Internship

Implementation of Product Identification

Using Bar Code for Automotive PU Foam Pads

At

Spack Automotives Pvt. Ltd, India

Location:

Greater Noida, Uttar Pradesh, India

Thiruvallur, Chennai, Tamil Nadu, India

Vania Aman Chopra

April ~ August 2019

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Note of thanks

10th August 2019

To,
Ms. Vania A Chopra
Modern School Vasant Vihar
Vasant Vihar
New Delhi

Sub: Internship / Trainee
Project: Barcode implementation on PU Foam pads

Dear Vania,

I refer to your internship and training in our company at both our facilities in Greater Noida and Chennai between April 2019 and August 2019.

I would like to note that you spent a total of 12 days at Spack factory in Greater Noida, 7 days at Spack Chennai factory and 1 day at Hyundai Transys Lear, Seat Plant, Chennai during your internship.

Your work as a trainee in the study and implementation of the barcode project was impressive, especially for your age. I like your logical way of thinking and approaching problems on the shop floor.

I wish you the best for your future.

Best regards,

Y J Shin
Executive Director

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IMPLEMENTATION OF BARCODE SYSTEM FOR CAR SEAT PU FOAM PADS OF SPACK AUTOMOTIVES FOR IDENTIFICATION AT HYUNDAI TRANSYS LEAR CAR SEAT ASSEMBLY LINE

Chapter 1 : INTRODUCTION

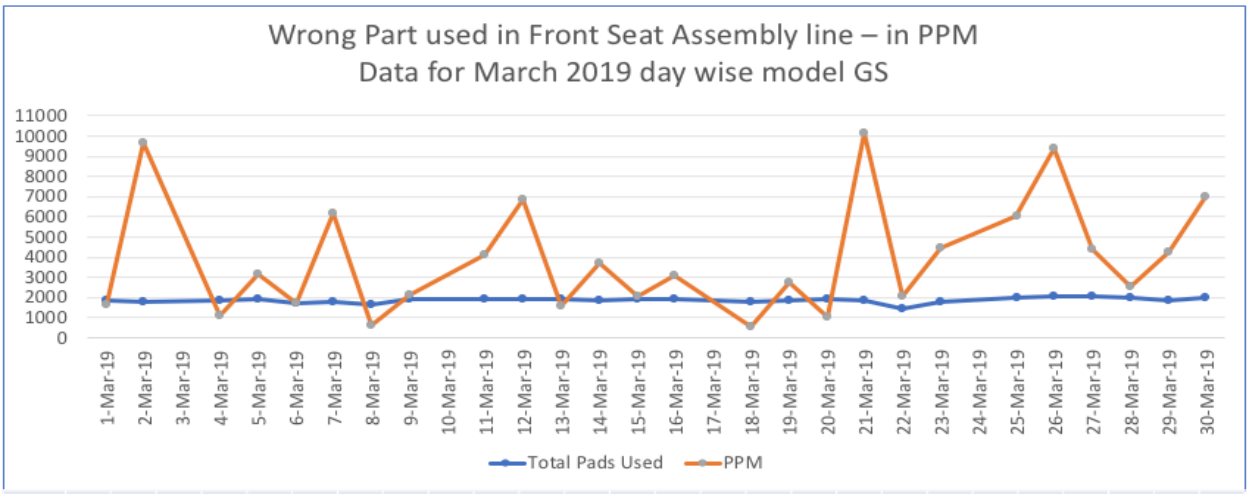
1.1 ABSTRACT

PU Foam Pad is an integral part of an Automotive Vehicle Seat, providing comfort to the driver and passenger. It is a component which is generally produced by a PU Foam moulding company, a Tier II company and in some cases by the Seat manufacturer, a Tier I company. The PU Foam is supplied to the car seat assembly line, where is it finally assembly into the seat.

It is important to identify each pad as it is unique in shape, size and hardness for every car model and every version of the car model, for example, the PU Foam pad for a Honda Civic Driver Cushion will be different from that of a Honda Accord and even with the Civic model it will be different for Leather and Fabric versions of the car or for the seat model with an air bag and the one without an air bag. The complexity increases when different models of car seats are assembled on the same assembly line. I was amazed at the complexity of the variants and at the simplicity and ease with which the operators on the line assembled the seats with the help of technology.

