S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

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Ahmedabad – Mehsana Highway,
Linch, Mehsana – 384435
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CYCLE 1
NAAC Accreditation 2023

ACADEMIC YEAR
2019-20

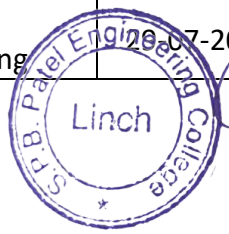
Submitted to

NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL

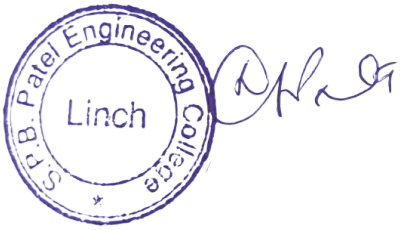
6.3.3 Percentage of teaching and non-teaching staff participating in Faculty development Programmes (FDP), Management Development Programmes (MDPs) professional development /administrative training programs during the last five years

Academic Year 2019-20

Sr. No.	Name of the participant	Title of the FDP /MDP/ professional development / administrative training program	Dates (from-to) (DD-MM-YYYY)
1	PATEL SHAILESHKUMAR TRIKAMLAL	NPTEL - Calculus of One Real Variable	July-Sep 2019
2	VAIDANT DIXIT	NPTEL - Product Design Using Value Engineering	July-Aug 2019
3	KUNALSINH R. KATHIA	NPTEL - Product Design Using Value Engineering	July-Aug 2019
4	CHIRAG MUKESHBHAI KORAT	NPTEL - Design for Quality, Manufacturing and Assembly	July-Sep 2019
5	AVANI DEDHIA	NPTEL - Design of Reinforced Concrete Structures - Online	July-Oct 2019
6	BHUPENDRA BHATT	NPTEL - Advanced Concepts in Fluid Mechanics - Online	July-Oct 2019
7	RAJAT MISHRA	NPTEL - Integrated Waste Management for a Smart City - Online	July-Oct 2019
8	KANUBHAI R PATEL	NPTEL - Integrated Waste Management for a Smart City - Online	July-Oct 2019
9	BHUPENDRA BHATT	NPTEL - Fundamentals of Conduction and Radiation - Online	July-Oct 2019
10	Rajat Mishra	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019
11	Jaimin Jani	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019
12	Nimisha Sharma	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019
13	Akshay Kansara	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019
14	Tausif Shaikh	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019
15	Kunalsinh Kathia	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019
16	Kamlesh Samadhiya	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019



Sr. No.	Name of the participant	Title of the FDP /MDP/ professional development / administrative training program	Dates (from-to) (DD-MM-YYYY)
17	Kanu Patel	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019
18	Nirav Joshi	52nd Faculty Development Program on Design Engineering	29-07-2019 to 01-08-2019
19	Kamlesh Samadhiya	'Design & Development of Electric and Hybrid Electric Vehicle Technology'	24th to 28th February 2020



This certificate is computer generated and can be verified by scanning the QR code given below. This will display the certificate from the NPTEL repository, https://nptel.ac.in/noc/

Roll No: NPTEL19MA18S11020060

To
PATEL SHAILESHKUMAR TRIKAMLAL
32,KRUPA RESIDENCY,NEAR JANPAT
HOTEL,PALAVASANA-384003
PALAVASANA(MEHSANA)
MEHSANA
GUJARAT
384003
PH. NO :8140013510

Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completed
<40	No Certificate

No. of credits recommended by NPTEL:2
An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.

Elite

NPTEL Online Certification

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

PATEL SHAILESHKUMAR TRIKAMLAL

for successfully completing the course

Calculus of One Real Variable

with a consolidated score of **85** %

Online Assignments	20.42/25	Proctored Exam	64.5/75

Total number of candidates certified in this course: **283**

Prof. Rajesh M.Hegde
Chairman, Centre for Continuing Education
IIT Kanpur

Jul-Sep 2019
(8 week course)

Prof. Satyaki Roy
NPTEL Coordinator
IIT Kanpur

Indian Institute of Technology Kanpur

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

This certificate is computer generated and can be verified by scanning the QR code given below. This will display the certificate from the NPTEL repository, https://nptel.ac.in/noc/

Roll No: NPTEL19ME51S21020134

To
VAIDANT DIXIT
A-103 SHLOK MIRABEL NEAR SATYAMEV VISTA
GOTA AHMEDABAD
AHMEDABAD
GUJARAT
382481
PH. NO :8141153008

Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completed
<40	No Certificate

No. of credits recommended by NPTEL:1
An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.

Elite

NPTEL Online Certification

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

VAIDANT DIXIT

for successfully completing the course

Product Design Using Value Engineering

with a consolidated score of **79** %

Online Assignments	23.33/25	Proctored Exam	55.5/75

Total number of candidates certified in this course: **817**

Prof. V. C. Srivastava
Coordinator, Continuing Education Centre
IIT Roorkee

Jul-Aug 2019
(4 week course)

Prof. Inderdeep Singh
NPTEL Coordinator
IIT Roorkee

Indian Institute of Technology Roorkee

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

Roll No:NPTEL19ME51S11020099

To KUNALSINH R. KATHIA
SHRUSTI-5, SECTOR- 1D,
ATPL
ADALAJ
GANDHINAGAR
GUJARAT
382421
PH. NO :9898800401

No. of weeks of NPTEL Courses	Equivalence of NPTEL course with regular FDP
4	$\frac{1}{2}$ FDP of one week
8	Full FDP of one week
12	$1\frac{1}{2}$ FDP

Duration of NPTEL course: 4 Weeks

NPTEL-AICTE
Faculty Development Programme

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

KUNALSINH R. KATHIA

for successfully completing the course

Product Design Using Value Engineering

with a consolidated score of **64** %

Prof. Andrew Thangaraj
NPTEL Coordinator
IIT Madras

(Jul-Aug 2019)

Prof. Dileep N. Malkhede
Advisor-I (Research, Institute & Faculty Development)
All India Council for Technical Education

Roll No: NPTEL19ME51S11020099

To validate and check scores: http://nptel.ac.in/noc

The candidate has studied the above course through MOOCs mode, has submitted online assignments and passed proctored exams.
This certificate is therefore acceptable for promotions under CAS as per AICTE notifications dated 24th July 2018, similar to other refresher / orientation courses.
F.No. AICTE / RIFD / FDP through MOOCs / 2017-18

Roll No:NPTEL19ME48S11020160

To CHIRAG MUKESHBHAI KORAT
7039, SWAROOP-5(WING-B), SECTOR-4, ATPL,
ADALAJ
GANDHINAGAR
GUJARAT
382421
PH. NO :9033501571

No. of weeks of NPTEL Courses	Equivalence of NPTEL course with regular FDP
4	$\frac{1}{2}$ FDP of one week
8	Full FDP of one week
12	$1\frac{1}{2}$ FDP

Duration of NPTEL course: 8 Weeks

NPTEL-AICTE
Faculty Development Programme

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

CHIRAG MUKESHBHAI KORAT

for successfully completing the course

Design for Quality, Manufacturing and Assembly

with a consolidated score of **70** %

Prof. Andrew Thangaraj
NPTEL Coordinator
IIT Madras

(Jul-Sep 2019)

Prof. Dileep N. Malkhede
Advisor-I (Research, Institute & Faculty Development)
All India Council for Technical Education

Roll No: NPTEL19ME48S11020160

To validate and check scores: http://nptel.ac.in/noc

The candidate has studied the above course through MOOCs mode, has submitted online assignments and passed proctored exams.
This certificate is therefore acceptable for promotions under CAS as per AICTE notifications dated 24th July 2018, similar to other refresher / orientation courses.
F.No. AICTE / RIFD / FDP through MOOCs / 2017-18

Roll No:NPTEL19CE22S31020227

To AVANI DEDHIA
E-117, 3RD PHASE, SIMANDHAR CITY,
TRIMANDIR SANKUL, AHMEDABAD-KALOL
HIGHWAY
ADALAJ
GANDHINAGAR
GUJARAT
382421
PH. NO :9773050881

No. of weeks of NPTEL Courses	Equivalence of NPTEL course with regular FDP
4	$\frac{1}{2}$ FDP of one week
8	Full FDP of one week
12	$1\frac{1}{2}$ FDP

Duration of NPTEL course: 12 Weeks

NPTEL-AICTE
Faculty Development Programme

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

AVANI DEDHIA

for successfully completing the course

Design of Reinforced Concrete Structures

with a consolidated score of **80** %

Prof. Andrew Thangaraj
NPTEL Coordinator
IIT Madras

(Jul-Oct 2019)

Prof. Dileep N. Malkhede
Advisor-I (Research, Institute & Faculty Development)
All India Council for Technical Education

Roll No: NPTEL19CE22S31020227

To validate and check scores: http://nptel.ac.in/noc

The candidate has studied the above course through MOOCs mode, has submitted online assignments and passed proctored exams.
This certificate is therefore acceptable for promotions under CAS as per AICTE notifications dated 24th July 2018, similar to other refresher / orientation courses.
F.No. AICTE / RIFD / FDP through MOOCs / 2017-18

Roll No:NPTEL19CE31S61020541

To RAJAT MISHRA
B-410, MANGAL DARSHAN APPARTMENT, OPP.
SAHEJ VILLA,
RADHANPUR ROAD
MEHSANA
GUJARAT
384002
PH. NO :9510982884

No. of weeks of NPTEL Courses	Equivalence of NPTEL course with regular FDP
4	$\frac{1}{2}$ FDP of one week
8	Full FDP of one week
12	$1\frac{1}{2}$ FDP

Duration of NPTEL course: 12 Weeks

NPTEL-AICTE
Faculty Development Programme

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

RAJAT MISHRA

for successfully completing the course

Integrated Waste Management for a Smart City

with a consolidated score of **83** %

Prof. Andrew Thangaraj
NPTEL Coordinator
IIT Madras

(Jul-Oct 2019)

Prof. Dileep N. Malkhede
Advisor-I (Research, Institute & Faculty Development)
All India Council for Technical Education

Roll No: NPTEL19CE31S61020541 To validate and check scores: http://nptel.ac.in/noc

The candidate has studied the above course through MOOCs mode, has submitted online assignments and passed proctored exams.
This certificate is therefore acceptable for promotions under CAS as per AICTE notifications dated 24th July 2018, similar to other refresher / orientation courses.
F.No. AICTE / RIFD / FDP through MOOCs / 2017-18

Roll No:NPTEL19CE31S61020545

To KANUBHAI R PATEL
11-AKASH GANGA SOCIETY, 0PP-SAIKRISHNA
HOSPITAL, RADHANPUR ROAD,
MEHSANA
GUJARAT
384002
PH. NO :9427209229

No. of weeks of NPTEL Courses	Equivalence of NPTEL course with regular FDP
4	$\frac{1}{2}$ FDP of one week
8	Full FDP of one week
12	$1\frac{1}{2}$ FDP

Duration of NPTEL course: 12 Weeks

NPTEL-AICTE
Faculty Development Programme

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

KANUBHAI R PATEL

for successfully completing the course

Integrated Waste Management for a Smart City

with a consolidated score of **47** %

Prof. Andrew Thangaraj
NPTEL Coordinator
IIT Madras

(Jul-Oct 2019)

Prof. Dileep N. Malkhede
Advisor-I (Research, Institute & Faculty Development)
All India Council for Technical Education

Roll No: NPTEL19CE31S61020545

To validate and check scores: http://nptel.ac.in/noc

The candidate has studied the above course through MOOCs mode, has submitted online assignments and passed proctored exams.
This certificate is therefore acceptable for promotions under CAS as per AICTE notifications dated 24th July 2018, similar to other refresher / orientation courses.
F.No. AICTE / RIFD / FDP through MOOCs / 2017-18

This certificate is computer generated and can be verified by scanning the QR code given below. This will display the certificate from the NPTEL repository, https://nptel.ac.in/noc/

Roll No: NPTEL19ME59S61020632

To
BHUPENDRA BHATT
GNAN B 122, SIMANDHAR CITY, TRIMANDIR ,
ADALAJ, GANDHINAGAR.GUJARAT
ADALAJ, GANDHINAGAR.
GANDHINAGAR
GUJARAT
382421
PH. NO :9574009998

Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completed
<40	No Certificate

No. of credits recommended by NPTEL:3
An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.

Elite

NPTEL Online Certification

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

BHUPENDRA BHATT

for successfully completing the course

Fundamentals of Conduction and Radiation

with a consolidated score of **69** %

Online Assignments	21.22/25	Proctored Exam	48/75

Total number of candidates certified in this course: **176**

Jul-Oct 2019
(12 week course)

Prof. Hemant B Kaushik
Head, Centre for Educational Technology
& NPTEL Coordinator
IIT Guwahati

Indian Institute of Technology Guwahati

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

“Report of 52nd Faculty Development Progam in Design Engineering”

29th July – 1st August 2019

GTU Chandkheda

Faculty

Rajat Mishra

Civil Engineering Department

S. P. B. PATEL ENGINEERING COLLEGE

SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

Day 1

Session -1

52nd Faculty Development Program in Design Engineering was held at GTU Chandkheda Campus from 29th July 2019 to 1st August 2019. Around 35 Participants from 9 different colleges participated in the FDP. The participating colleges included S.P.B. Patel Engineering College, Laxmi Institute of Technology, SAL Institute of Technology, KJFET Vadsma, SS Shroff Rotary Engineering College, Silver Oak Engineering College, GEC Dahod, SS Shah Engineering College, Bhavnagar.

Prof. Kamaljit Bhilola, Centre for Industrial Design - Open Deign School, Gujarat Technological welcomed all the participants. The session begun with the morning prayer.

Prof. Bhilola discussed about the current scenario of the placements and jobs in the different sectors and mentioned the skills sets required for the today's engineering graduates to be an employable engineers. He emphasized on the set of skill set mentioned by World Economic Forum.

He mentioned that Design Thinking is an approach to prepare the students to visualize complex challenges with a more critical thinking, creative and collaborative approach.

The Open Design School of GTU is one such platform provided by the GTU which provided the students and faculty members associated with GTU to develop Design Thinking ability and critical thinking approach by incorporating the Design Engineering as a Subject in the curriculum.

Prof. Bhilola discussed in detail about the Design Engineering Syllabus, its credit and different modules, framework and canvas for the different semester students of the GTU.

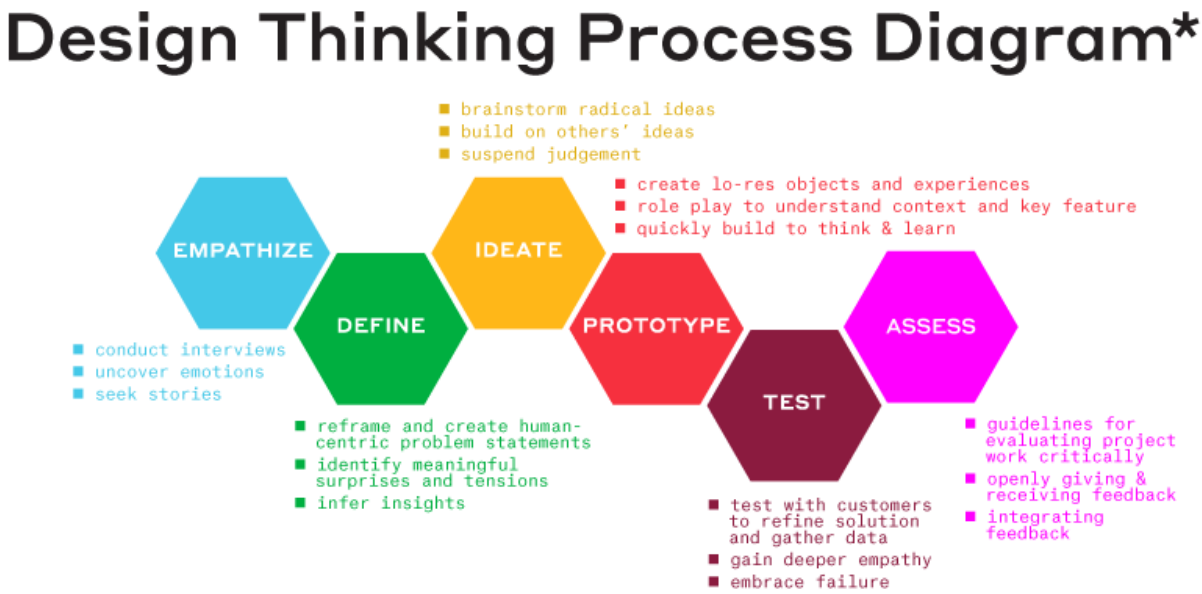
Prof. Bhilola explained the Design Thinking process by the circles of Why, How and What. He mentioned that the process start by "thinking from the future" rather than getting stuck in the current situation, hampered by self-limiting beliefs about what's possible.

Rather than instinctively jumping to HOW to solve a "problem," we start with WHY - Why is this project important?

Next we explore WHO - who cares, who's impacted, who's involved, and who's judging the success of your project?

Then move on to WHAT - what outcomes would go beyond "solving a problem" to surprise and delight your stakeholders?

He then explained the concept the Design Thinking in a more refined way wherein the process start with Empathize followed by Define, Ideate, Prototype, Test and Assess.



Professor Bhilola took upon the ***Case of Google Sprint***, which is a five-day process for answering critical business questions through design, prototyping, and testing ideas with users. At Google, Design Sprints are used to answer business questions, define product direction, build team culture and help other partners figure out their strategy. In other words, it helps answer critical business questions through rapid prototyping, and user testing.

Day 1

Session -2

The 2nd session was taken by Prof. Bhavin Khotari, Professor of Strategic Design Management, National Institute of Design. He started with taking up examples of grass root innovations around the world.

He emphasized that the design thinking requires a Human Centered Mindset for the engineers to innovate their work and create better experiences, products and services for their users or customers. **The Human Centered Mindset consist of following**

Learn from Failure

This mindset is all about the ability to learn from failure and use failure as a tool to improve your practices. Instead of being scared of failure, use every opportunity to experiment and grow from your mistakes.

Make It

Design thinking is about experimenting with prototypes. Make an idea real in order to better understand it and think through the problem.

Creative Confidence

This mindset is about approaching the world like a designer. It's understanding that you have creative ideas and the power to turn those ideas into a reality.

Empathy

Empathy is not only a wonderful skill for understanding your customers better. Our product or service should be built to help improve other people's lives and experiences, so never losing sight of an empathetic view of the world is key.

Optimism

Optimism is this embracement of possibility and knowledge that there is a better solution to the problem out there.

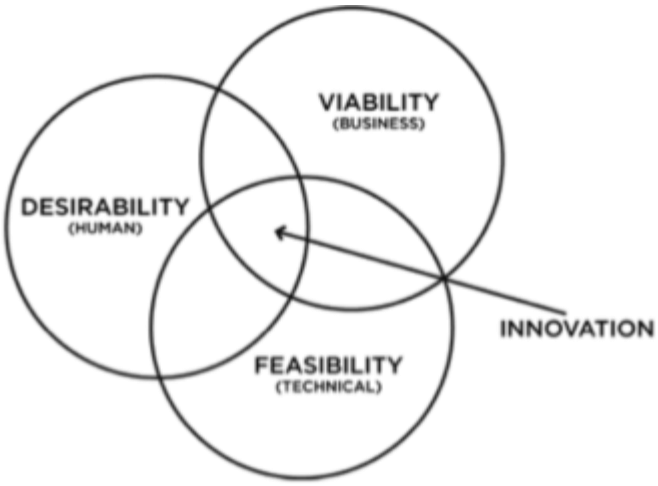
Embrace Ambiguity

Design thinking designers start from not knowing the answer to the problem.

Iterate, Iterate, Iterate

In order to reach the right solution, you need to receive feedback from customers early and frequently. By constantly improving and refining your work, you will be able to produce better ideas and arrive more quickly at the right solution.

Thereafter he explained the concept of Desirability, Feasibility and Viability in Design Thinking Process

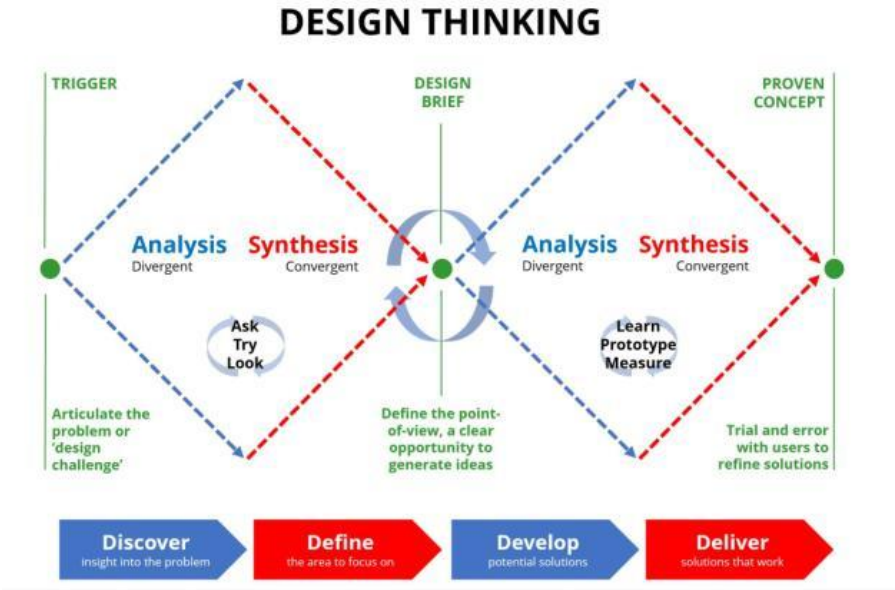


Desirability: The willingness and eagerness that a customer will "hire" the solution once they are aware that the solution exists.

Feasibility: The technical aspect for creating a successful product using the current and near future technical and operational capabilities of a firm and its partners.

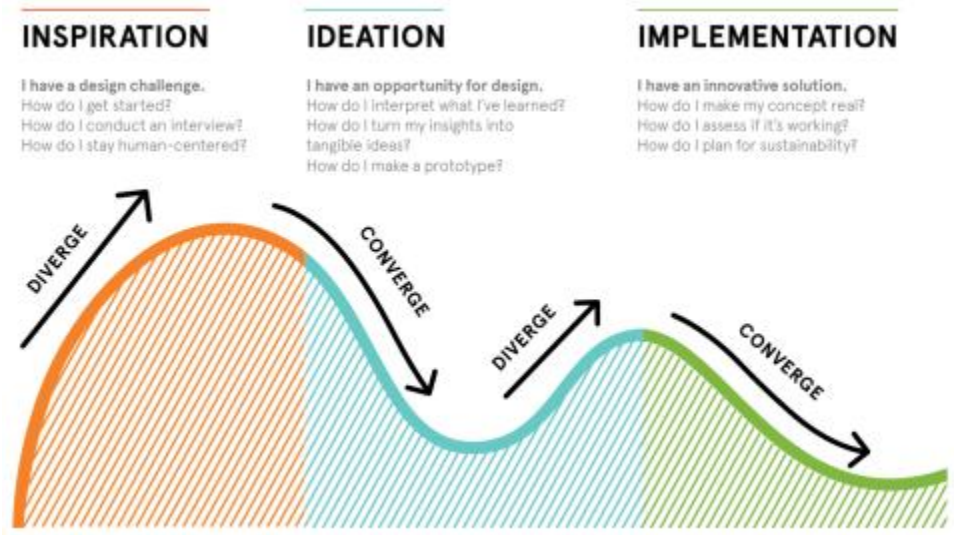
Viability: The financial and business model has to be able to reach our target customers. Deliver consistent value and delight to a large enough target market. And at a price-to-cost ratio that makes the venture worth competing for.

Thereafter he explained the Convergent and Divergent process of Design Thinking using **Double Diamond Design Thinking Process**



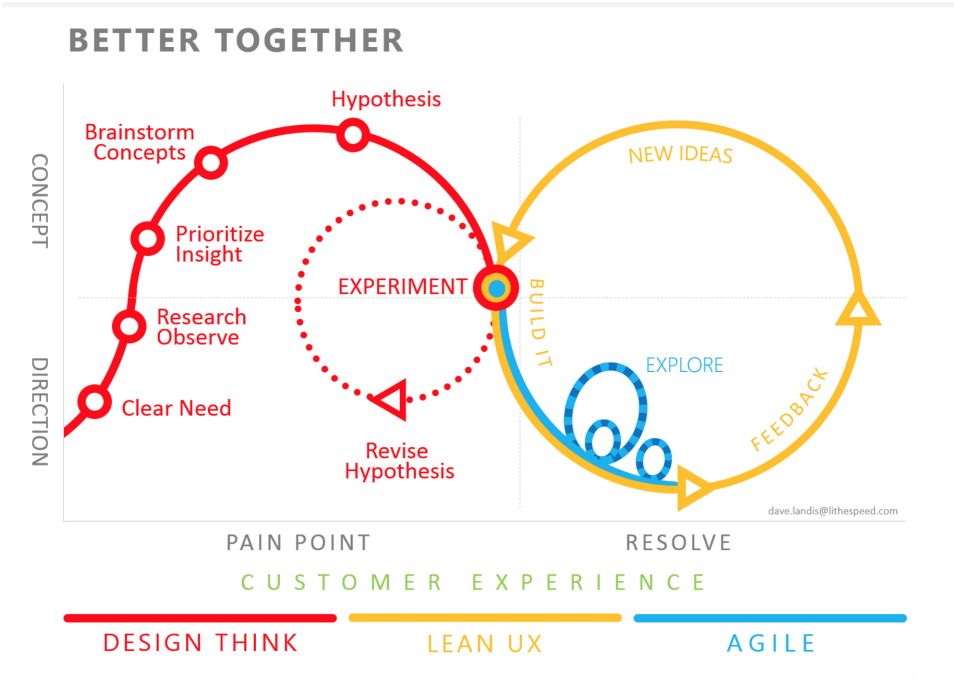
Double Diamond is divided into four phases — Discover, Define, Develop and Deliver — it is probably the best known and the most popular design process visualization.

The main feature of the Double Diamond is its emphasis on the “divergent” and “convergent thinking”, where first many ideas are created, before refining and narrowing down to the best idea. This is happening twice in this model—once to confirm the problem definition and once to create the solution.



In order to discover which ideas are best, the creative process is iterative. This means that ideas are developed, tested and refined a number of times, with weak ideas dropped in the process. This cycle is an essential part of good design.

Prof. Bhavin Kothari also explained the concept of combining **Design Thinking, Agile, and Lean process**



The lean mindset is what drives business to continuously learn through experimentation until they discover the right answers. It helps state what to build, all while improving the work that delivers the greatest value.

Agile, on the other hand, is all about achieving the best outcome through technology.

Design thinking helps to tie it all together by understanding limitations, recognizing and capitalizing on the opportunity, and exploring all the possibilities from a human-centered point of view.

When applied in unison, these methodologies can help any team create solutions that deliver the desired outcomes; as long as iteration is continuous.

Role of Empathize in Design Thinking

Prof. Kothari strongly and repeatedly said ***"Feel the Pain of the user".*** Design Thinking cannot begin without a deeper understanding of the people you are designing for. In order to gain those insights, it is important for us as a design thinker to empathize with the people we're designing for so that we can understand their needs, thoughts, emotions and motivations.

Empathy is the first step in design thinking because it is a skill that allows us to understand and share the same feelings that others feel. Through empathy, we are able to put ourselves in other people's shoes and connect with how they might be feeling about their problem, circumstance, or situation. Some questions to consider:

- What is the person feeling?
- What actions or words indicate this feeling?
- Can you identify their feelings through words?
- What words would *you* use to describe their feelings?

These are just some of the guided questions that designer can reflect on to identify the problem and how others are feeling about it.

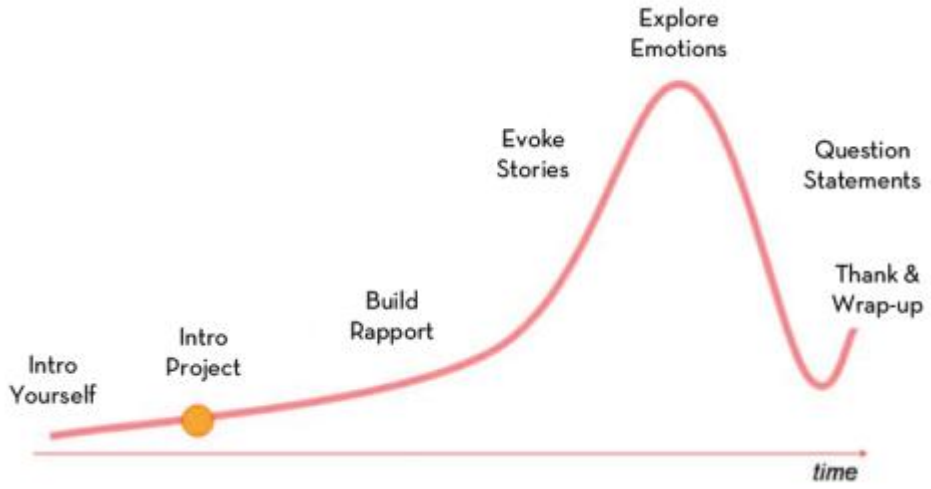
The Day 1 session ended with the question answer, feedback session and a brief introduction of the session for the next day.

Day 2

Session-1

The day started with the prayer, but with a different prayer song this time. A quick pre-cap of the yesterday session was done. There after the process of Empathy Interview, Interview cycle and Observation was discussed

- In searching for empathy in our design thinking process, we must spend time with the people for whom we are designing.
- True understanding comes from meaningful dialogue and interaction.
- The most common way to gain this is through a well-planned interview.



Following were the tips that were discussed and asked to be followed during empathy interview.

- Introduce yourself.
- Introduce your project.
- Shift your focus to the interviewee (ask name, where they come from).
- Build rapport.
- Ask about specific instances or occurrences (“Tell me about the last time..”)
- Keep questions to fewer than ten words.
- Ask one question at a time.
- Encourage stories.
- Look for inconsistencies and contradictions; what people say and what they do can be very different.
- Observe non-verbal cues, such as use of hands, facial expressions.
- Don’t suggest answers to your questions.
- Ask neutral questions like “What do you think about...?”
- Explore emotions like “Why do you feel...?” “What do you feel about...?”
- Question statements.
- If you get stuck, ask “why?” Constantly asking why digs deeper into emotion and motivation.
- Thank them and wrap things up.

Thereafter 7 teams were formed for the Field Work and, each teams comprised of faculties from different colleges and multiple branches. The teams were asked to go outside the campus, observe and conduct interviews of the respondents and define their problem.

Our group, Group No. 4 comprised of Prof. Rajat Mishra-Civil Engineering, Prof. Kunalsinh Kathia-Mechanical Engineering, Prof. Shreya Patel-Electrical Engineering, Prof Farhin Mansur-Computer Engineering, Prof. Harsha Padhiyar-Computer Engineering.

During the Observation and Empathy Interview session our team observed various type of persons who were of different gender, age group and profession. The persons were found doing various activities like crossing the roads, road side vending, auto rickshaws waiting for passengers, passengers alighting and boarding the bus, school children's etc.

The team conducted interviews of the persons in line with the points mentioned during earlier session, asked them about their daily work, business, problems they are facing, their expectations etc.

The team tried to put themselves in their shoes to empathize their current situations and define their problem.

Day -2

Session-2

- Session-2 started with the concept of Mind Mapping excersie.
- Mind mapping is an effective way to facilitate ideation, note taking and project planning.
- It generally starts with a simple idea or topic in the centre and the user would put ideas related, or inspired by the central idea around it, and connect all the ideas with lines.
- The user would then repeat the process for each idea generated to produce more ideas, just like a tree growing many new branches.
- Through the mind mapping exercise our team identified the pedestrian safety and road side vendors issues as their main area of concern.
- The problem identified through mind mapping was presented in front of the other team and the faculty co-ordinators.

Day-3

Session-1

The session was about AEIOU framework. AEIOU is a method that provides design thinkers with a framework for recording and classifying observations and information about their subject's Activities, Environments, Interactions, Objects, and Users.

Activities are the actions people take towards a goal, the paths they follow, and the modes they work in.

The various activities in the concern area included pedestrian crossing the roads, auto rickshaws waiting for passengers, passengers alighting and boarding the bus, road side vendors selling snacks and their products, traffic police controlling the traffic, school students etc.

Environments are the spaces where the activities take place. Look for what the atmosphere and context are like. How about the spaces? Are they shared or individual? How have the people adapted the environment for their own use, etc?

The rotary junction, rainy, accident spots, heavy traffic, congested spaces

Interactions are between a person and someone else or thing. Interactions are the building blocks of activities. Look out for people's routines, special interactions between individuals, groups, objects in the environment and across distance and time.

Passengers with drivers, hawkers/vendors with public, police with drivers, passengers with passengers

Objects are the building blocks of the environment. Look out for how objects are put to use and how they can take on unexpected uses depending on the context and actions.

Zebra Crossings, Traffic Signs, Traffic Lights, Auto rickshaws, hand carts, road side stalls

Users are the people whose behaviors, preferences, and needs are being observed. We generally look out for their values, biases, roles, relationships, etc.

Hawkers, pedestrians, vendors, passengers, disabled, elderly

Empathy Mapping

Empathy means understanding and awareness of other's feelings. Empathy means feeling as someone. With Empathy Mapping, learner can understand the emotions of a user.

Process

Identify the user- Fill some basic information's like Name, Age, Number of Family Members in the first section.

Identify the stakeholders- Stakeholders are the persons who are involved in the activities of user.

Note down all the activities which are performed by that user.

Create a story - Understand the emotions of the user. Think about what he/she will do in this situation and make Happy & Sad stories.

Following points were worth considering during Empathy Mapping

- Avoid enforced observations.
- User expectations play big role.
- No step-1 for thinking approach of design thinking.
- Avoid hypocrite thinking.
- Enter to emotion of user.
- Organic Evolution of Technology

Day-3

Session-2

Ideation

- Ideation is the third stage in the Design Thinking process.
- Ideation is the process where we generated ideas and solutions through sessions such as Randomization, Sketching, Prototyping, Brainstorming, Worst Possible Idea.
- Ideation is the most exciting stage in a Design Thinking project, because during Ideation, the aim was to generate a large quantity of ideas that our team filtered out and cut down into the best, most practical or most innovative ones in order to inspire new and better design solutions and products.
- Ideation helped us in
  - Asking the right questions and innovate with a strong focus on our users, their needs, and our insights about them.
  - Step beyond the obvious solutions and therefore increase the innovation potential of our solution.
  - Bring together perspectives and strengths of our team members.
  - Uncover unexpected areas of innovation.
  - Create volume and variety in our innovation options.
  - Get obvious solutions out of our heads, and drive our team beyond them.

Product Development

- We identified the problems and the possible solutions from the ideation canvas.
- After that, we thought about a product that can be developed for solving the problem.
- The solution we thought about our problem was providing a pedestrian under pass with shopping arena inside the under pass
- The steps followed under Product development were
  - Purpose: why we are making the product
  - People: for whom we are making the product
  - Product Experience: what we are expecting from the product
  - Product Functions: what our product can do
  - Product Features: what are the qualities of our product
  - Components: what our product includes
  - Customer Revalidation: Thoughts of the people for whom you are making the product. The Customer Revalidation was carried out by the members of the other team.

Day-4

Session -1

Prototype

- One of the best ways to gain insights in a Design Thinking process is to carry out some form of prototyping.
- The method involved producing an early, inexpensive, and scaled down version of the product in order to reveal any problems with the current design.
- Prototyping offered us the opportunity to bring our ideas to life, test the practicability of the current design, and to potentially investigate how a sample of users think and feel about a product.
- Our team produced a scaled prototype of our solution using the basic material like thermocol, cardboard, fevicol and popsicles sticks.
- The Prototype was explained to the other team members and faculty co-ordinator for feedback and inputs.

Session -2

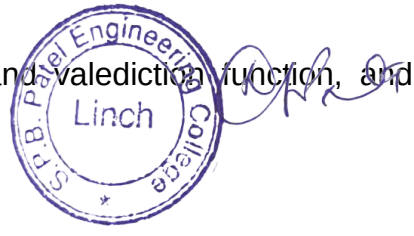
Learning Need Matrix

- The purpose of LNM is to identify the requirements of learning among the team members.
- While a new product/process is under development based on a unique idea, the team members need to learn and explore a lot of new skills and documents, methods and guidelines.
- The LNM tool is primarily addressing to be learnt by the students of engineering, broadly, it can be employed for use for any product/process under development.

Reverse Engineering

- Reverse engineering (RE) is the process of taking something apart and analyzing its workings in detail, usually with the intention to construct a new device or program that does the same thing without actually copying anything from the original.
- Resulting knowledge gained through the reverse-engineering process can then be applied to the design of similar products and that capitalizing on successes and learning from the shortcomings of existing designs is the objective of reverse engineering.
- Reverse Engineering can gives us the answers like
    - How do they formulate their starting points?
    - What is the lay-out of their thinking or their reasoning?

Finally the FDP ended with the certificate distribution and valediction function, and group photo session.



Saffrony Institute of Technology
S.P.B Patel Engineering College
Linch-Mehsana-384435

Report

On

Faculty Development Program
On
Design Engineering

(29th July 2019 to 1st August 2019)

Prepared by:

Jaimin H. Jani
(Computer Engineering Department)

Workshop Details:

Name of Speaker: Prof. Karamjit Sinh Bihola
Designation and Institute details: Date: July 29th 2019 to 1st August 2019
Duration: 9 AM to 5 PM
Venue: Gujarat Technological University, Chandkheda Campus, Ahmedabad
No. of Participants: around 55 faculties from GTU affiliated colleges.

Introduction and Objective of FDP

The core idea behind the workshop was to train faculty members from GTU affiliated colleges. One of the key objectives of this workshop was to guide us on how to convert ideas into human–centric deliverables by following the process of Design Thinking. The other objective was to convey "Think out-of-the-box" i.e. try to develop the mindset – which able to analyze from beneficiaries' perspective.

The workshop was organized for four days from 29th July 2019 to 1st August 2019.

Day1 – 29th July 2019, Monday

- The first session was inaugural-session in which two speakers shared their views. It started with Prof. Karamjit Sinh Bihola's opening note.
- In afternoon we were about to introduced an expert from NID.
- He welcomed all the participants & at very first, he showed his regrets about the way in which Design Engineering subject was being taught and evaluated across GTU affiliated colleges.
- According to him, because most of the faculties ware not trained for DE, students had no direction to follow.
- Continuation to his speech, he also instructed us how four-day FDP program would be conducted and also put across some interesting and related questions and facts, like why design engineering is introduced in GTU? What is the purpose behind the design engineering?
- He also introduced the Design thinking process.
- As the Design Engineering was introduced to the GTU around 2013 the intention was that students should come-up with some innovative idea. (Creativity vs. Innovation)
- Some PPT's ware also shown on Day one which included how the Idea of DE was taken – Tim Brown, CEO and president of IDEO.
- Then few examples and video-clips ware showed on the base of the design thinking & tried to convey how DE was integral part to solve some common problems which ware in a dire need to be solved, faced by society nowadays.
- On Day 1, we ware also introduced one expert from NID and he also conveyed the importance of Design thinking by giving some nice examples. NID expert was quite interactive and I was fortunate enough to answer some the questions he raised during the session.

Day 2 – 30th July 2019, Tuesday

- 2nd Day was again started with great enthusiasm by all the participants as we were already informed on the very first day that team forming exercise would be followed in the first half of second day of FDP.
- Before proceeding any further he explained the importance of observation using some images in PPT.
- Then the speaker provided the format used by GTU for the design thinking.
- Expert explained about the AEIOU sheet & what to do in those sheets, what important things should be taken care of.
- He also explained the importance of FDV, usefulness of "Seven-Why" technique for observation in during field visit.
- After that he explained about Mind-Map and Empathy canvas he also explained the role of the empathy canvas in the design engineering.

Part of a Team….

