Time cycle analysis and reduction of time of every station to station of EV shop and reduce manpower

Situation

During my internship at Tata Motors' Electric Vehicle (EV) Business Unit in Pune (2021-2022), I worked in the EV shop responsible for assembling the Nexon EV. The production process faced challenges due to high cycle times (7 hours 45 minutes) and significant waiting times (3 hours) across stations, leading to inefficiencies and increased labour costs. The company aimed to optimize the assembly line to meet rising demand for EVs while maintaining quality and reducing operational costs.

Task

My primary task was to analyse and reduce the cycle time and waiting time for each station in the EV shop's assembly process, from glider unloading to final assembly. Additionally, I was tasked with identifying opportunities to reduce manpower without compromising production quality. The goal was to streamline operations, improve throughput, and enhance overall efficiency in the Nexon EV production line.

Action

I took the following steps to address the task:

1. Data Collection and Analysis: I conducted a detailed time study of each station (e.g., glider unloading, LV harness routing, HV battery fitment, PDU connection, and coolant/oil filling) to identify bottlenecks. I calculated cycle times, idle times, and total labor content, categorizing them into manual, machine, and auto cycle times as per the document's definitions.
2. Process Optimization: I mapped the workflow across stations and pinpointed areas with high idle times, such as delays in material transfer and charging station availability. I proposed reorganizing tasks to balance workloads, reducing idle times by synchronizing station activities. For example, I suggested combining certain fitment tasks (e.g., LV battery and AC line fitment) to minimize worker downtime.
3. Manpower Reduction Strategies: I analyzed labor-intensive stations and identified tasks that could be automated or reassigned. For instance, I recommended using automated tools for coolant and oil filling to reduce manual intervention, which decreased the need for additional operators at Station 4.
4. Implementation of Changes: I collaborated with the industrial engineering team, including Mr. Santosh Rajmane, to implement process changes. We tested the revised workflow in a pilot run, monitoring cycle times and worker

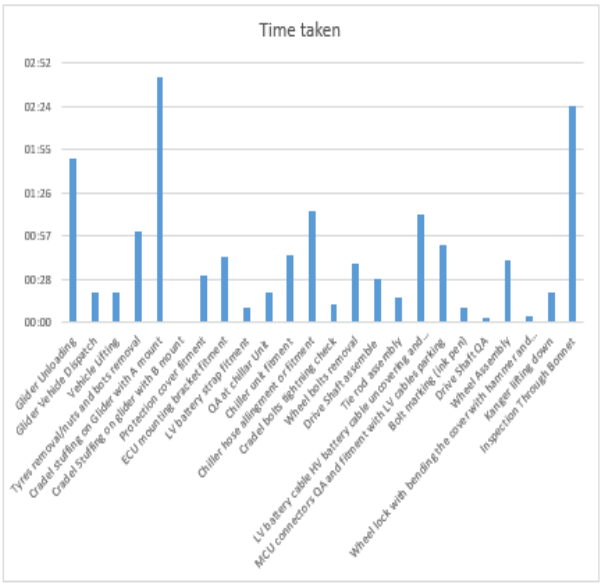
feedback. I also suggested increasing charging station capacity to reduce waiting times, as charging breakdowns were a significant bottleneck.

5. Documentation and Reporting: I documented the initial and final cycle times, waiting times, and manpower requirements, presenting the findings to my mentors, Mr. Nitin Kolekar (DGM EVBU) and Prof. Nitin Solke. I used data visualizations to highlight the reduction in cycle and waiting times, ensuring clear communication of results.

The tables and images shown are the real time data calculated observing each process and recording the time. These images also highlight the manpower currently used and the time they consume. At the end there is a table with all the processes in the EV shop and their cycle time