Each Foam pad, is therefore, made to a specific part number, the number is ingrained in the PU Foam mould and during moulding leaves an “etched” impression on the PU Foam pad. It is easy to identify the PU Foam pad by number, however, owing to the complexity and speed at which Pads are used on the line, it is impossible for the operators to read each number, memorize the model and usage. Looking at this complexity & speed of use and the Accuracy required, Hyundai Transys Lear asked its suppliers to implement a bar code system on the pads being supplied. A request for a solution and its implementation was generated.

In cases where a worker picks an incorrect part or wrong part, the line would have to be stopped and the seat be removed from the spot, incase part could not be replaced with a correct one immediately. This led to line loss and was being measured in Parts Per Million, this graph shows data from March 2019 for the front seat assembly line for GS model, where about 450 ~ 475 cars are made per day. Each front seat uses 2 pads and each car uses 2 front seats.



Date	3/1/19	3/2/19	3/4/19	3/5/19	3/6/19	3/7/19	3/8/19	3/9/19	3/11/19	3/12/19	3/13/19	3/14/19	3/15/19	3/16/19	3/18/19	3/19/19	3/20/19	3/21/19	3/22/19	3/23/19	3/25/19	3/26/19	3/27/19	3/28/19	3/29/19	3/30/19
Total Pads used	1820	1760	1840	1900	1740	1780	1650	1900	1940	1900	1930	1880	1940	1940	1780	1840	1890	1870	1450	1800	1980	2030	2040	1980	1870	2000
Wrong Part PPM	1648	9659	1087	3158	1724	6180	606	2105	4124	6842	1554	3723	2062	3093	562	2717	1058	10160	2069	4444	6061	9360	4412	2525	4278	7000

Source: Production Team, Hyundai Transys Lear India, Chennai

Spack Automotives, the PU Foam Pad supplier where I was an intern, was tasked with implementation, the main goal being achieving 100% Accuracy. It was very interesting for me to see how the problem was first understood, then dissected into smaller pieces (problems) and the each one addressed with a suitable solution, keeping in mind one goal 100% Accuracy with Fool Proofing.

During my in meetings and discussion at Spack both in Greater Noida and at Chennai, with the technical team, the engineering team, shop floor operators, IT team, ERP team, quality department personnel, maintenance team and management, I realized each one had a different set of problems they wanted addressed, all problems sounded genuine. The complexity of dealing with so many people is also challenging, I think I now have a better understanding of what management means, it is the driver which makes all these different parts of the organization move as one cohesive force.

I have, in my report, put information on the manufacturing process, the solution options, the decision on solution, phase of implementation and trouble shooting.

My internship was completed during the Trial Run stage, which was after some teething issues was successful, it was a great sense of achievement to see this complex project come to life.

Days spent during internship:

Company	Location	Total No. of Days spent
Spack Automotives Pvt. Ltd.	Greater Noida	12
Spack Automotives Pvt. Ltd.	Chennai	7
Hyundai Transys Lear India Pvt. Ltd.	Chennai	1

1.2 ACTIVITY & PROJECT FLOW

In the initial meeting, the team, comprising Business Development, Production, Quality & Dispatch members of Spack, decided on the work flow. It was the process which was to be followed for barcode implementation.

The same have been listed below.

1. Define Goal
2. Decide on Project Members
3. Collect information
4. Identify methods for solution
5. Finding the best solution
6. Identify tools & technology
7. Solution map with Processing
8. Prepare development & running cost
9. Start development
10. Trial run
11. Troubleshooting
12. Go live

1.3 DEFINE GOALS

Requirement: **Part Identification with 100% Accuracy**

Customer Line Requirement: To be implemented with a barcode print / sticker on PU Foam pads

Error Tolerance: Zero PPM

Requirement By:

Hyundai Transys Lear Automotive Pvt. Ltd., Chennai Plant

Project Start Date: April 3, 2019

Trial Run: August 2019

Go Live: 1 Sept 2019

1.4 PROJECT MEMBERS & RESPONSIBILITIES

S. No	Name	Designation	Responsibility	Contact Details
1.	S. S. Grewal	Managing Director	Budget Authorization Decision on Solution to be implemented Review of Project Progress	ss.grewal@powerspack.com 98100 72857
2.	Y. J. Shin	Executive Director – Chennai Plant	Budget Authorization Plant Level Team creation Customer interaction on best solution Defining roles and responsibilities for team members Initiating the production & quality process at the plant	yjshin@powerspack.com 95516 91050
3.	Malaya Mishra	Sr. GM – Business Development (PU)	Compiling a detailed report of the customer requirement Cost impact implementation with customer Communicating the customer requirement to Plant team	malaya.mishra@powerspack.com 99101 68179
5.	Anil Batra	Senior Manager – IT/ERP	Identifying discrepancies between the production processing and customer requirement Conceptualizing solutions to eliminate the discrepancies ERP linked Solution Implementation in ERP and on PU Line Trouble Shooting	anil.batra@powerspack.com 98113 78192
6.	Sanjeev Shrivastava	Asst. Manager – IT	Addressing all digital infrastructure requirements with the corresponding hardware and networking machinery Fool Proofing sticker printing and production sequencing Trouble Shooting	sanjeev.shrivastava@powerspack.com 98999 00257
8.	Vania A Chopra	Intern	Collecting data and documentation Identifying problems and correction Compile tools and technology Conducting trial run and to record outcomes / errors	vaniachopra@gmail.com 98100 97105

Chapter 2 : SOLUTION

2.1 INFORMATION COLLECTION

We collected the information pertaining to production, quality & dispatch of the pads to understand the problems that can occur in the process and to find the solutions before-hand. The information was collected from Department Head – ERP, Production and Dispatch, in addition to this further additional information, directly related to the barcode project implementation was also collected.

- **ERP System:**

a) Update customer information
b) Create a customer identification number
c) Generate a sales order
d) Transfer of the Finished Goods stock to the warehouse after scanning barcode
e) Scan barcode to add it to sales order
f) Send for production
g) Quality check
h) Rejected – transfer to scrap yard
i) Approved – transfer to dispatch area

- **Production:**

a) PLC
b) SCADA System
c) SCADA System network link to PLC
d) Data transfer from PLC to SCADA System
e) SCADA data analysis to identify production
f) Cycle time
g) Robotic chemical Injection into mould
h) Mould Closing
i) Mould opening
j) Transfer pad from the mould to Crusher – vacuum / roller.
k) Transfer pad from crusher to the inspection line

