INTERNSHIP REPORT

Completed at

RENAULT NISSAN

AUTOMOTIVE INDIA PVT LTD

Under the department

VPP-PLASTICS

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Duration of internship: 05/08/2019 TO 04/10/2019

Venue: Renault Nissan Automotive India Private Limited Plot No. 1, SIPCOT Industrial Park, Oragadam Mattur Post, Sriperumbudur, Kanchipuram – 602 105

Preface and Acknowledgement

For two months from August 2019 till October 2019, I did an internship at RNAIPL, An Automotive Industry which manufactures a capacity of approximately 400,000 vehicles per annum. The capacity is divided equally between *Renault India Private Limited* and *Nissan Motor India Private Limited*.

I worked on an assigned project to reduce the total cycle time of an injection molding process of car bumpers. The main content of the project is to change the parameters of the injection molding machines and come up with a good parameters to reduce the cycle time and improve the quality of the parts. This project was only a part of my objective in this internship period. The main objective was to operate the robots used in the bumper painting line, and I learned a lot from operating them with the help of few employees. I did not only gain a lot of knowledge but more importantly, I also had a great chance to sharpen my skills in a professional working environment by discussing with the supervisors, experts in the field and other staffs in the plant.

And I would like to take this opportunity to thank Mr. Suresh Logu (deputy manager), Mr. Shanmugam (Plastics), Pasupathi (team leader and supervisor), and all the employees for their great support on helping me complete this internship and project. And most importantly I would like to thank RNAIPL for giving me this great opportunity.

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List of Abbreviations

- **ASDU** – Alliance Standard Developing Unit
- **OEE** – Overall Equipment Effectiveness
- **DSTR** – Design Standard Time Ratio
- **DPR** -Daily Production report
- **QA**-Quality Assurance
- **PPE**-Personal Protective Equipment
- **FPES** – Fire Prevention Evaluation System.
- **SOS**-Standard operation Sheet
- **POS**-Process Operation Sheet
- **JPH**- Job Per Hour
- **TPM** –Total Productive Management
- **APW** - Alliance Production Way
- **FTB** -Firing Test Bench
- **ERT** - Emergency Response Team
- **QRQC** - Quick Response Quality Control
- **PDCA** - Plan Do Check Act
- **FIFO** - First In First Out
- **TDC** - Total Delivered Cost
- **DMD** – Daily Management Diagnosis
- **SES** – Safety Evaluation system
- **NG** - Not Good

Introduction to RNAIPL

Renault Nissan Automotive India Private Limited or RNAIPL for short is a plant in Oragadam, Chennai which was the first dedicated Alliance global plant. Representing an investment of over 45 billion Rupees over 7 years, the plant has the capacity to produce 480,000 units per year at full ramp up.

The Renault-Nissan Alliance had announced its plans to build a new manufacturing plant in Chennai, India, by the signature of a Memorandum of Understanding with the Government of Tamil Nadu on February 22nd, 2008. The official ground breaking ceremony took place on June 6th, 2008 and the production started in May 2010. The first vehicle produced at the plant was the Nissan Micra, a global hatchback.

Renault–Nissan Automotive India Private Limited has crossed a milestone of having manufactured 1 million cars from this plant.

The companies, which have been strategic partners since 1999, have nearly 350,000 employees and control seven major brands: Renault, Nissan, Infiniti, Renault Samsung Motors, Dacia, Datsun, Dongfeng and Lada.

RENAULT NISSAN

Production models

Renault

- **Renault Fluence (2011–2017)**
- **Renault Koleos (2011–2017)**
- **Renault Pulse (2012–2018)**
- **Renault Duster (2012–present)**
- **Renault Scala (2012–2018)**
- **Renault Lodgy (2015–present)**
- **Renault Kwid (2015–present)**
- **Renault Captur (2017–present)**
- **Renault Triber (2019–present)**

Nissan

- **Nissan Sunny (2012)–present**
- **Nissan Micra (2012–present)**
- **Nissan Terrano (2013–2018)**
- **Nissan GT-R (2017–present)**
- **Nissan Kicks (2018–present)**