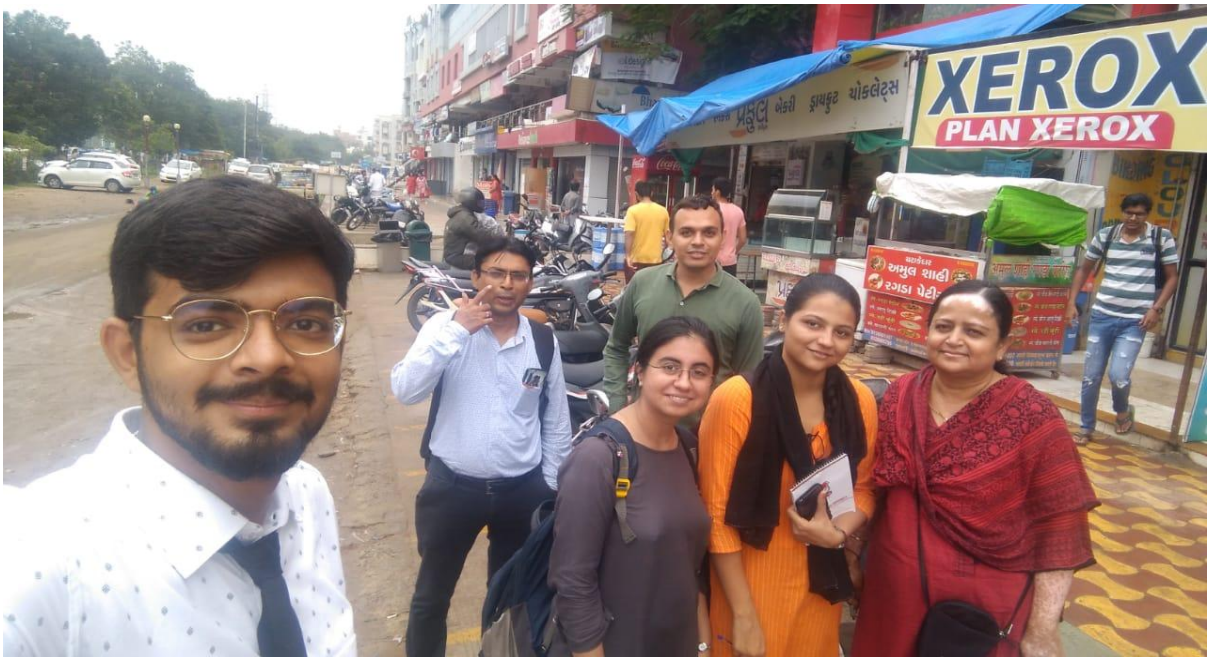
Team Members:

1. Prof. Jaimin Jani, Assistant Professor from Computer Engineering Department of Saffrony Institute of Technology,
2. Prof. Abhishek , Assistant Professor from Auto Engineering Department of Laxmi Institute of Technology, Valsad
3. Prof. Jimmy, Assistant Professor from Mechanical Engineering Department of Marwadi University, Rajkot
4. Prof. Krupali Joshi, Assistant Professor from Computer Engineering Department of, VIT, Vadodra.
5. Prof. Nisha Sukhwani, Assistant Professor from Information Technology Dept. of Silver Oak University, Ahmedabad

- In the afternoon session we had to go for field work, we had been told to select the domain in which we need to work.
- Initially everyone in the team presented their own domain selection criteria with why.
- I provided my input but some of the team members ware very much biased with the prior-solution already they had in their mind. I was unconvinced with the approach adopted my team at very first place and I also conveyed the same with supporting arguments. But team members ware in hurry to launch

"the product" on the very first day without even thinking what was the requirement of the users and the true essence of the Design Thinking.

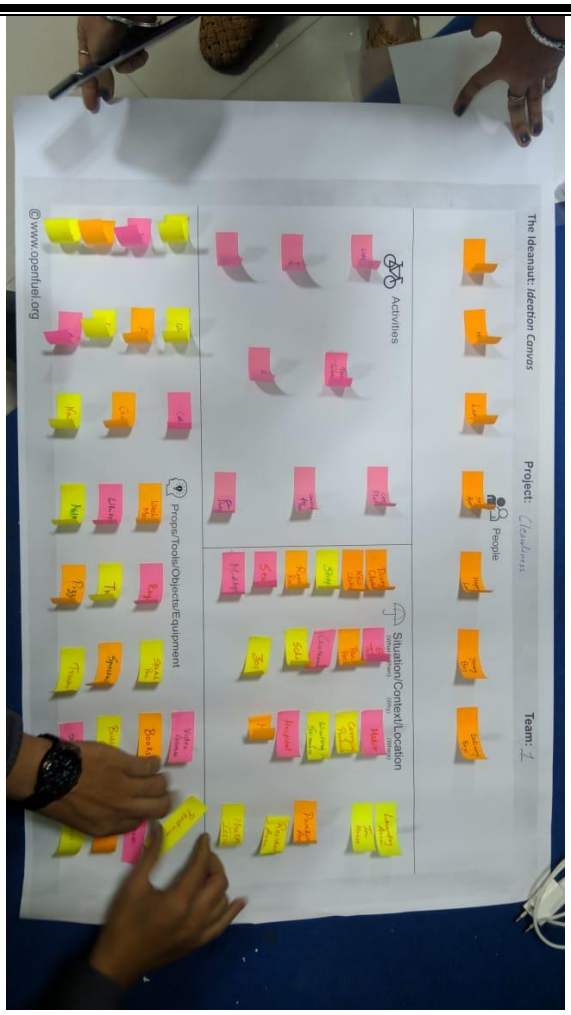
- Even worse, they didn't seem ready to use seven-why technique during field observation as per the discussion on Day 1.
- At one stage, I literally felt left-out as our team was killing the true purpose of the DE subject.
- Nevertheless, we went with majority and selected the "Plastic Waste Collection System". Again I submitted my input to my team that we ware in wrong foot as thinking about the "Solution" is totally inappropriate at this stage without even observing the stake-holders pain.
- Input was rejected with mute-negligence by proceeding the way they were doing but this time I strongly put my point not to put our words in to stakeholder's mouth and we started our field journey.



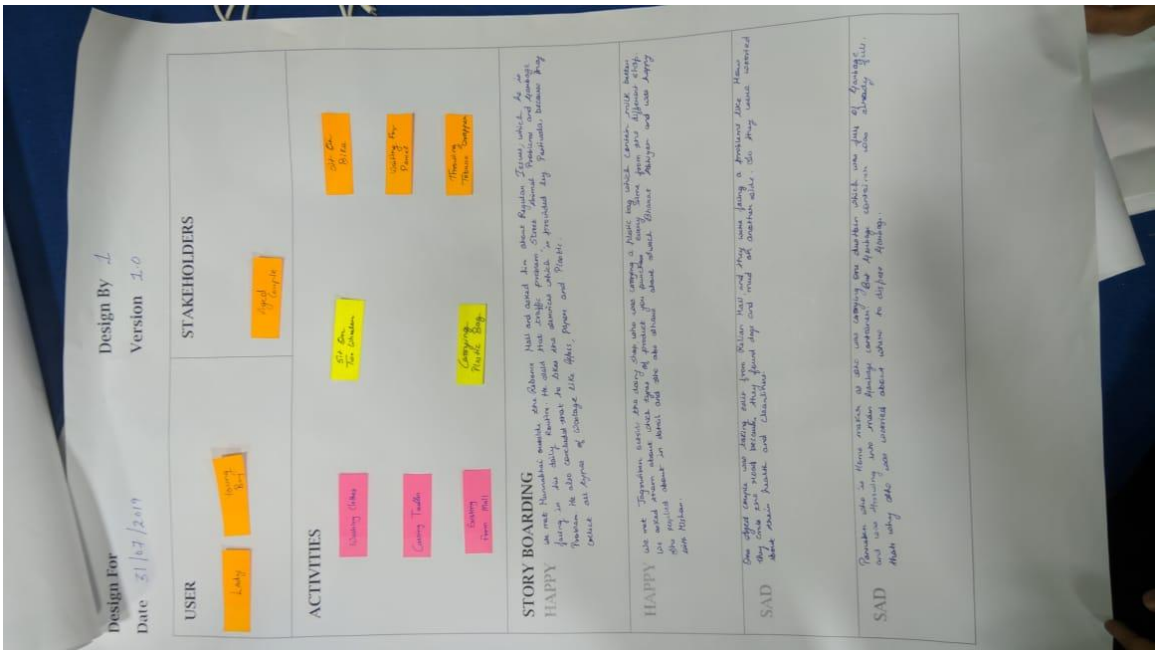
Day 3 – 31st July 2019, Wednesday

- Session was started by the Prof. Karmjit Bihola. And he again reminded the idea about what to do in the Empathy sheet. Other sheet that was of Mind mapping explained again as Mind Map would help in the ideation canvas work.
- In the mind mapping we had to create the sheet in which the domain would be main subject and had to make the flow chart type or the tree branch type which would connect the information that will useful for the domain which we had selected. We made the Mind mapping sheet according to our domain that we have selected.
- So after coming from the field work, whatever data was recorded in log-book was converted into the AEIOU Sheet with help of Sticky notes.
- Our team's idea was criticized in a very nice way by an expert of NID by initiating QA session weather everybody was on the same page as far as the Design Thinking process was concerned.
- Thereafter my team-members realized what I was telling from the beginning and one funny part was that some of the members' perspective about my way of giving input was changed instead of changing their mindset for the DE process.
- There also I forced my team to change the central theme as "Recycle" instead of the predefined solution name which I told them to put on the last day while prototype-display.

- Double-Diamond methodology applied for divergence and convergence.
- Using mind map came up with 10-15 problem statements.
- With the "solution-ready" mindset, we faced difficulties in deriving various problem statements.
- Still I tried my best and came up with some useful connections which ultimately lead us to the next stage. i.e. PDC.
- As far as Happy and Sad stories are concerned, I have to admit here that was not agree with any of them, but accepted by other members.



In Double Diamond Process…

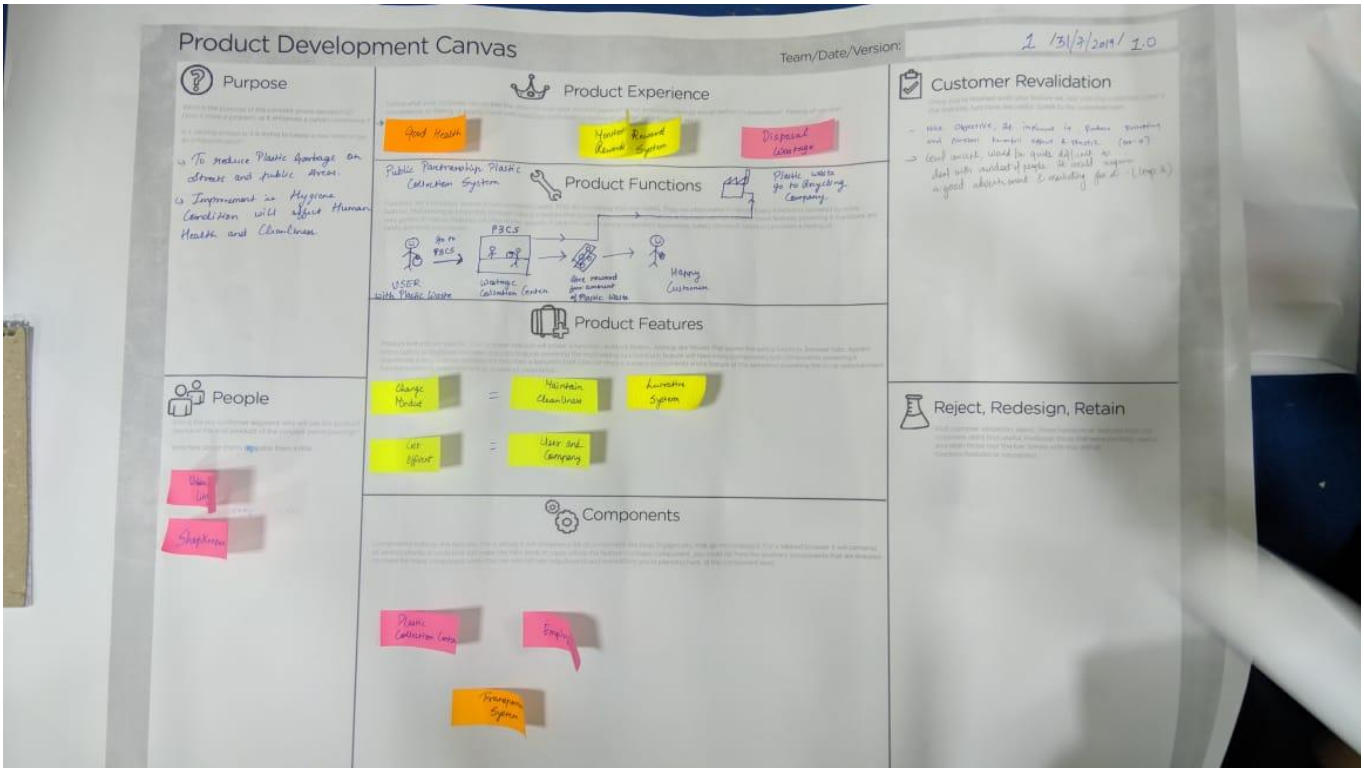


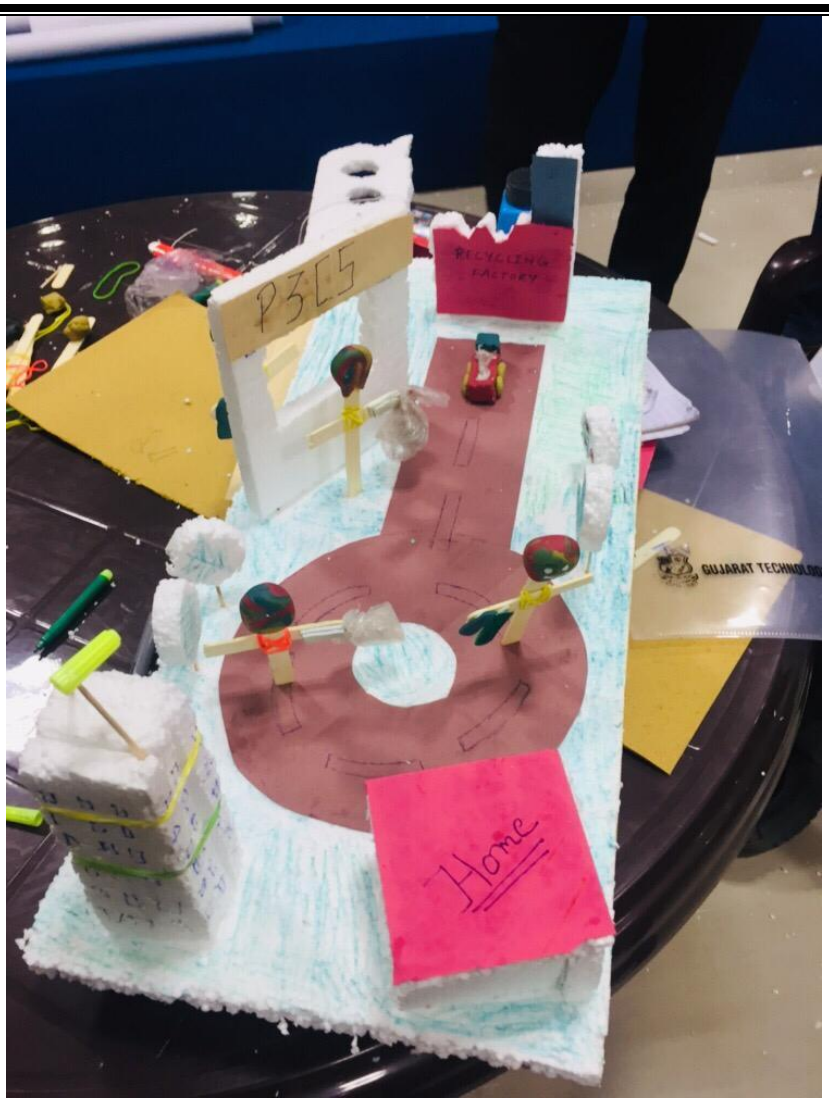
Happy and Sad Story…Empathy.

Day 4 – 1st August 2019, Thursday

- The last day of the workshop started with more excitement because all the participants had to come up with the problem statement and they were asked to solve that problem using the third Canvas: Product Development.
- In this session explanation about the product development sheet was provided to us.
- On that canvas, the participants were to fill the purpose of their product and the experience of user when they use their solution.
- Along with these things, product function, feature and components of the products needed to be filled in appropriate places on the canvas.
- Exchange of PDC with other teams again led us to second part of double diamond process.
- After weird combinations, we concluded to P3CS system i.e. "Public Partnership Plastic Collection System".
- We also took feedback from other teams about the Retention, Revision or Rejection phase.
- We got mixed response.
- We ware also given chance to present our work in form of presentation.
- The last day ended with a photo shoot for our project documentation for all the teams. These would work could be used as the reference material.
- The Faculty Members left with their participation certificate and with promise of organizing the same kind of workshops at their college for other faculties and students.

PDC:





Prototype…

Special notes:

(1) Fast pacing of all phases put unnecessary pressure; also discussed the same with speaker.
(2) Food was good.

Some funny Artifacts that never thought of came to existence…

Participation Certificate:

ESTD - 2007

GUJARAT TECHNOLOGICAL UNIVERSITY

CENTRE FOR INDUSTRIAL DESIGN (OPEN DESIGN SCHOOL)

CERTIFICATE OF APPRECIATION

This is to certify that Mr./Ms. **Jaimin Harshadray Jani** of **S.P.B. Patel Engineering College (Saffrony Institute of Technology)** has successfully participated in "Faculty Development Program for Design Engineering (Level 1)" from 29th July to 1st August, 2019 at GTU, Chandkheda campus for his/her creative efforts jointly with his/her team.

1st August, 2019
GTU, Ahmedabad

DR. K. N. KHER
REGISTRAR
GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD

S.P.B. Patel Engineering College
Linch

S. P. B. PATEL ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

Report on 52nd FDP (4-days) on Design Engineering

Name of Resource Person: Prof. Karamjitsinh Bihola
Designation and Institute details: Assistant Professor, GTU Design Team
Date: 29th July - 1st August 2019
Duration: 9 am to 5 pm
Venue: Gujarat Technological University, Chandkheda Campus, Ahmedabad
No. of Participants: 35 from various GTU affiliated colleges in Gujarat

Introduction and Objective:
The purpose to conduct the workshop was to infuse the methodology of Design Thinking into the mind-set of the students and the faculty members for enhancing problem solving skills so that it is used in the study of all the core subjects of every branch from the 3rd to 8th semester. It was also done to stimulate thought process and creativity among the students, to learn problem-solving techniques, to lessen the copy-paste in the Project work etc.

Workshop details:
Day 1 – 29th July 2019
The first session on the first day started with Welcome & Orientation session which includes Introduction to Design Engineering Course in which facilitator informed us about subject code changes done in 3rd and 4th semester Design Engineering , where as 5th and 6th semester will remain same. Also they informed us that there will be no external viva for 3rd and 4th Design Engineering subject, so there will be Internal Review which will be done by panel of 3 guide which includes internal guide, other branch facilitator and Industry expert(Optional but Recommended).

Then Prof. Karamjit Bihola started explaining Why Design Engineering is important?, What is Design Engineering? and How design engineering could be applied?, Phases of Design Engineering, all these things were explained using presentation. He also explained how design engineering could be applied in our day- to-day life and how it can be used to solve problems by finding out its simpler solutions.

What is Design Thinking?

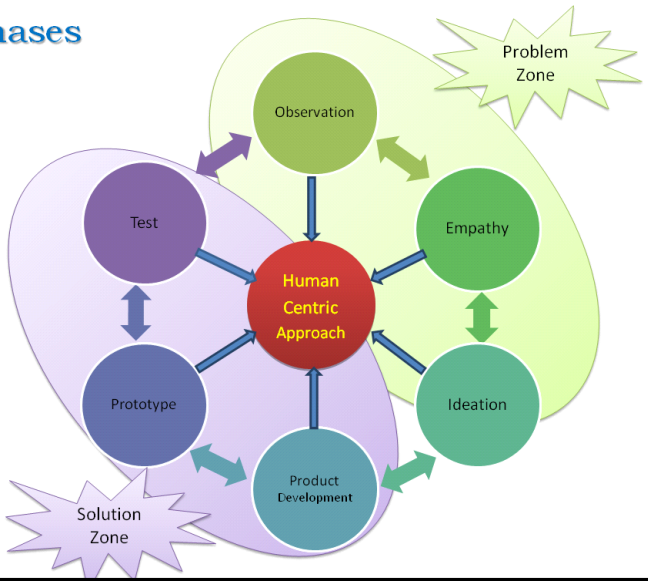
- ✓ *Controversial term* – particularly thinking part
- ✓ It is Decision making approach – lot more than just thinking……it's a……doing
- ✓ Moses Myth: Innovation is Miracle

(They believe that Innovation takes special gifted one that most of us just don't have)

Source: http://jeanneliedtka.com/

https://www.bloomberg.com/news/articles/2013-09-25/the-moses-myth-of-innovation

Design Thinking - Phases



© 2015 Karmjitsinh Bihola. All rights reserved.

Then the 2nd session was taken by Prof. Bhavin Kothari where he discussed in detail about what is design engineering and how it can be used for obtaining simpler solutions for larger problems using examples in very interesting way, where he tried to involve all the faculties.He focussed on three main aspects of Design Thinking :People(Desirability), Business(Viabililty), Technology(Feasability) with different examples.

The first day ended with the key learning points of that particular day.

Day 2 – 30th July 2019

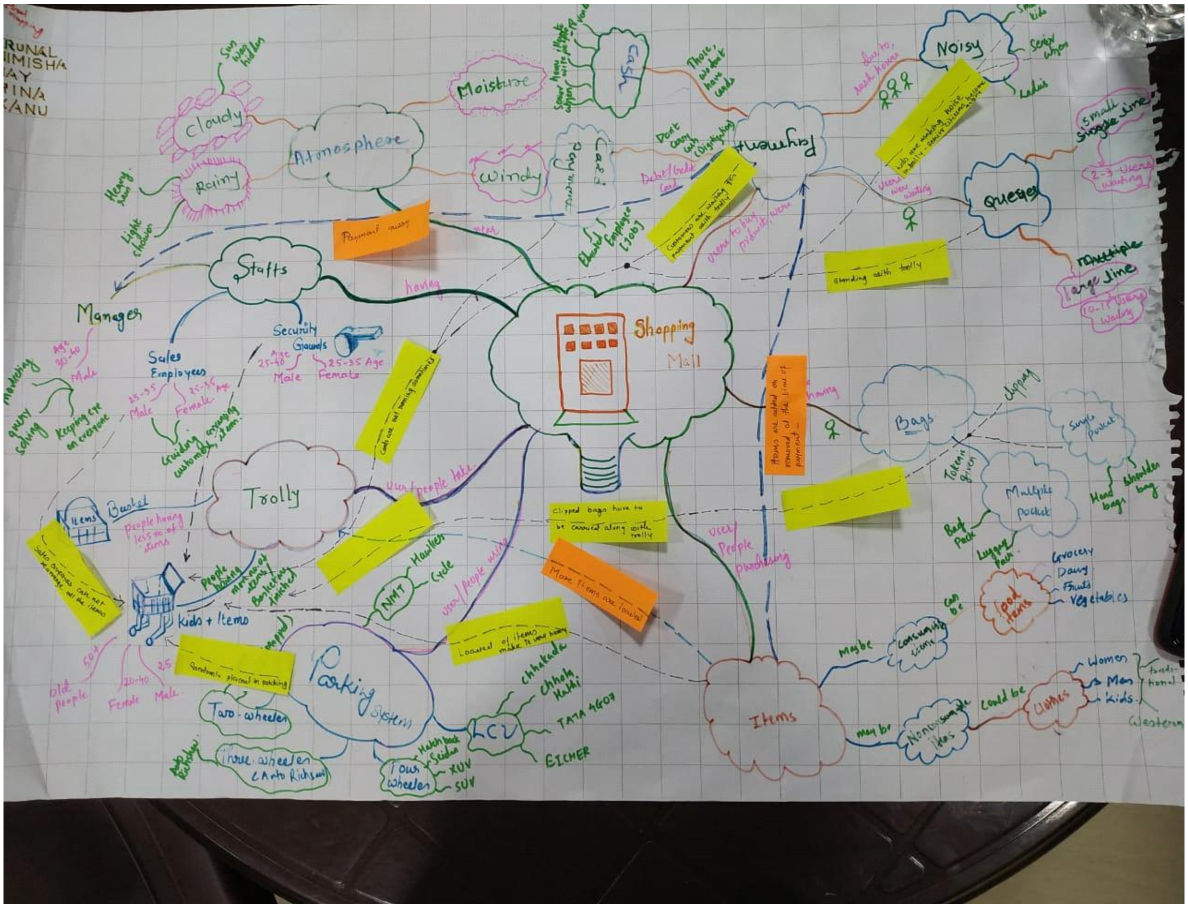
On Second day facilitator dicussed about applications of design thinking such as Design thinking could be applied to solve Social and Community issues through programs that are designed through design thinking process. Design thinking could provide consultancy for Industries, sustainable design solution and in turn provide practical learning to students. Design thinking could be useful for Make in India solutions through spreading awareness of Design Philosophy. Design thinking could be helpful to merge the gap for Design, Manufacturing, Business etc.by providing design thinking training to them. Design thinking concepts helps in skill development, pedagogical innovation, entrepreneurship, co-creation.Design thinking ease in developing problem solving skills, coverting ideas into solutions/Project to product, integrates design mindset with engineering learning, reduce copy-paste projects, also enhances learning by doing.

After that facilitator divided us into various teams and told that from that point,we need to work in a team.In that,our team consist of five members along with me.We were instructed to go out of college campus for observation and come back within two hours.

We went to D-Mart,we observed various things such as 1) Security check at entry point, 2) Customers buying various product 3) Inquiring about various products. There we noticed that in

rush hours people were facing problems of congestion due to design of trolley. So we decided to work on design of trolley and optimize the design of trolley so that it would acquire less space.

We came back to college campus and started discussing about our observation with facilitator .Then we started putting our observations onto Mind- mapping sheet.We were provided with sheets, sketch pens, sticky notes,and other decorating materials to draw and present our observations in designing way.



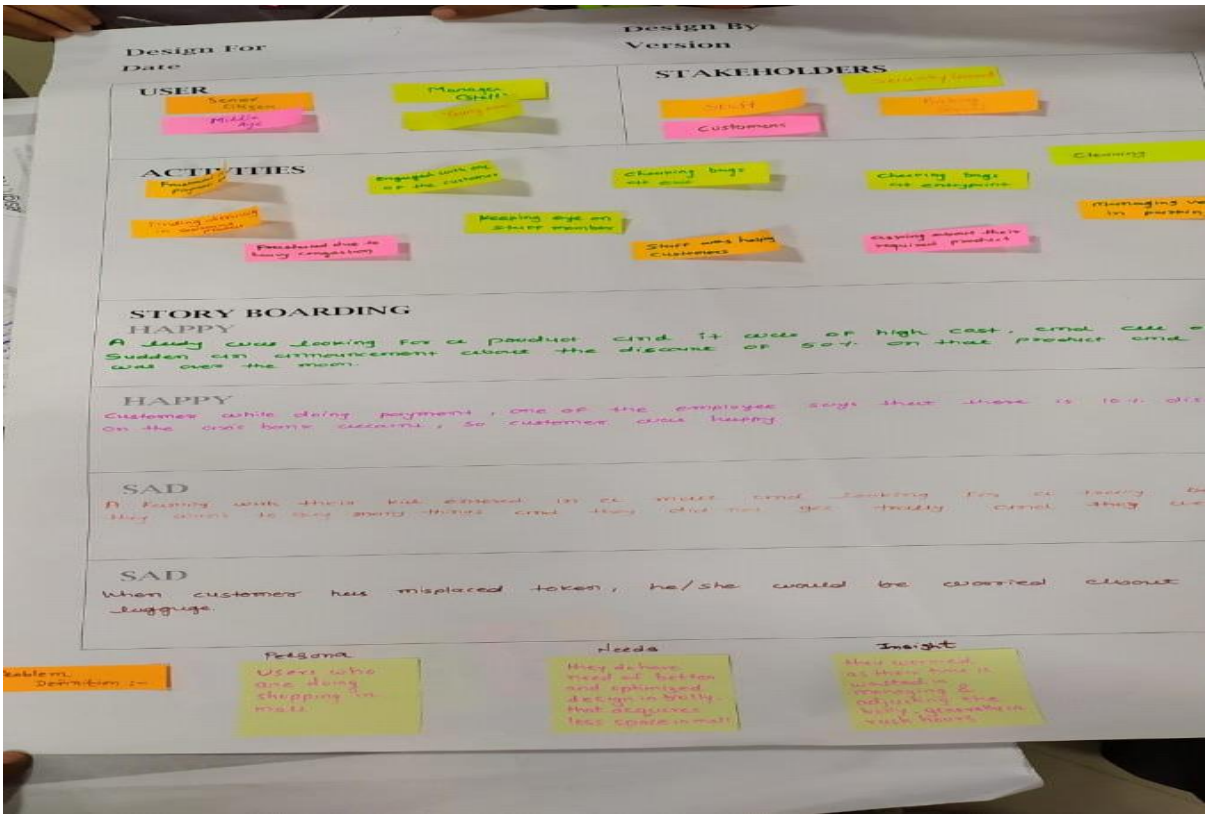
Shopping Mall
Atmosphere
Cloudy
Rainy
Moisture
Windy
Cash
Payment
Noisy
Queues
Staffs
Manager
Sales Employees
Security Guards
Trolly
Basket
Kids + Items
Parking system
Two-wheeler
Three wheeler (Auto Rickshaw)
Four wheeler
LCV
TATA 407
EICHER
Bags
Single pocket
Multiple pocket
Items
Food items
Grocery
Dairy
Fruits
Vegetables
Clothes
Women
Men
Kids
Large line
Small line

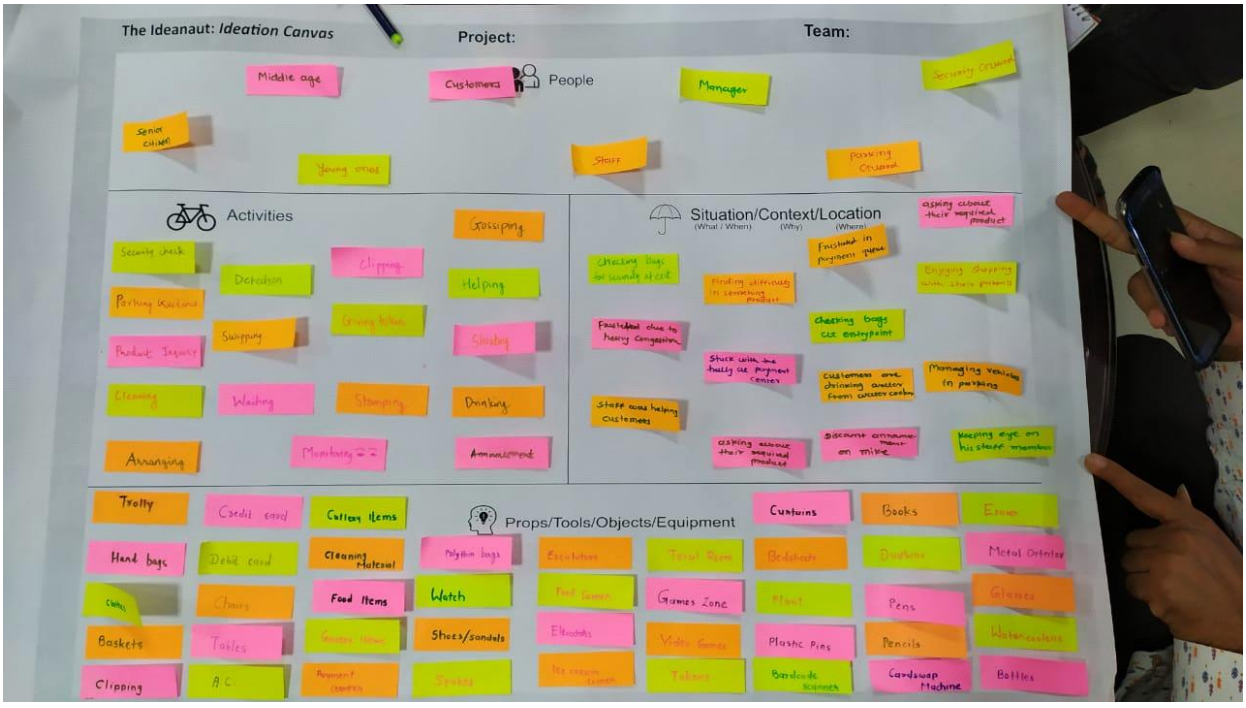
Day 3 – 31st July 2019

Third day started with drawing different sheets like empathy sheet, Ideation sheet, AEIOU sheet in which we present happy story, sad story related to our observations.

All of us in team started doing discussion about our observations, stories related to our domain.Prof. Karamjit Bihola helped us in understanding various things like what would be activities, users , stackholders, environment, situation etc. Prof. Karamjit Bihola told us to exchange sheets between groups present in the room. From that he told us to make atleast 50 combinations of Activities, Situation and Tools.Then he told us to take back our own sheets with that combinations prepared by other team. From that he told to find other problems that would be coming from these combinations.Actually his main goal was to make us find other related problems , so that their combined solution could be obtained.Then we mentioned three main aspects in our sheet: Persona , Needs, Insights of our domain.

Third day ended with completing different sheets and having valuable inputs from Prof. Karamjit Bihola and other team members.



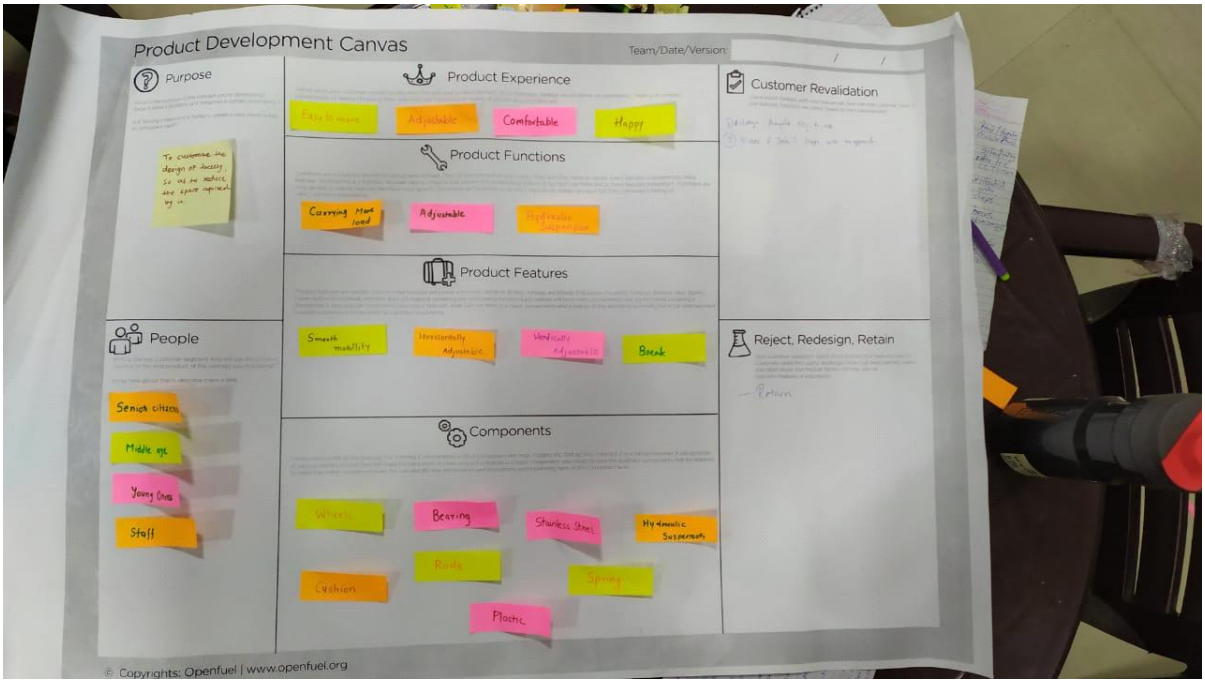


Day 4 – 1st July 2019

On the last day we were given task of completing product development sheet and prototype model. Also facilitator gave knowledge about reverese engineering and how it could be used in design engineering.We were provided with different materials to prepare prototype model like thermocol sheet, sketch pen, scissor, colourful papers etc. Finally we prepared our prototype model of "Trolley" which would be able to reduce space area acquired in the mall especially during rush hours.

At last, we all presentated our work with prototype model and had discussion on it and also got valuable inputs from Prof. Karamjit Bihola and all team members. Prof. Karamjit Bihola was happy with our work and told us to prepare final product in next FDP.

Finally we were provided with certificate for attending Faculty Development Programme.


Product Development Canvas
Team/Date/Version:
Purpose
Product Experience
Easy to move
Adjustable
Comfortable
Happy
Customer Revalidation
Product Functions
Carrying More load
Adjustable
Hydraulic Suspension
Product Features
Smooth mobility
Horizontally Adjustable
Vertically Adjustable
Break
People
Senior citizen
Middle age
Young Ones
Staff
Reject, Redesign, Retain
Components
Wheels
Bearing
Stainless Steel
Hydraulic Suspension
Rods
Spring
Cushion
Plastic
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ESTD - 2007

CENTRE FOR INDUSTRIAL DESIGN
(OPEN DESIGN SCHOOL)

CERTIFICATE OF APPRECIATION

This is to certify that Mr./Ms. **Nimisha Sharma** of **S.P.B. Patel Engineering College (Saffrony Institute of Technology)** has successfully participated in "Faculty Development Program for Design Engineering (Level 1)" from 29th July to 1st August, 2019 at GTU, Chandkheda campus for his/her creative efforts jointly with his/her team.

1st August, 2019
GTU, Ahmedabad

DR. K. N. KHER
REGISTRAR
GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD

Thanking you for granting me permission to attend this workshop which helped me to open up the vision and will help to apply in my coursework for better teaching.

Your's Sincerely,

Nimisha Sharma

S.P.B. Patel Engineering College
Linch

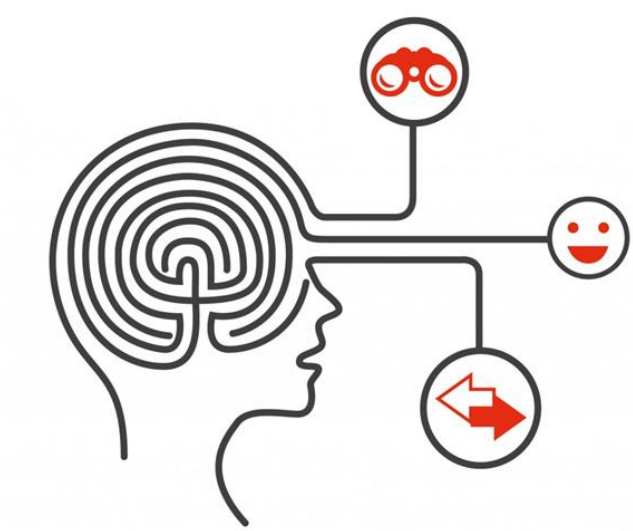
S. P. B. PATEL ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

Report on Faculty Development Program on Design Engineering - I

Name of Resource Person: Prof. Akshay Kansara
Designation and Institute details: Assistant Professor, S.P.B Patel Engineering College, Saffrony Institute of Technology
Date: 29th July to 1st August 2019
Duration: 10 am to 5 pm
Name of Speaker: Prof. Karamjit Sinh Bihola
Venue: Gujarat Technological University, Chandkheda Campus, Ahmedabad
No. of Participants: 35 from various GTU affiliated colleges in Gujarat

Introduction and Objective:
The main objective of this faculty development program was to introduce the Design Thinking methodology into the state of mind of the students and the Faculty Members so that it is used in the study of all the mainstay subjects. Other objectives were included like thought process and creativity among the students, problem-solving techniques and design engineering as a process.

Workshop details:
Day 1 – 29th July 2019
The first session of the first day started by Prof. Karamjit with prayer and then he had introduced design engineering from the scratch where he had started his session from the scratch where he had started with what is the conceptual need of this subject.



