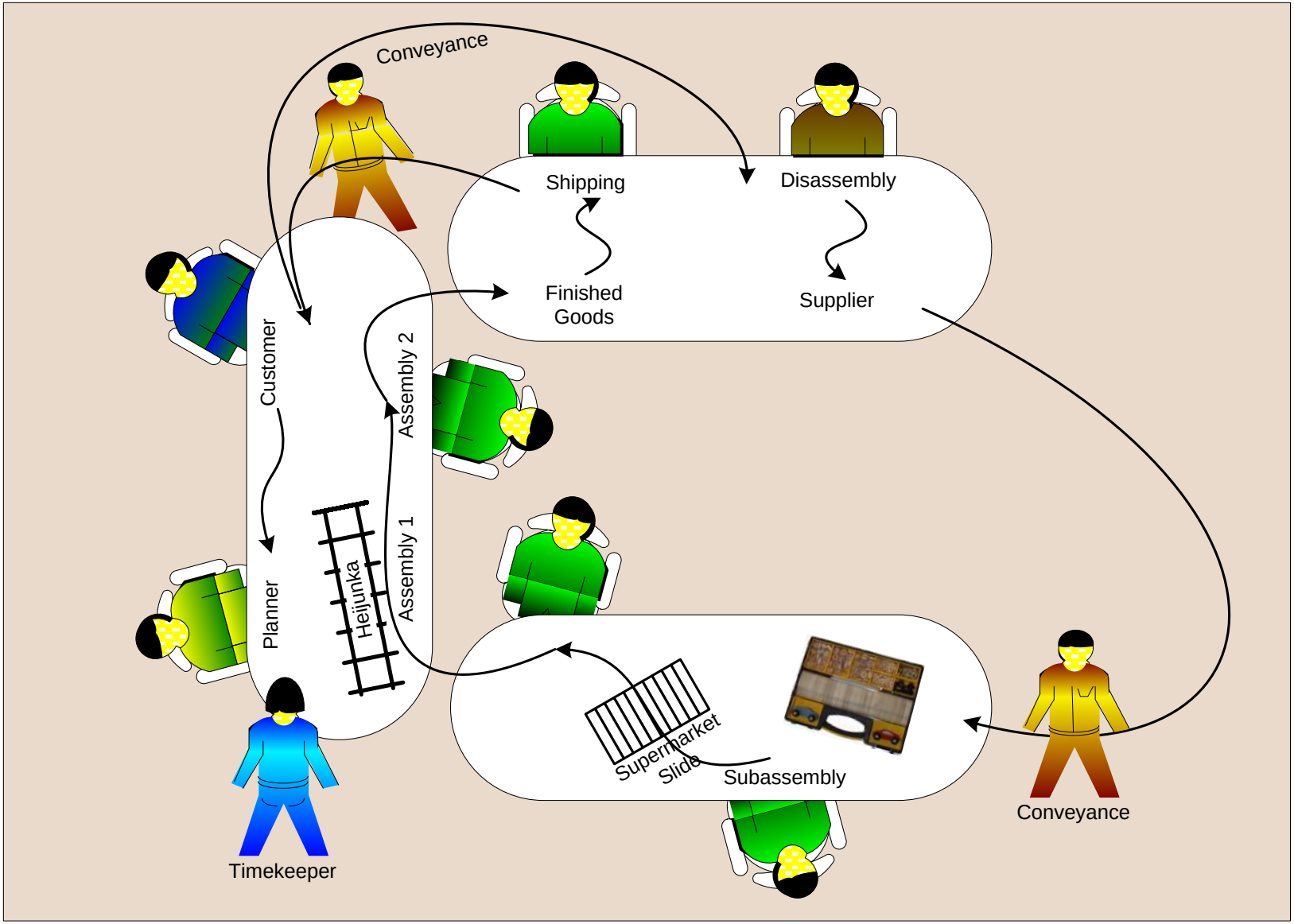
Lean Principles

Simulation Placemat Set

Heijunka

Leveling the waves

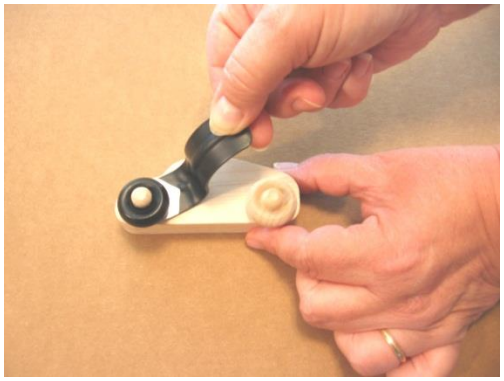


Suggested room set up

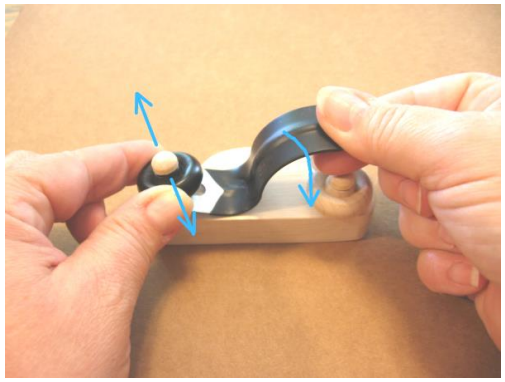
A word about safety and ergonomics:

- The simulation exercises use small components to produce toy cars. They are attractive to small children, therefore use caution when storing the components and keep them away from small children to prevent choking.
- The wooden pegs used to mount the wheels are made of a hard wood and should provide stable use over a long time. However, all wood will absorb moisture in high humidity conditions causing a slight swelling of the fibers and resulting is a tight fit of the wheel assembly. If this happens, the pegs may be reconditioned to remove the excess moisture by following the process *Instructions for microwave drying wooden pegs.doc* provided on the CD.
- If a tight peg / wheel assembly is difficult to remove, use the wheel extraction tool provided. Follow the instructions as shown.

To remove a tight wheel assembly, gently slide the wheel extraction tool under the wheel and around the axle peg.



Slowly pry up against the underside of the wheel or disk, with the tip of the tool centered with the peg, to bring the peg straight out of the hole.

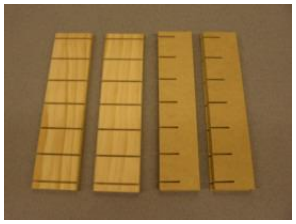
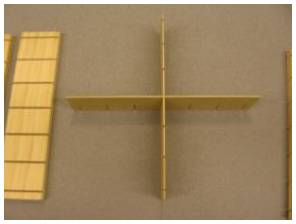
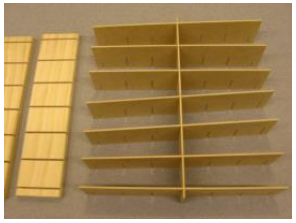
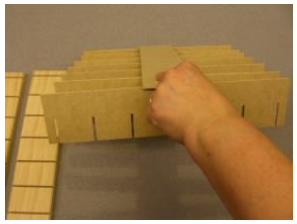
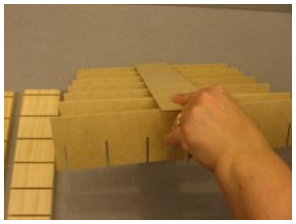
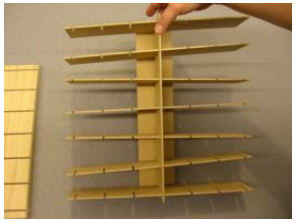
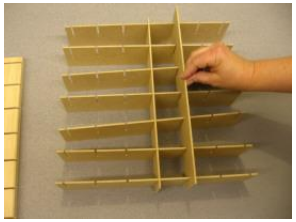
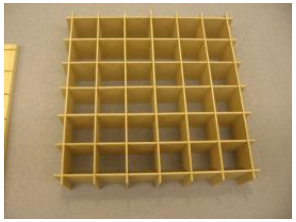


Gently rock the axle back and forth while pressing downward on the extraction tool handle. Use care not to flip the wheel and disk into the air. Do not bend the tool – press slowly and rock the peg loose.

- When inserting the wheel / peg assembly onto the car body, use a slight clockwise twist of the peg to ease insertion. Use the ergonomic tool provided to grip the peg and prevent finger soreness over the duration of the simulation event.

Assemble the Heijunka Box.

1. Caution: The hardboard material used is very stiff, and will crack if bending pressure is applied. Use care and go slowly to assure continued long use of the Heijunka Box.
2. Start by assembling the center boards by placing the first board with the open slots up.
3. Insert all cross boards with their slot down.
4. Lay a board across the intersection and slowly lift and rotate the partial box over onto its back
5. Insert the remaining cross boards, carefully juggling each interconnecting board until the slots line up
6. Attach the side brace boards by aligning the slot cuts with the cross board edges. The brace boards are slightly wider than the cross boards, which should align with the bevel cut edge of the brace.
7. Stand the Heijunka Box upright on a level surface.
8. When finished using the box, disassemble the box carefully so the brittle edges do not crack. Store in the protective foam lined kit container.

Facilitator Instructions:

- **Exercise Number 1 – Stable Demand**

  The purpose of this first round of simulation is to provide an opportunity for each participant to become accustomed to their role and to the flow of product. Therefore, the Heijunka schedule used in this first simulation exercise is based on an optimal demand to make it very stable and predictable and to allow each member of the team to focus on flow and to understand the process expectation.

- **Exercise Number 2 – Random Demand**

  The purpose of this second round of simulation is to provide an opportunity for each participant to become accustomed to the affect of Heijunka on unpredictable customer demand and its ability to level the production build even in the face of this unpredictable demand.

Facilitator Instructions:

- **Things to do during each exercise:**
  - Each exercise requires 8 to 10 participants to run the simulation and any number of participants in the observation team.
  - Place the participant placemats and kit materials around the tables as shown in the suggested room set up. Place the two Customer Lists at the customer station. Assemble the Heijunka Box following the pictorials.
  - Have the participants sit and read the process on their placemat, and if extra participants are available as observers, tell them to stand behind the hands-on participants and watch the action.

