

EVOLVING A CONTEXT-SENSITIVE PARTICIPATORY METHOD IN DESIGN OF PERSONAL TRANSPORT

A thesis submitted in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Nishant Sharma



Department of Design
Indian Institute of Technology Guwahati
Assam, India 781039

January 2018

EVOLVING A CONTEXT-SENSITIVE PARTICIPATORY METHOD IN DESIGN OF PERSONAL TRANSPORT

A thesis submitted in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Nishant Sharma

Roll Number: 08610506

Under supervision of
Prof Ravi Mokashi Punekar



Department of Design
Indian Institute of Technology Guwahati
Assam, India 781039

January 2018

DECLARATION

It is certified that the work contained in this thesis titled “EVOLVING A CONTEXT-SENSITIVE PARTICIPATORY METHOD IN DESIGN OF PERSONAL TRANSPORT” has been carried out by me, a student in the Department of Design, Indian Institute of Technology Guwahati under the guidance of Prof. Ravi Mokashi Punekar for the award of Doctor of Philosophy and that this work has not been submitted elsewhere for a degree.

Nishant Sharma

Date:

Department of Design

Indian Institute of Technology Guwahati

Guwahati 781 039

Assam, India

CERTIFICATE

The research work presented in this thesis entitled 'EVOLVING A CONTEXT-SENSITIVE PARTICIPATORY METHOD IN DESIGN OF PERSONAL TRANSPORT' has been carried out under my supervision and is a bonafide work of Mr. NISHANT SHARMA. This work submitted for the degree of Doctor of Philosophy is original and has not been submitted for any other degree or diploma to this institute or to any other institute or university. He has also fulfilled all the requirements including mandatory coursework as per the rules and regulations for the award of the degree of Doctor of Philosophy of Indian Institute of Technology Guwahati.

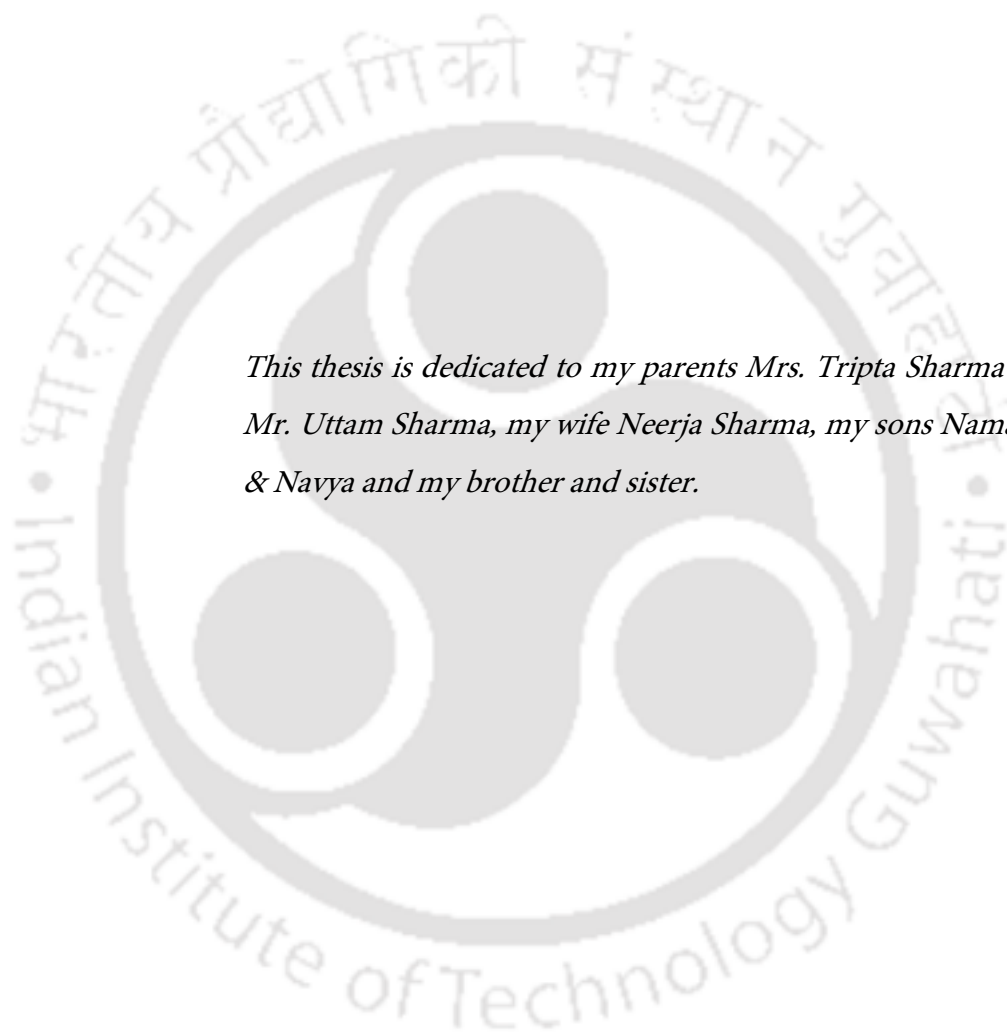
Ravi Mokashi Punekar

Professor, Department of Design

Indian Institute of Technology Guwahati

Guwahati 781 039

Assam, India



This thesis is dedicated to my parents Mrs. Tripta Sharma & Mr. Uttam Sharma, my wife Neerja Sharma, my sons Naman & Navya and my brother and sister.

ACKNOWLEDGEMENT

I would like to thank Prof. Ravi Mokashi Punekar for his valuable guidance and support throughout the duration of my research. His simple attitude, calm nature and in-depth knowledge makes him an ideal guide to work with. I would like to thank my research progress committee members Prof. A.K. Das, Prof. Debabrata Chakraborty and Prof. Debkumar Chakrabarti for their constructive and critical comments during my research. I would also like to thank all my colleagues at IIT Bombay, who gave me encouragement in difficult times. I would like to thank Prof. Uday Athavankar for constantly giving support and encouragement to complete the thesis.

I would like to thank my project associate Mr. Kiran Gangadharan for being a support every time I needed anything. I would also like to thank all my students who were part of this research.

I would like to specially thank Dr. Dennis Day and Dr. Mirka Rauniomaa for agreeing to participate in collaborative research.

ABSTRACT

Design of personal transport vehicles is complex, capital intensive and traditionally involves a large design and development time cycle. To mitigate risk of failure, companies conventionally follow methods and processes during the planning phase that spend enormous amount of money and effort to understand the needs of prospective customers. Despite these traditionally accepted studio based top-down approaches in product planning during the Fuzzy Front End (FFE), the planning department fails to effectively understand the users and their needs. The outcome of these studies result in evolving a design brief that fails to enrich the designers tasked with the responsibility of developing proposals that meet market success. This offers scope for a thorough rethinking of established practices and methods followed in the automobile sector. New design research methods, such as Participatory Design Method (PDM), make a shift from conventional studio-led approach of ‘designing for the user’ to ‘designing with the end user’. Researchers have used this approach at the early stage of product planning to effectively understand context specific needs of end users, their tacit knowledge and their deep aspirations. Such inputs can be very useful for designers to enrich their approach and see them reflected in the design concepts they develop.

Prompted by various case examples of context-sensitive consumer needs for the emerging automobile market opportunities in India, research into developing Participatory Design Method for personal transport vehicles was identified as the focus of this thesis research.

This thesis titled ‘Evolving a Context-sensitive Participatory Method in Design of Personal Transport’ has eight chapters. The research establishes a methodology for eliciting tacit and unmet needs to be mediated by an effective 3D toolkit in participatory sessions with the end user. It focuses on ‘making’ as an activity for eliciting tacit and unmet needs. The proposed methodology develops a detailed protocol for the key stages of a typical design process viz. need analysis, conceptualization and evaluation. The research methodology for each key stage has four important components: planning, participatory design, analysis of outcome and finalization of participatory design methodology. This makes design and research inseparable in this methodology.

The contours of the protocol for setting up the participatory design method of four activities and details of their execution described are:

- 1) Method for designing toolkit
- 2) Method for Participatory Design with novice users
- 3) Method for collective form generation by designers
- 4) Method for collective evaluation by end users

In the proposed participatory methodology, first stage involves a participatory activity to generate context-sensitive information through participatory research with novice users. This is followed by analysis to help translate these inputs in developing a visual design brief (in Fuzzy Front End phase). This is given as inputs to a team of professional designers. The designers participate in a collaborative manner, engage in visual representation and conceptualize the holistic vehicle product based on the visual brief (design phase) in the form of 3D concept renderings; and finally participatory evaluation of concepts is again undertaken by users (evaluation phase).

This research makes a contribution in establishing a detailed protocol in developing the Participatory Design methodology for eliciting tacit and unmet needs for personal transport vehicles.

A sizeable amount of effort and time was involved to develop a suitable design of toolkit. The research has resulted in developing an effective 3D toolkit to help novice participants express their aspirations and unmet needs mediated by the 3D toolkit. The key features of the 3D toolkit offer possibilities to tap and understand users' aspirations and needs for the immediate, mid-phase and future product launches. The variation in abstractness of elements of the toolkit and its use during participatory sessions resulted in outcomes of need identification pertaining to future scenarios of use. The use of the 3D toolkit as a 'making tool' forms an integral part of the proposed methodology to contribute to the objectives of product design and development.

The methodology evolved after conducting experiments. Each experiment led to new learning of approach to Participatory Design Method. This research has contributed in providing a detailed methodology that provides a guideline in planning the protocol for

conducting design experiments; the requirements for the experimental setups; and methods, approaches and checklists for validation of outcome of the different experiments in Participatory Design research method. These experiments helped in consolidating the overall proposed PDM approach for personal transport vehicle.

Structure of the Thesis in chapters

This research and its findings are outlined by dividing the thesis into the following chapters:

Chapter 1: Introduction

It contextualizes the practice of a ‘top-down’ approach to automobile design practiced in the west and its trickled down reflections into the growing automobile sector in the Indian scenario. The researcher’s professional experience forms the motivation in seeking new directions for alternative modes of inquiry involving end users as partners in the design process. This sets the premise for identification of Participatory Research Methodology as a basis of inquiry in seeking users’ tacit knowledge and aspirations in the design of personal transport vehicles that meet context-sensitive needs. In this chapter the hypothesis, aim and objectives for this research are outlined.

Chapter 2: Developments in Design Research Methods – An Overview through Literature Review

This chapter covers literature review of the various developments in Design Process established in Industrial Design in its quest for establishing the ‘designerly way’ of systematic enquiry. It covers the various approaches of knowledge domains that have enriched and influenced these processes. The study then lays focus specific to the processes followed in the automotive sector.

Chapter 3: Participatory Design Method

This chapter elaborates on the status of current practices in the Participatory Design Method, which is the focus of this research. It studies the approach to inquiry specific to aspects of requirement capture involving participation of end users in the participatory design process.

Chapter 4: Participatory Design Experiment – Gaining Context-Sensitive Insights with End users

This chapter is divided into two sub-sections under which the stages of the research are outlined:

Sub-section 1: Planning the Participatory Design Method (PDM)

It outlines the stages of Planning the Participatory Design method to capture tacit knowledge and aspirations of end users involving selections of participants and the Design of 3D toolkit as an assistive aid during user participation in requirement capture

Sub-section 2: Conducting Participatory Design Session

Involves conducting the Participatory Design Method (PDM) session using the 3-D toolkit and seeking insights from user participants. Users participate in experiments and express their needs and aspirations of design ideas that are mediated using the 3-D toolkit based on four possible combinations viz. Ideas that capture their requirements using a) Abstract elements; b) Concrete elements; c) Concrete–Abstract combination elements; and d) Abstract-Concrete combination elements.

Based on a detailed analysis of this study with users, insights are drawn from the above experiments and the Design Brief/s are formulated for specialist designers to translate the requirement capture into Visual Design concepts.

Chapter 5: Collective Form Generation by a Set of Expert Designers

- 1) Collective Form Generation: Translating product specification into car form by trained designers. In this phase specialist product designers are tasked with visualization of car forms, which have emerged as product specification from the above phase.
- 2) Analysis of the designers' process of Translating Product specification into car form by trained designers.

Chapter 6: Participatory Evaluation by Users

This chapter presents an experiment in participatory user evaluation, its analysis and learning that feeds the overall proposed methodology.

Chapter 7: Proposed Participatory Design Method

This chapter, consolidates the outcome of the above experiments by outlining the proposed methodology, planning of experiments, resources, analysis etc. for the proposed Context-Sensitive Participatory Method in Design of Personal Transport - as indicated in the title of this thesis.

Chapter 8 Conclusions of Research, Limitations and Future Scope

This chapter covers insights and verification of the hypothesis, limitations of the research, future scope for research.

It must be mentioned that another significant outcome due to this research has been the positive response received from the Design Research community at large. Participation in International Research conferences during the progress of the research has resulted in testing the PD methodology with the international design community. They have contributed to enriching the learning of participatory research methods proposed in this thesis. The outcome of this research has resulted in four paper publications of this research in relevant conferences and design journals. It has resulted in partnership with other leading researchers related to design research methods.

TABLE OF CONTENTS

Declaration	III
Certificate	IV
Acknowledgement	VI
Abstract	VII
Table of Contents	XII
List of Figures	XVI
List of Tables	XX
Abbreviations	XXI
Chapter 1: Introduction	1
1.0 Introduction	1
1.1 Design for Automobile: An Overview of the Automobile Sector, Characteristics, Approaches and Trends	1
1.1.1 The Characteristics of Automobile and its Manufacture	1
1.1.2 Recent Trends in Automobile Design Development	3
1.1.3 Notes on Automobile Styling Process, Styling Studio and Design Work Typology	4
1.1.4 Concept Vehicles: Beyond Routine Design Work	7
1.1.5 Emergent Trends in Automobile Design in the 21 st Century - Breaking New Grounds and Innovations for Future	8
1.2 Indian Automotive Industry	12
1.2.1 The Emerging Landscape of Indian Auto Industry	12
1.3 Motivation for Research	18
1.3.1 Case Study 1: Design of Scooter for Women (Indian Market)	18
1.3.2 Case Study 2: Observational Research in Five Indian Cities	20
1.3.3 Observations and Insight from Two Case Studies	23
1.4 Identification of Research Problem	24
1.5 Research Questions	26
1.6 Hypothesis	27
1.7 Aim	27
1.8 Objectives	27
1.8.1 Case Study	28
1.9 Structure of the Thesis in Chapters	29
Chapter 2: Developments in Design Research Methods – an overview through Literature Review	33
2.0 Introduction	33
2.1 State of Art Theoretical Framework of Design Research	33
2.2 1950-1960: Scientific Temper	35
2.3 1970-1990: Communicative Function of Design	37
2.4 User Centered Zone: Design Methods Since 90's	38
2.4.1 Investigating Design Situations	39
2.4.2 Investigating User Behavior	40
2.4.3 Contextual Enquiry	41
2.4.4 Lead User Innovation	41

2.5	Critical Design: Design Led and User as Audience	42
2.6	Semantics, Design, and Emotion: Mid 1990s.....	42
2.7	The Participatory Design Research.....	44
2.7.1	Generative Design Research	46
2.7.2	Generative Tools Bubble.....	47
2.8	Concluding Remarks	48
Chapter 3:	Participatory Design Method	51
3.0	Introduction.....	51
3.1	Participatory Design Method as Generative Design Method	51
3.2	Participatory Design Model	52
3.2.1	Preparing the Study.....	53
3.2.2	Sensitization.....	54
3.2.3	Participatory Design Session with Users.....	55
3.2.4	Analysis.....	60
3.2.5	Communicating the Knowledge to Design Team.....	61
3.2.6	Conversation Analysis in Participatory Sessions: Ethnomethodological Method.....	62
3.3	Concluding Remarks	63
Chapter 4:	Participatory Design Experiments – Gaining Context-Sensitive Insights with End users	65
4.0	Introduction.....	65
4.1	Outlining a Structure for Conducting Research Experiments.....	65
4.2	Stage 0: Design of PD Toolkit - Design and Development of 3D Generative Toolkit as an Aid for Requirement Capture.....	68
4.2.1	Designing a New Toolkit:	68
4.2.2	User Centric Way of Designing Generative Toolkit	70
4.2.3	Leanings from the First Toolkit.....	78
4.2.4	Design and Fabrication of Concrete Toolkit	79
4.2.5	Four Types of Toolkits.....	85
4.2.6	Concluding Remarks of Stage 0.....	88
4.3	Stage 1: Participatory Design with Novice Users.....	88
4.3.1	Conducting the Participatory Design Method to Access Tacit Knowledge and Aspirations of End Users.....	90
4.3.2	Sensitizing.....	92
4.3.3	Conducting the Participatory Design Method Session using 3D Toolkit.....	94
4.3.4	Analysis of Participatory Research.....	102
4.3.5	Communicating Results: Context Mapping: Formulation of Design Brief for Specialist Designers to Translate Requirement Capture into Design Concepts	113
4.3.6	Experiment Repeated with Foreign Expert Groups	116
4.4	Concluding Remarks on the Participatory Research 1.....	123
Chapter 5:	Collective Form generation by a group of expert designers	125
5.0	Introduction.....	125
5.1	Planning.....	126
5.1.1	Selection of Participants.....	126
5.1.2	Preparation of Support Media	126
5.1.3	Time Plan for Participatory Research 2	128
5.1.4	Role of Moderator	128
5.1.5	Instrument of Data Collection.....	128
5.2	Conducting Participatory Research 2: Collective Form Generation by Expert Group	128
5.2.1	Background and Tasks.....	128
5.2.2	Conducting Session.....	130
5.3	Analysis – Sketch as Mediator for Participatory Visualization.....	137

5.3.1	Literature and Theory	138
5.3.2	Data and Methods	139
5.3.3	Results	140
5.4	Concluding Remarks on the Participatory Research 2.....	148
Chapter 6:	Participatory Evaluation by users.....	151
6.0	Introduction.....	151
6.1	Planning The Participatory Evaluation Session.....	153
6.1.1	Selection of Participants.....	153
6.1.2	Time Plan.....	153
6.1.3	Mode of Conducting.....	153
6.1.4	Instrument of Data Collection.....	154
6.1.5	Data: Visual Renderings of Vehicle Concepts	154
6.2	Conducting: Participatory Concept Evaluation.....	158
6.2.1	Observations on the Participatory Research 3.....	158
6.3	Analysis Based On Conversation Analytics of Audio Recording	159
6.3.1	Methodology and Data Analysis of Conversation during Concept Validation.....	159
6.3.2	Analysis.....	161
6.3.3	Discussion.....	168
6.4	Concluding Remarks on the Participatory Research 4.....	169
Chapter 7:	Proposed Participatory Design method.....	171
7.0	Introduction.....	171
7.1	Participatory Toolkit Design as Precursor to PD Research.....	172
7.1.1	From Subsection, I of Chapter 4.....	172
7.2	PD Session With Novice Users.....	176
7.2.1	Planning of Experiments.....	178
7.2.2	Sensitizing.....	179
7.2.3	Conducting Participatory Design (PD) Session	180
7.2.4	Analysis.....	182
7.2.5	Communicating Results: Context Mapping	184
7.2.6	Final Process Flow.....	184
7.3	Collective Form Generation By Group of Designers.....	187
7.3.1	Planning Document Checklist.....	187
7.3.2	Conducting.....	188
7.3.3	Final Process Flow.....	189
7.4	Participatory Evaluation.....	193
7.4.1	A Checklist is Prepared Before Conducting Participatory Evaluation (Table 7.7).	193
7.4.2	Conducting Evaluation Activity.....	194
7.5	Consolidating into an Overall Participatory Approach.....	197
7.5.1	Detailed Protocol.....	197
7.6	Concluding Remarks	203
Chapter 8:	Conclusions of Research, limitations and future scope.....	205
8.0	Conclusions.....	205
8.0.1	Evolved a Participatory Approach for Context-Sensitive Design	205
8.0.2	Evolved Participatory Design Method that Integrates with Design Process	206
8.0.3	Clearer Fuzzy Front End.....	207
8.0.4	Process and Tools Empower Novice User Group and Expert Design Group	207
8.0.5	Artifacts as Enablers in Catalyzing and Strengthening Participatory Design Process.....	207
8.0.6	Synergy with Multi-Functional Teams	208
8.1	Limitations of This Research.....	208
8.1.1	Limitation of Literature Because of Confidentiality.....	208
8.1.2	Toolkit Limitations: Need More for Details	208
8.1.3	Participatory Design: A Long Process from Planning to Analysis.....	209

8.1.4	Collective Form: Strategy Shift in Studios	209
8.1.5	External Appearances may Hinder Real Evaluation in Participatory Settings.....	209
8.1.6	Limitations in Evolved Approach	210
8.2	Future Scope of this Research	210
Appendix 1: Questionnaire for user centric toolkit:.....		213
Appendix 2: User responses with codes for Toolkit Design		214
Appendix 3: Affinity analysis of Data.....		217
Appendix 4A: Detailed CAD drawings of Abstract ToolKit.....		223
Appendix 4B: Detailed CAD drawings of Concrete Toolkit.....		226
Appendix 5: Videos of Participatory activity.....		231
Appendix 6: Pictures for time lapse video.....		232
Appendix 7a: Transcription: PD with Concrete Toolkit.....		254
Appendix 7b: Transcription: PD with Abstract Toolkit.....		267
Appendix 7c: Transcription: PD with Concrete-Abstract Toolkit		277
Appendix 7d: Transcription: PD with Abstract- Concrete Toolkit		287
Appendix 8: Time lapse video made with still images.....		292
Appendix 9: Video of experiment with foreign experts		293
Appendix 10a: Transcription of Concrete PD activity in Sonderborg, Denmark		294
Appendix 10b: Transcription of Abstract PD activity in Sonderborg, Denmark		307
Appendix 11: Video of collective form generation		312
Appendix 12: Transcript Symbols and Notations		313
Appendix 13: Participatory Study in MDII on which evaluation is based.		314
Appendix 14: Renderings for evaluation		317
Appendix 15: Video of evaluation, Excerpt of video for analysis		321
Appendix 16: List of Conference Papers		322
Reference		323

LIST OF FIGURES

Figure 1.1: GM Autonomy (Sabatini, 2010)	9
Figure 1.2: BMW GINA (Boeriu, 2014)	10
Figure 1.3: Smart Car (Stigh, 2012).....	11
Figure 1.4: Toyota I Unit (Thomas, 2005)	12
Figure 1.5: Domestic Market Share (SIAM, 2017).....	14
Figure 1.6: Entry Level Motorcycle India (Hero Corporate Website, 2017).....	15
Figure 1.7: Entry Level Car India (Maruti Alto 800, 2012).....	15
Figure 1.8: Accessories on Motorcycles (Blasco, 2010).....	16
Figure 1.9: Accessories on Car (Car Dekho, 2017)	16
Figure 1.10: Observational Research in five Indian cities.....	21
Figure 2.1: Topography of Design Research (Adapted from E. Sanders, 2006, p. 4).....	34
Figure 2.2: The main phases of design (Adapted from Archer, 1984, p. 64).....	36
Figure 2.3: Loewy standing on his design, PRR S1 steam locomotive (CBS, 2017).....	37
Figure 2.4: Volkswagen's new 'Beetle' (Autoblog, 2005)	38
Figure 2.5: Coding and decoding of products (Adapted from Crilly, Moultrie, & Clarkson, 2004)....	43
Figure 2.6: Different levels of knowledge about experience are accessed by different techniques (Visser et al., 2005, p. 123).....	47
Figure 3.1: Stages of Participatory Design Research.....	52
Figure 3.2: Preparing the study.....	53
Figure 3.3: Sensitizing tools.....	54
Figure 3.4: Participatory design session with users.....	55
Figure 3.5: Framework of participatory activity.....	56
Figure 3.6: Making tangible things.....	56
Figure 3.7: Acting, Enacting and Playing.....	58
Figure 3.8: Talking, Telling and Explaining.....	58
Figure 3.9: Analysis	60
Figure 3.10: Communicate results (Context mapping).....	61
Figure 4.1: Basic Outline.....	66
Figure 4.2: Toolkit Design and object mediated participatory design	69
Figure 4.3: A Coded responses spread on table Figure 4.3:B Affinity analysis with coded responses.....	71
Figure 4.4: Superimposing two-wheeler over four-wheeler	73
Figure 4.5: Quick polystyrene foam mock-ups joined by Blu-tac	73
Figure 4.6: Making the grid with the reference of the wheel and generating the modules	74
Figure 4.7: Abstract toolkit with all elements	74

Figure 4.8: Fabricated toolkit and button magnets.....	75
Figure 4.9: Breaking the vehicle architecture to various sub-segments.....	80
Figure 4.10: 3D Modelling and 3D Slicing, Splitting 3D model, Segmentation of Model	81
Figure 4.11: Baseplate design, Placement of the wheels.....	81
Figure 4.12: Wheels fabricated in dual colour in acrylic.....	82
Figure 4.13: Passenger Mannequins fabricated in acrylic.....	82
Figure 4.14: Passenger placed in vehicle architecture.....	83
Figure 4.15: Luggage box configurations	83
Figure 4.16: Bottom and Top platform.....	83
Figure 4.17: Top platform	84
Figure 4.18: Modelling the various segments in the vehicle Architecture.....	84
Figure 4.19: Simulated model of one of the Permutation and Combination.....	85
Figure 4.20: All components of concrete participatory toolkit.....	86
Figure 4.21: All components of abstract participatory toolkit	86
Figure 4.22: All components of concrete-abstract participatory toolkit.....	87
Figure 4.23: All components of abstract-concrete participatory toolkit.....	87
Figure 4.24: Stage 0,1 of participatory design research	88
Figure 4.25: Participatory research with novice users.....	89
Figure 4.26: Worksheet as sensitizing tool.....	92
Figure 4.27: Two filled worksheets.....	93
Figure 4.28: Participatory activity with concrete toolkit.....	96
Figure 4.29: Seating schematics concrete	96
Figure 4.30: Participatory activity with abstract toolkit	97
Figure 4.31: Seating schematics abstract	98
Figure 4.32: Participatory activity with concrete-abstract toolkit.....	99
Figure 4.33: Seating schematics concrete-abstract.....	99
Figure 4.34: Participatory activity with abstract-concrete toolkit.....	100
Figure 4.35: Seating schematics abstract-concrete.....	101
Figure 4.36: Analysis of participatory research in Stage 1	102
Figure 4.37: Analysis Structure.....	103
Figure 4.38: Concurrent analysis of Various types of data working in coherence	104
Figure 4.39: Video grab of participatory activity with time lapse images.....	105
Figure 4.40: Concepts mapped on a time scale.....	106
Figure 4.41: Video grab of participatory activity with time lapse images.....	107
Figure 4.42: Concepts mapped on a time scale.....	108
Figure 4.43: Video grab of participatory activity with time lapse images.....	109
Figure 4.44: Concepts mapped on a time scale.....	110

Figure 4.45: Video grab of participatory activity with time lapse images.....	111
Figure 4.46: Concepts mapped on a time scale.....	112
Figure 4.47: Communicating results of participatory design in stage 1.....	114
Figure 4.48: One line brief in tabulated form.	115
Figure 4.49: Visual Representation of Participatory Data	116
Figure 4.50: Participatory activity with concrete toolkit in Sønderborg, Denmark	117
Figure 4.51: Seating schematics of participatory activity with concrete toolkit.....	118
Figure 4.52: Participatory activity with abstract toolkit in Sønderborg, Denmark.....	118
Figure 4.53: Seating schematics of participatory activity with abstract toolkit.....	119
Figure 5.1: Collective form generation by designers in design phase.....	125
Figure 5.2: Visual Representation of Participatory Data.....	127
Figure 5.3: Template for human package.....	127
Figure 5.4: Visual brief.....	129
Figure 5.5: Seating schematics	130
Figure 5.6: Interchangeable cab and luggage modules proposed by P2.....	132
Figure 5.7: Participant-P3's two-part vehicle proposal	132
Figure 5.8: Participant-P1's Rollers as way of attaching modules.	133
Figure 5.9: Sketching over the template and negotiating.....	133
Figure 5.10: Sketch Integration undertaken by P1.....	134
Figure 5.11: Perspective view of cargo/cab module undertaken by P2.....	135
Figure 5.12: Perspective view of rear of driver's cab.....	135
Figure 5.13: Various side view explorations undertaken by P4	135
Figure 5.14: Perspective view of overall vehicle.	136
Figure 5.15: Sketch co-rendered.....	136
Figure 5.16: Sketch at center of analytic gaze	137
Figure 5.17: Illustration 2	140
Figure 5.18: Excerpt 1	140
Figure 5.19: Illustration 3	143
Figure 5.20: Excerpt 2	143
Figure 5.21: Excerpt 3	145
Figure 6.1: Participatory evaluation in evaluation phase	151
Figure 6.2: Seating schematics	154
Figure 6.3: Renderings of concept 1,2,3.....	155
Figure 6.4: CAD renderings.....	156
Figure 6.5: Rendering with scenarios.....	157
Figure 6.6 Rendering of dashboard of vehicle	158
Figure 6.7: Evaluation of sketches	158

Figure 6.8: Two video cameras were used to capture the interaction	160
Figure 6.9: Rendering of a vehicle concept.	164
Figure 6.10: Subhani picks up the rendering.	164
Figure 6.11: Pratap picks up the rendering.	165
Figure 6.12: Rao picks up the rendering.	166
Figure 7.1: Stage 0: Designing participatory toolkit.	172
Figure 7.2: Process of designing and fabricating a participatory toolkit.	173
Figure 7.3: Multiple attach-ability and configurability	175
Figure 7.4: Sequential build up from array of components	176
Figure 7.5: Object mediated participatory research: Stage 1	177
Figure 7.6: Journey map and time map of a journey	179
Figure 7.7: Examples of filled sensitizing worksheets.	180
Figure 7.8: Example of still images for time lapse video	183
Figure 7.9: Example of visual brief	184
Figure 7.10: Complete illustration of participatory activity with novice users	185
Figure 7.11: Collective form generation by designers: Stage 2	187
Figure 7.12: Complete illustration of participatory activity with designers	191
Figure 7.13: Participatory evaluation by users: Stage 3	193
Figure 7.14: Complete illustration of participatory evaluation with users	195
Figure 7.15: Overall participatory approach for vehicle design	200
Figure 7.16: Detailed protocol of experiments	201

LIST OF TABLES

Table 1.1: Typical Design Process	5
Table 3.1: Components of ‘preparing the study’ stage	53
Table 3.2: Sensitizing tools and the design considerations	54
Table 3.3: Different types of toolkits (Visser et al., 2005), (E. B. –N. Sanders, 2013).....	57
Table 3.4: Tools and techniques for enacting. (E. B. –N. Sanders, 2013)	58
Table 3.5: Tools and techniques for telling. (E. B. –N. Sanders, 2013)	58
Table 3.6: Methods and Tools for telling, making and enacting (adapted from (Visser et al., 2005) ..	59
Table 3.7: Stages of analysis.....	61
Table 4.1: Analysis to arrive at design insights from key insights	71
Table 4.2: From design insights to design features.....	72
Table 4.3: Pilot study.....	76
Table 4.4: Appropriateness of toolkit tested through pilot study	77
Table 4.5: Overall time plan.....	91
Table 4.6: Participatory experiment time plan	94
Table 4.7: Transcript excerpt of participatory activity with concrete toolkit.....	106
Table 4.8: Transcript excerpt of participatory activity with abstract toolkit.....	108
Table 4.9: Transcript excerpt of participatory activity with concrete-abstract toolkit	110
Table 4.10: Transcript excerpt of participatory activity with abstract-concrete toolkit	112
Table 4.11: Excerpt of transcription.....	120
Table 4.12: Excerpt of transcription.....	122
Table 5.1: Transcript.....	141
Table 5.2: Transcript.....	144
Table 5.3: Actions outside and inside sketching space.....	145
Table 5.4: Transcript.....	146
Table 6.1: Time plan.....	153
Table 6.2: Transcript 1: Moderator initiates and co-ordinates the final round-up.....	163
Table 6.3: Transcript 2: User participants circulate the rendering as they assess.....	165
Table 6.4: Transcript 3: User assesses the rendering in favour of appearance.....	167
Table 7.1: Example of coded responses	174
Table 7.2: Overall schedule of participatory research.....	178
Table 7.3: Planning with details.....	178
Table 7.4: Planning checklist	180
Table 7.5: Example of transcript.....	183
Table 7.6: Checklist for participatory activity with designers	187
Table 7.7: Checklist for participatory evaluation with users	193

ABBREVIATIONS

3D: Three Dimensional

AMP: Auto Mission Plan

CAD: Computer Aided Design

CAS: Computer Aided Surfacing

CNC: Computer Numerical Control

DLO: Day Light Openings

DSLR: Digital Single Lens Reflex

FFE: Fuzzy Front End

MNC: Multi-National Companies

OEM: Original Equipment Manufacturer

PD: Participatory Design

PDM: Participatory Design Method

PDM: Participatory Design Method

PIN-C: Participatory Innovation Conference

SIAM: Society of Indian Automobile Manufacturers

SIAM: Society of Indian Automobile Manufactures

SUV: Sports Utility Vehicle

CHAPTER 1: INTRODUCTION

1.0 Introduction

This chapter outlines an overview of considerations that affect design for the automotive sector focusing on personal transport. It discusses the broad trends in design and development process; typical work patterns of a design studio that follows a 'top-down' approach where the designer undertakes creative work within very tight design constraints due to the nature of a very capital intensive, high risk business environment.

It discusses trends in automobile design and development witnessed in emergent markets in India, in which new automobiles are launched concurrently following a shared platform and design features as per global trends. However, due to such a top-down approach, it seems to pay little heed to the cultural diversities of the Indian user, his/her needs and expectations. It highlights the need for context-sensitive studies appropriate for the Indian context. This chapter then outlines the Hypothesis, Aim, Objectives and the plan of experiments for this research.

It makes a case for design research that explores Participatory Design Method, as an alternative approach where emphasis is upon 'designing with users' rather than 'designing for users'.

1.1 Design for Automobile: An Overview of the Automobile Sector, Characteristics, Approaches and Trends

1.1.1 The Characteristics of Automobile and its Manufacture

The automobile sector is marked by the complex technical nature of the product; its capital intensive manufacturing process; and its volatile market dynamics. The elaborate design and development process and long lead time are typical of this sector. Historically over the past one hundred years, this sector has seen tremendous developments in terms of technology and aesthetics of vehicles. Recent developments in automobiles continue to follow technology trends.

This sector is characterized by the following aspects:

Technically Complex: Automobiles are technically complex, immensely user-focused and magnificently styled products. Its manufacturing comprises of design involving numerous components, sub-systems and assemblies like power train, transmission, electrical sub-assemblies etc. working together. Design and development of automobiles involves the use of wide variety of materials; Human Factors including comfort, safety and use; style and aesthetics. This makes the design and engineering of the product quite challenging but also exciting.

Capital Intensive: Automotive products being capital-intensive, involve high investments. For example, a new car to be launched in the market needs approximately Rupees 2000 crore (Twenty Billion Rupees) to design and manufacture. Total project cost of Tata Nano project was Rupees 2000 Crores (Ashish K. Mishra, 2011). Therefore, auto companies across the globe spend millions of dollars in market research to understand the market potential before the design phase to mitigate the risk of market failure. Intense market competition has led to strategies for market segmentation. This is reflected in product differentiation such as family car, sports utility vehicle, multi-utility vehicle, coupe etc. So, to address the variety of needs, manufacturers tend to make variations of vehicles from the same basic platform and sell different products in different vehicle segments. This is termed as Shared Platform Approach in which, by changing style and technology, vehicles can be positioned differently in the market. Typical examples are cars, vans, SUVs etc.

Design and Development Lead-Time: Vehicle design typically involves a long design and development process. Design lead-time from the conception of initial idea to the launch of a car can range from three to five years. Lead times in two wheelers are relatively smaller than those of cars. Longevity of the design is important for the car to remain competitive in the market. This is a challenge for the automotive designer who has to ensure that the vehicle does not lose its relevance in the market in a short time span.

