Reflections on Chen, et.al. 2010

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2018-04-03

Kaizen and lean tools

- Process at a glance
- Value-stream mapping
- The ‘5 whys’
- Kaizen events
- Standard operation routine sheets
- Design of experiment

Process for Kaizen event

- Root cause identification.
- Goal.
- Process description.
- Proposal.
- Implementation.

Case study

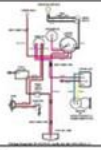
- "… a small electrical manufacturing business in the Midwestern United States. The major products of Company A are industrial switchgears and switchboards."

Current status

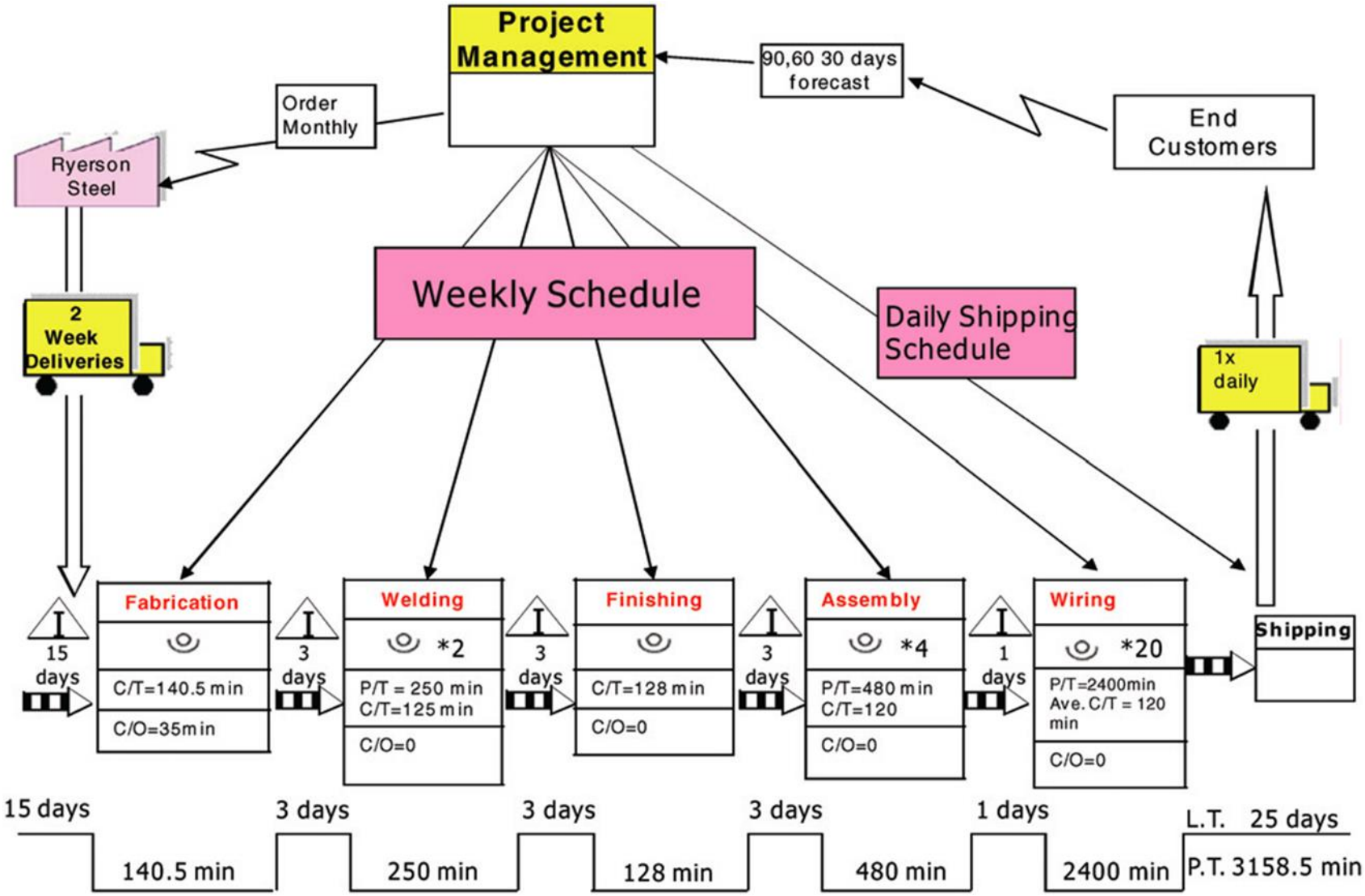
Process detail

Process #	1	2	3	4	5
Process sketch					
Operation description	Shear	Plasma Cut	De-bur	Brake	Cut
Average Cycle time	5 min	47 min	15 min	22.2 min	15 min
Uptime %	100	90	100	100	100