    Note: If available as part of the kit purchase, have the observation team perform the 10-Second Test to look for NVA opportunities. Use the observations for discussion after the event.
  - Tell the timekeeper to call start when ready and start the timer. Tell everyone to follow their process. Timing is very important, so it will naturally require a bit of time to get everyone accustomed to their role and the expectations placed upon them.

NOTE: don't take up time explaining the exercise in detail - just get them started. The initial confusion will quickly settle out as they read their process and activities become obvious.

Customer

Stable Demand

Use a wet-erase marker to check off the orders as they are placed, and again as they are delivered.

Customer List - optimum sequence					
Seq			**Car**	**Wheels**	**Details**
Pitch 1		2 minutes			
1	a	☐ ☐	Plain	Plain	Yes
2	a	☐ ☐	Plain	Plain	Yes
3	b	☐ ☐	Plain	Black	Yes
4	d	☐ ☐	Red	Black	No
5	e	☐ ☐	Blue	Plain	No
Pitch 2		2 minutes			
6	a	☐ ☐	Plain	Plain	Yes
7	a	☐ ☐	Plain	Plain	Yes
8	b	☐ ☐	Plain	Black	Yes
9	c	☐ ☐	Red	Plain	No
10	f	☐ ☐	Blue	Black	No
Pitch 3		2 minutes			
11	a	☐ ☐	Plain	Plain	Yes
12	a	☐ ☐	Plain	Plain	Yes
13	b	☐ ☐	Plain	Black	Yes
14	d	☐ ☐	Red	Black	No
15	e	☐ ☐	Blue	Plain	No
Pitch 4		2 minutes			
16	a	☐ ☐	Plain	Plain	Yes
17	a	☐ ☐	Plain	Plain	Yes
18	b	☐ ☐	Plain	Black	Yes
19	c	☐ ☐	Red	Plain	No
20	f	☐ ☐	Blue	Black	No

Customer List - optimum sequence					
Seq			**Car**	**Wheels**	**Details**
Pitch 5		2 minutes			
21	a	☐ ☐	Plain	Plain	Yes
22	a	☐ ☐	Plain	Plain	Yes
23	b	☐ ☐	Plain	Black	Yes
24	d	☐ ☐	Red	Black	No
25	e	☐ ☐	Blue	Plain	No
Pitch 6		2 minutes			
26	a	☐ ☐	Plain	Plain	Yes
27	a	☐ ☐	Plain	Plain	Yes
28	b	☐ ☐	Plain	Black	Yes
29	c	☐ ☐	Red	Plain	No
30	f	☐ ☐	Blue	Black	No
Pitch 7		2 minutes			
31	a	☐ ☐	Plain	Plain	Yes
32	a	☐ ☐	Plain	Plain	Yes
33	b	☐ ☐	Plain	Black	Yes
34	d	☐ ☐	Red	Black	No
35	e	☐ ☐	Blue	Plain	No
Pitch 8		2 minutes			
36	a	☐ ☐	Plain	Plain	Yes
37	a	☐ ☐	Plain	Plain	Yes
38	b	☐ ☐	Plain	Black	Yes
39	c	☐ ☐	Red	Plain	No
40	f	☐ ☐	Blue	Black	No

Customer

Random Demand

Use a wet-erase marker to check off the orders as they are placed, and again as they are delivered.

Customer List - random sequence					
Seq			**Car**	**Wheels**	**Details**
Pitch 1		2 minutes			
1	a	☐ ☐	Plain	Plain	Yes
2	a	☐ ☐	Plain	Plain	Yes
3	b	☐ ☐	Plain	Black	Yes
4	a	☐ ☐	Plain	Plain	Yes
5	b	☐ ☐	Plain	Black	Yes
Pitch 2		2 minutes			
6	d	☐ ☐	Red	Black	No
7	e	☐ ☐	Blue	Plain	No
8	a	☐ ☐	Plain	Plain	Yes
9	c	☐ ☐	Red	Plain	No
10	f	☐ ☐	Blue	Black	No
Pitch 3		2 minutes			
11	a	☐ ☐	Plain	Plain	Yes
12	a	☐ ☐	Plain	Plain	Yes
13	a	☐ ☐	Plain	Plain	Yes
14	a	☐ ☐	Plain	Plain	Yes
15	b	☐ ☐	Plain	Black	Yes
Pitch 4		2 minutes			
16	a	☐ ☐	Plain	Plain	Yes
17	d	☐ ☐	Red	Black	No
18	e	☐ ☐	Blue	Plain	No
19	b	☐ ☐	Plain	Black	Yes
20	b	☐ ☐	Plain	Black	Yes

