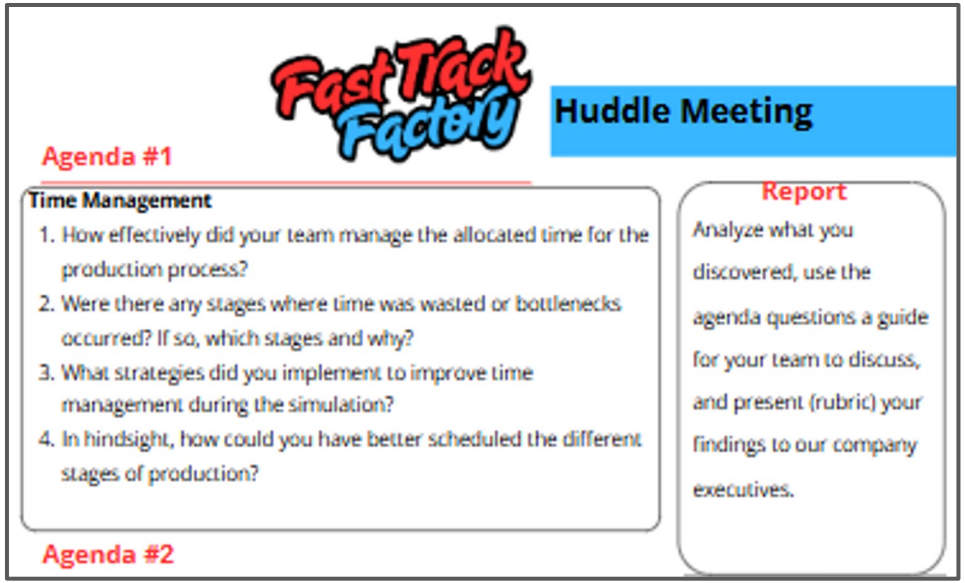
How might rearranging the assembly line layout increase productivity?

What changes in personnel roles or tasks could lead to faster and more accurate assembly?

How might your proposed revisions impact overall profitability?

Let’s Analyze Our Performance!

Use the Fast Track Huddle Meeting Handout to guide your team on



Fast Track Factory

Huddle Meeting

Agenda #1

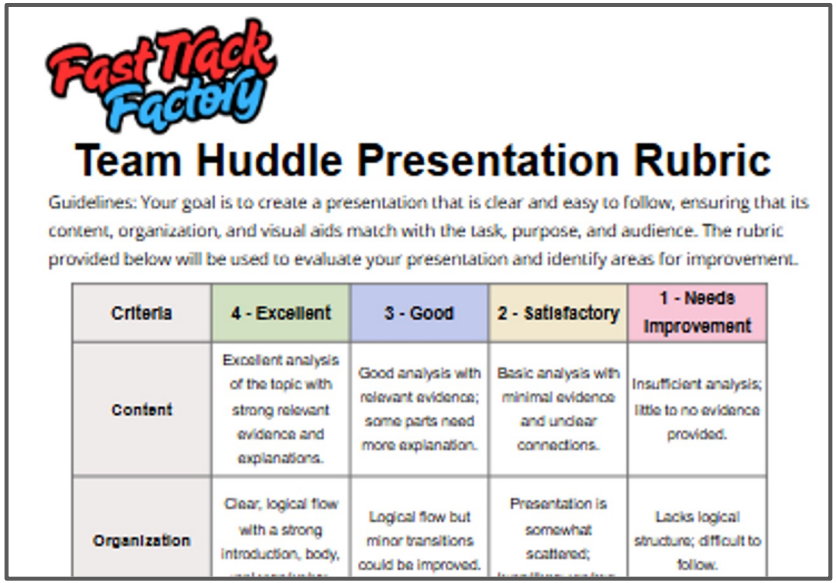
Time Management

1. How effectively did your team manage the allocated time for the production process?
2. Were there any stages where time was wasted or bottlenecks occurred? If so, which stages and why?
3. What strategies did you implement to improve time management during the simulation?
4. In hindsight, how could you have better scheduled the different stages of production?

Report

Analyze what you discovered, use the agenda questions a guide for your team to discuss, and present (rubric) your findings to our company executives.

Agenda #2



Fast Track Factory

Team Huddle Presentation Rubric

Guidelines: Your goal is to create a presentation that is clear and easy to follow, ensuring that its content, organization, and visual aids match with the task, purpose, and audience. The rubric provided below will be used to evaluate your presentation and identify areas for improvement.

Criteria	4 - Excellent	3 - Good	2 - Satisfactory	1 - Needs Improvement
Content	Excellent analysis of the topic with strong relevant evidence and explanations.	Good analysis with relevant evidence; some parts need more explanation.	Basic analysis with minimal evidence and unclear connections.	Insufficient analysis; little to no evidence provided.
Organization	Clear, logical flow with a strong introduction, body,	Logical flow but minor transitions could be improved.	Presentation is somewhat scattered;	Lacks logical structure; difficult to follow.

Thank You “Efficiency Experts!”

Ready for Presentations!

Thank you! Our company executives are ready to listen to your findings. You will have 7 minutes to present to our team.