Workers	1	1	1	1	2
Area	Fabrication	Fabrication	Fabrication	Fabrication	Welding

Process #	6	7	8	9	10
Process sketch					
Operation description	Weld	De-bur	Wash	Dry	Paint
Average Cycle time	235 min	45 min	20 min	5 min	20 min
Uptime %	100	100	100	100	100
Workers	2	1	1	1	1
Area	Welding	Finishing	Finishing	Finishing	Finishing

Process #	11	12	13
Process sketch			
Operation description	Bake	Assemble	Wire
Average Cycle time	30 min	480 min	2400 min
Uptime %	100	100	100
Workers Required	1	4	20
Area of Shop	Finishing	Assembly	Wiring

Current state VSM



Standard operation routine sheet for fabrication operation

#	Name of operation	Manual time	Machine time
1	Shear	5	
2	Plasma	Load-3 Unload-2	42
3	Debur	15	
4	Brake	22.5	

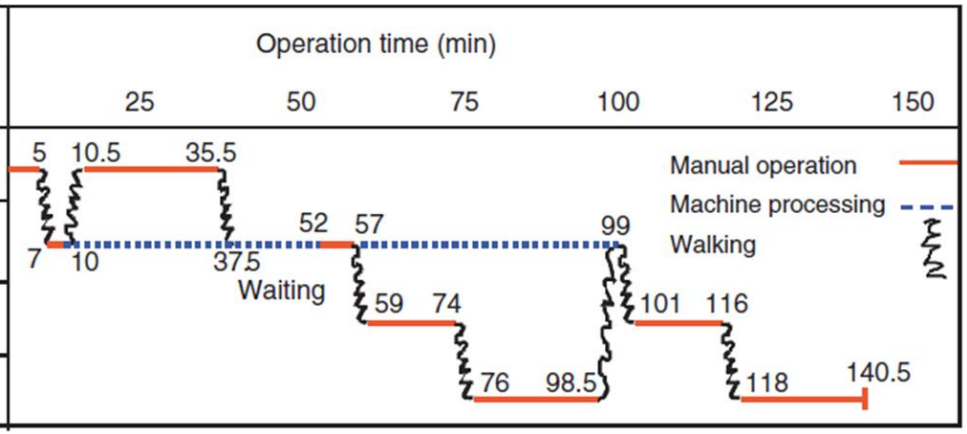


Figure 4. Standard operation routine sheet for fabrication operation.