l) Rejected – transfer the pads to scrap yard

m) Approved – transfer the pads for dispatch area

- **Dispatch:**

a) Generate a sales invoice from the plant to the customer

b) Scan barcode before dispatch

c) Transfer pads to the warehouse with barcode scanning

d) Generate a sales invoice from the warehouse to the customer

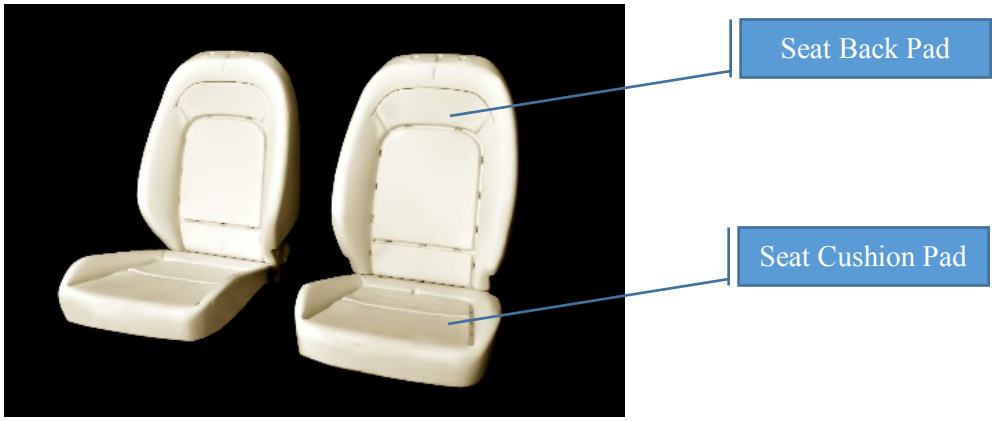
e) Scan barcode before dispatch

- **Additional Information:**

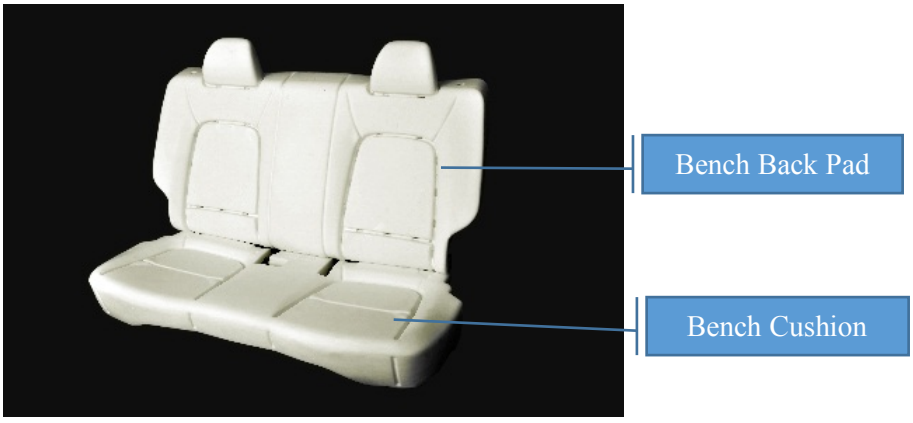
a) We analyzed the time gap (cycle time) between chemical pouring & demoulding.

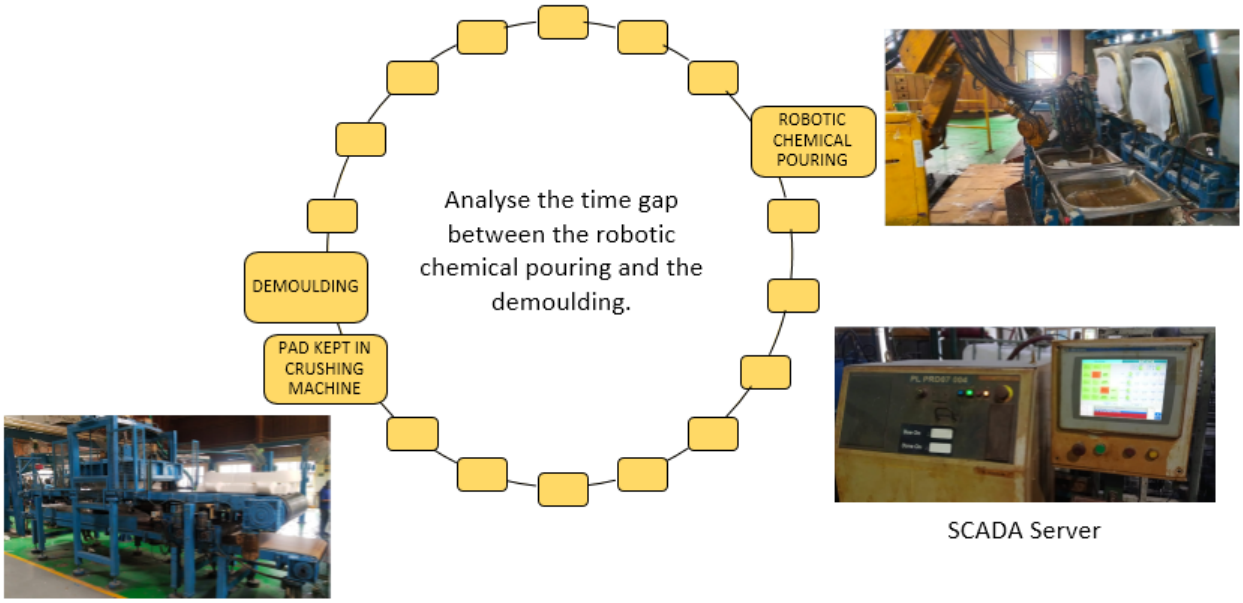
b) It was important to note that a carrier can accommodate:- (image for reference only)

i. 2 Small Moulds – 2 Seat Back Pad Moulds or 2 Seat Cushion Pad Moulds



ii. One Big Mould – Bench Cushion Pad Mould or Bench Back Pad Mould





The above carousel image depicts a continuous line with 18 Carriers at Spack Chennai Plant. The line runs at a pre-fixed speed (Cycle time), set to get the best results in terms of pad production, which is based on the chemical reaction and cure time.

The robot injects chemical in an open mould, the mould closes & then opens at the pre-fixed destination after the cycle time is completed.

The pad is taken out by an operator, who then puts it in the crushing machine to process it further till it is finally dispatched to the customer for assembly.

The Scada server records the machine production, process parameters and it identifies any irregularities in the process. They have preset tolerances for every parameter, in reading goes out of parameter, an alarm sounds and a machine operator attends to it and corrects it.