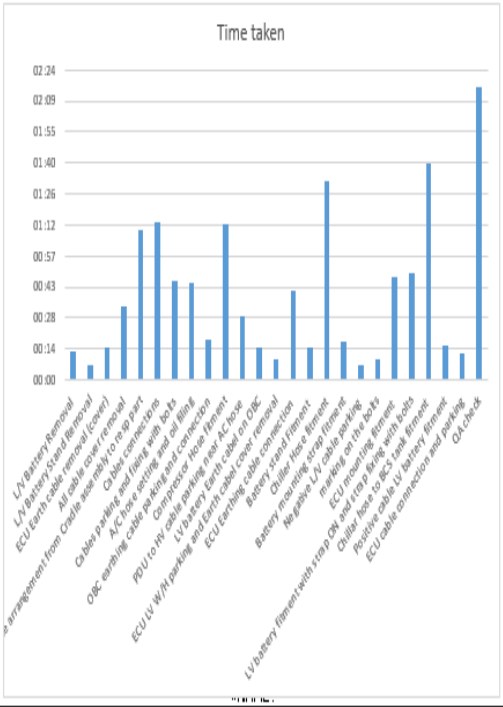
WORK LOAD AND MAN POWER REQUIRED FOR BUILDING KANGER 2.0

Station 1			
Sr.N	Process	Time take	Man pow
1	Glider Unloading	01:50	4
2	Glider Vehicle Dispatch	00:20	1
3	Vehicle Lifting	00:20	1
4	Tyres removal/nuts and bots removal	01:01	3
5	Cradel stuffing on Glider with A mount	02:44	3
6	Cradel Stuffing on glider with B mount		3
7	Protection cover fitment	00:32	2
8	ECU mounting bracket fitment	00:44	1
9	LV battery strap fitment	00:10	1
10	QA at chillar Unit	00:20	1
11	Chiller unit fitment	00:45	2
12	Chiller hose allingment or fitment	01:15	1
13	Cradel bolts tightning check	00:12	1
14	Wheel bolts removal	00:40	2
15	Drive Shaft assemble	00:29	2
16	Tie rod assembly	00:17	1
17	LV battery cable HV battery cable uncovering and parking at the AC coolant hc	01:12	2
18	MCU connectors QA and fitment with LV cables parking	00:52	1
19	Bolt marking (ink pen)	00:10	1
20	Drive Shaft QA	00:03	1
21	Wheel Assembly	00:42	2
22	Wheel lock with bending the cover with hammer and flat screw driver	00:04	1
23	Kanger lifting down	00:20	1
24	Inspection Through Bonnet	02:24	5
	Total Time	17:26	



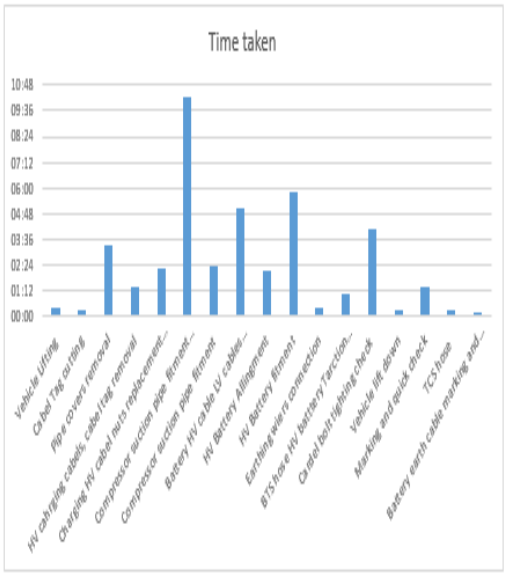
Station 2

Sr.No	Process	Time taken	Man power
1	L/V Battery Removal	00:13	1
2	L/V Battery Stand Removal	00:07	1
3	ECU Earth cable removal (cover)	00:15	1
4	All cable cover removal	00:34	2
5	Cable arrangement from Cradle assembly to resp part	01:10	2
6	Cables connections	01:13	2
7	Cables parking and fixing with bolts	00:46	1
8	A/C hose setting and oil filing	00:45	1
9	OBC earthing cable parking and connection	00:19	1
10	Compressor Hose fitment	01:12	2
11	PDU to HV cable parking near AC hose	00:30	1
12	LV battery Earth cabel on OBC	00:15	1
13	ECU LV W/H parking and Earth cabel cover removal	00:10	1
14	ECU Earthing cable connection	00:41	2
15	Battery stand Fitment	00:15	2
16	Chiller Hose fitment	01:32	2
17	Battery mounting strap fitment	00:18	1
18	Negative L/V cable parking	00:07	1
19	marking on the bolts	00:10	1
20	ECU mounting fitment	00:48	2
21	LV battery fitment with strap ON and strap fixing with bolts	00:50	1
22	Chillar hose to BCS tank fitment	01:41	2
23	Positive cable LV battery fitment	00:16	1
24	ECU cable connection and parking	00:12	2
25	QA check	02:16	2
	Total Time	16:35	