Design Thinking

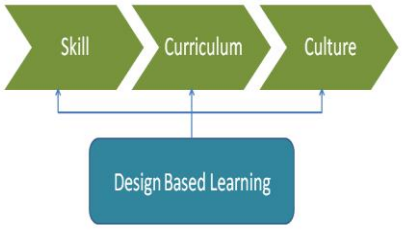
Prof. Karmjitsinh Bihola
GTU – Design Team

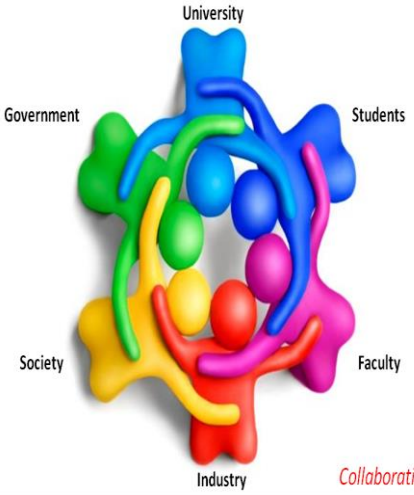
He had also mentioned in introductory session that how design engineering will help and has involved in education and innovation for the 21st century with some facts. He had also presented few facts in which how this young generation can help and work towards design thinking process from "Thinkers to Doers" where we have lots of ideas but we don't have clear approach to implement those ideas where this subject can play a key role. He had given some statistical analysis of colleges and students in India.

He had also shared how GTU is working and basic structure which is required. Then he had discussed contextual need of this subject where he had shared few points like how to inculcate design thinking mindset in students and faculty members, problem solving skills, converting idea into solutions, learning by doing and practical approaches with examples. One of the key point which I took that when anyone is converting his/her idea to the solution it should be followed by DVF approach means the solution should be such that Desirable(People), Viable(Business), and Feasible(Technology) where design thinking is related to desirable part and while innovation pat is in the centre of this approach. He had also shared various design thinking phases like Observation, Empathy, Ideation, (where these will play as problem zone or we can say problem identification) Product Development, Prototype, Test (where these will play as solution zone or we can say problem solution) and all these should ne human centric. He had also discussed about students experience while applying theory into practical. He had also shared few examples where someone has come up with solutions.

After lunch session we had expert session by Prof. Bhavin Kothari from National Institute of Design. He had also given the insight of design thinking approach in detail. His session was very informative. Most of the session was based on question answer type where he had involved all of us very effectively.

Structure



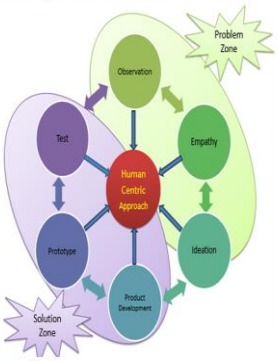


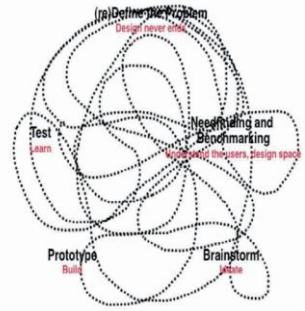
Collaboration is required

Design Driven Innovation at GTU

- Skill Develop-ment
- Pedagogical Innovation
- Entrepre-neurship
- Sustainable Design Solution
- Co-Creation

Theoretical v/s Real process flow



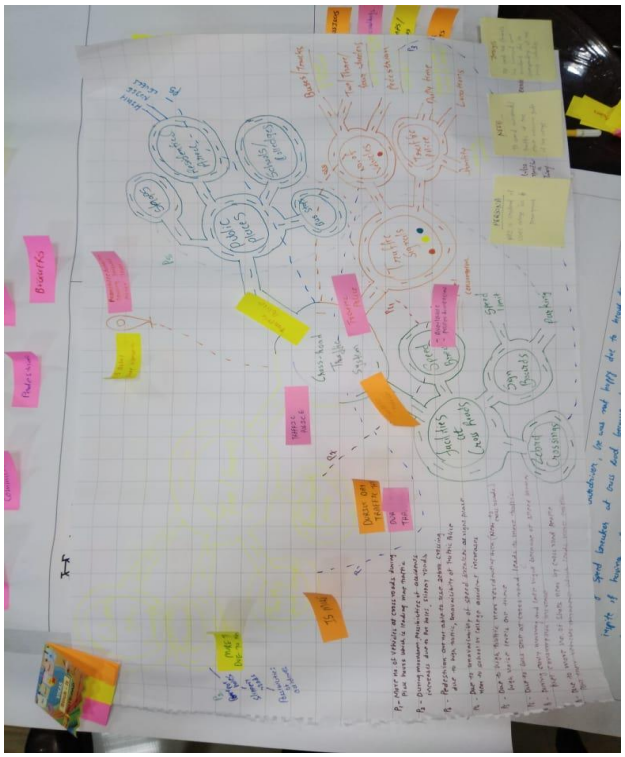


The first day concluded with presentation by Prof. Karamjit Sinh Bihola and Prof. Bhavin Kothari with their design experiences and discussion with all the participants.

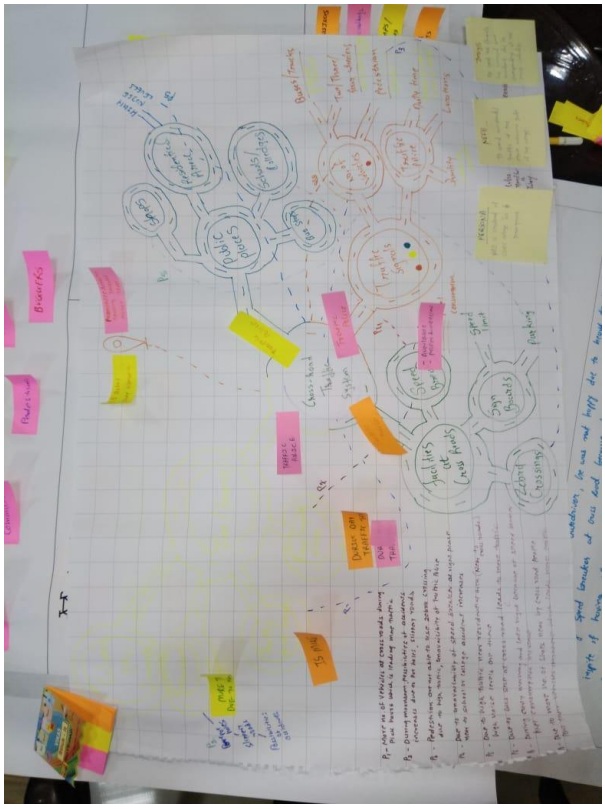
Day 2 – 30th July 2019

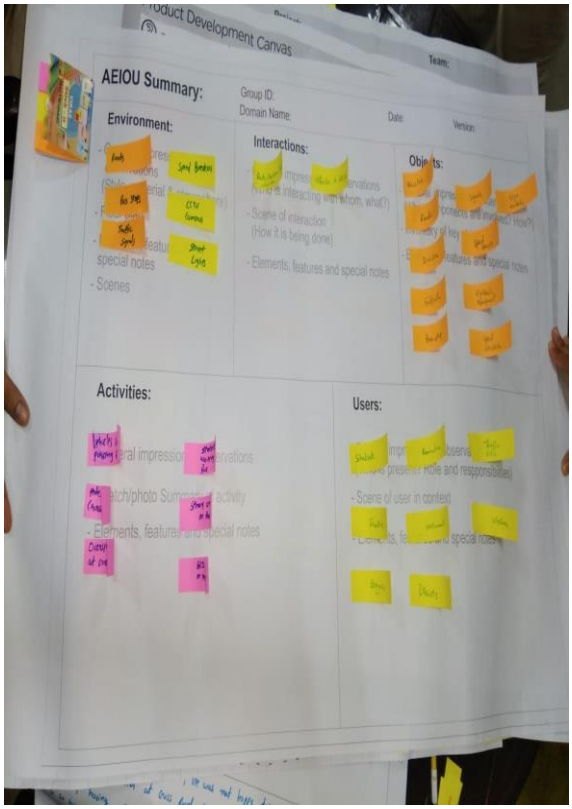
The 1st session on the second day started with few topics which were not covered on the first day by Prof. Karamjit Sinh Bihola followed by prayer. He had discussed more in detail about the observation part and how it helps to identify problem from all aspects. He had introduced different canvases which we needed to follow and submit to him each day. He had also touched upon on empathy part during the first session. He had also introduced Mind Maping technique. After the first session, all the participants were devided into the groups where teams were formed such that all the team members should be from different colleges and different departments. My team number was 5 and we were five faculty members Prof. Akshay Kansara (IT Dept., SPBPEC, SIT), Prof. Nirav Joshi (Electical Dept., SPBPEC, SIT), Prof. Pranjlee Acharya (Computer Dept., Silver Oak University), Prof. Narendra B Gohil (Electrical Dept., Shantilala Shah Engineering College) and Prof. Tarang Jayswal (Electrical Dept., SAL Education Campus).

First task was to observe and identify the problem which we as a team wanted to work for next three days by applying design thinking principles. So we went outside the campus and with the inputs from all team members we came up with one problem domain which was based on traffic problems nearby cross roads and we targeted ONGC cross roads at GTU Chandkheda.



We also talked with few people around the cross roads and had taken inputs from them. They had shared mixed reviews. We noted all the points and then we reached back to the seminar hall. But it was a great learning experience for all of us. Personally it was first time where I had done this kind of work for any project.





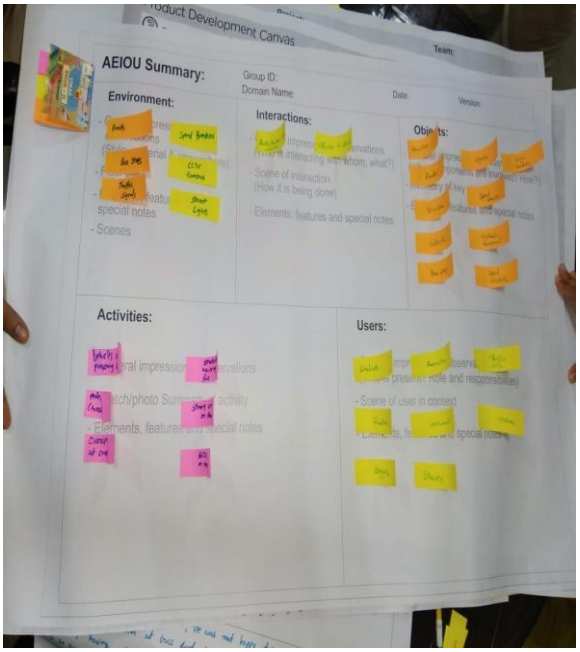
After delicious lunch, we all gathered for 2nd session where again we had with us Prof. Bhavin Kothari. Initially his session was started with few glimpses from last session then both the experts had asked our experience, learning and the domain in which we wanted to work one by one team in which the whole presentation was like question answer based from all the teams and experts. After the presentations from few teams Prof. Bhavin Kothari had took the stage and explained us mistakes which we all had done during the observation part and also guided how to correct them for the remaining days. He had also shared few points from his previous presentation.

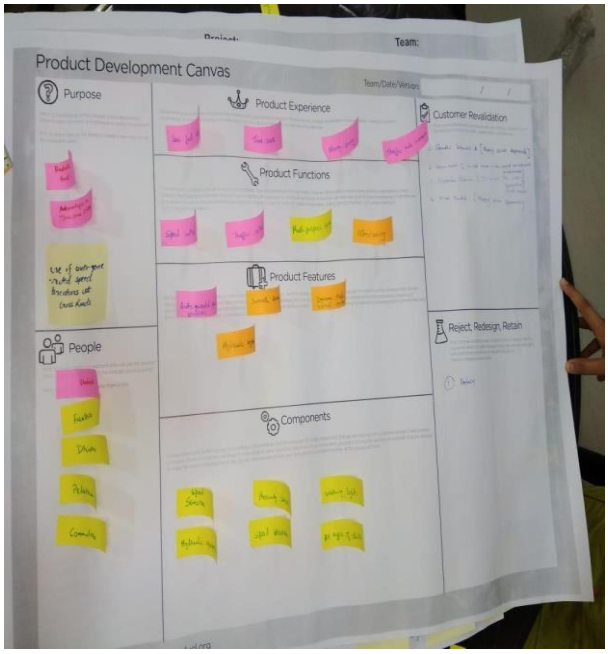
The second day ended with presentation based on our observations and domain selection by all the teams with their experiences, discussions and questions - answers with all the participants and with two experts as well.

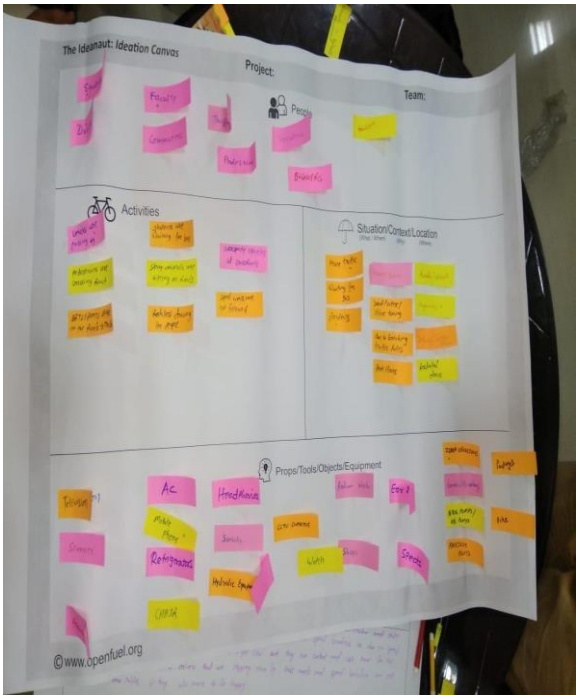
Day 3 – 31st July 2019

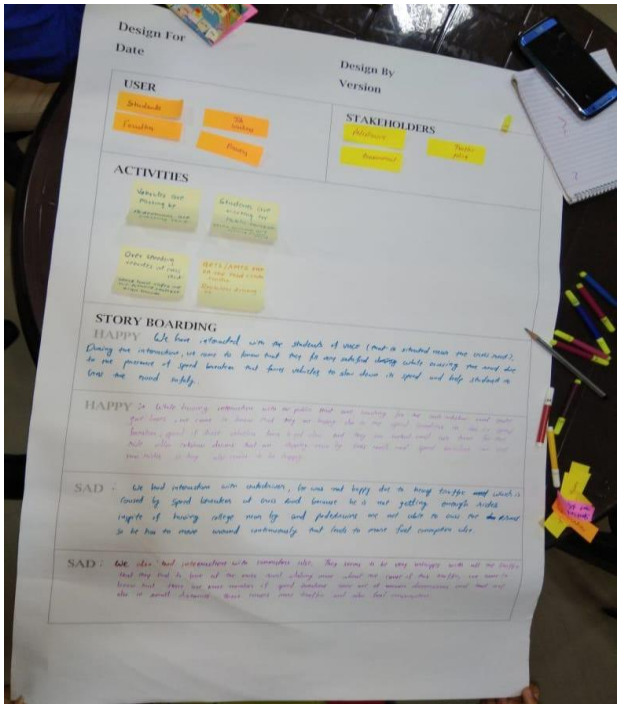
The 1st session on the third day started with prayer and work which we had done on the second day. Prof. Karmjit Sinh Bihola had introduced other canvases like Ideation canvas, Happy/Sad story based canvas and product development canvas. He had also given insights about "Problem articulation" during his presentation.

After that we had started to look after all the canvases one by one where faculty members from my team had given their suggestions which helped us a lot to come up with all canvases. Mean while we also asked Prof. Karamjit Simh Bihola for his input to make it clear. Initially we were in confusions from which canvas we should start because somehow we were not able to complete our work on AEIOU canvas so we took help from karamjit sir and then we divided our work amongst our team members.







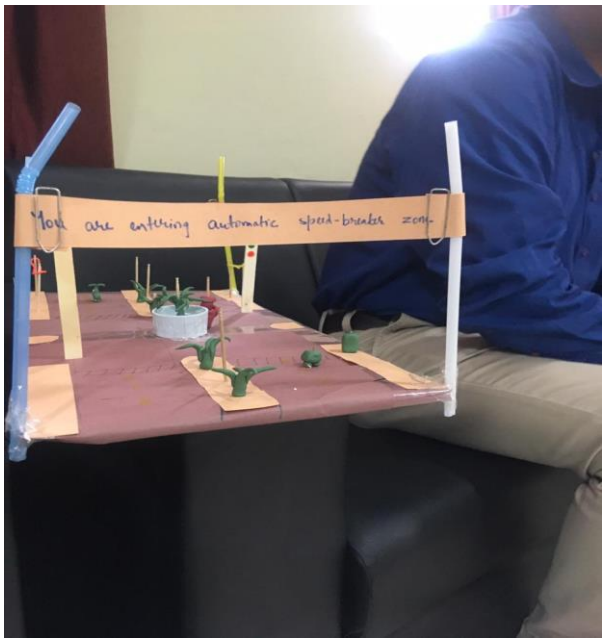


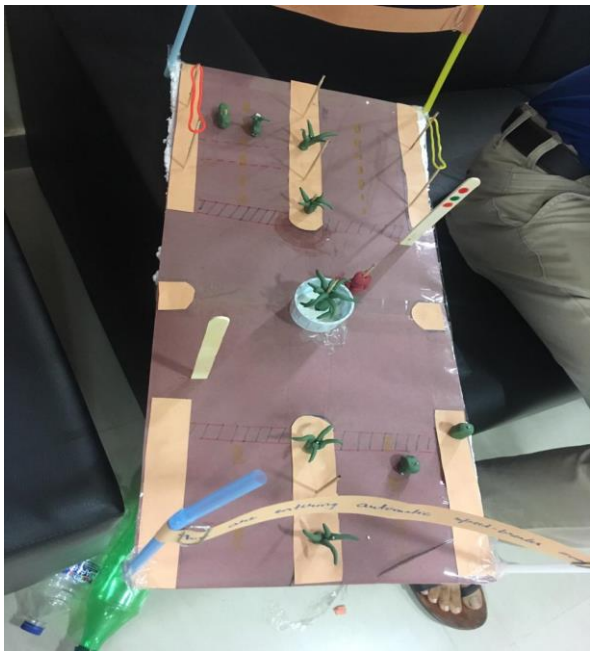
After completing this task, Prof. Karamjeet Sinh Bihola had instructed us to exchange the canvas with other team and informed each team to identify at least 50 combinations between Activity, Environment and Objects. It was an interesting task because it helped our team to see our work from different perspective with other inputs. We had also given our inputs to other team. We got to know many sides of our domain. Thanks to Karamjit sir for his valuable idea.

The third day ended with presentations, points which were provided from different teams on our product development canvas with their experiences, discussions and questions - answers with all the participants and with two experts as well.

Day 4 – 1st August 2019

The 1st session on the fourth day started with prayer and then Prof. Karamjit had asked all the teams to come up with prototype model where we had created our prototype model on 'Traffic problems at Cross Road'. We had used materials which were provided by Prof. Karamjit Sinh Bihola. It was really an exciting activity because we supposed to build our product based on all three days work which we did with all inputs. All the teams were super excited to show their prototype. Finally we had created our model and we had also presented our work in front of all the teams and Prof. Karamjis Sinh Bihola. We also got few suggestions which we can work out on our prototype model.





At the end all the participants have received a certificate for completion of FDP.

In gist the four days workshop was filled with full of knowledge, awareness about Design Engineering workshop which was needed, activity based learning, canvases which we had created and al last prototype which helped us to see our idea or thought we took on the first day how it would work.

Thanking you for granting me permission to attend this workshop which helped me to open up the vision about this subject and will help to apply in my students project work for Design Engineering as well as for final year project.

GUJARAT TECHNOLOGICAL UNIVERSITY

ESTD - 2007

CENTRE FOR INDUSTRIAL DESIGN
(OPEN DESIGN SCHOOL)

CERTIFICATE OF APPRECIATION

This is to certify that Mr./Ms. **Akshay Rameshchandra Kansara** of **S.P.B. Patel Engineering College (Saffrony Institute of Technology)** has successfully participated in "Faculty Development Program for Design Engineering (Level 1)" from 29th July to 1st August, 2019 at GTU, Chandkheda campus for his/her creative efforts jointly with his/her team.

1st August, 2019
GTU, Ahmedabad

DR. K. N. KHER
REGISTRAR
GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD

Your's Sincerely,

Prof. Akshay kansara

S.P.B. Patel Engineering College
Linch

	Saffrony Institute of Technology **S.P.B Patel Engineering College** **Linch-Mehsana-384435**

Report on 'Faculty Development Program for for Design Engineering (Level-1)'

Name of Expert: Prof. KaramjitSinh Bihola & Prof.Bhavin Kothari

Designation and Institute details: Prof. Karmjitsinh Bihola- Asst. Professor of GTU Centre for Industrial Design, Prof.Bhavin Kothari-Senior faculty Member in Strategic Design Management discipline at National Institute of Design

Date: 29th July to 1st August, 2019

Duration: 9 am to 5 pm

Venue: Gujarat Technological University, Chandkheda Campus, Ahmedabad

No. of Participants: 44 from various GTU affiliated colleges.

Team Members:

1. Tausif M Shaikh, Assistant Professor from Mechanical Engineering Department of Saffrony Institute of Technology
2. Nilam Thakkar, Assistant Professor from Information Technology Department of Sal Institute of Technology
3. Janki Patel, Assistant Professor from Civil Engineering Department of Bhagwan Mahavir College of Engineering & Technology, Surat
4. Kamlesh Ram, Assistant Professor from Mechanical Engineering Department of, GEC Bhavnagar

Introduction and Objective:

GTU introduced courses of Design Engineering through Design Spine, during the academic year 2014-15, beginning from 3rd semester. Design Engineering is a very unique and pioneering initiative of GTU and it is based on **"Design Thinking"** methodologies developed and used by engineers and designers all over the globe. One of the key objectives of this workshop was to change mindset of Students and faculty members through methodology of Design thinking for utilize in the study of all the core subjects of every branch. The other objectives were to stimulus thought process and creativity among the students, to learn problem-solving techniques, and also to have different sessions for all the members of design thinking team to ensure the conversion of prototypes into final useful product which is helpful to address problems of Society and Industry.

Workshop details:

Day1 - July 29, 2019

The first session on the first day was started by Prof. Karmjitsinh Bihola with Prayer. He welcomed all the participants of the Faculty development program. The session started with an inspiring speech by Prof Karmjitsinh Bihola, GTU for considering the subject as a chance to develop design thinking as an integral part of engineering studies. He explained when and why design engineering is introduced in GTU. What is the purpose behind the design engineering? He explained the basic guidelines and flow of Design Engineering from 3rd semester to 6th semester. He discussed the schedule by explaining which activity would be done in these four days. He gave information about introduced continuous assessment card system for review of Design engineering projects. Also he gave information about SSIP grant upto 2 Lacks for best projects and best projects can be carrying forward in final year projects under SSIP Grant. Idea was taken from the Stanford University and MIT and also from Books on creativity ideation by Edward de Bono. Design thinking approach was explained with different examples and videos. He explained how so many innovations have been carried out in the world by following the Design Thinking process. Design Thinking is Human Centered process with lots of iterative cycles to reach the final solution for satisfying User's Unmet Needs. He also talked about innovation ladder and

Organization transformation through Design thinking, design Driven innovation from UN website through 17 stages goal and Contextual needs for design like mindset, problem solving skills, project to product etc.. Discusion of ground rules for design thinking and Approach of traditional thinking v/s Design Thinking and 21st Skills by World Economic forum required for students to become industry ready. He concluded session one with design thinking phases and explaining 3 types of problem like known-known, known-unknown and unknown-unknown.

Then the 2nd session started by Prof.Bhavin Kothari-Senior faculty Member in Strategic Design Management discipline at National Institute of Design and the topic was Design Thinking for engineers. The session was started with exercise and group discussion session and then brief about the concept of VUCA (Vulnerable, Uncertain, Complex and Ambiguous) ,Design thinking by triple bottom line through design thinking and importance of DFV (Desirablity, Feasibility and Viability) Model for design thinking and by combination of all three experience innovation. He played the video of Korean Parking problem by best solution by S-Oil Company through design thinking. He also brief about Double Diamond design process by system thinking (convert problem into wicked problem) and gave the example of clock by observation research to generate insight, Capture Latent (Hidden) Need with best suitable examples, Empathy Mapping

,Difference of design thinking ,Essence of design thinking and deductive V/s abdicative approach.

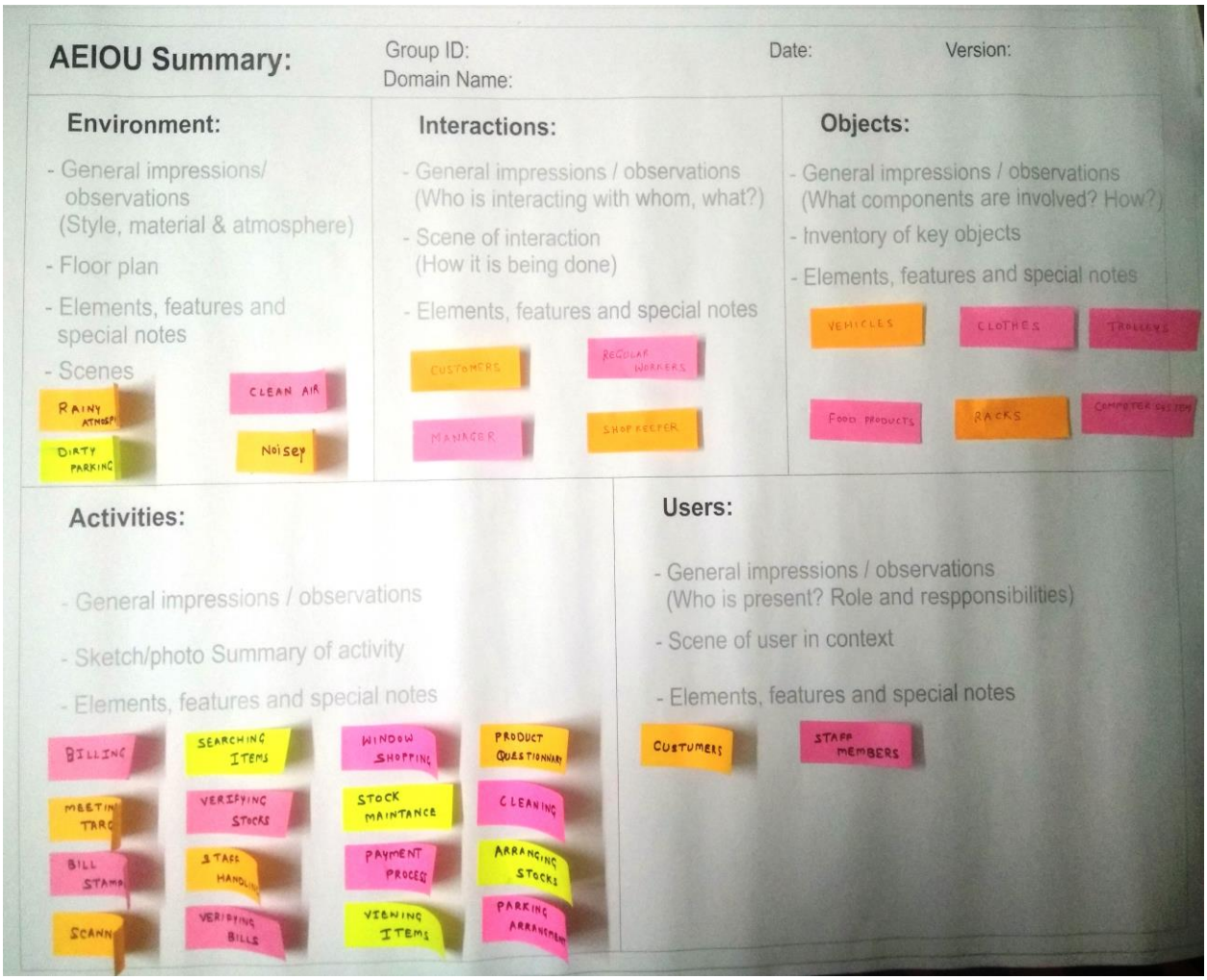
The Third Session started by Prof. Karmjitsinh Bihola on Empathize. He suggested that feel the pain of user's because good design comes from the heart not from the brain. He explained concept of empathize with Observe, Immerse and Engage and also told story of Darwin-Power of observation. He gave the example of old lady with walking stand on staircase with front adjustable legs and shows best possible Solution through design thinking and water wheel concept model to transfer the water for village ladies. Importance of Team formation and Logbook were explained. After that the team formation was done in the creative way by forming groups based on discipline and then finally 4 or 5 in a team were chosen based on total number of participants. Total 7 teams were formed because only 29 present out of 44 on first day. At last Observation phase was described through AEIOU Framework (Activity, Environment, Interaction, Objects and User's) technique with the help of a Case Study. All team members are set together and AEIOU sheet were distributed among the groups.

The first day ended with concluding notes of full day.

Day2 - July 30, 2019

The first session on the second day was started by Prof. Karmjitsinh Bihola with Prayer and a discussion about the experience of the first day was begun and queries of the Faculty Members were solved by the Prof.Karmjit Bihola. After discussion, it was started with development of AEIOU by Ethno hub and explains the important about the observation part in the design thinking process. Also given the detail explanations of the AEIOU sheet and observation tips. After that case study of farm project(drip tube well) and also shared experience of field of pirana site. He explained few tools for observation like Beginners Mind-Set, Set Bench Mark- initially look for quantity over quality, Macro-Micro observation and wearing multidisciplinary hat and interview tips like always ask 5-ways and encourage for telling more information. Then he has explained about the research plan like who and where to observe? What are different roles of your team? What to observe and learn? Inventory check before setting off.

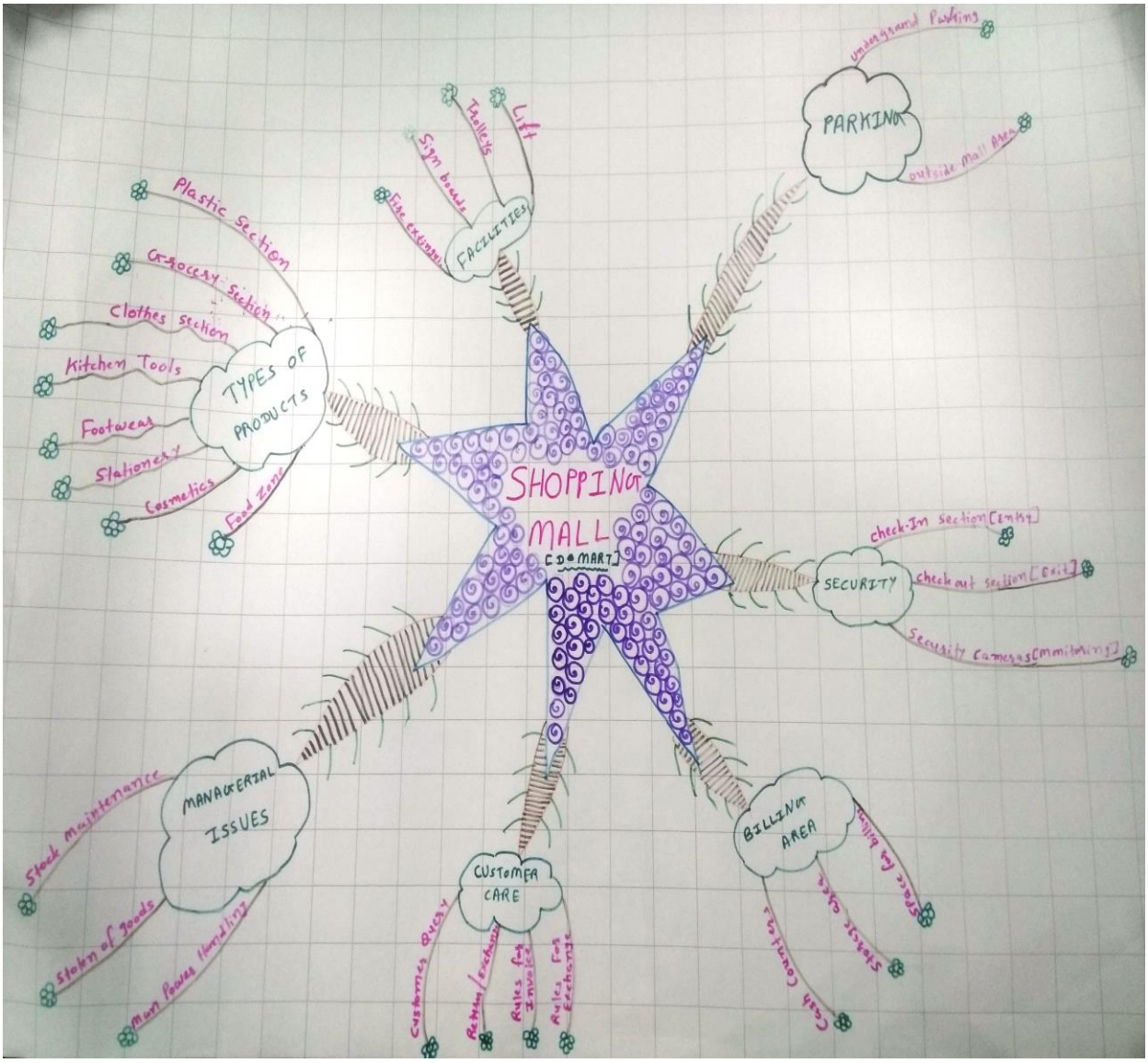
After that there was application of the session that we have to go for the field work, we have told to select the domain in which we have to work. As we know there was only 2 hours to select the domain .So, we visited 2 or 3 shopping malls and we had selected the domain of the shopping mall So after coming to the field work, whatever data was collected from the observation in the log book was converted into the AEIOU Sheet with help of Sticky notes.



AEIOU FRAMEWORK OF D'MART SHOPPING MALL

The second session was started after returning from field observation; all teams were guided for Mind Mapping – A graphical visualization technique by expert, Karmjitsinh Bihola. Mind Mapping is the visual representation technique that includes a central idea surrounded by connected branches of associated topics to better organize the messy and unorganized data.

There were three major types of Mind Mapping: Information Mind Map, Concept Mind Map and Application Mind Map. It helps to better organize, understand, communicate and recall the topics. Then Empathy Mapping Canvas was explained by the karmjitsinh Bihola; Empathy Map helps to understand and identify the emotional and unmet needs of user. Observation and Empathy process is the foundation of any Design Thinking project and one must spend enough amount of time for this phase by doing observation and interaction again and again.



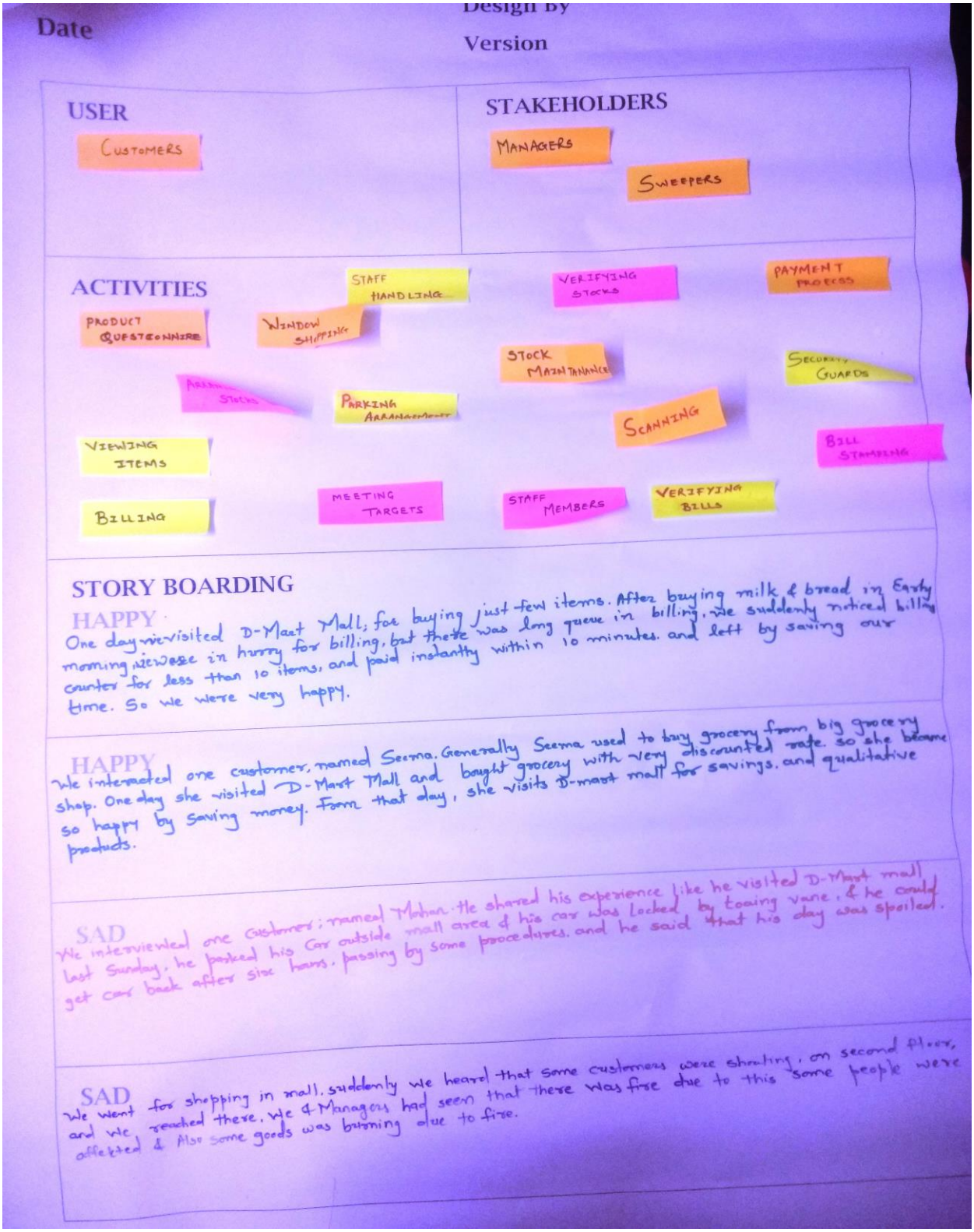
MIND MAPPING CANVAS DEVELOPMENT

Then, in third session each team worked on preparation of AEIOU framework, Mind Map with their observation data of selected domain with use of canvas, colorful sticky notes, sketch pens and other crafty materials .Prof Karmjitsinh Bihola and Prof.Bhavin Kothari guided the teams personally for filling their canvases and cleared the doubts. After completing the canvas activity, all the teams presented their observation and empathization work to experts and other groups and also received the comments.