High Volatility of the Auto Market: Automotive market is highly volatile in nature. Manufacturers are forced to provide constant updates through modifications to the products in order to stay competitive in the market and to extend the life of their

products. These quick modifications demanded from designers can be new facelifts, graphics or redesigning certain elements or areas to adapt to the brand's evolving design language.

1.1.2 Recent Trends in Automobile Design Development

Vehicle design over the last century has been influenced by changing trends in technology, society, culture, fashion etc. However, in addition to these, in the recent globalized competitive settings, the following newer trends are seen in contemporary vehicle design practice.

1.1.2.1 Shared Platform

Considering high costs and risk of design and development, manufacturers do not frequently design and develop new vehicle products. Rather, automobile manufacturers have adopted the Shared Platform Approach to overcome rising development costs. A platform in cars is typically defined as floor panels (core + front + end), engine, powertrain and suspension (Muffatto, 1999, p. 148). Single platform may have different lengths (depending on wheelbase). The basic idea of 'shared platform' is that cars having same platform could be manufactured in the same assembly line. However, cars can have variants outwardly and even different types of cars can be made. This concept is followed by manufacturers such as General Motors and Volkswagen, who have a number of sub-brands that cater to different markets. The different models for these brands, while keeping the underlying technology same, have their own aesthetics. For instance, Volkswagen Golf, a premium hatchback and Skoda Octavia, a midsize sedan, share the same platform while maintaining distinctly different appearances that are targeted to entirely different audiences. Another aspect of platform sharing is parts sharing. This cost saving measure sees different brands sharing smaller components in the interior and exterior (such as control knobs and buttons) across different models or components. While going from an older product to new, many components might be carried over. More limited the budget, higher the number of components that will be carried over.

While on the one hand, management demands that newer/updated product look sufficiently different from the older version, the designers are left with the daunting

challenge of trying to impart maximum visual impact making the minimum amount of changes in the existing design. In such a scenario, the designers are challenged to work within a lot of constraints.

1.1.2.2 Cross-Cultural Considerations for Global Products

There were two very important phenomena witnessed in the 1990s - global consolidation (Orsato & Wells, 2007, p. 1000) of auto companies through mergers and acquisitions to achieve global presence and increase in the range of product lines launched in all the countries. This proved to be highly economical since manufacturers worked on just one platform for their global model. After the famous intercontinental merger of American Chrysler Corporation with Germany's Daimler Benz, pace of acquisition and merger became even greater (Orsato & Wells, 2007, p. 1000). However, the differences of cultures and regulations across different countries raised some challenges for auto companies. This situation of cross-cultural issues led to cosmetic variations in the design features. Sometimes interestingly, this resulted in the unexpected use of the vehicle that it was never intended for when the product was envisaged. Example: Maruti Suzuki Omni as an ambulance or a cargo delivery vehicle and Toyota Innova as an executive-cab. In such an environment, designers and researchers across globe were pressed with a challenge of designing for an 'unfamiliar world.'

The last 20-25 years have seen the trend of building holistic platforms and increased sharing of components. Even then, manufacturers meet with limited success and therefore cannot overlook customers aspirations. As a consequence, most companies tend to go for a 'middle of the road' approach and design products that carry minimum financial risks. Often this 'risk-averse' attitude from the top management forces designers to rein in their creative freedom and make compromises.

1.1.3 Notes on Automobile Styling Process, Styling Studio and Design Work

Typology

The most routine work done in major automotive design studios is the refinement of existing products. New product design and development is done once in a few years. It is therefore not common to see a completely new design project being undertaken.

Styling Studio: The Design studios of a typical major automobile manufacturer usually follow a ‘top down’ approach in product design and development. The studio comprises of a large team of around 200 people. This team typically consists of exterior and interior designers (stylists), color-material-trim designers, engineers, clay model makers, Computer Aided Design/Computer Aided Surfacing (CAD/CAS) modelers and marketing executives. The engineers include specialists in mechanical, electrical and manufacturing areas. The studio is generally divided into three departments viz. Exterior Design, Interior Design, Color and Trim Design. In each of these departments there are designers, model-makers, studio engineers and CAD/CAS modelers. The studio itself will have various spaces like sketching space, modeling space, digital modeling space, VR space, and Presentation space.

1.1.3.1 Typical Automobile Design Process

Most automotive companies have customized the design process for their own requirements but in general automotive design process (Table 1.1) is similar in all auto companies (Lewin & Borroff, 2010, p. 75).

Table 1.1: Typical Design Process

	STAGES	USER STUDY METHOD	PHASE
1	Product Planning	Consumer Research, Focus group, competitor study	Fuzzy Front End
<i>Deliverable: The Design Brief</i>			
2	Concept Generation		Design Phase
3	Theme Selection	Focus Groups-Auto Clinics	Design Phase
4	Refining concept, 3D and computer model development		Design Phase
5	Design Evaluation (Virtual Reality)	Focus Groups-Auto Clinics	Design/Evaluation Phase
<i>Deliverable: Styling surfaces</i>			
7	Prototype Development/Product testing		Development Phase
8	Product Launch		Development Phase

FUZZY FRONT END: PRE-DESIGN

In the Fuzzy Front End (FFE) phase of the product planning stage, the upper management takes the lead in planning for a new vehicle product program. It commits to the production of an automobile with typically 2-4 year lead time. A cross-functional team comprising of designers and marketing professionals put time and efforts to identify and gauge potential user expectations through market research. Market research techniques like questionnaire, lifestyle reference, competitors study (user reactions) etc. are commonly used to obtain user responses. A 'product brief' is the output of product planning stage.

DESIGN/ STYLING PHASE

The 'product brief' received by Styling/Design Studio is the starting point for all the designers.

The Concept Generation: A designer's role in an auto company starts from concept generation. Designers engage themselves in extensive sketching by using techniques like Mood boards, Metaphors, Clichés, Branding, Intuitions for target market and context, Fashion styles etc. (Lewin & Borroff, 2010) and convert them into design proposals (themes). A large Design team in an auto industry, typically starts from the exteriors and then interiors (Armi, 2003).

Theme selection: The top management selects the design/styling themes that suit the product brief made in the planning stage. Sometimes several style directions are chosen for taking to the next stage. Some companies also have a practice of conducting focus-group studies where photorealistic renders of the concepts are used for the theme selection. Through consumer research (focus groups), these themes are evaluated and finally one is chosen for development. At this stage, product teams are put together by the program managers and area managers (body, electrical, etc.). These managers select sub system managers (interior and exterior), engineers and studio designers to work on the detailed design. At this stage, a seating buck is designed for ergonomics study and interior design.

Refining the concept, 3D Modeling/Clay modeling: The design team generates more refined concepts that match the selected theme, design the features, and specify parts.

At this stage, a traditional milling of full-scale clay model with hand or CNC milling of clay is undertaken to sculpt out the design. If CNC milling is to be used, digital sculptors would need to digitally model the final concept. Once the clay model is made, this is for the first-time that the whole team and top management see the vehicle form in full scale. The discussion on cost target, marketing, features' incorporation, manufacturing etc. are discussed around the clay model.

Design Evaluation and Styling Freeze: After the 3D model making, users are engaged and focus-group method is undertaken to evaluate the design. Their inputs help to facilitate decision making for the management on investment for tooling. Styling is typically then frozen and the product moves ahead for development. Computer Aided Surfaces (CAS) are generated at this stage in the styling studio. CAS is the final deliverable from the studio to engineering team.

DEVELOPMENT PHASE: POST STYLING

After the styling is frozen, the engineering team takes over for component design. Using engineering parameters, engineers develop parts/components from Computer Aided Surfaces (CAS) obtained from styling studio. There are many negotiations that go on between the engineering team and the design team.

1.1.4 Concept Vehicles: Beyond Routine Design Work

Companies also engage in the development of what are known as 'concept studies', other than the work concerning existing and upcoming 'real-world' products. Concept models are designed and developed independently from production models, and such products serve certain important functions for the company. The designers undertake 'concept vehicle' projects so that they can explore and design with unconstrained creativity. These projects are usually exhibited in major auto shows in front of large audiences and media presence. The strategic intent of each company differs while designing concept models. Some manufacturers want to explore hitherto unseen forms, aesthetics and overall experiences. Others want to showcase cutting-edge technology while keeping the visuals conventional to an extent. Even for the most unconventional concept studies, this strategic decision is important and carefully made. Companies cannot afford to present controversial or divisive designs that might alienate their potential customers. Three strategic roles of concept studies are: exploring market

reactions and expectations, shaping attitudes & paving the way for innovations and maintaining brand relevance (Keinonen & Takala, 2010).

EXPLORING MARKET REACTIONS AND EXPECTATIONS

No design could be put into production if it doesn't appeal to potential users. Concept studies are a way to gauge public reaction and see if they are willing to accept a shift in the design of a company's models. Companies are also aware that regardless of the level of innovation, designs that stray too far from conventional trends might find difficulty to garner public approval.

SHAPING ATTITUDES AND PAVING THE WAY FOR INNOVATIONS

Concept studies are a convenient way to 'ease' the customers into an upcoming shift in the design language of a company. More often than not, concept models hint at the look and feel of production ('real') models that the company might release in the near future. In this scenario, concept studies serve as a kind of primer, in that they prepare the users for the design evolution that the company's models are about to go through. The showcasing of upcoming technology and innovations also serve the same purpose.

MAINTAINING BRAND RELEVANCE

Concept studies are a way of showing that the company is driven by innovation and creative thinking. The company's intent to create increasingly better products reinforce their relevance as a brand in the public eye. Since concepts also hint at future production models, people tend to be more interested in the brand and are likely to consider them as prospective choice in the buying decision.

Since the mindset of auto companies follow typically a 'top-down' approach, they believe in making things and then gauging peoples' reactions, and not the other way around.

1.1.5 Emergent Trends in Automobile Design in the 21st Century - Breaking New Grounds and Innovations for Future

Most of the cars currently in the market are technically very sound, making it very difficult for a model to stand out in terms of technical merits alone. As a result, there is a shift towards seeking symbolic meanings by designing a complete experience for the

customer through branding, communications and product design, all the way to the customer experience in the showroom or while seeing website, social media etc.

The advancements in science, technology, culture and economics all have their influence in New Product Development (NPD) in the automotive industry. As the landscape of the industry is extremely competitive, manufacturers try hard to introduce cutting-edge technology and innovation into their products. This is reflected in vehicle design as well, with several breakthrough innovations having been developed in recent years. Following are three examples, which illustrate the future trends made possible with these innovations.

1.1.5.1 Multi-architecture

AUTONOMY GM (2001)

The AUTONomy concept (Figure 1.1) by General Motors breaks the mold of traditional design and manufacturing paradigms. Their approach is what is called a 'skateboard' chassis - a highly adaptive, scalable modular and upgradeable architecture which incorporates all the essential systems such as propulsion system, an electronic network, electric traction and drive motors and on-board energy storage.



Figure 1.1: GM Autonomy (Sabatini, 2010)

The elegance of this approach is that since the chassis integrates all the technical components in itself, the body is free to be flexibly designed in any way. The

architecture can support virtually unlimited body styles, and can be swapped in true 'plug and play' fashion.

1.1.5.2 Mass Customization

BMW GINA (2001)

The "Geometry and function in 'N' Adaptations", abbreviated as GINA (Figure 1.2), is the vision of the team of designers at BMW led by Chris Bangle. The aim was to "challenge existing principles and conventional processes". GINA is a two-seater sports car which substitutes a traditional sheet metal body with a type of polyurethane-coated Spandex. The material is flexible, stretchable, water resistant, translucent, resists temperature changes, and doesn't swell or shrink.



Figure 1.2: BMW GINA (Boeriu, 2014)

Beneath this 'skin' is a dynamic structure, which can alter the shape of the entire car, depending on the situation or by the driver's choice (personalization). An aluminum wire structure creates the essential form, whereas the moving parts are composed of carbon struts supported by electric and hydraulic actuators. The car in itself possesses several dynamic characteristics, such as the skin covering the headlights separating and opening as though they are eyelids.

SMART CAR (2009)

Smart (Figure 1.3), an automotive sub brand of Daimler AG, is a manufacturer of micro cars and super minis. The idea was to create a vehicle suitable for the busy European

cities, so that it would be compact enough to navigate the typically narrow streets and easy to park. The end result is a car that is 250 centimeters long, which is equal to the width of a regular parking slot. The car could be parked 'nose in', that is perpendicular to the road, and as a result, three Smart Cars could occupy the space needed by a normal car.



Figure 1.3: Smart Car (Stigh, 2012)

The car was designed to be appealing to young people and affordable enough for them. One of the innovations Smart introduced for the fashion-conscious young demographic of Europe is the option of personalizing their car via a web-based interface. The car featured interchangeable body panels that could be customized according to the preference of each individual user, and this choice could be made virtually without needing to see the actual car.

1.1.5.3 Designing inside out

TOYOTA I UNIT (2005)

Toyota I-unit (Figure 1.4) embodies the concept of personal mobility. It is an ultra-compact single-seater, four wheeled vehicle which is a cross between a Microcar, a motorcycle and a vehicular exoskeleton. The vehicle is designed to be used on roads but also does not hinder interaction with pedestrians. The I-Unit has two modes to make this possible. In the 'low speed' mode, the rider nearly stands upright, which enables

him/her to have conversations face-to-face with people. In this mode, they can also move around through a crowd. The 'high speed' mode, on the other hand sets the driver in a much lower reclined seating position. This mode enables normal road driving and has a low center of gravity, which makes it stable and safe at the higher speeds.



Figure 1.4: Toyota I Unit (Thomas, 2005)

1.2 Indian Automotive Industry

This section presents the scope and challenges in automobile design unique to the Indian Automotive Industry sector highlighting the changing landscape of automotive industry in India. It discusses and differentiates automobile approaches of western and developed contexts versus the Indian market. It then discusses the design challenges that MNC-OEMs in India and Indian manufactures adopt for meeting market opportunities and expectation of a large and emerging Indian market.

1.2.1 The Emerging Landscape of Indian Auto Industry

1.2.1.1 Growth Story

India, a nation of 1.2 billion people, coupled with a booming economy, is rapidly emerging as a big market for automobiles in the global scenario. With the liberalization policies of the early 1990's, India became home to major global auto players that are trying to cater to the diverse and challenging demands of modern Indian consumers. Global players like Suzuki, Toyota, Volkswagen, Ford, Hyundai, Honda, Peugeot,

Mitsubishi, Daewoo, Volvo, Mercedes-Benz and many more have not only introduced their models in India in the last 20 years but some of them have also set up production and R&D set ups in India.

Indian OEMs didn't stay behind. They also displayed confidence in bringing out new vehicles. Home grown Indian manufacturers including the TATA group adapted to these market dynamics by introducing in 1999, their in-house developed models 'Indica'. Other Indian OEMs like Mahindra and Mahindra soon followed them by launching new vehicles designed and developed in India. In the two decades to follow, the Indian consumer is today spoilt for choice with the slew of increasingly sophisticated automobile models being launched each year.

The presence of a large number of OEMs from around the world has resulted in a highly heterogeneous presence of vehicles on the roads. The same categories of vehicles see a number of highly diverse models, which reflect the diversity in the user preferences themselves

The dynamics of the market is reflected in the demographic data in a report Auto Mission Plan (AMP) submitted by Ministry of Heavy Industries, Government of India in 2006 highlighting growth projections of the automobile sector in India:

'Rising per capita Income and the changing demographic distribution are conducive for growth. India has the highest proportion of population below 35 years, 70%, (potential buyers), which means that 130 million people will get added to the working population between 2003 and 2009. The trends indicate that two-wheelers, small and medium cars would remain dominant and a shift towards high-end cars is expected at a faster rate.....'

Higher disposable incomes coupled with availability of easy finance options have driven the Passenger vehicle segment.....'

The two-wheeler segment growth is led by rapid urbanization and resultant rise in demand from semi-urban and rural areas, increasing income levels, wider product range available to customers, and easy finance options'.

(Ministry of Heavy Industries & Public Enterprises, 2006)

1.2.1.2 Indian Automotive Market

Over the last few decades, there has been a rapid increase in vehicular sales. A total of 21.86 million vehicles were sold in 2016-2017, compared to 20.46 million from the previous year (SIAM, 2017).

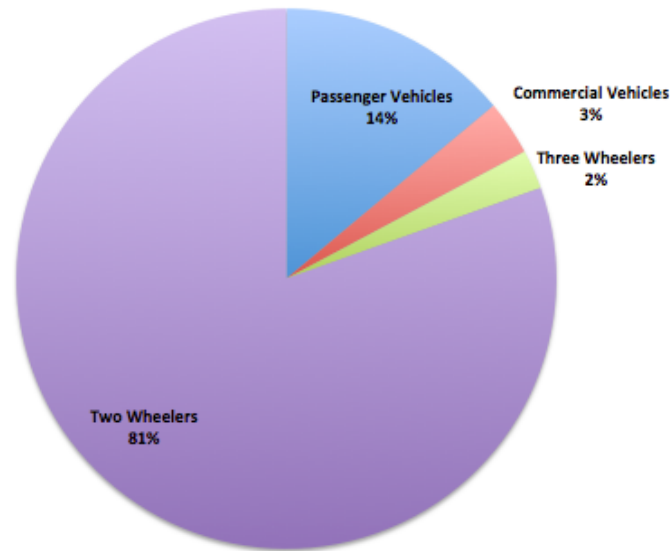


Figure 1.5: Domestic Market Share (SIAM, 2017)

As seen in Figure 1.5, the market is dominated by two wheelers, which account for nearly 81% of the total sales volume. The preference for two wheelers is primarily due to their affordability and fuel efficiency, not to mention the fact that two-wheelers make for good urban commuting in the crowded Indian cities.

Two-wheeler Category: Two-wheelers (typical example in Figure 1.6) in industry in India can broadly be categorized into three segments; scooters, motorcycles and mopeds and the three key players are Hero Honda, Bajaj Auto Ltd., and TVS Motor Company. Low cubic capacity engines, high fuel efficiencies and low emission levels characterize these two wheelers. The Indian regulations for two-wheeler emissions are one of the most stringent globally (Technology Roadmap 2006). While 'low margins and high volumes' drive the industry, customers look for the latest technologies and exciting features in value-for-money products. Styling is fast becoming a differentiator in addition to fuel efficiency. In 2015-2016, around 16.4 million two wheelers were sold in India and that accounted for 80% of the total vehicles sold (SIAM 2016).



Figure 1.6: Entry Level Motorcycle India (Hero Corporate Website, 2017)

Passenger vehicles take the second place, with 14% of the market share. The prominence of passenger cars has increased over the years, with a lot of two-wheeler customers 'upgrading' to a car. Commercial vehicles and three wheelers hold similar market shares, with around 3% and 2 % respectively.

Four-Wheeler category: In the four-wheel category, the compact cars (typical example in Figure 1.7) accounted for 60% of the total passenger car sales in India (Technology Roadmap 2006). In 2005–2006, around 0.6 million small cars were sold in India. The reason for large sale of compact cars is because of their affordability, good maneuverability and low maintenance and operating costs.



Figure 1.7: Entry Level Car India (Maruti Alto 800, 2012)

India has grown to be an attractive destination for fuel-efficient small cars. Hyundai for instance has made India its global manufacturing base for small cars (AMP 2006). With

the presence of almost all the global brands in India, Indian customers get a large option to pick one that is more affordable and reliable.

1.2.1.3 A Study of Accessories and Decorative Market for the Automobile Sector – Aspiring for Personalization

Customers desire for post-purchase accessorizing of the vehicle is a reflection on the desire to personalize, enhance aesthetics, improve driving experience and provide protection from rain, dust etc. The presence of a large accessory market for automobiles in India is a reflection of this opportunity for the Small and medium sector who manufacture a diverse range of accessories (examples in Figure 1.8 and Figure 1.9) that are post fitted on to the vehicle after purchase and help 'Personalization' of the vehicle to meet aspirations of each customer.



Figure 1.8: Accessories on Motorcycles (Blasco, 2010)



Figure 1.9: Accessories on Car (Car Dekho, 2017)

Some of the examples of adaptation provided by the OEMs are: redesign of front grilles of cars for a more 'smiley' look, sari guards used in motorcycles, use of bright colors etc.

Others extended by the MSME sector include custom alloy wheels, seat covers, bull bars, motorcycle tank covers which double up as glove boxes and so on. Another burgeoning area is the decorative market, which includes custom decals, small idols of deities, stickers of actors and other graphical elements that show the individuality of the customer.

1.2.1.4 Indian Market: Unique but Difficult

The above facts clearly imply that there is increasing competition in both two-wheeler and four-wheeler markets, with foreign and native brands battling it on price, product features and designs to draw the attention of potential buyers. In such a competitive market survival on quality, reliability and efficiency are benchmarked as given; it is design as the distinguishing factor that has come into play. Companies have realized the hard way that simply launching a global product in the Indian market does not suffice for market success. Understanding preferences of the diverse expectations and aspirations of the Indian consumer has become an issue of paramount importance in the recent years. Understanding the social cultural diversity of such a large market itself provides a challenge for both native and foreign manufacturers.

Design of vehicles have to factor in the wide variety of purposes of use - Commuting, shopping, carrying goods, school runs and fun trips are just a few examples. Rapid urbanization throws challenges of designing for functional needs rather than only for speed, as the infrastructure of roads is still not ready to meet the increasing numbers of vehicles, leading to traffic congestions, accidents and environmental pollution. Vehicles follow stringent standards to regulate air pollution.

LIMITATIONS OF THESE APPROACHES FELT BY MNCs AND INDIAN OEMS

The approaches mentioned in the previous sections have undoubtedly led to the development of several successful vehicles over the years. However, there are certain drawbacks to them that are becoming increasingly significant. One of the major deciding factors of any design project is the cost involved. In order to save costs, most MNCs bring their global models directly to India, with the designers tasked with simply adapting the design to fit into our market. While this certainly saves costs, it almost completely disregards the social and cultural background in India. Even Indian OEMs

are largely reluctant to tap Indian culture and values for design inspiration, and instead choose to imitate western aesthetics. The same applies in the field of design research as well, where traditionally established practices are carried over without considering the sheer amount of diversity present in the population of target users. It can be argued that most manufacturers have in fact failed to perfectly understand the complex needs and requirements of the Indian customer and design vehicles catering to these needs. The greatest supporting evidence to this argument is the burgeoning accessory market in the country. Customers spend a lot of time and money on their purchased products in order to emphasize their personality and also to fill in some of the gaps in requirements that the original product failed to satisfy, this clearly points to the need to have a better way of understanding the users' needs and translating them to design output.

It can be easily concluded that Indian market is a difficult market and 'seeking solutions for diversity' offers design opportunities and 'understanding diversity' offers research challenges.

1.3 Motivation for Research

This section presents two preliminary context specific studies that motivated to undertake this research. First, Design of Scooter for Women (Indian market), second one related to observational research regarding use of two wheelers in India. These were immersive experiences of the researcher, who as a practicing professional designer had opportunities to undertake these studies.

1.3.1 Case Study 1: Design of Scooter for Women (Indian Market)

1.3.1.1 Researcher's Personal Experience as In-House Designer for an Automobile Manufacturing Company

Aprilia Motors Italy, a two-wheeler Italian company, in 2004, was engaged in designing of a 100cc-four stroke scooter for women in India. The platform of the product was shared with their Italian product called Sonic. Hence the engine, frame and transmission were kept same as Sonic. Sonic already had presence in the European market and had substantial success. But when product-planning department conducted Auto-clinics (focus groups) to get the responses from the target users in India, they found that women (target users) had rated it very low. In contrast, home-grown

scooterette (light scooter) like TVS-Scooty and Bajaj-Spirit were rated very well. As a result, this project came as an opportunity to this researcher to work on a design team at Hero Global Design (their Indian counterpart) where styling was to be contextualized. This researcher/designer along with other styling team members started concept generations. Aprilia team in Venice, Italy also, concurrently started to conceptualize on the same brief. In the theme selection presentation, the researcher's concept was selected. Italian designers had very European inspired stylish appearance driven by branding. Whereas researcher being a designer from India with prior experience of the Indian user had considerations reflected in his concepts that were built from his working in the Indian auto industry.

1.3.1.2 Approach:

As a designer from India, the design concepts reflected considerations - Elegance and Feminine, Large skirts to cover engine and shock-absorbers, Large floorboards for carrying loose luggage, gas cylinder and kids, Large glove box, Large space for helmet storage, Smooth lines, integrating form from shield to seats to body panels, Not aggressive but polite.

1.3.1.3 Design Methods factored in aspects of:

- 1) *Market Research using a Focus group technique.* Images of the Indian scooters from the competitors, Aprilia Sonic (Italian) were checked for acceptance of Aprilia in deciding the styling strategy against competitors.
- 2) Context Information was gathered using *Visual References* (Mood-boards) to capture the essence of context of the Indian target market.
- 3) Idea generation was done using '*Sketching as a method for Idea generation*'
- 4) Design Evaluation was done using *Focus groups- Auto-clinics*.

1.3.1.4 Product Styling

Styling and Stance was based on metaphors and characters. Branding requirements were created through metaphors for styling of the vehicle. Engagement on this project gave an overall understanding of process in the context of working with MNC and designing for India. Being a part of an international team was an opportunity of knowing the approaches and ways of designers of different nationality. It gave an

opportunity to the designer/researcher for a first-time real encounter with user validations (Auto- clinics). After the project, the researcher was deeply inquisitive and motivated to pursue user research and engage in studies at the very beginning of the design process or at the Fuzzy Front End (FFE) and formed his early motivation to take up this research.

1.3.2 Case Study 2: Observational Research in Five Indian Cities

Considering that India was emerging as one of the fastest growing two-wheeler industry, this self-initiated study was undertaken as an independent researcher in September 2007. Field studies and documentation were undertaken in New Delhi, Kolkata, Bangalore, Pune and Ahmedabad. These cities were selected as they covered a broad cross section of geographical region of India; all were strong two-wheeler markets; all the cities were metros; climatically they were diverse - extremes of cold to moderate to hot; and they offered rich diversity of product use.

The study aimed to learn how Indians put their two wheelers to diverse use. The study examined the patterns of use of two wheelers on Indian roads to understand the various kind of activities people perform on two wheelers; creative adaptations of their use; what it meant to the user to own his two-wheeler; consider safety, seating, attire, luggage, family and modification and manipulations etc. From these studies, the researcher aimed to examine if new insights can be translated into actionable design guidelines. Photo-documents of some of those images are presented below (Figure 1.10):





Figure 1.10: Observational Research in five Indian cities

The protocol followed in this Observational Research Method included:

Observations: First few hours in each city were spent observing the context to understand how people drive, what they keep, how they keep etc. Photographs were taken using a digital automatic camera.

Coding and Sorting: Each image was coded with number and city name and were subsequently sorted out into folders under the categories - safety, seating, attire, luggage, family and modification. One image could be sorted in multiple folders. Digital way of handling data helps here.

Data sheet: Observations (as automotive design expert) were recorded in data sheet. If there were more than one observation, they were put in separate cells.

Sorting and Affinity: Data sheet was printed; each cell was cut. Each cell had code, image and observations. Design/Researcher sorted these using affinity analysis that gave design insights. Many design insights were clubbed to form key-insights. These key insights are:

- The Pillion riders are neglected in most of the vehicle designs, with maximum emphasis given on the comfort of the Rider only.

- Instead of 2-seater, Indian 2-wheelers need to be redefined as 2.5-seater, with a well-deserved emphasis on children who travel with them. Children need support for their hands and feet, and assurance of safety and security.
- The two wheelers must take into consideration; the nature of users and the ergonomic issues related to them, based on differences in their body structures, their dressing styles, their postural differences and behavioural characteristics.
- Two wheelers in India with their current design do not address the traditional dressing styles of the people, and the people wearing clothes like Sari, Lungi, and Skirts have to face discomfort.
- The two wheelers with their current designs must ideally allow only two passengers for safety concerns, and any more adult passengers should be discouraged. But considering Indian situations, a vehicle must allow a convenient and safe place to accommodate an additional passenger whenever the need arises.
- Two wheelers demand protection at both levels viz. the protection for the user, and also for the vehicle itself, from pollution, dust, rain and sunlight.
- Two wheelers of India must take into consideration the comfort of the riders who hold, carry and manage diverse types and forms of luggage, by providing supplementary support and space for the same.
- Two wheelers in India must allow maximum flexibility to store and hold luggage of varying sizes, nature and numbers without much compromise on its primary function of carrying passengers.
- India has a lot of variety in types of users and their needs and style of using the vehicles. Hence, they have a tendency to adapt themselves appropriately to any vehicle as and when required, to suit their needs.

- The riders of a two-wheeler have a choice of the way they use the vehicle, both in terms of their posture as well as the way they use the accessories.
- Two wheelers with their current design, engage both the hands (and at times feet) of the riders while riding; whereas it is desirable at times to have the freedom to use one hand for other activities like holding a box or supporting a baby child.
- Two wheelers have certain unique features, which offer an advantage over other vehicles, and make them suitable for typical Indian settings.
- Indian users have a variety of needs and it may be difficult for a single vehicle to suit all of them. The 2-wheelers allow a lot of possibility of modifications to suit the variety of needs of people.
- When parked, the two wheelers in India behave as an extension to the public spaces where they are located and allow people the convenience to enjoy benefits of such places.
- The users of two-wheelers in India often break the traffic rules and guidelines- e.g. underage riding, riding without helmets, riding while using mobile phones etc. that must be discouraged by suitable design intervention.

1.3.3 Observations and Insight from Two Case Studies:

These studies indicate that for a complex market like India, with its highly diverse user population and contexts, there exists the need for a higher degree of user involvement in the design process to understand their aspirations and needs in a vehicle. As can be seen so far, the traditionally accepted approach to designing vehicles is facing certain drawbacks in terms of understanding the user and their needs. This offers scope for a thorough rethinking of the established practices and methods followed in the automobile sector. These observations emphasize the need to evolve design methods at the early stage of product planning to understand better the needs of end users, their tacit knowledge and understanding; their context specific aspirations. Such inputs can be very useful for designers to enrich their approach that can get reflected in the design

concepts that they develop. This implies the need to explore approaches that make the end user inclusive during the early stage of design development, where designing 'with the end user' can be explored rather than the conventional studio led approach of 'designing for the user'. This calls for deeper study into exploring emerging practices in design research methods such as Participatory Design Method, Contextual Mapping Method as alternative approaches to design of personal transport that is specific for the Indian context. This can result in a better understanding of the Indian user's mindset during the design stage so that manufacturers could cater better to market opportunities.

1.4 Identification of Research Problem

It has been firmly established that the needs of users have to be thoroughly understood for requirement capture before beginning the process of designing a new vehicle. Understandably, manufacturers invest a lot of effort and money to make sure that the elicitation of user needs is done properly. However, there are a number of drawbacks to the current approaches employed in vehicle design process.

The methods employed for user research, including traditional interviews, surveys, questionnaires, focus groups etc. are undeniably user centric, but they do not delve deeper into the users' minds to truly understand what they prefer and need. More often than not, the true needs of the users may not be expressed in words. This can be due to either the lack of a suitable medium for users to express themselves, or a gap in communication between the users and the researchers. As a result, the designers and the researchers either work with only the requirements that they explicitly received from the users, or try to interpret the tacit requirements in their own way. Flaws in understanding user needs can end up flawing the entire design process.

Another issue prevalent in India is the sheer diversity in the users. User-centric research methods are largely generic in nature, and do not account for the subtle differences in culture, languages or economic background seen all over India. As a result, a requirement elicitation method that works well in one part of the country may not work at all in another part. This creates tremendous challenges for design researchers to carry out their studies properly.

Closely associated with the diversity in the users is the diversity in their context of use. The same product can be put to use in multiple contexts, some of which may not have been considered at all during the design phase. The same model of entry-level motorcycle can be used for daily office commute by a bank clerk in Delhi, and for selling fish by a fisherman in Cochin. Understanding the breadth of this spectrum of user contexts is very important for the successful execution of a design. The traditional approaches of design research make very few attempts to understand how the users function in their respective contexts.

It is evident that there is a need for state-of-the-art methods for user research in automotive design, as the current methods are rather ineffective in gathering deep knowledge about users and user contexts. One of the problems associated with most of the current methods is that they still keep the users at an arm's length and regard them as mere subjects. The designer or researcher assumes the role of an expert whose job is to design *for* the user. The users are experts in their own experiences and needs, but they are not given a medium to articulate these needs. The next generation of design research methods needs to include the user more closely into the design process, so that even their unsaid needs are captured properly.

1.4.1.1 Need to User-Centric Way of Designing Products and to Participatory Design

Automotive design has always been highly user-centric in nature, in that all the design activities revolve around satisfying the users' needs and preferences. However, in a market like India, the established practices of design research have not been completely effective. The large amount of diversity among the target customers, as well as the diversity in the contexts of using products have caused the elicitation of user requirements to be quite difficult. The situation clearly calls for the need to understand the users at a much deeper level, as well as to increase their involvement in the Fuzzy Front End (FFE) of the design process. Design approaches till now have been advocating the need to 'design for users'. The current scenario prompts to think beyond this, to the realm of 'designing with users'. This is where the concept of participatory design comes into play. A detailed write-up will be outlined regarding the development of participatory design methods in the next section i.e. Literature Survey

1.4.1.2 Possibility of Participatory Design in Automobile Design

Most automotive design studios follow the 'top down' approach, where the designer generates concepts based on the user research data and the New Product Development process goes on to realize the concepts. The designer is considered as an 'expert', whose job is to design solutions based on the information collected from the users. One of the problems here is that the user is considered as a mere subject who are expected to provide the designer with information and respond to the concepts developed by the designer. This approach completely disregards the possibility that the user could be an expert in their own experiences and context, and also the fact that many of their needs and requirements are often not verbally communicated.

At the end of the day, the users will decide whether or not a product finds success in the market. The drawbacks of the current approach warrant a thorough introspection about the role of user in the whole scheme of things. It is clear that the next generation of processes should try to introduce a higher level of user involvement in design and design research.

1.5 Research Questions

Following research questions address issues raised in above section:

- How can we access users' deep aspirations and tacit knowledge in the context of vehicle design using participatory design?
- How can we evolve effective participatory toolkit for vehicle design for eliciting users' deep aspirations and tacit knowledge?
- What would be comprehensive participatory design methodology for vehicle design process?

Sub-questions:

- What would be the protocol for participatory design with novice users in the fuzzy front end of the design process?
- What would be the protocol for collective form generation by a group of expert designers in the creative phase of the design process?

- What would be protocol for participatory evaluation by the users in the evaluation phase of the design process?

1.6 Hypothesis

In order to design context-sensitive vehicle products for the diverse Indian market, automobile designers must gain access to the users' deep aspirations and tacit knowledge, for which, it would be required to evolve Participatory Design Research Methodology to be used in Fuzzy Front End (FFE) of vehicle design process.

1.7 Aim

To evolve a comprehensive context-sensitive Participatory Design Research Methodology for Personal Transport Vehicles with corresponding components:

- a. To develop methods and tools that capture tacit knowledge and aspirations of end users in the design of personal mobility devices for Indian users.
- b. To develop methods and tools that enables collective form generation by a group of designers.
- c. To develop methods and tools that enable participatory validation by users.

1.8 Objectives

- To examine design research methods appropriate for product requirement-capture suitable for design of a personal transport vehicle for an Indian user's needs.
- To design suitable 2D/3D assistive tools that help novice and expert end users to express deep tacit knowledge and aspirations for a desired personal transport vehicle they wish to possess.
- To examine ways and means to identify product requirement specifications that end users desire.
- To devise a way to communicate deep user aspirations to designers.

- To collectively allow designer group to design context-sensitive vehicle product, the process of transformation of product specification into design concepts of personal transport for context specific requirements suitable for the Indian context, actively learn from it and contribute in the overall methodology.
- To analyze with subject experts the process that designers undergo in transforming product specifications from concept visualizations into tangible 3D product forms of personal transport vehicle.
- To engage users for concept evaluation, actively learn from it and contribute in the overall methodology.
- To finally propose a methodology for context-sensitive participatory design of Personal Transport.

1.8.1 Case Study

In this research, aim is to evolve a Participatory Design Method in the context of developing a vehicle for India that aims to bridge the gap between two wheelers and cars. This would be undertaken as a case study to outline a detailed protocol for the Participatory Design Methodology to understand the three stages of a typical design process; Need Identification, Ideation and Evaluation.

