Production analysis, Skid and Trolley Analysis in Car Manufacturing Industry - Case Study

Summary

Client Organization is a global automotive industry leader specializing in the production of body-in-white closures, exhaust systems, and closure manufacturing equipment.

They provide a complete turn-key solution, offer a fully integrated production system that supports customers from product design, tool development, through mass production. The flawless execution of their Full Vertical Approach enables them to achieve short vehicle development timeframes with exceptional quality.

To quickly understand their design, a simulation study is done to ascertain the required operating parameters.

Aims/Objectives

- Understand system throughput.
- Identify Bottlenecks
- Skid analysis.
- Trolley Analysis.
- # of vehicles (forklift and tow-trucks needed

Key Points

- Current Facility can achieve required throughput.
- Entry at paint is bottleneck.
- Recommended skid count of 70 – 90 skids
- Recommended trolley count of 358 trolleys
- 3 forklifts and 4 tow-trucks are required

Client's Challenge

- Random Sequence of products on mainline
- Conveyor rules to maintain WIP
- Recovery during major breakdowns
- Blackbox operation of subassemblies
- Batch production and changeovers on Subassemblies

PMI's Approach.

The study was organized in a 6-stage process:

1. Data Verification and Static analysis
2. Conceptualization
3. Model Building and verification.

4. Testing Scenario's
5. Results and Conclusion

Data Verification and Static analysis – Check data provided by client, analyse information and theoretically estimate the possible utilization and output from the system.

Conceptualization – Understand all parameters, rules and possible changes in the manufacturing system. Come up with a flexible model building method to quickly accommodate possible changes.

Model Building and Verification – Using Simulation software, build and check behaviour of model against static analysis.

Testing Scenario's – Tweak parameters and analyse the model to bring value to current facility.

Results and Conclusion – Throughput target is achieved. Optimization of skid, trolley and MHE counts. Tabulate all scenario's tested for client reference.

Involvement of Associates –

- PMI – 1 Project Manager, 1 Engineer.
- Client – 2 Project coordinators.

Static Analysis -

- Analyse batch building of subassemblies based on required model mix and setup batches that can meet the target throughput.

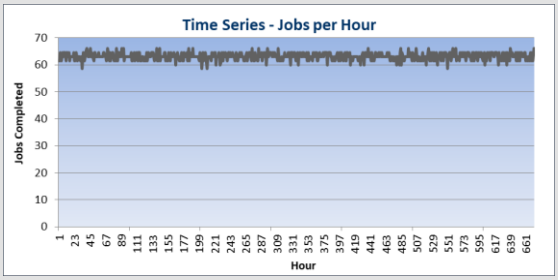
S.No	Front Door		Rear Door		Hood / Tailgate	
	Model	Quantity	Model	Quantity	Class	Quantity
1	5	30	1	81	1	95
2	1	81	4	41	2	41
3	2	54	1	81	1	81
4	1	68	4	41	2	41
5	3	68	1	81	1	95
6	1	81	4	41	2	41
7	4	68	1	81	1	81
8	1	68	4	41	2	41
9	4	68	1	81	1	95
10	1	81	4	41	2	41
11	4	68	1	81	1	95
12	1	68	4	41	2	41
13	2	54	1	81	1	95
14	1	81	4	57	2	27
15	3	68	1	86	1	84
16	1	68				
17	4	68				
18	1	81				
19	4	68				
20	1	68				
21	2	30				
22	1	81				
23	3	56				
24	1	68				
25	4	68				
26	1	81				
27	4	68				
28	1	68				
29	4	35				
30	1	65				

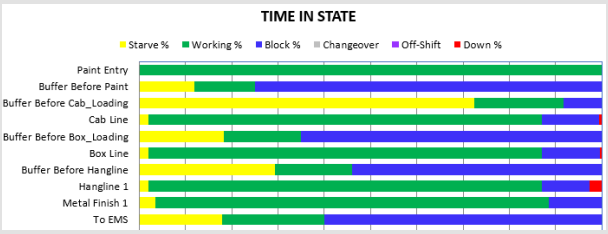
- Machines Utilization factoring in changeovers and downtimes