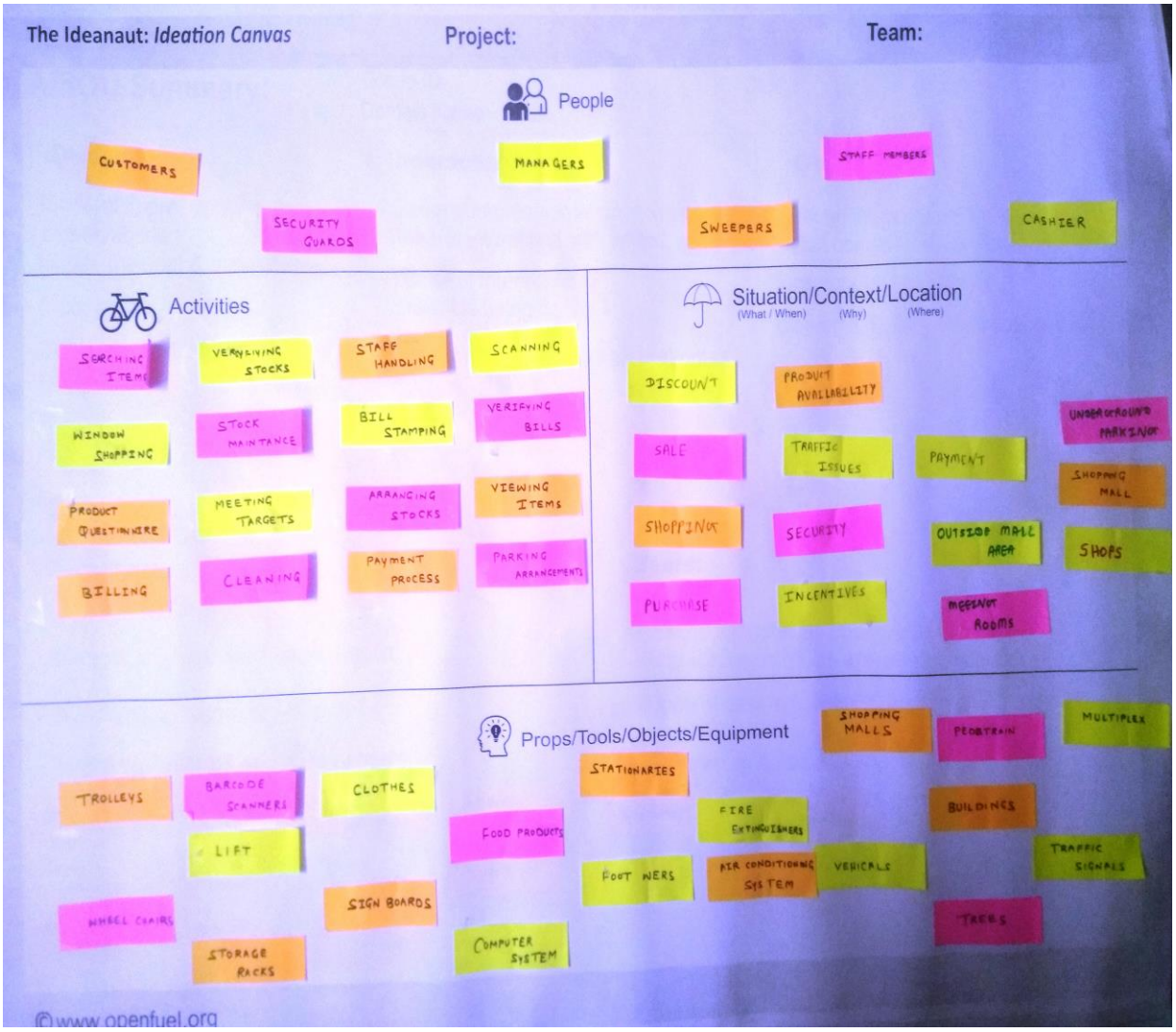
Day3 - July 31, 2019

Again, the first session of 3rd day was started with common discussion about the experience of the second day and queries of the Faculty Members were solved by the expert. He explained empathy mapping – To empathize users, to find emotional/unarticulated need of users and storytelling trough ideation of Happy/Excitement and sad/Pain moment. Then Ideation Canvas was explained by the Prof. Karmjitsinh Bihola with the help of a presentation. Ideation is the new idea is novel combination of existing ideas .He explained through some existing examples of innovation. After getting lots of ideas, as per the User needs, all possible ideas need to be combined and refined for better solution as Design Thinking is convergent and divergent process in nature after that concept of Left brain v/s Right brain explained through observation activity through colors. The Mentor explained how things can be connected to get a better idea. In ideation stage one should not worry about the feasibility of their ideas, one should appreciate indefinite ideas.

Then, in second session we started working on our Ideation Canvas. The Ideation canvas comprises of people, activities for observed domain, variation of activities related to Situation/Context/Location and Props. All activities need to vary with different situation (What/Which), context (Why) and location (Where) which may be relevant or irrelevant to the selected domain. In the same way random props/tools/products/equipment/technology shall be listed down. The problem statement may be completely changed or refined at the end of the Ideation activity as the whole of the Design Thinking process is iterative in nature. Creativity is intelligence having fun; Think out of the box and briefing about brainstorming rules.

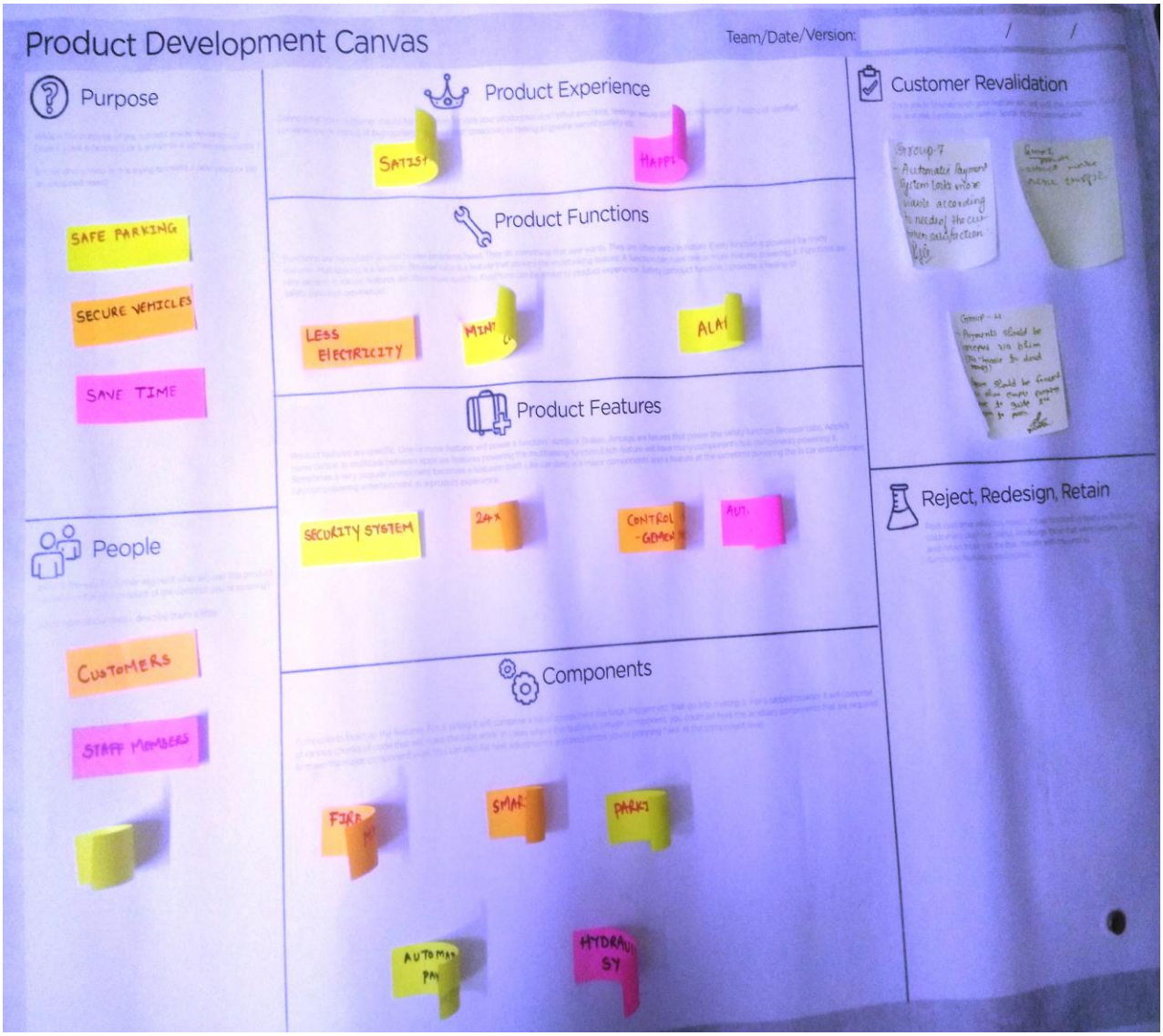


EMPATHY CANVAS DEVELOPMENT



IDEATION CANVAS DEVELOPMENT

Then Third session started with played videos of S–oil –''Neutral Campaign'' and Dole Piano stairs in Brussels during the Heart Week in Belgium for fun. After that Product Development Canvas was explained and Product Development canvas comprises the purpose of the project, the User Experience, Product Function, Feature and components of the solution. We defined our problem statement after completing this canvas, we need to verify our ideas with the other groups and modify as per comment.



PRODUCT DEVELOPMENT CANVAS

Day4 – August 01, 2019

The first session of last day started with continue working with Product development canvas for redefined the final product statement and completed the task of canvas activities. After that Prof. Karmjitsinh Bihola, delivered a brief talk covering the concept of reverse engineering -3 Level Approach and LNM (Learning Need Matrix) theory and different ways to find out their learning

needs in terms of customer perspective and Engineer's Perspective. In LNM, mainly out of syllabus topics will be listed out and each topic will be learnt by each team member in order to complete the Project. It will also help students to learn Skill Sets required by the industry after they completing UG course.

In Second Session rough prototype design model was carried out from waste material available. Every team members tried to convert their idea in the prototype with varities of ways. Building the rough sketch/ model given them chance to work with team spirit and provided broad idea about how their design should look like.we came up with D'Mart Card for saving time for those who want to do cashless payment with product level scanning for saving time in weekend.

In the valedictory session, all teams talked about their problem statement and unique features of their solution. Experts gave very important suggestions for each design project and concluded the workshop with their expert comments. Then certificates were awarded to all participants for their efforts and active participation in these 4 days FDP of Design Engineering.

PROTOTYPE MODEL

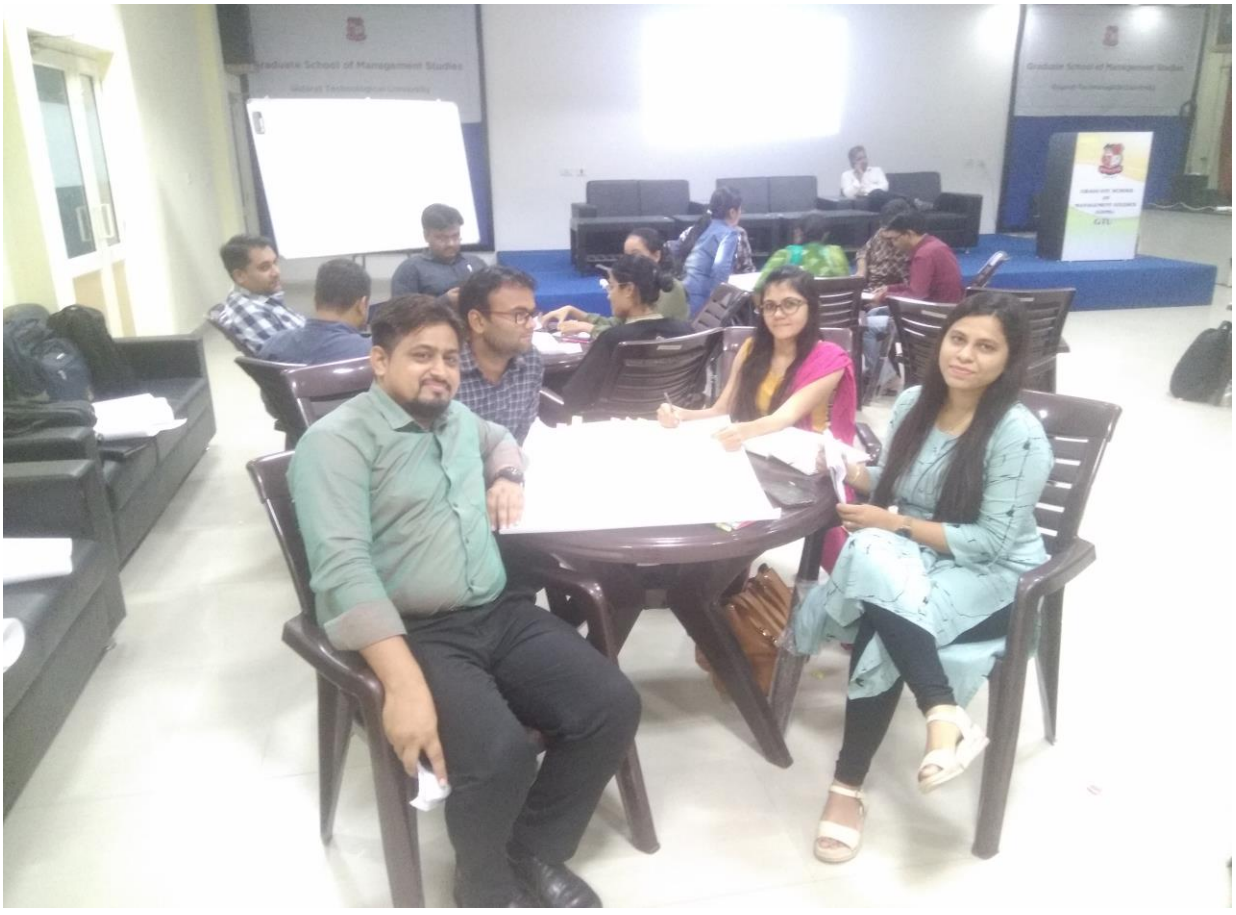
To sum up my views the 4 days FDP helped in to guide us on how to convert ideas into products. And also help to identify problems of industry or society and to find out various ways to address the unmet social, ecological and industrial needs.

Thanking you for granting us permission to attend this workshop which helped me to open up the vision and will help to apply in the teaching and also motivates and guide the students to work towards the direction so that they can strive for meeting the needs of our society.

Your's sincerely,

Tausif Shaikh
Mechanical Engineering Department

WORKSHOP AT A GLANCE:



S.P.B. Patel Engineering College
Linch

Saffrony Institute of Technology

S.P.B. Patel Engineering College

REPORT

on

FDP-DESIGN ENGINEERING

Phase-I

29th September to 1st August 2019

Prepared by

Prof. Kunalsinh Kathia

Mechanical Engineering Department

Index

Report Prepared on: 8th August 2019

Report prepared by:

(Prof. Kunalsinh Kathia)
Assistant Professor
Mechanical Engineering Department

Approved by:

(Prof. Chitralekha Nahar)
H.o.D Mechanical & Automobile)
Saffrony Institute of Technology

INTRODUCTION

Date: 29th September to 1st August 2019

Time: 10:00 AM to 5:00 PM

Venue: GTU, Chandkheda (Shed 4)

Participants:

Sr.	Name	Department
1	Prof. Rajat Mishra	Civil
2	Prof. Akshay Kansara	Computer
3	Prof. Kamlesh Samadhiya	Automobile
4	Prof. Kanu Patel	EC
5	Prof. Tausif shaikh	Mechanical
6	Prof. Kunalsinh Kathia	Mechancial
7	Prof. Nimisha sharma	Computer
8	Prof. Kumkum Bhattacharyaji	Civil
9	Prof. Jaimin Jani	Computer
10	Prof. Nirav Joshi	Electrical

About Design engineering:

This Subject is introduced in GTU for nurture the students in various technical streams for make them understand the importance and procedure to innovate/modify/design something. This subject helps to understand the responsibility of an engineer towards society by shaping their imagination and view to look towards problems of the society.

Design is not any template which can be applied anywhere to find out the solution of the project. This subject helps to the students for bringing their ideas into the real world. GTU have had done very hard efforts to bring this vision into the spotlight by training various faculties through different FDP's. This year I have attained the FDP of Design thinking Phase-I from 29th September to 1st August 2019.

Design thinking subject has various phases for every semester from 3rd to 6th semester. Phases like, Empathy mapping, AEIOU, Reverse engineering, Prototyping are designed very well to make them understand the way to inculcate the design framework. Design thinking framework helps our students to master many skills like Communication, Innovate, Critical thinking, Public dealing etc.

Detailed Summary

Day One (29th September 2019)

Day one has started with prayer and introductory session. We all have had one introductory session with Mr. karamjeetsinh . He has asked everybody to stand up and give the introduction. He has started his first session by giving brief summary about the FDP schedule. That schedule us as below:

Day 1:

- Session 1 – Welcome & Orientation session– Introduction to Design Engineering Course
- Session 2 – Introduction – What is Design Thinking? Its importance, socio-economic relevance
- Session 3 – Learning Tools to better Learn Design Thinking – Bio Mimicry, Analogy, Gestalt Model and Heuristic Approach – All with examples
- Session 4 – Hands on Exercises – Team Building and Log book

Day 2:

- Session 5 – Empathy – Observation techniques & Field work
- Session 6 – Field Visit – To gather observation data
- Session 7 – Summarization of Data - Analysis of Data gathered during Observations through Mind Mapping
- Session 8 – Empathy Mapping & Problem Definition – Canvas Preparation

Day 3:

- Session 9 – Ideation – Brainstorming techniques to Innovation
- Session 10 – Ideation Canvas – Canvas Preparation
- Session 11 – Product Development – Form, Function, Features
- Session 12 – Product Development Canvas – Canvas Preparation

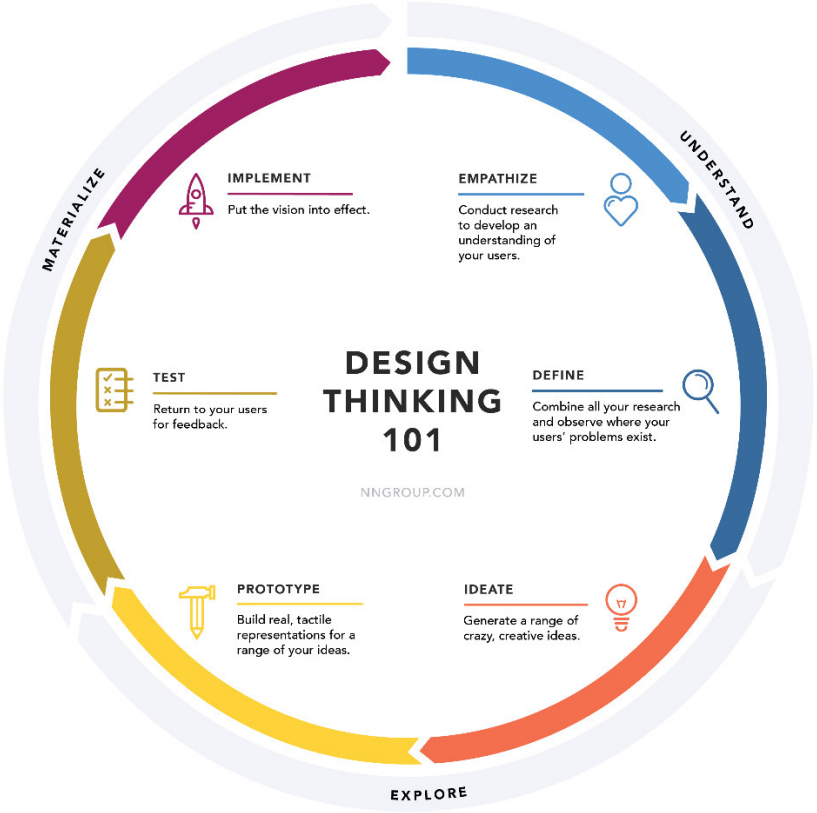
Day 4:

- Session 13 – Reverse Engineering – Redesigning Branch Specific artefact/component/product
- Session 14 – Disassembly & Identify Technical aspects

- Session 15 – Prototyping techniques
- Session 16 – Building rough prototype (Hands-on activity)
- Recap on FDP and certificate distribution

After this schedule introduction, Mr. Karamjeetsinh have presented another slide for clearing the basics and fundamentals of Design Engineering subject. Where he has sensitised some of the topics like Why Design engineering, what is the design engineering? Importance of D.E, etc. I am summarising my some of the key learnings here.

Key Notes



What are the essentials of DE phases?

DE -1A

- What is design has to be understood properly by the student
- No branch specific
- AEIOU

DE-1B

- Refine design thinking
- Branch specific

- Ideation and early product development

DE-2A

- Community and design thinking process
- From observation to detail phase

DE-2B

- Building the solution
- Continue from 5th Sem
- Learning by doing phase
- Prototype and Testing phase.

Some External related insights:

1. During 3rd and 4th sem there will be internal examiner
2. During 5th and 6th sem there will be external examiner
3. They have implemented Evaluation card system
4. There will be 3 evaluation per sem.
5. Guide -one faculty and one industry expert (optional)

What if students want to carry their project for fund raising?

1. They can get SSIP up to 2lac rupees.
2. DIC Lab support for testing the instruments.
3. Start-up fundings from foreign universities upto 21 lac Rs.
4. http://dic.gtu.ac.in (Visit for more)

Design thinking ladder:

"Design is too important to be left for designers"

What is required to do a proper design?

1. Design Thinking Mindset
2. Problem solving skills
3. Convert ideas in solution

4. Integrate design mindset with engineering learnings

Just:

- Observe: See the world with no problematic eyes
- Immerse: Involve with the peoples to feel their pain
- Engage: Act on their need

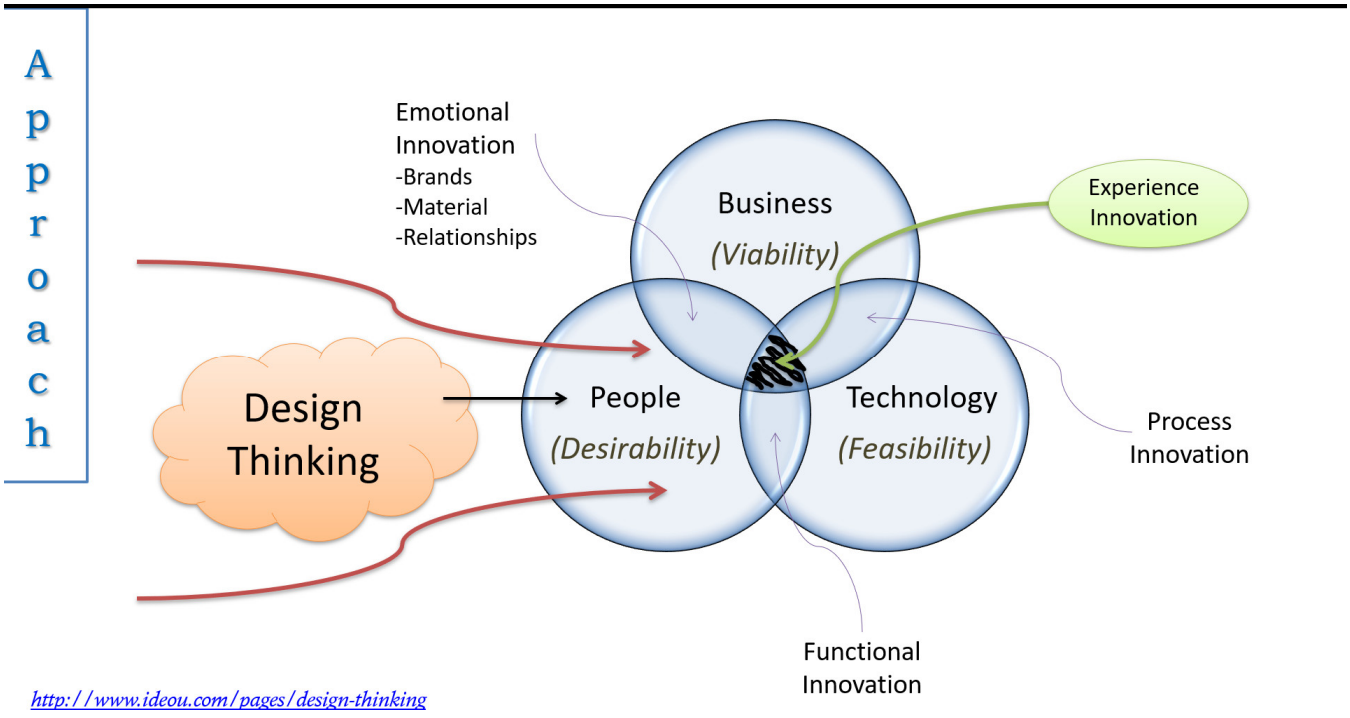
AEIOU

Then Mr. Karamjeetsinh has explained AEIOU Framework and its importance.

1. Activity
2. Environmental
3. Interaction
4. Objects
5. Users

Design approach:

1. **Desirability: DO they really need it?**
2. **Feasibility: Can we make it:**
3. **Viability: How can they afford it?**



http://www.ideou.com/pages/design-thinking

At the end of the day we were instructed to go for field visit on the next day to do survey and work on it.

Day Two (30th September 2019)

Day two has started with prayer and the session from Mr. Crimethink. He has brief us for todays activity and many of us have cleared doubt about yesterday's session. Then everybody was distributed in the team of 4-5 members having multidisciplinary branch. My team was having following members:

No	Name	Branch
1	Prof. Rajat Mishra	Civil
2	Prof. Kunalsinh Kathia	Mechanical
3	Prof. Shreyas Patel	Electrical
4	Prof. Farhin Khan	Computer
5	Prof. Harsha Prajapati	Computer

After group formation we were instructed to go for field visit for Two hrs. The instructions were to do proper survey with the team and try to find "PAIN" part of the people. So, our team have left for visit the other cross roads to observe the activity. In-between we have discussed about our roles and responsibilities also.

Observation technique:

1. Distinguished interpretation from observation
2. Don't let your expectations affect your observations
3. Look for anything that surprise you
4. slow down the things when on the field; avoid distraction
5. Different times of the day
6. Take note, photo, video
7. Try to picture scene from different views
8. Capture everything in notes, see, feel, hear

There were some interview tips were given to us by Mr. Karamjeetsinh:

- Choose one is interview and another is writing
- Encourage storytelling, ask open ended questions
- Ask why (5 Whys)
- Do not skip new topic when you have exhausted the current one.
- Capture thought

Tools for observation

- Begginers midset
- Set benchmark
- Macro-Micro (Leaf, Tree, Forest)

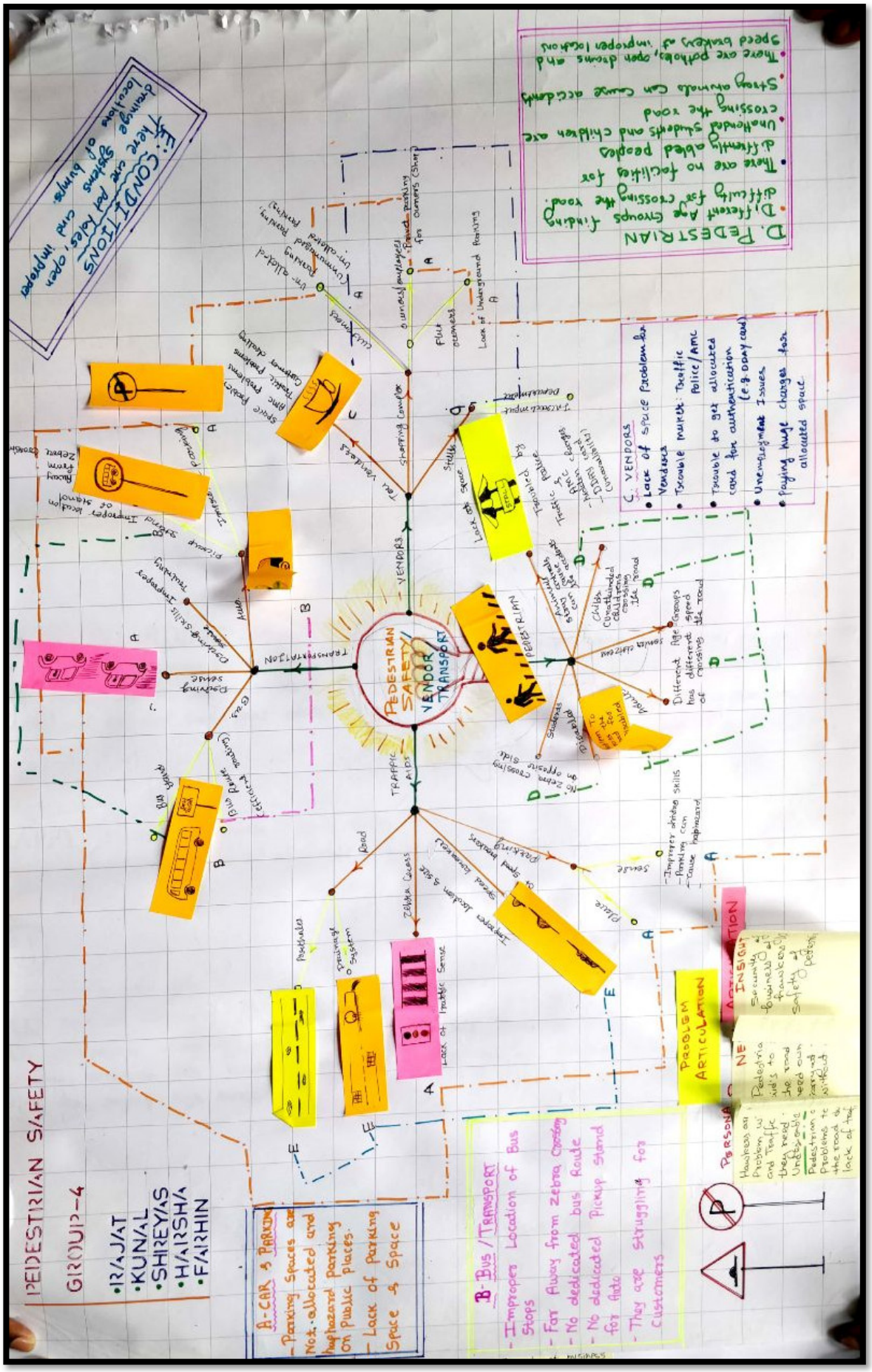
After reaching to the gate of VGCE we have started observing traffic abnormalities and the activities around us. Prof. Rajat Mishra was observing the traffic abnormalities, Me and Shreyas sir were observing the surrounding activities, Other two madam were asking to rickshawalas about their problem.

Following observations were made during field visit:

1. **Traffic abnormalities:**
    a. Peoples were crossing the road without passing through zebra crossing
    b. One couple was crossing the road without seeing at right side
    c. School students were crossing the road without worring about traffic.
    d. There was no zebra crossing on the opposite side of the road
    e. Bus stand was far away from zebra crossing.
    f. Rickshawala's were struggling for the customers.
2. **Vendor's Pain:**
    a. They were troubled by Traffic police.
    b. AMC were charging them too high cost
    c. They do not have a rights to stay at their place.
    d. There were no earning security because of Trouble by peoples.
3. **Rickshawala's Pain:**
    a. He has to fight to get customers because there was no rickshaw stand
    b. He has to work hard for parking places, there were no dedicated parking space.

After coming back to the GTU we have finalized our domain to the Traffic management and Pedestrian. All the teams have presented their observation, We have presented our observation regarding Pain of rickshwala, and vendor and pedestrian. We have received very food comments for our observation.

Mind Mapping Activity


PEDESTRIAN SAFETY
GROUP-4
•RAJAT
•KUNAL
•SHREYAS
•HARSHA
•FARHIN
PEDESTRIAN SAFETY / VENDOR TRANSPORT
VENDORS
TRANSPORTATION
PEDESTRIAN
TRAFFIC AIDS
D. PEDESTRIAN
C. VENDORS
B-Bus /TRANSPORT
A-CAR & PARKING
PROBLEM ARTICULATION
PERSONA
INSIGHT
IDEATION

In second half we were given a lecture on Mind mapping technique. That how to do mind mapping and its importance. Mr. Karamjeetsinh has instructed us to prepare mind map of what you saw there during field visit. We have given a blank chart and some sketch pens to complete our mind map before the end of the day. We have started jotting down our observations over the canvas and sketched very beautiful Mind map.

At the end of the day we have left behind lots of experiences and learnings of design thinking Day-II.

Day Three (31st September 2019)

Day three has started with prayer at 9:30 AM. Mr.Karamjeetsinh have given an insights about "Problem articulation" during his presentation he has touched following points.

Problem articulation

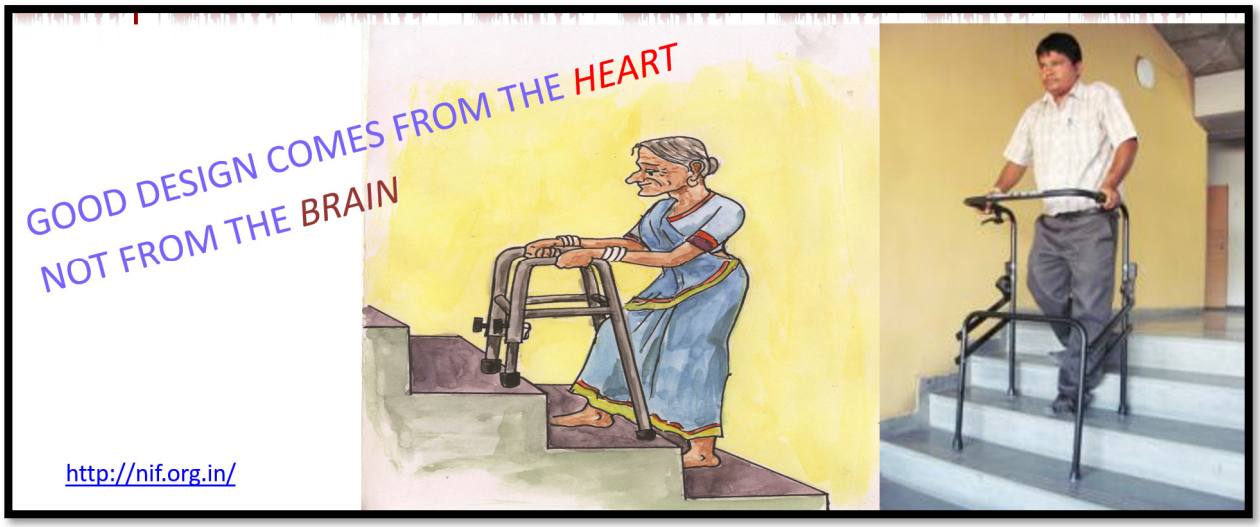
- Stakeholders - Needs way to
- Problem - Because
- Insights

What is Innovation?
A new idea, Which is novel combination of existing ideas.

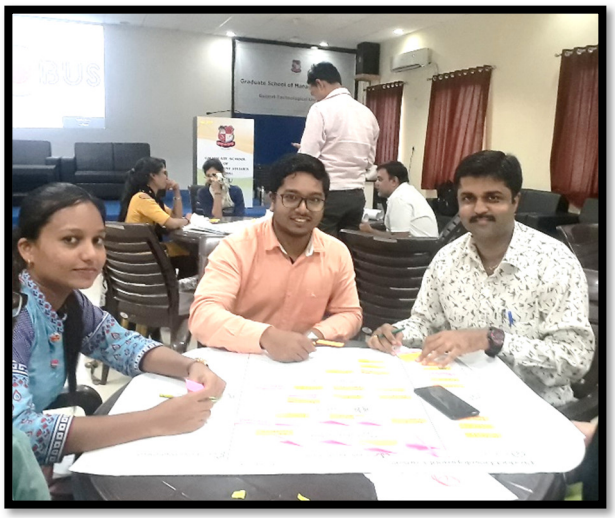
Brainstorm Rules

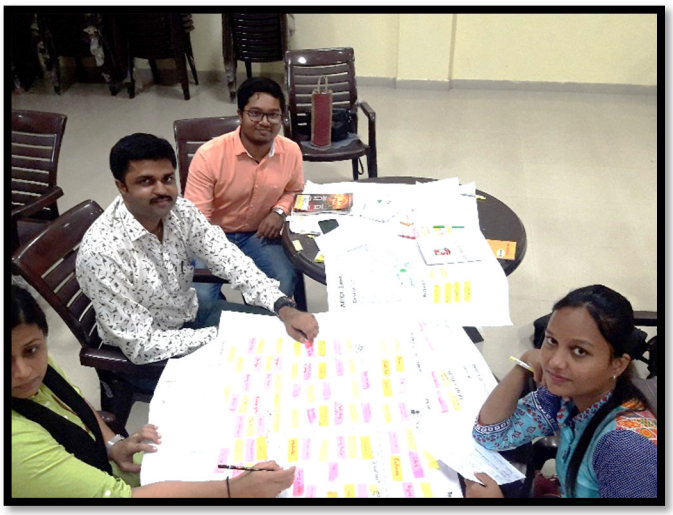
- ✓ One conversion at time
- ✓ Go for Quality
- ✓ Headline
- ✓ Build on idea of others
- ✓ Encourage wild idea
- ✓ Be visual
- ✓ Stay in topic
- ✓ No blocking

The expert faculty was invited to train us from NIT has given us an idea about how to think in a way of design thinking. How the design can be simple if you think very simple. The idea behind his session was to awake us all for thinking "**Out of the Box**". He has shown us a many different products from day to day life and explained how a simple change in that product can bring revolutionary change in the world.

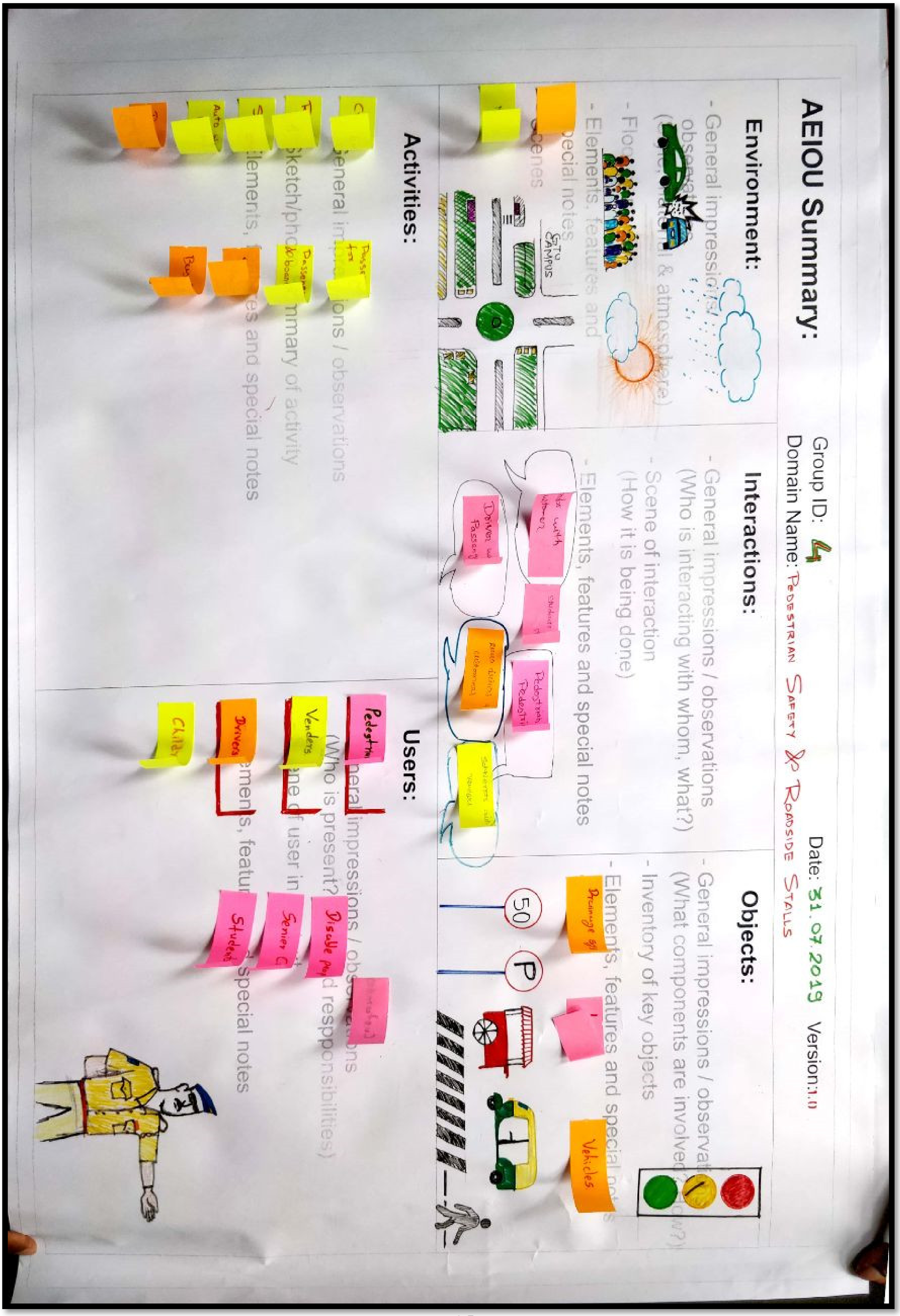


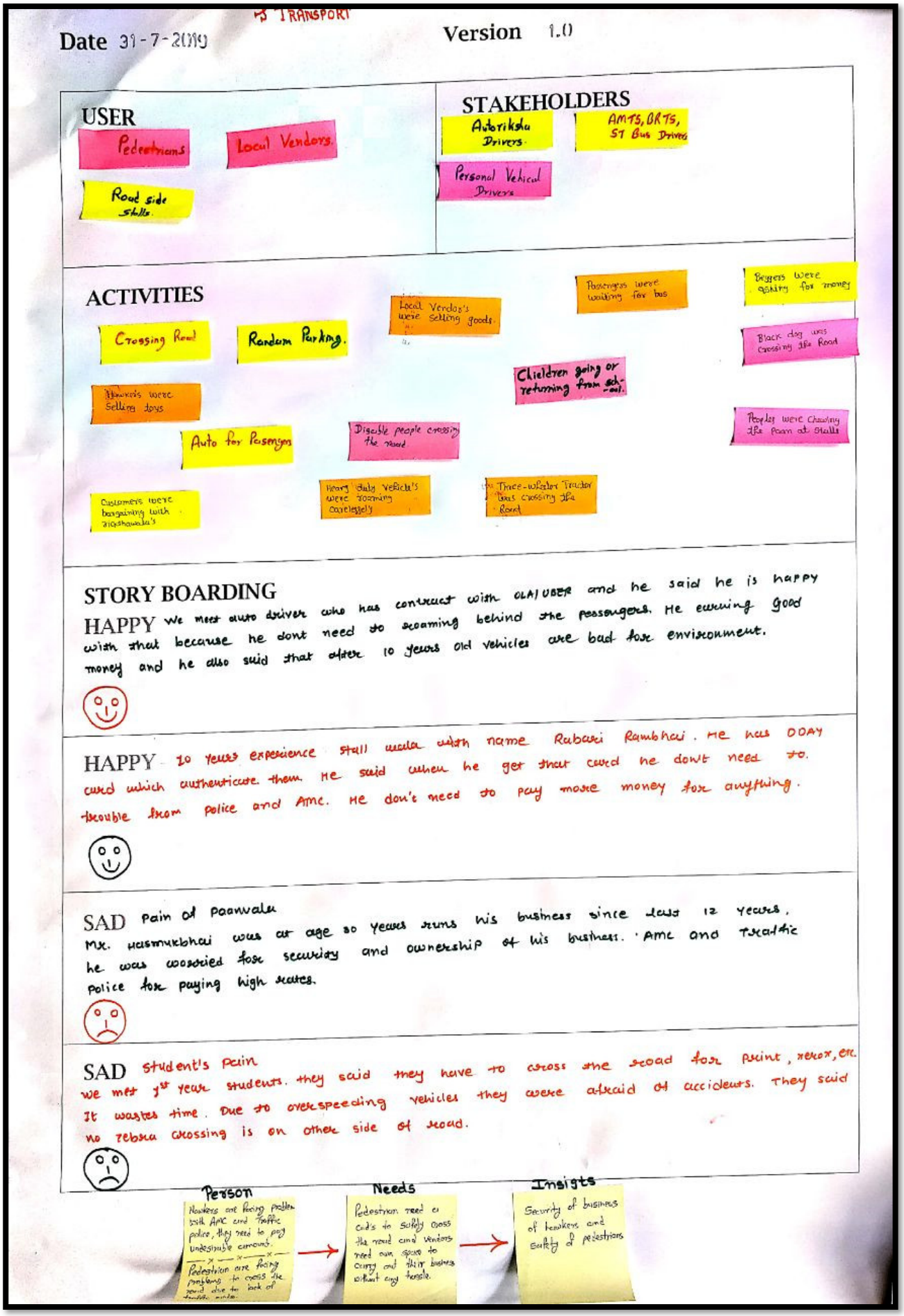
After that we have proceed to prepare and work on IDEATION canvas and PDC- Product development canvas. These two canvases were followed by Mind map. So , first our task was to finish the mind map canvas, by connecting all the relevant incidents to find the core objective of our project. After that we reached to our title “Pedestrian safety & Vendors”.