Customer List - random sequence					
Seq			**Car**	**Wheels**	**Details**
Pitch 5		2 minutes			
21	c	☐ ☐	Red	Plain	No
22	f	☐ ☐	Blue	Black	No
23	a	☐ ☐	Plain	Plain	Yes
24	d	☐ ☐	Red	Black	No
25	e	☐ ☐	Blue	Plain	No
Pitch 6		2 minutes			
26	a	☐ ☐	Plain	Plain	Yes
27	a	☐ ☐	Plain	Plain	Yes
28	a	☐ ☐	Plain	Plain	Yes
29	b	☐ ☐	Plain	Black	Yes
30	c	☐ ☐	Red	Plain	No
Pitch 7		2 minutes			
31	f	☐ ☐	Blue	Black	No
32	a	☐ ☐	Plain	Plain	Yes
33	b	☐ ☐	Plain	Black	Yes
34	d	☐ ☐	Red	Black	No
35	e	☐ ☐	Blue	Plain	No
Pitch 8		2 minutes			
36	a	☐ ☐	Plain	Plain	Yes
37	a	☐ ☐	Plain	Plain	Yes
38	b	☐ ☐	Plain	Black	Yes
39	c	☐ ☐	Red	Plain	No
40	f	☐ ☐	Blue	Black	No

Finished Goods - *On-Time Metric – Stable Demand*

Customer List - optimum sequence					
Seq			**Car**	**Wheels**	**Details**
Pitch 1		2 minutes			
1	a	☐ ☐	Plain	Plain	Yes
2	a	☐ ☐	Plain	Plain	Yes
3	b	☐ ☐	Plain	Black	Yes
4	d	☐ ☐	Red	Black	No
5	e	☐ ☐	Blue	Plain	No
Pitch 2		2 minutes			
6	a	☐ ☐	Plain	Plain	Yes
7	a	☐ ☐	Plain	Plain	Yes
8	b	☐ ☐	Plain	Black	Yes
9	c	☐ ☐	Red	Plain	No
10	f	☐ ☐	Blue	Black	No
Pitch 3		2 minutes			
11	a	☐ ☐	Plain	Plain	Yes
12	a	☐ ☐	Plain	Plain	Yes
13	b	☐ ☐	Plain	Black	Yes
14	d	☐ ☐	Red	Black	No
15	e	☐ ☐	Blue	Plain	No
Pitch 4		2 minutes			
16	a	☐ ☐	Plain	Plain	Yes
17	a	☐ ☐	Plain	Plain	Yes
18	b	☐ ☐	Plain	Black	Yes
19	c	☐ ☐	Red	Plain	No
20	f	☐ ☐	Blue	Black	No

	time order accepted				due between 75 and 90 sec		
	start time	**Assy 1**	**Assy 2**	**to FGI**	**ship time due**	**to Customer**	**On-Time**
	2:00	pitch increment			1:15	0:15	
Pitch #1	2:00	0:35	0:25	3:00	3:15	3:30	
	2:35	0:35	0:25	3:35	3:50	4:05	
	3:10	0:15	0:25	3:50	4:25	4:40	
	3:25	0:15	0:05	3:45	4:40	4:55	
	3:40	0:15	0:05	4:00	4:55	5:10	
Pitch #2	4:00	0:35	0:25	5:00	5:15	5:30	
	4:35	0:35	0:25	5:35	5:50	6:05	
	5:10	0:15	0:25	5:50	6:25	6:40	
	5:25	0:15	0:05	5:45	6:40	6:55	
	5:40	0:15	0:05	6:00	6:55	7:10	
Pitch #3	6:00	0:35	0:25	7:00	7:15	7:30	
	6:35	0:35	0:25	7:35	7:50	8:05	
	7:10	0:15	0:25	7:50	8:25	8:40	
	7:25	0:15	0:05	7:45	8:40	8:55	
	7:40	0:15	0:05	8:00	8:55	9:10	
Pitch #4	8:00	0:35	0:25	9:00	9:15	9:30	
	8:35	0:35	0:25	9:35	9:50	10:05	
	9:10	0:15	0:25	9:50	10:25	10:40	
	9:25	0:15	0:05	9:45	10:40	10:55	
	9:40	0:15	0:05	10:00	10:55	11:10	

earliest latest

On-Time Delivery Window

Finished Goods - *On-Time Metric – Random Demand*

Customer List - random sequence					
Seq			**Car**	**Wheels**	**Details**
Pitch 1		2 minutes			
1	a	☐ ☐	Plain	Plain	Yes
2	a	☐ ☐	Plain	Plain	Yes
3	b	☐ ☐	Plain	Black	Yes
4	a	☐ ☐	Plain	Plain	Yes
5	b	☐ ☐	Plain	Black	Yes
Pitch 2		2 minutes			
6	d	☐ ☐	Red	Black	No
7	e	☐ ☐	Blue	Plain	No
8	a	☐ ☐	Plain	Plain	Yes
9	c	☐ ☐	Red	Plain	No
10	f	☐ ☐	Blue	Black	No
Pitch 3		2 minutes			
11	a	☐ ☐	Plain	Plain	Yes
12	a	☐ ☐	Plain	Plain	Yes
13	a	☐ ☐	Plain	Plain	Yes
14	a	☐ ☐	Plain	Plain	Yes
15	b	☐ ☐	Plain	Black	Yes
Pitch 4		2 minutes			
16	a	☐ ☐	Plain	Plain	Yes
17	d	☐ ☐	Red	Black	No
18	e	☐ ☐	Blue	Plain	No
19	b	☐ ☐	Plain	Black	Yes
20	b	☐ ☐	Plain	Black	Yes