Standard operation routine sheet for finishing operation

#	Name of operation	Manual time	Machine time
1	Debur	45	
2	Wash	20	
3	Dry	5	
4	Paint	20	
5	Bake		30

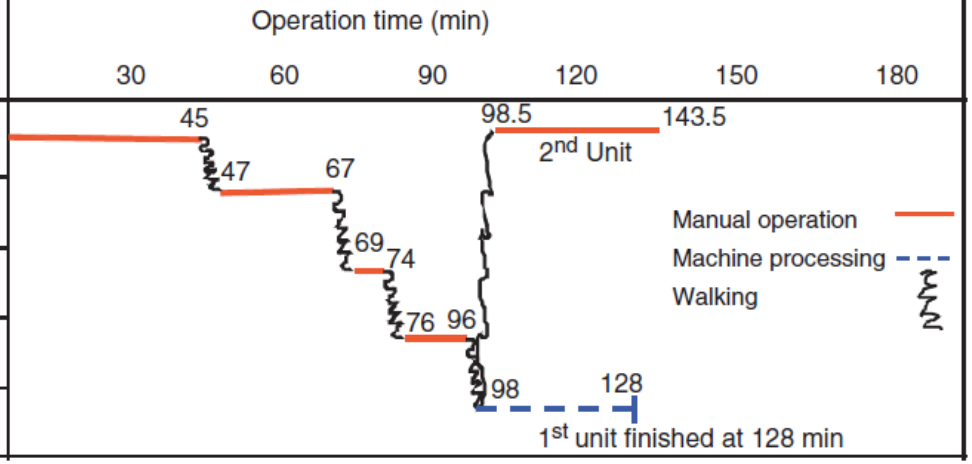


Figure 5. Standard operation routine sheet for finishing operation.

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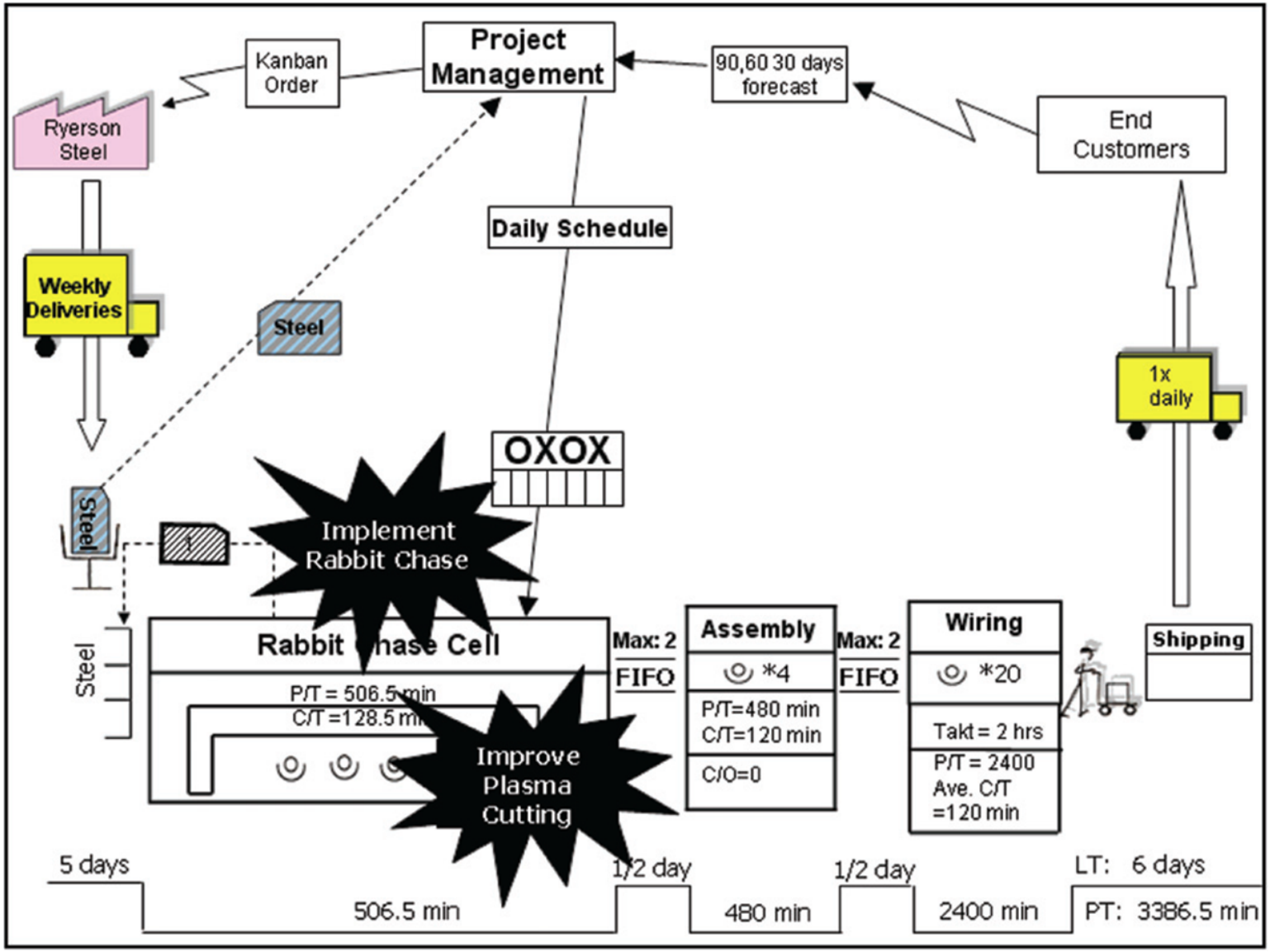
Future state