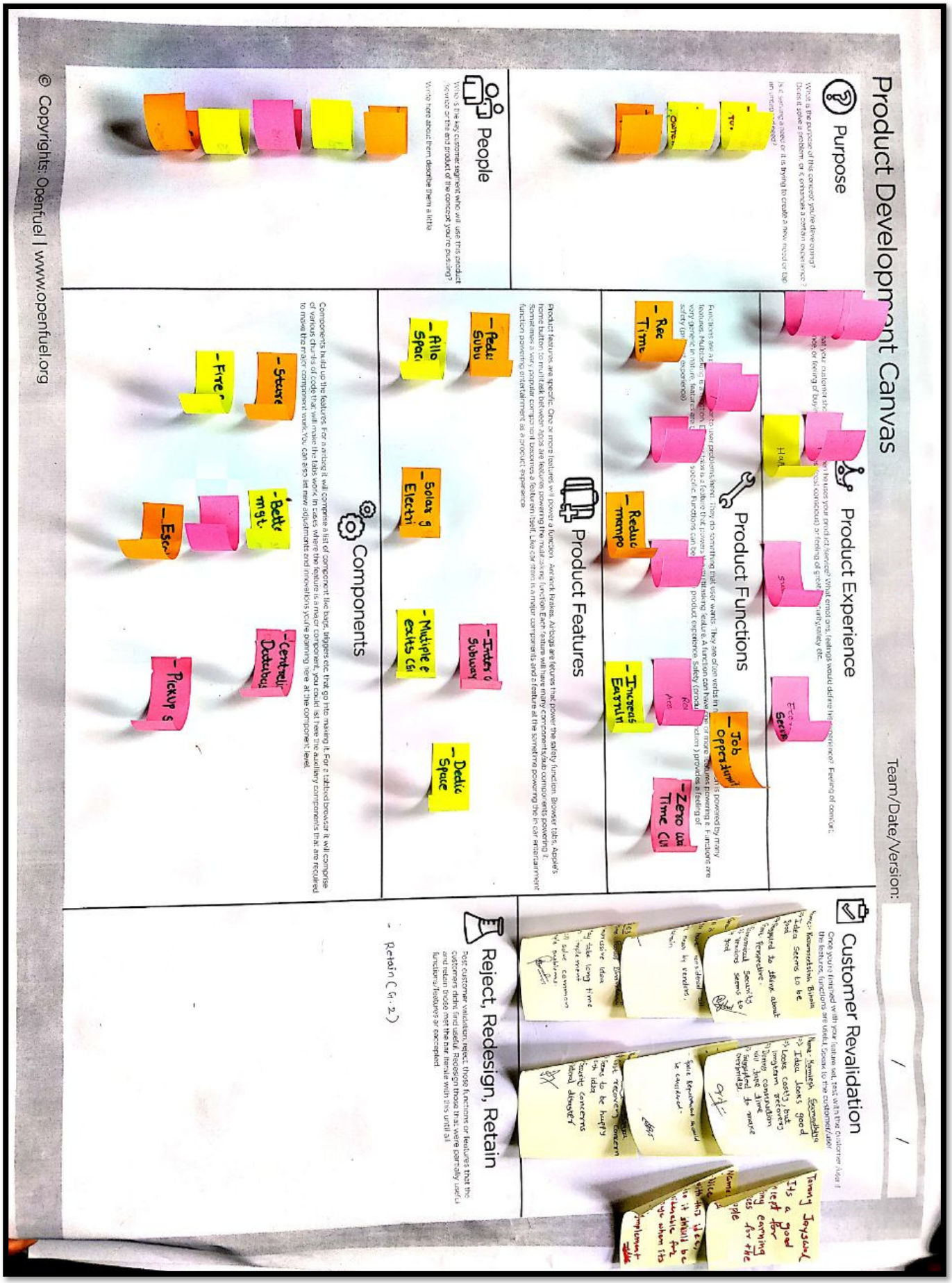


After Mind map we have proceed to the PDC , Team have worked vey well to identify the elements for PDC. We have learnt lot through PDC. After this activity , Mr.Karamjeet instructed to exchange the canvas and instructed to identify atleadt 50+ combinations between Activity , Environment and Objects. It is notable that upto this level no team was at the stage to finalize the solution, because we were synthesizing our problem. Day III has ended with the completion of Ideation and PDC.


AEIOU Summary:
Group ID: 4
Domain Name: Pedestrian Safety & Roadside Stalls
Date: 31.07.2019
Version: 1.0
Environment:
Interactions:
- General impressions / observations
(Who is interacting with whom, what?)
- Scene of interaction
(How it is being done)
- Elements, features and special notes
Objects:
- Inventory of key objects
Activities:
Users:
Pedestrian
Venders
Drivers
Senior C
Students
Vehicles


TRANSPORT
Date 31-7-2019
Version 1.0
USER
Pedestrians
Local Vendors
Road side Stalls
STAKEHOLDERS
Autorikshu Drivers
AMTS, BRTS, ST Bus Drivers
Personal Vehical Drivers
ACTIVITIES
Crossing Road
Random Parking
Local Vendors were selling goods
Passengers were waiting for bus
Beggers were asking for money
Black dog was crossing the Road
Children going or returning from school
Hawkers were Selling toys
Auto for Passengers
Disable people crossing the road
People were Chewing the paan at Stalls
Customers were bargaining with rickshawala's
Heavy duty Vehicle's were roaming carelessly
Three-wheeler Tractor was crossing the Road
STORY BOARDING
HAPPY We meet auto driver who has contract with OLA/UBER and he said he is happy with that because he dont need to screaming behind the passengers. He earning good money and he also said that after 10 years old vehicles are bad for environment.
HAPPY 20 years experience stall ucala with name Rabari Rambhai. He has DOAY card which authenticate them. He said when he get that card he don't need to. trouble from police and Amc. He don't need to pay more money for anything.
SAD Pain of paanwala
Mr. Hasmukhbhai was at age 30 years runs his business since last 12 years, he was worried for security and ownership of his business. Amc and Traffic police for paying high rates.
SAD Student's Pain
We met 3rd year students. they said they have to cross the road for print, xerox, etc. It wastes time. Due to overspeeding vehicles they were afraid of accidents. They said no zebra crossing is on other side of road.
Person
Needs
Insigts
Hawkers are facing problem with AMC and Traffic police, they need to pay undesirable amount.
Pedestrian are facing problems to cross the road due to lack of
Pedestrian need a card's to safely cross the road and vendors need own space to carry out their business without any hassle.
Security of business of hawkers and safety of pedestrians


The Ideanaut: Ideation Canvas
Project:
Team: MAD THINKERS
People
Activities
(What / When)
(Where)
©www.openfuel.org


Product Development Canvas
Team/Date/Version:
Purpose
People
Product Experience
Product Functions
Product Features
Components
Customer Revalidation
Reject, Redesign, Retain
Retain (1, 2)
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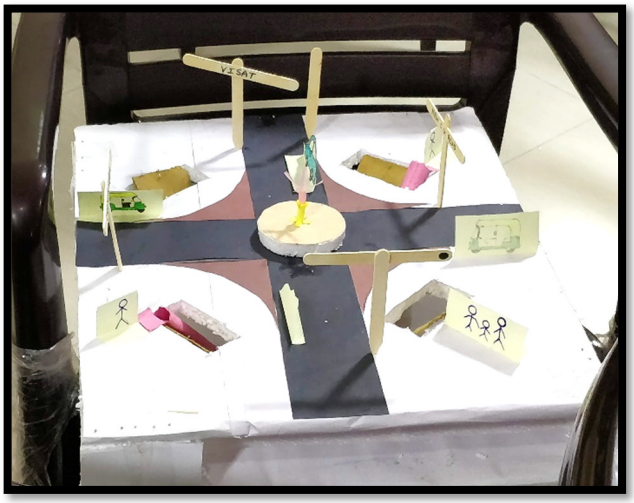
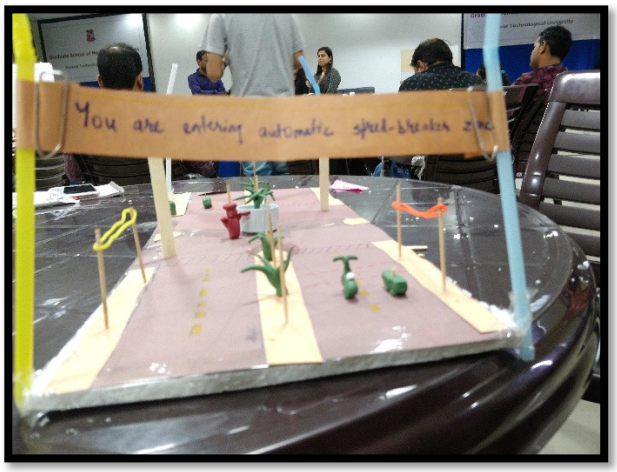
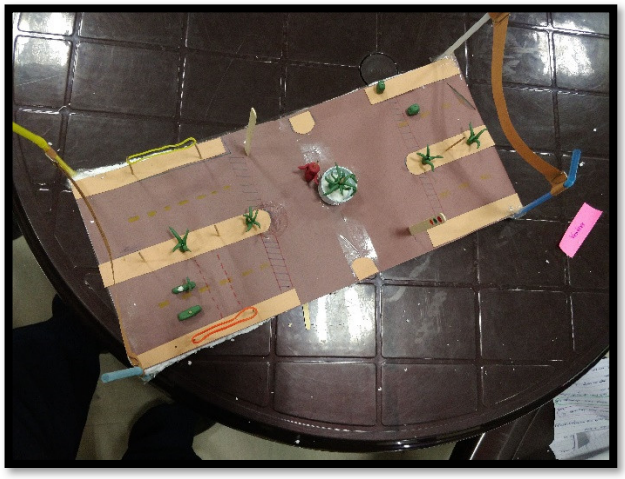
Day Four (01st August 2019)

Last day of FDP was so exciting because that day we have to build a Prototype and have to present infront of all the other reams. All were excited to show their prototype but there were a challenge before that was to build a prototype out of the given material. Mr.Karamjeetsinh have shared his experiences with all of us for prototype. Mr karamajeetsinh have instructed everybody to make the prototype out of the limited material. We, Have decided to build a underground tunnel at crossroads to accommodate the vendors and pedestrians. So, we have made a thermocol model, where all team members were excitingly involved to finish the tasks. Everybody was working at full energy to build their prototype more better looking and attractive. Because at the end of this session , every team has to come here and present their prototype models . We have finished our prototype before lunch session only. Here is the glimpse of our model.



Prototypes from other teams

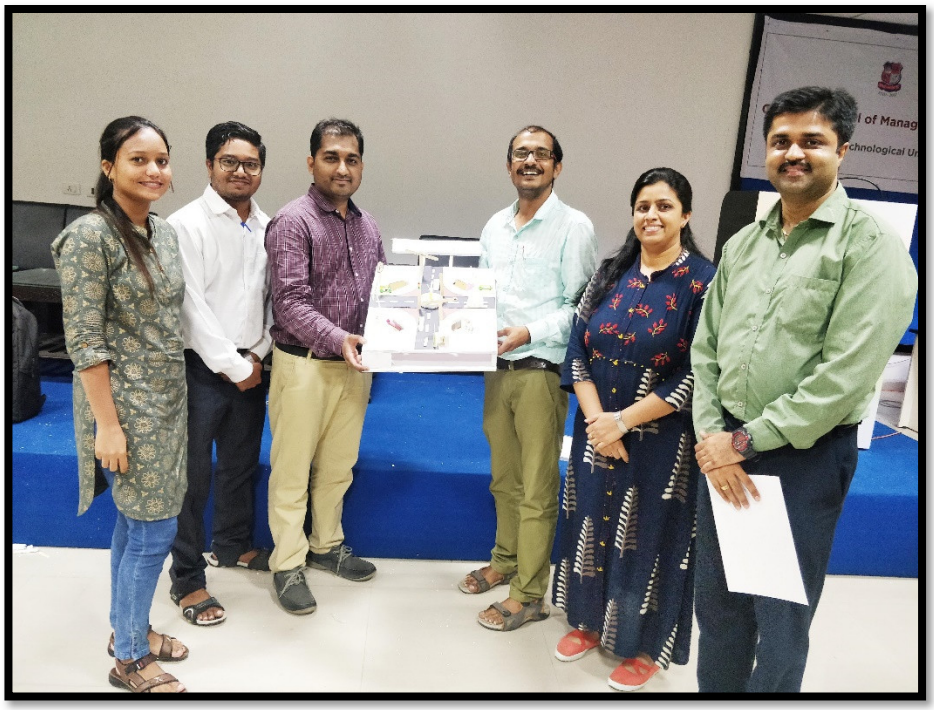




After completion of prototype model we all have had a presentation round, where every team has to come up at stage with their prototype and to present the idea. Here are the photographs.

Certificate distribution ceremony

At the end of the day everybody have received a certificate for completion of FDP with promise to deliver this knowledge to all the students of Design engineering.



Team with Karamjeetsinh Bihola sir

Team Saffrony at FDP

S. P. B. PATEL ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

Report on Design Engineering Workshop (Level 1)

Name of Resource Person: Prof. Prof. Karmjeetsinh Bihola
Designation and Institute details: Asst. Professor, Centre for Industrial Design (Open Design School), GTU, Ahmeabad
Date: 29th July to 1st August 2019
Duration: 10 am to 5 pm
Venue: Gujarat Technological University, Chandkheda Campus, Shed 4, Ahmedabad
No. of Participants: 44 from various GTU affiliated colleges in Gujarat

Introduction and Objective:
The purpose of Design Engineering Workshop (Level 1) was to make aware the faculty members (who haven't attended the DE workshop before) about importance of Design Engineering for self as well as for student's development. The objective was to give insights of Design Engineering to carry out and help students for the better project work for the society and in proper way. If the faculty member knows the basic concepts of the DE subject then it would help to guide the students in better way.

Workshop details:
Day 1 – 29th July 2019

It was 52nd 4 days workshop on Design Engineering (Level-1) held at GTU in Shed no. 4.

From Saffrony Institute of Technology there were 9 more faculties (Prof. Kunalsinh, Prof. Akshay, Prof. Kumkum, Prof. Nimisha, Prof. Kanu, Prof. Rajat, Prof. Gaurav, Prof. Jaimin and Prof. Tausif) along with me had attended the workshop.

The first session of the first day of the workshop started by Prof. Karmjitsinh Bihola (Asst. Prof. – Centre for Industrial Design – Open Design School, GTU). They welcomed all the participants and discussed about the schedule of the four days workshop. They stated that from 3rd semester to 6th semester following subjects are being taught to the engineering students of GTU. In 3rd sem - DE – 1A (Module 1) then in 4th sem – DE – 1B (Module 2) Applying Design Thinking then in 5th sem DE – 2A (Module 3) also on Applying Design Thinking and in 6th sem DE – 2B (Module 4) Building the Solutions. They discussed about the Design Engg Course Scheme. They

told that from this term the Subject Code and Credit is changed, he also added for 3rd and 4th sem there will be no external viva, the internal examiner will take the viva. For 5th and 6th sem there will be the external viva. Meanwhile he played the prayer "Humko Mann Ki Shakti Dena". They told now onwards Continuous Assessment Card is introduced for DE subject.

SSIP grants up to Rs. 2 Lacs for best projects are given, best DE projects can be carry forwarded in final year project under SSIP grant. Sir also have given the web links regarding DE related help or query as below design@gtu.edu.in, http://dic.gtu.ac.in, designproject@gtu.edu.in especially for DE subject related query.

Session 1: Design Thinking by Prof. Karmjitsinh Bihola (GTU – Design Team)

The session started with the questions - Why? What? How?

They explained about the various basic questions should come in our mind before designing or thinking anything. Then they emphasized the need for 'unlearning' by showing the upside down world map. They also discussed about the 21st century skills like Foundational Literacies, Competencies and Character qualities. Afterward they showed Plethora – video regarding what is happening in world in 1 second and how fast the world is changing, the need, demand and solutions changing.

Design Engineering was thought and implemented by Stanford University and even Steve Jobs had also did it. Sir, asked the question 'will technology replace me?' They also discussed about innovation ladder and shown the video on Change 2 by Gero Leonard. They told about Design thinking transforming organizations around the globe and in India which are given below:

Global – P&G, Apple, Google, SAP, Microsoft, IBM, GE
India – Infosys, TCS, Mahindra, L&T, FCB Ulka, Phillips, Pepci Co India.

Sir also told that the Noble Prize for innovation is being given. Then they discussed on Indian approach – global context, collaboration is required by: students, faculties, industries, society, university and government. Also discussed about Google Sprint for fast data acquisition, Un's SDG (Sustainable Development Goal), contextual needs, design thinking mindset, problem solving skills, converting ideas into solutions (project to product), integrate design mindset with engineering learning, reduced copy paste projects, learning by doing, hands on building skills, practical approach etc.
They also told that fro design thinking ground rules, child state of mind and adult state of learning is required. Means design thinker should be open minded and have fun while learn and to keep Google IQ aside. Sir discussed about Tradition thinking Vs Design thinking. They insisted multidisciplinary approach for good projects and told that design thinker should have skill to see problems as opportunities. The failures should be celebrated.
They discussed about Desirability, Feasibility and Viability. Design thinking phases like Observation, Empathy, Ideation, Product development, Prototype and Test. They also discussed

about the human centric approach, theoretical Vs real process flow. There are 3 types of problems: 1. Known Knowns, 2. Known Unknowns and Unknown Unknowns.

Then after lunch, there was a session of Prof. Bhavin Kothari (Professor – Strategic Design Management – NID) on the topic 'Design thinking for engineers'. Sir, started with the questions Roti Jali Kyu?, Pan sasda kyu? And Ghoda ada kyu? Then they discussed about the concept 'VUCA' that is Vulnerable, Uncertain, complex and ambiguous. Sir, showed the image of one parking place and asked to give solutions. They showed video of South Korea's traffic solution at parking place. Then they discussed about Double Diamond Design process, they showed the path form discover – define – develop – deliver.

They nicely explained Analysis (Divergent) part and Synthesis (Convergent) part of design thinking. Then after they practiced us a clock exercise which was based on observation skills. They explained about the difference between See, Look and Observe. Then after they showed us a toothpick, kitchen tong, water pouch puncture pin cap, step trolley for staircase climbing, circular piped gas stove body for better cleaning etc. and told to identify the kind of design engineering done on it. They emphasized on question everything and empathy mapping and also discussed about creating different mindset what is Vs what if, deductive Vs abdicative.

Seesion by Karmjeet Sir, discussed on empathize and showed the image of old lady walking with adjustable leg stand and facing problem at the last step of staircase. Sir discussed about Gandhiyan Young Innovation Awards. They also told the story of Akash tablet why the project failed. Then they three parts of empathize like Observe, immerse and Engage. They told to do the observation again and again help a lot and the gives detailed insights. They also shared the story of Darvin, power of observation.

Day 2 – 30th July 2019

In the starting of the first session Mr. Nirav Patel has announced about 1 day workshop on OPMP electric circuit and application on 2nd Aug 2019. The day started with the prayer 'Raghupati Raghav Rajaram'. Then Sir have started session on AEIOU. They nicely explained the meanings of AEIOU and then after they discussed about the AEIOU summary part. Sir told each and evry observation whether it is relevant or irrelevant should be noted down first in AEIOU sheet. Sir discussed case study on Pirana dumping site, Ahmadabad. Sir told that while observing we should look people's expressions and behaviours which really help in data collection for the project work. They suggested some interview tips; always ask why (5 whys) one will take interview and another will note down the points of discussion. Sir discussed about macro and micro observations and one should wear multi disciplinary hat (means to understand the things in different views). Then they focused on research plan for the work and field work.

After his session they made seven teams (each team had 5 members of different branch and college) and told every group that for two hours go for field visit nearby GTU Campus inside as well as outside, find out the domain, take observations, do interview, understand the mindset of

people and its impact on field work. So each group have started working on different domains and carried out filed visit. Our team observed the traffic issue due to BRTS and so finalized it as a domain. Likewise all the seven teams have taken different domains for field work. We five members had divided in two group means two in one group and three in another group to get the work done speedily and to have more data. During our field work we met different people like, Petrol filling person at petrol pump, person who came to fill the fuel, road side mobile cover vendor, people waiting for bus at bus stand and student eating vadapav at nearby stole. After two hours of field visit we came back and summarised the data which we have gathered by interviewing the people and noting their views and our observations. This activity gave us insights of how to carry out project research for good project work and its importance.

Session by Prof. Bhavin Kothari after the lunch. They discussed about mind map concept and showed us a video of very good examples of observation skills (the videos was on 21 changes in 40 seconds) they told there are three types of mind mapping, 1. Information mind map, 2. Concept mind map and 3. Application mind map. They told to carry out mind map activity on each team domains work so we carried out mind map activity on BRTS. Sir, also shared that with the help of mind map and observations Maruti Suzuki motors have made their car dashboards such that so that the things can be put on it which is the need of Indians. Mahindra & Mahindra motors are also designing their car models especially keeping in mind the knee rest for Indian drivers.

Day 3 – 31st July 2019

The first session started with the prayer 'Itni shakti hume dena data'. Session by Karmjeet Bihola Sir. They carried out revision of mind map activity then explained about empathy mapping. They told, to understand the domain – AEIOU should be filled out first. They discussed about difference and essence of Design Thinking. Then they discussed about ideation and what is innovation. They gave some beautiful examples likebaed on Steve Jobs interview, Walkman + pendrive = Ipod, Book + Computer = Kindly, Ipad, McBook, Encyclopedia + CD = Microsoft Encarta, Car + Boat + Fissh = Submarine, Car + Kitchen = Food Truck etc. Sir insisted to think out of the box and added that brainstorming is also a crucial thing required for good project results.

Then after Sir have given introduction about Ideation Canvas. There was one activity carried out in which each team has shuffled its canvas with other team and tried to collect at least 50 plus data from People, Activity, Situation context and Props / Tools, objects. Likewise each team has to check its own sheet and come down to a common problem solution. Sir told that in some of the colleges the DE project work of 3rd sem is carried out up to 6th sem and in some cases up to final year projects too, that should not happen at all. Sir, insisted that in each sem there should e a different domain project work assigned so that students can easily understand each and every aspects of the Design Engineering.

Then after tea break Sir has shown us various videos like, Beam Lens (Don Molenaar CEO), Bookniture, 'Coolest iwth mixture juicer with USB charger, Bottle opener, Aqua duct cycle for storage and cleaning, purifying the water with peddle effect, S-Oil 'Neutral campaign", Episode 459 – bestof youtube.com (regarding big Piano switches like stairs), etc.

Then after they explained about Product Development Canvas and discussed about its various things like, Purpose, People, Product Experience, Product Function, Product Features, Components, Customer Realization and Product Redesign / Retain. Sir told all the team members to fill the details in the sheet so all the participants have started filling it.

Day 4 – 1st August 2019

The fourth and the last day of DE training were started with the prayer 'Yeh mat kaho khuda se meri muskile badi hai'. The session of the day was started by Karmjeet Sir. We continued to fill our Product Development Canvas. Then they discussed about learning need matrix, ways to prototype, diagram – mock up – interaction – model – role play / drama and quick prototype. Sir showed us a very good video of Operation Theatre (ENT doctor – Gyrus ENT). The learning form the video was that there was no ergonomic consideration for doctor's hand during operation. Then they showed one more video on Vacuum cleaner and told that about 5200 prototypes were made to put the product in the market. The learning was to do continuous hard work and analyse the work until it gets success. Sir also told about Ajanta Ellora Caves and its paintings, Apollo 13 movie example.

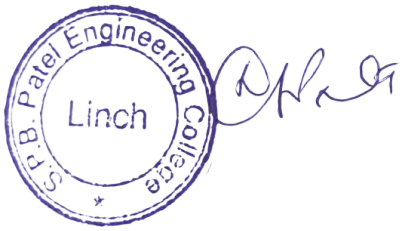
Afterward, Sir told to make a prototype model of their team so each team has started to make new prototype. Our team has made prototype model on BRTS traffic issue and its solution. Then after lunch session there was a presentation of each team regarding their prototype model and its explanation. Then after Sir told that actually a reverse engineering is an unethical practice. Then they showed the various levels of RE. Sir also discussed about customer's perspective and engineer's perspective regarding the product. They informed about to register on GTU Design Engineering web site registration portal for trained faculty members and on which each trained faculty member will have to upload his/her own DE certificate and follow the guidelines regarding DE. And at the end of the day there was a certificate distribution and group photo session.

In gist the four days of the workshop were very interesting and I have got very good knowledge and insights about Design Engineering and all my doubts were cleared about DE subject.

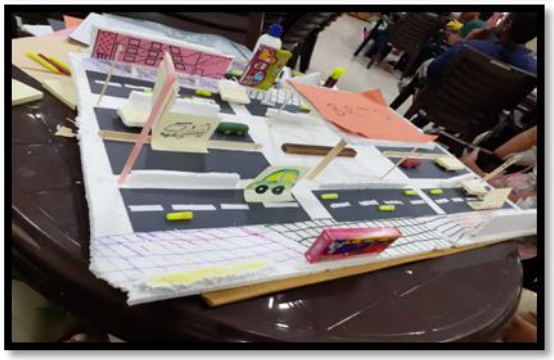
Thanking you for granting me permission to attend this workshop which helped me a lot to open up the vision and in future it will help me to apply in my students final year project work as well as for my coursework for better teaching to my students.

Yours sincerely,

Kamlesh Samadhiya



Glimpse of the workshop



A

DETAILED REPORT ON A TRAINING

"Faculty development program For Design Engineering (Level-1)"

Attended at GTU, Chandkheda

During 29TH July to 1ST August - 2019

Submitted by:

Nirav Ratilal Joshi

Electrical Engineering Department

S. P. B. PATEL ENGINEERING COLLEGE

SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

Saffrony Institute of Technology | S.P.B. Patel Engineering College |

Near Dholasan Approach Road, Ahmedabad-Mehsana Highway,

At. & P.O. Linch, Dist. Mehsana, Gujarat

Index

Overall training Details:

Date: 29th july – 1st august

Venue: GTU, Chandkheda campus

Time: 9 am to 5 pm (everyday)

No. of participants: 28-30

Workshop Program: (Level 1 – Basic)

Day 1:
Session 1 – **Welcome & Orientation session**– Introduction to Design Engineering Course
Session 2 – **Introduction** – What is Design Thinking? Its importance, socio-economic relevance
Session 3 – **Learning Tools to better Learn Design Thinking** – Bio Mimicry, Analogy, Gestalt Model and Heuristic Approach – All with examples
Session 4 – **Hands on Exercises** – Team Building and Log book

Day 2:
Session 5 – **Empathy** – Observation techniques & Field work
Session 6 – **Field Visit** – To gather observation data
Session 7 – **Summarization of Data -** Analysis of Data gathered during Observations through Mind Mapping
Session 8 – **Empathy Mapping & Problem Definition** – Canvas Preparation

Day 3:
Session 9 – **Ideation** – Brainstorming techniques to Innovation
Session 10 – **Ideation Canvas** – Canvas Preparation
Session 11 – **Product Development** – Form, Function, Features
Session 12 – **Product Development Canvas** – Canvas Preparation

Day 4:
Session 13 – **Reverse Engineering** – Redesigning Branch Specific artefact/component/product
Session 14 – **Disassembly & Identify Technical aspects**
Session 15 – **Prototyping techniques**
Session 16 – **Building rough prototype (Hands-on activity)**
Recap on FDP and certificate distribution

Introduction & Basic Objectives:

The origin of the design engineering subject in GTU syllabus is based on the fact that the students that are passing out are not getting jobs. After conducting a deep research, it came to know that the students are not having that much skills required by the organizations. To fulfill the required amount of skill sets in the students, Design engineering subject is introduced. This training helps in understanding the needs of this subject, what actually the subject is and which different ways can be implemented to improve student's skill set.

As a part of a faculty member of GTU, it is my duty and responsibility to undergone this training and learn each and every aspects of this subject. This objective of the training is to train and educate all the faculty members so that the faculty members can educate the students for the same cause.

One of the key objectives of this initiative is to infuse the methodology of Design Thinking into the mind-set of the students and the faculty members for enhancing problem solving skills so that it is used in the study of all the core subjects of every branch. Other core objectives include; To stimulate thought process and creativity among the students, To learn problem-solving techniques, To lessen the copy-paste in the Project work etc.

Training Details of DAY-1

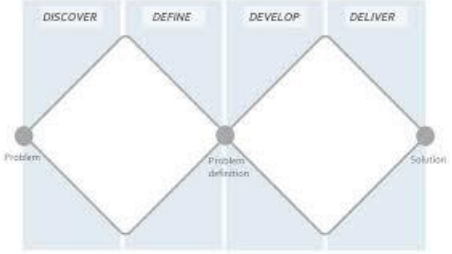
Training on the day one starts with a mind relaxing and spiritual prayer that turned the environment nicely. Afterwards, the tutor from the GTU (Prof. Karmjitsingh Bihola) has started the conversion by introducing himself and the design engineering subject. The beginning part of his presentation was from the need and origin of this subject that I have discussed in earlier segment. Later on he moved towards the teaching scheme of all the four semester (3^{rd}, 4^{th}, 5^{th} & 6^{th}) of design engineering subject. From this segment, I came to know about the credit details of this subject in each semester. He then informed all the participants that GTU has changed the course code of the subject DE of 3^{rd} and 4^{th} semester and there won't be any external evolution from this academic year. During that presentation, sir informed that for 3^{rd} semester, students need to select very basic and small project that is not related to their respective branch. Objective behind doing this is to develop the design thinking mind-set and to understand the basic process of the design thinking. Moreover, students have to select different projects in 3^{rd} and 4^{th} semester and they can continue their 5^{th} semester project in 6^{th} semester if they want. GTU has followed this scheme so that before going into the final year project, students can master the design thinking process. Also it is to be noted that, students can carry forward their design project into the final year if they want. After completing the basic guidelines about the teaching scheme, sir gave some details of the DE portal and guided participants about the design engineering website.

The next portion of the presentation was more focused about the design engineering subject. This portion was started from three questions (why, what and how). Session-I was more about why design engineering and the answer to the question is the considerable amount of unemployment after completing the graduation in the engineering. The reasons for it can be many such as lack of skill sets, not upgraded syllabus, technological change, no adaptive mind-set etc. After research, it came to know that students are lacking in around 21 such skill sets needed by any organization. These skills can be categorized in the three category, I) Foundational literacies, II) Competencies and III) character qualities. Design engineering is part of a solution to these problems. It helps with the changing the mind-set, it talks more about the process irrespective of the result. Moreover difference between traditional thinking and design thinking were described. In that comparison, the key points were: (a) In design thinking, one need to go for right question rather than right answer, (b) In

design thinking, one need to listen more compared to speaking more in traditional thinking, (c) Design thinking involves creative and innovative process where traditional thinking involves existed and proven process.

Moving towards the "What" question, we were taught that design thinking is the mindset of creative process for solving problems. This process starts with the diversion and ends up with the conversion process. Design thinking is mindset that is human centered, empathic, optimistic and experimental. In short design thinking is the confidence that new, better things are possible and that you can make them possible. It involves three major areas (a) desirability (b) viability and (c) feasibility and subset of these three things is innovation. Design thinking involves two zones (a) problem zone and (b) solution zone. In problem zone, Observation, empathy and ideation is done. Solution zone includes product development, prototype and testing.

After such healthy introduction on design thinking, we had a 40-50 min lunch break. After lunch break, we had an expert from National institute of design Professor Bhavin Kothari. Professor Bhavin Kothari is Senior Faculty with Strategic Design Management discipline at National Institute of Design. Prof Kothari is a qualified Engineer–Planner from CEPT University and has pursued another master in Intellectual Property Rights from NALSAR University. He has more than 21 years of experience. Bhavin sir has started his lecture with more interaction so that everybody after lunch doesn't feel boring. He then moved towards design thinking. Sir described that design thinking is an approach to think out of box. It gives an opportunity to look at the things from macro level to the micro level. After that sir described that how we conditioned our mind with an example of baby elephant. With that it concluded that design thinking should be desirable, feasible and affordable. Moreover, design thinking process can be understood by double diamond process as shown in figure. After that we had a tea break.



After the tea break, session resumed from where it was left. Bhavin sir started from the most vital part of the design thinking, “Observation”. According to him, observation is the most important part of any system if one can observe the problem with the right intention, solution is not so far. Observation has three vital questions (a) I’m taking this photo because? (b) I’m thinking about this because? And (c) I’m feeling about it because. Basic objective of the observation is to capture the latent need, what is unmet, unfelt and unrealized. These come by questioning everything. One need to understand the real pain of user and then think of what is being done and why it is being done.

Listening is the second most important part of the design thinking. One should cultivate the ability to listen. One should be able to understand the actual behavior changes, body language and facial expression while listening to the users. One should not look intimidating, take approval first and then thank profusely to everyone. After that Karmjit sir has introduced us with the empathy mapping before winding up the day-1 and at the end guided everyone with the next day schedule.

Training Details of DAY-2

Training on the day two resumed at 10 AM with a mind relaxing and spiritual prayer as done in day one. Prof. Karmjitsingh Bihola has started the conversion by introducing the design thinking. The beginning part of his presentation started from the definition of design thinking that it is an approach to innovation that draws from designers' toolkit to integrate the needs of people, the possibility of technology and the requirements for business success. Later on he gave the example of apple iphone X and said that why people is going madly after this phone. The basic explanation he wanted to make is combination of experience and innovation. Then sir has introduced us with the design thinking process (HOW-phase). It includes six activities such as observation, empathy, ideation, product development, prototype and test. Sir described that there are three type of problems (a) known- known (b) known-unknown and (c) unknown- unknown. After that he introduced the empathy part that how one should extract the real problem by empathy. Empathy includes observe, immerse and engage part. After that we need to go to the field for taking data and to find the actual problem. Before that we need to form the teams and Karmjit sir has formed the team randomly. In my team we were five members namely Akshay sir (from our institute), Tarang sir (SAL engineering college), Pranjalee (Silver oak college) and Narendra gohel (SSEC).

After the team formation, first task that we had on our hand is to find the domain. Well I must say that our team was misguided by the inputs from one of the team member. He suggested selecting automatic speed breaker system. As he directly gave the solution of such problems, the focus and concentration of our team was not coming back to the real process. The real process focuses more on problems rather than the solutions. But the design thinking process is iterative process and one can start the process from any step conditioned he/she must have the experience of the process. After the discussion on the domain our team went to on the field. We went to the ONGC circle near the entrance gate of VGCE, chandkheda and observed the traffic and speed breaker near the cross road. We also had an interaction with one auto rickshaw driver. He was aged person and he spent his entire life on that road, he was very frustrated with his current position and was very angry on the traffic situation. We interacted with him and collected the data along with that we also observed how people is

facing the trouble near the cross road. After collecting the information, we sat at the bus stop near the cross road and discussed few things. Our team has also prepared AEIOU canvas with the collective inputs of all the team members. After that Akshay sir and me has captured some photographs and recorded the videos of that cross road. With this information and data, we went back to the training place and it was lunch break, so we went for the lunch. During this activity, I got the chance to have conversation with the members and to know them.

After the lunch, every team gathered to the training venue. Professor Bhavin Kothari was back to the training. He and karmjit sir has suggested the team members to come on the stage and describe what they have observed. Each team has started presenting their observation, and during that process I came to know that what can be different perspective of the different people and how certain things can be seen from the different angles. Due to the shortage of the time, our team did not get the chance to present our observation as every team was taking around 15-20 minutes. So karmjit sir has stopped this process and moved towards the mind mapping canvas.

Mind mapping technique is a visual representation of hierarchical information that includes center idea. It helps us to generate, visualize, organize and classify the information. Mind map is important to reduce the overlapped information. It is a better way to communicate with the users and it helps to improve memory by taking and making notes. Moreover sir has given some examples of the mind map with some case studies, he made us understand that how it can be formed and what does it includes actually. There are some types of mind maps such as information mind map (map tree with information), Concept mind map (tree with pictures and information) and application mind map. With the deep understanding, our team has started forming the mind mapping canvas. As our domain was related to the traffic issues near the cross road, school and colleges, I gave an idea to draw a mind map in cross road fashion only. Each member has liked and agreed on this idea and we went with this approach. We have concluded the main roads and sub roads and circles and then started drawing the mind map. Initially till tea time we have almost finished with drawing part. So we went for the tea break.

After the tea break, we resumed our work. It is to be noted that in our team two members (one from SAL and one from SSEC) were not taking that much interest in this activities. We have finished the mind map and showed it to the karmjit sir. He has given his inputs, suggestions and some correction. After taking his inputs, we have corrected our mind

map and completed it. This activity has took so much time as other team members were also busy and so much involved in it. Karmjit sir has then introduced us with the AEIOU canvas and went through each aspects of the AEIOU sheet. He showed one case study of his students, that how they have found the domain and how they have filled the AEIOU canvas. With these guidelines, we have started making it, but we did not have that time to finish it. With such activities time has flew away very fast compared to the day-1.