2.2 IDENTIFY METHODS FOR SOLUTION

- **Option A**: Using Mould Scanning

a) Fix a barcode sticker on the outside area of each mould
b) A barcode scanner will scan the outer sticker
c) Print the barcode immediately after scanning
d) One operator will take the pad from the mould, take the barcode sticker from the barcode printer and paste the barcode on the pad

- **Option B**: Using Scada System

a) The existing system available gives the data information to the SCADA server for pad production.
b) Assess the information from the SCADA server
c) Print the barcode against production data available in the SCADA server.
d) One operator will take the pad from the mould and the barcode sticker from the barcode printer and paste the barcode on the pad

- **Option C**: Print within the Mould

a) Use advanced technology for printing the barcode shape on the pad, and have a mould available for the same
b) No manpower required for using the process

2.3 FINDING THE BEST SOLUTION

- **Option A**: Using Mould Scanning

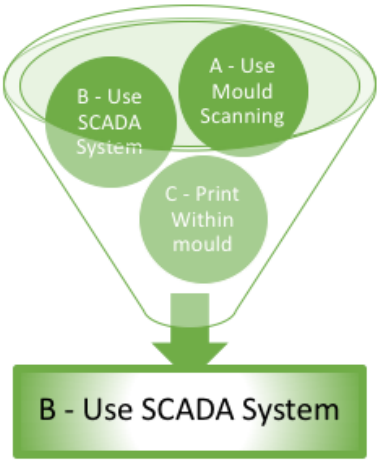
a) Sticker can detach due to mould temperature
b) Sticker can detach at time of mould cleaning / loading & unloading
c) Chemical or dust may settle on the mould and obstruct scanning
d) Mould Release Agent spray affects sticker surface
e) No dependency on the SCADA server
f) Simple printing method, scan the mould and print the sticker
g) Software requirement is for configuring the printing equipment

- **Option B**: Using Scada System

a) Network connectivity between PLC /SCADA server breaks and data fails to record, stopping the barcode printing
b) Barcode printing software system will manage the cycle time between data recording and mould opening
c) If the mould is running blank, then the system will neither record the production nor print the barcode
d) Software requirement for setting up the machine/item details for printing requirement

- **Option C**: Print within the Mould

a) Unable to find the technology which prints barcode within Mould.
b) We made a plate with Barcode impression (unique to the mould) & attached it inside test mould so as to get impression of the Barcode in Pad Surface itself.
c) However, we were unable to scan due to the reason that the whole pad is white and barcode scanner was unable to identify the shape of the barcode.
d) Also, in this option, we had to print additional barcode with date & time, to be attached on each pad after demoulding



2.4 IDENTIFY TOOLS & TECHNOLOGY

The team decided to go-ahead with option B, i.e., taking help of SCADA System to print the Barcode. The following table contains the Tool & Technology requirement by the ERP, production & Dispatch Departments.

S.No.	Requirement	Status
1.	SCADA Server - Factory Talk View version 10	Available
2.	SQL Database (*Version 2014)*	SQL server express *free version which support 10GB database*
3.	Customized Application for Printing Process - Developed in C# & ASP.Net	Developed In-House
4.	One Computer for printing barcode	New Installed
5.	One Commercial barcode printer	New Installed
6.	One Stand-By normal barcode printing	New Installed
7.	Barcode scanner – Plant	New Installed
8.	Barcode scanner – Warehouse	New Installed
9.	Barcode scanner - stand by for safety	New Installed

Barcode Specifications

Size: 18 digits

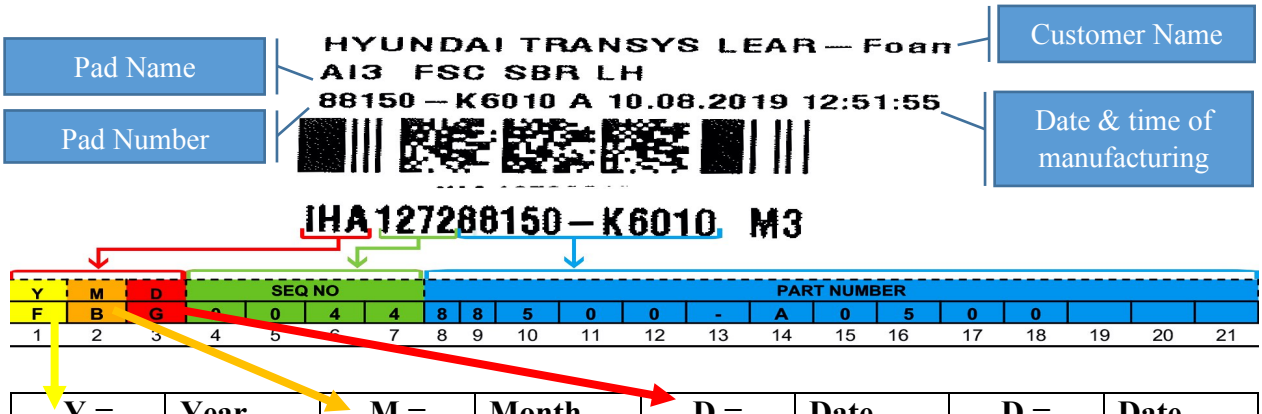
First 3 Digits: Date "YMD"