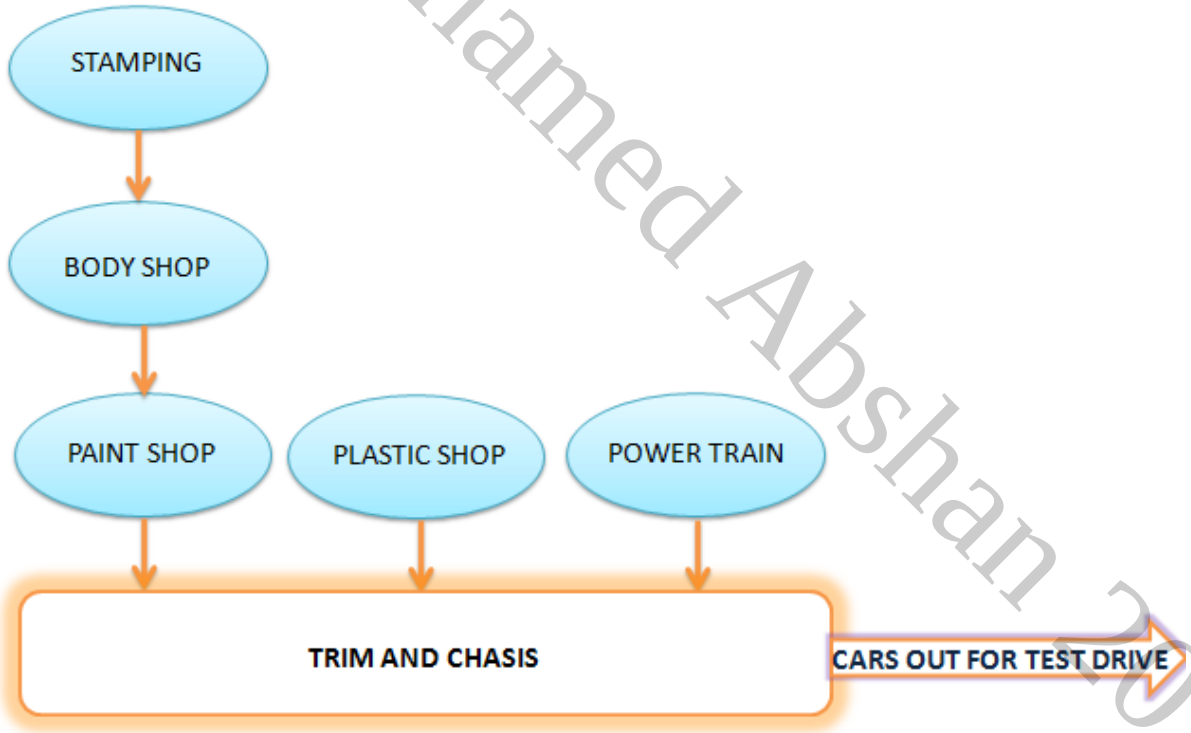
Datsun

- **Datsun Go (2013)–present**
- **Datsun Go+ (2013–present)**
- **Datsun redi-Go (2015–present)**

RNAIPL departments and layout

The entire plant is built with various departments which contribute in manufacturing different model cars. The main departments are:

- Stamping Department
- Body Shop
- Paint Shop
- Plastic Shop
- Power train-1
- Power train-2
- Trim and Chassis



Stamping Department:

In stamping department the external body parts of the car such as car frames and doors are manufactured using steel alloy sheets. Stamping is one of the manufacturing process of placing the flat metal sheet in a die and stamping it with desired force to form a desired shape.

BLANKING

Firstly Coils of steel sheets are picked up by crane and transferred to coil-car that transfers the coil to the uncoiler and goes through various process such as washing, Leveler, Looping, Feeding, Pressing and finally a piler device piles the cut material. From here cut material are transferred to pressing and piercing line.

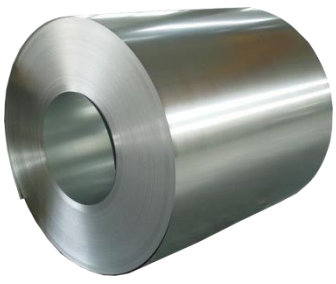
PRESSING AND PIERCING

There are three Piercing lines, XL-LINE (5400T), L-LINE(2400T), and Line-3 (5400T). And each line has 4 different presses. After the parts are pressed and pierced into desired shapes, they are moved for quality checking.

QUALITY CHECK

The quality check is done manually, and the parts are moved to body shop if they pass the quality check test.