	time order accepted				due between 75 and 90 sec		
	start time	**Assy 1**	**Assy 2**	**to FGI**	**ship time due**	**to Customer**	
	2:00	pitch increment			1:15	0:15	On-Time
Pitch #1	2:00	0:35	0:25	3:00	3:15	3:30	
	2:35	0:35	0:25	3:35	3:50	4:05	
	3:10	0:15	0:25	3:50	4:25	4:40	
	3:25	0:15	0:05	3:45	4:40	4:55	
	3:40	0:15	0:05	4:00	4:55	5:10	
Pitch #2	4:00	0:35	0:25	5:00	5:15	5:30	
	4:35	0:35	0:25	5:35	5:50	6:05	
	5:10	0:15	0:25	5:50	6:25	6:40	
	5:25	0:15	0:05	5:45	6:40	6:55	
	5:40	0:15	0:05	6:00	6:55	7:10	
Pitch #3	6:00	0:35	0:25	7:00	7:15	7:30	
	6:35	0:35	0:25	7:35	7:50	8:05	
	7:10	0:15	0:25	7:50	8:25	8:40	
	7:25	0:15	0:05	7:45	8:40	8:55	
	7:40	0:15	0:05	8:00	8:55	9:10	
Pitch #4	8:00	0:35	0:25	9:00	9:15	9:30	
	8:35	0:35	0:25	9:35	9:50	10:05	
	9:10	0:15	0:25	9:50	10:25	10:40	
	9:25	0:15	0:05	9:45	10:40	10:55	
	9:40	0:15	0:05	10:00	10:55	11:10	
					earliest	latest	
					On-Time Delivery Window		

The LeanMan

Finished Goods - *On-Time Metric – Stable Demand*

Customer List - optimum sequence					
Seq			**Car**	**Wheels**	**Details**
Pitch 5		2 minutes			
21	a	☐ ☐	Plain	Plain	Yes
22	a	☐ ☐	Plain	Plain	Yes
23	b	☐ ☐	Plain	Black	Yes
24	d	☐ ☐	Red	Black	No
25	e	☐ ☐	Blue	Plain	No
Pitch 6		2 minutes			
26	a	☐ ☐	Plain	Plain	Yes
27	a	☐ ☐	Plain	Plain	Yes
28	b	☐ ☐	Plain	Black	Yes
29	c	☐ ☐	Red	Plain	No
30	f	☐ ☐	Blue	Black	No
Pitch 7		2 minutes			
31	a	☐ ☐	Plain	Plain	Yes
32	a	☐ ☐	Plain	Plain	Yes
33	b	☐ ☐	Plain	Black	Yes
34	d	☐ ☐	Red	Black	No
35	e	☐ ☐	Blue	Plain	No
Pitch 8		2 minutes			
36	a	☐ ☐	Plain	Plain	Yes
37	a	☐ ☐	Plain	Plain	Yes
38	b	☐ ☐	Plain	Black	Yes
39	c	☐ ☐	Red	Plain	No
40	f	☐ ☐	Blue	Black	No

	time order accepted				due between 75 and 90 sec		
	start time	**Assy 1**	**Assy 2**	**to FGI**	**ship time due**	**to Customer**	
	2:00	pitch increment			1:15	0:15	On-Time
Pitch #5	10:00	0:35	0:25	11:00	11:15	11:30	
	10:35	0:35	0:25	11:35	11:50	12:05	
	11:10	0:15	0:25	11:50	12:25	12:40	
	11:25	0:15	0:05	11:45	12:40	12:55	
	11:40	0:15	0:05	12:00	12:55	13:10	
Pitch #6	12:00	0:35	0:25	13:00	13:15	13:30	
	12:35	0:35	0:25	13:35	13:50	14:05	
	13:10	0:15	0:25	13:50	14:25	14:40	
	13:25	0:15	0:05	13:45	14:40	14:55	
	13:40	0:15	0:05	14:00	14:55	15:10	
Pitch #7	14:00	0:35	0:25	15:00	15:15	15:30	
	14:35	0:35	0:25	15:35	15:50	16:05	
	15:10	0:15	0:25	15:50	16:25	16:40	
	15:25	0:15	0:05	15:45	16:40	16:55	
	15:40	0:15	0:05	16:00	16:55	17:10	
Pitch #8	16:00	0:35	0:25	17:00	17:15	17:30	
	16:35	0:35	0:25	17:35	17:50	18:05	
	17:10	0:15	0:25	17:50	18:25	18:40	
	17:25	0:15	0:05	17:45	18:40	18:55	
	17:40	0:15	0:05	18:00	18:55	19:10	
	18:00				earliest	latest	
					On-Time Delivery Window		