Training Details of DAY-3

Training on the day three has started with as usual peaceful and spiritual prayer. Prof. Karmjitsingh Bihola has started the day three training with the introduction to the empathy mapping canvas. As he described, this canvas helps to empathies user, find the emotional needs of the users. This canvas includes very interesting part named as storytelling. This part includes two happy stories and two sad stories of the users. This portion is filled with the help of the interaction that each team has did with users. There are certain possibilities that some group of people is happy with the current situation or they could be having certain advantages from the problem. Moreover there are sad part of this also presents. It includes the story of the user to understand their basic needs. This portion in the canvas must be filled in paragraphed way. It should be seemed that we are writing the story of a bollywood movie.

In the first half of the training, everyone was very busy in making these empathy mapping and AEIOU framework canvas. Our team was focused on this task and with the discussion and some sort of planning. We were talking and making these canvases, it was very enjoyable moments as the discussions during the making process were funny and at the same time fruitful also. With each canvases, we were learning the new phases of the design processes and along with that we were understanding the real meaning of the process. After the lunch break, sir has started the session with innovation. Innovation is novel combination of creativity and existing technology. Any new or small modification in the existing technology leads to the innovation. With the understanding of it, he gave so many examples. The main and basic idea behind it was to think out of box for the solution and to learn this technique, ideation canvas was very important. The next canvas was of the ideation canvas. This canvas has four portions such as people, activities, solution/context/location and props/tools/objects/equipment. In the people potion, one need to include all the people connected to the problem solution. Activities are as same as in AEIOU framework. Solution/context/location includes some solution that one has thought to the respective activity. These three were there but the final portion was actually quite funny and interesting. This portion should be filled with any random props/objects/tools/equipments that are not the part of your respective domain. These actually can be anything but not related to your domain. At the first we included so many things related to the domain, but after the correction from the trainer, we removed all the sticky notes and filled that portion again with the random

items. This activity was actually very funny because one need think of any wild guess and each guess was bringing the joy. With this funny conversation, we have finished the canvas. At the start of this canvas, we didn't understand the purpose of including out of domain things in the canvas, but later on sir has described that your solution could be anything but if you think of your domain only it may happen that you could not reach to the innovation. After that, Sir has told us to write at least fifty random combinations of these four portions. Moreover, we need to exchange our combination with the other teams and look for any combination that conveys any meaningful idea. From this activity, one can have new ideas to make any product or to have any solution of the existing problem.

The next task was to make the product development canvas. The guidelines on how to make this canvas were given by Karmjit sir and the introduction and importance part was also taught. We have started working on that sheet. It was really amazing that the whole day we were working on the different canvases and at the end we were feeling so tired. Any how we have held our nerve and completed the sheet. At the end we need to send our product development sheet to the other team for review and feedbacks. We have taken reviews and feedback from the Kanu sir's team and after that our team has also reviewed their product development sheet. At the end it was very fruitful day in terms of learning and understanding the process.

Training Details of DAY-4

This was the last day of the training and as usual the day has started from the amazing prayer. The next task was to complete all the canvases that are pending. We have some sort of work pending in a few canvases. We have started working on it and completed it with in the span of 30 to 45 minutes. After that, we have taken the photographs of all the canvases. It was felt very satisfactory.

On the very next minute, Karamjit sir has started his lecture with the prototyping portion. He in his presentation gave so many examples of some prototype. He described that a prototype can be anything a picture, a role play, a video or any other simple construction made up of simple gadgets. Basically the prototype should convey the meaning and purpose of your actual product.

The next task for us was to make the prototype of our product, which was an automated speed breaker for cross road that situated near schools and colleges. Karmjit sir has provided so many things such as thermocole sheets, colour pages, threads, glue, sketch pens, clay, etc, from which one can make a simple prototype. We took some time to think of designing portion our product. We have drawn a graphical representation of our prototype on the paper. After finalizing the basic framework, we went to collect raw materials like thermo sheets, colour pages, glue, sketch pens and clay. We were discussing and planning on work distribution. After deciding the job role, we have started implementing it. We were making the model of cross roads. As time passes, we actually started enjoying it and realized that the small kid in us is still living. Also it gave so many opportunities to mingle with the other teams. Each team was enjoying this activity. Everyone was in very good mood. We even didn't realize that it was lunch break. No team wants leave the activity and go for lunch break. Eventually the organizers had to switch off the lights so that we had to go for lunch. Finally we went for the lunch and came back. After coming back to the table, we have resumed our work and started decorating our highways by placing bikes, buses, trees, street lights, traffic signals, traffic police and buildings using clay and other raw materials. With the hard work of more than 2-3 hours, we were done with our prototype and after looking at it everyone were

amazed as it was very beautiful and we didn't even imagine that it would look like this when we've started it.

The final round is to present our prototype and to have comments and feedbacks from the audience. First team has started their prototype presentation and after that everyone was asking the questions and that part was actually full of enjoyment. Our turn came and we went on the stage, we have presented our prototype and we were ready for the questions. We have had some questions; some of them were very genuine and important for the improvement of our product. We have noted those points.

After the presentation round, we were almost done with the training but still some things were left such as LNM canvas. Karmjit sir has quickly gone for the LNM canvas presentation and taught us that what is its meaning and why we are doing it, how it can be made and filled. After that he gave some information about the de portal and guided us to the websites. On the second last part, sir has asked for the feedbacks from us and one the key feedback was to have such kind of training with around 5 days.

At the last, it was time for the certificate distribution. To save the time, sir has decided to not to go for the photographs while collecting the certificates and we'll have group photographs later on. Everyone has quickly collected their certificates and at the end it was the time for the group photographs. Everyone has taken their positions and finally we have captured so many photographs with almost everyone. Those were the happiest moments of the training. At the end it was time to say goodbyes. The training happily ended with so many learning and fun.

Conclusion

From this four day training, the one thing that I have learnt is that rather than thinking about the process, one needs to focus more on the process part. If the process is right, result is going to be in your side only. Along with that the learning lesion was to give more importance part on the observation part as if the observation is very sharp to capture the smallest things, solution would be that simpler and helpful. Also, one must have childish behavior in terms of knowledge. One should go for the questions more and try to understand the real problem of the users. It is very helpful tool when you wanted to understand the real problem. Finally, I can conclude this training with the sentence that, the training was the combination of both learning and fun

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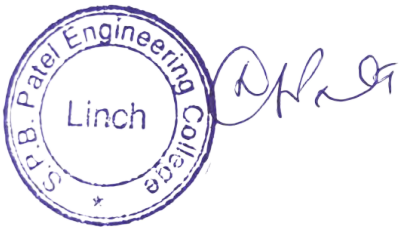


S. P. B. PATEL ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

Report of 5 Day FDP on
'Design & Development of Electric and Hybrid Electric Vehicle Technology'

Date: 24th to 28th February 2020
Name of Resource Person: Mr. Sudhir Vaidya – Program Coordinator – SAE India
Duration: 9:30 am to 5:15 pm
Venue: S.L. Kirloskar Auditorium Hall, College of Engineering Pune, Maharashtra
No. of Participants: 51 faculty members of all over India along with some M.Tech students of COEP
Report Prepared by: Kamlesh Samadhiya

Objective of the FDP:

There is a gap between technology taught in engineering colleges and technology which is practiced in the industry. The technology is developing at a very fast rate and the college curriculums are not keeping pace with the race. The solution to fill this gap is by giving the faculty members exposure to the industry practices by sessions and experience sharing of industry persons. The current era is of electric mobility as the air pollution is a big issue. After attending this workshop faculty members will understand the concepts of electric and hybrid electric vehicles in detail, their current market, current and upcoming technologies.

Day 1 – 24th Feb 2020: The program started with our national anthem. Host ma'am welcomed all the dignitaries on the dias: Mr. P. V. Nibandhe - Chairman SAE western region, Dr. Nalgaonkar - HOD Mech – COEP, Dr.. P.B. Joshi - Dy. Director, SAE India, Dr. Ahuja - Director – COEP, Sudhir Vaidhya - Program Coordinator - SAE India and Dr. Mohan Khund - Program Coordinator – COEP.

Session 1: on 'Electric Vehicles Scenarios, Road Map & Challenges for India' by Mr. Kapil Baidya (Tata Motors Ltd.). Sir gave statistics about number of cars used per 1000 person by developed countries is approx. 837, average cars used per 1000 person by the world are approx. 156 and for India the cars used per 1000 people are approx. 22. Sir told the policy makers of India seats in Delhi but the irony is Delhi is the biggest polluted city of the country. They should really think for pollution control and Delhi government also putting lots of efforts to overcome the issue. Moving towards EV & HEV mobility could be the great solution but there are some hurdles too which needs to be overcome in coming future. Sir told as our country is having Sun shine always available irrespective of seasons as compared to other countries and since last 10 years tremendous development is done with the help of solar energy.

All new cars mandated to be electric in Germany by 2030 and for India? Then sir discussed about why electric car? As Thomas Edison told Electricity is the thing, there are no whirring grinding gears with their numerous levers to confuse, no dangerous and evil smelling gasoline and no

noise. Recent advancement in technology like Li-Ion batteries – 5X cheaper than earlier, 4X lighter, 3X increase in life and can be charged in hour, advancement in electronics and increasing vehicle performance has led the EV mobility a reality for all. Each and every country of the world is working on successful EV mobility. Then sir discussed about power grid to smart grid. He also discussed about new EV technology can power your house too.

Then sir discussed about E-mobility solution for future transport.

- No requirement of fossil fuel.
- E-mobility is one of the potential solutions for reducing pollution.
- EVs are clean and easy to use.
- EVs have low maintenance cost, only few moving parts.
- Electric motors: Easier to control than IC engine, compact – high power to weight ratio, clean – no lubrication, quieter- less moving parts, no combustion and energy efficient.
- The fuel for EV is electricity and this can be generated from renewable sources like wind and solar.

Sir then discussed about evolution of transport on three wheelers. In some cities three wheeled EV rickshaws are running for public transport in markets. Then sir discussed about amendment bill no. 37, 2015. As far as the architecture of EV is concerned the EVs mostly have skate board type of design structure on which the batteries are mounted and mostly in the middle structure so that in case of frontal and rear collision of EV the vehicle can be safe and no chance of explosion.

Then sir discussed about classification based on degree of hybridization of power train: (1) Micro Hybrid, (2) Mild Hybrid, (3) Full Hybrid, (4) Plug in Hybrid and (5) Full Electric and elaborated the system of all above types of vehicles in detail.

Then sir discussed about the manufacturers of electric vehicles and major EV components suppliers of the world. They also discussed about EV statistics for registered EVs and its growth trend worldwide. Then sir discussed about battery types and prices. Sir also discussed about NITI Ayog and mobility transportation approach. Sir told electric buses, cars in metro cities can save up to 60 billion dollars by 2030. As per NITI Ayog report finding India could save 64% energy in 2030 by shifting to shared electric mobility (download NITI Ayog report on electric vehicles). Then sir discussed about Auto Policy & GST rate – 2018 draft. Earlier GST on EV was 12% but now it is 5%. Then sir discussed about holistic approach to mobility transformation.

The 1st is “System integration” - where the opportunity areas are:
1. Mobility as a service
2. Interoperable transport data.

The 2nd is “Shared infrastructure development” – where the opportunity areas are:
1. Mobility oriented development
2. Vehicle grid integration

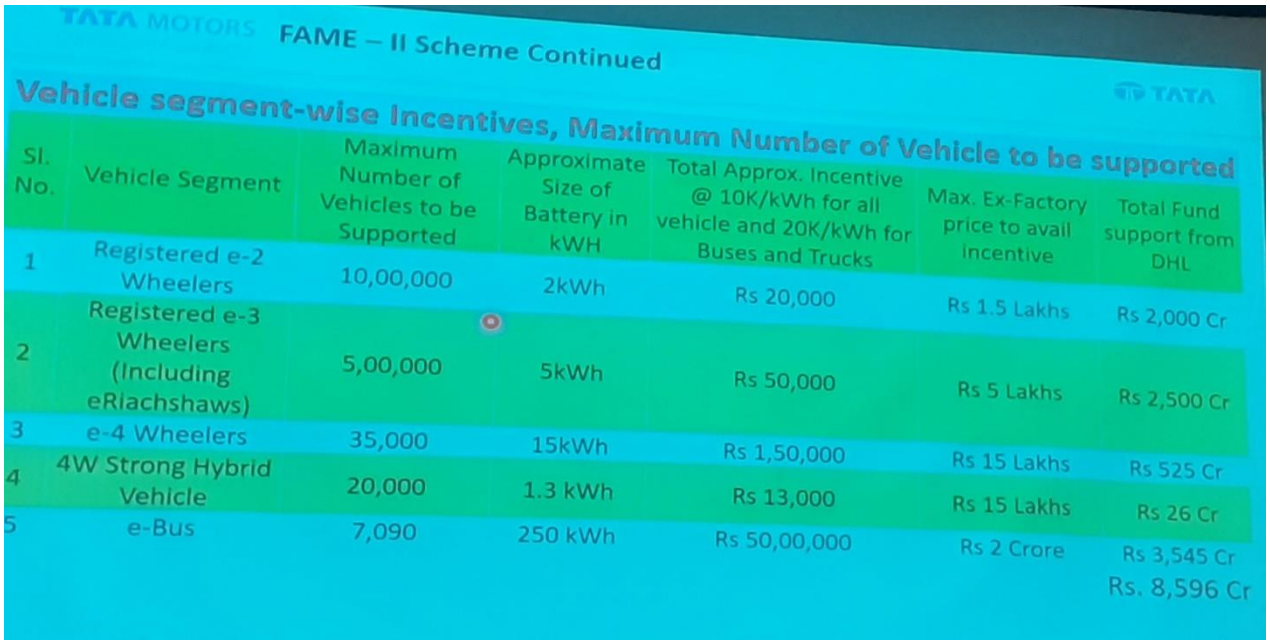
The 3rd is “Scaled manufacturing” – where the opportunity areas are:
1 Product manufacturing
2 Electric vehicle deployments

Then sir discussed about EV policy stakeholders in India. Following are EV policy stakeholders in India:

- Department of Heavy Industry
- Ministry of Road Transport & Highways
- Bureau of Indian Standards
- NITI Ayog
- Ministry of Urban Development
- Central Electricity Authority (CEA)
- Ministry of Power
- Department of Science & Technology (DST)
- ARAI

Sir briefed about National Electric Mobility Mission Plan (NEMMP) – 2020 and FAME India scheme (search out on Google). He discussed about what is FAME India scheme and its objectives. FAME stands for Faster Adoption and Manufacturing of Evs and Hybrids). Then sir discussed the flow and evolution for developing EV policy in India in 2013 - 2015 – FAME I – 2017 (Karnataka EV policy) – 2018 (Maharashtra EV policy) and 2019 – FAME II. Sir discussed about EV policy stake holders in India like: Department of Heavy Industries, Ministry of Road Transport and Highways (MoRT&H), Bureau of Indian Standards (BIS), NITI Ayog, Ministry of urban Development, Ministry of Power, Department of Science and Technology and ARAI. Then sir discussed about the **'Green Number Plate'** on vehicles which run by electric power. The government of India has announced that EVs will be marked by green coloured number plates, the first batch these plates will be given to Mahindra's electric car **'eVerito'**. Bengaluru based start-up Lithium urban Technology is the first to get a green number plated car. The green number plates on EVs have numbers in white font for private vehicles and in yellow font for commercial vehicles and cabs.

Then sir discussed about phase II of FAME India scheme. See the image below:



Phase Manufacturing Program (PMP) for EVs was also discussed. Sir told about battery market potential in India. Then sir showed battery market for electric buses in 2018. Sir told total battery market size for e-bus segment could be in the range of 64 MWh in 2018 as per report published by CES. There can be slight variations on the efficiency side depending upon 9m and 12m bus and also on AC and non AC. The leading battery cell suppliers in India for EVs and battery chemistry are as below:

Leading battery cell suppliers in India for EVs	**Battery Chemistry**
Samsung SDI	NMC Lithium Nickel Manganese Cobalt Oxide (NMC)
BYD	LFP Lithium Iron Phosphate (LFP)
LG Chem	NMC
Leclanche	NMC
CALB	LFP
CATL	LFP

Leading battery pack manufacturers for electric buses in India are

- Octillion Power Systems
- KPIT
- Sun Mobility
- BYD

Then sir discussed about EV standardization and regulation framework. Then he discussed about EV challenges for establishing EV mobility in India. The costs are reducing by 1/5 then the earlier. As far as the safety is concerned the battery may explode and for that proper battery management system is there. There should have proper battery cooling system. There should have such infrastructure that if people stay for 15 to 20 minutes for 'Nasta' or refreshment time and their vehicles can be charged quickly.

Sir had discussed about the barriers to greater adoption of EVs. Sir told;

Are we shifting pollution sources from urban to power plant?

Do we have infrastructure for support?

Is EV affordable? – Initial cost, - Life cycle cost, - Customer willingness to pay more for green vehicles, - Need to have special promotional policies, etc.

Is EV acceptable? – Does meet consumer demands? – Features compared to ICE? – Zero fuelling time? – Cost sensitivity, etc.

He also discussed about EVs adaptation, availability and indigenous solution in connection with barriers for adoption.

Then sir discussed about concerns of Indian Auto sector:

- Fear of industry shakeout: 60% revenue comes from Engine & Power train
- Ancillary impact: fear of casting forging requirement minimal
- Jobs at stake: 1.5 million jobs at risk
- Infrastructure concerns: charging stations? Dependable cost efficient
- Wooing buyers: Is customer ready? Range anxiety!!!
- China factor: fear that China will food with EV as did for smartphones
- Inadequate financial push: can India afford financial incentives (Denmark 22K dollars, USA 7K dollars, Norway 18K dollars, UK 6K dollars)
- A diktat, not a dialogue: policy to form industry on board
- Too many cooks: DHI, MoRTH, MNRE, MoUD, MoP, NITI Ayog.

Sir then discussed about EV challenges and its probable solutions. Sir also told about industrial revolution 1.0 to 4.0. Then sir discussed about various battery sizes and its applications. The various cell chemistry is given below: Vanadium redox flow battery, Iron-Chromium battery, Lead Acid, Lead advanced, NaS, Nickel Cadmium (NiCd), Nickel Metal Hydride (NiMH), Lithium Nickel Cobalt Aluminium Oxides (LCO), Lithium iron Phosphate (LFP), Lithium Titanate, Lithium Metal Polymer (LMP), Lithium Sulphide, Lithium Air, etc. The applications of battery in terms of portable use, transport applications and stationary applications. At last sir told 'Go green before the greenery go'.

Session 2: on 'EV system design and architecture' by Dr. Dhananjay Kumar of COEP. Sir told all over the world Lithium is used in one or the other way. After fission the 3rd particle is Lithium. Sir then discussed about materials used in EVs like aluminium, carbon fibre and conventional steel and their characteristics. They also discussed about industry revolution transformation from 1.0 to 4.0 and latest technologies of cars. Then sir discussed about various battery sizes and its applications. Sir discussed about series and parallel hybrid and series / parallel hybrid systems, complex hybrid systems, automated guided vehicle systems, FROG (Free Ranging On Grid Technology), shared mobility, he added autonomous EV can run 24X7 but humans can't. Sir also discussed about various battery chemistries, future trend of batteries for e-mobility, challengesand specific needs and at last sir discussed about graph of vehicle range (Km) Vs battery system weight (Kg). Actually due to 1st session which was started late as well as the presentation of Dr. Dhananjay Kumar was not getting connected to the projector system, they simply overviewed the session and told next day he will take full session and cover the session topic.

Session 3: on "Vehicle Dynamics and Traction System" by Chidanand S. from Eaton group, Pune. The outline of the session was basics of vehicle longitudinal dynamics, road loads, vehicle performance metrics, introduction to traction system and available combinations, what is an ideal

traction system prime-mover, engines, electric machines and combinations of both, transmission systems, need of transmissions and its trends in EV, overview on types of transmissions and optimizations of shift schedules.

Sir first discussed about different types of resistance which acts on vehicles. Sir gave one example of bicycle. He told about head vent and tail vent. One cycle is full inflated in facing head vent air resistance whereas the other cycle is half inflated and facing tail vent resistance. Both cycle will go at particular speed and then stopped. Sir told what performance we see while buying a vehicle? Then sir discussed about vehicle performance metrics. Acceleration in gear and through gear, max speed, stops and start running gradebility, economy (kmph). Sir ten discussed about what we need from one traction drive? Then sir discussed about ideal power curve and engine / electric machine. Then he discussed bout ideal traction curve, need of transmissions etc.

Session 4: on "Fuel cell technology for mobility and power generation application" by Mr. Sushil Ramdasi Dy. Director, Power Train Engg., ARAI. Sir started his session on present power train scenario with regard to engines. Sir discussed about present power train scenario (engines). He told the drivers of electric mobility are,

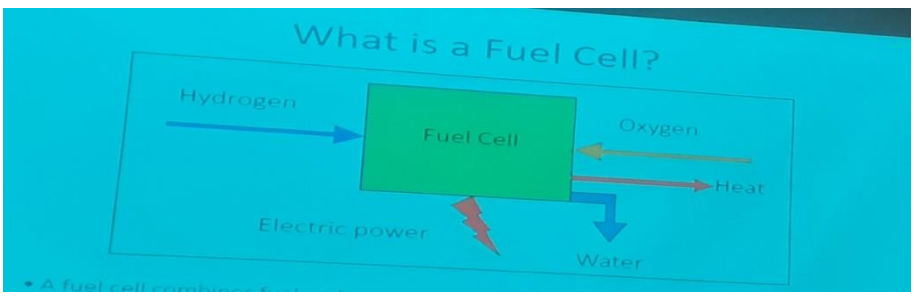
- Stringent emission norms
- Fuel economy
- High specific power
- High torque back up
- Low fuel consumption
- Improved NVH
- Enhanced durability
- High power to weight ratio

The following are the major challenges for adoption of electric mobility:

1. Emission, 2. Noise, 3. Cost, 4. Durability.

Then sir discussed about Bharat Stage norms and Euro norms. The challenges are fossil fuel depletion, need to reduce import of crude oil percentage, upcoming CO2 reduction targets (< 99g/Km), global warming and greenhouse gas effects. Then sir showed the global roadmap for sustainable mobility. Sir discussed about hybrid vehicles and EVs. He gave example of micro hybrid car – Mahindra Scorpio (only start & stop function), mild hybrid – diesel Maruti Suzuki Ciaz (for regenerative braking) and full parallel hybrid – Toyota Prius. Sir told everybody is talking about EVs but the reality is only 3% total share of EVs is there worldwide.

Sir then discussed about why fuel cell is important? Fuel cell vehicle is only EV, the difference is only on-board you can carry methanol, ethanol, hydrogen which will generally generate electricity to charge the battery. Then he gave introduction of 'fuel cell'. The fuel cell combines fuel and oxidant electrochemically to produce the electricity. It is two or three times more efficient than an



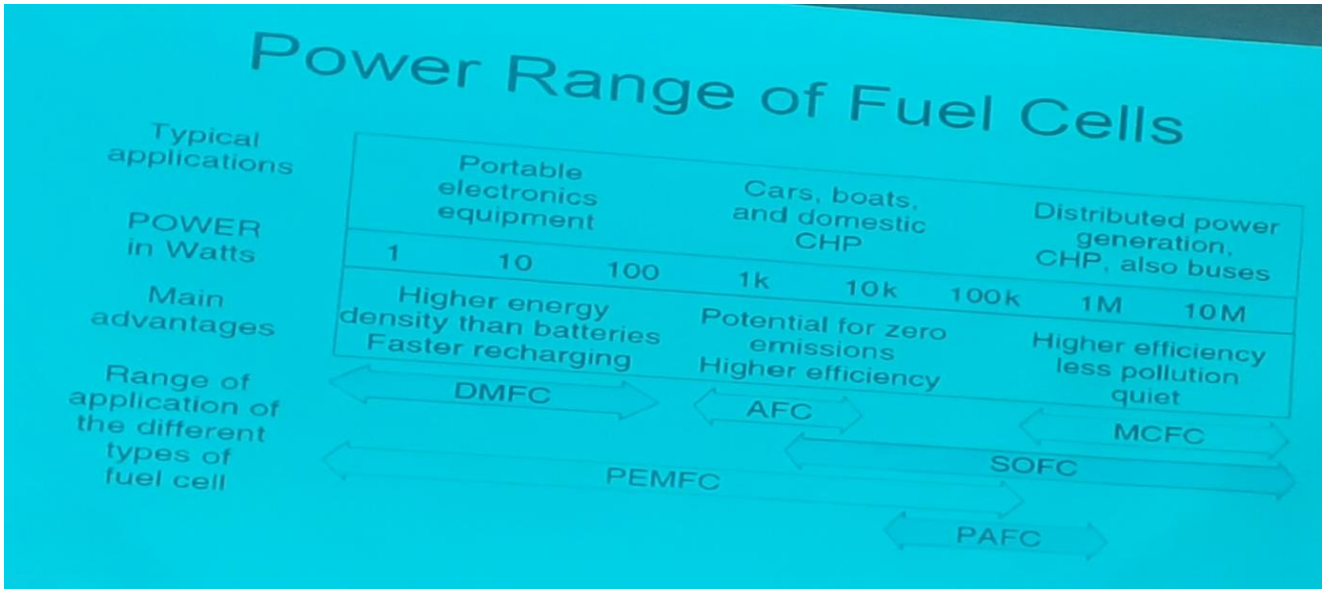
internal combustion engine. Fuel cell stack is quite, has no moving parts and produces zero emissions. Then Sir discussed about the brief history of fuel cell as below:

- William Grove invented $H_2/0_2$ fuel cell in 1839. He called it a 'gas battery'.
- In 1858 F.T. Bacon demonstrated for the first time, the fuel cell as a practical device by feeding the H_2 and O_2 to Nickel electrodes on either side of KOH electrolyte.
- In the 1960s, Pratt and Whitney commercialized Bacon's design for the US space program. Fuel cells were used in the Gemini, Apollo and Shuttle programs. They provided electric power and the crews drank the product water.
- In 1967, Nafion was invented by DuPont. In 1997, Los Alamos National Lab patented a way to reduce Platinum usage to $1/10^{th}$.
- In 2003, President George W. Bush unveiled the hydrogen initiative.
- Toyota, Hyundai, Honda, Nissan, GM, VW, Ballard, Plug power etc. have invested in automotive and forklift fuel cells.
- Doosan, Bloom, Fuel Cell Energy, Posco, Panasonic etc. produce fuel cells for stationery power application.
- SFC, Samsung, IBM, Casio etc. are commercializing small fuel cells for portable electronic applications.

Sir then discussed about types of fuel cells.

Fuel Cell Type	**Mobile Ion**	**Operating temperature**	**Applications and Notes**
Alkaline (AFC)	OH-	50 to 200 deg. C	Used in space vehicles eg. Apollo shuttle
Proton exchange membrane (PEMFC)	H+	30 to 100 deg. C	Vehicles and mobile applications and for lower power CHP systems
Direct Methanol (DMFC)	H+	20 to 90 deg. C	Suitable for portable electronic systems of low power running for long times.
Phosphoric Acid (PAFC)	H+	Up to 220 deg. C	Large numbers of 200 – KW CHP systems in use
Molten Carbonate (MCFC)	CO3 (2-)	Up to 650 deg. C	Suitable for medium – to large scale CHP systems up to MW capacity
Solid Oxide (SOFC)	O 2-	500 to 1000 deg. C	Suitable for all sizes of CHP systems, 2KW to multi-MW

Power range of fuel cells:



Sir discussed about PEM (Polymer Electrolyte Membrane) fuel cell and stack. Honda Clarity, Toyota Mirae and Hyundai Tuscan are PEM fuel cell vehicles. He discussed about Fuel cells are portable power (DFMC) which means Direct Methanol Fuel Cell and fuel cells for stationery power (SOFC) which means Solid Oxide Fuel Cells. The Pros. and Cons. of fuel cells are given below:

Advantages of fuel cells:

1. Higher efficiency compared to I.C. Engines
2. Zero emission at the point of use.
3. No moving parts in the stack, so quitter.

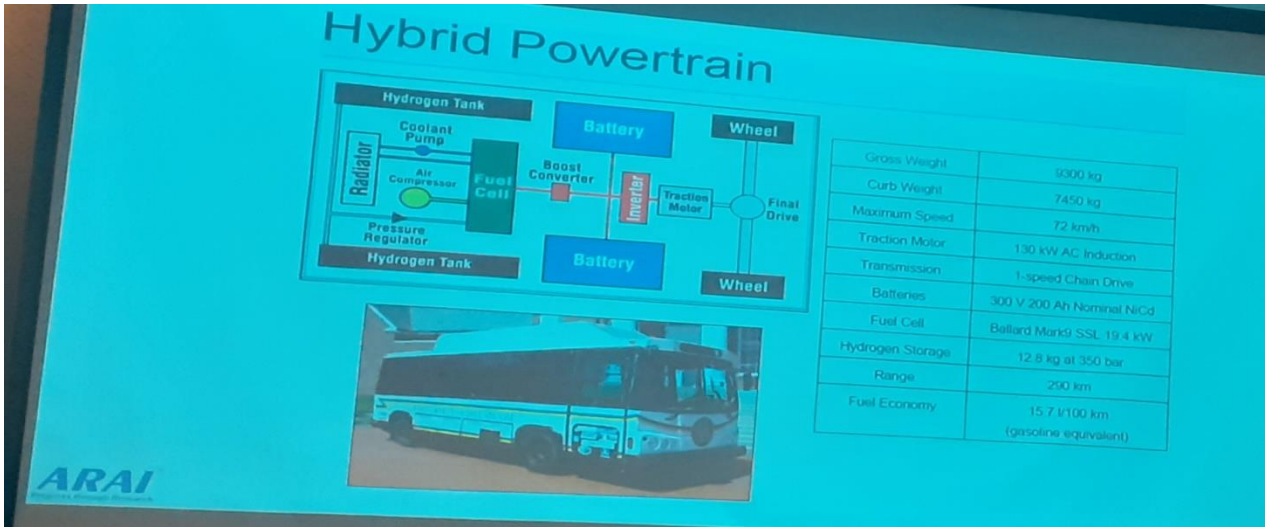
Challenges:

1. Cost (materials, labours, economy of scale)
2. 2. Durability (membrane, catalysts)
3. Lack of H2 infrastructure. H2 is difficult to produce, transport and store.

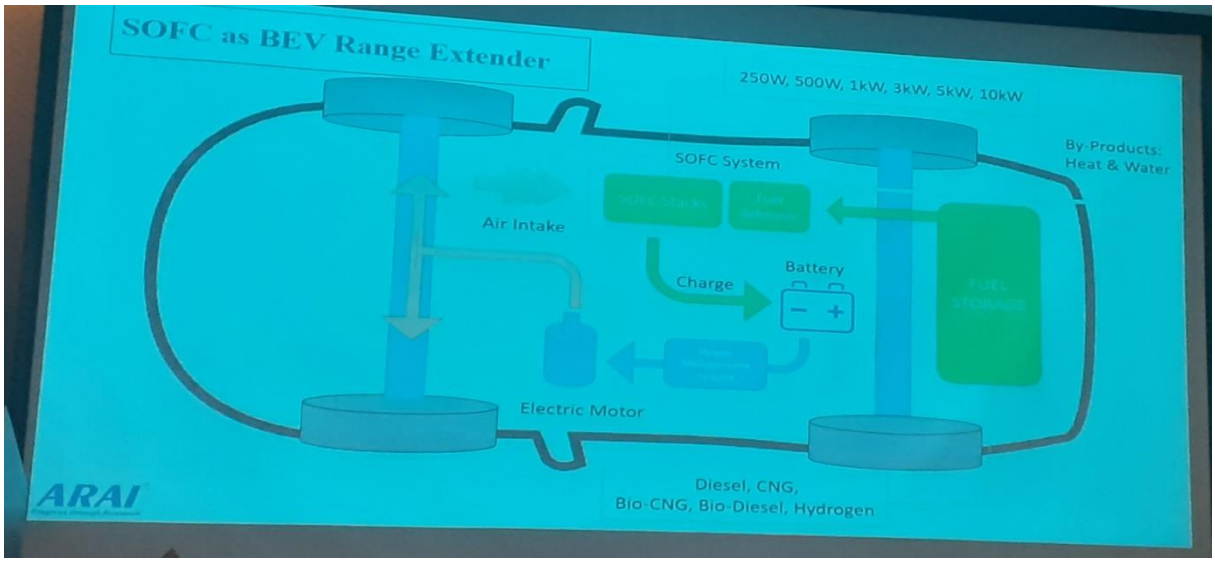
Sir discussed about thermodynamics of fuel cell. He added it is the exact opposite process of electrolysis. Then sir discussed about anode and cathode reactions. Then he discussed typical fuel cell construction (their layers). He also discussed about Gibbs free energy concept which is used in fuel cell and four voltage loss mechanism in fuel cell. Sit told Polymer Electrolyte Membrane which is known as PEM was patented by DuPont as Nafion. Si discussed about fuel cell vehicle balance of plant as given below:

1. Air supply systems – Electric turbo, air supply sensors (O2, H2), High pressure pipes for hydrogen supply
2. Water Management systems – Cathode side humidifier
3. Thermal management systems – Cooling arrangements
4. Hydrogen supply system – Hydrogen tank, hydrogen metering device
5. Traction motor – Power electronics for motor controlling
6. Lithium Ion battery

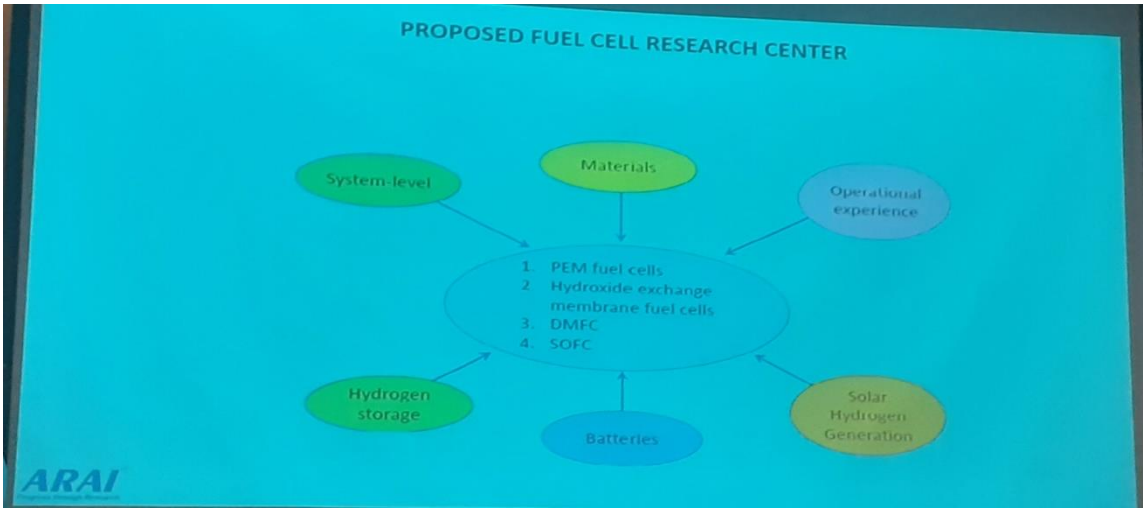
He added fuel cell vehicle is EV as well as HEV too. Following is the hybrid power train layout.



Then sir discussed about SOFC and advantages and disadvantages of it. He added Nissan unveiled world's first SOFC based vehicle in 2016 and the model was Nissan Leaf. Then he discussed about fuelling of fuel cells and steam methane reforming. He told ARAI is taking initiatives for fuel cell vehicles. Then sir showed the layout of SOFC and BEV range extender, see the picture below.



Then at the end of his presentation sir have shown the proposed research centre for fuel cell by ARAI, see the picture below.



Day 2 – 25th Feb 2020:

Session 1: on "IOT of EV" by Dr. Dhananjay Kumar of COEP. Sir started his session by telling EV consists of 5 things in its systems which are given below:

1. Body structure – in which he discussed about materials used for body construction.
2. Battery
3. Transmission system – DC to AC, but AC is suitable, he discussed about brushless motors
4. Battery management system (BMS)
5. Sensors.

He discussed that now industrial revolution 4.0 is going on and the role of humans is getting obsolete. Internet of Things (IOT) is removing humans. He told by IOT the vehicle communicates with signals and the road. The vehicle can not only for mobility but has so many other aspects to perform. Sir told 50% of the investment is used for electricity and 50% for energy generation. Sir also discussed on vehicle revenue model. Then he showed the future trends of batteries for E-mobility.

Sir told that the big challenge for EV is to reduce the cost of Li-Ion batteries. Then sir discussed that there are three main components of battery;

1. Copper and aluminium,
2. Anode and Cathode and
3. Whole assembly.

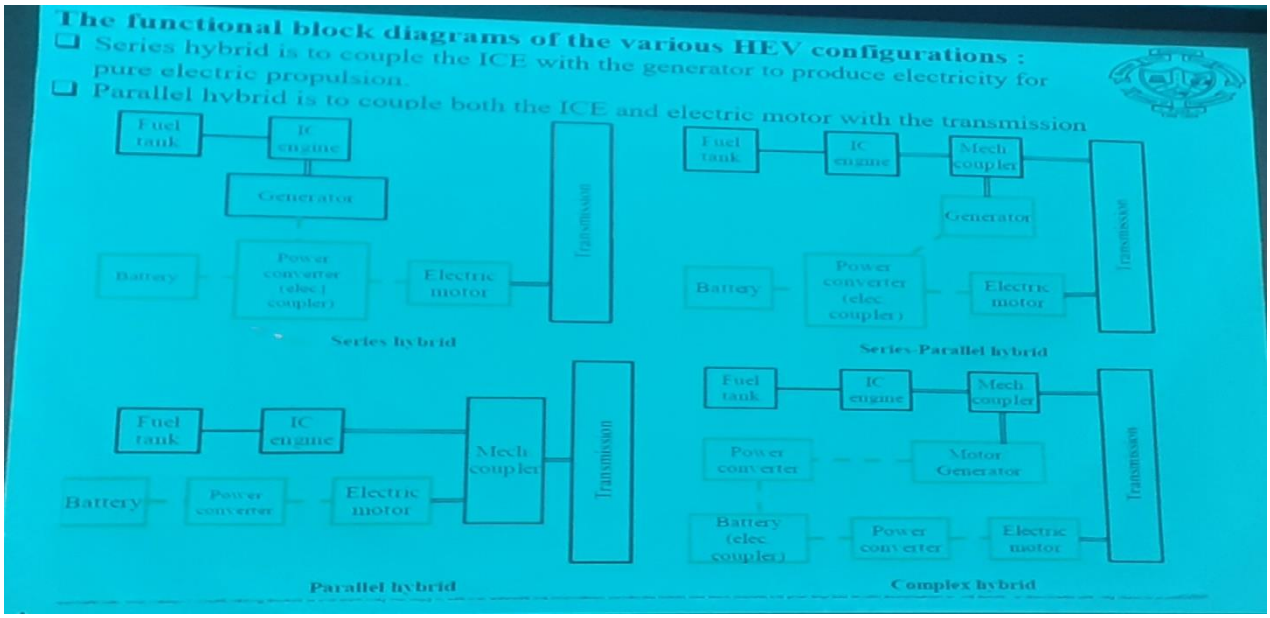
Then sir told chemical formulation for battery is big point to consider, that who will supply or produce it? Who will do cell manufacturing for batteries? Sir told battery manufacturing is a point of consideration for making EVs. The technology road map was discussed. The power assembly technology towards higher integration and power density was discussed. The main target are, better cooling, higher integration, and multi inverters.
(1). Converters co-integration:
- DC/DC Boost + inverter + generator
- Inverter + LV-HV DC/DC
- On board DC/DC + LV-HV DC/DC
(2). Direct cooling
(3). Double side cooling
(4). Co-integration motor + inverter
- increase power density
- Inverter mechatronic design to fit with motor aspect ratio
(5). Dual motors
(6). In wheel motors.
Then sir discussed about power module technology towards higher integration and power density
He gave following examples like,
Denso 2008 / Lexus L5: - Single IGBT/diode packaging, - Flip chip soldering, -Double side cooling, - Too expensive.
Toyota 2010: - Standard packaging, - Ribbon bonding, - Direct substrate cooling.
Honda 2010: - Epoxy packaging, - Cu Lead bonding, - Direct substrate cooling

Delphi 2010: - Single IGBT/diodes packaging, - Flip chip soldering, - Direct substrate cooling
Bosch 2013: - Moulded package, - Die on Lead frame, - Thick copper layer for thermal spreading, - Direct substrate cooling.
Mitsubishi 2014: - Six pack IGBT/Diode package, - Cooling fin, - Thick copper layer for thermal spreading, - Direct substrate cooling.