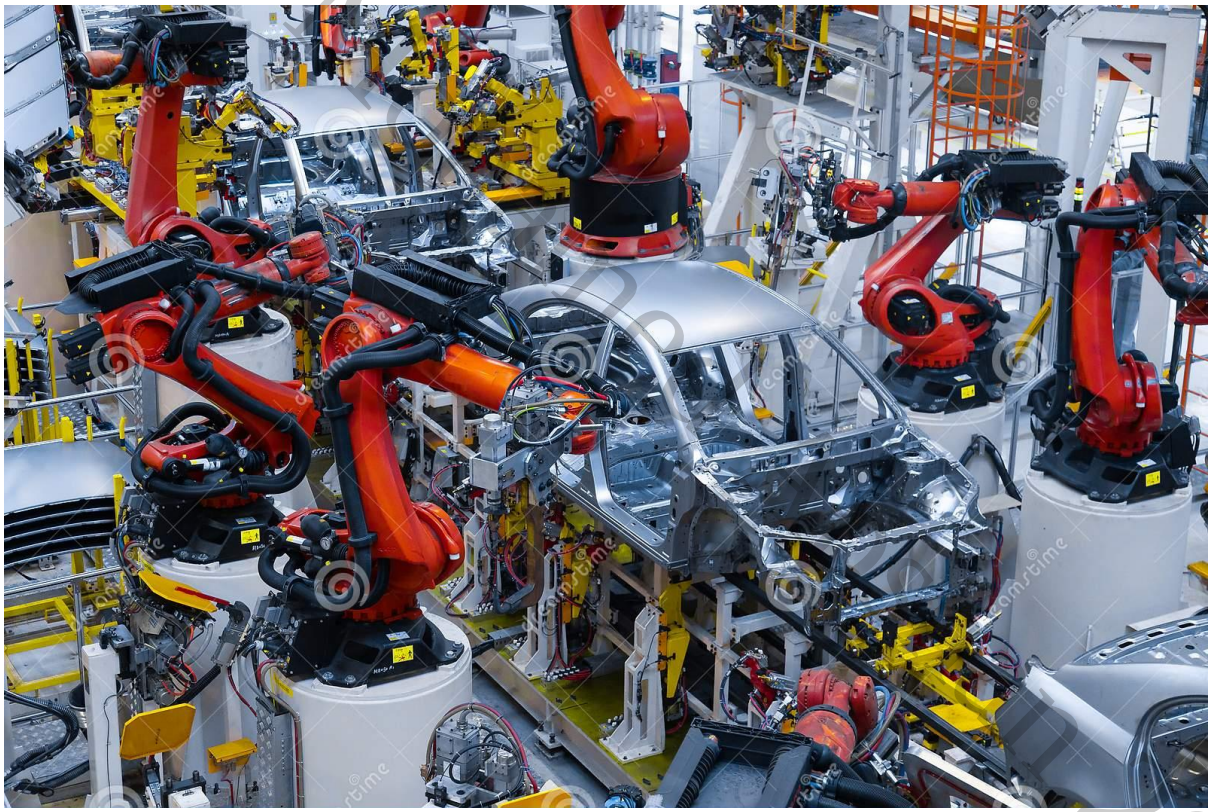
Raw material



Body shop:

The parts from stamping department are moved to body shop using forklifts. Here different stamped components are welded to make different car frames like doors, chassis, engine compartments, hoods, front and rear cabins, etc.

Some parts are manually welded and some are welded by robots like ABB for precision and accuracy. Body shop consist of two main line, six sub lines (three each) and 290 sub stations. The main frame of the car is supplied by a supplier as three parts which are welded in this plant.



Paint shop:

Car bodies arrive here at paint shop and goes through different stages of painting process. There are two lines in this paint shop, each of the line for different car models.