Finished Goods - *On-Time Metric – Random Demand*

Customer List - random sequence					
Seq			**Car**	**Wheels**	**Details**
Pitch 5		2 minutes			
21	c	☐ ☐	Red	Plain	No
22	f	☐ ☐	Blue	Black	No
23	a	☐ ☐	Plain	Plain	Yes
24	d	☐ ☐	Red	Black	No
25	e	☐ ☐	Blue	Plain	No
Pitch 6		2 minutes			
26	a	☐ ☐	Plain	Plain	Yes
27	a	☐ ☐	Plain	Plain	Yes
28	a	☐ ☐	Plain	Plain	Yes
29	b	☐ ☐	Plain	Black	Yes
30	c	☐ ☐	Red	Plain	No
Pitch 7		2 minutes			
31	f	☐ ☐	Blue	Black	No
32	a	☐ ☐	Plain	Plain	Yes
33	b	☐ ☐	Plain	Black	Yes
34	d	☐ ☐	Red	Black	No
35	e	☐ ☐	Blue	Plain	No
Pitch 8		2 minutes			
36	a	☐ ☐	Plain	Plain	Yes
37	a	☐ ☐	Plain	Plain	Yes
38	b	☐ ☐	Plain	Black	Yes
39	c	☐ ☐	Red	Plain	No
40	f	☐ ☐	Blue	Black	No

	time order accepted				due between 75 and 90 sec		
	start time	**Assy 1**	**Assy 2**	**to FGI**	**ship time due**	**to Customer**	
	2:00	pitch increment					On-Time
Pitch #5	10:00	0:35	0:25	11:00	11:15	11:30	
	10:35	0:35	0:25	11:35	11:50	12:05	
	11:10	0:15	0:25	11:50	12:25	12:40	
	11:25	0:15	0:05	11:45	12:40	12:55	
	11:40	0:15	0:05	12:00	12:55	13:10	
Pitch #6	12:00	0:35	0:25	13:00	13:15	13:30	
	12:35	0:35	0:25	13:35	13:50	14:05	
	13:10	0:15	0:25	13:50	14:25	14:40	
	13:25	0:15	0:05	13:45	14:40	14:55	
	13:40	0:15	0:05	14:00	14:55	15:10	
Pitch #7	14:00	0:35	0:25	15:00	15:15	15:30	
	14:35	0:35	0:25	15:35	15:50	16:05	
	15:10	0:15	0:25	15:50	16:25	16:40	
	15:25	0:15	0:05	15:45	16:40	16:55	
	15:40	0:15	0:05	16:00	16:55	17:10	
Pitch #8	16:00	0:35	0:25	17:00	17:15	17:30	
	16:35	0:35	0:25	17:35	17:50	18:05	
	17:10	0:15	0:25	17:50	18:25	18:40	
	17:25	0:15	0:05	17:45	18:40	18:55	
	17:40	0:15	0:05	18:00	18:55	19:10	
	18:00				earliest	latest	
					On-Time Delivery Window		

Customer

Order the items off the Customer List order card, in the sequence given, with adherence to the constraints. In simulation #1 use the Stable Demand List to sequence the orders in a repeat pattern that mimics the presentation Plan 5 pattern and allow the team to get the feel for the simulation. In simulation #2 use the Random Demand List to sequence orders in a disarray more likely to mimic a series of customer orders, and allow the power of the Heijunka to show through.

Constraints

- Only one Kanban Job Order [MOVE] Card placed at a time.
- Orders are selected from the Customer List and only to the maximum number of each model defined on the list.
- Orders are placed at approximately 20 second intervals, plus or minus 4 seconds.

  Use the 2nd stopwatch provided with the kit if available, or

  1. *hum the music to final Jeopardy*
  2. *hum it to yourself – quietly*
- Each order for plain cars can be 1 or 2 cars per Kanban Job Order [MOVE] Card, but typically use 1 pc batch orders
- Each order for color car bodies can only be 1 pc jobs
- Each order for same color car can only be placed for 1 car every 2 minutes (1 per pitch interval)

Fun Hint: for a totally random third simulation, toss a die every 20 seconds and order the car corresponding to the associated model from 1 to 6. (die not included)

Completions

- Take delivery of the completed order and the Kanban Job Order [MOVE] Card and check off completion on the Customer List.
- Wipe the Kanban Job Order [MOVE] Card clean for reuse (wet erase markers clean with a damp tissue or sponge).
- Send the completed car(s) to the Supply Chain person. Call out “conveyance” when cars are ready to be transported.

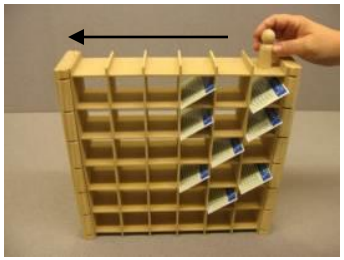
Planner

Receive periodic orders for cars from the customer for the 6 models available and produce them assuring accurate on-time delivery while managing a level production work load.

Scheduling

- Calculate order acceptance time for each Kanban Job Order [MOVE] Card received from customer, basing the time on visual observation of the Heijunka Box and the next available pitch increment time for the model ordered. The time is obtained from the timekeeper's stopwatch by calling out "time stamp" and adding the appropriate additional time for the pitch increment where the order is expected to be planned. The Timekeeper will respond in minutes and seconds. Record the TimeStamp on the back of the Kanban Job Order [MOVE] Card.
- On-time is defined as TimeStamp plus 90 seconds per car. Record the due time on the card by adding 1 minute 30 seconds to the recorded TimeStamp, less the early delivery window of 15 seconds.