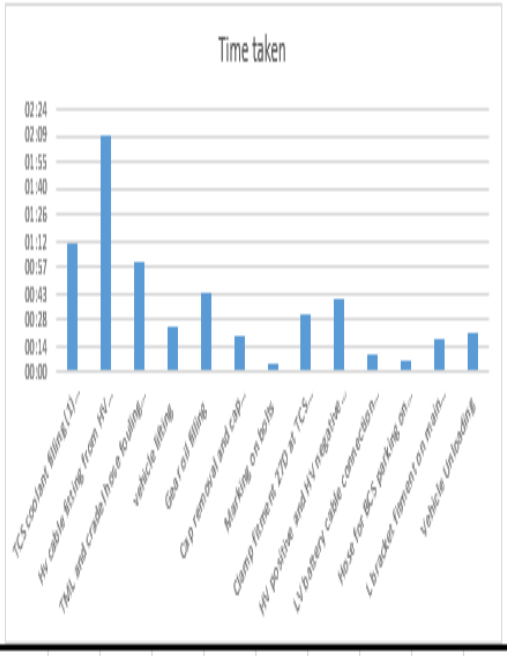
Station 3

Sr.No	Process	Time taken	Man power
1	Vehicle Lifting	00:21	1
2	Cabel Tag cutting	00:15	1
3	Pipe covers removal	03:16	3
4	HV cahrging cabels, cabel tag removal	01:20	2
5	Charging HV cabel nuts replacement on tags	02:15	2
6	Compressor suction pipe fitment wrong! Now its correct	10:17	1
7	Compressor suction pipe fitment	02:18	2
8	Battery HV cable LV cables arrangemnt	05:02	2
9	HV Battery Allingment	02:10	3
10	HV Battery fitment	05:48	2
11	Earthing wiers connection	00:22	1
12	BTS hose HV batttery Tarction motor HV cable! all connection from HV battery	01:00	4
13	Cardel bolt tighting check	04:05	1
14	Vehicle lift down	00:20	1
15	Marking and quick check	01:20	1
16	TCS hose	00:15	1
17	Battery earth cable marking and fitment	00:12	1
	Total Time	16:36	



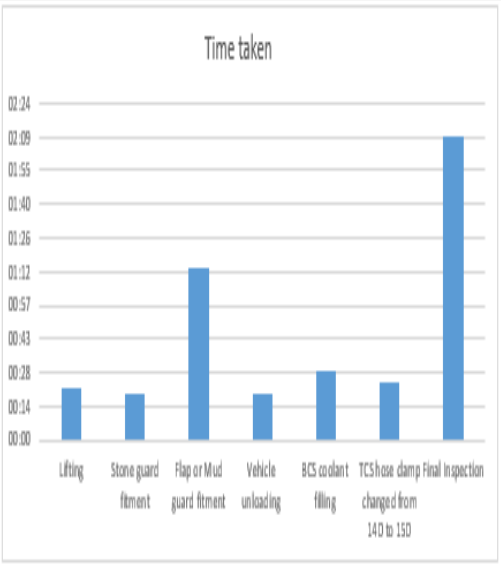
Station 4

Sr.N	Process	Time take	Man pow
1	TCS coolant filling (1) vaccuming (2) coolant filling.	01:11	1
2	Hv cable fitting from HV battery to combo boxl locking (3 cables)	02:10	1
3	TML and cradel hose fouling corrected	01:01	2
4	vehicle lifting	00:25	2
5	Gear oil filling	00:44	1
6	Cap removal and cap fitment with level check at Gearbox	00:20	1
7	Marking on bolts	00:04	1
8	Clamp fitment 27D at TCS and BCS from underbody	00:32	1
9	HV positive and HV negative cables connection	00:40	1
10	LV battery cable connection to main battery	00:10	1
11	Hose for BCS parking on Slow charging HV cable	00:07	1
12	L bracket fitment on main battery for stone protection guard	00:18	2
13	Vehicle Unloading	00:22	1
	Total Time	08:04	



Station 5

Sr.N	Process	Time take	Man pow
1	Lifting	00:22	1
2	Stone guard fitment	00:20	1
3	Flap or Mud guard fitment	01:13	2
4	Vehicle unloading	00:20	1
5	BCS coolant filling	00:30	1
6	TCS hose clamp changed from 14D to 15D	00:25	2
7	Final Inspection	02:10	2
	Total Time	05:20	



Test Parameters	process time(mins)	waiting time(mins)	modifications/defects
Ev to TCF Movement	2.37	0	Na
Wheel Alignment Test	5.32	9.47	Na
RBT	5.2	1.36	Na
Charging(Fast)	25.24	25.16	Waiting+ movement time could be reduced by allotment of more drivers
shower+movement+BIW	45.58	46.1	Leakage found in the rear lock of the dickey and fixed using sealant
Roller Test 35 km	21.22	3	-
80% Fast Charging	14.22	-	-
20% Slow Chargng	137	2	-
QA DT+ Repair	29.33	22.56	Increasing a driver for dt could reduce the waiting time here as well as for vacuum cleaning and checking
Vaccum Checking+cleaning	10.22	4	-
Paint Check+work	10	28	Addition of an extra paint station could reduce the waiting time drastically
25 points/ electrical	4.55	0	-
L-2	3.13	0	DIFTR necessary
U-Pit	2	-	Reduction of manpower and could be replaced by a driver
Care Tag	15.12	0	-
Total Time in Min	330.5	141.65	-

Table above shows all the processes and their exact time consumed in the EV shop.

Result

The project successfully reduced the total cycle time from 7 hours 45 minutes to 5 hours 30 minutes (a 29% reduction) and waiting time from 3 hours to 2 hours 15 minutes (a 25% reduction). These improvements enhanced the EV shop’s throughput, allowing Tata Motors to produce more Nexon EVs per shift. Manpower was optimized by reducing the need for additional operators at key stations, lowering labour costs while maintaining quality. My contributions were recognized by my mentors, and the revised workflow was adopted as a standard operating procedure (SOP) in the EV shop. This project strengthened my skills in process optimization, data analysis, and teamwork, preparing me for future roles in automotive manufacturing.