Next 4 Digits: Sequence of the day in numbers (*1 to 9999 range: Start at 1 and end at 9999 everyday*)

Next 11 Digits: Customer Part Number

Other Details: Barcode for each pad will be unique, print and paste on production line, immediate after demoulding.

The below image depicts the barcode which is printed on the pad. The tables depicts the sequence which is used to depict the Year, Month & Date of manufacture of the pad in barcode.



Y =	Year	M =	Month	D =	Date	D =	Date
A	2011	A	January	1	1	H	17
B	2012	B	February	2	2	I	18
C	2013	C	March	3	3	J	19
D	2014	D	April	4	4	K	20
E	2015	E	May	5	5	L	21
F	2016	F	June	6	6	M	22
G	2017	G	July	7	7	N	23
H	2018	H	August	8	8	O	24
I	2019	I	September	9	9	P	24
J	2020	J	October	A	10	Q	26
K	2021	K	November	B	11	R	27
L	2022	L	December	C	12	S	28
				D	13	T	29

2.5 SOLUTION MAP WITH PROCESSING

The Scada System Option has been finalized.

There are 18 carriers in the Carousel line at Spack Chennai and all the carriers are occupied at a given time. The Scada server has been re-programmed, where the PLC Part Number is fed into it by the Production team, which is linked to the chemical pour by robot of that pad & also the Pad Name and Part Number to be depicted on the barcode.

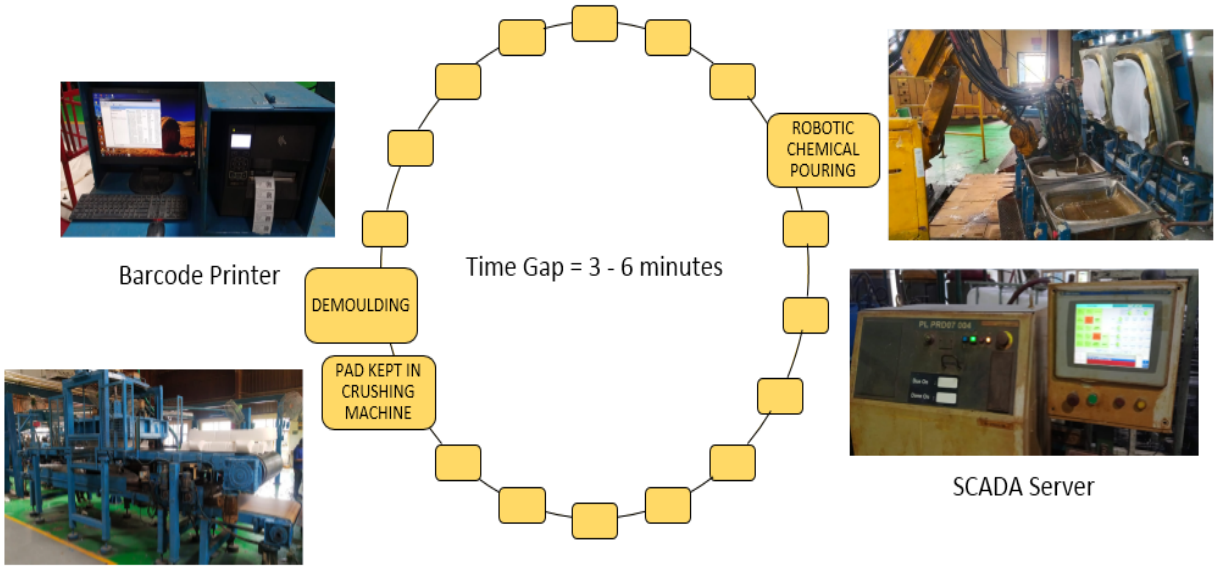
This PLC Part Number has to be changed according to the mould being loaded at the time so that the Robot injects the correct recipe and also the barcode provides the correct information of the pad being produced.