1.8.1.1 *The Design opportunity gap*

In India, around 13.5 million two-wheelers are sold annually, and that accounts for 77.32% of the total number of vehicles sold (Figure 1.5). As regards slightly larger vehicles, compact cars account for 60% of the total passenger car sales in India. The general price of two-wheelers in India range from 30,000INR to 80,000INR, and the cheapest car starts from 2,00,000 INR. There has been a long-felt gap between two-wheelers and cars. Over the years, two-wheeler manufacturers perceived this gap as an opportunity to launch expensive scooters and motorcycles while car manufacturers stripped down features to come up with economy models—both gaining only limited success.

1.9 Structure of the Thesis in Chapters

This research and its findings is structured by dividing the thesis into the following chapters:

Chapter 1: Introduction

It contextualizes the practice of a ‘top-down’ approach to automobile design practiced in the West and its trickle down reflections into the growing automobile sector in the Indian scenario. The researcher’s professional experience forms the motivation in seeking new directions for alternative modes of inquiry involving end users as partners in the design process. This sets the premise for identification of Participatory Research Methodology as a basis of inquiry in seeking users tacit knowledge and aspirations in the design of personal transport vehicles that meet context-sensitive needs. The hypothesis, aim and objectives for this research are outlined on this premise.

Chapter 2: Developments in Design Research Methods – An Overview through Literature Review

This chapter covers literature review of the various developments in Design Process established in Industrial Design in its quest for establishing the ‘designerly way’ of systematic enquiry. It covers the various approaches of knowledge domains that have enriched and influenced these processes. The study then lays focus specific to the processes in the automotive sector.

Chapter 3: Participatory Design Method

This chapter elaborates on the status of current practices in the Participatory Design Method (PDM), which is the focus of this research. It studies the inquiry specific approach to the design and development of requirement capture involving participation of end users in the participatory design process.

Chapter 4: Participatory Design Experiment – Gaining Context-Sensitive Insights with End Users

This chapter is divided into two sub-sections under which the stages of the research are outlined:

Sub-section 1: Planning the Participatory Design Method (PDM)

Following Participatory Design Method (PDM) it outlines the stages of Planning the Participatory Design method for requirement capture of tacit knowledge and aspirations of end users involving selections of participants and the design of 3D assistive aids to aid user participation in requirement capture.

Sub-section 2: Conducting Participatory Design Session

Involves conducting the Participatory Design Method (PDM) session using the 3-D Toolkit and seeking insights from user participants. Users express their needs and aspirations of their design ideas that are captured using the 3-D toolkit based on four possible combinations viz. Ideas that capture their requirements using Abstract elements; Concrete elements; Concrete-Abstract combination elements and Abstract-Concrete combinations elements.

Based on a detailed analysis of this study with users, insights are drawn from the above experiments and the Design brief/s are formulated for specialist designers to translate requirement capture into Design concepts

Chapter 5: Collective Form Generation by a Set of Expert Designers

- a) Collective Form Generation: Translating Product specification into car form by trained designers. In this phase specialist product designers are tasked with visualization of car forms, which have emerged as product specification from the above phase.
- a) Analysis of the designers' process of Translating Product specification into car form by trained designers

Chapter 6: Participatory Evaluation by Users

This chapter presents experiment in user evaluation, its analysis and learning that feed the overall proposed methodology.

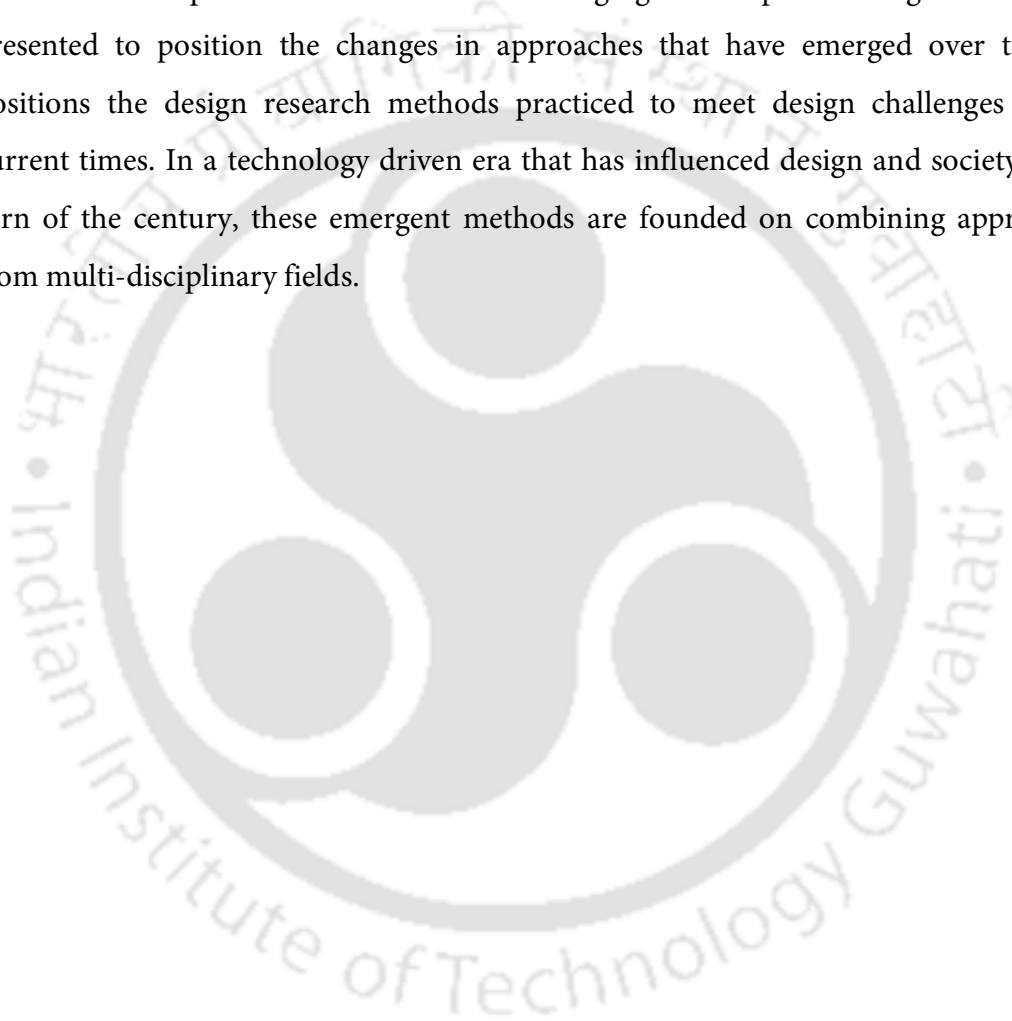
Chapter 7: Proposed Participatory Design Method

This chapter, explains the entire proposed methodology, planning of experiments, resources, analysis etc. in detail.

Chapter 8 Conclusions of Research, Limitations and Future Scope

Covers insights and verification of the hypothesis, limitations of the research, future scope for research.

In the next chapter an overview of the changing landscape of Design Methods is presented to position the changes in approaches that have emerged over time. It positions the design research methods practiced to meet design challenges in the current times. In a technology driven era that has influenced design and society at the turn of the century, these emergent methods are founded on combining approaches from multi-disciplinary fields.





CHAPTER 2: DEVELOPMENTS IN DESIGN

RESEARCH METHODS – AN OVERVIEW

THROUGH LITERATURE REVIEW

2.0 Introduction

In this chapter, through literature review, an overview of developments of design research methods, evolved in the design profession over the last fifty years, is presented. The shifts in perspective and approaches are highlighted. The chapter clearly highlights the shift of focus and attention from 'design of the objects' to 'design of experiences'. The shift in approach has brought into focus the user centricity and deep user understanding as the driving force that design methods currently follow. Many of these emergent methods, have been quickly adopted in design and development of digital, interactive, smart products and product systems.

However, current vehicle design practice has not seemingly, yet explored the emergent design methods. This is more specifically true for design professionals designing for the Indian context. The literature review clearly suggests the need to explore this research gap in developing a context-sensitive method specific to the Indian context following a participatory design method. In order to plan design methods for transportation design, it may be required to base them on theoretical models of Industrial Design.

2.1 State of Art Theoretical Framework of Design Research

The profession of Design has evolved from being design practice-oriented to design research-oriented over the last fifty years. The changing role of designers is attributed to evolving technologies, improvements in manufacturing, coupled with stratified needs of users in different eras. Researchers and design thinkers have put together understanding of design research methods and have provided a theoretical base in a cognitive map.

Sanders (E. Sanders, 2006, p. 4) has developed a framework of design research methods. An intellectual inquiry, chronologically, is presented regarding how those development years saw the change in the way users are seen; 'users as subject' and 'users as partners'.

Taken as a reference, Sanders's framework provides us with good starting point and contextualizes our research endeavors in larger scheme of things.

It constitutes mapping of essentially all disciplines related to design research (Figure 2.1). The map succinctly summarizes the chronological account of various fields of study lending support to design research. It also depicts the transition of role of designer/ researcher, and perception of user in the design process.

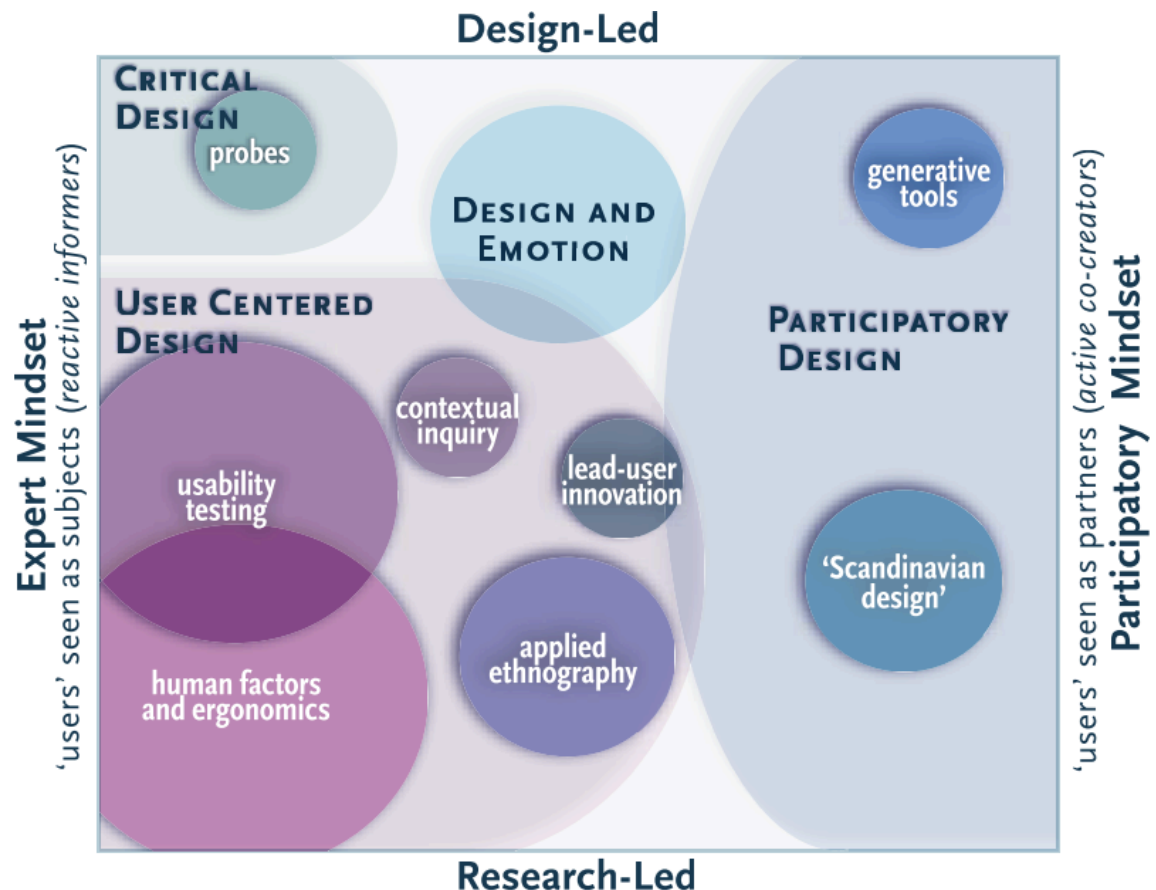


Figure 2.1: Topography of Design Research (Adapted from E. Sanders, 2006, p. 4)

While reading chart (Figure 2.1) from bottom to top, it is clear that lower half of chart is research heavy, evolved from a research perspective and the upper half of chart is design heavy, evolved from a design perspective. Research tools and methods already available in other domains were mainly used to understand users' functional needs. In the mid 2000s, such research tools gave way to more creative and designerly tools.

From left to right, the chart specifies the users' role in the entire design process and also depicts the mindset of the designer/researcher. Left-half sees 'users as subjects' and right-half 'users as partners'. In the bottom left corner, 'researcher' scientifically garners

user's observed responses, responses to stimuli, queries etc. Since the users mainly provide responses in some way, they are usually termed as 'respondents' or 'informants'. Contrasting it, methods in the top left corner allow 'designer' to design tools and methods to provoke or probe users. Users here are termed as 'audience'. Overall the entire left side of chart is called 'Design for users'. However, in methods shown on the entire right side, users actively participate as partners in the design process. Depicting this way as 'designing with users', designers or researchers work along with users in creating new concepts and ideas, thereby sharing their experiences. Historically, there has been a transition in 'designing for user' to 'designing with user'.

Bubbles in the chart like 'contextual enquiry' and 'lead user innovation' are independent design research methods without any support from professional organizations. Clusters represent larger amount of activity than bubbles and are supported by fields of study/research or professional organizations. These clusters and bubbles, club up as larger spaces called zones. So, there are four zones and each zone encompasses respective clusters and bubbles. Before talking about each of these bubbles, clusters and zones, it may be important to talk about very early paradigms of design.

2.2 1950-1960: Scientific Temper

As post World War II era threw a lot of design challenges to designers, it was soon realized that intuitive way of designing was not possible (Alexander, 1964). Inspired from Space programs, systematic design process was undertaken, that constituted of Analysis, Synthesis and Evaluation (Jones, 1984, p. 11). For the first time, a scientific temper was given to the design process. As seen in the literature, 'analysis' assumed the most important space in the design process (French, 1985). This was also called 'Analytic Paradigm of Architecture and Design' (Tzonis, 1990). Horst Rittel also referred to these as 'First Generation Design Methods' (Rittel, 1972). Chris Jones (Jones, 1984, p. 11), laying stress on 'Analysis' stage referred analysis to be a set of logically related performance specifications.

Bruce Archer model (Archer, 1984, p. 64) defined six types of activities:

- Programming: establish crucial issues; propose a course of action.

- Data Collection: collect, classify and store data.
- Analysis: Identify sub-problems; prepare performance (or design)
- Synthesis: prepare outline design proposals
- Development: develop prototype design(s); prepare and execute validation studies.
- Communication: prepare manufacturing documentation.

He summarized this process into three broad phases: analytical, creative and executive as shown in Figure 2.2.

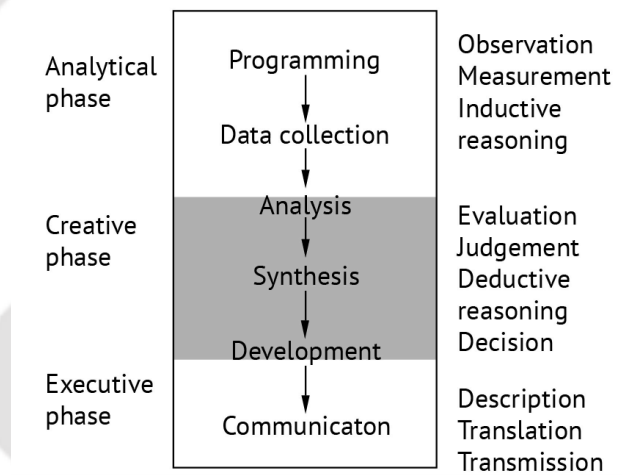


Figure 2.2: The main phases of design (Adapted from Archer, 1984, p. 64)

This era brought forth proliferation of rationalism (Alexander, 1964) in design and is characterized as Cartesian deductive. During that phase of time, some of the earlier definitions of design reflected this attention towards functional considerations that dominated design approaches:

- *Finding the right physical components of a physical structure* (Alexander, 1963)
- *A goal directed activity* (Archer, 1965)
- *The performing of a very complicated act of faith* (Jones, 1966)

Definitions of that era clearly highlight the scientific nature of the design process.

Meanwhile in Hochschule für Gestaltung Ulm, Tomas Maldonado & Gui Bonseipe consciously started to relate science and design, that brought in new aesthetics termed as Techno-aesthetics, also referred to as Ulm-functionalism (Bürdek, 2005, p. 254). This methodology influenced the curriculum and approaches of two pioneer design schools of India; National Institute of Design Ahmedabad established in 1967 and Industrial Design Centre IIT Bombay, Mumbai established in 1969.

Famous transportation designer, Raymond Loewy (Figure 2.3) imparted streamlined forms inspired from then known technical field of 'aerodynamics'. This work is also contextualized in Art-Deco movement of Modernism.



Figure 2.3: Loewy standing on his design, PRR S1 steam locomotive (CBS, 2017)

2.3 1970-1990: Communicative Function of Design

A paradigm shift was experienced in 1970s and 1980s. People were disillusioned (Sparke, 2013) by deductive methods and they gave way to inductive methods (Bürdek, 2005, p. 257) that laid stress on user and the user's context. For the first-time user and user context got prominence and started to assume centrality.

Context of use:

'If form represents the solution for the problem of design and context defines the form then discussions about design are not only about form but unity of form and context'. (Alexander, 1964)

People wanted to associate their identity with a product; therefore, they looked for more humanistic approaches. During this period, attention shifted to the communicative function of design from actual function of design. Object was dominated by image and representation. This movement celebrated eclecticism of products and exhibited strong relationships of objects with their consumers. In late 80s, there was a distinct shift in the design approach from 'how products are made' to 'what products mean to end users'. Design was expected to respond to the user needs, his context, his cultural diversity (despite globalization) and his/her aspirations by designing the context-sensitive and expressive forms of products, services and systems. Though post-modernism started to decline in 1990s, some car manufacturers like Chrysler, BMW and Volkswagen embraced the tendency of staying in nostalgic past, and being contemporary thereby appealing to different markets. One of the examples is Volkswagen's new Beetle (Figure 2.4), designed by J Mays and Freeman Thomas.



Figure 2.4: Volkswagen's new 'Beetle' (Autoblog, 2005)

2.4 User Centered Zone: Design Methods Since 90's

'User centric methods' is a large zone that has evolved over a longer period of time. In 1990s, rapid advancements in technology influenced design methods to accommodate a

wider range of knowledge domains of users' interactions. Machine language, Psychology and human cognition influenced design methods in significant ways. Focus in products and product systems shifted from the physical to predominantly cognitive abilities. A new set of methods drawing from multiple and cross disciplines; Information Technology, manufacturing along with humanities, social sciences and languages evolved. They explored user-centered parameters that may influence design decisions. It therefore became important to engage users at the beginning of the design process and at the stage of validation and evaluation. This has led to the developments and practice of design methods that engage the end user directly at the Fuzzy Front End of the design process. Methods that explore both design approaches 'for the users' and 'with the users'.

2.4.1 Investigating Design Situations

For a designer to initiate creative activity and design products, he/she is typically presented criteria that speak for observable, physiological, ergonomic, psychological user needs. For the products to meet exact user requirements, user centered design process came into forefront. Because such methods needed specialized skills and knowledge, design research methods tried to latch on already set ways of gathering such information.

To explore user requirements specifically known only to users; structured, semi-structured and open ended user interviews started to be used (Jones, 1992). Coupled with unobtrusive observational study of users in users' scenarios, above mentioned methods have been yielding an illuminating look into user needs. It was also required to understand the behavior of people to understand implicit aspirations there was introduced the field of Applied Ethnography. In the larger sense, ethnography involves observing societies and cultural phenomena. In terms of design research, Ethnography involves observing user behavior in a specific environment relevant to the design problem.

When a large population of users is expected to provide usable information for understanding their needs, questionnaires became standard practice. In this objective study, researchers would reach out to a large number of people who have rapid access to

the kinds of information critical for design decisions. Analysis is mainly through quantitative statistical method. In 1980s, qualitative methods like opinion scaling method- Osgood Semantic Differential (Hill, Osgood, Suci, & Tannenbaum, 1958) also became popular.

2.4.2 Investigating User Behavior

In 1960s literature, one finds mention of Human Factors or Ergonomics - to explore behavior patterns and predict the performance limits of potential users of a new design. It became a field in itself. It had lot of bearing on cockpit design for vehicles and aircrafts, safety, etc. and therefore attained prominence. It addressed user abilities and design requirements of interfaces (the part of design that affects users). This field would prescribe limiting values, which must not be exceeded if users are to carry out actions required without error, injury, or discomfort.

Man-Machine System Designing (Singleton, 1966) gained importance. This was to achieve internal compatibility between human and machine components of a system and external compatibility between the system and the environment in which it operates. This notable field emerged during the early 1960s. Closely associated with it was Usability Testing. Usability testing involves a set of comprehensive test procedures, which test the products before its market launch. A small group of test subjects provide fast and reliable findings about how potential users could react to the usage of product or interface, how they would navigate through it, understandability of specific solutions, as well as the overall intuitiveness (look and feel).

As product development became more expensive and capital intensive, companies wanted to take less risk of failing in the market. One method that evolved was Focus Groups, a scientific method, in which a product in any form like sketch, mockup or computer models is presented to a series of potential buyers (carefully recruited) and questions them from various perspectives.

Focus groups also known as Product Clinics are undertaken with carefully pre-selected users who can provide reliable results using relatively small random samples (of five to eight subjects). The questions aim to elicit the subjects' response to different aspects of design, such as its market prospects, uniqueness, and the way it fits into the subject's

sphere of life. Subjective reactions such as impressions of material and surface qualities, smells and other such reactions are also important in driving the design process forward. Designs are judged in their respective contexts. These contexts are also generated to obtain adequate responses from the subjects. This method called Auto-clinic has been used quite well in the automotive domain. It helps them to keep their products refined and apt for the target market. Automotive products are expensive to develop and produce, therefore focus groups work brilliantly in this scenario

2.4.3 Contextual Enquiry

Chronologically located in 1997, Contextual Enquiry (Beyer & Holtzblatt, 1998) involves the designer observing and discussing with the user in their natural environment for designing purpose of a specific product, be it their home or workplace. This method allows the designer to understand not just the user, but also the environment in which he or she operates. By observing their mannerisms, the objects they use and the way they generally interact with their surroundings, the designer can get a clearer picture of the user's profile. Based on what they see, the designer can make queries or engage the user in discussions in an open-ended manner to elicit further responses. The designer can also share their own insights, which may prompt the user to think in more directions to elucidate their own requirements.

2.4.4 Lead User Innovation

Lead User Innovation pioneered by Eric von Hippel came to forefront in 1996. Eric von Hippel, professor of MIT, works with “lead users” (E V Hippel, 2005) in co-creative activities. Lead users are experts who first sense the need of a product/service, who have already innovated with design for themselves and more essentially, who are willing to share their knowledge. They do not depend on the manufacturer to make products for them. often these innovations may be beneficial for other users too. Therefore, Lead User identification (Eric von Hippel, 1986) is an essential method used by companies to identify newest innovations in their product areas giving them crucial insight on changing users’ needs. There are two contributing factors to Lead User Innovation: increasing design capability of users is made possible by rapidly advancing hardware and software; as well technology such as internet which provides a platform on which

users could share their innovations with each other. Manufacturers draw satisfaction in decisions of mass-producing the design, which was modified by one of the Lead Users.

Patricia Seybold has been working with “lead customers”. Lead customers are small percentage of your current customers who are truly creative and innovative. They are most profitable customers but may not be the most vocal customers. They care about the way each product and service matters to them and how these products/services help them achieve what they care about. Patricia’s research spanned 25 years in identifying, interviewing, selecting, and grouping customers together to participate in Customer Scenario Mapping sessions (Seybold, 2011) for customer co-design session.

2.5 Critical Design: Design Led and User as Audience

Critical Design emerged around 1999 when Dunne wrote a remarkable book on the subject (Dunne, 1999). Critical Design is believed to question ‘the only possibility of design’ and immense focus on usability and utility. It is design-led, with the designer in the role of the expert.

Cultural Probes (B. Gaver, Dunne, & Pacenti, 1999) is more of an artistic method of studying users. This method is concerned with understanding the overall cultural outlook of a population - the way they envision their lives, the way they go about them and what they think about the world and people around them. Even though these findings do not seem to contribute directly to a design process, they are valuable in understanding the subtleties of the users' mindsets. The outcome of a cultural probe in itself is not meant to be analyzed or broken down, but reflected upon during later stages of design so that the designer will always have a clear view of whom they are designing for.

2.6 Semantics, Design, and Emotion: Mid 1990s

Products were regarded more than what they intended to do functionally during and after post modernism. And for users, it was the identity associated with the products that mattered a lot. In that direction, during mid 1980s, an enquiry was made as to how users interpret products, as users may not have access to the designers of the products. Shannon’s (Shannon, 1948) communication model comprising of five elements: *source, transmitter, channel, receiver and destination* was taken as basis. Mono (Mono, 1997),

Krippendorff and Butter (Krippendorff & Butter, 1984), inspired from Shanon's model, proposed Design team (source), Product (transmitter), Environment (channel), senses (receiver) and response (destination). A new term 'Product Semantics' (Krippendorff, 2006) was referred to as a theoretical framework adopted from language and anthropology. This study looked closely at how designers imparted forms and how those forms were interpreted by users. The designer (source) codes or shapes specific products and then consumer receives the message through the five senses and finally provides a response. It was a matter of interest for researchers to probe the relation of message built to be interpreted (designer) and message transmitted that gets interpreted (consumer).

When the message reaches the destination, it is termed as response. A detailed analysis of the consumer response to products was proposed to comprise of cognition and affect, which are followed by behavior (Figure 2.5).

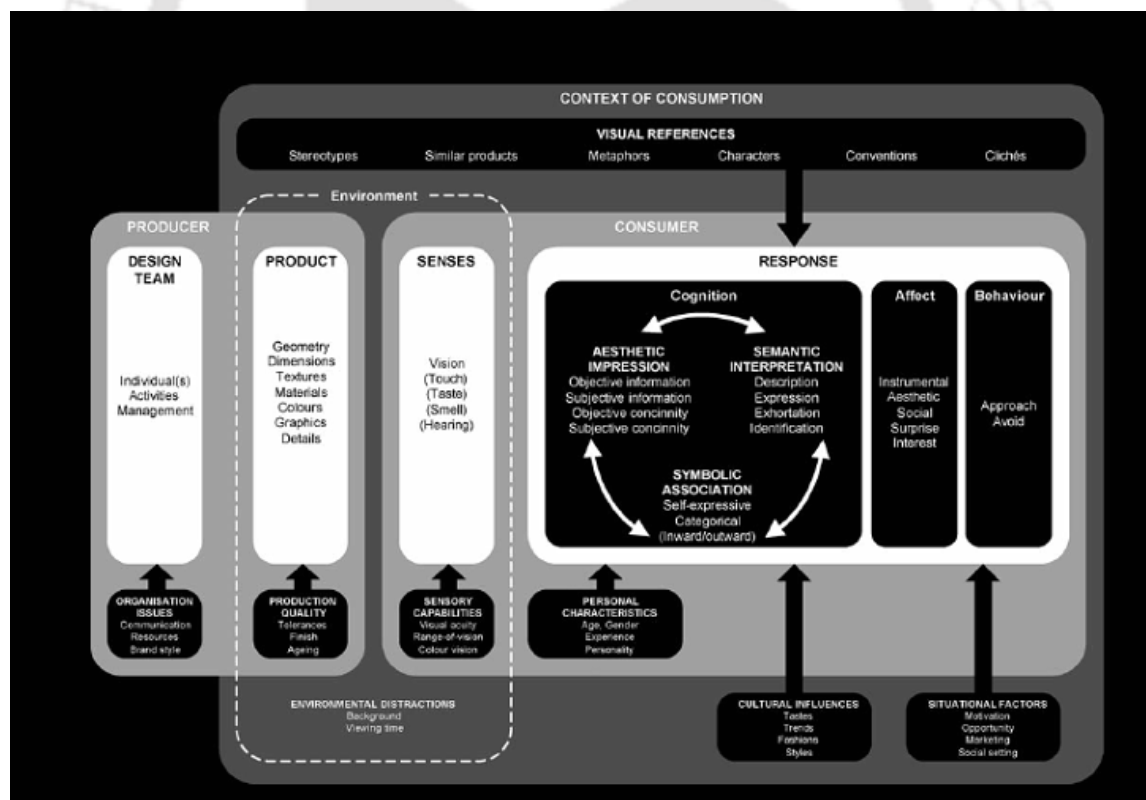


Figure 2.5: Coding and decoding of products (Adapted from Crilly, Moultrie, & Clarkson, 2004)

It has been well established that products elicit a user's affective or emotional responses when the user interacts with the semiotics of the product. Combined with cognitive responses, affective responses influence behavioral response. The word *affect* is

commonly used as an umbrella term to describe these emotions, moods, and feelings. Consumers may experience a variety of potentially contradictory feelings towards an object, such as admiration, disappointment, amusement, and disgust. The field of design and emotions is a design led method; users are still however seen as respondents. Desmet (Desmet, 2002) proposed five categories for emotional responses that products may elicit: instrumental, aesthetic, social, surprise and interest.

Instrumental emotions (such as disappointment or satisfaction) stem from perceptions of whether a product will assist the user in achieving their objectives. Aesthetic emotions (such as disgust or attraction) relate to the potential for products to 'delight and offend our senses'. Social emotions (such as indignation or admiration) result from the extent to which products are seen to comply with socially determined standards. Surprise emotions (such as amazement) are driven by the perception of novelty in a design. Finally, Interest emotions (such as boredom or fascination) are elicited by the perception of 'challenge combined with promise'. (Crilly et al., 2004, p. 7)

Donald Norman (Norman, 2004) describes both affect and cognition as information processing systems, where the cognitive system makes sense of the world and the affective system is judgmental. Design and emotions have relevance in design practice today. Product design and automotive companies have started to use some of the methods developed in this area. So much so that design research has probed ways and means to measure these parameters.

2.7 The Participatory Design Research

Participatory design covers the right side of Sanders's graph space (refer Figure 2.1). Participatory design has its roots in Scandinavia. Originated in 1970s, as Scandinavian Legacy, people could democratically participate in implementation of new technology at the workplace thereby developing new systems for the workspace to increase productivity. It was then research-led and later it became design led. It became a subject of great interest, Shuler and Namioka (Schuler & Namioka, 1993) wrote a book on Participatory Design in 1993 presenting the principles and practices of the field. During those years and early 2000s, as represented by the horizontal dimension (Figure 2.1), the participatory design paradigm, considers the user as an active partner in the

Fuzzy Front End of design process rather than a subject, informant or mere respondent. Participatory design is an emerging domain of design research that is not only of greater interest to the academic design research community but also to design practitioners involved in the development of human-centered products, systems, services and/or environments.

In that direction, over the years many methods of engaging users in participatory settings came into being for co-designing activities. Users were now seen as potential partner in the design and development. Thinking tools (Ehn & Kyng, 1991), user dialogue (Jacob Buur & Bagger, 1999) were some initial efforts towards the contributions of ordinary users in the design of products and services. From the literature of participatory research, one also finds, Buur and Andreason describing modelling as an important tool for designing or communicating with others (J Buur & Andreasen, 1989). A dynamic questionnaire methodology (Huang & Krawczyk, 2007) generates design options based on the client's needs and available modular components from selected product suppliers. This makes it possible to simulate the final design before processing orders for assembling and manufacturing entailing mass customization in a collaborative manner.

Engaging users through prototyping tools has been considered as an important method for active integration of the users in participatory design of products and services. Participatory way of designing newer software applications or hardware features can use 'prototypes' alongside the applications or hardware already available in the mass manufactured products. This integration engages users in co-designing/co-developing features for products and services as exemplified in a case of participatory design of software application for cars (Hoffmann, Leimeister, & Krcmar, 2010).

Taking forward from the currently practiced participatory design approaches, meta-design (Fischer & Giaccardi, 2006) goes beyond the notion of original system design. It embraces a process, by virtue of which, role of users as co-designers does not end with end of design lead time but continues for entire existence of the system. As a new mindset, meta-design shifted control from designers to users and empowered users to

continuously create and contribute their own aspirations and visions for existence of system.

In 2000s the discipline gained popularity as more and more products and services related companies started to find this approach useful in their practice. Not to mention brain storming and synectics (Gordon, 1961) techniques also started to gain popularity in corporate and academic set ups. In 2012, Elizabeth Sanders and Jan Stappers authored a long awaited comprehensive book on participatory design research- Convivial Toolbox (L. Sanders & Stappers, 2012). With over 50 contributions from researchers/practitioners around the world, the book covers the underlying principles of generative design research, presents case studies and importantly presents methods and techniques of participatory design research.

Following section will explain about generative design research that brings people directly into the design process to ensure that manufacturers meet their deeper aspirations for the future. Chapter 3 will discuss in details about the methods employed in conducting and analysis of generative research.

2.7.1 Generative Design Research

Designers are increasingly paying importance to contextual information in the design process to make products effective for functional and emotional needs (Bodker, 2000), (Mattelmaki & Battarbee, 2002), (Grudin & Pruitt, 2002). Sanders defines context as ‘all factors that influence the experience of a product use’ (Visser, Stappers, van der Lugt, & Sanders, 2005, p. 121). In order to explore contexts, generative techniques (P J Stappers & Sanders, 2003) are used. Effective use of these techniques help user-participants elicit their emotional responses and deep aspirations. Information gained from user participants can be in the form of explanation of context, anecdotes, stories that are deeply connected with users’ memories and experiences around the given product or system.

A key feature of participatory design is the use of physical artefacts which serve as thinking tools (Ehn & Kyng, 1991) during the design process. These artefacts help the user to articulate their thoughts and communicate their ideas and concepts with the designer without the need to know complex design terminology.

It was in 1990s, to uncover what people would know, feel and dream that Sanders introduced generative techniques (P J Stappers & Sanders, 2003). The experiential knowledge people possess is mainly tacit (Polayni & Gloucester, 1983) and latent. Such knowledge is very difficult to express in words even though people can act upon it. Projective techniques would provide a view into future states of people. These techniques can reveal tacit knowledge and expose latent needs (Visser et al., 2005). By using generative techniques, user participants are allowed to construct and then express their tacit and latent levels of knowledge about their experiences. This knowledge attained by accessing the unknown world of user experience is highly useful for the designing of better products and services.

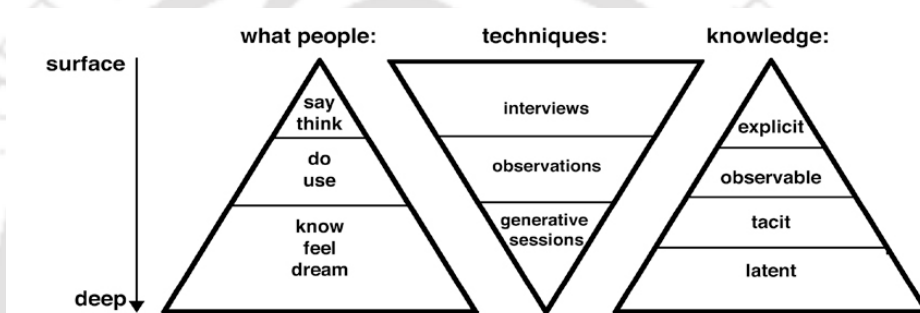


Figure 2.6: Different levels of knowledge about experience are accessed by different techniques (Visser et al., 2005, p. 123)

2.7.2 Generative Tools Bubble

Generative tools bubble (E. B. Sanders, 2000), (Visser et al., 2005) is a design-led space in the participatory design zone. Generative Tools enable stakeholders to communicate their experiences in an uninterrupted manner. The term 'generative' originates from the fact that virtually infinite ideas can be generated from a limited set of stimulus items. The tools themselves can vary from one problem to the next and can have many varieties (Visser et al., 2005, p. 129). The tools and techniques are important and often designed when there is strong understanding of the problem's context. More often than once, use of ethnographic information proves to be the foundation for design of such tools. Since there is no universal toolkit for all kinds of products to elicit deep user information as stated above it lends us an opportunity to design toolkits and approaches for vehicle design endeavors (Visser et al., 2005, p. 138).