Then sir discussed about semiconductor devices. He showed that how technology replaces te drives, see the following picture.

Sir then discussed about industrial chain for automotive for 2015, 2020 and 2035. 150 billion US dollars are spent for R&D of auto sector. Sir told up to 2015 there was some common pattern of usual car makers (OEM), Tier 1, Tier 2 companies were dealing the auto sector, but in 2020 the scenario has started changing. Some new EV and HEV segment car players came in to market and started leading the segment and may be in 2035 the whole scenario may be totally changed by new players in the field of EVs.

Sir then started session discussion on 'Basic architecture of hybrid drivetrain and analysis of series drive train". Sir told the translation of fuel energy into work at the wheels for a typical mid-size vehicle in urban and highway driving have lots of losses which we should recover with the help of EVs. Sir discussed about load power decomposition. Then he showed and discussed about the functional block diagrams of various HEV configurations like, Series hybrid, Series parallel, Parallel hybrid, and complex hybrid. See the picture given below;



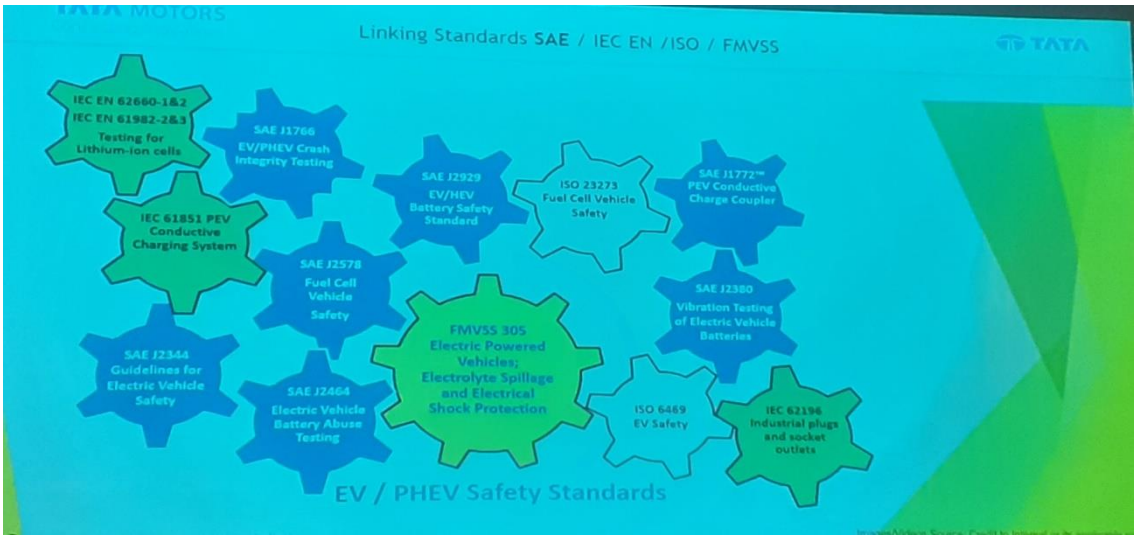
Then sir discussed about power flow in HEVs, torque coupling and parallel hybrid systems, torque coupling with planetary gear box, single and multi-motor drives, at the end of the session he discussed about carbon fibre wheel single piece and for mass production that might become cheap.

Session 2: on "Automotive standards and testing for electric vehicles" by Mr. Anand Vijaykumar (Tata Motors Ltd., Pune). The content of his session was,

1. Global standards and regulatory requirements & purpose
2. Indian standards and regulatory requirements & purpose
3. Electric vehicle components test and requirements
4. System functional safety requirements.

Sir started his session by asking what a standard is and gave its definition. Then he showed the standardization organization, see the picture below;

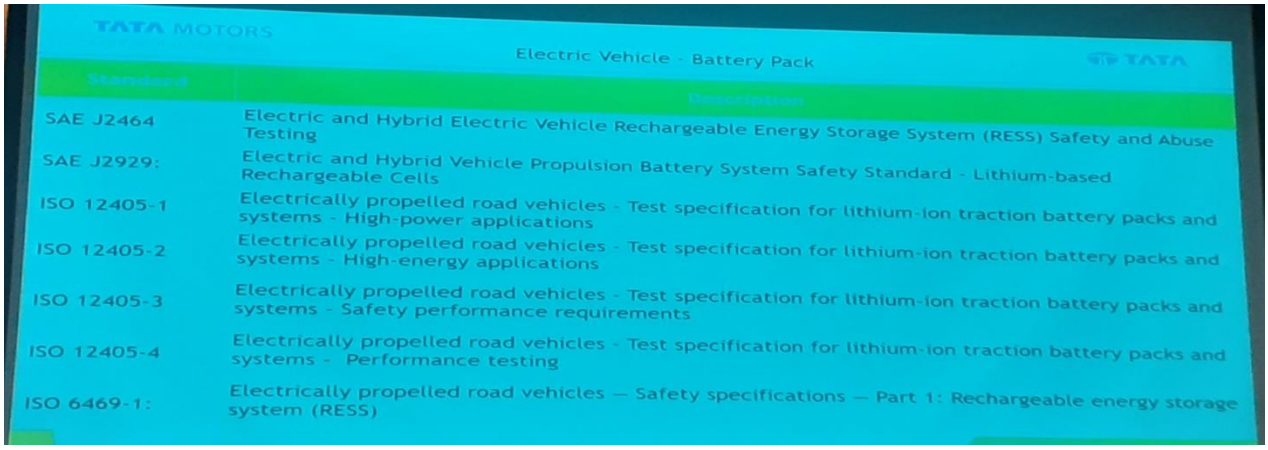
Then sir discussed about linking standards like SAE/IECEN/ISO/FMVSS and EV / PHEV safety standards see the picture below;

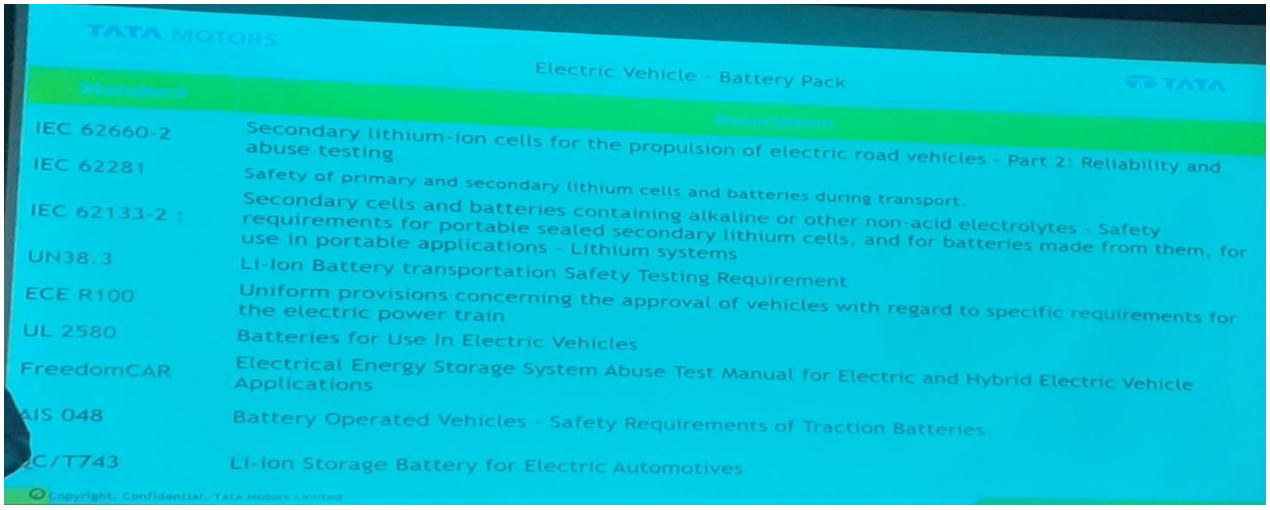


Then he discussed about Vehicle to vehicle (V2V), Vehicle to Grid (V2G) and Vehicle to Infrastructure (V2I). Then general discussion on electric vehicle standards was carried out like – Communication and security ISO/IEC 15118-V2G communication, IEC 61850-7-420 DER logical nodes, ISO/IEC 15408 – Series security technics and ISO/IEC 27001-1 security technics. Then for safety of EV – ISO 6469 & 17409, EMC of vehicle (general) ISO 7637, 11451 & 11452, and for Battery cells and packs – SFS-EN 62660-1 & 2, ISO 12405-1, 2 & 3.

Sir then discussed about EV battery packs.

International Standards	EU	USA	India	China
SAE J2464 SAE J2929 ISO 12405 ISO 6469 IEC 62660-2 IEC 62281 IEC 62133-2 UN.38.3:2015	ECE R 100	UL 2580 Freedom Car	AIS 048	QC/T743





Sir then discussed about some abuse scenarios generally associated to the failure of LiB include;

Mechanical	Control and Monitoring	Manufacturing
Crush	External short circuit	Internal short circuit
Penetration	Over charge	

Shock	Under charge
Vibration	Loss of isolation 9internal)
External thermal exposure	Internal thermal control
Environmental exposure	Cell properties (balance)
Chemical exposure	

Failure modes generally associated to a LiB RESS:

- Physical decomposition and exothermic release of stored energy
- Venting of the LiB electrolyte (releasing flammable and/or toxic fumes)

Then sir discussed about various standards for EV charging systems as given below;

International standards	**EU**	**USA**	**India**	**China**
IEC 61851-1	EN 62196-3	SAE J1772	AIS 138-1	QC/T/895
IEC 61581-21-1			AIS 138-2	QC/T/841
IEC 61581-21-2				QC/T/842
IEC 61581-22				
IEC 61581-23				
IEC 61581-24				
IEC 62196-1				
J2894-1				
J2894-2				

For EV traction motor standards;

IEC 60034-1:2017 Rotating electrical machines – Part 1 Rating and performance.
AIS-038 (Rev.1) Electrical power train vehicles – construction and function safety requirements.
Sir told (1) Performance, (2) Durability, (3) e\Environment (vibration, mud, water, dust, salt and temperature), (4) EMC / EMI test, and (5) Fail Safe testing all these tests are done by Tier 1 companies.

For EV motor controller unit standards;
AIS-004 (Part 3): Electromagnetic for automotive vehicle & ESA
AIS-038: 2003: Battery operated vehicles – Requirements for construction and functional safety.
AIS-041: 2003: Battery operated vehicles measurement of net power and the maximum 30 minute power and speed.
AIS-049: 2003: Battery operated vehicles – CMVR Type approval for battery operated vehicles
SAE/USCAR 37: High voltage connector performance supplement to SAE/USCAR 2
SAE J 2894/2: Power quality test procedures for plug in electric vehicle chargers.

Sir discussed about DC-DC connectors and told that EVs don't have alternators. He also discussed about EMC which is Electromagnetic capacitance and EMI which is Electromagnetic interference.

For EV high voltage cables & connector standards;
ISO 6722-1 Road vehicles 60V and 600V single core cables
(Part 1: Dimensions test methods and requirements for copper conductor cables)
FMVSS 305 Electric Powered Vehicles: Electrolyte spillage and electrical shock protection
S 208 Occupant Crash Protection
SAE J1654 Unshielded High Voltage Primary Cable
SAE J1673 High Voltage Automotive Wiring Assembly Design
IEC 60811-2-1 – Common test methods for insulating and sheathing materials of electric and optical cables
Part 2-1: Methods specific to elastomeric compounds – Ozone resistance, Dot set and mineral oil immersion tests.

Sir then discussed about EV testing. He told baseline vehicle performance at outset of testing conducted at a proving location like; acceleration, maximum speed, braking, deceleration in drive, fully electric range (when applicable), vehicle cost down testing to obtain drag coefficients for fuel economy testing on a chassis dynamometer and end-of-test performance consisting of relevant testing for comparison to baseline. Sir then discussed about Power Analysis Test – Vehicle Level like; Fast DC charger tests, baseline test with variable load and PV configurations, closed loop operation of PEV with grid simulator, charging impact test and then voltage at All Circuit Locations for Varying Load and PV Profile and after that sir ended his session.

After lunch break the next speaker was unable to come for presentation due to some emergency so the last session of the day was started.

Session 3: on "Finance for Engineers" by Dr. Vinita Ahire Kale of MIT, Maharashtra. She started the session with the definition of finance and balance sheet understanding. She told there are four types of finance like, (1) Public, (2) Private, (3) Corporate, and (4) Personal. She nicely elaborated all four types of finance. Then she discussed about finance and accounting, and financial management. She told there are three key areas of finance;

1. Raising of funds
2. Investment of funds
3. Distribution of funds.

Then she explained the rule for good financial management.
Rule 1: Investment in assets must generate a return which is at least equal to the cost of capital.
Rule 2: Assets must bring a cash flow before liabilities demand an outflow.

She then discussed about the pillars of financial management like;

- Earn profit more than cost of capital.
- Ability to manage cash flow.

She discussed about financial statements. It includes;

1. Income statement
2. Balance sheet

3. Cash flow statement

Then she explained profit and loss example and balance sheet example and comparison of 'Tata Motors Ltd.' and 'Maruti Suzuki Ltd.'. She nicely did detailing of the data of both the companies. Then she discussed about GAP – Generally Accounting Principle which is used in India. Then she showed and explained the annual report of the company 'Dabur' which is kind of standalone balance sheet and ended her session.

Day 3 – 26th Feb 2020: During whole day total three industrial visits were carried out.

Visit of **ARAI – 'HTC lab campus'** Chakan, Pune was carried out in the morning. They showed us Passive Safety lab where actual crash test of vehicles is carried out. Then visit of Emission and power train lab. Then visit of 'Centre of Excellence', where they gave presentation and discussed and explained about CMVR – certification of EV/HEV, retro fitment means we can convert into fuel electric vehicle, AIS standards for EV/HEV, E-motor and controller characterization. They told motor controller is known as invertor. They told different test beds for EV/HEVs are developed by ARAI and testing is going on. -40 deg. C to +80 deg. C temp. test is carried out in the lab. They told there is no Lithium in our country but recently in Karnataka it is found. Then they discussed about Li-Ion cells, its modules and packs. They discussed about short circuit test, vibration test, thermal shock, nail penetration test combined temp. tests etc. are carried out for battery in the lab.

Then they showed Electrochemical Impedance Spectroscopy machines, battery emulation & BMS emulation and explained about it. They told for EV charging and testing Govt. of India is going to invest 1000 Crores. Then they showed the ARAI prototype development of EV charging device so that for intercity operability chargers can be developed and the EVs can be charged in any city. Then they showed and discussed about EMI & EMC testing facility. Then we visited Transmission and Green Test Centre (TGTC) where CVT, DCT and automatic transmission are also tested. Then visit of CoE – Green Mobility. We visited vehicle EMC chamber and battery power grid station where harmonics and flickering testing will is done. Then after they showed and explained us the world's first 5 rollers testing facility where 2, 3, and 4 wheelers can be tested. They showed EMC chassis dynamometer with 9 meters turn table having 220 Kw e-motor capacity test bed.

Then visit of battery lab where they showed battery vibration testing rig, battery nail penetration test rig (which is used to check internal short circuit in the battery – they generate nail penetration in the battery and tests the battery to see the effect). Then they showed battery evacuation lab. Then they showed Bharat EV DC chargers and other chargers like DC001, GBIT, CCSDC, CCSAC, the chargers are fast and slow types. After that visit of cell level testing lab where the voltage rating is kept from 0 to 28 V and the temperature affects or not that is checked as well as coulumbic efficiency is checked. Then BMS cell balancing and single cell balancing is explained. At the end visit of TGTC lab where all kind of vehicle layouts can be tested for drive line like FERW, REFW, FEFW, RERW and FE4X4. The visit of whole ARAI HTC campus was a great learning experience for all.

Visit of '**Mahindra Vehicle Manufacturer Ltd.' (MVML) Chakan Plant**, Pune was carried out in the afternoon. First of all they gave introduction of operations of Mahindra & Mahindra group and its group of companies. Then they showed the press shop of the plant which has very big

press machine of Schuler which has five big robotic presses where different vehicle models of Mahindra like Scorpio, XUV 500 & 300, KUV 100, TUV 300, Bolero, Dost, Supro etc. were made. Then they showed us body shop and weld shop where now a days 100% robotic welding is done for vehicle manufacturing. Most of the welding is spot welding. They showed and discussed about the application of Poka Yoke for welding and other assembly related problem finding and solving. Then they showed and explained about the assembly line of the plant. To see the live manufacturing of some famous vehicles of Mahindra was a great experience of all of us.

Visit of **'Octillion Power Systems, Pune** which is a battery power pack manufacturer company in India and also a leading battery cooling solution provider company for buses. Dr. Yashodhar Gokhle owner of the company welcomed us and explained about the company. He told they have 250 patents and they introduced the liquid cooling for battery in India. They discussed about different types of battery cells. He told Tesla is making cylindrical cells earlier they were using Panasonic cells. They told they made around 150 prototypes of batteries. They told Samsung do 2000 check points for their battery.

They he showed us and explained the flexible bus bar which is used to connect two power packs. Then they showed bus battery pack which they supplied to Tata Motors for their electric buses in Pune. The weight of bus battery pack is approximately 700 Kgs and has shape of rectangle or square. The battery pack is fitted on top of the bus or bottom of the bus. They told they are master in battery liquid cooling systems and for that they use glycol and water. The visit was really a great learning experience for all.

Day 4 – 27th Feb 2020:

Session 1: on **'EV development and the evolving role of control systems'** Part 1 was taken by Mr. Ashwin and Part 2 was taken Mr. Anand Subramaniyam of ARAI – ARAI Technology Group. They

Part 1: He started the session with the overview of mobility today in the whole world. Then he discussed about present scenario of India. He discussed the concept of CASE – Connected Autonomous Shared/Service Electric. He show cased the global mobility scenario as below;

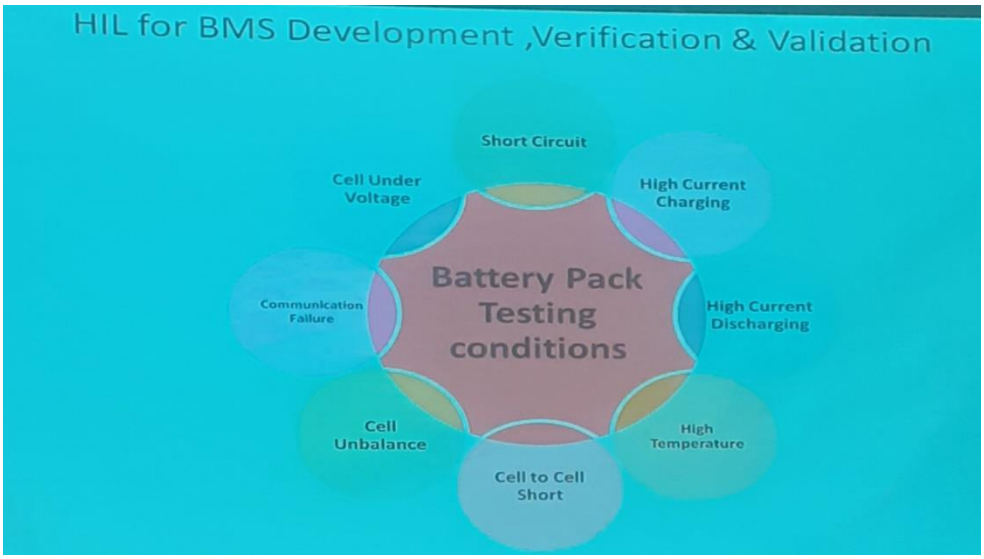
- Tesla has set a goal to produce 300,000 electric cars per year in 2018 and a million in 2020
- Autonomous and ride shared vehicles almost exclusively electric
- Volvo cars to Focus on electric vehicles from 2019
- France to ban sales of petrol and diesel cars by 2040
- 10X growth led by China and Europe
- Europe moving away from diesels
- Volvo, Diamler, BMW, VW, GM, Ford will offer EVs across their portfolios
- VW alone estimating 150 GWh battery demand by 2025
- Norway (2025), France and UK (2040) ban ICEs
- China also expected to announce ICEV ban for 2030 – 2040 time frame
- All new cars mandated to be electric in Germany by 2030
- 2025 global Li-Ion EV demand projected to be approx. 700 GWh

Then he discussed about the CASE concept for India. He talked about XEV configurations (X can be electric or hybrid in general) and its architecture. Then spectrum of Electric Drive Vehicle (EDV) technologies is discussed. He discussed about design and development of EV and HEVs.

He told several engineering factors are that are essential to ensure that a safe, reliable, and robust vehicle are addressed as below;

- Benchmarking
- Sizing and simulation
- Platform and architecture characterization
- Control strategy development and calibration via MIL/HIL/SIL
- Functional safety (ISO 26262)
- Packaging study and mechanical integration
- Electric and electronic system integration
- Subsystem of EV operations
- Electrical safety for high voltage systems
- Structural and safety analysis for mechanical modifications/additions
- Vehicle dynamics analysis on effect of electrification/hybridization
- Multi system communication and interfacing
- Testing and validation.

He told that for benchmarking process various things are carried out like; 1. Benchmarking study to develop a better mechanical, electrical, electronic and control systems, 2. Market study and specification benchmarking, 3. Photo benchmarking and system understanding, 4. DOE system / component benchmarking, 5. Instrumentation and DAQ analysis, 6. Sizing based on benchmarked data. Then he discussed about HIL for BMS development, verification and validation, see the picture below,



Then he discussed about design for safety, and battery pack fitments of some famous EV car companies. He also discussed about battery cooling systems of various EV company car models, AI and ML in control system of EVs, AI for BMS. At last he told about the challenges for the EVs. Presently there is a mix of curiosity and anxiety, as it is associated with any new technology. In 1900, more than one quarter of the almost 4,200 American automobiles produced were electric. Gasoline vehicles when introduced were considered ‘too dangerous’. He told something similar is being faced by e-mobility today. He told very interesting fact that in 1900s there were horses on the roads of New York and in 1913s there were no horses on the roads, where that horses had gone?

Part 2 of the session was taken by Mr. Anand Subramanian of ARAI, Technology Group. He discussed about simulation for EV and HEV for 1. Control system development, 2. System integration and 3. Vehicle calibration and overall simulation set up for EV/HEV systems at ARAI. He discussed about components simulation and parameterization, backward and forward simulation using Matlab – Simulink and AME Sim interface. He also discussed about Hardware in Loop (HIL) simulation and Hybrid Supervisory Control Development and ICON – Intelligent Vehicle Controller Signals.

He discussed about HERTS – Hybrid Electric Real Time Simulation which is developed by ARAI. He discussed about battery pack testing conditions, battery development verification and validation, and functional safety analysis as per ISO 26262. He discussed about mechanical system design and simulation and Mahindra's electric car Reva's retrofitting set up and failure. He discussed about virtual testing for model, strength, stiffness and safety aspects. Then after he discussed about battery cell structure and its types like; 1. Cylindrical, 2. Prismatic and 3. Pouch type. He discussed about battery pack cooling requirements and gave one example of Nissan Leaf car. They told the car is actually designed for Japan but they sold it in Australia. After three years of usage the battery of that vehicle was getting drained down to 50% and Nissan people didn't have answer for that. They told their Australian customers that they will replace the battery pack but ultimately that disappointed their customers and made them unhappy.

He then discussed about energy storage and management devices, State of Safety (SOS). He told Tesla uses AI and ML for their battery and that is why their battery lasts for 7 to 8 years whereas their rival companies' battery lasts up to 2 to 3 years.

Session 2: on 'Safety for EV/HEV' by Rushabh J. of Eaton Technologies Pvt. Ltd., Pune. Sir started his session with Li-Ion battery safety. In 2006, Dell laptops had fire issues due to battery heating or explosion, in 2014, Boing Dreamliner had battery fire issue and in 2009, Audi had found its first electric model battery fire issue. He told due to research and advancement in battery technology the battery explosion issues are tackled down to almost zero. He discussed about root cause form Li-Ion design and quality issue. Nio recalled its 5000 electric SUV E58 model cars due to battery issues. Then he discussed about electric vehicles safety hazards like; Shock protection, elimination/mitigation of potential thermal explosive events, energy storage integrity/protection, energy storage rupture and toxic gas management, low energy stranding, unintended vehicle movement etc.

He pointed out that the sound of EV is very less or kind of very low which we hardly understand that the car is running or not in standstill condition and that can create some safety issues whereas the sound of ICE can be easily recognized and such issues can be overcome. He told product life cycle is influence by standards and regulation. He added that Li-Ion is kind of pollution creating batteries. Then he discussed about safety standards and functional safety standards in automotive safety ISO 26262. He summarized his session as EV safety is result of close coordination between electrical, electro-mechanical and mechanical systems. For new players it needs significant investment of time to understand regulation landscape and learn thumb rules of EV protection, the functional safety complaint system adds in significant efforts.

Session 3: on 'Hybrid Vehicles and Drive Train' by Dillip Kumar Cheni, Sr. System Specialist, Electric Mobility Group, Eaton India Innovation Centre, Pune. Sir first showed us the Eaton electrical product portfolios. HE told company is associated with 1. Power electronics, 2. Power distribution and protection, and 3. Power systems. Then he discussed about on-board chargers in cars, off-board chargers in charging stations. He told why do we need electric mobility? He answered that nicely as given below;

(1). Society: - Increased urbanization (Smart & Mega cities), Growing mobility.
(2). Technology: - Advantages of E-motors Vs ICEs, Increase in efficiency, Safety
(3). Environment: - Climate change, CO_2 emissions, Noise pollution
(4). Infrastructure: - Capacity to supply energy for electric vehicles (home, work, and on the road)
(5). Economy: - Limited Oil reserves, Rising prices of fossil fuels
(6). Geo political: - Emission regulations, Emission free zones, Govt. subsidies.
The above all points are the answer of why do we need electric mobility.

For CO_2 emissions it may happen that there will be free zone in which we can't drive diesel or petrol cars. Then after he discussed about 'well to wheel' analysis and 'tank to wheel' analysis. Then he discussed about various advantages and disadvantages of e-mobility. He discussed that as far as the infrastructure for battery charging is concerned the China is world leader and have developed massive charging infrastructure compared to other countries.

He discussed about categories of EVs like;

(1). Electricity generated in the vehicle:

Micro hybrid – in which the electric components are only used for the start/stop.
Mild hybrid – like micro hybrid plus the electric motor supports the combustion of the engine. It is not possible to drive exclusively with electricity regenerative braking.
Full hybrid – like mild hybrid plus the electric motor supports the combustion engine, purely electric drive is possible.

(2). Charging with external electricity:

Plug in hybrid (PHEV) – like HEV plus plug in hybrid have high voltage batteries that can also be charged externally.
Hybrid with range extender (RXBEV) – like BEV plus the range is extended by a combustion engine that generates electrical energy for the electric motor.
Battery electric vehicle (BEV) – moved only by an electric drive, the energy required to run the vehicle is supplied by a high voltage battery that is charged externally.
Electric vehicles with fuel cell (FCBEV) – moved only by an electric drive, the energy for operation is produced by fuel cell, it is fuelled with hydrogen.

He told the way we charge our cell phones the battery performance affects the same happens with car battery too. He told that most of the battery in the world is made from Lithium and China has purchased most of the world's Lithium ores. He told Japan have fuel cell technology. Then he discussed about drive combinations for EV/HEV. He told China is the only country who developed recycling of Li-ion batteries. He told the cell phone batteries which we discard or throw away are capable enough of having 30% of energy/power. He discussed about HEV system design considerations like,

- Maximize fuel economy
- Minimize emissions

- Maintain or improve drivability / performance
- Minimize system cost
- Improve system reliability
- Reduce maintenance
- Integrate customer requested features and components.

Then he discussed about HEV system architecture and explained Eaton hybrid system and also explained about motor controller invertors. Then he discussed about operation modes of HEV; 1. Driving modes and 2. Stationary modes.

In driving modes: Electric launch / EV mode, parallel hybrid drive, engine only drive, regenerative braking.

In stationary modes: Electric powered PTO operation, engine powered PTO operation, auxiliary power operation, export power operation etc. were discussed.

Then he discussed about benefits of hybrid systems and its applications in tractor, city drive, utility purpose, utility with e-PTO, and passenger transport etc. HE told high speed electric motor are very compact than other machines or engines. Then he discussed about the clients of Eaton hybrid like; Fedex, UPS, DAF, Alabama Power, the Pepsi bottling group, Coca cola enterprises, Freighliner, FPL, Kenworth, Duke energy, Georgia Power, Altec, Foton etc. At the end of the session he discussed about Hill Start Assist (HIS) and Engine Off at Idle (EOAI) concepts and summarized his session.

Session 4: on 'Design & Development of EV/HEV technology – CAE Analysis' by Mr. Suresh Perienjery, Partner Technical manager of PTC. He discussed on following agenda;

- Introduction
- Design requirement of EV
- CAE solutions for EV

He started his session by giving introduction of PTC (Parametric Technological Corporation). Then discussed about design requirements of EV for CAE analysis like, body structure, multi materials and manufacturing, chassis design and manufacturing, battery design, control system, cooling system and safety, motor and gearbox design , control and NVH, right weighting and range maximization, environment awareness and system controls, vehicle dynamics and torque vectoring etc. Then he discussed about CAE solutions for EVs as given below in table;

Subject	CAE solution
Material Science & Metallurgy	CAE Structures
	CAE Nonlinear
	CAE Fatigue
	CAE Metal Forming
	CAE Composites
Basic Thermodynamics	CAE Structures
Fluid Mechanics	CFD

Subject	CAE solution
Additive Manufacturing	CAE Lattice Structure Analysis
	CAE Support Structure Analysis
Automotive Chassis, Steering	MBD Vehicle Dynamics
Automotive Transmissions, Drivelines	MBD Vehicle Dynamics
Mechanical Measurement & Metrology	Metrology / CMM
	Tolerance Analysis
Ergonomics	Human Interface Study

Theory of Machines	MBD Kinematics		Human Comfort Analysis
	MBD Kinetics		
	MBD Mechanisms	Electrical	Clearance and Creepage Analysis
Applied Thermal Engineering	CFD		
Manufacturing Technology	CAE Metal Forming		
	CAE Mold Flow		

Then he discussed about all software and their speciality in short.

Session 5: on 'Advanced Driver Assistance Systems (ADAS)' by Cdr. (Dr.) Shishir Shahay, Retd. Indian Navy, Autonomous Driving Practice, KPIT, Pune. Sir discussed about KPIT Company working and its service. His session content was as below;

1. Felt need why ADAS?
2. A representative list of ADAS features
3. Levels of ADAS
4. The five pillars of autonomous driving

He told KPIT is a leading automotive software provider. He told as per data collected by US, in 2014, there were 32675 traffic related fatalities found, 94% are attributed to driver error, 2.3 million injuries & 6.1 million collision reported. Then sir discussed about 5 pillars of Autonomous Driving as per below;

1. Sensing – Pre-processing of sensor data, - Time synchronization and fusion
2. Perception – Making sense out of the information – Common Information Plot (CIP) about others (movable and static objects)
3. Localization – Where am I? And what / who is around me?
4. Planning – long term planning, - short term planning
5. Control – subject to known constraints and capabilities, how can I efficiently and effectively reach my destination? How can I react to changing situations?

He discussed about Object and Event Detection and Response (OEDR). Then he discussed about IPG Land rover software. Then he discussed about AI types for autonomous driving like; Reinforcement learning, Trend / Regression analysis and Supervise learning. Then he discussed about CARLA development, ROS – Robotic Operating System, UDACITY – Online course provider. Sir then emphasised on required skill set for this field professional must have like knowledge of Mathematics – Calculus, linear algebra, probability theory, projective geometry and projectory exposure, estimation theory and deep learning, prefatory exposure, Newtonian mechanics, fundamentals of control systems, embedded system design, very good C++ coding skills and last never give up attitude.

Sir discussed about sensor fit, external sensors 9GPS, Cameras, Radiation Electromagnetic Signal, radiation and acoustic (ultrasonic) by Ultra Sonic Sensors (USSs). Then he discussed about internal sensors like, wheel speed, steering sensors, engine sensors etc. Then he gave some suggestions for taking part in high level robotic competitions. At the end of his session he told us to go for online course learning on Coursera – 'Autonomous Cars I & II'.

Day 5 – 28th Feb 2020:

Session 1: on 'EV Infrastructure Overview' by Mr. Mandhar Patil of TCS. He told that TCS is not only the IT Company but it is involved in other fields too. He discussed about TCS's EV experience, charging methods and charging time, charging modes, global charging standards scenario, charging protocols, COMBO, CHADEMO and GBIT. Then he discussed about outside and inside of EV.

For outside of EV following things are taken into consideration;

1. Electrical power quality
2. Regulation and standard compliance
3. Installation guidelines
4. Charger compatibility check
5. Off-board charging system.

For inside of EV following things are taken into consideration;

1. On-board charging system
2. DC/DC convertors
3. Battery management system
4. Motor control software
5. Telematics data analysis

Then sir discussed about globally charging methods;

1. Normal charge: Single three phase AC supply + On-board charger.
2. Quick charge: Three phase AC supply + Off-board charger
3. Battery exchange

Then sir discussed about wireless charger and battery charging time. Then he discussed about potential charging sites as, quick charger for short stay and normal charger for longer stay. He then discussed about safety in charging infrastructure. Then he talked about charging modes and ratings in European, USA and India. Then he discussed about charging interface, charging standards, EV charging connectors, home charging, and public charging. Then he discussed about various charging protocols as given below;

Protocols	Charging Type
Control Pilot	AC charging only
Control Pilot with PLC (COMBO)	AC and DC charging
CHAdeMO	DC charging
BG/T	AC and DC charging

Then he discussed about charging system communication, proximity signal, control pilot signal (EVSE – Electric Vehicle Supply Equipment), COMBO protocol where digital communication happens in EV & EVSE in combo protocol. Then at the end of his session he discussed about CHAdeMO protocol and GB/T protocol.

Session 2: on 'Li-Ion batteries and Battery Management System' by Mr. Poonam Chandra Kulkarni of Vehicle Electrification Group, John Deere Technology Centre, John Deere. He stated his session with EV as in off highway vehicle benefits as 1. Precision agriculture, 2. Machine efficient and 3. Torque. The agenda of his session was electromagnetic cells and terminology, How Li-Ion cell works? Elements of Li-Ion battery module, Battery pack and BMS.

He discussed about the difference between cell and battery. Then he discussed about cell nominal voltage and chare difference.

Cell Nominal Voltage:

- Nominal voltage is different from cell voltage under load, is more of an average or or typical voltage.
- Cell (nominal) voltage depends on the combination of active chemicals used in the cell.
- For many nickel based cells, it is 1.2 V (e.g., NiCad, NiMH)
- For many Lithium based cells, this is over 3 V.

Cell Nominal Capacity:

- This specifies the quantity of charge, in ampere hours (Ah) or mili ampere hours (mAh) that the cell is rated to hold.

Then he discussed about the C – Rate:

- The C rate is relative measure of cell electrical current
- It is the constant current charge or discharge rate that the cell can sustain for one hour
- A 20 Ah cell should be able to deliver 20 A ('1C') for 1 h or 2 A 9'C/10') for about 10 h (but, the relationship is not strictly linear)
- If the cell is discharged at a 10C rate, it will be completely discharged in about six minutes.

Then he discussed about cell energy and power difference:

- A cell stores energy in electrochemical form, which it can later release to do work
- The total energy storage capacity of a cell is roughly its nominal voltage multiplied by its nominal capacity (mWh, Wh or KWh)
- The energy release rate is the cell's instantaneous power (mW, W or KW)

Then he discussed about components of electrochemical cell. The key components are negative electrode, positive electrode, electrolyte, separator and current collectors. He discussed about functions of cell components as below;

Negative Electrode:

- In an electrochemical cell, the negative electrode is often a metal or an alloy or hydrogen
- During discharge, it gives up electrons to external circuit, is oxidized
- During charge, accepts electrons from external circuit, is reduced
- During discharge, it is the anode

Positive Electrode:

- In an electrochemical cell, the positive electrode is often a metallic oxide, sulphide, or oxygen
- During discharge, accepts electrons from circuit, is reduced
- During charge, gives up electrons to external circuit, is oxidized
- During discharge, it is the cathode

Electrolyte:

- The electrolyte provides the medium for internal ion charge transfer between the electrodes (sulphuric acid for PbA)
- As electrons move in the external circuit, compensating ions must move internal to the cell

Separator:

- The separator electrically isolates the positive and negative electrodes to avoid short circuit and self-discharge of the cell

Current Collectors:

- These are metal foils – to which electrodes are adhered – that conduct electrical current to cell terminals

Then he discussed about some popular chemistry for battery as given below in table;

Electrochemistry	**Negative Electrode**	**Positive Electrode**	**Electrolyte**	**Nominal Voltage**
Lead Acid	Pb	PbO2	H2SO4	2.1 V
Dry Cell	Zn	MnO2	ZnCl2	1.6 V
Alkaline	Zn	MnO2	KOH	1.5 V
Nickel Cadmium	Cd	NiOOH	KOH	1.35 V
Nickel Zinc	Zn	NiOOH	KOH	1.73 V
Zinc Air	Zn	O2	KOH	1.65 V

Sir then discussed about rechargeable cells. He told why Lithium is famous for battery because it is placed on periodic table on top left corner which have high energy density. Then he discussed about the advantages of Li-Ion battery and the Lithium is available in ample amount in the world but there may be some mining and environmental issues are there. Then he discussed about working of Li-Ion cell, cell electrode, electrode material and electrolyte for Li-Ion cells.

Then he discussed about SoC – State of Charge as below;

- Cell SoC related to average Li concentration in the negative electrode particles
- SoC depends on average concentrations over entire electrode, not the same as voltage
- Further, average concentrations not affected by (1) changing infrastructure, which changes voltage, doesn't change SoC, (2) Resisting a cell, which changes voltage, doesn't change SoC, (3) Entire current profile vs. net current, which changes voltage but not SoC

- In, summary SoC changes only due to passage of current, either charging or discharging the cell due to external circuitry, or due to self-discharge within the cell
- Voltage useful as indirect indicator of SoC, but not as measurement of SoC.

Then he discussed about cell format and battery pack and packaging cell compression. He discussed about thermal management of battery as below;

Air cooled: - Air forced through module or pack, - Lowest efficiency and heat rejection
Liquid cooled: - Cold plate below cells, - Cooling fins between cells, - Flooded with coolant or oil
Passive: - No active cooling, - May be sealed box.

At the end of his session he discussed about cell interconnect, battery management system and its need, and BMS architecture, BMS master and slave role, and cell balancing.

Session 3: on 'Advanced diagnostic systems in Automotive' by Mr. Shyam Kulkarni of MMPL. Sir started his session with the point need of diagnosis. He told automotive exists different state of technical complexity, in last decades the fundamental changes have occurred, visual inspection changed to electrical measuring systems, and electrical measuring systems have enhanced scope of diagnostic procedure. Then sir discussed about different diagnostic methods like; 1. On-board diagnostic systems, 2. Off-board diagnostic systems and 3. Online diagnostic systems. Then he discussed about advanced diagnostic methods like, the control units use different bus systems, e.g., CAN, Flex Ray, LIN or MOST to communicate with each other.