The Robot receives a message confirmation of the incoming mould with the help of RFID in the carrier and injects chemical recipe into the given mould in a preprogrammed pouring pattern. The information of the Part Number is shared with the Bar Code printer with a time gap for printing based on the cycle time.

The operator de-moulds the pad from the mould after it opens pastes the barcode on the pre-decided area, the pad is then placed on the crushing machine conveyor.

Further pad is inspected and moved to storage for a 24 hour curing cycle, post which it is moved to the Finished Goods Area and dispatched based on customer schedule.

The Pad is finally placed at customer assembly line side, where the operator picks the pad based on requirement and scan its barcode, which is confirmed by seat assembly line computer for use in the particular seat assembly.



PU Foam Carousel Mould Sequencing

Carrier Information of the Moulds along with the PLC Part No.

This helps the PU Machine recognize the Part Name and Part Number to be printed on the Barcode

The below table depicts the carrier number, the mould(s) mounted on the carrier & the corresponding customer part number. The PLC part no. is inserted by the production team in the server corresponding to the mould.

Carrier No.	Customer Part No.	Customer Part Name	PLC Part No.
1	89150-B4100	BA 5DR PAD RSC W/O CTR WIRE	BA RSC 100%
2	89150-B4000	BA 5DR PAD RSC WITH CTR WIRE	BA RSC 100% EXP
3	89150-B4200	PAD&FRM ASSY RSC BA/LA-AMERICA	BA RSC 100% LA
4	88150-A0000	PAD ASSY FRT SEAT CUSH LH GS	GS FSC LH
	88250-A0000	PAD ASSY FRT SEAT CUSH RH GS	GS FSC RH
5	88350-A0010	PAD ASSY FSB LH SAB GS	GS FSB LH
	88450-A0010	PAD ASSY FSB RH SAB GS	GS FSB RH
6	89150-A0000	PAD & FRM ASSY RR SEAT CUSH GS	GS RSC 100%
7	89350-A0000	PAD ASSY RR SEAT BACK H/BACKGS	GS RSB 100% HB
8	88250-A0500	PAD ASSY FRT SEAT CUSH RH GS.	GS FSC SBR RH
	88150-A0510	PAD ASSY FSC LH GS	GS FSC SBR LH
9	89350-A0200	PAD ASSY - RR SEAT BACK U/D	GS RSB 100% UD

Carrier No.	Customer Part No.	Customer Part Name	PLC Part No.
10	89350-A0500	PAD ASSY-RR SEAT BACK, LH	GS RSB 60% SB
	89350-A0510	PAD ASSY - RR SEAT BACK, RH	GS RSB 60% DB
11	89350-H6100	PAD&FRAME ASSY-RR SEAT BACK	HCI RSB 100% HB EXP
12	89350-H6200	PAD&FRAME ASSY-RR SEAT BACK	HCI RSB 100% UD DOM
13	89350-H6400	PAD&FRAME ASSY-RR SEAT BACK	HCI RSB 100% UD EXP
14	89350-H6500	PAD ASSY-RR SEAT BACK-LH	HCI RSB 40%
	89450-H6500	PAD ASSY-RR SEAT BACK-RH	HCI RSB 60%
15	89150-H6000	PAD&FRAME ASSY-RR SEAT CUSH	HCI RSC 100% DOM
16	89150-H6700	PAD & FRAME ASSY-RR SEAT CUSH	HCI RSC 100% EXP
17	89350-A0520	PAD ASSY-RR SEAT BACK LH UD/DOWN+A/REST	GS RSB 60% 520
18	88450-C7010S	IB FSB RH, STD	IB FSB STD RH
	88350-C7010S	IB FSB LH, STD	IB FSB STD RH

Chapter 3 : COST

3.1 INVESTMENT

Development & Investment cost:

One Time Cost – Investment				
S.No.	**Requirement**	**Qty.**	**Cost / Unit Rs.**	**Total Cost Rs.**
1.	Desktop	1	40,000	40,000
2.	Barcode printer - Commercial	1	40,000	40,000
3.	Barcode printer – Normal	1	16,000	16,000
4.	Barcode Scanner	3	2,500	7,500
5.	Software Development Cost	1	150,000	150,000
6.	Other Hardware	1	30,000	30,000
Total				**283,500**