The car bodies go through the painting line with different stages such as:

- Pre-treatment line (PT-line): Here the body goes through different stages of cleaning process such as two degreaser stages, two water rinsing stages, conditioner, phosphate treatment zone and finally two stages of rinsing using deionized water.
- Electro-Deposit line (ED-line): Here cationic paint is used as a primer for car bodies, and rinsed with fresh water.
- ED-Oven: Then the car bodies go through this oven for drying the ED paint.
- Sealer Zone: Here a sealant is applied at all the exterior edges to prevent leakage, then the car bodies go through the oven for drying the sealant.
- ED Standing Zone: At this zone, extra ED paints are removed manually using sand paper to make the paint layer uniform.
- Body Arranging Zone: Here the car bodies are arranged in three different lines, main line, side line, and repair line.
- Dust Off Zone: At this zone the dust on the car bodies are removed to prevent contamination, because the next zone is the main painting line.
- Top Coat Zone: Here the car body goes through different stages to get painted such as anti-corrosion coating, primer coating, primer flash off zone (to dry the primer) followed by base zone where the main paint is sprayed by the robot, and sprayed manually. Then they go through base flash off zone to dry the base paint then finally to the clear zone.

From here the car body goes to the Trim and Chassis

Plastics shop:

At this shop the car front and rear bumpers are manufactured using Injection molding process. Then they go through different sub-stations which are:

- Injection molding
- Masking station
- Plastics paint shop

Injection Molding process:

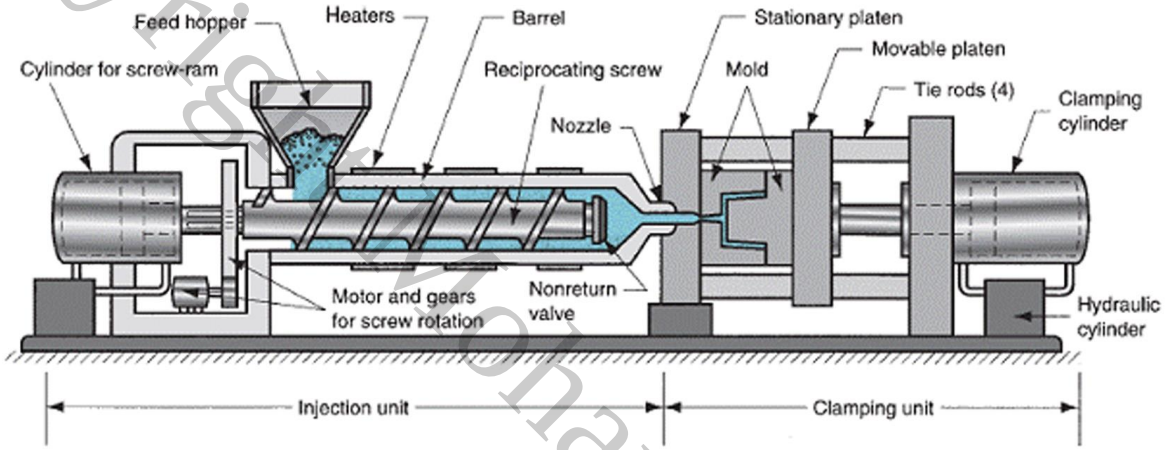
There are three IMM (Injection Molding Machines). IMM-1, IMM-2 and IMM-3.

IMM-1 and IMM-2 are operated mechanically using hydraulic cylinders, and the rated maximum clamping force of this machine is 3150 Ton. IMM-3 is operated electrically using high torque servo motors which has a maximum clamping force of 3000 Ton. The injection molding process flow are as follows:

- **Raw material storage and debagging station:** Here the raw materials, PPE (Polypropylene) are stored and debagged into large containers (2000 and 2500 L).
- **Raw material Silo:** This silo has a capacity of 8000 L, and its main purpose is to store the raw material and avoid water contamination.
- **Dryer:** There are three dryer bins which works one by one. They are set to be at 85^{o}c to remove water contamination. Water contamination in the raw material could affect the quality of the molded part.
- **Blender:** There 2 types of material to be blended, the virgin PPE (new PPE's) and regrinded PPE. These two material are transferred from the hopper to the blender and mixed well. 80% virgin and 20% regrinded PPE is used.

The regrinded PPE cannot be more than 20% because the machine might get clogged.

- **Injection Molding Process:** At this machine, the PPE go through seven heaters using screw rotation. And the molten PPE is injected into the closed mold with 5 different speed stages and the part cools down using water coolant which is set to the standard 22°c. The screw position indicates the PPE flow.



- **Take Out Robot:** After the cooling is done the mold opens and a CNC type robot slides down and picks up the molded part using suction cups and moves it to a conveyor. Then the part is moved using the conveyor to Deburr.
- **Part Deburr:** Here the gates and flashes are removed manually from the molded part and inspected manually for concerns like air bubble, weld line etc..