Sir have discussed about hardware design of diagnostic tools. Then he discussed about diagnostic protocol;

- A set of contacts used for diagnostic communication between a diagnostic device and an ECU in the vehicle
- Defined in a way to meet development stages, manufacturing and services requirements
- Following are the broadly used communication protocol
  (1). KWP2000 – Keyword Protocol 2000
  (2). UDS – Unified Diagnostic Services

Then sir discussed about diagnostic protocol CAN (Controller Area Network) as below;

- It is a digital bus system for the use between electronics system
- CAN is based on two logic status (a) RECESSIVE, (b) DOMINANT
- CAN transmit signals on a Can bus which consists of Can high CAN low
- CAN uses message based addressing
- This involves assigning fixed identifier to each messages
- Communication speed can be set to suits the size of the network
- CAN 2.0A – 11 Bit length identifier
- CAN 2.0B – 29 Bit length identifier

Then sir discussed about diagnostic based symptom detection as below;

- Identification of unusual vehicle conditions by comparing the expected vehicle behaviour with the observed behaviour. Detected discrepancies are called symptoms.
- Abduction of faults. Based on the symptoms, possible underlying faults are inferred.
- Initiation of countermeasures, such as a warning to the driver.
- Symptoms are detected in the software modules on the ECUs.

Sir discussed about Failure Modes identification process, different failure modes and failure sequence. A structured failure approach to (1) Identifying the ways in which a product or process can fail, (2) Estimating risk associated with specific causes, (3) Prioritizing the actions that should be taken to reduce risk. Then sir discussed about tools for identifying errors like; Noise factors, input signals, ideal response, control factors, error states, component level, system level and vehicle level. Then he discussed about various problem solving tools which are given below;

Trend chart	Five Why's	Decision Analysis
Control Chart	Computer Aided Engineering	Action Plan
Pareto Chart	APQP	Root Cause Analysis
Brainstorm	Situation Analysis	Cause and Effect Diagram
Check sheet	Flowchart	Scatter Diagram
Histogram	Failure Analysis	Design of Experiment
Nominal Group Technique	Database	Poka Yoke

The five days FDP was a great learning experience for me and all participants hi have attended this. I have come to know about various aspects in the field of design and development of EV and HEV technologies. This will really help me to go ahead for my Ph.D research proposal presentation work. It was really a great learning and knowledge experience for me.

I am thankful to Mr. Sudhir Vaidya, Program Coordinator & Manager SAE Western India Group, Mr. Sanjay Nibandhe, Chairman SAE Western Region, Mr. P.B. Joshi, Dy. Director SAE, Dr. K.C. Vora, Sr. Dy. Director ARAI, Dr. Prof. Nalgaonkar, HoD Mech. Engg. Dept. COEP, Dr. Prof. Mohan Khund, Program Coordinator, COEP for successful organization of and restless efforts for this 5 days FDP. I am thankful to all the experts who have given their valuable time and shared their experiences. I am thankful to ARAI HTC Campus authority, MVML plant authority and Octillion Power System (Dr. Yashodhar Gokhle, Owner) for providing visit permission. I am thankful to Dr. Mohan Khund of COEP and Mr. Khajure (Warden), COEP Boys Hostel for making arrangement for my stay over there. I am also thankful to Prof. Chitralekha Nahar (HOD ME&AE, I/c Principal) and our management for giving me permission to attend 5 days FDP at Pune, Maharashtra.

Yours Sincerely,

Prof. Kamlesh Samadhiya
Section Head (AE)
SPBPEC (SIT)

5 days FDP sessions at glance:

S.P.B. PATEL
ENGINEERING COLLEGE
SAFFRONY INSTITUTE OF TECHNOLOGY CAMPUS

Report

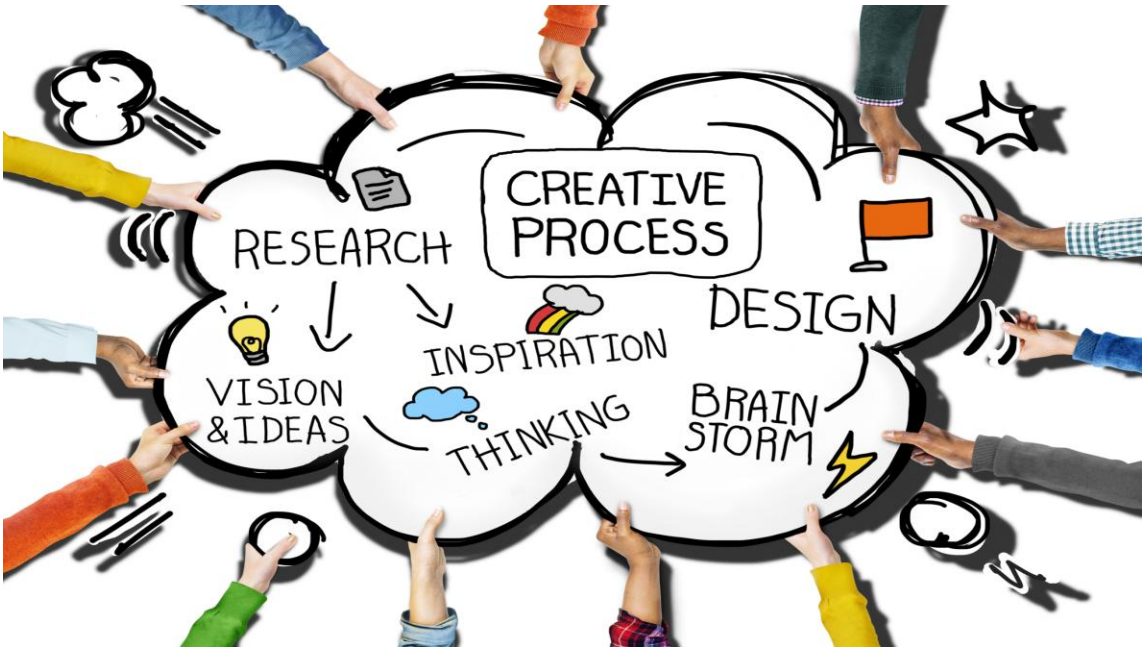
On

52nd Faculty Development Program
On
Design Engineering

(29th July 2019 to 1st August 2019)

Highlights of Workshop Details:

Name of Speaker: Prof. Karamjit Sinh Bihola, Prof Bhavin Khotari
Designation and Institute details: Date: July 29th 2019 to 1st August 2019
Duration: 9 AM to 5 PM
Venue: Gujarat Technological University, Chandkheda Campus, Ahmedabad
No. of Participants: Around 55 faculties from GTU affiliated colleges.



Introduction and Objective of FDP

What is Design Thinking?

Design Thinking is a systematic, human-centered approach to solving complex problems within all aspects of life. The approach goes far beyond traditional concerns such as shape and layout. And unlike traditional scientific and engineering approaches, which address a task from the view of technical solvability, user needs and requirements as well as user-oriented invention are central to the process.

This approach calls for continuous feedback between the developer of a solution and the target users. Design Thinkers step into the end users' shoes – not only interviewing them, but also carefully observing their behaviors. Solutions and ideas are concretized and communicated in the form of prototypes as early as possible, so that potential users can test them and provide feedback – long before the completion or launch. In this way, Design Thinking generates practical results

The pivotal idea behind the workshop was to enhance faculty members thinking process and to interaction and exchange of ideas with other faculty members from various GTU affiliated colleges. One of the basic aims of this workshop was to guide us on how to convert ideas into easy, engineering approach by following the step wise process of Design Thinking. The other objective was to target the basic need meeting the actual need of the concerned problem.

Day1 – 29th July 2019, Monday

The day begin with morning prayer which showered us with some positivity , then key speaker introduced to the whole concept of "DESIGN THINKING" and he delivered the schedule of whole workshop. The first speaker for the pre lunch session was carried out by **Prof. Karamjit Sinh Bihola's**. The speaker gave all faculties' warm welcome and he shared his view regarding the importance of design thinking subject and it role play in building once career. He also shared that many the faculties are not trained for subject design thinking and to utter surprise its lead to poor guidance to students and their project.
He further added that, even some faculties lack interest and thereby the student also ignorant about the subject HE also instructed us to understand the importance of this workshop and after benefits which can incurred by the good student project.
He briefed four-day FDP flow program and also shared across some unknown, interesting and related questions and facts, like whole concept behind this "why design engineering and it's the purpose".

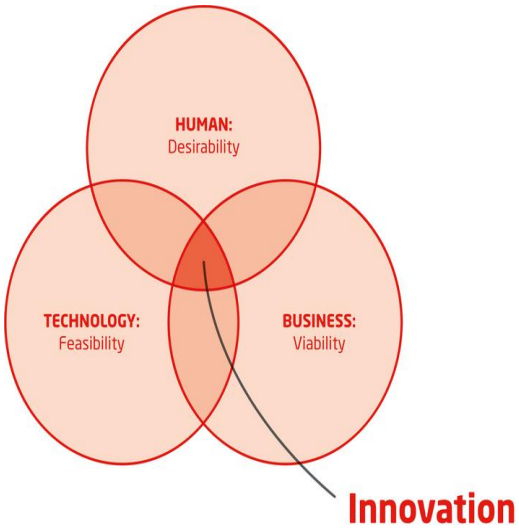
He explained the various phases of design thinking by various PPT and concepts of thinking process. As the Design Engineering was introduced to the GTU around 2013 the main aim was that students should come-up with some innovative idea. (Creativity vs. Innovation) and they should fulfill the gap with bookish knowledge and its practical implementation.

Some PPT's ware also showed which included how the Idea of DE was taken – Tim Brown, CEO and president of IDEO.

Then few everyday examples and video-clips were showed on the base of the design thinking & tried to convey how DE was plays a pivotal part to solve some everyday problems .

Learning of the first session:

Thinking according to human perspective where technology and business meets human needs creating **innovation.**



The post lunch session was carried out by NID professor Bhavin khotari sir, sir screwed our brains more into the design thinking process and, it was worth listening to his way of seeing the things and even he nurtured with the same within us. He explained us with seeing the things meticulously and indeed its importance in problem solution.
The way petty small things were so beautifully crafted by design thinking process tools. He enlisted few examples and changed our way of thinking process from regular way of thinking. He explained the hidden problem which we everyone lag behind the process.

Learning:

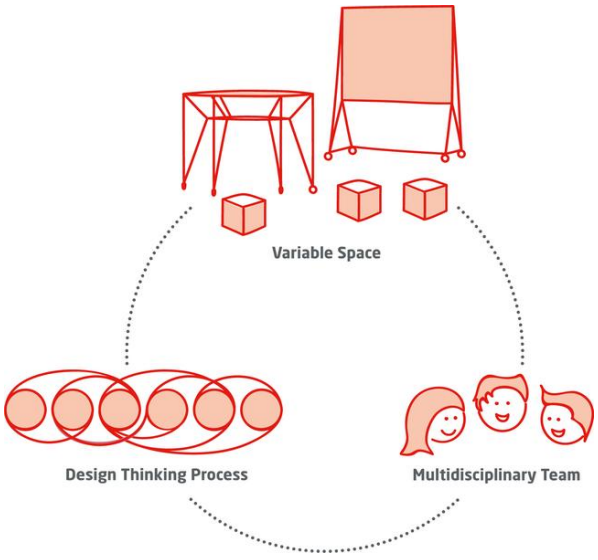
"One size fits for all" is a wrong concept, try to reach and dig out the real problem.

Day 2 – 30th July 2019, Tuesday

The 2nd Day was again started with morning prayer and next level of curiosity and more with screwing brain thoughts as last day our speaker explained the flow of day -2 could which out actually to lead understanding real design thinking process.
The day started with team building, everyone was unknown and from different traits of engineering branches.
Our honorable speaker explained us minute –minute observation, and taking detailed observation of each and every thing. He explained the preparation AEIOU sheet and its utility in upcoming phases. He shared the ideas and process to be kept in mind before out the observation
He also explained the importance of FDV, usefulness of "Seven-Why" technique for observation in during field visit. He also added that "mind map" concept and empathy canvas and its need in the whole design thinking process.
Sir, then randomly made the team members keeping in mind each member should be different branch. My team comprised of

Team Members:
1. Prof. kumkum Bhattacharya Assistant Professor from Civil Engineering Department of Saffrony Institute of Technology,
2. Prof.Jayesh Parmar , Assistant Professor from mechanical Engineering Department of shantlal shal college ,Bhavnagar
3. Prof.Soorjit Wadia, Assistant Professor from chemical Engineering Department of Shroff engineering college, Ankleshwar
4. Prof. Ishita Dave Joshi, Assistant Professor from Computer Engineering Department of, MSET, Vadodra.

Learning: The concept of mind mapping and interdisciplinary projects importance. Even understood and thereby visualizing every single object with other end approach.



Compiling the pre lunch and post lunch session we all team members went for the field visit. So we started observing every single thing with all facts and ideas given by our speaker sir.

In this session we went for the visit looking for specific domain in which we need to put our main focus and start working for the map preparation and so swell the sheet. So once we started we basically found a very slight instant example of auto driver anger and pain.

So we all quickly reached to the auto driver, introduced ourselves and tried to understand exactly the reason for his anger and pain. The main motto keeping our design thinking process in ideas we went with flow, we asked him seven why questions and thereby we noted basically all the problems and tried to understood his woes, his expressions as this were also our part of design thing process phases.

We then again reached few other drivers trying to understand reach with the same domain for working the sheet, and do mind mapping. So we talked with union leader, and even daily wage auto drivers. After whole process of study we conclude that the problem is same for all, but solution differs with every single human being. The details of the field visit are:

Place: outside the GTU campus near to ONGC circle.

Climate: cloudy with partial rains

Date & time: 30th July. 11:30-1:00

Once we gathered the data we reached and then started working on our mind mapping sheet. The observations were put on single frame on one sheet which was quite mind blogging task. We all understood that "A Mind Map is a powerful graphic technique A Mind Map is a powerful graphic technique which harnesses the full range of cortical which harnesses the full range of cortical skills in a single, powerful manner skills in a single, powerful manner – word, – image, – number, number, – logic, – rhythm, rhythm, – color – spatial awareness". We together prepared the AEIOU- Resulted in preparation of environment, the interactions, objects, the activities involved and users.

Learning: Every single human being has different perspective of seeing the things, and to understand it we really need to focus on our latent problem.

Day 3 – 31st July 2019, Wednesday

The day begin with lots of thinking but morning prayer gives us more power to screw our design mind. The morning session was started by the Prof. Karmjit Bihola sir. He explained us that mind mapping sheet and the all ideas doing with the empathy sheet.
The understanding helped us in rest completion of AEIOU Sheet and modifications, ideation canvas and empathy sheet and the validation of sheet from other domain user. The idea was implementing our design concept on the empathy of the auto driver woes. The sheet was prepared keeping the all the observation and its related latent observations. The sheet was prepared with help of colorful sticky notes, and we several times screwed our speaker sir mind by asking him ample amount of questions.

The sheet was prepared with our domain keeping mind which was: Reducing the unnecessary queues on CNG gas pump stations. We figured this as our main domain which ultimately leads to other latent problems like reduction of pollution, cost, and safety.
Out of this two days, this day was really so exciting and interesting, as we all were hooked to every level of thinking process which could result in perfect solution. Here we applied the: "Double-Diamond methodology applied for divergence and convergence" ideas and concepts and solutions. With our entire mind map we deliberately reached to ample number problem statements. We concluded with happy and sad stories of auto drivers and passerby and somewhat we targeted to reach one as whole.

Learning: We understood the value of different branch and the different level of thinking process.

Day 4 – 1st August 2019, Thursday

The day begins with Morning Prayer which geared up all of us for the last session. The last day of the workshop started with more enthusiasm as final verge that is the problem statement and they were asked to solve that problem using the third Canvas: Product Development.
In this session explanation about the product development sheet was provided to us.
On that canvas, the team members were asked to feel the empathy of the user and final product. We all participants were to fill the purpose of their product and the experience of user when they use their solution and come with sustainable solution.

Along with these things, product function, feature and components of the products needed to be filled in appropriate places on the canvas. We all exchanged our PDC with other teams again led us to second part of double diamond process. We all our team members decided and came out with solution that requirement of CNG stations in more number. The CNG pump station could lead to:

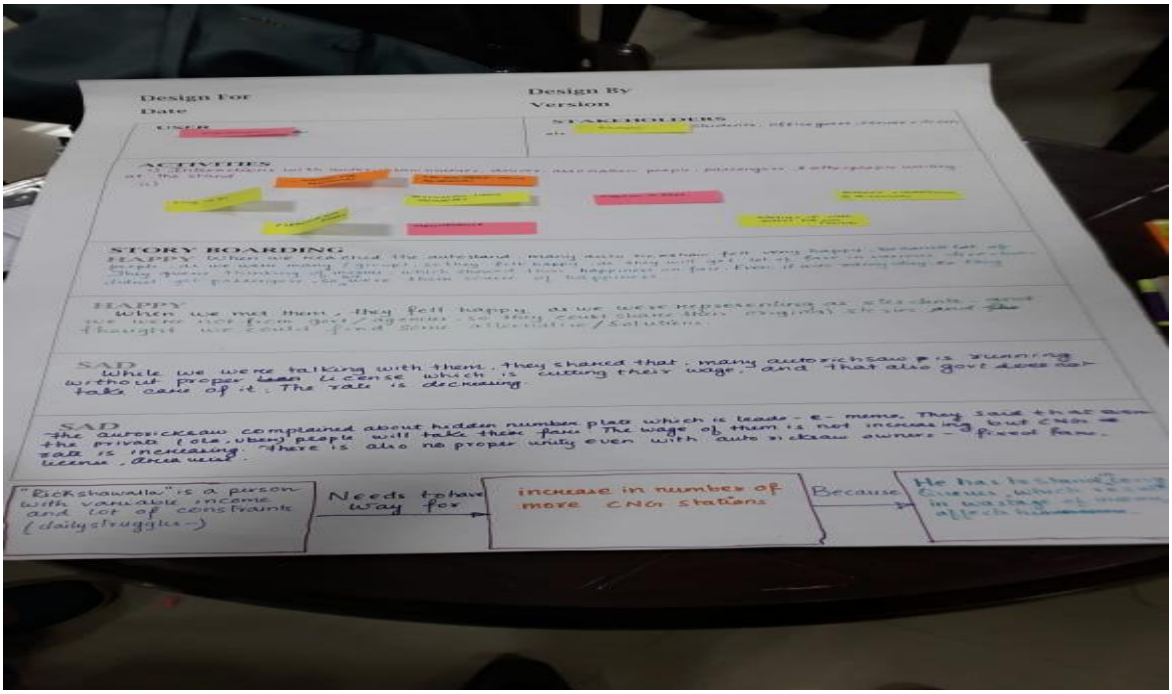
i) Reduction of Unnecessary queues.
ii) Pollution free
iii) Sustainable solution.
iv) Cost and economy.
v) Ownership.

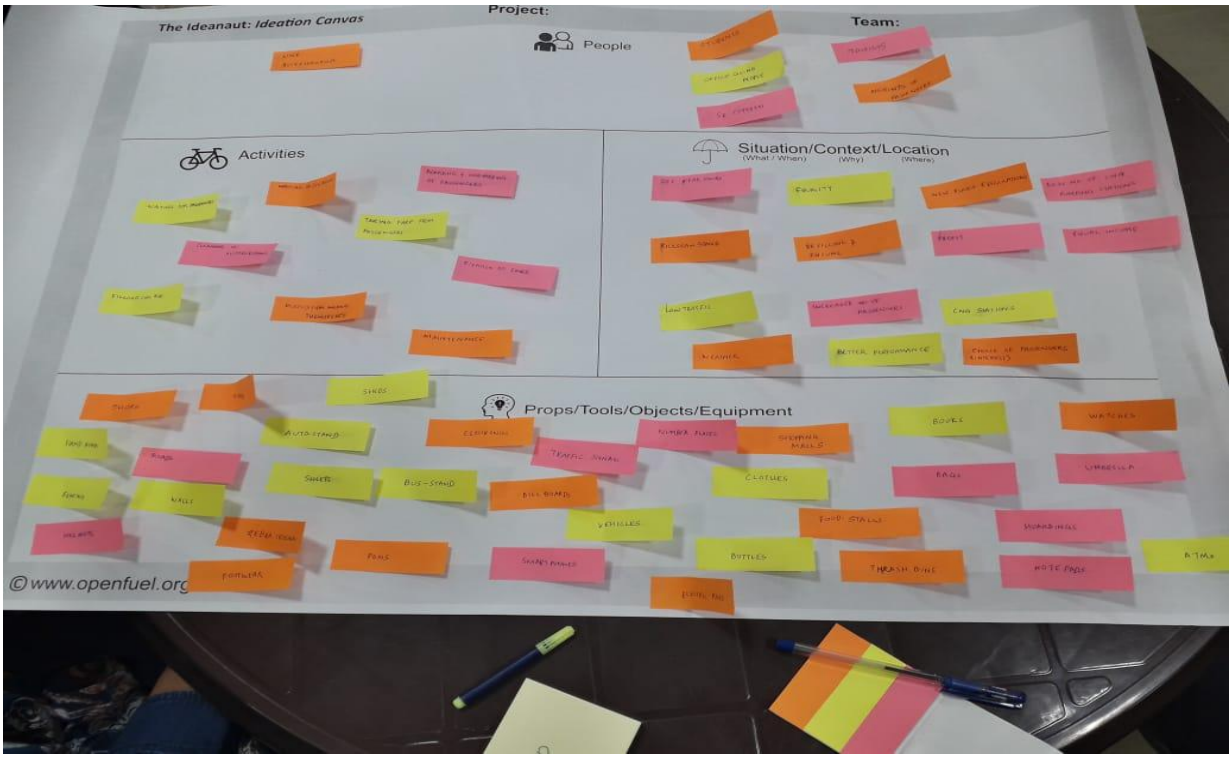
We also took feedback from other team's members about the Retention, Revision or Rejection phase of our team product. We got mixed response and tried to convince every member of the other team with our product or solution. We ware also given chance to present our work in form of presentation.
After all the presentation, sir explained the tool of reverse engineering process. The last part was too fast it seems, things wrapped quickly.

The last session ended a photo shoot for our project documentation for all the teams. It concluded with valedictory function and group photo session.

Learning: One solution which should at least reach maximum sustainable solution for the maximum user woes and reach out everyone.

Few Photos of the workshop




The Ideanaut: Ideation Canvas
Project:
Team:
People
Activities
Situation/Context/Location
(What / When)
(Why)
(Where)
Props/Tools/Objects/Equipment
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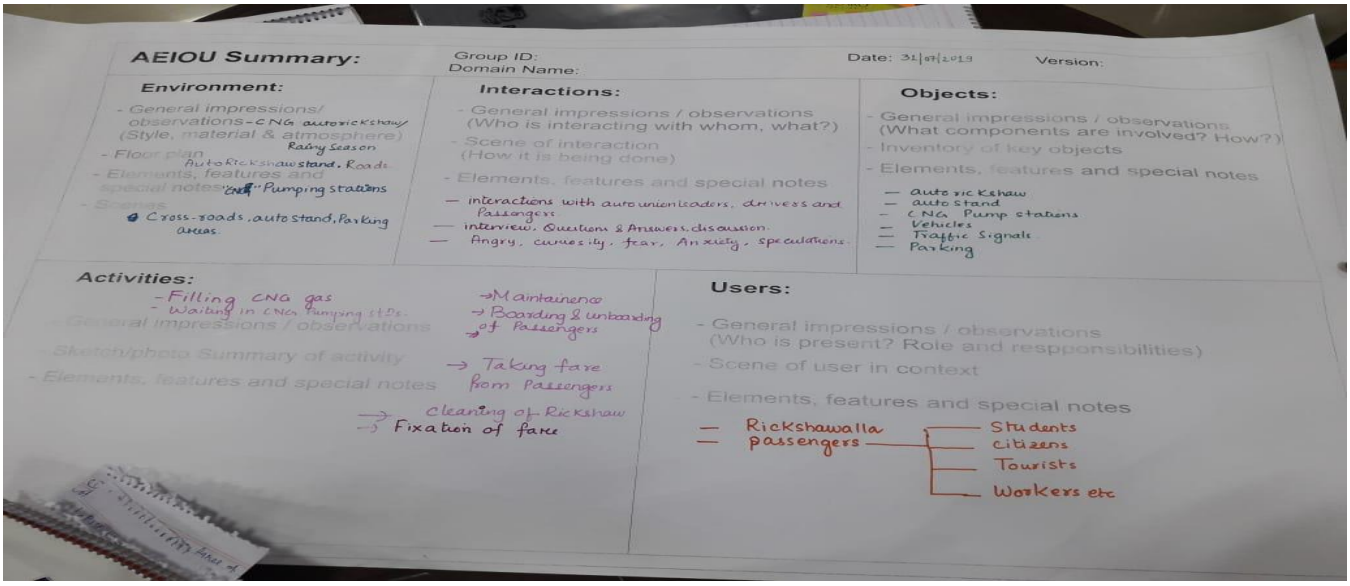


AEIOU Summary:

Group ID:
Domain Name:

Date: 31/07/2019 Version:

Environment:

- General impressions/ observations - CNG autorickshaw (Style, material & atmosphere)
- Floor plan — Auto Rickshaw stand, Roads, Rainy Season
- Elements, features and special notes — CNG Pumping stations
- Cross-roads, auto stand, Parking areas.

Interactions:

- General impressions / observations (Who is interacting with whom, what?)
- Scene of interaction (How it is being done)
- Elements, features and special notes
  - interactions with auto union leaders, drivers and Passengers
  - interview, Questions & Answers, discussion.
  - Angry, curiosity, fear, Anxiety, speculations.

Objects:

- General impressions / observations (What components are involved? How?)
- Inventory of key objects
- Elements, features and special notes
  - Autorickshaw
  - auto Stand
  - CNG Pump stations
  - Vehicles
  - Traffic Signals
  - Parking

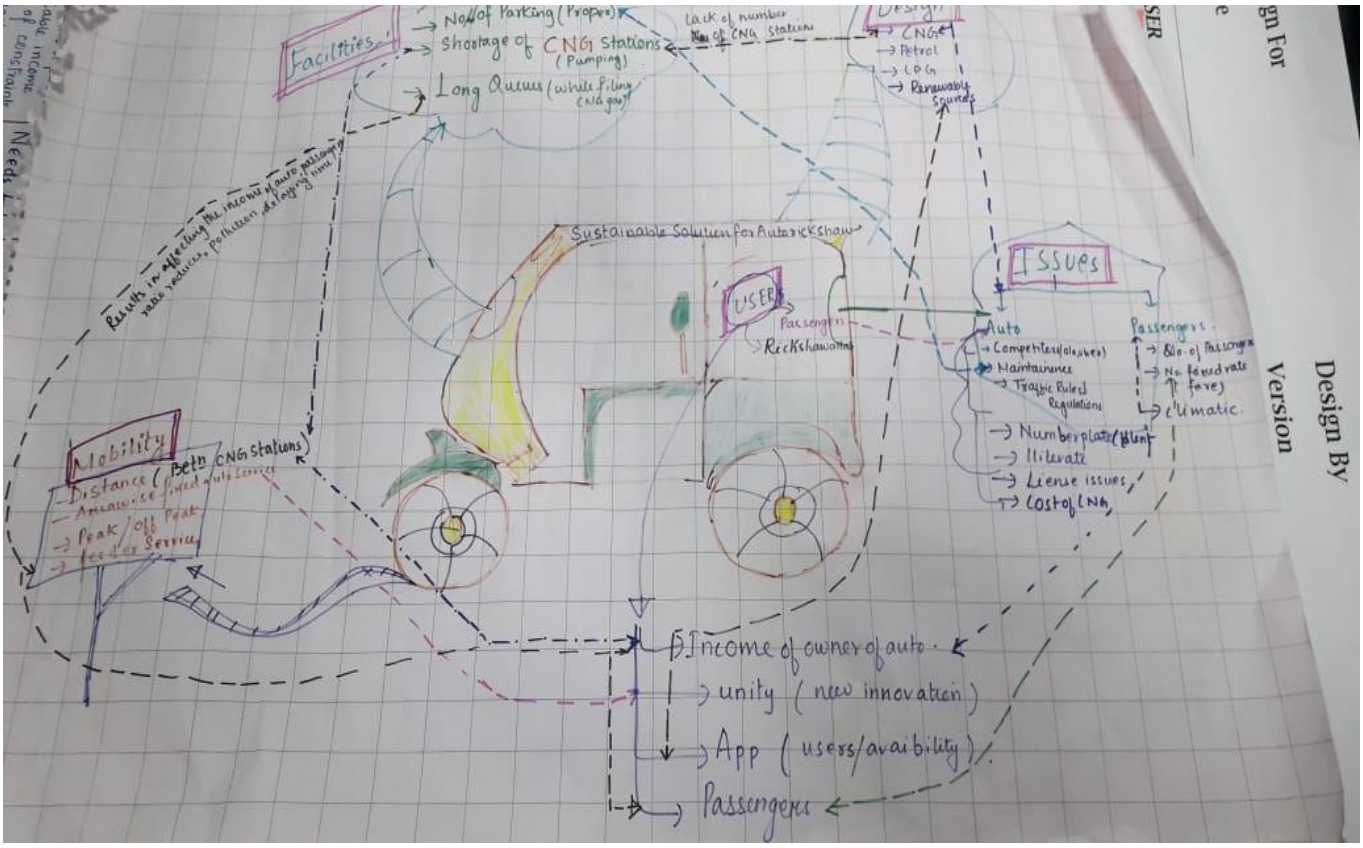
Activities:

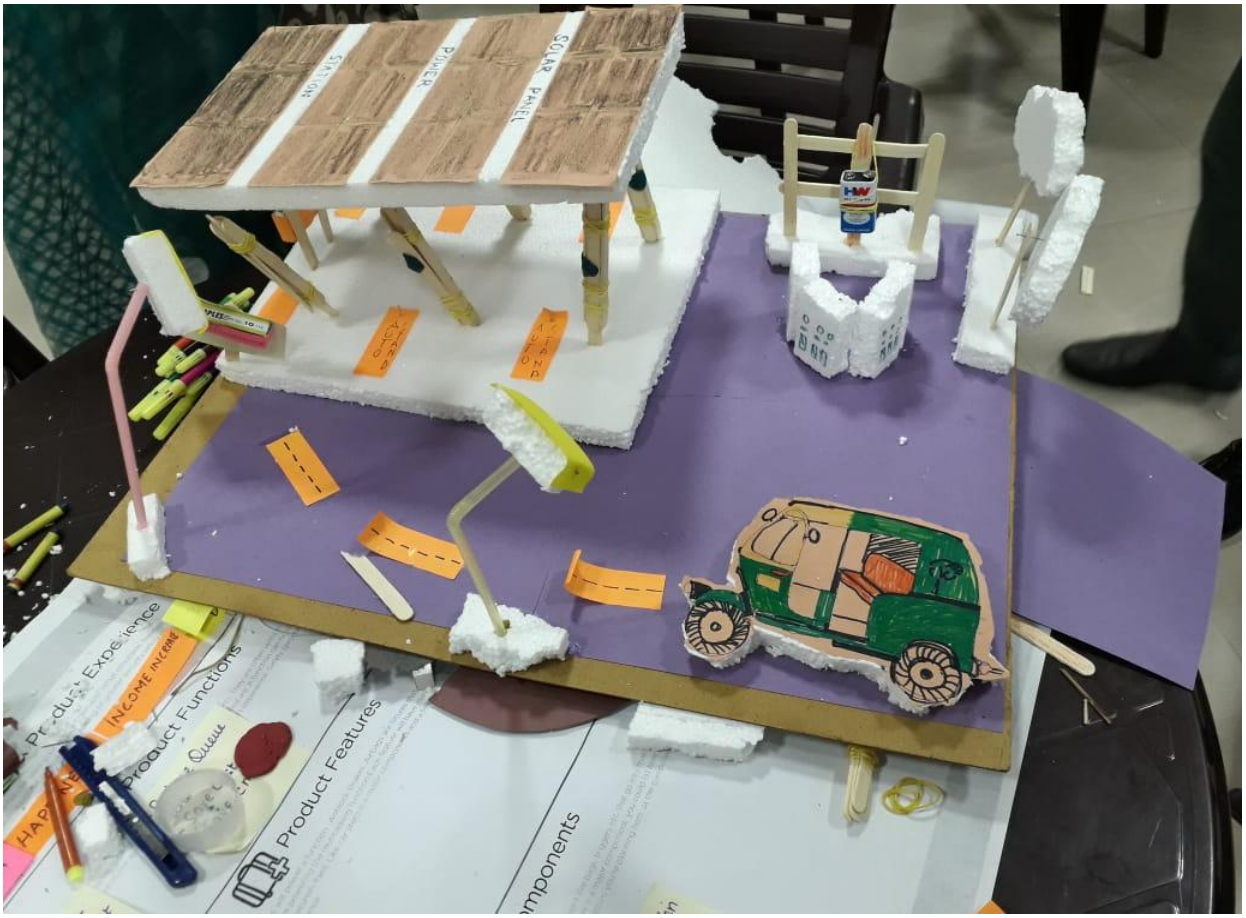
- Filling CNG gas
- Waiting in CNG Pumping stations
- General impressions / observations
- Sketch/photo Summary of activity
- Elements, features and special notes

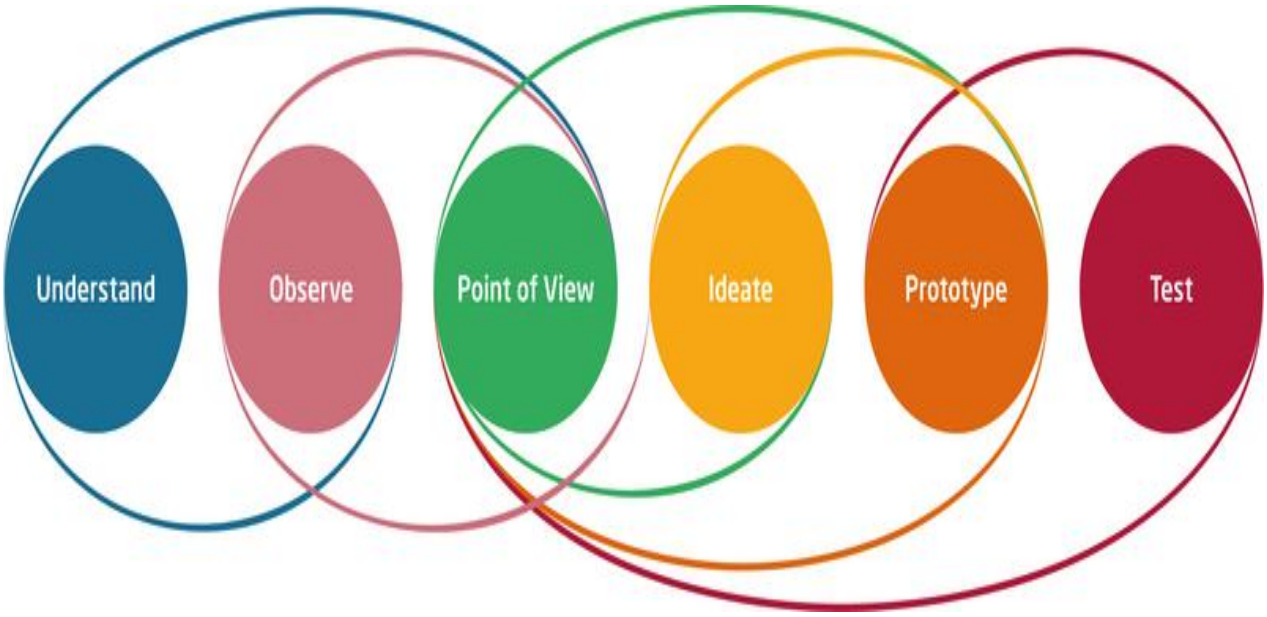
→ Maintainence
→ Boarding & unboarding of Passengers
→ Taking fare from Passengers
→ Cleaning of Rickshaw
→ Fixation of fare

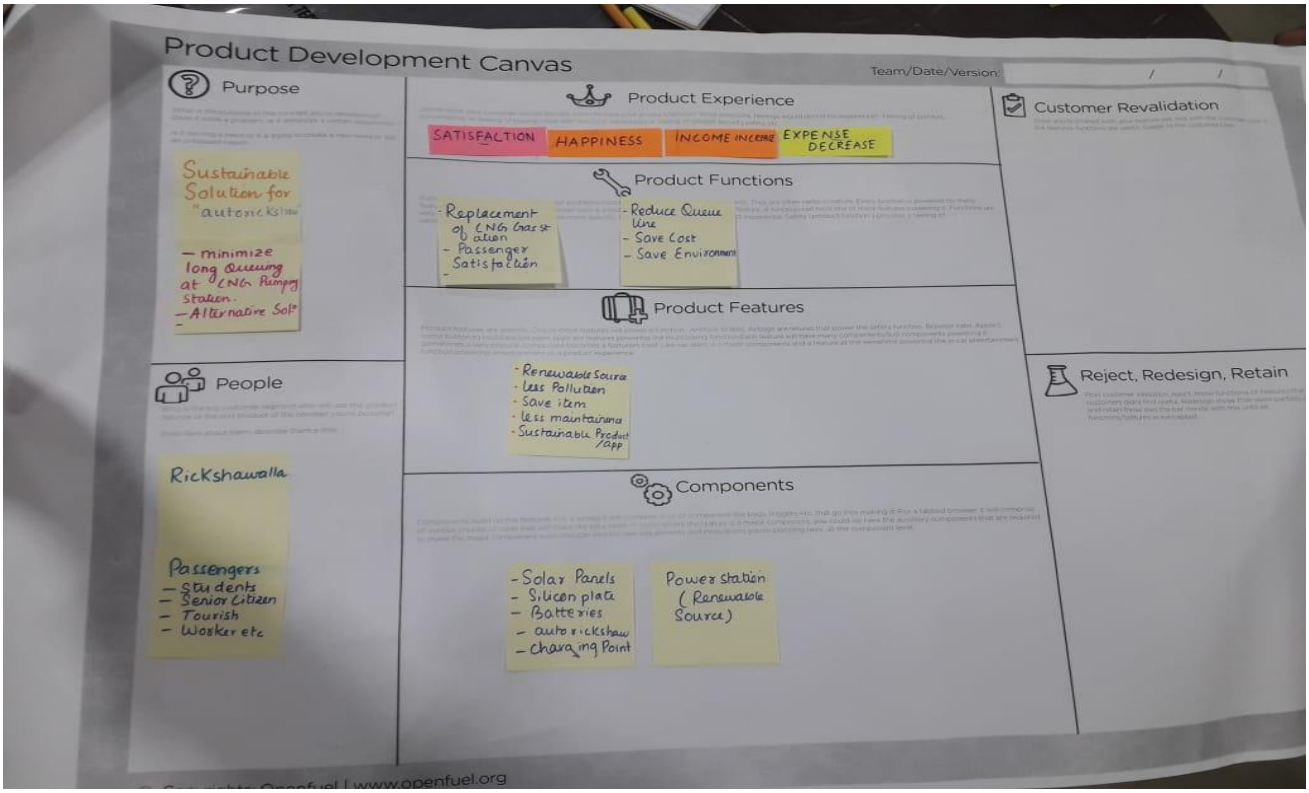
Users:

- General impressions / observations (Who is present? Role and responsibilities)
- Scene of user in context
- Elements, features and special notes
  - Rickshawalla
  - passengers
    - Students
    - citizens
    - Tourists
    - Workers etc

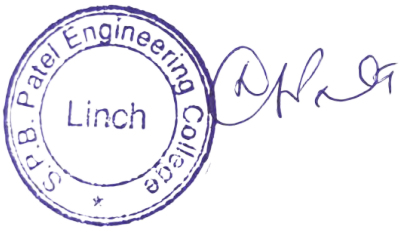



Product Features


Understand
Observe
Point of View
Ideate
Prototype
Test


Product Development Canvas
Team/Date/Version:
Purpose
Sustainable Solution for "autorickshaw"
- minimize long queuing at CNG Pumping station.
- Alternative Sol^n
Product Experience
SATISFACTION
HAPPINESS
INCOME INCREASE
EXPENSE DECREASE
Customer Revalidation
Product Functions
- Replacement of CNG Gas station
- Passenger Satisfaction
- Reduce Queue line
- Save Cost
- Save Environment
Product Features
- Renewable Source
- less Pollution
- Save item
- less maintainance
- Sustainable Product /App
People
Rickshawalla
Passengers
- Students
- Senior Citizen
- Tourish
- Worker etc
Components
- Solar Panels
- Silicon plate
- Batteries
- auto rickshaw
- charging Point
Power station (Renewable Source)
Reject, Redesign, Retain
www.openfuel.org

I would express my deep gratitude to my team members for the cooperation and team work for coming with solution and my college authorities for giving me this opportunity.



Yours sincerely

Kumkum Bhattacharya

Civil engineering Department.