A newer definition of Design has much more humanistic and inclusive approach.

Industrial Design is a strategic problem-solving process that drives innovation, builds business success, and leads to a better quality of life through innovative products, systems, services, and experiences. Industrial Design bridges the gap between what is and what's possible. It is a trans-disciplinary profession that harnesses creativity to resolve problems and co-create solutions with the intent of making a product, system, service, experience or a business, better. At its heart, Industrial Design provides a more optimistic way of looking at the future by reframing problems as opportunities. It links innovation, technology, research, business, and customers to provide new value and competitive advantage across economic, social, and environmental spheres. (WDO, 2017)

2.8 Concluding Remarks

This chapter navigated through paradigms of enquiry related to the evolution of design methods. Generative Design is the newer approach in design methods, which focuses on 'user as partner'. It is not just a design method but also a shift in paradigm, where users are seen as active participants in the design process. Considering technology trends of our times, it is evident that Participatory Design research methods will increasingly be integral to design studies and practice. User responses would be sought in order to access deep user aspirations to be able to effectively design products and product forms.

Its practice is still however at an infancy stage. There is clear lack of framework or methodology backed by case studies to prove its ability to work with wide variety of products like furniture, automotive, white goods etc. After careful examination of literature, there is a clear need for ways to plan, execute and leverage participatory methods in the Fuzzy Front End of the design process to arrive at context-sensitive design solutions. What tools could prove to be essential mediators to elicit user aspirations, expectations, tacit knowledge and experience while designing a product? Will these be in the form of 'three-dimensional visualization toolkits' (both virtual and real) for the domain of product design? Is there an opportunity to apply/utilize user insights for product explorations by designers based on the use of participatory tools and processes as a part of framework? Designers could get more inspired with informed views of the users' needs and expectations before the act of form giving. Will these

inputs enable them to have a better understanding of the features and functional aspects of products?

The next chapter, at length discusses the process of Participatory Design Method as the focus of this research. Next chapter would help develop a framework of participatory method to be applied to the case example of design development of a personal transport vehicle for Indian context.





CHAPTER 3: PARTICIPATORY DESIGN METHOD

3.0 Introduction

In chapter 1, automobile design/styling practice was examined and the approach for generating new vehicle concepts was studied; and in chapter 2, an overview of the landscape of developments in design research methods was presented and subsequently contemporary approaches that moved from 'design led' methods to 'design research led' methods were covered.

Rapid developments in technology will continue to influence transportation in dramatically new ways. Notions of mass customization; cultural and contextual factors; proliferated application of 3D printing in mobility; building product intelligence into mobility devices etc. will demand that design for the transport domain will have to make inclusive approaches where the focus shifts from the present practice of 'design for the user' to that of 'design with the user'. Needless to say, context will have stronger role to play in designing of vehicles.

This chapter outlines the practice of Participatory Design to lay the foundation for designing of context-sensitive personal vehicle design. It examines in detail the method of participatory design as the basis and precursor for planning and setting up exploratory experiments in design of Personal Transport vehicle for the Indian context.

3.1 Participatory Design Method as Generative Design Method

As stated in the previous chapter, in Participatory Design, users along with designers are involved in the Fuzzy Front End of the design process to generate new ideas. Users may not have the expertise to create detailed concepts or an understanding of the practical factors like manufacturing etc., but they are the best experts of knowing their own experiences. The question is how to elicit those experiences. In that direction, when engaging users in participatory design in the Fuzzy Front End, the task for designer will broadly be three-fold.

Participatory Design Session: The first task is to design generative tools corresponding to the participatory design task at hand. Then allow users to directly participate in a

generative session and illustrate their ideas and concepts in a basic format in the form of sketches, stories, models/ mock-ups etc. (Brandt, 2007)

Analysis: The second task is to analyze the concepts and understand the design requirements that the users have conveyed implicitly in their concepts (Pieter Jan Stappers & Visser, 2007).

Context Mapping: The third task is to interpret, develop and flesh out the concepts - adding and trimming ideas where needed, and combining them into a final concept which would then be reviewed by the users (Visser et al., 2005).

3.2 Participatory Design Model

A qualitative Participatory Design process and its stages has been outlined by Stappers and Sanders (Visser et al., 2005) and is summarized through illustration in Figure 3.1.

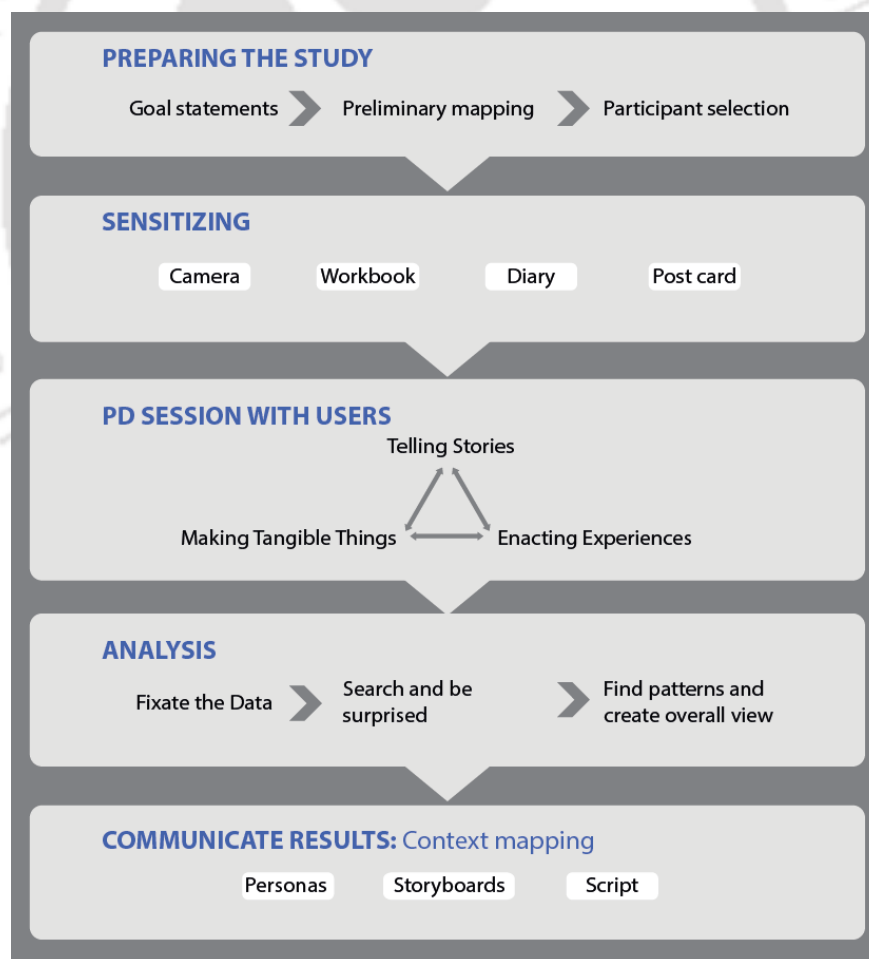


Figure 3.1: Stages of Participatory Design Research

A Participatory Design study entails stages; preparing the study, sensitizing, participatory session with users, analysis and communicating results.

3.2.1 Preparing the Study

In this first stage, researchers choose various methods/tools for the subsequent stages of sensitizing, participatory group sessions, analysis and communication. To arrive at effective methods/tools, it is important to first make a right goal statement of such a study, map current knowledge of the researcher and make an appropriate selection of participants.

PREPARING THE STUDY

Goal statements ➤ Preliminary mapping ➤ Participant selection

Figure 3.2: Preparing the study

Figure 3.2 shows components of this stage of participatory design that are undertaken sequentially. A brief description and remarks of each of these components are listed in Table 3.1.

Table 3.1: Components of 'preparing the study' stage

Goal Statement	<i>A clear and unambiguous goal</i>	• Lends focus and structure to entire participatory design exercise.
Preliminary Mapping	<i>Mapping researcher's knowledge and views from experience</i>	• Ensures that biases are not projected on the participants. • Provides support to researcher in devising instructions for participatory session.
Participant selection	<i>Selecting right participants</i>	• Diverse backgrounds bring rich and diverse discussions • A creative person in group is useful in making visualisations. • Four to six participants for giving ample attention.

3.2.2 Sensitization

The next step involves sensitizing the participants to prepare them for the group sessions. Sensitization (Sleeswijk Visser & Visser, 2006) is important since the effectiveness of the sessions depend on the participants accessing, expressing and discussing their experiences. Sensitizing is a preparatory for participants to freely reflect, wonder, and express their thoughts and dreams before the participatory session. Sensitization package prepares and motivates participants to access their experiences (Visser et al., 2005). They later express these experiences and discuss in group sessions.

3.2.2.1 Sensitizing Package

Sensitizing packages have some roots from cultural probes (Djajadiningrat, Gaver, & Fres, 2000). Figure 3.3 presents different types of sensitizing tools.



Figure 3.3: Sensitizing tools

Table 3.2 shows features of sensitizing tools and the right side shows the guidelines for creating sensitizing package.

Table 3.2: Sensitizing tools and the design considerations

Disposable Camera	Disposable camera to capture pictures in the environment. Pictures with captions provide strong visual material and ensures freedom to participants.	For the objective mentioned, following are the guidelines for creating sensitizing package: The package should be informal and fun to work on but at the same time be professional to ensure seriousness. Subject to be covered in sensitizing through sensitizing tools must be broader in nature. The package imbuing activities
Personal Workbook	A personal workbook to allow fun. Contains questions to answer, stuff to draw and often provided with stickers too.	

Diary	To continuously engage with subject, diary focuses on participants to do, write or draw every day.	should inspire and provoke participants. The package should be designed in such a manner that participants gradually become aware about their experiences.
Post Cards	Contains small exercise, participants receive post cards, answers them and sends back. Element of surprise draws participant's attention.	Should have sufficient blank space that encourages them to write their ideas or comments. Activities should be short and simple and must not take more than 5 to 10 minutes per day.

3.2.3 Participatory Design Session with Users

A group of participants come together to perform generative exercises. They use toolkits/tools to collectively create artifacts that aid them in expressing their thoughts, feeling and ideas. Currently documented tools and techniques of Participatory Design can be explained through the framework developed by (Brandt, Binder, & Sanders, 2012). There are mainly three activities in the framework (Figure 3.4) and each has tools and techniques. Tools and techniques mainly differ in 'form'.



Figure 3.4: Participatory design session with users

The framework of participatory activity comprises of making things, enacting and telling stories (Figure 3.5).

Framework is flexible and users' session can enter from any of the points, the activities tend to fire the next and can go in a loop.

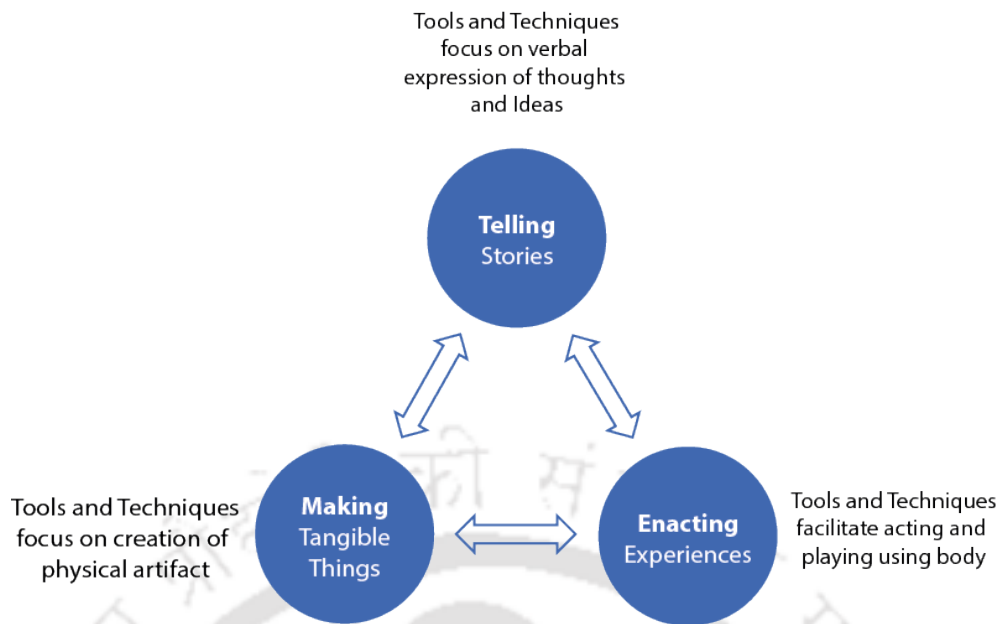


Figure 3.5: Framework of participatory activity

3.2.3.1 Making

Generative toolkits are used to follow a more deliberate and steered process of facilitation, participation, reflection, delving for deeper layers in the past, making understanding. (E. B.-N. Sanders & Stappers, 2014, p. 8)



Figure 3.6: Making tangible things

"Modelling is considered as an important tool for the designer to describe, visualize, and sculpture her thoughts when designing by herself or when designing or communicating with others "- (J Buur & Andreasen, 1989)

"....a prototype is a limited representation of a design that allows users to interact with it and to explore its suitability...." (Sharp, Preece, & Rogers, 2011)

Beyer and Holtzblatt (Beyer & Holtzblatt, 1998) stress the importance of using various prototyping techniques in user centered system design. Different types of Tools and Techniques are used for 'making'. Table 3.3 presents different types of toolkits and significance of each of these techniques respectively.

Table 3.3: Different types of toolkits (Visser et al., 2005), (E. B. –N. Sanders, 2013)

2D Collages	Using Visual and Verbal triggers on the background with timelines, circles etc.	Collaging: Suited for eliciting memories and emotional responses
		
2D Mapping	Using Visual and Verbal components on patterned backgrounds	Mapping: Suited for eliciting intuitive relations of patterns of processes.
		
3D Mock-ups	Using foam, clay, Legos. Velcro models (Colvin, 2007, p. 3)	Modelling: Enables Participants to embody their ideas or give form to their unmet needs
		
Low Tech Prototypes	Improvised prototypes made with very limited resources	
Provotypes	Design artefacts from future	
3D space models (small scale)	Such as doll house toolkit	

In earlier phase of research, concrete and abstract toolkits with two variants of each were developed for conducting the experiments (Nishant Sharma, 2011). The results of the experiments demonstrated the influence of types of toolkits in the participatory research.

3.2.3.2 Enacting

User participants use above mentioned tools to act, enact or play to express their envisaged experience.



Figure 3.7: Acting, Enacting and Playing

Some of the tools/techniques found in the literature are listed in Table 3.4

Table 3.4: Tools and techniques for enacting. (E. B. –N. Sanders, 2013)

Game boards and game pieces and rules for playing
Props and black boxes
3-D space models (full scale)
Scenario-making in the space models or through sand play
Participatory envisioning and enactment by setting users in future situations
Improvisation
Acting out, skits and play acting
Role playing with actors, pretenders, puppets, dolls etc.

3.2.3.3 *Telling*

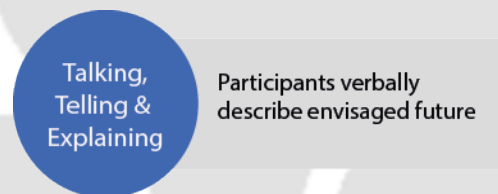


Figure 3.8: Talking, Telling and Explaining

Some of the tools/techniques that are found in the literature are listed in Table 3.5.

Table 3.5: Tools and techniques for telling. (E. B. –N. Sanders, 2013)

Stories and storyboarding through writing, drawing, blogs, wikis, photos, video etc.
Diaries and daily logs through writing, drawing, blogs, photos, video etc.
Self-observation through photos, video, blogs, writing, drawing etc.
Documentaries and movie-making
Experience timelines or maps
Paper spaces to collect, organize, categorize, reframe, chart and/or make decisions about ideas or concepts through group brainstorming and collective mind mapping.
Cards to organize, categorize and prioritize ideas. The cards may contain video snippets, incidents, signs, traces, moments, photos, domains, technologies, templates and what if provocations.
Voting dots to prioritize ideas.

3.2.3.4 *General Principles to devise tools and techniques*

Some general principles found in literature for deciding methods and tools for telling, making and enacting (Visser et al., 2005) are listed in Table 3.6.

Table 3.6: Methods and Tools for telling, making and enacting (adapted from (Visser et al., 2005))

Methods and Tools for Telling, Making and Enacting	<i>vary according to time and stage of new product design development process from early to later stage</i>	• Initial stages with deal with dreams, visions and experiences. • In the later stage, narratives, scenarios and artefacts resemble the objects, services and environment.
Methods and Tools for Telling, Making and Enacting	<i>vary according to the level of planning involved</i>	• Impromptu approach can quickly be implemented. Carefully planned toolkit may take time to implement but they still need to be ambiguous enough to be termed generative. • Impromptu toolkit may have risk of being open-ended for novice participants but carefully planned can motivate participants. • Poses difficulty in predicting length of session. Length of session can be planned. • Open ended responses are difficult to analyze. Analysis is efficient and effective.
Methods and Tools for Telling, Making and Enacting	<i>Vary in terms of materiality</i>	• Depending on objectives of participatory research, tools can be 2D or 3D but they should have sufficiently enough components for multiple and unique combinations.
Methods and Tools for Telling, Making and Enacting	<i>Vary in how people are put together for their use</i>	• There are two ways of involving in the activities: participation and collaboration. • A participant might work on something of their own, such as narrating a story or creating a collage to express their thought or feelings.
Methods and Tools for Telling, Making and Enacting	<i>Vary in scale</i>	• The scale of tools and components vary in scale depending on whether they are used for individual or group applications
Methods and Tools for Telling, Making and Enacting	<i>Vary in terms of purpose</i>	• There are two categories of generative tools and techniques: cognitive and emotional. • Cognitive tools prompt and facilitate people to explore and express how they understand things or events.

- Emotional tools prompt and facilitate people to access their memories and experiences, communicate their feelings and aspirations for the future.

3.2.3.5 Conducting Session

RECORDING THE SESSION

Once participants open up by expressing their experience, feelings, thoughts and ideas, they would want to continue sharing them with others. This informal session delivers lot of useful information. Therefore, it is very important to record the session in complete detail. Video and audio recording is typically used, along with notes made by the researcher.

FACILITATE THE SESSION

The facilitator must lead the session with full attention and the ability to observe, concentrate and intervene if required. He or she may guide participants in a step-by-step manner. The important thing to remember is, the facilitator must assume participants to be experts on the subject and participants must feel themselves as experts. Since there is nothing wrong in any utterance, action, facilitators must tell participants that every opinion, experience would be respected.

3.2.4 Analysis

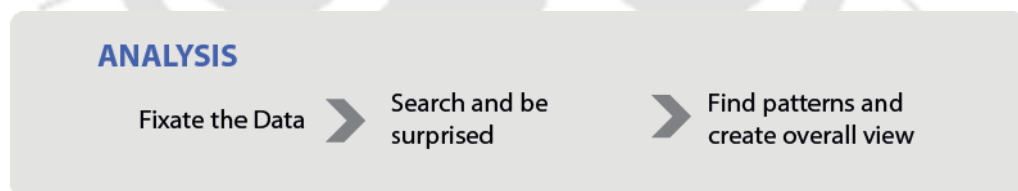


Figure 3.9: Analysis

Output of generative session is rich, complex and provides diverse set of unstructured qualitative data. In the session, stories and anecdotes while ‘making’ artifacts are recorded on video and audio. So, there are lot of visuals and stories. Visuals and stories are intertwined and have relationships. For such fragmented multilayered data, analysis tools such as Zmet (Coulter, Zaltman, & Coulter, 2001) would not suffice. Resorting to grounding theory (Corbin & Strauss, 1990) for analysis from data, the three-phase

structure (Figure 3.9) is recommended which allows a researcher to find patterns. Table 3.7 explains these stages (Visser et al., 2005) in detail.

Table 3.7: Stages of analysis

1. Fixate the data	Researcher meticulously documents various thoughts and remarks immediately after he facilitates the session. Video and audio recordings are transcribed to text as it would be easy to annotate and highlight.
2. Search and Be Surprised	Researcher searches for interesting indicators in the raw data i.e. tapes, transcripts and artefacts. Researcher checks out for the nature of topics discussed, reasons for mentioning topics, specific quotes, ideas and so on. Researcher uncovers layer of information and is ready to be surprised by the insights that come up. Post-it notes can be made to be able to arrange and re-arrange for further analysis.
3. Finding Patterns and Create Overall View	The collated data, notes and annotations can be arranged and re-arranged to detect underlying patterns or recurrent themes. It is advisable to work spatially on big walls so that broad overviews are created and patterns and themes can be shown visually.

3.2.5 Communicating the Knowledge to Design Team

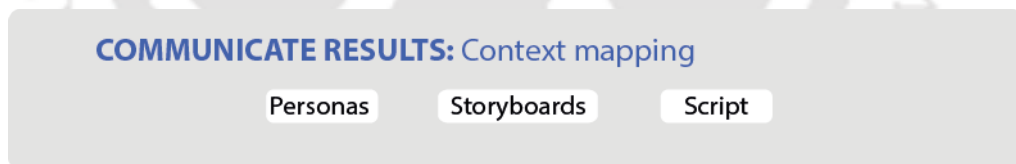


Figure 3.10: Communicate results (Context mapping)

Once analysis is done, it is pertinent to share the results and findings with multidisciplinary team (Sleeswijk Visser, van der Lugt, & Stappers, 2007) viz. designers, marketing, engineers, financial managers, marketing managers and public relations managers. Designers need this information for them to be informed and inspired for concept generation in the early phases of development process. Traditional methods like reports, diagrammatic form of ethnography data will not work because the data is multifaceted, multi-layered and deals with functional and affective aspects. More visual

and descriptive approaches are necessary to communicate such complex data effectively as the main objective is always on creating empathy for users in the design team.

One effective approach is to present the findings as a compilation of carefully selected raw data with clues for interpretation. The key themes, patterns and relations can be presented using anecdotes. Visuals of created artefacts and also sensitization packages can be used to illustrate relationships. Effective use of typography, diagrams and illustrations are useful for designers. Narrative structures like Personas, Storyboards and script are gaining popularity, as they consolidate findings into stories of 'Real People' thus prompting the designer to understand and empathize with users in a deeper way.

3.2.6 Conversation Analysis in Participatory Sessions: Ethnomethodological Method

Ethnomethodology, a radical form of sociology formulated by Harald Garfinkel (Garfinkel, 1967) generally include a variety of methods of inquiry; ethnomethodological ethnography (Wieder, 1974), conversation analysis (G Psathas, 1995) self-observation (Rodriguez & Ryave, 2002) and membership categorization analysis (Hester & Eglin, 1997). Ethno-methodologists investigate the everyday methods people use in their social affairs. There is a focus on concrete activities, which are coeval with an intelligible organization that actors already provide and that is, therefore available for scientific analysis. Members of society achieve this intelligible organization through actual, coordinated, concerted, procedural behaviors or methods and practices.' (Maynard & Kardarsh, 2007). The present participatory research uses conversation analysis as a technique for demonstrating the orderliness of talk-in-interaction. Conversation Analysis is a qualitative analysis method used in social interaction that is inductive and micro-analytic in nature (Giouzele, 2009). This technique is increasingly being used in participatory analysis.

Participatory researchers employing conversation analysts use audio and video recordings of interactions occurring in the most natural formats rather than scripted or constructed. The recordings are then replayed many times to write a transcription of the participatory interaction of the group. Gail Jefferson (Gail Jefferson, 1990) developed conventions used in transcribing a talk in conversation analysis. Effective

transcripts for participatory analysis shows effective speech, laughter, silence & its length, bodily conduct, gazes, gestures etc. For body behaviors Mondada's (Mondada, 2006) conventions can be used. Researchers aim for richer data that can be obtained using high end technology and high definition cameras and audio recorders.

Additionally, as discussed later in chapter 6, our focus on 'the sketch' for participatory interaction, relies on recent developments within conversation analysis which have brought to bear the wealth of semiotic resources in interaction other than language (Goodwin, LeBaron, & Streeck, 2011).

3.3 Concluding Remarks

Participatory Design Methodology is in its evolving stage and continues to embrace new tools, techniques and methods. It was learnt that people explore their unmet needs when they engage in the process of making mock-ups and prototypes in generative sessions. Tools/toolkits design therefore becomes important as it has a significant bearing on making a participatory research effective. Tools may vary on the basis of purpose, scale, materiality, time of engagement etc.

Participatory design researchers have published some case examples in the domain of industrial design to underpin participatory research. There is however an opportunity to devise a participatory approach for vehicle design since there hasn't been sufficient research work or case studies from practice of vehicle design. With the given framework of Participatory Design and using personal transport design as a case examples, unmet and tacit needs of users may be accessed.

This research takes cues from collective modeling/prototyping and looks at the possibility of exploring tools and techniques specific to transport design before attempting to conduct Participatory session with users. The next chapter will present the evolution of different designs of 3D toolkit for a case study in personal transport design. The chapter then presents participatory session with different user groups and analysis of the Participatory Design session.



CHAPTER 4: PARTICIPATORY DESIGN

EXPERIMENTS – GAINING CONTEXT-SENSITIVE INSIGHTS WITH END USERS

4.0 Introduction

This chapter presents overall structure of experiments, planning of participatory design research experiment and conducting experiments. These experiments would aid in evolving a context-sensitive approach in design of personal transport vehicle for Indian users. As indicated in chapter 2 (literature review) and chapter 3 (participatory design), participatory design methods will be used in experiments that would be structured on the three basic stages of the design process viz. research, ideation and evaluation. The participatory method involves a ‘bottom up’ approach that is introduced during the early Fuzzy Front End of the creative problem solving process. It attempts to gain tacit insights and aspirations from target users that help requirement capture through a series of experiments. These insights systematically contribute towards evolving the design brief for the expert design team engaged subsequently in developing and translating these insights into design concepts.

These experiments involve proactive engagement and involvement of novice end user with expert design group. The chapter presents:

- a) Outline of overall approach undertaken in this thesis research
- b) Developments in design toolkit specific for vehicle design and its evolution.
- c) Planning and conducting participatory experiment with novice aspirants and subsequently analyzing the results to obtain insights.
- d) Formulation of design brief for specialist designers.

4.1 Outlining a Structure for Conducting Research Experiments

Participatory research experiments were developed for devising context-sensitive approach for vehicle design,. These experiments were developed over typical vehicle

design processes that comprise of – Fuzzy Front End (FFE) phase; design phase and evaluation phase (Table 1.1). Participatory experiments in these three phases are required to generate context-sensitive information through participatory research with novice users. This information after analysis translates into a visual brief (Fuzzy Front End phase). Trained designers engage with visual brief to conceptualize the holistic vehicle product (design phase). Finally, to round it off, Participatory evaluation of concepts by users (evaluation phase) is done. Basic outline is shown in Figure 4.1.

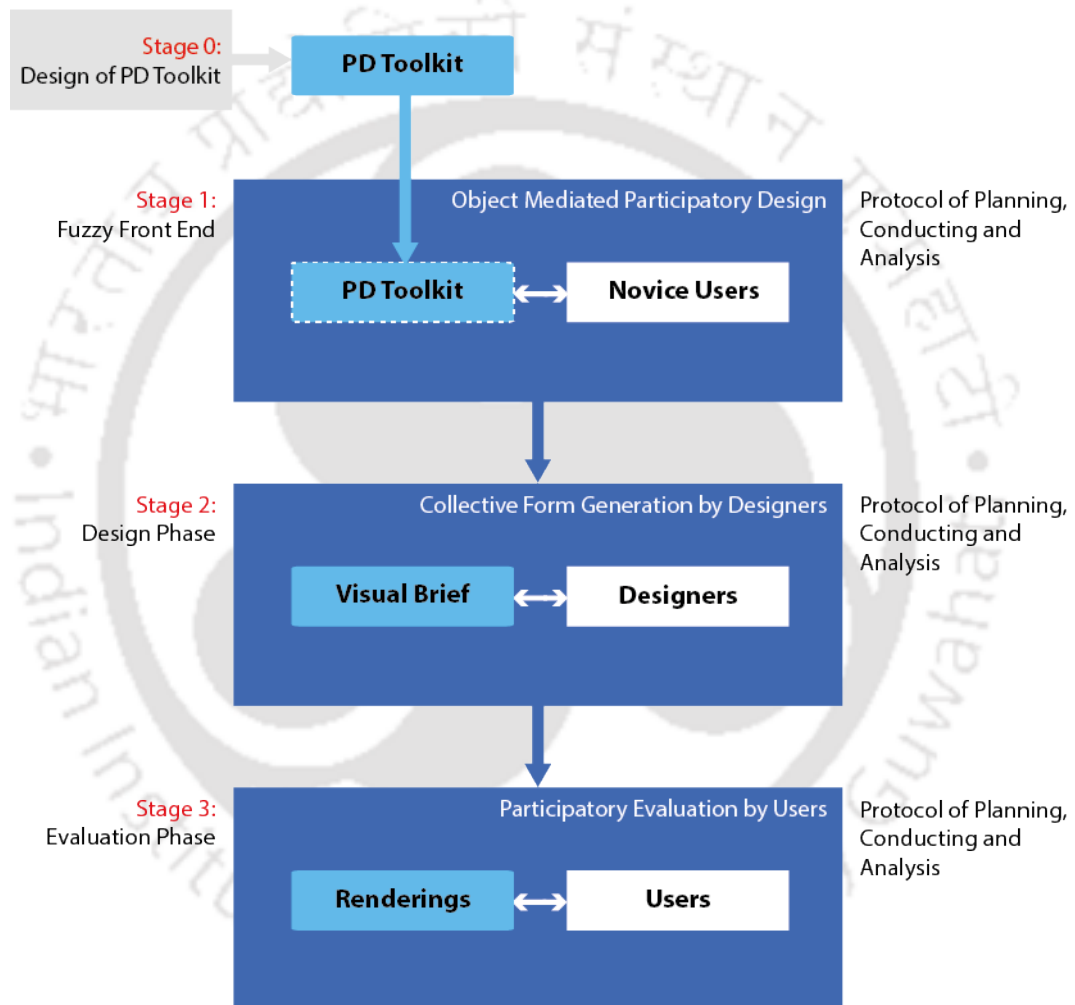


Figure 4.1: Basic Outline

Envisaged as evolving research, learning from each experiment would feed into subsequent experiment. Each stage of the framework will have the following components: a) Planning of Participatory Research, b) Conducting of Qualitative Participatory Research and c) Qualitative Analysis. The protocol of each of these will be developed and elaborated as it progresses to the next sections. There are three

stakeholders in participatory process; users as respondents, designers as facilitators and designers as form givers.

Following are the details of experiments:

Stage 0, Stage 1:

- Design and development of three-dimensional concept simulation/ generative kit as aid for novice end user for identification and capture of product aspiration during Fuzzy Front End FFE of design process. This experiment explores the Fuzzy Front End of the design process following a participatory design method (PDM) to help bring to the surface tacit knowledge, aspirations amongst targeted novice Indian users
- The above experiment in PDM is planned to be repeated abroad with international design groups during design workshops/ clinics held during the International Participatory Design Conference (PIN-C).

Stage 2:

- The aspirational need requirements of end users from the product form the design brief for domain experts (trained student automobile designers). Their task is to visualize and translate the identified aspirational product requirement into tangible visual form through product sketches and drawings. These Concept illustrations are subject to visual refinement in the form of renderings by trained expert stylists.
- Data captured of this process is further processed through video analysis-engaging expertise of international experts to understand the participatory process of form creation and the role that sketches play in this process.

Stage 3:

- The final concept renderings are then subject to confirmatory testing with the targeted end user group following a participatory method that is recorded to capture the responses of end users.
- Dialogue Analysis, Video Analysis engaging the expertise of an international expert, all help to validate and confirm the gains of PDM and their contribution to the Design process.

Research methodology employed in the entire thesis is 'Qualitative' in nature drawn from the collective responses from novice and expert user groups. The data obtained from the experiments would be rich in the form of pictures, videos, audio, and sketches. The data would be qualitatively analyzed.

4.2 Stage 0: Design of PD Toolkit - Design and Development of 3D Generative Toolkit as an Aid for Requirement Capture

4.2.1 Designing a New Toolkit:

It was clear from the literature review that there was a need of 3D participatory toolkit for conducting experiments. Mock-ups and prototype (Refer chapter 3) help elicit user's tacit knowledge. As per research studies (P J Stappers & Sanders, 2003), toolkits can be designed specifically for the product/project in question. It threw an opportunity for this research to develop a new toolkit that will be appropriate for the context of vehicle design. Figure 4.2 shows the stage-wise design of the toolkit and its application.

Current toolkits like Lego, Velcro etc. have limited flexibility being able to get constructed in fixed pattern offerings. They have limitations in eliciting interiors and exteriors of vehicles. After carefully examining the literature review, it was noticed that there was no participatory endeavor and toolkit design for vehicle design. To facilitate a PDM, a 3D participatory toolkit specifically suitable for the case study is required. It was felt that users may get excited by new and fresh ways of 'making'. Understanding the main objective of research, it was decided to pursue the design of toolkit with the considerations presented in Table 3.6.

The essential considerations for the design of PD generative toolkits is to enable elicitation of tacit knowledge among a cross section of socio-cultural population and to gauge their aspirations for vehicles design other than two wheelers and four wheelers.. The toolkit should be inviting, easy to use so as to help them to conceptualize these other possibilities.

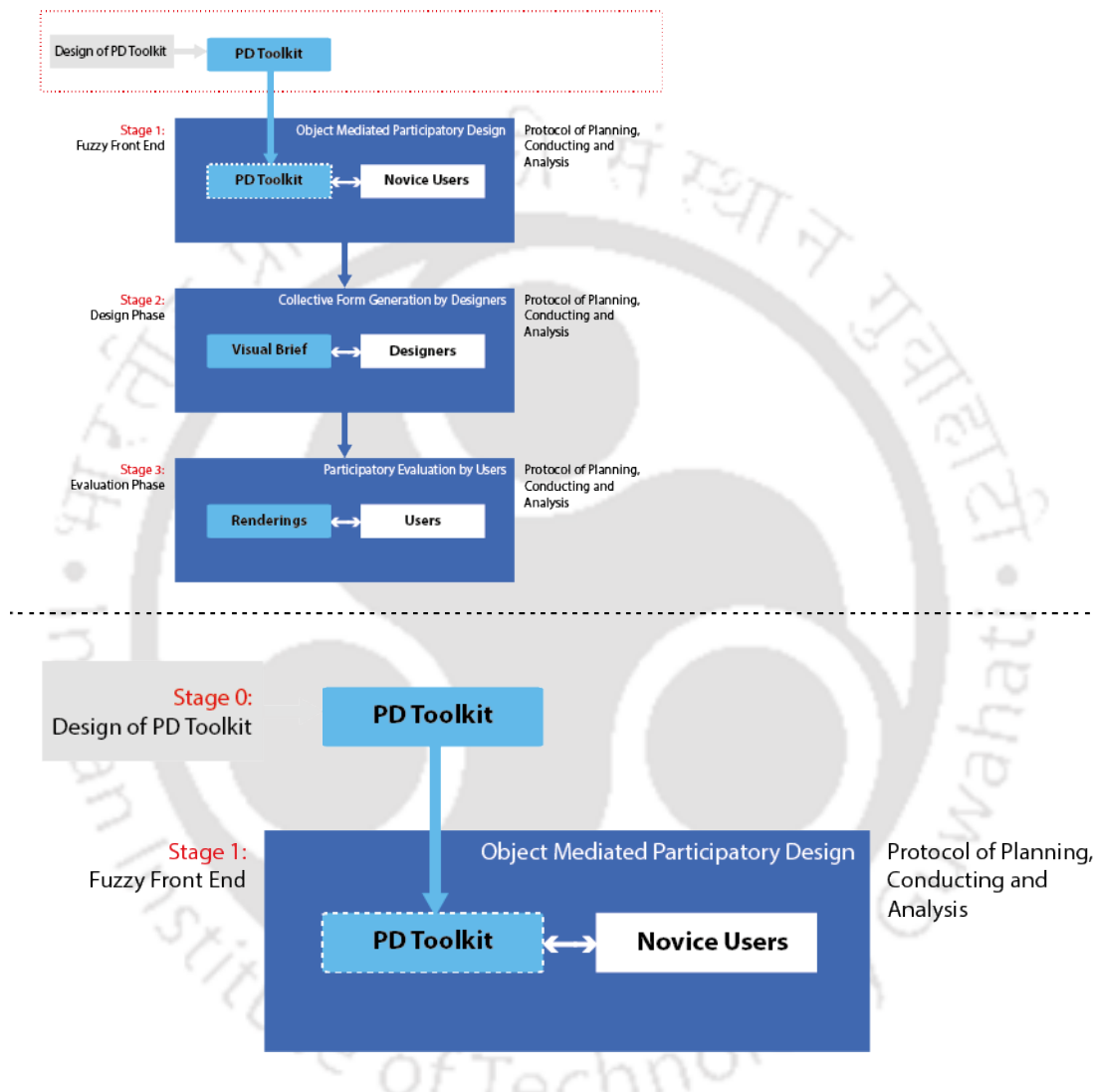


Figure 4.2: Toolkit Design and object mediated participatory design

This subsection presents different stages of toolkit development; the lessons learnt in making variants of toolkits and finally present discussion/concluding remarks. The development process of the toolkit in itself forms an important contribution to this research and is covered in great detail in this subsection because of evolving nature of research with reflections of researcher.