The parts are then moved to the masking station using tow trucks.

<u>Masking station:</u> At this station, the bumpers gets prepared to go to the painting line. Some part of the bumpers should be covered manually using masking tapes to avoid getting painted by robots, so these bumpers are covered according to the bumper models.

Bumper Paint shop: The masked bumpers arrive here using tow trucks. At this shop the car bumpers and also the plastic mirror covers are painted. The mirror covers are not manufactured in this plant, they are supplied by suppliers.

The car bumpers and mirror covers are loaded in a jig which is attached to a conveyor line and they go through different stages of painting:

- **Flaming process:** The conveyor moves slowly and the parts are heated using constant flame by two robots.
- **Air blowing:** blowers are used to clean off the dust particles on the surface.
- **Primer coat:** A layer of primer coating are sprayed by robots.
- **Primer Paint:** Manually primer paint is sprayed for more accuracy.
- **Base Zone:** The parts arrive here after a flash off. The main paint is first sprayed by robots then sprayed manually for uniform coating.
- **Oven:** Here the base paint gets dried well.
- **Check and Repair:** After a flash off done by robots, the parts move to be checked for quality and repair if has to be done.

After the painting process, the bumper parts are moved to sub assembly station. Here all the electronics such as sensors, headlight and indicator light are mounted to the bumpers and gets ready to be moved to the main line (Trim and Chassis).

QMC: **Q**uick **M**old **C**hange is a system used in molding area, it is used for changing the mold quickly in the Injection molding machine. This system is completely automated and controlled by PLC. The operator must use the overhead crane to place the mold on a moving plate, after that everything is automated. The moving plate moves the mold on to the preheat plate, and after the preheating is done, the used mold is taken out and replaced with the new mold automatically. The entire process takes approximately 8.5 minutes.

Here at Plastics shop, there is another sub-station known as:

Tyre Sub-Assembly: Here the rubber part of the tyre and metal frame arrive from the supplier. At this station the tyres are assembled by robots and inspected under an inspection camera. These assembled tyres are then moved to storage area by AGV's (Automated Guided Vehicles).

Power Train-1 and Power Train-2:

At this zone the main car engines are manufactured. The casting shop the cylinder head and cylinder blocks are manufactured using two types of casting machines, high and low pressure die casting. These casted parts then move to Engine shop line where two lines manufacture petrol and diesel engines.

Trim and Chassis:

At this department, there are two lines in operation. Here is where all the car components arrive and assembled into cars. At each line there are 31 stations and at each station 2 to 4 parts are assembled.

At each line there are six sub lines which are:

Primary line: Here the car body arrives from the paint shop and the doors are separated.

Trim line: At this line, all the interior components such as seat belt, front and rear glass, plastic parts, floor mat, and other electronic components like speedometer panel etc.. are assembled.

Chassis trim line: At this line, all exterior parts and systems like brake system, suspension systems, fuel tank, exhaust line etc.. are assembled.

Engine assembly: The engine is assembled and all attachments are done manually.

Pre-final: Here the coolant, fuel, brake oil and other oils are filled using automated filling machines. And they go to the final line where doors are mounted.

Tester line: Wheel alignment, leakage testing, brake system and other systems are manually tested here.

Test Drive and Parking:

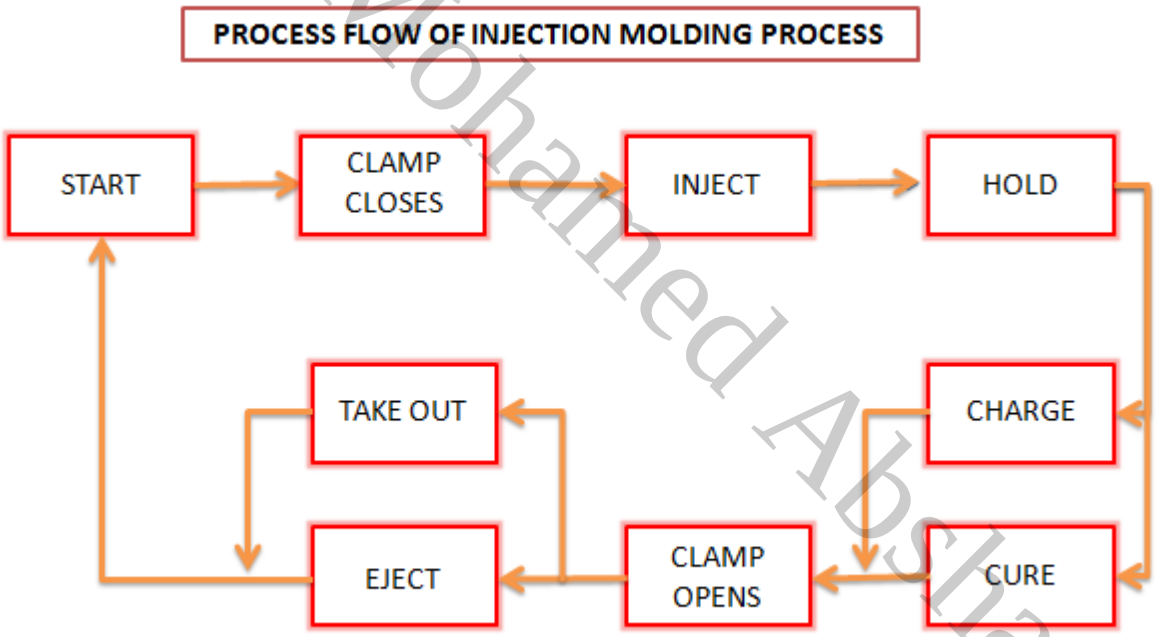
The finished cars from the line are taken to the test drive track by the plants experienced testers to test the performance of the car.

PROJECT: CYCLE TIME REDUCTION OF AN INJECTION MOLDING PROCESS.

Part Model: MC14 REAR

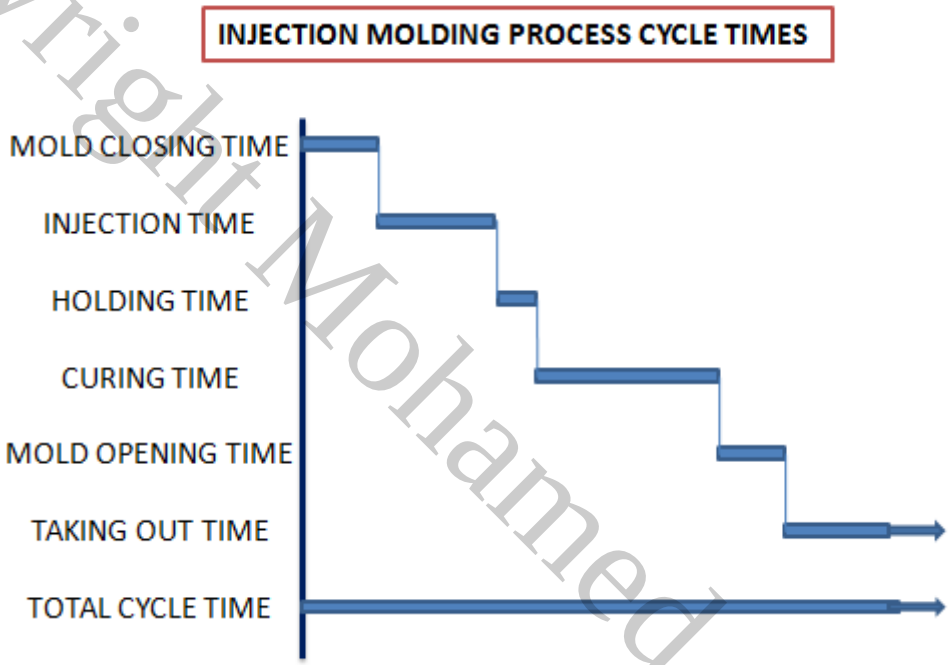
Project overview and objective:

Cycle time of an injection molding process is the time taken for one part to get completely molded. The time starts from closing the mold till opening the mold and the robot picking it.



Process flow explained: At first the mold closes completely and seals, then the injection process starts, after injecting completely the mold holds its position for a particular set time, then the curing and charging is done simultaneously. Charging is filling the injection chamber with molten PPE for the next injection. Finally the mold opens slowly at a set speed, and ejects the part out while the CNC type robot slides down and picks the part and moves up. This explanation looks easy but there are lot of parameters in the machine to achieve this process.

Different molds have different cycle times depending on the mold design. There currently 48 bumper molds in the plant such as MC14FR, MC14RR, K2FR, K2RR, MY13FR, and MY13RR etc. The last 2 letters indicates front (FR) and rear (RR) bumpers.