  Example: a 1 pc order is due in TimeStamp+1 min 15 sec
- Create the Heijunka Kanban Production Card from the Kanban Job Order [MOVE] Card, and send the Kanban Job Order [MOVE] Card to Finished Goods / Shipping.
- The Heijunka Kanban Production Card is created using the plan rules for each model as defined by the team for the Heijunka and flow selected. Insert the Heijunka Card into the proper pitch and row of the Heijunka Box, leveling the work for each pitch. Note: you will be working the Box right to left as you load from the back side, while the assembler pulls left to right.
- The planner should stay well ahead of the work team, preferably at least one pitch period.



Planner View

Constraints

- Orders are placed by the Customer only to the maximum number of each model defined on the Customer List.
- Orders will be placed at 20 second intervals (+ / - 4 seconds) but not more than 24 seconds.
- Each order for plain cars can be between 1 and 2 cars per job order, but typically they will be 1 pc batch orders.
- Each order for color car bodies can only be 1 pc jobs and the same color car can only be placed for only 1 car of the same color in the same pitch interval.

Timekeeper

Keep time for the simulation event, provide the time stamps used for metrics, and maintain the "drum beat" used to regulate the flow.

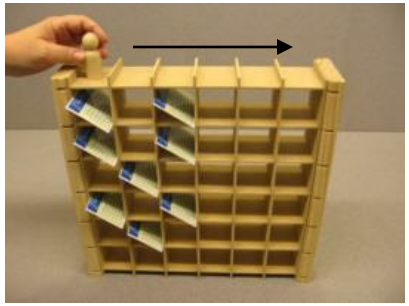
Timekeeping

- Start the simulation event and the stopwatch. Time the overall event and run for 20 total minutes, then call stop.
- At time zero, start the customer placing orders and the planner setting Heijunka kanban cards into the Heijunka box. The assembly team waits idle while you allow two minutes for this head start.
- Anytime a team member calls out "time stamp" reply with the time reading off the stopwatch in minutes and seconds. Avoid excess word like "2 minutes 15 seconds" and use "2 15" instead.
- The timekeeper maintains the "beat" for the assembly team by using the Timekeeper marker – a simulation only device placed on top of the "pitch in operation" column of the Heijunka Box, and moved to the next pitch on two minute intervals.

  In actual practice, the pitch is typically a half-day, or a shift change or some period such as a break horn sounding that is easily recognized across the value stream as a "drum beat."

Timekeeper

- At the 2 minute mark, call start for the assembly operation and place the Timekeeper on top of the first pitch column of the Heijunka box to indicate which "pitch" is active. The Timekeeper is moved one column over at the stroke of each additional two minute mark on the stopwatch. At the end of the last column, move the Timekeeper back to the first column and repeat until the simulation is finished.
- The simulation operation will run for a total of 20 minutes on the stopwatch. Call "all stop" to end the simulation. You may allow conveyance to continue for another minute until all cars in process are delivered and metrics are complete.



Finished Goods / Shipping

Manage finished goods inventory, regulate the delivery of customer orders, and maintain the on-time delivery metric.

Finished Goods

- Receive completed cars from production into finished goods inventory.

Shipping

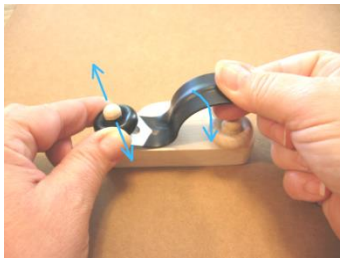
- Receive the Kanban Job Order [MOVE] Card from planning and line them up in delivery sequence, delivering the car(s) from finished goods as ordered to the customer at the delivery time specified (TimeStamp plus 90 seconds per car ordered, or the due time written on the card if pre-calculated by the planner).
- Deliver the completed car order and Job Order [MOVE] Card to the customer on time. If at a distance, call out “conveyance” to have the car and card delivered to the customer.
- Record the on-time metric on the metric sheet using a wet-erase marker, or just check if the time is inside the “window” indicated on the metric sheet. The on-time window is defined as “15 seconds early - zero seconds late.”
- Return the completed Heijunka Production Card, wiped clean, to the planner for reuse (wet erase markers clean with a damp tissue or sponge.) complete.

Supply Chain

Manage Provide raw materials to the Subassembly inventory location and provide transportation for materials and goods.

Disassembly

- Receive completed cars from the customer and disassemble them into their component parts.
  - Color car bodies are very few in number and must be available for reuse within less than 30 seconds. Therefore, any color car returned takes priority over any plain car for disassembly.
  - Black wheels are less in number than plain wheels, and are to be considered as the second priority for disassembly
- Plain cars have headlight and tail light “details” which are to be removed and discarded.
- Call out “conveyance” when materials are ready to be delivered.