3.2 COST PER PIECE

Running Cost – Per Piece Cost		
S.No.	**Requirement**	**Cost per Piece Rs.**
1.	Barcode sticker per piece @ 0.15 (Sticker size 28mm)	0.17
2.	Barcode paper roll (300 meter)	0.03
3.	Manpower Cost Per day @880/5000 pads/day	0.27
4.	Printer Head Cost /Yearly once change @26000	0.01
5.	Sticker	0.48
Total		**0.96**

Chapter 4 : IMPLEMENTATION

4.1 START DEVELOPMENT

The tasks were finalized & allocated to the team members for completion as per below table:

S.No	Task	Responsibility	Location
1.	Hardware Specification & Selection	Sanjeev, IT Department	Greater Noida
2.	Hardware Procurement	Madhavan, Purchase Team, Chennai	Chennai
3.	Software Development – SCADA / PLC	Shiv Kumar, Electrical Maintenance Head	Greater Noida
4.	Software Development & SCADA / PLC / ERP Linkage	Anil Batra, ERP Head	Greater Noida
5.	Software Testing & Trial (as Intern)	**Vania, Intern**	Greater Noida
6.	Software Setup	Ramasami, ERP Team	Chennai
7.	Software + Hardware - Testing & Review	Anil Batra, ERP Team Shiv Kumar, Electrical Maintenance Sarvanan – Maintenance Head Chennai	Chennai
8.	Production Team Live Trials	Senthil, Production Head,	Chennai
9.	Barcode Pasting on PAD	Surinder Babu, Production Shift In charge	Chennai
10.	Barcode Pasting on PAD + Noting of Problems	**Vania, Intern**	Chennai
11.	Barcode printer maintenance	IT Team	Chennai
12.	Barcode Sticker procurement	Madhavan, Purchase Team, Chennai	Chennai

4.2 TRIAL RUN

After the initial requirements for the process were met, the team decided for a trial run to check for teething problems and find their solutions before the final implementation.

This trial run undertook on Sundays & in the evenings as we could not disrupt the normal production & dispatch of pads as per customer schedule.

We did face some problems initially & found the solutions for the same after brain-storming with the team.

After successful trial run at the end of month, we were finally ready to implement the process in day-to-day production & dispatch of the pads.

Trial Run: August 2019

Chapter 5 : TROUBLE SHOOTING

The below table contains the issues we faced in the trial run & the solutions we found for the same.

S.No.	Issue	Solution
1.	Mismatch in mould opening and barcode printing time when cycle time changes.	Re-calibrate the time and fix in the software according to the change in cycle time as the same is not live synchronized.
2.	Sticker was either removed from the pad or stuck on roller while PAD pressing process, approx. 0.5% to 1%.	Trained the operator to ensure the stickers were securely placed and upgraded the printing sheet for one with better adhesive.
3.	The machine was printing blank stickers with just the machine ID because the items were undefined in the software.	Configured the software to define the item being sent for printing and shared the software user manual with the production team for future reference in troubleshooting.
4.	Inexperienced operators with low training hours were assigned tasks for pasting stickers.	Mandated that all operators had to participate in 3 or more mock processing activities conducted by seniors before assigning them roles in the production line.
5.	Barcodes for all products were getting printed but only a few of the products needed to be printed.	Adjusted the software configurations and applied a filter that allowed each item in the product line to be enabled or disabled for printing based on the requirement.

Chapter 6 : GO LIVE

6.1 GO LIVE

“Go Live”: September 1, 2019

The Plant implemented the process for Barcode in September & it was deemed a success after a month when no errors were found either in the pad dispatch to customer nor during the assembly at customer end.

6.2 STATUS ON CUSTOMER LINE

Below are pictures of:

Pads in Trolley on Seat Assembly Line Side with Barcode sticker

Seat Assembly Line operator scanning barcode to confirm correct part Number usage

Seat Assembly Line operator scanning barcode to confirm correct part Number usage

Note of thanks:

I appreciate the courtesy extended by the Management and Operations team at Hyundai Transys Lear India Pvt. Ltd. Chennai and thank them for permitting me to witness the seat assembly at their Chennai factory and to understand from their production and quality teams on the requirement.

I thank the team and management at Spack Automotives Pvt. Ltd, Greater Noida and Chennai factories for permitting to me to participate in the meetings and to be a part of the implementation of part identification project by use of barcode. I thank them for their patience and for permitting me to participate as and when I could schedule based on school timing.

Thank you.