Total Cycle Time explained:

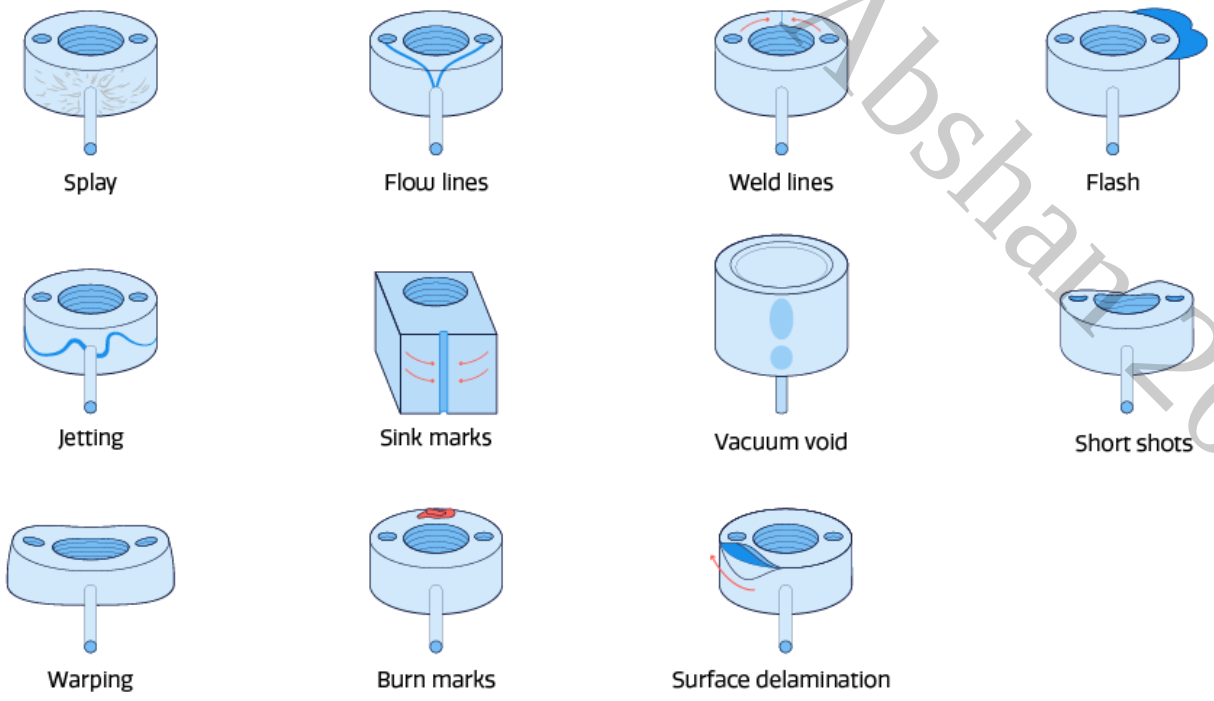
- **Mold closing time:** It's the time taken to completely close the mold just after the robot picks up the part.
- **Injection time:** Time taken to completely inject the molten PPE
- **Holding time:** Little time given to fill the mold completely on all gaps and at this time the injection nozzle prevents the molten PPE from returning from the mold.
- **Curing time:** The time taken for the part to completely cure with the help of flowing water coolant.
- **Mold opening time:** It's the time taken to open the mold complete but slowly to prevent air trap.

- **Taking out time:** Time taken for the mold to eject the part and the robot slides down and picks it and moves up just before the mold closes again.
- **Total cycle time:** It's the entire time starting from the point where the mold starts closing until the robot picks up and slides up completely. Note, the time taken for the robot to place the part on the conveyor is not included in total cycle time.

Project Objective

I was assigned to find an efficient way to reduce the total cycle time of the molding part MC14 REAR model. I was told to operate the HMI Panel of IMM-1, and find the best parameters to reduce the total cycle time.

The main objective of this project is to increase the production rate and to improve the quality of the part. Quality of the part can vary depending on the machine parameters, for example if the last stage of injection speed is too high, there may be air trap on the part where the molten PPE's meet from the hot runner.