4.2.2 User Centric Way of Designing Generative Toolkit

This researcher's former professional experience in vehicle design and his engagement in conducting observation research covered earlier in Chapter 1 form a precursor to this researcher's strong interest in user-centric research studies. Having experience in practice of designing two wheelers and cars in the industry, the researcher became a reflective practitioner (Schön, 1983). This forms the inspiration and motivation for a user-centric Participatory Design Method (PDM) approach for designing a toolkit for vehicle design. Participatory approach to development of the toolkit could be designed by user centric approaches and would perhaps germinate from potential users and would embed needs of potential users. It was felt that this approach of user-centricity would always keep the spirit of users alive from the very start in the entire participatory framework.

The following stages were undertaken to design the participatory toolkit:

- 1) Accessing Users Responses to attain design insights.
- 2) Conversion of insights into design features for a 3D participatory toolkit.
- 3) Integrating Design features into a coherent product.

4.2.2.1 *Accessing Users Responses to attain design insights.*

Using a simple questionnaire, responses were sought from ten diverse respondents. The diversities were in terms of age, socio-economic status and region. Six respondents, who were users of either two-wheeler or four-wheeler were identified. They were diverse in age, profession and vehicle ownership. They were given a small questionnaire (Appendix 1). The questions inquired of personal experience of participant such as

- 1) List five positive attributes of use of two wheelers?
- 2) List five positive attributes of use of cars?

Respondents were encouraged to bring forth responses from their experiences, incidents and anecdotes. The responses were collected and coded (Appendix 2). Using affinity analysis, their coded responses were spread on table (Figure 4.3A). Responses with similar attributes found affinity and were clubbed together (Figure 4.3B) under new heading, generating Key insights (Appendix 3)



Figure 4.3: A Coded responses spread on table Figure 4.3:B Affinity analysis with coded responses

From Key insights, design insights were drawn. Table 4.1 summarizes the approach.

Table 4.1: Analysis to arrive at design insights from key insights

CODE	KEY INSIGHTS	DESIGN INSIGHTS
US4WG04_005, US4WG05_004, US2WG05_006, US4WG07_005, US4WG10_004	A vehicle should have ability to carry luggage Small to Large Luggage. High usability.	Efficient Luggage carrying luggage capability from small to large.
US2WG03_005, US2WG05_005, US2WG05_007, US2WG08_001, US2WG01_002, US2WG03_003, US2WG04_003, US2WG07_007, US2WG10_002, US2WG10_005	A low maintenance cost with high durability and reliability. Cost of owning the vehicle should be low. Operational cost of the vehicle should be low.	High durability with low operational and maintenance cost.
US2WG01_004, US2WG02_001, US2WG02_002, US2WG04_004, US2WG06_001, US2WG07_003, US2WG09_001, US2WG10_004	Experience of wind in the open vehicles give a pleasurable experience. Sync with nature is a pleasurable experience.	Flexibility to have the pleasure of feeling nature and wind
US2WG01_001, US2WG03_001, US2WG04_002, US4WG05_002, US2WG05_002, US2WG05_004, US2WG07_001, US2WG07_006, US4WG09_003, US2WG09_002, US2WG09_003, US4WG10_006, US2WG10_001, US2WG03_002, US2WG05_003, US2WG09_004, US2WG09_007	A vehicles should be easy to operate and handle The vehicle should have high maneuverability even in the crowded places. The vehicle should be easy to park with least footprint.	An easy to handle, drive, maneuver and should have small footprint
US4WG01_005, US2WG01_003, US4WG03_005, US2WG04_001, US2WG05_001, US2WG07_002, US2WG07_005, US2WG10_003, US2WG03_004, US2WG06_002, US2WG06_004, US2WG08_002, US2WG09_005, US2WG09_006	Speed is usually associated with Thrill. Fun and thrill are often associated with speed. The feel of travelling in Four-wheeler is better than two-wheeler.	Two-Wheelers have more thrill, however the feeling of Four-wheeler is better
US4WG01_004, US4WG03_002, US4WG04_002, US4WG04_003, US2WG04_005, US4WG06_003, US4WG07_008, US2WG07_004, US4WG09_004, US4WG09_005, US4WG10_005, US2WG04_007	A vehicle should allow people to travel in a family or in a group It allows people to converse and interact with friends and family. However, the vehicle should A vehicle should be suitable for long drive.	People need more interactive seating space.
US4WG01_001, US4WG03_001, US4WG05_001, US4WG05_003, US4WG07_001, US4WG08_003, US4WG10_001, US4WG10_002, US4WG10_003, US4WG01_003, US4WG03_004, US4WG04_006, US4WG05_006, US4WG06_002, US4WG07_003, US4WG08_001, US4WG09_001	Closed vehicle should protect well from noise, pollution, hot sun and rain. It should also protect from mild impacts. A vehicle should give a feeling of security	Vehicle should be rugged and show express sense of security
US4WG03_003, US4WG04_004, US4WG06_005, US4WG07_002, US4WG07_007, US4WG09_002, US4WG08_002, US4WG02_001, US4WG02_002, US4WG02_003, US4WG06_004, US4WG07_004, US4WG07_006, US4WG01_002, US4WG04_001, US2WG04_006, US4WG06_001, US4WG06_006, US2WG06_003, US4WG05_005	A vehicle should give pleasure of riding with no pressure of driving even in the narrow lanes. A vehicle should allow to have one's own private space to indulge.	Vehicle needs to be maneuvered without losing any pleasure of driving.

4.2.2.2 Conversion of Design Insights into Design Features

Essential design components, in their coherence, define the type of vehicle and proportions. Toolkit must be designed in such a form that many possible variations and configurations could be made. Therefore, toolkits must have design features that facilitate them to create multiple manifestations when they are given to user participants. From researcher's own experience as practitioner, four design components for this specific research were identified. These were - 1) Passenger, 2) Chassis/ Frame, 3) Wheels, 4) Luggage.

Table 4.2 highlights the design features of the toolkit.

Table 4.2: From design insights to design features

DESIGN INSIGHTS	DESIGN FEATURES
Efficient Luggage carrying. luggage capability from small to large.	Variation of Luggage
High durability with low operational and maintenance cost.	Simplicity of Construction
Flexibility to have the pleasure of feeling nature and wind	DLOs and open spaces
An easy to handle, drive, manoeuvre and should have small footprint	Flexibility for frame and architecture
Two-wheelers have more thrill. However, the feeling of Four-wheeler is better	Re-configurability for 2w, 3w and 4w
People need more interactive seating space.	Scale and configuration of seating space
Vehicle should be rugged and should express the sense of security	Ability to showcase both open and closed
Vehicle needs to be manoeuvrable without losing any pressure on driving.	Flexibility of cab & luggage location

As seen in Table 4.2, the key words that appeared for different elements of vehicles were: variation, flexibility, re-configurability, and scalability. The ideas and user insights for vehicle in such a 3D toolkit can be reduced to four basic components. The toolkit

should offer - 1) Flexibility: number of passengers, location of cab, luggage and wheels, 2) Scalability: frame and architecture 3) Variability: luggage and 4) Re-configurability.

4.2.2.3 Integrating obtained Design Features into a Coherent Product

Design of toolkit was undertaken by superimposing entry level two-wheeler over four-wheeler in different views (Figure 4.4). Wheel was identified as the basic unit and the proportions of rest of essential components viz.; passenger space, chassis/ frame & luggage were devised based on wheel. A library of variations of these components would become part of participatory toolkit. It was obvious from overlapped images that wheelbase and wheel track were important attributes of the toolkit to allow users to visualize a 2-wheeler, 3-wheeler or 4-wheeler vehicle. Therefore, smooth movements in both x and y-axis was required to allow various wheel positions.

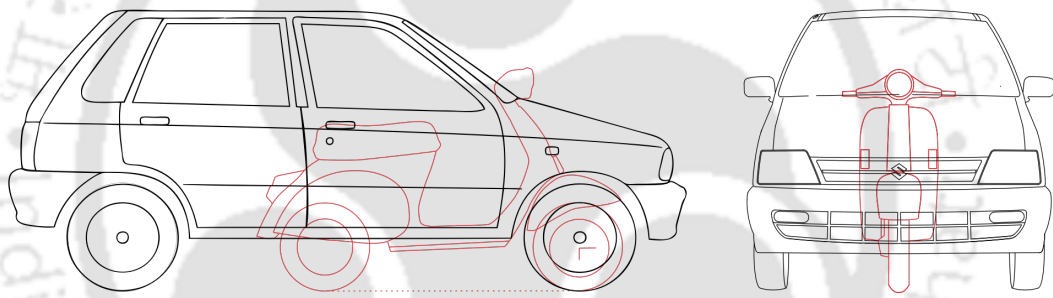


Figure 4.4: Superimposing two-wheeler over four-wheeler

Once wheels were configured, the kit shall allow plugging in of other essential components, enabling users to elicit expectations and aspirations. An example of exploratory polystyrene foam model is shown below (Figure 4.5).

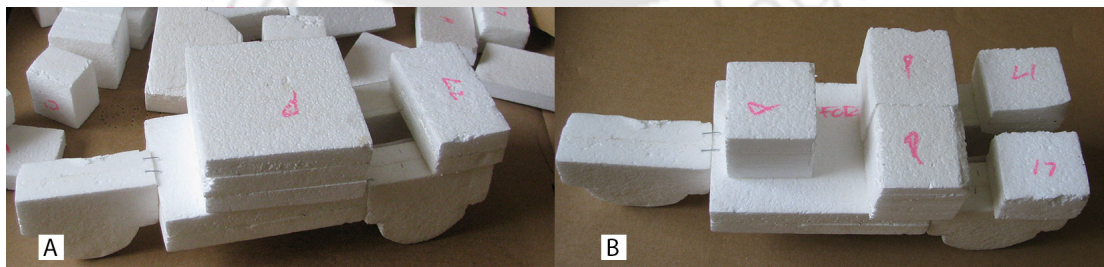


Figure 4.5: Quick polystyrene foam mock-ups joined by Blu-tac

When the mockup functioned satisfactorily, it was required to develop actual toolkit with all the possibilities mentioned above for - flexibility, scalability, variability and re-configurability.

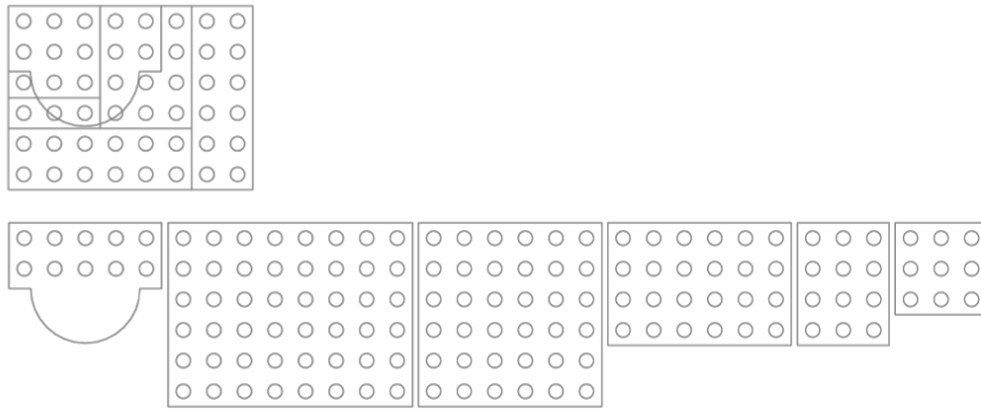


Figure 4.6: Making the grid with the reference of the wheel and generating the modules

Grid patterns were explored (Figure 4.6) and all the components were made based on the grid. Grid was a critical part of toolkit design. Please refer to Drawing (Appendix 4A). The family of shapes needed to work coherently from all sides. Also, it was required to consider sufficient tolerances so that when it is made, it would fit without any error. Once grid was finalized, a 3D CAD model was developed (Figure 4.7).

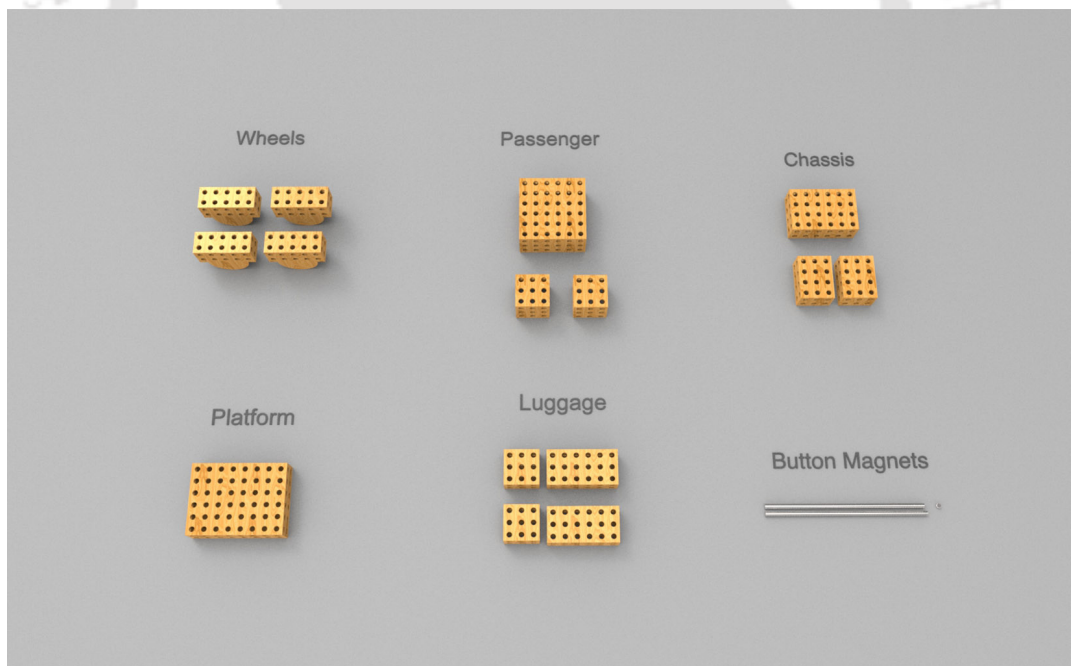


Figure 4.7: Abstract toolkit with all elements

PROTOTYPING

The participatory toolkit, was made with laser cut MDF board with holes. Steel sheets were placed inside the modular elements (Figure 4.8). The holes and button magnets were used to allow plug and play action while using the kit (Figure 4.8 A, B). The color

of all elements was kept same in order to avoid any bias while generating concepts through the toolkit. Further, in this modular participatory toolkit, the size of all essential components shares a proportional relationship. This relationship is important to keep the toolkit simple and effective.

For quick and easy joining of the components, button magnets were used. Thin steel sheets were planned on the inside wall of the components for the magnets to latch on. MDF was chosen for toolkit over acrylic and polystyrene as former is less glossy and reflective and has nice feel to touch. MDF kit was laser cut with holes in the grid pattern with each hole of diameter 0.5mm larger than magnet diameter to allow magnets to comfortable sit in.

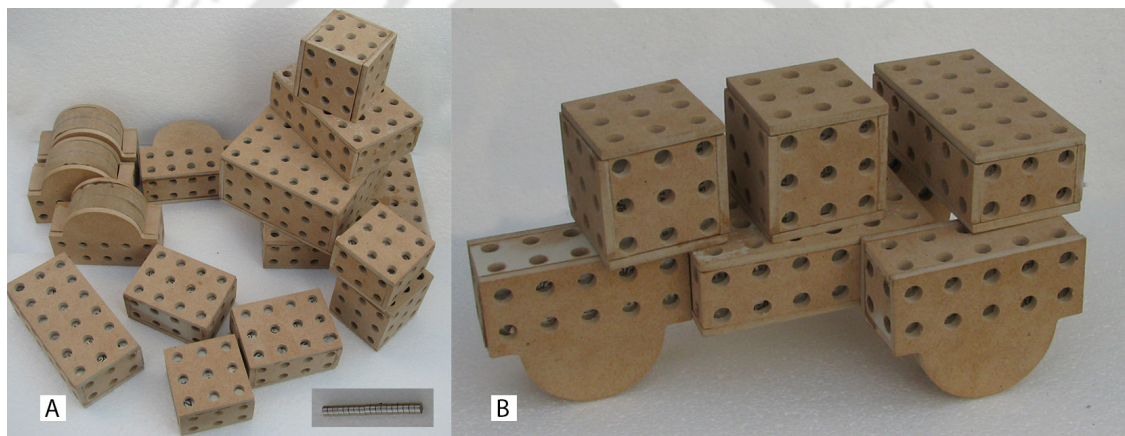


Figure 4.8: Fabricated toolkit and button magnets

The exercise was time-consuming, but at the end, it turned out to be quite playful especially with magnets. However, separating magnets was not easy as to join two blocks one needed two magnets. The prototype allowed better flexibility in assembling the blocks, because the joining elements were (button magnets) not a part of the blocks. Thus, allowing wider possibilities than LEGO blocks. See final drawing in Appendix 4A.

4.2.2.4 Pilot to test the toolkit:

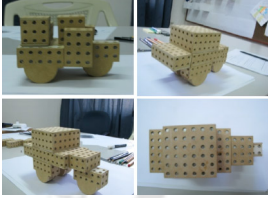
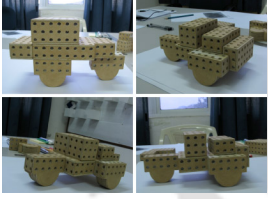
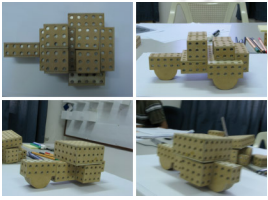
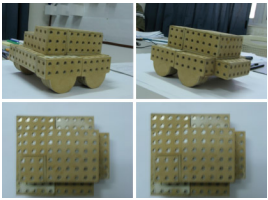
Immediately, when the kit was ready, one pilot study was conducted with postgraduate students of IIT Guwahati. They were explained about the toolkit. In a group of four, they were given this toolkit. They were asked to design a vehicle, collectively, that can bridge the gap between two-wheelers and cars in India. Initially they hesitated but once they finished the first form, they were quite fast in subsequent concept generations. Two

groups used the kit, both groups were able to make around 6-7 concepts with the toolkit in 30 minutes. After each concept the researcher wrote about the concept they made and captured images.

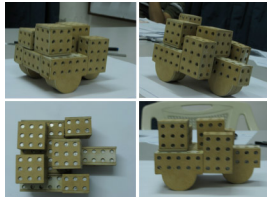
EXAMPLES OF USE: PILOT EXPLORATION

The use of toolkit explained through an example (Table 4.3) by a group that was a part of the pilot study. The group comprised of four post graduate students of IIT Guwahati-India. Output was categorized it into three parts: 1) Vehicle Configuration 2) Cab and proportion 3) Luggage.

Table 4.3: Pilot study

CONCEPTS	VEHICLE CONFIGURATION	CAB & PROPORTION	LUGGAGE
	3wheel, large ground clearance, rear wheel compact, front wheel is forward	3 seater, high seating, seating above rear wheel	Luggage space above front wheel, cantilever luggage space at rear
Concept 1			
	3 wheel, low ground clearance, separate front wheel	4 passengers, distribute it front rear row	Luggage space extending front rear of cabin
Concept 2			
	2 wheel, low ground clearance, separate front/rear wheel	4 passengers, low seating	Wide chassis at rear
Concept 3			
	4 wheel, wide and compact	5 passengers, cabin is more on rear	Extended luggage space

Concept 4



3 wheel, compact vehicle,
separate front wheels

3 distinct seats

Luggage space on sides
of driver

Concept 5

QUICK ANALYSIS OF THE PILOT

It was noticed during the session and by going through pilot samples that the participants were able to elicit their deep aspirations through concepts. However, a pattern was observed in the concepts. They were very futuristic and in some case non-realizable. It was clearly visible that the toolkit empowered pilot participants to think in futuristic terms. Some concepts were reported beyond their capabilities. They reported this in an informal discussion after the pilot.

REINFORCING TOOLKIT DESIGN

After carefully looking into data obtained, the design of the toolkit was reinforced. Results of the pilot example added with design features, documented below (Table 4.4), highlighted the appropriateness of the participatory toolkit developed for vehicle design in the case study.

Table 4.4: Appropriateness of toolkit tested through pilot study

S. NO.	DESIGN FEATURES	RESULTS FROM EXAMPLE
1	Flexibility Number of passengers Location of cab, luggage and wheels	Multiple possibilities-Number of passengers. Number of wheels, wheel location dictates the concept and makes vehicle look compact or wide. Various possible locations of cab space as per users' choice.
2	Scalability Frame and architecture Scale in z axis (height)	Variations in the ground clearances. Variations in seating/ cab height.

3	Variability Luggage	Variation in the size of luggage. Various possibilities of boot spaces on all sides of vehicles.
4	Re-configurability Various possible configurations of 2-wheelers, 3-wheelers and 4-wheelers	A good mix of 2,3 and 4 wheelers in the concepts. Within a particular definition of product, various possibilities in terms of location of wheels, wheel track and wheel base.

4.2.3 Leanings from the First Toolkit

It was evident from the pilot test that the toolkit proved effective in mediating the participatory design process. It was also noticed that the outcome of the use of such a toolkit was resulted in responses that are very futuristic and ones that will not be realizable in the near future. It can be concluded that including the toolkit enabled users to respond with ideas based on tacit knowledge and futuristic ideas. But these responses are still context-sensitive being a group exercise and are not necessarily random in nature. This being a group exercise, the outcome reflects deeper tacit knowledge and aspirations of user groups.

As per Sanders, this kind of toolkit can to be called an impromptu toolkit (E. B. –N. Sanders, 2013). However, it was never the intention of making a toolkit that resulted in ideas that offered only futuristic responses. At this point of time, it became necessary to know how the toolkit could be used to prompt both futuristic and also more contemporary solutions for immediate needs. A toolkit which has more clearly defined design elements for set boundaries was considered. For reference, the terminology ‘Abstract’ was used for the former toolkit and ‘Concrete’ for the latter. It can be called ‘carefully designed toolkit’ (E. B. –N. Sanders, 2013). Considering ‘Abstract and Concrete’ as two ends of this conceptual spectrum, a range of four types of toolkits were now envisaged for setting up the experiments.

The next section will elaborate the design of concrete toolkit as it unfolded.

4.2.4 Design and Fabrication of Concrete Toolkit

This section will explain design considerations in developing the 3Dimensional 'concrete' toolkit and fabricating it.

4.2.4.1 Design Considerations

Carefully designed 'concrete' toolkit needed to have elements that are identifiable and offered less abstraction.

Passengers: Passenger components must look like human beings rather than 'abstract' boxes. When user participant picks up this element, he/she becomes conscious of human being's limits, strengths, experiences (both physical and psychological needs). However, as designer practitioner himself, the researcher is aware of the fact that both seating postures in two-wheeler and four-wheeler are different. Same toolkit must allow participants to come out with variations in configuration. It is a design challenge.

Luggage: More realistic luggage boxes should be planned with different volumes and sizes. A participant must be able to pick and choose from different volumes of luggage boxes, which in turn gives us their clear requirement. It was also more important to allow users to have flexibility of placing it anywhere as per their requirement.

Wheel: After first prototype and with the researcher's own experience, wheels are the most important aspect of the participatory toolkit. The way wheels are placed in the side-view and front-view decides wheelbase and wheel track. Flexibility must be offered for options between choice of two-wheeler, three-wheeler, four-wheeler or more. After careful thought, wheels assumed the starting point of the participatory activity. So, the challenge was to arrive at a model that first allows placing specific number of wheels and some rough wheelbase. However it being a flexible system, the participant is free to change numbers and arrangements freely.

Frame/Body: The participatory toolkit must allow a good body or frame for the basic configuration of vehicle to be identified. When designing, care has to be taken to avoid any biases for/against any vehicle configuration. The designed configurations could be scooters, motorcycles, cars, three-wheeler vehicles etc. Once these considerations were

articulated, it wasn't difficult to imagine that there is an inherent sequence in such toolkits starting always with wheel and then following it with corresponding elements.

4.2.4.2 Design of Concrete Toolkit

A new refined version of the 'concrete toolkit' was built keeping the same basic grid used in the 'abstract toolkit' built earlier. This would help participants to see continuity and inter connectedness of the experiment they are to undertake.

STAGE 1 – DEFINING THE GRID

Like the abstract toolkit, the design of the concrete toolkit also started with superimposition of entry-level two-wheeler over entry-level car (Figure 4.4) in Adobe Illustrator software. For easy manipulation, a CAD model was made using Rhino software by scaling it down to 1:10 proportion. The vehicle frame was suitably segmented as shown in Figure 4.9.

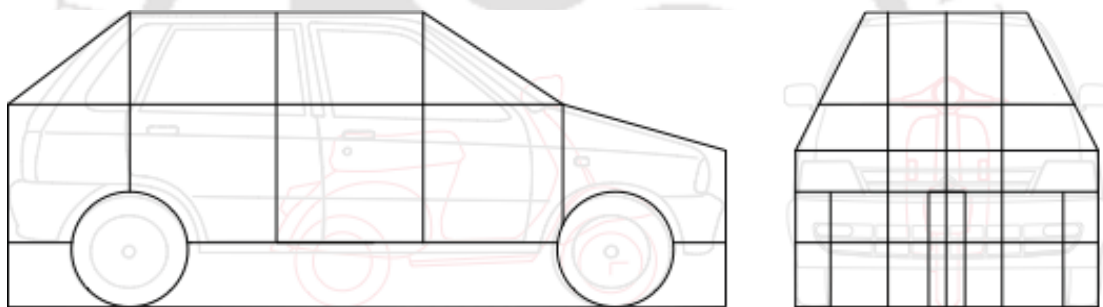


Figure 4.9: Breaking the vehicle architecture to various sub-segments

The Vehicle segments depicted following elements:

- 1) Passenger
- 2) Seat
- 3) Bottom Platform
- 4) Top Platform
- 5) Luggage
- 6) Wheels

Basic elements, having been identified, the drawings were ready to be taken forward for modeling.

STAGE 2 – 3D MODELING AND SLICING

The 2D drafting was transferred to a 3D model. The model was sliced (Figure 4.10) in relation to various segments of its architecture.

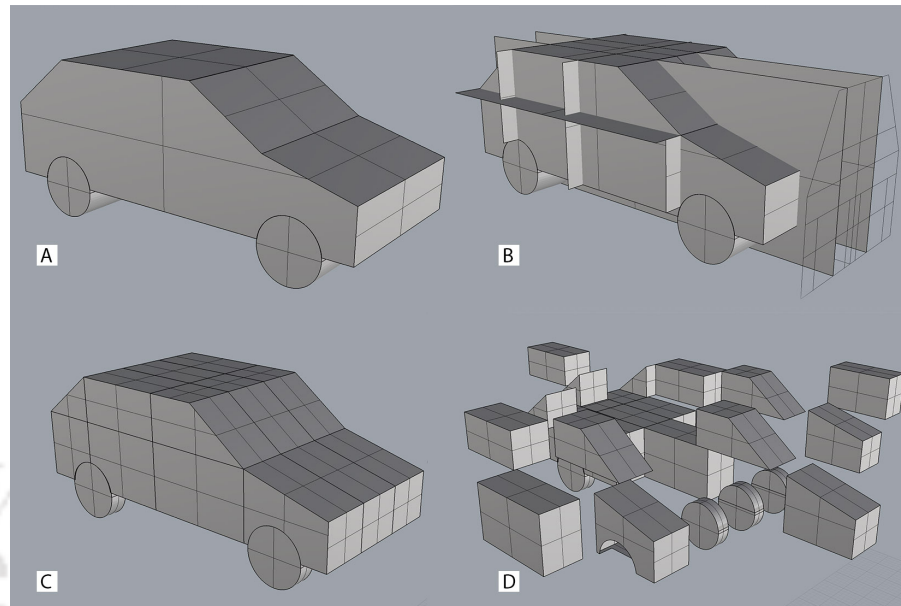


Figure 4.10: 3D Modelling and 3D Slicing, Splitting 3D model, Segmentation of Model

4.2.4.3 Components of the Concrete Toolkit

BASEPLATE

After slicing, the model was segregated into various segments as shown above and a base plate was initiated to stabilize the wheels, which could help the participants to focus on building up from the wheelbase.

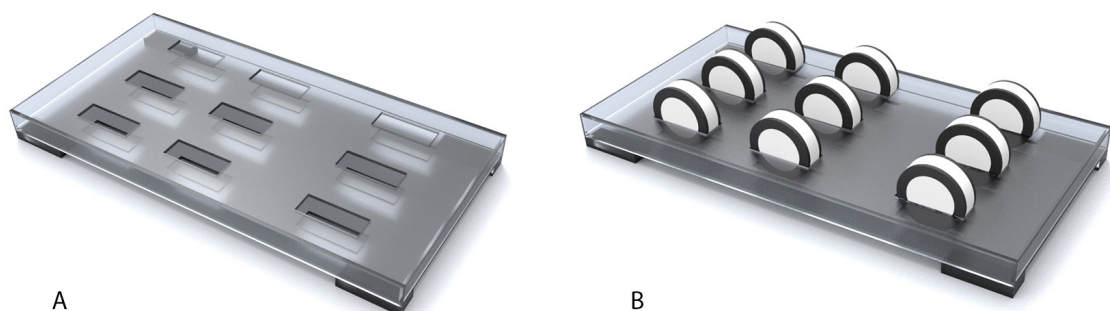


Figure 4.11: Baseplate design, Placement of the wheels

Having done on CAD, the base plate (Figure 4.11 A, B) was chosen to be transparent in acrylic. It was observed that, changing the shape of wheels, luggage, and passengers

would deliver promising possibilities. A base platform was designed with multiple possibilities to place wheels over them.

WHEELS

Wheels (Figure 4.12) were made to look more realistic, with black ring on the white disc. Passengers, Luggage and frames were in white.

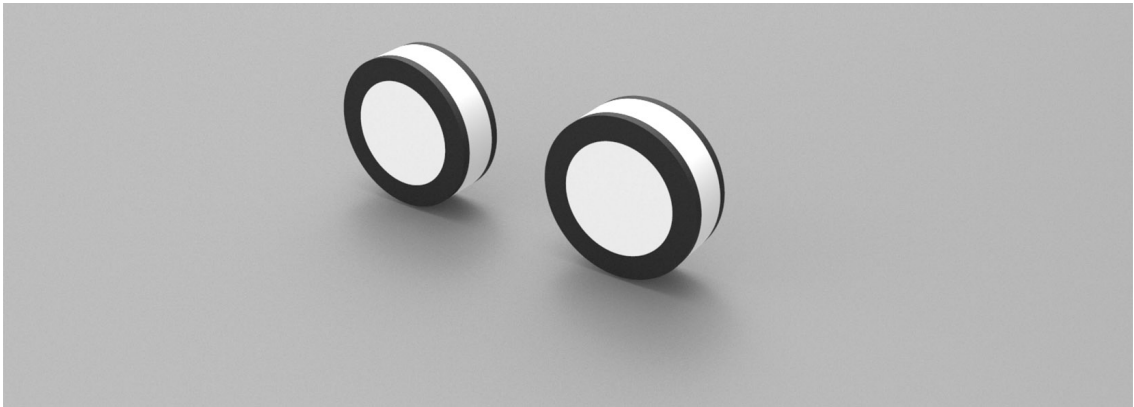


Figure 4.12: Wheels fabricated in dual colour in acrylic

PASSENGERS

The passenger models were aligned into the main model to get better proportion towards the concrete idea of the passenger. A modular version of the seating posture was encompassed with seats for the same. Multiple permutations and combinations were tried using the software to understand concrete concept identity. Human figures were made in such a way that they could easily be placed on two-wheeler concepts as well as on four-wheeler concepts (Figure 4.13, Figure 4.14).



Figure 4.13: Passenger Mannequins fabricated in acrylic

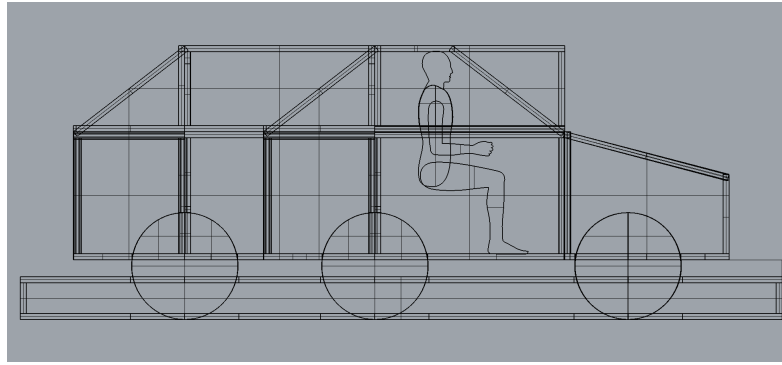


Figure 4.14: Passenger placed in vehicle architecture.

LUGGAGE

Luggage boxes (Figure 4.15), seating spaces were actually made with one side open boxes in order to relate with a real vehicle.

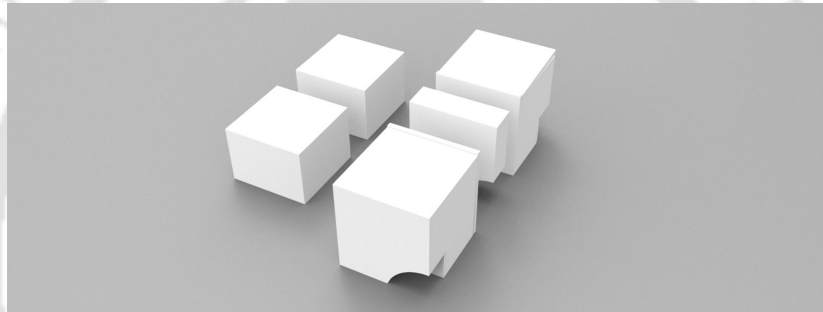


Figure 4.15: Luggage box configurations

BOTTOM AND TOP PLATFORM

Bottom and top platform as shown in Figure 4.16, Figure 4.17 were made in different configurations to allow participants to make different vehicle forms with different roof options like covered and open.