Finding & Recommendations

After doing analysis and evaluation following results were obtained –

1. Phase 1 – Skid analysis and throughput analysis.
2. Machines Utilizations studied – Paint Entry is the bottleneck.





3. Considering expected WIP for recovery during major breakdowns, the following shows the recommendation of 70-90 skids.

					Maximum Capacity (Units)							
					10	7	5	6	107	39	37	36
					Average Buffer Fill Up (Units)							
S.No	Skids on Mainline	TPUT @ Paint	% Block at Cab line	% Block at Box line	Hangline	B/w Hangline	Metal Finish	Metal Finish to EMS	On EMS	Paint to Cab loading	B/w Cab and Box Loading	Box Loading to Hangline
1	20	38.1	38.3	38.3	19.0	2.4	5.0	1.3	10.1	7.3	1.7	3.5
2	30	60.5	2.0	2.0	19.0	3.7	5.0	2.0	16.1	11.7	2.6	5.6
3	40	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	2.7	11.8
4	50	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	2.7	21.8
5	60	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	2.7	31.8
6	70	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	2.8	36.0
7	80	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	12.7	36.0
8	90	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	22.7	36.0
9	100	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	27.7	36.0
10	110	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	32.7	36.0
11	120	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	12.1	37.0	36.0
12	130	61.7	0.0	0.0	19.0	7.0	5.0	2.1	20.3	21.9	37.0	36.0
13	140	61.7	0.0	0.0	19.0	7.0	5.0	5.0	17.4	39.0	37.0	36.0

4. Phase 2 – Trolley analysis. The best scenario is shown below.

		Model	Trolley Count	Startup at Market Place	Trolley count Variation at market place			Trolley count Variation at Lineside		
					Min	Avg	Max	Min	Avg	Max
Front Door	RH Door	P (CC)	34	5	18	27.4	31	1	1.8	2
		P (RC)	12	5	2	5.8	9	1	2.0	2
		P (SC)	11	5	1	4.0	8	1	2.0	2
		J (CC)	24	5	4	12.9	21	1	1.9	2
		J (RC)	8	5	1	3.4	5	1	2.0	2
	LH Door	P (CC)	34	5	19	27.5	31	1	1.8	2
		P (RC)	12	5	2	5.8	9	1	2.0	2
		P (SC)	11	5	1	4.0	8	1	2.0	2
		J (CC)	24	5	4	13.0	21	1	1.9	2
		J (RC)	8	5	1	3.4	5	1	2.0	2
Rear Door	RH Door	P (CC)	19	5	1	14.0	16	1	1.8	2
		J (RC)	18	5	1	9.5	15	1	1.9	2
	LH Door	P (CC)	19	5	1	14.0	16	1	1.8	2
		J (RC)	18	5	1	9.5	15	1	1.9	2
Hood		P Class	28	5	1	20.5	24	1	1.6	2
		J Class	21	5	3	12.7	18	1	1.9	2
Tailgate		P Class	28	5	1	20.1	24	1	1.6	2
		J Class	21	5	3	12.5	18	1	1.9	2
Fender		LH J Class	4	1	1	1.5	2	1	2.0	2
		RH J Class	4	1	1	1.5	2	1	2.0	2
Total			358							

5. A forced delay is seen on the mainline due to long travel time of the tow-truck. It is the second bottleneck. A sensitivity analysis is done to study benefit of improvement.

Scenario	Tow-Truck Trip Time	Simulation Results					
		Tow-truck - # of Trolleys / Trip			Total wait % at Hangline	Avg Forklift Utilisation	Avg Tow-Truck Utilisation
		1	2	3			
1	16	6.3%	10.8%	82.9%	1.4%	79.4%	71.0%
2	15	6.8%	11.6%	81.5%	0.9%	79.4%	67.0%
3	14	7.4%	11.9%	80.7%	0.6%	79.4%	62.9%
4	13	7.9%	12.7%	79.5%	0.4%	79.4%	58.8%
5	12	8.6%	13.2%	78.2%	0.3%	79.4%	54.7%
6	11	9.2%	12.6%	78.1%	0.1%	79.4%	50.2%
7	10	9.3%	13.2%	77.5%	0.1%	79.4%	45.8%
8	9	9.4%	13.4%	77.2%	0.0%	79.4%	41.3%
9	8	9.8%	12.6%	77.6%	0.0%	79.4%	36.7%

6. Model is flexible to add more vehicles (Tow-trucks and forklifts), update line speeds, downtimes, changeovers and check deviation of model mix due to randomness.

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