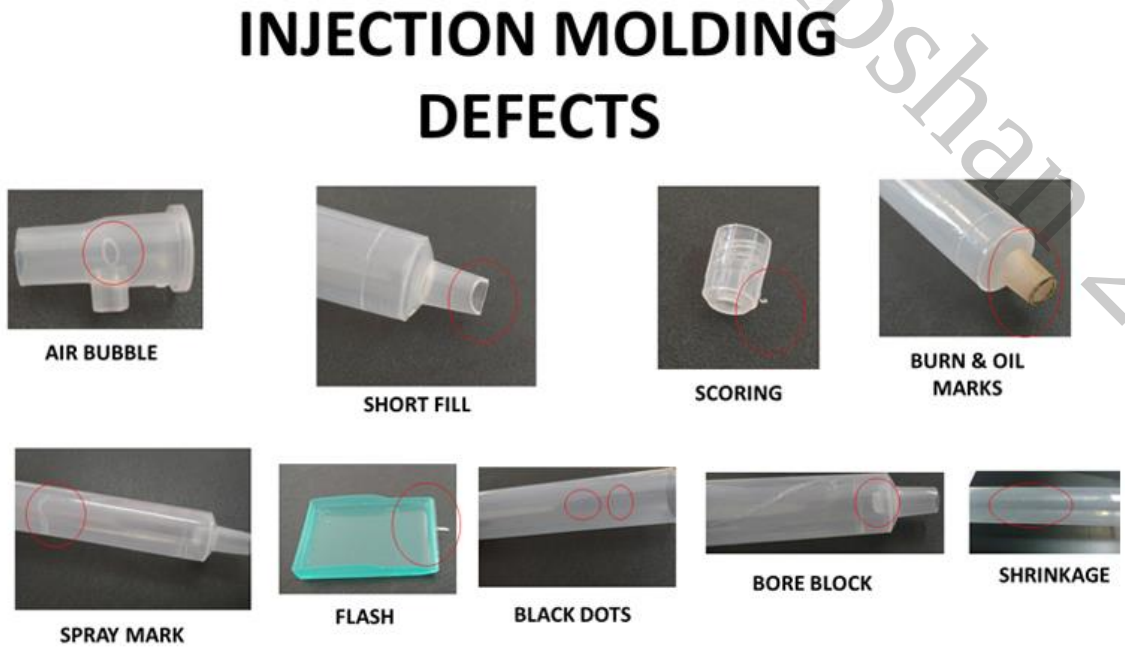
Project Plan

Before starting the project, I took 1 week time to understand the complete process by discussing with the machine engineers and the technicians, and also understood how to operate the three machines. During the weekdays production cannot be stopped for testing my parameters, so I took weekends to test my parameters by molding 5 to 10 parts.

Technical Review

There are technical parameters which I am allowed to change like 5 stages of injection speeds, 5 stages of injection positions, 6 stages of injection pressure, holding time, speed and pressure, 7 different barrel temperatures and etc. Some parameters cannot be changed due to standard, like chiller temperature and regrind ratio.

Using the process parameters files and after making few trials, I came up with good parameters which can reduce up to 3 seconds per part in IMM_1, and I believed the parts won't have any of the following defects.



Project Outcome

After the final trial I submitted my parameter to the supervisor and the team leader for checking, and they found it perfect and approved that these parameters can be used in production:

The process parameters are as follows:

Before

Injection speed and position:

INJ POS (mm)	275	125	70	40	21
INJ SPD (%)	60	65	55	45	35

Hold time: 3.5 sec

Mold open time: 5.5 sec

Mold close time: 7.2 sec

After

Injection speed and position:

INJ POS (mm)	265	120	60	40	21
INJ SPD (%)	70	70	60	50	35

Hold time: 2.5 sec

Mold open time: 4.5 sec

Mold close time: 6.0 sec

*The injection speed of the first four stages has been increased and the last stage is slowed down to prevent air trap on the parts.

Outcome: After the trial we noticed that the total cycle time was changed from **49.8** seconds to **46.5** seconds

Conclusion

I found that a car we enjoy driving has to go through hundreds of stages to reach us is one piece.

The entire internship period was a very useful experience and gained a lot of practical knowledge and skills. By meeting experienced workers and professionals, I gained very good communication skills too.

I learned that the plant uses all the best effective ways in maintaining the plant and found that every second is important in production. Finally this internship has given me new thoughts and motivation to pursue a career in automotive field.

THANK YOU