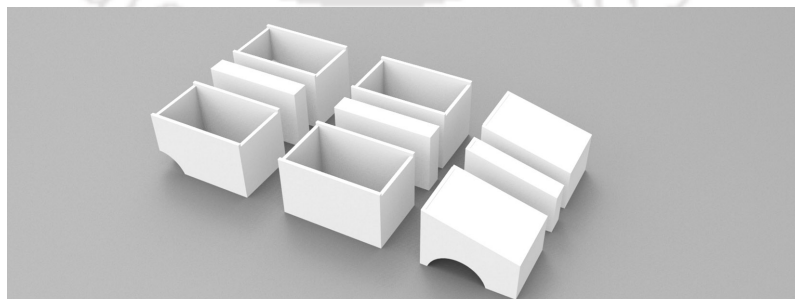


Figure 4.16: Bottom and Top platform

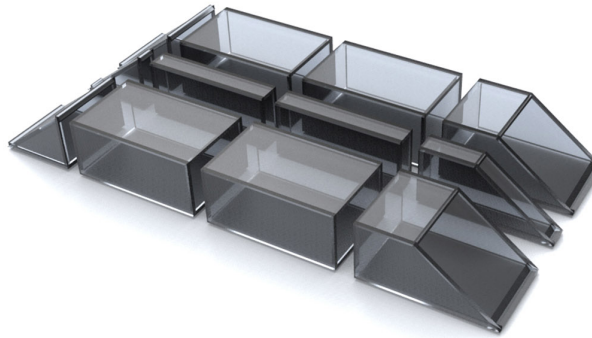


Figure 4.17: Top platform

4.2.4.4 3D Layout and Simulation

Simulation (Figure 4.18) was done on computer to try different configurations (Figure 4.19). Results seemed more practical and doable. Later the development drawing of the model was released and a prototype was built in for various experiments with the participants. Detailed drawings are in Appendix 4B.

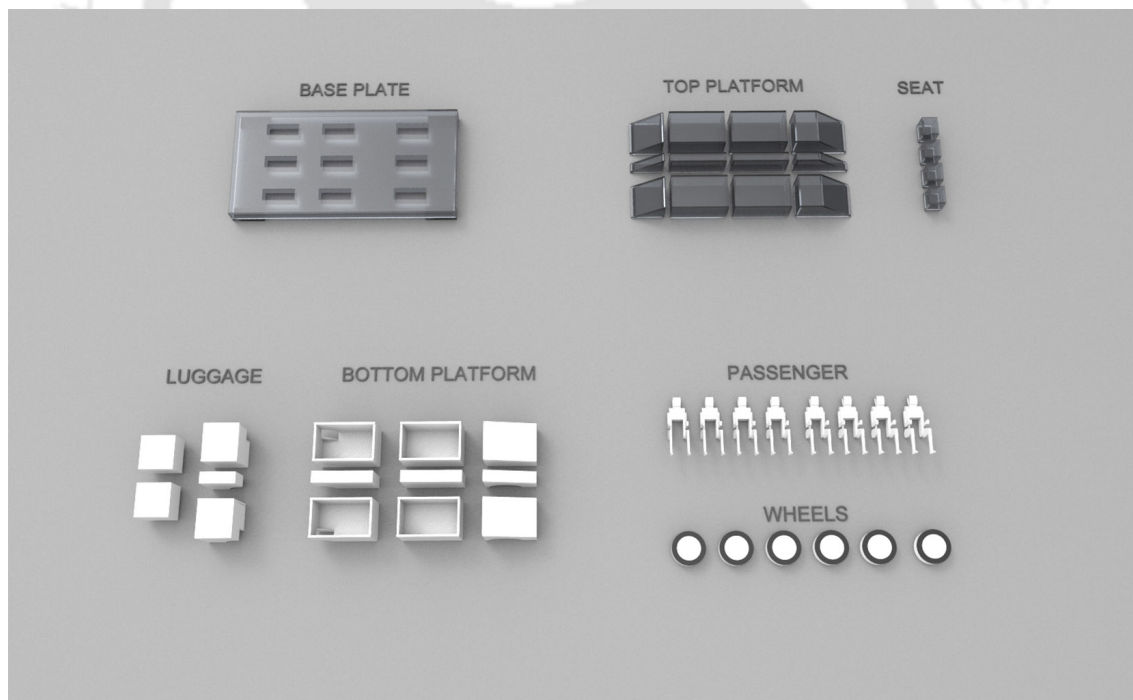


Figure 4.18: Modelling the various segments in the vehicle Architecture

A development drawing developed for abstract toolkit was taken as reference for digital fabrication of the concrete toolkit. This was then taken to a laser cutting machine for cutting and subsequently joining each plate with hand using gluing agent- chloroform. Acrylic sheet with thickness of 3mm was used. The model had generated a playful

architecture incorporating new material sense, identity and texture with tool. This resulted in a better interaction of ideas amongst participants.

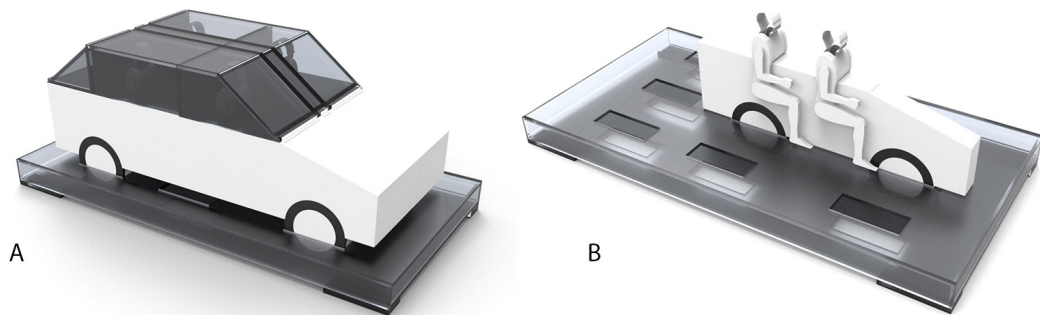


Figure 4.19: Simulated model of one of the Permutation and Combination

4.2.5 Four Types of Toolkits

In the quest to find out effective toolkits for use in Participatory Design session for context-sensitive vehicle design, abstract and concrete toolkits were explored. Extending it a little further, two hybrid toolkits were also attempted that would also serve well for generative exercises. This section explains each toolkit and their intrinsic characteristics. Before that, the researcher would like to introduce two more terminologies

- a. Artificial World: This is that part of toolkit that is related to the vehicle, its specifications, configurations etc.
- b. Man World: This is that part of toolkit that is related to human being like passengers, seating, luggage etc.

Following is the brief description of all toolkits.

Concrete Toolkit: The elements viz. wheels, chassis/body, passenger and luggage are replicas of actual product elements. It has a transparent base frame with slots to place wheels. Various vehicle configurations like two-wheeler, three-wheeler, and four-wheeler can be made by the use of this toolkit. Refer Figure 4.20.

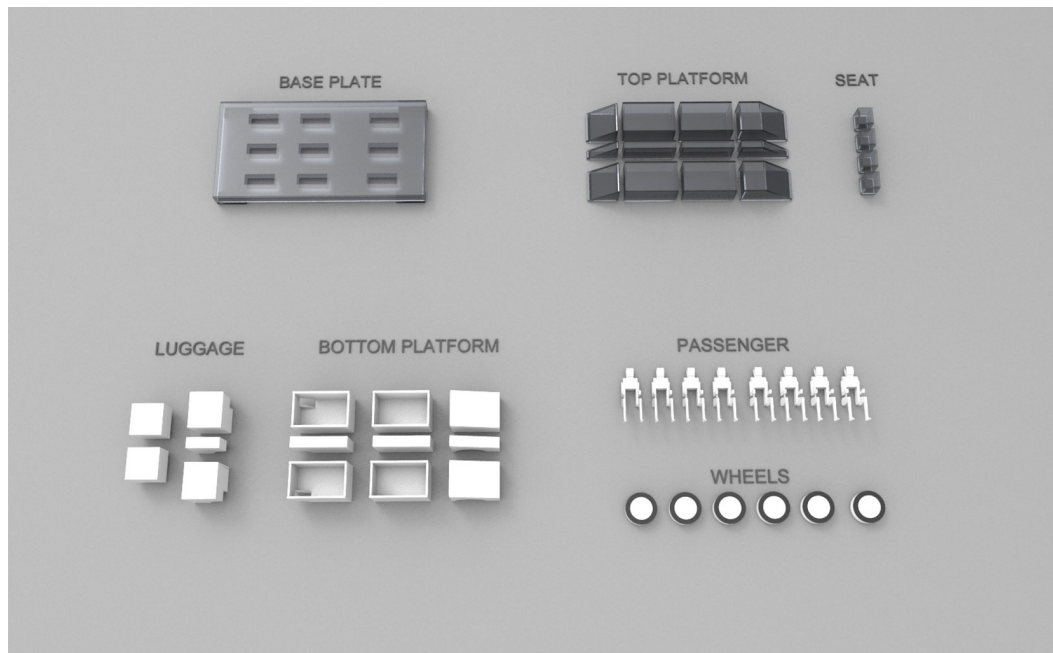


Figure 4.20: All components of concrete participatory toolkit

Abstract Toolkit: The elements viz. wheels, chassis/body, passenger and luggage are abstract or indicative in their appearance. This allows users to devise any form of vehicle product. The blocks could magnetically join with the help of button magnets. This allows users to quickly join the blocks and visualize. Refer Figure 4.21.

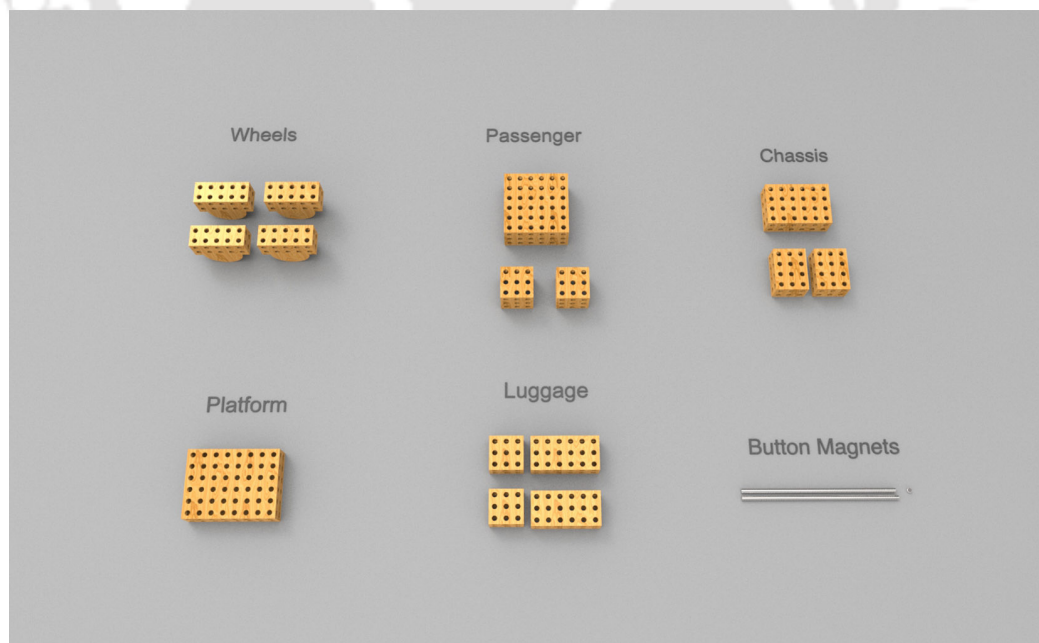


Figure 4.21: All components of abstract participatory toolkit

Concrete-Abstract (Hybrid) Toolkit: In this toolkit (Figure 4.22) the artificial world is concrete and man world is abstract. Here artificial world elements like base plate and

elements of wheels and body are from concrete toolkit and man world like passengers and luggage are from abstract toolkit. Vehicle configurations begin by placing wheels in the slots and then manipulation with abstract and concrete elements.

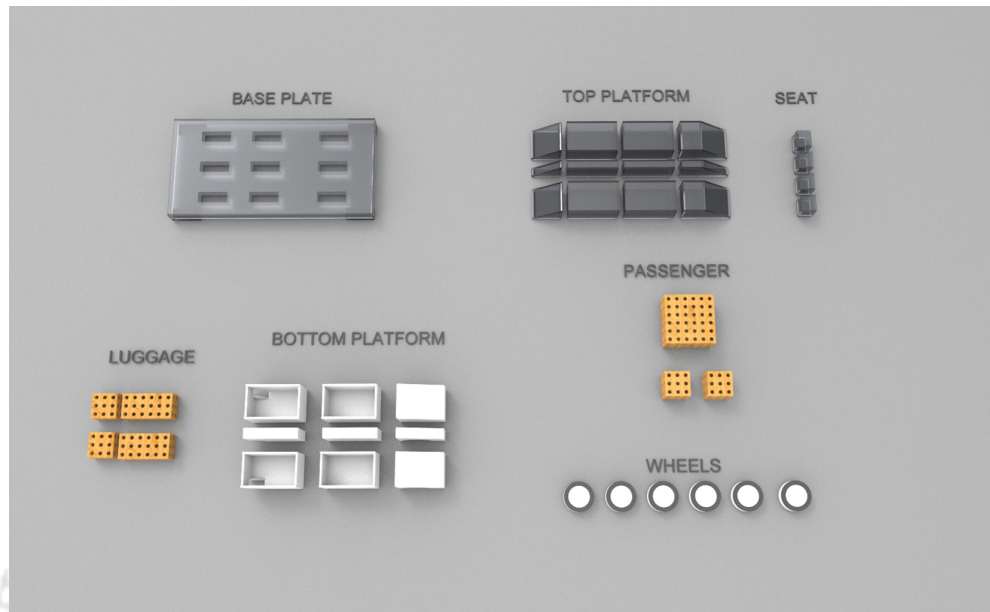


Figure 4.22: All components of concrete-abstract participatory toolkit

Abstract-Concrete (Hybrid) Toolkit: In this toolkit (Figure 4.23) the man world is concrete and artificial world is abstract. Abstract blocks of wheels & chassis/body with concrete elements of passengers & luggage are used.

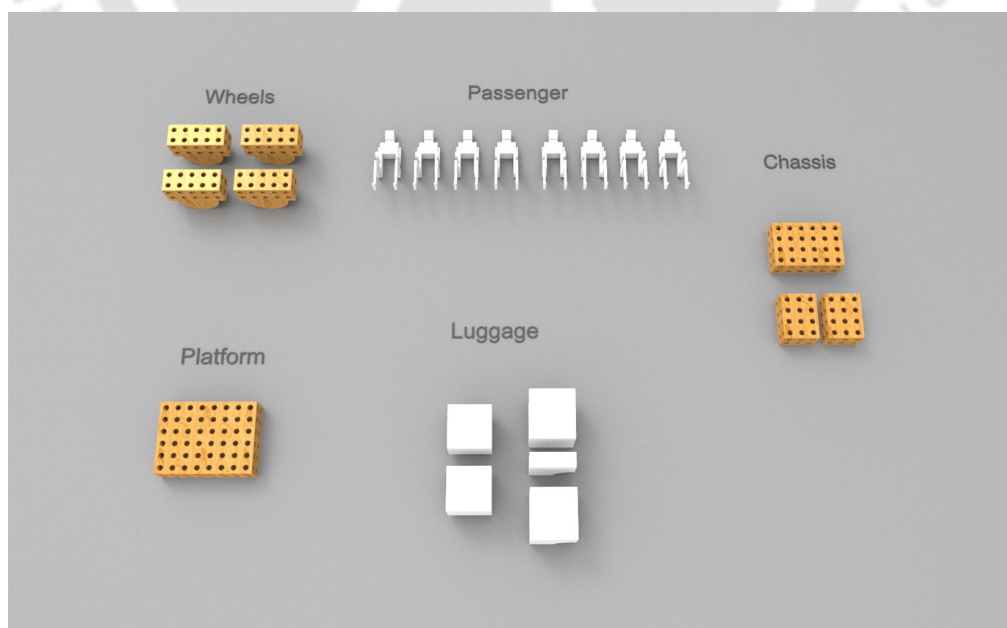


Figure 4.23: All components of abstract-concrete participatory toolkit

4.2.6 Concluding Remarks of Stage 0

It has also now been established that the toolkit is a critical part of Participatory Design (Figure 4.24). It has to evolve for the given Participatory Design objectives. For our research endeavors, where vehicles are complex products, effective toolkits are required to effectively help elicit deep user aspirations and tacit knowledge.

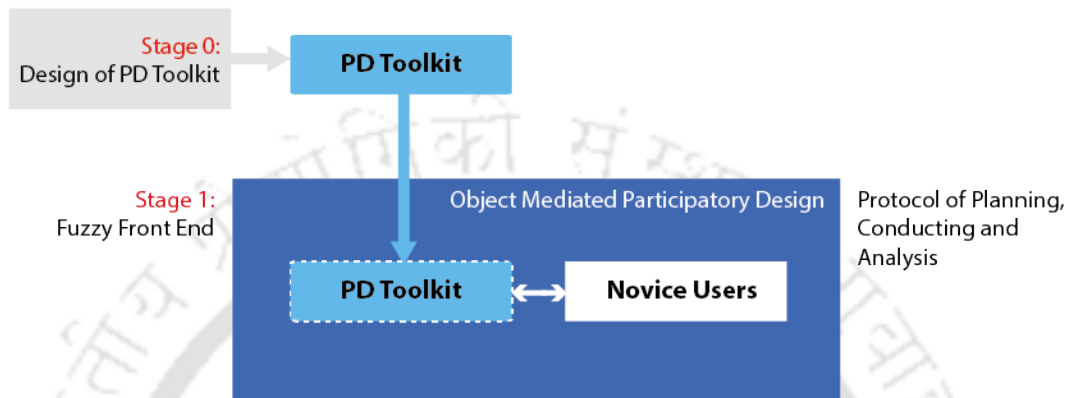


Figure 4.24: Stage 0,1 of participatory design research

Toolkit design is like just another well designed product. It demands design thinking, technical understanding, domain expertise and experience. For experiments, the toolkits made are modular and can be scaled to explore its use for other types of vehicle design. This kit is expected to work for both incremental design interventions and innovative vehicle designs. It has a limitation for interior design. However, a new kind of kit can be thought from this point of view. So, in next section, the entire participatory session with different user groups by using four different toolkits is presented.

4.3 Stage 1: Participatory Design with Novice Users

For context-sensitive vehicle design, different toolkits to be used in Participatory Design session were designed and fabricated. In this research, user participants collectively make, tell and enact to present their deep tacit needs. It is envisaged that participants in a group will collectively give shape to the toolkits and present concepts in the given time. Further, the different toolkits will aid users to come out with different solutions.

Main objective of this experiment is to uncover users' aspirations. This experiment is to be done with four different teams with four different toolkits. Once all the ideas and concepts are generated by the participants, data is analyzed and presented in such a form that automotive designers understand the users' aspiration clearly and use them

effectively to create shapes and forms for the vehicle design. Referring to original outline (Figure 4.25), different 3D toolkits were made ready for participatory experiment. Stage 1 of the experiment is participatory design research with novice users.

As learnt in Participatory Methodology outlined in the earlier chapter, the stages comprise of planning, sensitizing, conducting, analysis and context-mapping. Overall outline of structure of Stage 1 is as follows:

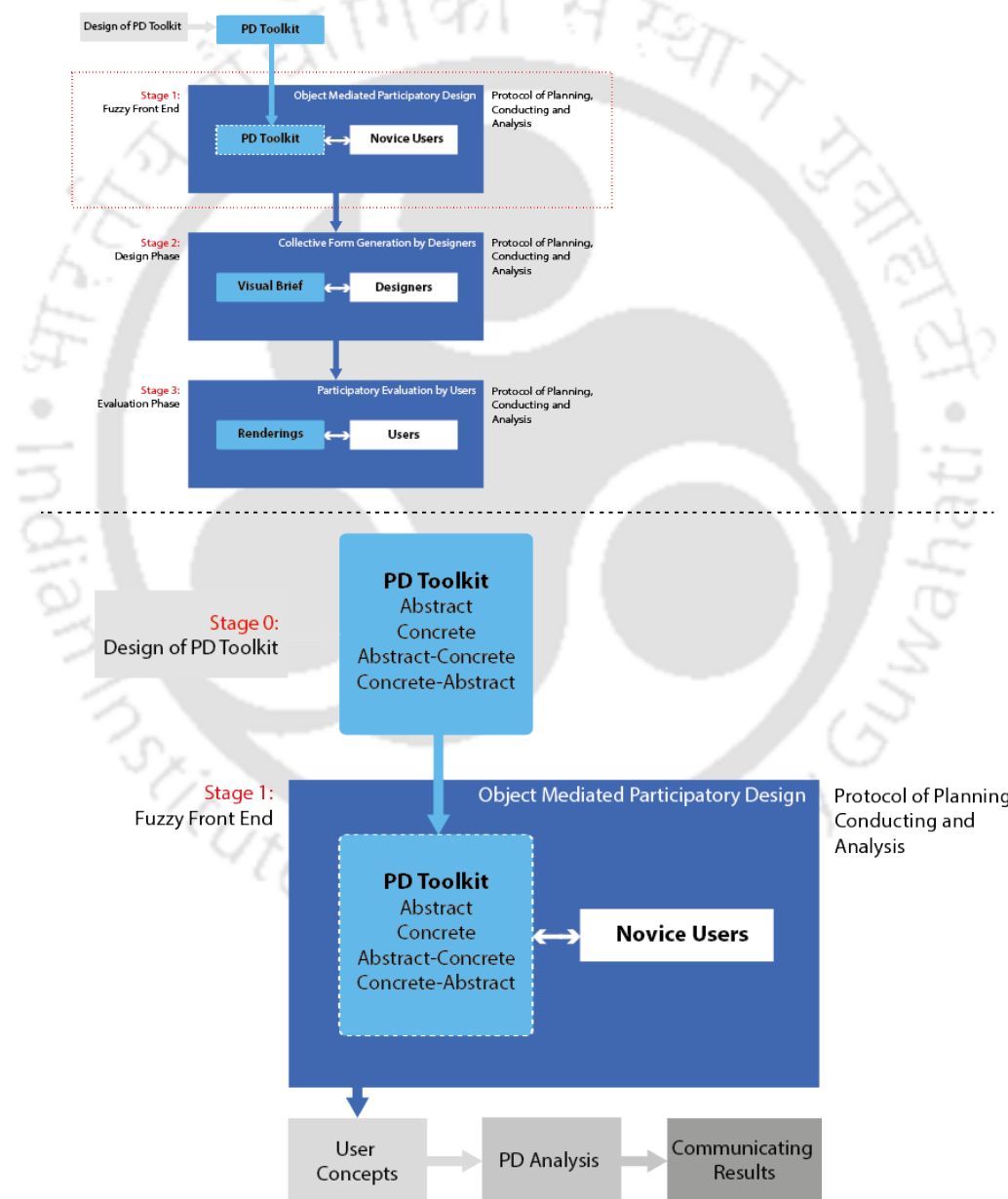


Figure 4.25: Participatory research with novice users

Objective of this study was to explore users experience of personal transport and devise a map that outlines the aspirational aspects of personal transport for automotive designers. Sixteen participants were identified to be part of this research. They were in the age group of 20-55 years who use either a two-wheeler or four-wheeler daily. Four sessions were conducted with four different toolkits. 'Making' as a technique is used for identifying the users' unmet and tacit needs. A series of participatory experiments were planned. These experiments engage the participants to use the Abstract and Concrete toolkits in a four possible combinations.

- 1) Generation of aspirational ideas and design concepts using only Abstract elements of the toolkit.
- 2) Generation of aspirational ideas and design concepts using only Concrete elements of the toolkit
- 3) Generation of aspirational ideas and design concepts using only mix of Abstract – Concrete elements of the toolkit
- 4) Generation of aspirational ideas and design concepts using only mix of Concrete – Abstract elements of the Toolkit

4.3.1 Conducting the Participatory Design Method to Access Tacit Knowledge and Aspirations of End Users

4.3.1.1 Planning: Goal Statement

To explore context related information from prospective users and identify needs that will bridge the gap between two-wheelers and cars in India.

4.3.1.2 Preliminary Mapping

Notes were made on all possible needs that can address the gap between two-wheeler and cars.

4.3.1.3 Selection of participants for Research Activity 1

As per the literature on PDM, four to six participants were identified and chosen for each session. In total sixteen participants were selected for four sessions. These participants were aspirants of buying new personal transport vehicle and were carefully chosen for diversity in their income and age. Each group comprised of working

professionals, postgraduate students and at least one-woman member to elicit a woman's perspective. All participants were from Mumbai.

4.3.1.4 *Preparing Participatory Research activity*

Experiments were to be conducted at different times and places. Each experiment was to use a separate set up for data recording. Participants were not repeated to help overcome any unwanted bias and inhibitions.

4.3.1.5 *Mode of Conducting Research Activity 1*

SCHEDULE AND TIMEPLAN

An overall time plan of the participatory research was laid down. Detailed schedule of the different experiments is shown in the next section.

Table 4.5: Overall time plan

Date	Days	Preparation Time
Planning	One week	Goals: You all are experts, Basic rules.
Recruitment	1-2 weeks	1-2 weeks
Sensitizing	Two days before experiment	One week
Conducting	Every alternate day	1 week
Analysis	4 weeks	1 week
Communicating results	1 week	1 week

RESEARCHER ROLE:

Two postgraduate students assisted the researcher in conducting different experiments. After the initial engagement in sensitizing participants to the experiment, the role of the researcher was that of an observer for the rest of the stages of the experiments.

INSTRUMENT OF DATA COLLECTION

The following set up was arranged as part of the experimental set up.

- a. Videography with audio equipment to record utterances while the participants were engaged in PD Session.

- b. Set up for a digital SLR cameras for time-lapse photography focused on the worktable to capture images of the proceeding every 15 seconds. The idea behind time-lapse video was to help quickly reveal how manifestations of the form happened and what the participants made over the different duration of the session.

4.3.2 Sensitizing

A theme 'Commuting to work/school' was given to participants two days before the participatory session. This had a broader context and significance, so that participants don't develop a focused understanding for any specific type of vehicle. The workbook format was chosen for the participants to record their observations.

4.3.2.1 Probing for type of transport

A map of Mumbai was given to the participants and they were asked to map how they commute.

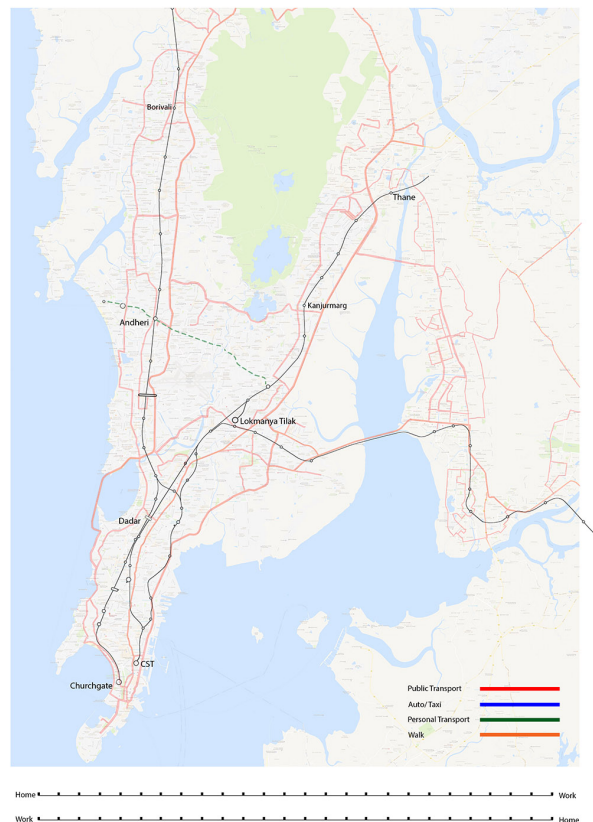


Figure 4.26: Worksheet as sensitizing tool

As shown in Figure 4.26, four color pens were given to the participants to mark the four modes of transport they may be using viz. public transport, auto-rickshaw/taxi, personal transport and walk.

They were asked to draw over the map the type of transport they would take every day for their commuting. Their commute can be mix of modes of transport.

4.3.2.2 Probing for time taken for travel

Figure 4.27 shows two filled samples.

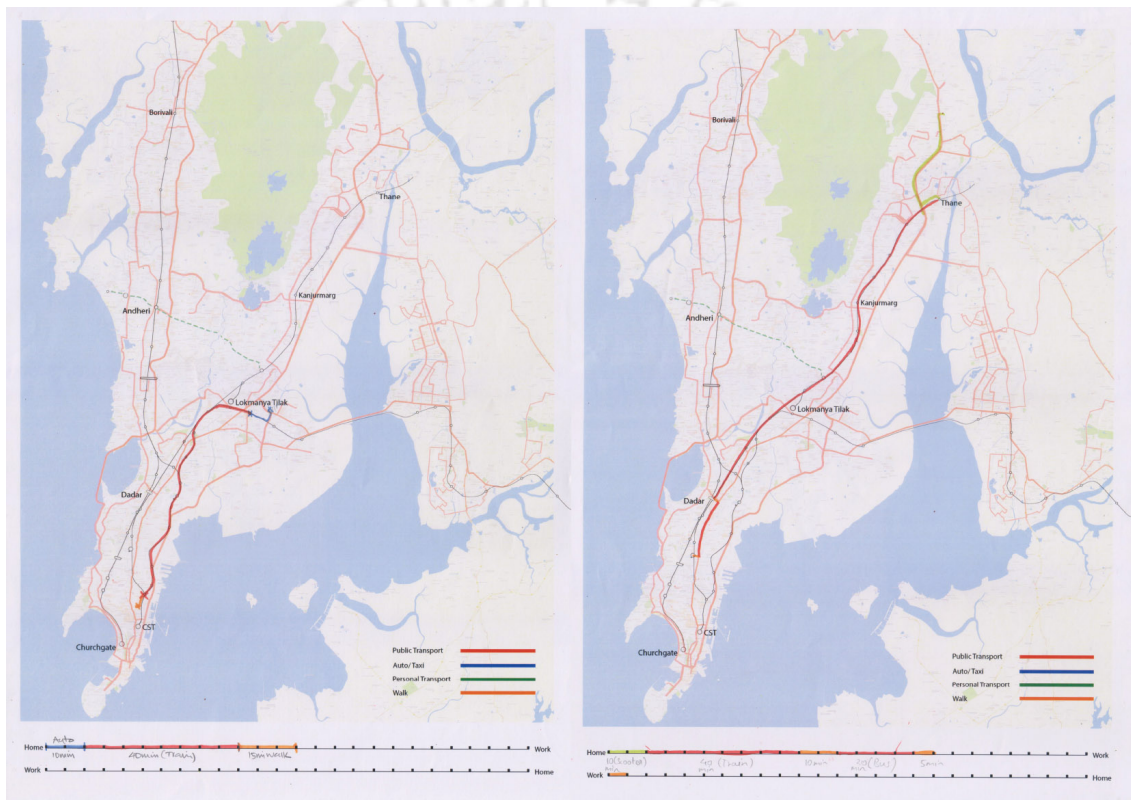


Figure 4.27: Two filled worksheets

This allowed them to reflect on their daily commuting and essentially thinking and reflecting on each component of journey with respect to time and type. This way of sensitizing ensured active engagement with the theme of 'daily travel', two days in advance.

4.3.3 Conducting the Participatory Design Method Session using 3D Toolkit

4.3.3.1 Conducting Session

As outlined in the planning stage, the activity was carried out with two different kinds of model toolkits viz. abstract and concrete in four different combinations; 1) abstract-only, 2) concrete- only, 3) abstract-concrete and 4) concrete- abstract. Sixteen participants for four different sessions were invited. Each session had four participants. Table 4.6 shows the detailed time plan and procedure.

Table 4.6: Participatory experiment time plan

	TIME	ACTION	CHECK LIST
Different Venue	05 minutes	Introduction	Goals: You all are experts, Basic rules.
	10 minutes	Warm up	Round of introduction, sharing of their sensitization.
	05 minutes	Explaining Problem	'Gap between Two-wheeler and Cars'.
Actual Venue	05 minutes	Instructions	Demo. How it works. What each module means.
	30-40 minutes	Conducting Session	Make and Tell in a group. Researcher records stuff.

As per the schedule, the participants reached the conference room where the set up was done. For introduction and sensitization part, they were requested to sit at a different space than that for the PD experiment. This ensured that they don't start interacting with the toolkits before being introduced to the participatory design problem. After preliminary introductions of the participants and the researcher, they were informed that their participation required working in a group.

INTRODUCTION AND WARM UP

The duration of the warm up exercise was for 10 minutes.

As an icebreaker and as sensitizing tool, each participant was asked to talk about his or her daily commute from home to office and back. This way participants got to know about each other and were made comfortable. After this session the participants were taken to the next room for the participatory session.

EXPLAINING THE PROBLEM

User participants took seats around the table on which the toolkit was kept. After introducing the objectives briefly, the Researcher talked about the gap between two wheelers and cars in India. The problem was now stated to the participants - 'How would you collectively as a group bridge the gap between two wheelers and cars in India'? They were shown all the elements of the toolkit. Explanations were given on how they could use the toolkit as an aid to discuss views and assist them in coming out with as many alternatives ideas as possible.

CONDUCTING SESSION

Duration of each session was around 50 minutes. Data recording began as video cameras started to roll and DSLR camera began capturing pictures during the entire session. This mode of the experiment was repeated for all the four experiments. Researcher's role was to start the sessions and then be an observer during the rest of the session. The memory cards etc. in cameras were periodically replaced by the researcher as and when it was needed.

In all the following four sessions were held:

- Participatory activity with Concrete toolkit
- Participatory activity with Abstract toolkit
- Participatory activity with Concrete - Abstract toolkit
- Participatory activity with Abstract - Concrete toolkit

4.3.3.2 Participatory Activity with Concrete toolkit

During this session the toolkit comprised of all the elements viz. wheels, chassis/ body, passenger and luggage as replicas of actual product elements. It has a transparent base frame with slots to place wheels. Various vehicle configurations like Two-Wheeler, Three-Wheeler, and Four-wheeler can be made by use of this toolkit.

A snap shot of participatory activity is shown in Figure 4.28. Full video in Appendix 5.



Figure 4.28: Participatory activity with concrete toolkit

Seating layout for the experiment, as shown in Figure 4.29, was kept keeping in mind the effective interaction with toolkit and effective framing for DSLR camera & video camera.

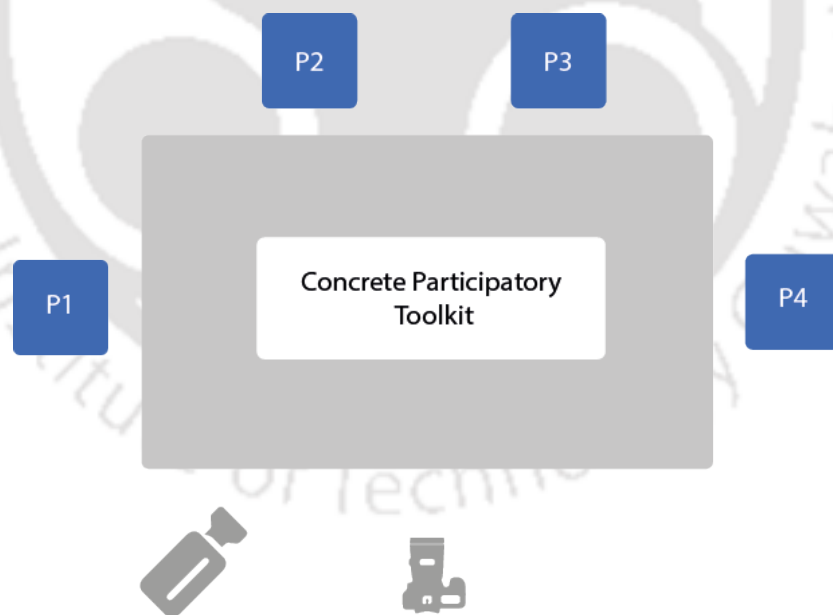


Figure 4.29: Seating schematics concrete

PROTOTYPING APPROACH

Intent of step-by-step prototyping is also explored in this process. The activity normally starts from the wheels, as wheels need to go into slots followed by body/ chassis, passengers etc.