Setting the future state

1. Calculate Company A's takt time and pitch.
2. Determine if finished goods should go to a supermarket or ship directly to customers.
3. Identify where to use continuous flow processing.
4. Determine where to use supermarket pull mechanisms.
5. Determine the location of the pacemaker.
6. Determine how to level the production mix at the pacemaker.
7. Determine the increment of movement at the pacemaker.
8. Identify the improvements needed to achieve the future state.

Future state VSM



Kaizen event 1

- Reducing waiting time and defects at the plasma cutting machine.

Kaizen event 1

Problem statement: There is waiting time in the production sector.

1. **Why is there waiting time?**
   - The cycle times are different: 140.5 min in fabrication, 250 min in welding, and 128 min in finishing. The fabrication stage is the bottleneck.
2. **Why is the fabrication stage the bottleneck?**
   - Cycle time of the plasma cutter is 42 minutes, which creates production delay.
3. **Why is the cycle time of the plasma cutter 42 minutes?**
   - The plasma cutter creates defects that need reworked. In addition, inspection time is added for this reason.
4. **Why does the plasma cutter create defects?**
   - The plasma cutter is not working on its optimal parameter settings.
5. **Why does the plasma cutter not work on the optimal parameter settings?**
   - The optimal parameter settings were not available, because no DOE (Design of Experiment) study had been conducted.

Figure 7. '5 whys' for waiting time root cause.

Kaizen event 2

- Reducing inventory waste.

Kaizen event 2

Problem statement: There is inventory in the production sector.

1. **Why is there a lot of inventory between the fabrication and welding areas?**
   - Inventory buildup occurs whenever there are delays in the welding operations.
2. **What causes delays in the welding operations?**
   - Since two welding operators share the load, if one of them is absent, the welding operation delays the other processes. This is because there is no substitution of workers when a welder is unable to be at work.
3. **Why is there no substitution?**
   - Only two operators are trained as welders and skilled welders are a very limited resource in the Midwest.
4. **Why are all employees not trained as welders?**
   - The company does not currently cross-train employees.
5. **Why is there no cross training?**
   - The company does not have a system to cross-train workers

Figure 12. '5 whys' for inventory root cause.