Conveyance

- Transport materials between the customer and the supply chain disassembly person’s input, and between the disassembly person’s output and the subassembly inventory area.
- Respond whenever someone calls out “conveyance” to transport the materials or goods as required.
  - Develop a sense of priority to respond appropriately when two or more calls for conveyance are requested. When two or more conveyance persons are available, work out a system of response that will assure success.
    1. Color car bodies are very few in number and must be disassembled and the car body available for reuse within less than 30 seconds. Therefore, any color car returned to raw inventory takes priority over all other needs.
    2. Customer on-time is also very important, and fortunately operates within a window of time.

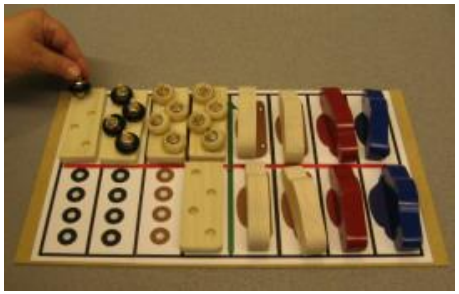
       15 seconds early – zero seconds late. Use the buffer wisely.
    1. Black wheels are less in number than plain wheels, and are to be considered as a higher priority than plain car bodies or plain wheels for return to raw inventory.

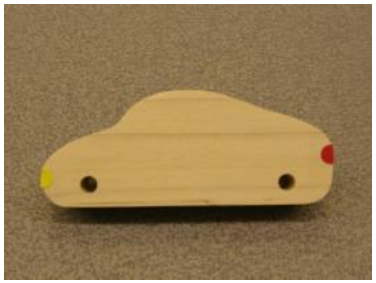
Subassembly

Maintain the min/max point of use supermarket inventory for the assembly area.

Subassembly

- The min/max slide supermarket contains plain wheel subassemblies, black wheel subassemblies, plain car bodies with head light and tail light detail, and color car bodies with no detail. Each column of the supermarket with a minimum number of each component to be maintained at all times, and a maximum number to be used to prevent overproduction.
- When a subassembly component drops below its max level point, the subassembly person picks raw components from inventory, completes the subassembly, and fills up the supermarket to the max line again.
    1. If a subassembly or component drops below its minimum level then this subassembly or component becomes the priority to replenish as soon as possible. NOTE: You may discover that the wheel subassemblies do not want to behave and stay where put in the gravity fed store. If you place one of the subassembly holding fixture blocks from the car factory simulation kit into each of the gravity store subassembly areas, you can easily mount each subassembly onto a fixture to contain them in place.
    2. When applying headlight and tail light details to car bodies, place the color dot on the end so it overlaps the edge of the car and wraps slightly around to the side. It will make later removal much easier.





Assembly #1

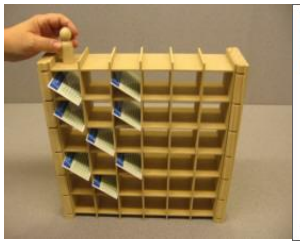
Pull the Heijunka kanban card from the Heijunka box, complete assembly of the model indicated and in the quantity indicated and deliver to Assembly #2.

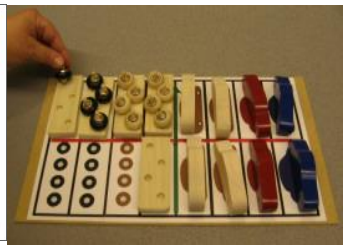
Assembly #1

- Monitor the Heijunka Box for the active pitch which is indicated by the “Timekeeper” at the top of one of the columns. Pull the cards starting at the top one card at a time and assemble the car model indicated and in the quantity specified. Note: you will be pulling from the Box left to right while the Planner will be loading the Box from the reverse side, staying a few pitch increments ahead of you.
- Pull material from the slide supermarket one piece at a time as required, assembling the car as you go.
- Pass the car to the second assembly person in 1-pc flow for final assembly and, if required, continue with the next car until the quantity required by the kanban card is complete.
- Repeat the steps again, pulling the next lower kanban card from the same pitch and completing each assembly until all cards in the pitch are complete.
- Wait until the Timekeeper is moved to the next pitch column, and repeat again.
  If finished early, stop until the Timekeeper is moved. If finished late, work to catch up to the correct pitch.

CAUTION: Use the ergonomic tool to insert axle pegs to prevent sore fingers, as shown

Timekeeper





Assembly #2

Pull the partial final assembly from Assembly #1 and complete assembly of the model indicated and in the quantity indicated and deliver to Finished Goods.

Assembly #2

- As each car is passed to you from assembly 1, perform an inspection to assure the model indicated on the Heijunka Card is the model actually built.
- Perform the final assembly as required.
- Perform final inspection.
  - Color of wheels, color of body, wheels rotate, headlight and tail light details attached as required.
    - If rework is required which requires subassembly materials from the slide supermarket, pass the car upstream to assembly 1 for repair.
    - If rework is required which you can perform, such as wheel adjustment, perform the task.
- Pass the completed car(s) and Heijunka card to Finished Goods as a set.
- Repeat the steps again, as required.