It was noted that participants used key words in their conversation that were normally familiar and had precedence (Refer Transcript in Appendix 7A). These key words were names of vehicle brands, wheel configurations, features, type of vehicles etc. This form of toolkit helped elicit more concrete and definitive responses in its natural use.

4.3.3.3 Participatory Activity with Abstract Toolkit

During this session the toolkit comprised of all the elements viz. wheels, chassis/ body, passenger and luggage as abstract or indicative representations in their appearance. This allowed users to devise configurations of any form of vehicle. The blocks could magnetically join with the help of button magnets. Thus, users could quickly join and visualize combinations more at an abstract schematic level.

A snap shot of participatory activity is shown in Figure 4.30. Full video in Appendix 5.



Figure 4.30: Participatory activity with abstract toolkit

Seating layout for the experiment, as shown in Figure 4.31, was kept keeping in mind the effective interaction with toolkit and effective framing for DSLR camera & video camera.

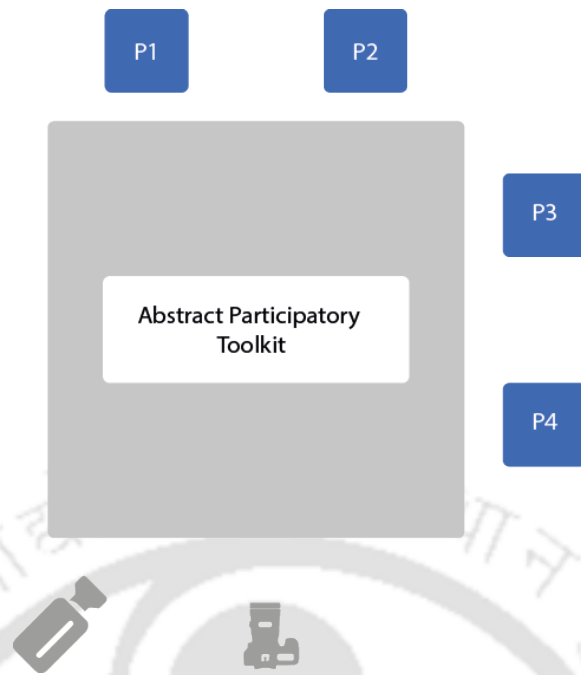


Figure 4.31: Seating schematics abstract

APPROACH

In this instance, the commencement is not defined as the kit modules offer open ended possibilities and are not well defined. It was observed that this kind of toolkit allows users to choose their own start and also allows them to interpret results in their own way. Solutions that emerged were more systems oriented and very futuristic. Keywords that were used by the participants were not familiar and mostly had no precedent. These keywords were about modularity, multilevel design, sleeper berths, touch-button controls etc. (Refer Transcript in Appendix 7B). This form of toolkit helps elicits more abstract responses in its natural use.

4.3.3.4 Participatory Activity with Concrete-Abstract Toolkit

In this session participants were given the option to mix elements drawing from the concrete toolkit and the abstract toolkit.

They could draw a mixed combination of elements such as base plate and elements of wheels and body from the concrete toolkit and elements such as passengers and luggage from the abstract toolkit. This mix when matched in combination resulted in vehicle ideas that emerged from the artificial world and the man world. These ideas were referred under the category 'Concrete –Abstract'. It was noted that participants began

vehicle configurations by placing wheels in the slots followed by manipulation with abstract and concrete elements. A snap shot of participatory activity is shown in Figure 4.32. Full video in Appendix 5.



Figure 4.32: Participatory activity with concrete-abstract toolkit

Seating layout for the experiment, as shown in Figure 4.33, was kept keeping in mind the effective interaction with toolkit and effective framing for DSLR camera & video camera.

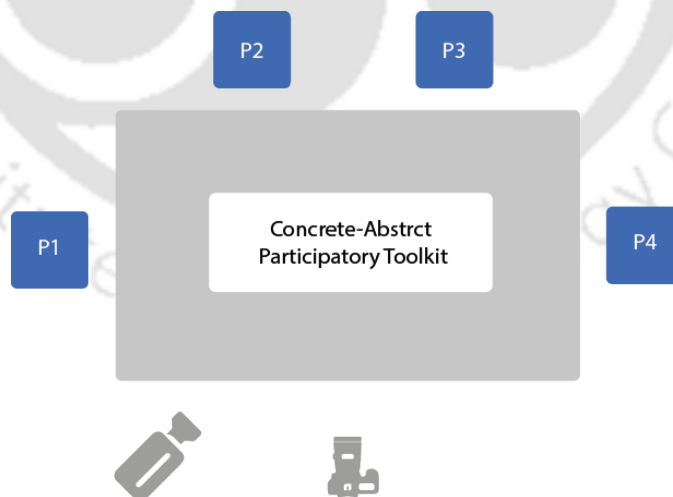


Figure 4.33: Seating schematics concrete-abstract

APPROACH

This approach was intended to regulate start and then allow participants free use of the abstract elements for the man world to help gain more insights.

The keywords that participants used during the session were familiar and the solution proposed focused towards current vehicle problems. The keywords used during their discussions were space efficiency, safety, storage space, vehicle footprint etc. (Refer Transcript in Appendix 7C). This hybrid form of toolkit helped elicit controlled abstraction in its natural use.

4.3.3.5 Participatory Activity with Abstract-Concrete toolkit

This formed a variation of the earlier session. In this session participants were again given the option to mix elements drawing from the concrete toolkit and the abstract toolkit – but the elements of the man world are concrete and elements of the artificial world are abstract. They could draw a mixed combination of elements such as concrete elements of passengers & luggage from the concrete toolkit and elements such as wheels & chassis/ body from the abstract toolkit. These ideas were referred under the category ‘Abstract- Concrete ’. A snap shot of participatory activity is shown in Figure 4.34. Full video in Appendix 5.



Figure 4.34: Participatory activity with abstract-concrete toolkit

Seating layout for the experiment, as shown in Figure 4.33, was kept keeping in mind the effective interaction with toolkit and effective framing for DSLR camera & video camera.

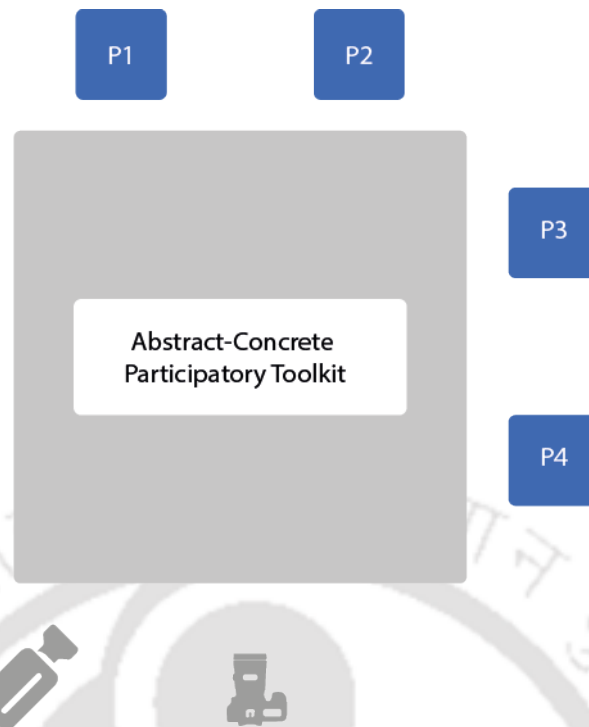


Figure 4.35: Seating schematics abstract-concrete

APPROACH

This approach was intended to allow participants to freely choose any starting point and then control it with concrete elements. The keywords emphasized during the discussions were on passengers; issues surrounding comfort & safety; accidents; personal mobility; etc. (Refer Transcript in Appendix 7D).

It was noted that the use of the toolkit in such a combination yielded more free-flow of creative ideas that were also practical in nature.

4.3.3.6 Observational Remarks for All Sessions

The researcher as observer noted that during the experiment there were moments when all participants were talking and deliberating while prototyping with the toolkit. Although there were also moments when there was a lull, the participants were seen to be actively co-developing concepts. Even when there was calmness with no verbal communication between participants they were connected through the toolkit. The toolkit mediated participatory session, pushing participants to think beyond their boundaries. Towards the end of the session, they were exhausted. No conflicts were observed.

The researcher thanked each participant at the end of each experiment.

4.3.4 Analysis of Participatory Research

What followed the four experiment sessions was an analysis of the data drawn and documented during the sessions. Figure 4.36 outlines the analysis that was planned regarding the participatory data. There were two objectives for the analysis: a) Decipher and gain insight of users aspirations for vehicle design that emerged from four discrete experiments in the participatory research. b) Create quick visual map for briefing the expert designer group.

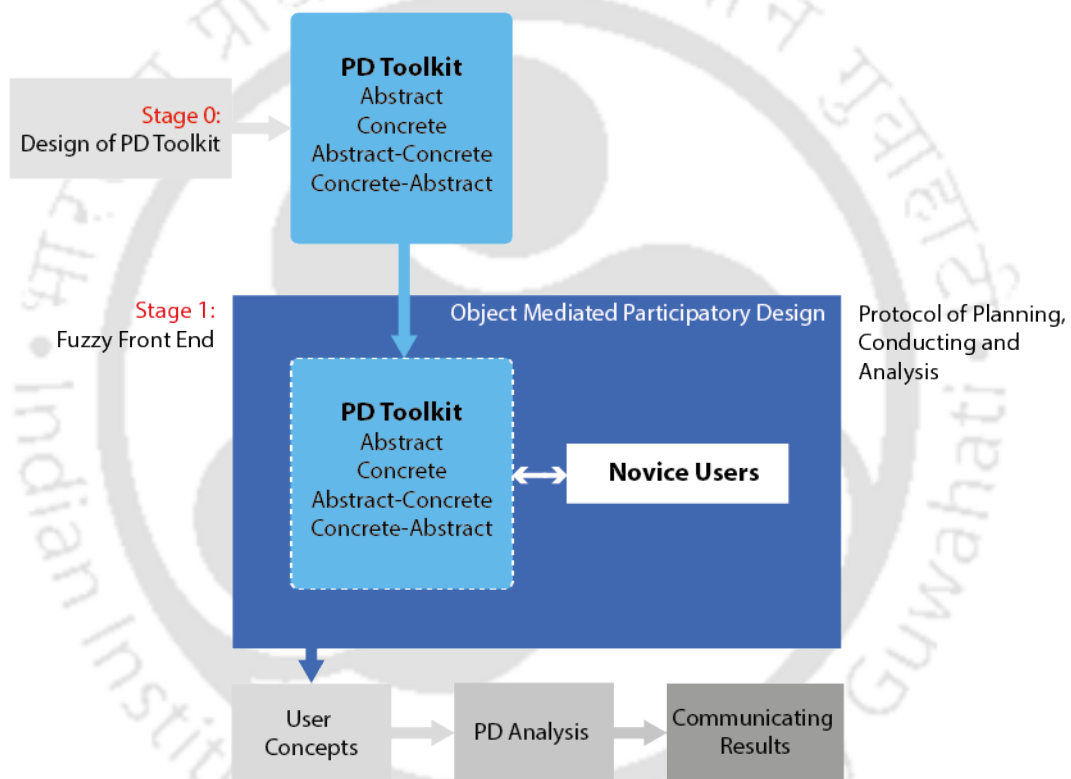


Figure 4.36: Analysis of participatory research in Stage 1

This was undertaken by an analysis of data drawn through

- a) Making time-lapse video of the pictures clicked by DSLR camera and
- b) Transcription of videotaped data

This would help to arrive at the brief description of concept configuration that the four user groups made. Figure 4.37 and Figure 4.38 respectively, show the analysis structure

and the various types of data viz. pictures, video, transcripts analyzed to arrive at insights.

4.3.4.1 Analysis Structure

Following analysis structure (as shown in Figure 4.37) was followed in analyzing the videotaped data and DSLR pics.

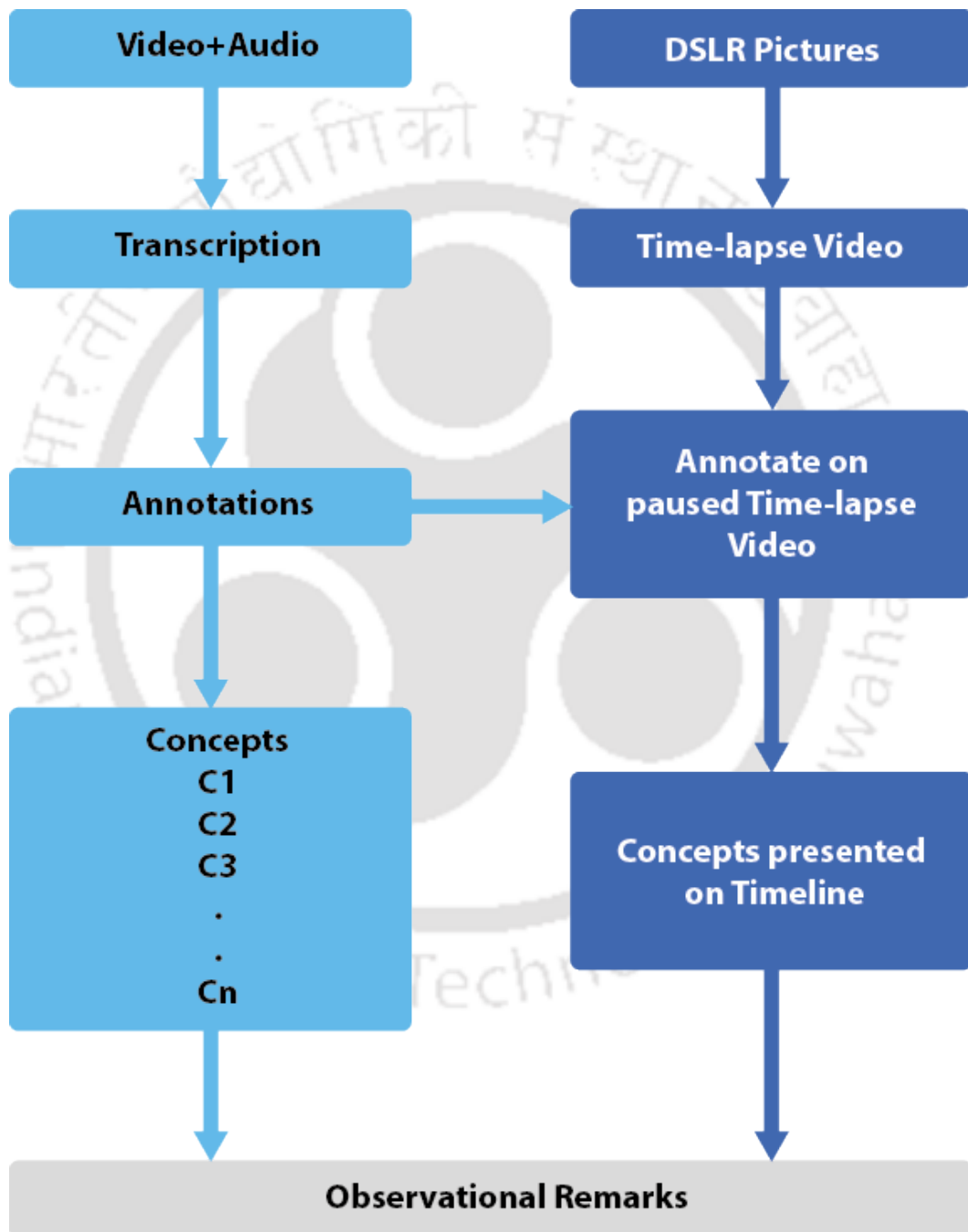


Figure 4.37: Analysis Structure

Concurrent analysis as seen in the literature makes it an essential base for different types of data viz. pictures, video and transcript as shown in Figure 4.38 . Following section will attempt to present it in detail.

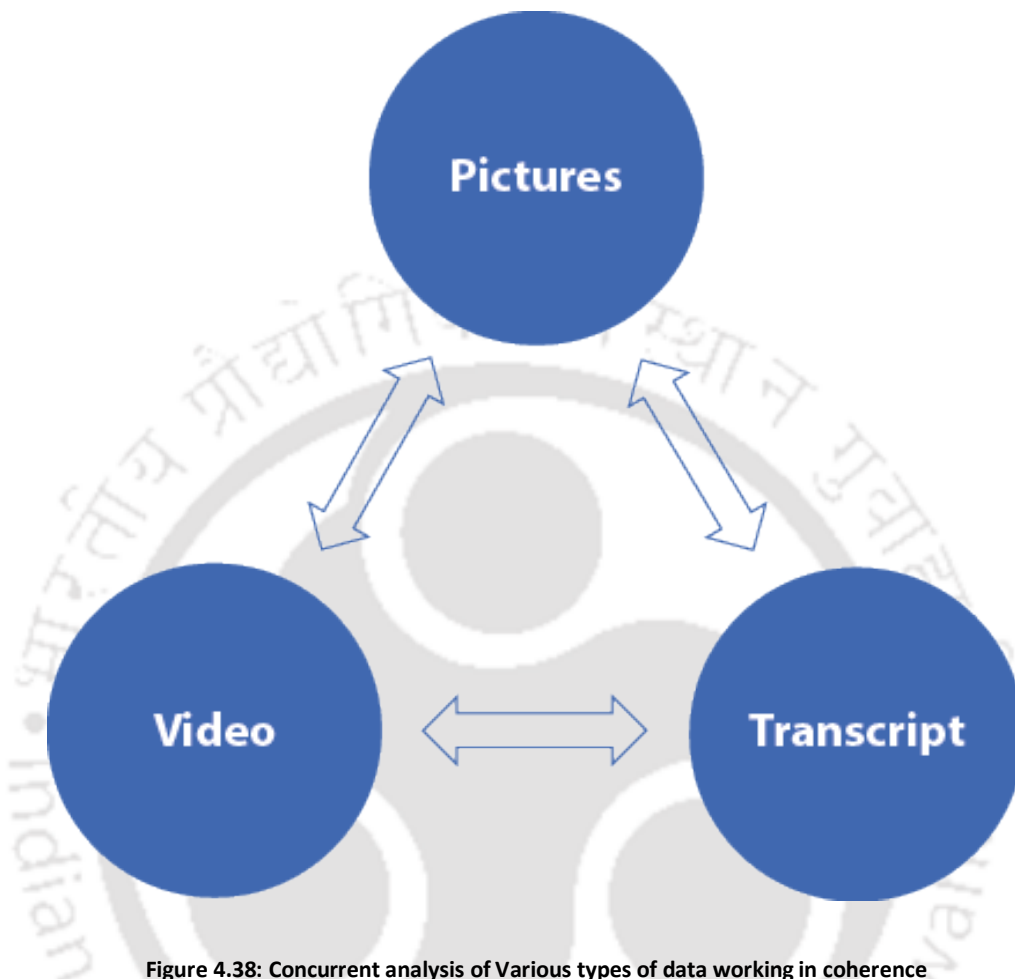


Figure 4.38: Concurrent analysis of Various types of data working in coherence

4.3.4.2 Data organization and transcription

Transcription of audio recording and their analysis to find keywords and patterns.

DATA AND ORGANIZATION OF DATA

The data obtained was in picture and video format. All video recording of the session was converted into digital video data. Pictures captured with the DSLR were put in different folders for each of the four experiments. The pictures were of high resolution and the data was heavy.

TRANSCRIPTION

All videos were transcribed and coded. There were many instances when they were speaking to each other. After careful listening and repetitive playing, transcriptions were

made. This was a time consuming exercise. Transcriptions helped in identifying each concept the user participants made during the participatory session.

TIME-LAPSE VIDEO

24 fps was chosen for the time-lapse video. The software Apple i-video was used to line up the video. A five second pause was introduced on each picture frame that showed the complete concept in each of collective concept generation. Each video had time-lapse for the process of manifestation with different hands working on it and stops for 5 seconds at places where concepts were fully made. This helped in quick understanding of bodily conduct. The information gained from each idea combined with expertise in vehicle design helped in articulating a brief description of concepts. Using video editing software, short descriptions were placed in frames of each concept made by participant groups. The videos provided results of the design analysis of each concept with text underpinning it. All four time-lapse videos were lined up and played.

Following section outlines a brief summary of the analysis of the insights drawn for the four experimental sessions.

4.3.4.3 Analysis of Participatory Activity using Concrete Toolkit



Figure 4.39: Video grab of participatory activity with time lapse images

Figure 4.39 shows video grab of participatory activity with time lapse images. Please see Appendix 8 for detailed time lapse video. Full video of this activity is in CD attached herewith (Appendix 5).

Table 4.7 presents one excerpt of the transcript of experiment done with concrete toolkit.

Table 4.7: Transcript excerpt of participatory activity with concrete toolkit

...		
115	Ruchin	<i>yeha chcha hai...par yeh car nahi hai.</i> this is good .. but this isnt a car
116	Mohan	<i>yeh ek long vehicle banta hai na...</i> but this will become a long vehicle
117	Ruchin	<i>yeha actually aisa chahiye..</i> here actually you need it like this
118	Devekar	<i>actually yeh bhi upar chahiye..</i> this also actually should be above
119	Ruchin	nahi...jeep.gypsy no...jeep(as a brand) ... gypsy (as car by maruti suzuki)
120	Mohan	gypsey
121	Nancy	<i>gypsey car hai..</i> this is like gypsy (as a car by maruti suzuki)
122	Mohan	gypsey car mein pooche who open rehta hai
123	Ruchin	<i>yeh bada adventure type vehicle lagta hai..</i> this looks like an adventorous vehicle
124	Mohan	<i>yeh acha hai..bahut badhiya</i> this is good. very good
125	Ruchin	<i>aur zyada luggage k liye usko supportk liye...</i> this support for extra luggage
126	Mohan	<i>yeh mahindra mahindra jeep hai...abhi latest jungle m ein jata hai na...</i> <i>ok...ho gaya...abhi chota jeep bhi bana sakta hai..</i> mahindra (car brand) the latest cars can go off roads.. now they can make smaller jeep(brand)
127	Devekar	<i>kaise</i> how?
128	Mohan	<i>idhar...idhar do wheel daalne ka....idhar ek wheel idhar ek wheel</i> here put one of the wheels, and the other here this can be complete area could be for luggage
...		

GRAPHIC REPRESENTATION

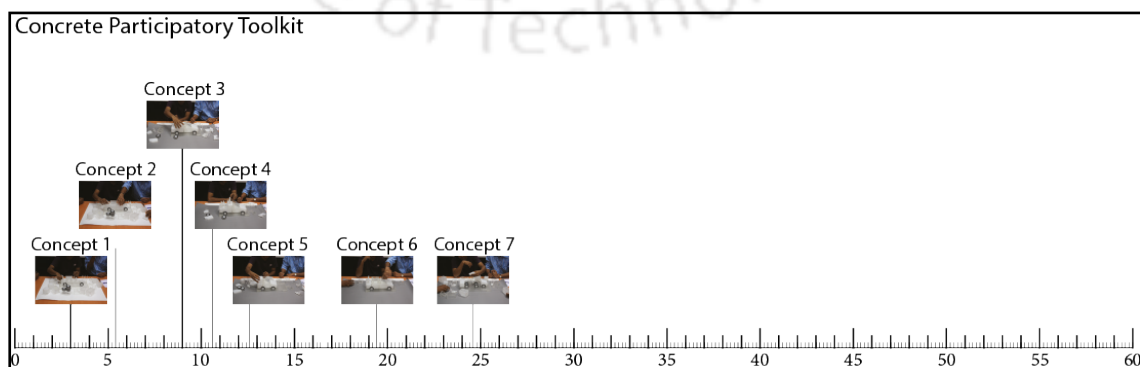


Figure 4.40: Concepts mapped on a time scale

Figure 4.40 gives graphical representation of the output mapped on time scale. This visually indicates instances when collectively ideas took shape of various concepts.

CONCEPTS (BRIEF DESCRIPTION): PARTICIPATORY PROTOTYPING: CONCRETE PARTICIPATORY TOOLKIT

As seen in the graphical representation above, the concepts made by users were as follows:

- 1) Two-Wheeler, Four Seater, Long Vehicle, Small Luggage
- 2) Three-Wheeler, Two Seater, Compact Vehicle, Large Luggage space
- 3) Wheeler, Front Covered, Rear Open Seating/ Luggage
- 4) Four-Wheeler, Six (Open) + Two(Closed), Flexible Luggage
- 5) Four Seater, Compact Vehicle, Two (Closed) + Two (Open)
- 6) Four Seater, Eight Seater, Flexible for Opening/ Closing, Face to Face Seating
- 7) Six-Wheeler, Very Long Vehicle for Family Use, In-Tandem Seating

APPLICATION: CONCRETE

This form of toolkit can be used for near future design endeavors like re-designing or re-styling existing products.

4.3.4.4 Analysis of Participatory Activity using Abstract Toolkit

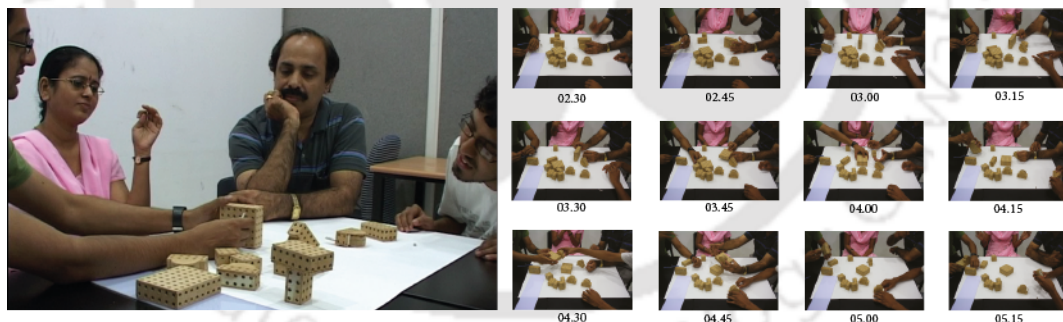


Figure 4.41: Video grab of participatory activity with time lapse images

Figure 4.41 shows video grab of participatory activity with time lapse images. Please see Appendix 8 for detailed time lapse video. Full video of this activity is in CD attached herewith (Appendix 5).

Table 4.8 presents one excerpt of the transcript of experiment done with abstract toolkit.

Table 4.8: Transcript excerpt of participatory activity with abstract toolkit

...		
16	Anupama	<i>hum logon ko lagna chahiye ke hum log kar sakte hai...aisa nahi ke in the middle of way</i> we people should feel that we can do it.. its not like in the middle of the way....
17	Yatin	<i>yeh fayda karega kya..aise chaar aur jod diye jaye</i> <i>will this be beneficial if we join these four</i>
18	Anupama	<i>aisa koi slow medium fast button.. if we press slow, automatic fast...middle ...fast...</i> <i>aisa just press buttons...so thatapne ko problem nahin hai</i> there should be some button controls such as - slow, medium, fast... so that it won't be that difficult
19	Yatin	<i>isme aisa nikal jayega</i> this will come off like this
20	Rajan	<i>who to nikal jayeega definitely...</i> that will come off definitely
21	Yatin	maybe agar dono rahenge to dono atak kar denge <i>maybe if both of them were present they would be stuck together</i>
22	Toussef	<i>us lane mein... gaadi ki speed girne ..suppose sab gaadi 80 ki speed se ja rahi hain</i> <i>aur tum 60 se ja rahi haintoh kuch announcement ya indication hona chahiye...</i> <i>tum left mein aa jao</i> so if you are going at the speed 60 and a passerby comes at 80 then there should be some indication for us to move
23	Anupama	<i>scale ka nahin ...jaisa tum logon ka mixer mein rehte hai na...</i> <i>wise buttons....wohi speed mein jayega na...there has to be ..we we don't know...</i> <i>driving a new corner, they will not come to know kitna speed hai...</i> <i>mixer mein 1,2,3,4,5, ..ya fan mein...1,2,3,4,5..</i> <i>who button press karega to gaadi age jaane chahiye..aisa kuch hona chahiye</i> the car should have preset speeds just like in a ceiling fan or mixer . you just have to press the buttons and it will go. this will be helpful when you are cornering some turn for the first time, you don't know how the curve is, so you set the speed and the car will go automatically
...		

GRAPHIC REPRESENTATION

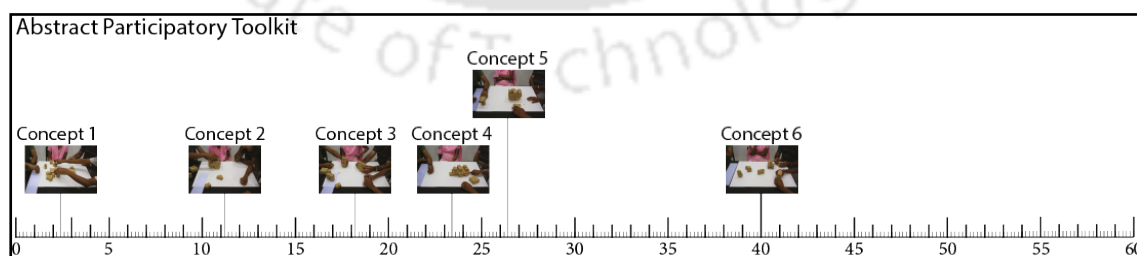


Figure 4.42: Concepts mapped on a time scale

Figure 4.42 gives graphical representation of the output mapped on time scale. This visually indicates instances when collectively ideas took shape of various concepts.

CONCEPTS (BRIEF DESCRIPTION): PARTICIPATORY PROTOTYPING: ABSTRACT PARTICIPATORY TOOLKIT

As seen in the graphical representation above, the concepts made by users were as follows:

- 1) Two Wheeled High and Compact Module, Possibility of Joining two sideways
- 2) Very Compact Three Wheeled Vehicle
- 3) Single Wheeled High and Compact Module, Possibility of Joining two sideways
- 4) Four-Wheeled, Two Seater, One Bed for Longer Distances
- 5) Four-Wheeler, Compact and High Four-Seater Vehicle
- 6) Four-Wheeler, Compact and High Four-Wheeler

APPLICATION

These responses through this kind of method may be used for very futuristic design projects where thoughts flow freely through actions and can take any direction through the use of any module of the toolkit.

4.3.4.5 Analysis of Participatory Activity using Concrete-Abstract Toolkit

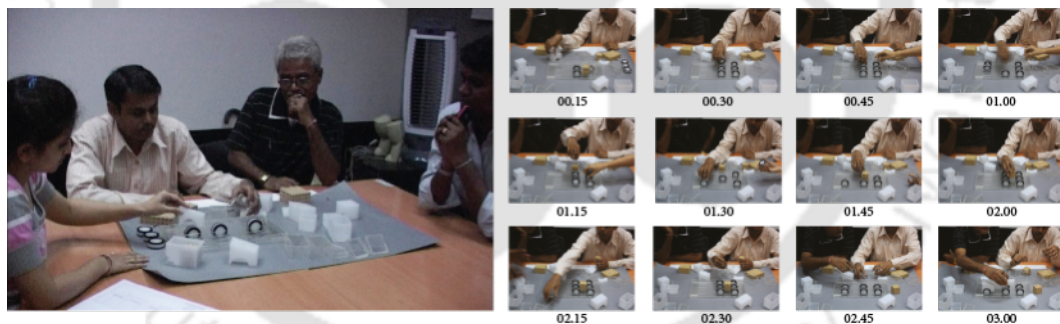


Figure 4.43: Video grab of participatory activity with time lapse images

Figure 4.43 shows video grab of participatory activity with time lapse images. Please see Appendix 8 for detailed time lapse video. Full video of this activity is in CD attached herewith (Appendix 5).

Table 4.9 presents one excerpt of the transcript of experiment done with concrete-abstract toolkit.

Table 4.9: Transcript excerpt of participatory activity with concrete-abstract toolkit

79	Vinay	any point of time you can divide
80	Truveni	you can travel together
81	Vinay	<i>abhi 4 log hain.. 4 log idhar jaane wale hain 2 office ... other are going somewhere else...kabhi bhi divide kar sakte hain...it's detachable...tu jaise bol raha hai....2 raste alag</i> for eg. 4 people going to two different offices, they can divide anywhere they want. it's detachable like you wre saying it
82	Ashish	i was just going it as a scenario..
83	Vinay	even if there is some problem with parking ... divide and park...
84	Ashish	divide and park...
85	Vinay	haa!
86	Vinay	woh bike ka to already bol diya...parking ka hai..they can carry more no of people... <i>so he has already spoken about the parking</i>
87	Truveni	one more thing i thought of it now is ki... 3w se hum log may be... jaise hum logon ne pehale kiya tha ...verticle type kiya tha...arrangement taki uska length badh jaye.. and again we can ...ek wahan ka nikal ke..ek woh nikal dijiye na... <i>one more thing i thought of (shuffles around the pieces and gives reference two previous configuration)</i>
88	Ashish	ek nikal de?.. <i>remove one?</i>
89	Truveni	ek nikal de ...vertical aur horizontal ...unhi teen pahinyon ko use kar kr... <i>removing one and using three wheels in vertical and horizontal direction</i>
90	Ashish	taki... kya hum zyada... <i>so what is the end result?</i>
91	Truveni	taki ... woh jaise pahile tha ... haan! <i>so everything will be the same as before</i>
92	Ashish	ho sakta hai, pehale ek ke pahiyek ek baith le..then ... dadhane ke liye, ek baaju nain ek baith sakta hai... <i>it can be such that one can sit one after the other and now we can make them sit side to side</i> <i>so</i> <i>as to increase interaction between</i>

GRAPHIC REPRESENTATION

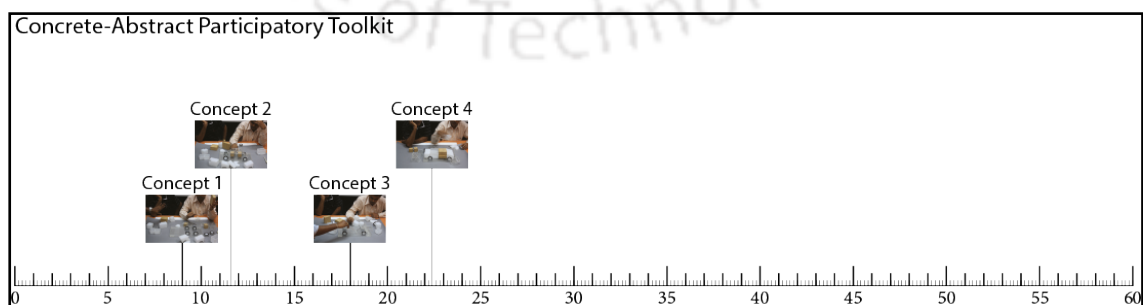


Figure 4.44: Concepts mapped on a time scale

Figure 4.44 gives graphical representation of the output mapped on time scale. This visually indicates instances when collectively ideas took shape of various concepts.

CONCEPTS (BRIEF DESCRIPTION): PARTICIPATORY PROTOTYPING: CONCRETE-ABSTRACT PARTICIPATORY TOOLKIT

As seen in the graphical representation above, the concepts made by users were as follows:

- 1) Two-Wheeler, Two Seater (Different Levels), Compact Vehicle
- 2) Four-Wheeler, Two Seater, Enclosed Bi- directional Vehicle
- 3) Three/ Four-Wheeler with Spring Bound Cab for Protecting against Accidents
- 4) Four-Wheeler, Two Seater, Very Large Luggage Space

APPLICATION

The response generated through this kind of toolkit may be used for design of moderately futuristic projects where practicality is more important.

4.3.4.6 Analysis of Participatory Activity using Abstract- Concrete Toolkit



Figure 4.45: Video grab of participatory activity with time lapse images

Figure 4.45 shows video grab of participatory activity with time lapse images. Please see Appendix 8 for detailed time lapse video. Full video of this activity is in CD attached herewith (Appendix 5).

Table 4.10 presents one excerpt of the transcript of experiment done with abstract-concrete toolkit.