Kaizen event 2

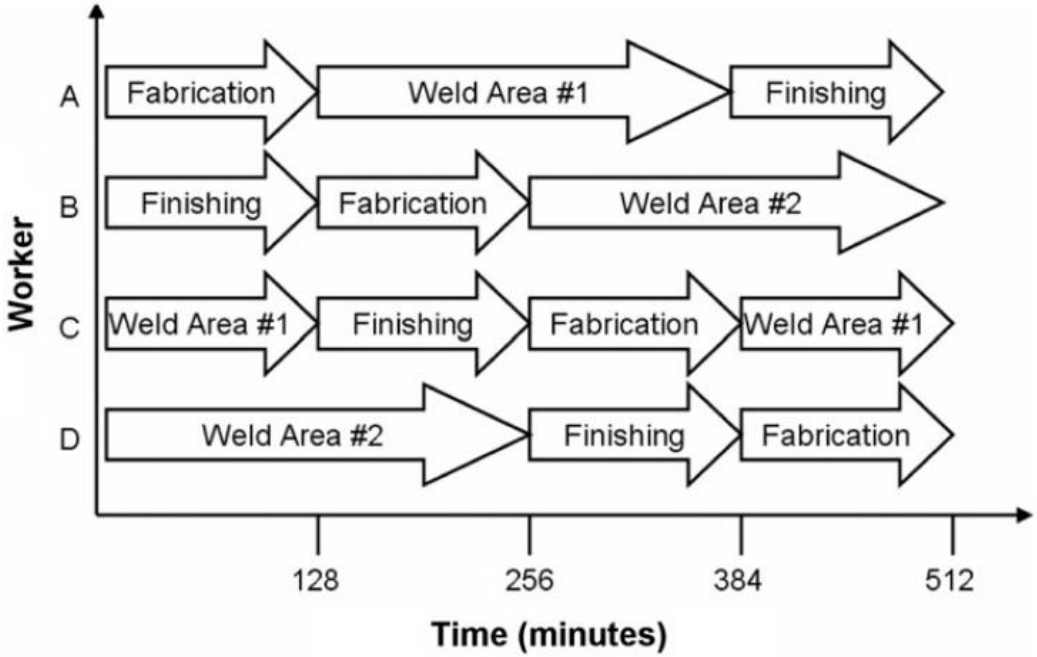


Figure 13. Positions of workers in a four worker rabbit chasing cell. Fabrication (128.5 min), welding (250 min), finishing (128 min).

Kaizen event 2

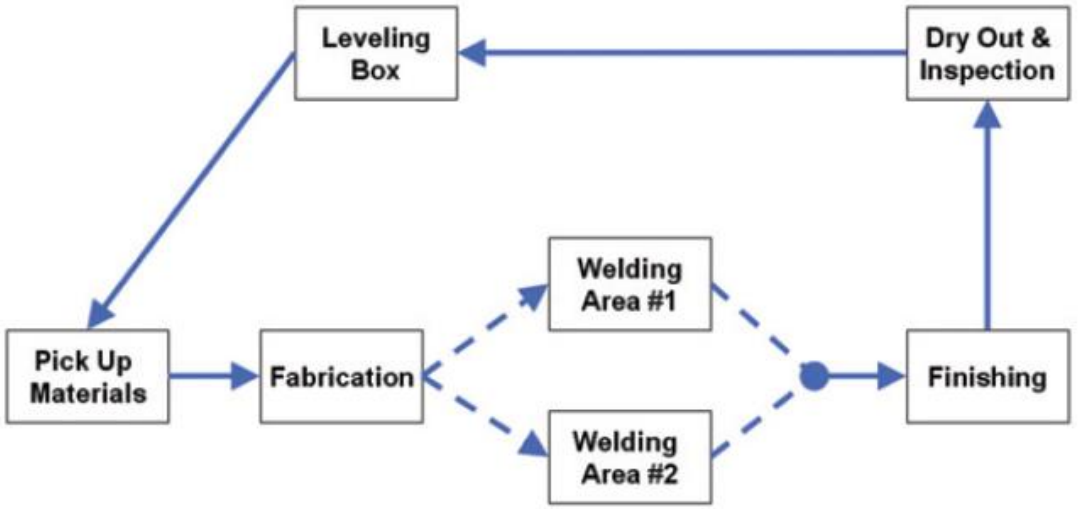


Figure 14. Flow of the proposed rabbit chasing system.