Table 4.10: Transcript excerpt of participatory activity with abstract-concrete toolkit

18	Lakshmi	three wheeler personal use
19	Lakshmi	auto covered two wheeler
20	Patkar	advantage over existing bike or
21	Lakshmi	two wheeler which is covered
22	Rishi	storage box
23	Lakshmi	three wheeler to personal wheel mage.....boots space...you must take a Rickshaw to the station
24	Rishi	then you have additional vehicle also..
25	Lakshmi	additional vehicle.....additional trolley
26	Rahul	<i>three wheeler ase...ek minute</i> three wheeler... like this... one minute
27	Rishi	into the puddle puddle
28	Patkar	but magnet
29	Rishi	<i>mene socha ulta kiya</i> Was done opposite to what I said...
30	Patkar	<i>support lage....</i> It would need support

GRAPHIC REPRESENTATION

Figure 4.46 gives graphical representation of the output mapped on time scale. This visually indicates instances when collectively ideas took shape of various concepts.

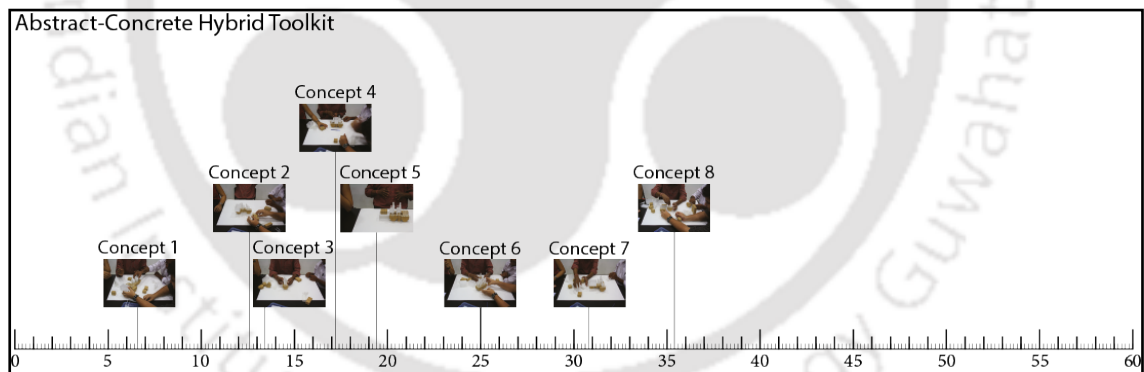


Figure 4.46: Concepts mapped on a time scale

CONCEPTS (BRIEF DESCRIPTION): PARTICIPATORY PROTOTYPING 4: ABSTRACT-CONCRETE HYBRID TOOLKIT

As seen in the graphical representation above, the concepts made by users were as follows:

- 1) Three-Wheeler, Four Seater (2 in-tandem, 2 sideways), Wide Rear Luggage
- 2) Three-Wheeler, Two Seater, Very Large Luggage Space
- 3) Wide Two Wheeled (Segway-Type), Two Seater with Middle Luggage space
- 4) Four Wheeled, Four-seater (Back to Back Seating), Large Luggage Space

- 5) Four Wheeled, Four-seater, Compact, Large Luggage Space
- 6) Compact Width, Four-Seater Vehicle
- 7) Three-Wheeler, Single Seater, Large Luggage Space

APPLICATION

The responses generated through this kind of toolkit may be used for futuristic design projects, where free flow of creativity is more important.

4.3.4.7 Discussion on analysis

In conducting these experiments it was observed that Velcro or any toolkit that works on 'one size fits all' couldn't generate satisfactory results. These experiments in participatory research offered immense possibilities. Abstract toolkit helped people to make futuristic concepts whereas concrete helped them to generate ideas for immediate short term needs – ones that are less futuristic but something that can be planned today. So, if company wishes to probe target customer base to understand what are people's aspirations and expectations for a very futuristic scenario, the Abstract toolkit can be used. If a company wants to find out what to innovate for users in short and immediate time span of 2-3 years, a participatory workshop aided with a concrete toolkit may help to peek into users' deep aspirations and experiences.

The 3D toolkits can play a pivotal role in participatory prototyping for bringing out responses that have a relation with parameters of timeframe for the future. The diversity of ideas generated by users are qualitatively very interesting and offer rich dividends for designers to develop them into marketable products. The success of the outcome of these experiments was reflected in this researcher being invited to conduct a workshop in Denmark with expert groups.

4.3.5 Communicating Results: Context Mapping: Formulation of Design Brief for Specialist Designers to Translate Requirement Capture into Design Concepts

It is not unusual that designer and researcher could be two different persons, separated by space and time in participatory research. It is true that designers at this stage of concept generation need exact and well packaged requirement capturing information for the product they are designing in order to stay focused on deep user insights. This can be in the form of visuals, text, videos etc. It is also required to represent the user

data generated from the participatory prototyping in a format that is understandable and inspiring for the participating designers to visualize and generate the vehicle form design. In this section, analysis (Figure 4.47) of the data received from participatory prototyping is visually represented in a format that comprises of:

- 1) An elaborate brief that talks about vehicle architecture, spaces, volumes and proportions.
- 2) Snapshots of participatory prototyping done with the concrete toolkit and
- 3) Access to raw video data of participatory session.

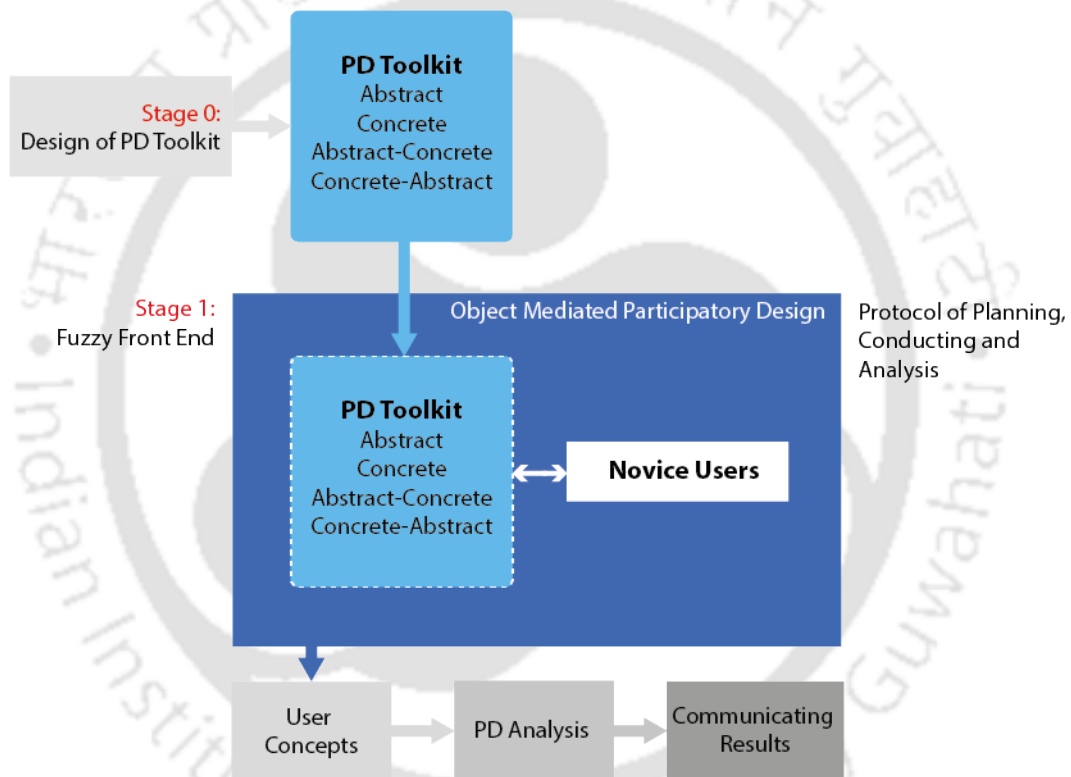


Figure 4.47: Communicating results of participatory design in stage 1

4.3.5.1 Visual map of Context

In order to inspire and inform designers with data generated from participatory research, it is important to represent data in a visual format that is easily understandable for the designers.

Data was generated in the form of transcripts, time-lapse video, edited video and embodied concept visuals from the participatory research,. This data had to be

translated into an easily and effectively understandable format for a group of designers. On careful examination of the data, the researcher created a one line brief for each generated concept and recorded them in the table as shown in

Figure 4.48.

Number of Wheels	Number of Passengers	Cab Type	Luggage Postion	Seating Closed	Seating Open	Seating Configuration	Proportions of Package	Volume of Luggage
4	4 (2)	Luggage/Seat Changeable	Luggage open	2	2	Side by side	Between Car and SUV	Large and Compartmental

Figure 4.48: One line brief in tabulated form.

This brief describes the primary functional elements (defining a vehicle architecture - number of wheels, number of passengers etc.), the secondary functional elements (addressing the spaces and volumes - cab type, luggage position, seating closed/open, seating configurations etc.) and tertiary functional elements that relate to the relative proportions of primary and secondary elements (proportions of overall package, volume of luggage etc.).

During this experimental session, seven designer briefs emerged. These were summarized in a data sheet with above-mentioned components. Three levels of chunking were done - primary elements, secondary elements and tertiary elements to precisely represent the group's needs and aspirations. The final brief was articulated from this and few snapshots of the concepts supporting the evolved brief were captured.

The overall structure of visual representation had three elements as shown in Figure 4.49 comprising of final brief, snapshots and raw video.

THE ELEMENTS INCLUDED:

- 4) Detailed functional brief containing data of vehicle architecture, elements of space and volumes and relative proportions.
- 5) Two images/snapshots of the chosen concept created by users in the experiment.
- 6) Link to raw data of participatory prototyping for designers to refer back to the session.

This resulted in the visual representation being ready for the participating four designers to get involved in collective form generating exercise that was to follow as the next stage of the research.

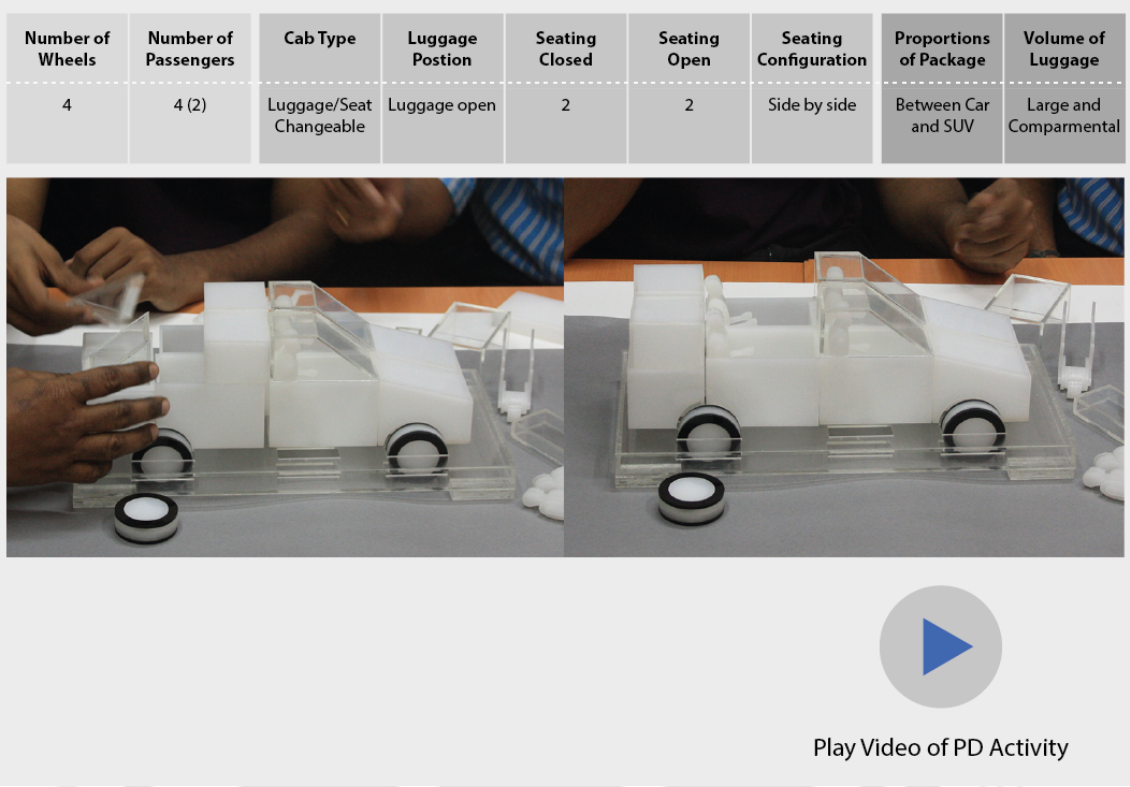


Figure 4.49: Visual Representation of Participatory Data

DISCUSSIONS

The data was made ready for designers. After the participatory design session with different users, the researcher presented and published the paper in PIN-C conference in Sønderborg, Denmark. Conference organizers also requested to bring both toolkits and conduct a workshop with other presenters and experts of Participatory Design in the conference.

4.3.6 Experiment Repeated with Foreign Expert Groups

As a part of the workshop in an international conference- PIN-C 2011 (Participatory Innovation Conference), the researcher conducted the same Participatory Research 1 with domain experts in Sønderborg, Denmark. Concrete and abstract toolkits were taken to Denmark.

4.3.6.1 Preparation

Two groups were formed and the groups were provided with abstract and concrete toolkits for participatory prototyping.

4.3.6.2 Conducting

The researcher explained about how the toolkits operates. The session was videotaped. One microphone was kept on the table to capture their voices. Toolkit was provided in the center of the table. Both the groups had four members. Participants were researchers from the area of participatory design, psychology, industrial design etc. The researcher briefed them about the experiment and the problem of ‘bridging the gap between two wheelers and cars’. The researcher played the role of observer, and moved from one table to another for the same.



Figure 4.50: Participatory activity with concrete toolkit in Sønderborg, Denmark

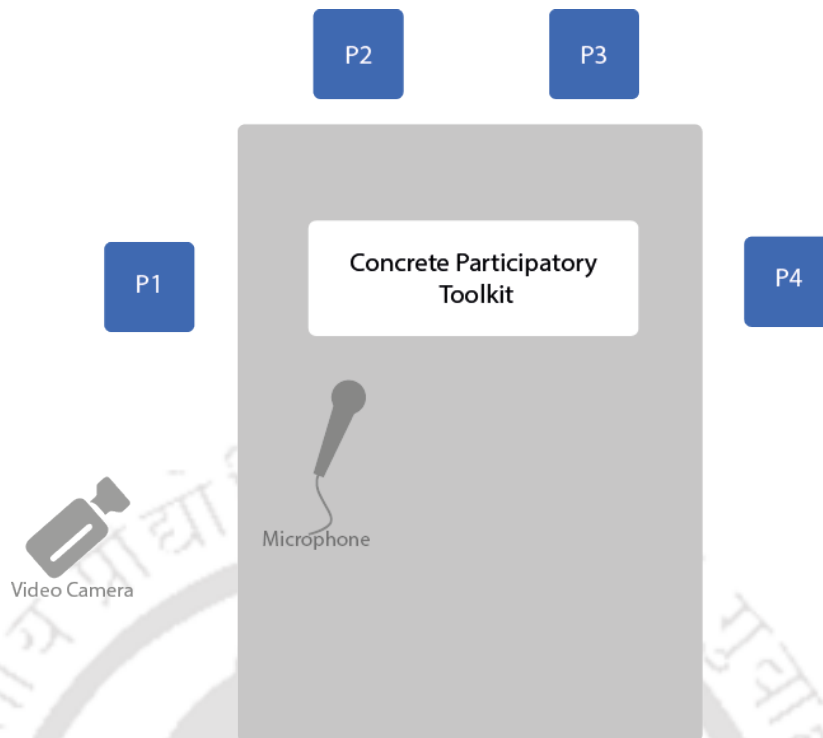


Figure 4.51: Seating schematics of participatory activity with concrete toolkit



Figure 4.52: Participatory activity with abstract toolkit in Sønderborg, Denmark

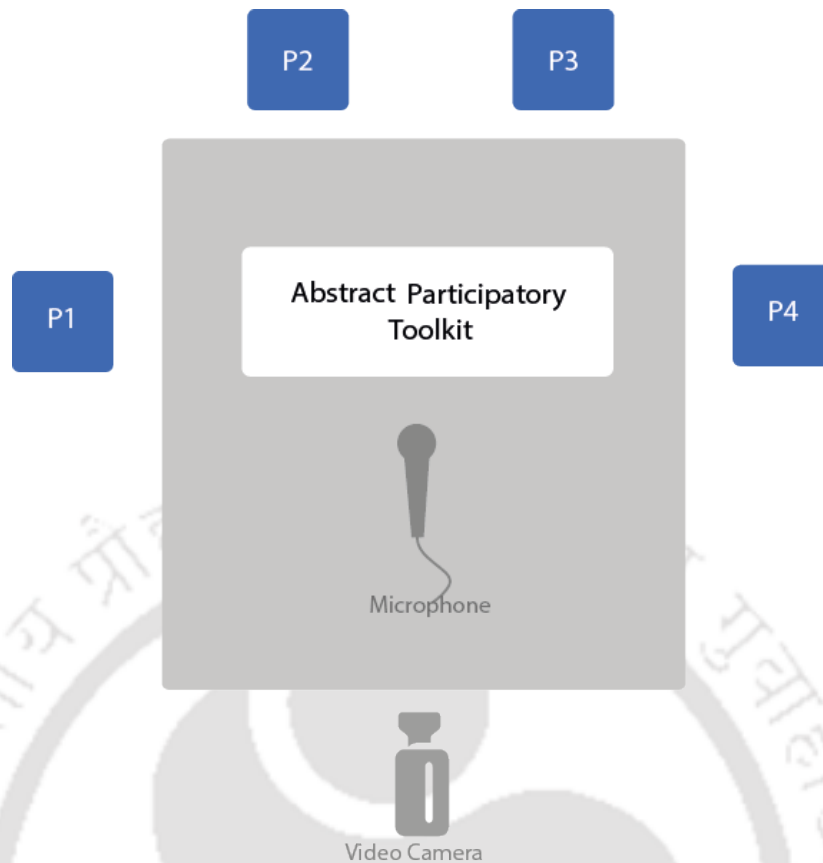


Figure 4.53: Seating schematics of participatory activity with abstract toolkit

OBSERVATIONS DURING THE SESSION

International participants were quick to start the conversation, shared stories and used the toolkit. There were light movements and some serious prototyping, but the group went lull after a while. People got exhausted. Here is the summary of both prototyping:

4.3.6.3 Analysis: Concrete

PD SUMMARY (CONCRETE TOOLKIT)

It started with the explanation of toolkit and understanding the background of the same kind of experiment done with the Indian groups. The interest was to find their way of looking at the gap between 2-wheeler and 4-wheeler. In India people prefer utility and choose vehicles, which can perform various tasks of individuals and their family.

Table 4.11: Excerpt of transcription

43	Person 4	I have three cars
44	Person 3	You have three cars, I don't have a driving license
45	Person 1	Things happen. You wanna buy one ?
46	Person 1	I have one car and its there on the ... Station car...so
47	Person 4	What irritates me really is that there are a lot driving around in that car which is way too big
48	Person 1	Yeah
49	Person 1	We have a staking car, we don't. I mean. We have two and we never use it
50	Person 1	And then we have a small car with only two seats and lots of room on the back
51	Person 1	So you can have a Christmas tree and take the and that's the one we use the most
52	Person 1	And now we have got our another own car which have a couple of more seats. So that, you know, if they have to take somebody somewhere, we can still do that
53	Person 1	So that, you know, if they have to take somebody somewhere, we can still do that
54	Person 4	Also you know that there is a very much of western problem.
55	Person 4	People buy a bigger car because there are some occasions where they need a big car
56	Person 4	And if they are not in occasion or they have to buy a Christmas tree...
57	Person 4	They have money only to buy one big car. So it has to Everything

When they started with the discussion, one member said that she uses her 3 cars for different purposes. From there the idea of multi-utility and modular units came into picture. All the people cannot afford to have different cars. So, there is a need to have some kind of flexibility in the cars, which can act as multipurpose vehicle. People don't want big car all the time but occasionally. So, the idea of sharing or borrowing was agreed upon. They discussed about the feasibility of such cars, and should have some solution to retain or store unwanted unit when not in use. Therefore, it has to be easy to attach and detach. Or it can just be a collapsible unit. They tried different forms with the given toolkit to represent their ideas. They tried to attach 2 cars which can be easily converted into single car/ car with more of a storage place or car with the more seats. They can be attached like how train compartments are attached. This can be done in sharing basis as per the requirement of individual. Another idea was to attach car to a moped, which will be more like trike. They also thought of plugging two engines together when two cars are attached to each other.

While having discussions with other members, they realized that everyone was not involved in building unit out of toolkit because of accessibility issue. Each one could see only one perspective of the form. Solution was to have a round table so that everybody can see the unit from all the perspectives. The toolkit was concrete, but when they tried to convert their ideas through them, it turned into an abstract unit. Also, they mentioned that this final form of the model is not exactly what they want to convey as they faced physical constraint in the toolkit and output was close to their ideas.

4.3.6.4 Analysis: Abstract

PD SUMMARY (ABSTRACT TOOLKIT)

They found it interesting to form a vehicle out of those given blocks. One of the members shared her experience of her visit to India where she found around 22 people travelling in 1 rickshaw. So, it is very necessary to have flexible unit for transportation so that these people can be accommodated. In a way, they thought of finding corresponding issue in their society too. One of the members came up with the idea of bringing sustainable cars that can last for say 60 years, which needs to serve the purpose of different phases of your life. Like how people are doing with their houses, they are making them flexible.

According to them, requirement of a car for single person is very much different than a family. Here some kind of extendable concept will make sense. They illustrated it with the given blocks. One of the larger boxes is a kind of large unit, which you only need at the time of holidays. This unit can be shared among the people who want them and can be attached to their own car as and when required. They thought that the idea of sharing is ecological and cost-effective. Many people own bikes or scooter but for moving something then they need cars, therefore this concept of sharing is relevant. But the issue in this concept is that people normally like to make cars personal, they leave their stuff in the car itself. If you are borrowing it then you have to clean it every time and it will be like hotel check-in/check-out. One member added the necessity of variation in engine power, as borrowed unit will consume more power than normal car unit.

Table 4.12: Excerpt of transcription

21	Person 4	these two boxes just make this real time and each day you build your car
22	Person 2	i like sharing idea but first i was thinking if you have all the parts you can make it yourself .. but in India you don't have money to do it .and you don't really need it... i like the idea of sharing...
23	Person 1	but from the ecological problem...we have the same problem but we don't have the same economical problem ..
24	Person 2	i always use the bike for shorter places but if you are moving furniture you will need like a car or something
25	Person 1	that's interesting I am also a biker and i have only the bike but i don't have a car .. so for me cars are strange ...
26	Person 4	we bought the first car when we had our first son it proved to be difficult not to use.. but there were concrete circumstances especially the stuff you need around the kids(diapers)
27	Person 1	therefore you can imagine also that there is this concept of sharing car where you go borrow the car when you need a car .. you can imagine that the small unit can be borrowed and the additional unit you can borrow ... various other units if you need them...
28	Person 4	and i think some people would like to have something of their personal because people put their stuff in their car , for us the house is small so the car for us is additional storage space .. but if you borrow , you have to clean it before giving it back.. it would be like a hotel ..

One member shared his experience of their first car as it was bought when they had their first child. According to him car becomes a necessity at this point of time especially with the stuff you need to carry along with the children.

They also discussed the idea for creating living space in the car, which can act as a part of house as well. There could be a unit at the back of the vehicle, which can be attached or detached. They also shared ideas for using this car space for different purposes like using it as office, watching movies, children's play area etc. like how carpenters live in their vans and store their tools.

They found the blocks in a toolkit iconic but kind of abstract. They were mainly talking about modularity of the vehicle and therefore those blocks were not enough to present their thoughts. According to them, they can calculate the number of different forms which can be made out of blocks by selecting them. So, this process is more of selection rather than creation. In short, they started with the possibility of arranging the blocks to

form a vehicle and ended up with the concept of modularity and creating living space in a vehicle.

4.4 Concluding Remarks on the Participatory Research 1

3D Toolkits in various forms played a pivotal role in participatory activity. Depending on the design lead-time and business goals, four types of participatory toolkits viz. concrete, abstract, concrete-abstract hybrid and abstract-concrete hybrid can yield concepts for near future, moderately-futuristic, futuristic and very futuristic design projects in prototyping activity (Nishant Sharma, 2011).

Step by step moderation is possible with concrete elements for more practical responses.

Using all types of toolkits, designers/researchers can map possible directions for near future, moderately futuristic, futuristic and very futuristic design projects and further use them in the design process. The experiment with novice users was taken up primarily to apply the toolkit and elicit responses from users. It was established that specific type of toolkit elicits specific types of responses.

A 3D toolkit does aid a small group of four members to actively prototype and participate in prevailing discussions. Their focus stays in the space where 3D kit is deployed. The outcome is usually a manifestation of shape through blocks and stories, utterances, anecdotes.

The designer extends his responsibility, more so in the Fuzzy Front End. He designs a toolkit with basic understanding of users. He then designs PD research from planning to analysis. This new role of designer and extension of design process leads to effective elicitation of users' tacit and unmet needs.

The design team in a vehicle design set up collates solutions that are made by participants. These solutions are then analyzed by making transcripts. Patterns are observed using Grounded Theory. One or more patterns take the shape of the initial brief that gives direction to designers. Data gained from this session must be presented to designers to start ideating the basic format of the vehicle. This needs to be done in such a way that it is effectively understandable to him and he gets sufficiently motivated. In this methodology, the researcher proposes to give it to a group of designers.

The next chapter presents a collective form visualization with a group of designers to take this process forward.



CHAPTER 5: COLLECTIVE FORM GENERATION BY A GROUP OF EXPERT DESIGNERS

5.0 Introduction

In the previous section, a ‘visual map’ of the brief was obtained after analysis of participatory activity. Taking the framework of research experiments forward (Figure 5.1), this visual brief is now ready to be taken up with expert designers to collectively be translated into vehicle product concepts. These product concepts would then be rendered and the renderings would be subject to user evaluation following a participatory process.

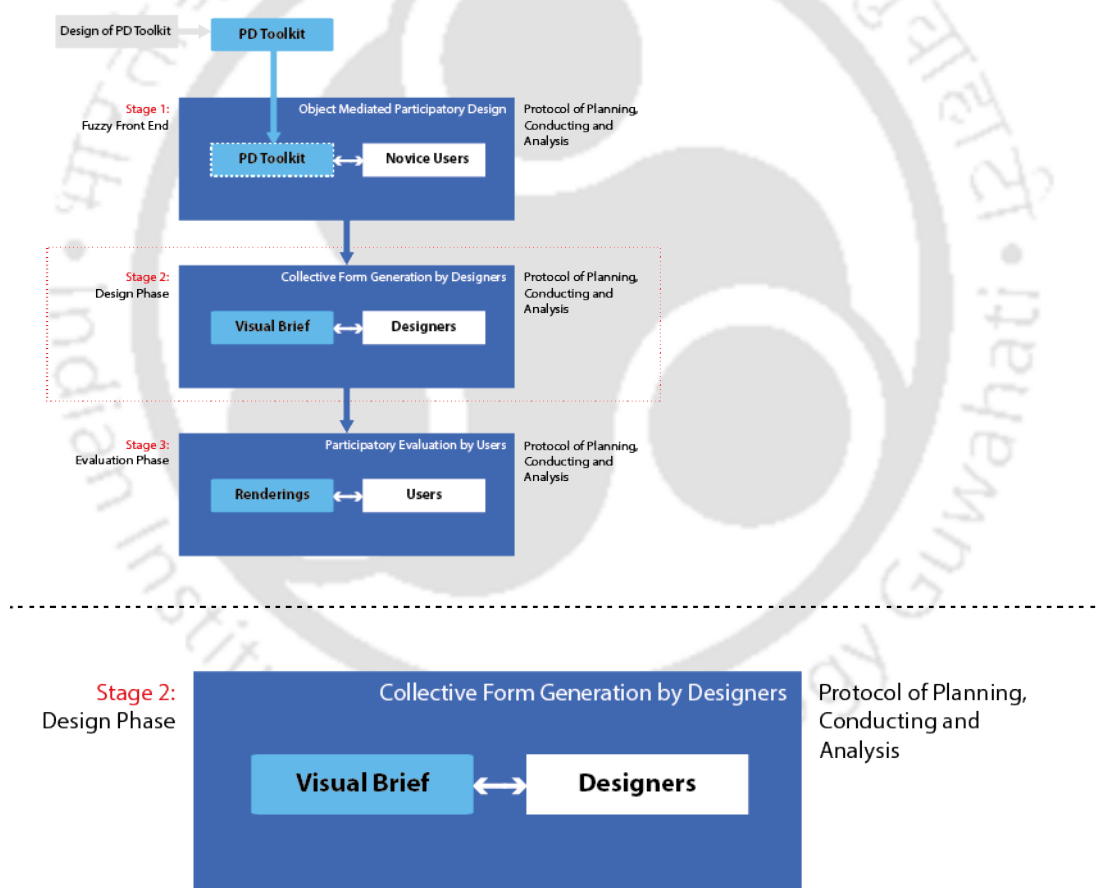


Figure 5.1: Collective form generation by designers in design phase

Context map is an effective tool to inform designers about the deep user insights obtained from participatory research. This chapter presents form visualization undertaken with a team of four expert designers in a collective manner. The designers were introduced to the visual brief/context map and based on these inputs asked to

create vehicle concepts. This chapter demonstrates, how the deep and tacit context-sensitive information generated from participatory research was used in form conceptualization of a vehicle through a collective exercise undertaken by a group of designers.

5.1 Planning

Four senior student designers specializing in vehicle and transport design were invited to collectively participate in design of vehicle forms that are context-sensitive. Collaboratively, through a process of sketching they were to visualize, illustrate and negotiate to evolve alternative conceptual form proposals. The designers used sketching as a tool to discuss, conceptualize and negotiate concepts to finalize the vehicle form. The exercise culminates in designers illustrating through renderings, the vehicle form that has functional and formal information embedded in them. The deliverable of this activity is collective participation in form visualization through informed sketches.

The larger objective of planning this phase of the research was to gain insights from the exercise and understand the main framework of participatory research as well as the role of the designer in this exercise of vehicle design.

5.1.1 Selection of Participants

Four postgraduate design students specializing in 'mobility and vehicle design' program were chosen for this exercise, as they are trained and well aware of the process of concept generation and visualization. They had in their design portfolio at least two design projects as a part of their masters of design program

They participated to conceptualize vehicle forms using the visual brief. They were expected to evolve forms collectively through sketches. These sketches later were later translated into renderings in a typical styling process.

5.1.2 Preparation of Support Media

Arrangements were made for the following towards conducting this exercise:

- a) Visual map (Figure 5.2)
- b) Template-Human package (Figure 5.3)
- c) Projector

d) Stationary

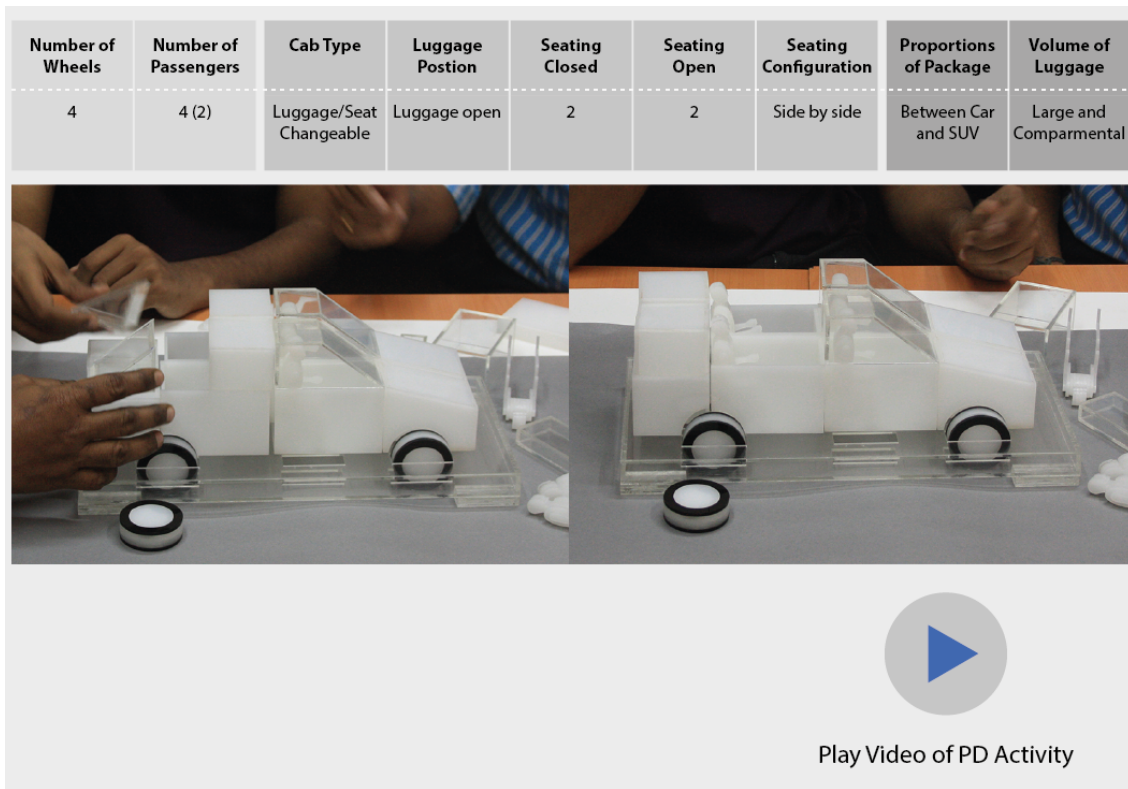


Figure 5.2: Visual Representation of Participatory Data

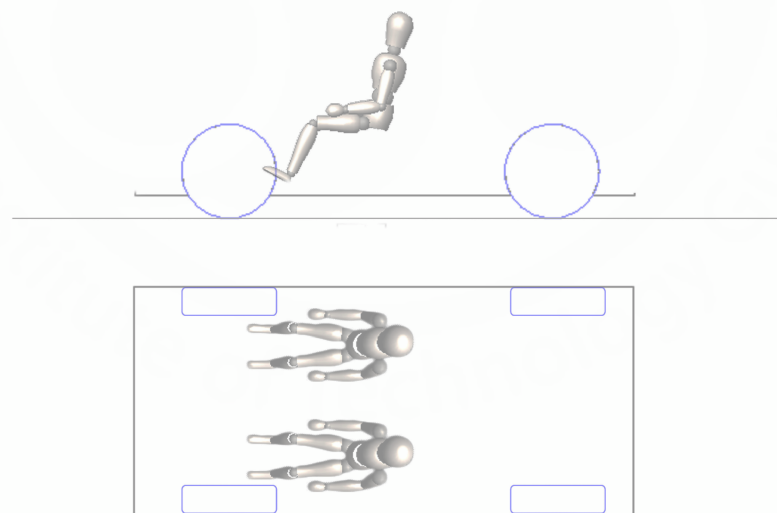


Figure 5.3: Template for human package

Two postgraduate students extended support to the researcher in setting up the experiment. The designers were given access to the video recording for reference. A laptop connected to a projector was used for browsing during the experiment. Design stationary including sheets, ball point pens and markers was provided for sketching.

5.1.3 Time Plan for Participatory Research 2

The designers were briefed about the following three tasks they were to accomplish:

- 1) Conceptualizing and sketching.
- 2) Present sketches to each other and then negotiate for one form.
- 3) Joint sketching and presentation.

5.1.4 Role of Moderator

The Designers were informed in advance that there would be no discussion with the moderator in order to observe the natural ability of visual representation to communicate in the form generation.

5.1.5 Instrument of Data Collection

The whole process was planned to be recorded for data using videography with audio recording.

5.2 Conducting Participatory Research 2: Collective Form Generation by Expert Group

As mentioned earlier, the activity was carried out with the designers by dividing the task in following manner:

- 1) Background and Tasks
- 2) Conducting Session
 - a) Conceptualizing
 - b) Negotiation
 - c) Joint sketching and Presentation

5.2.1 Background and Tasks

A quick narration of the participatory session conducted earlier with novice users was done and they were explained the goals and objectives of this exercise. They were also briefed about the concrete toolkit experiment. The designers were explained how users evolved concepts (functional needs) using the toolkit. Then the structure of the visual representation comprising the three elements was highlighted as reference.

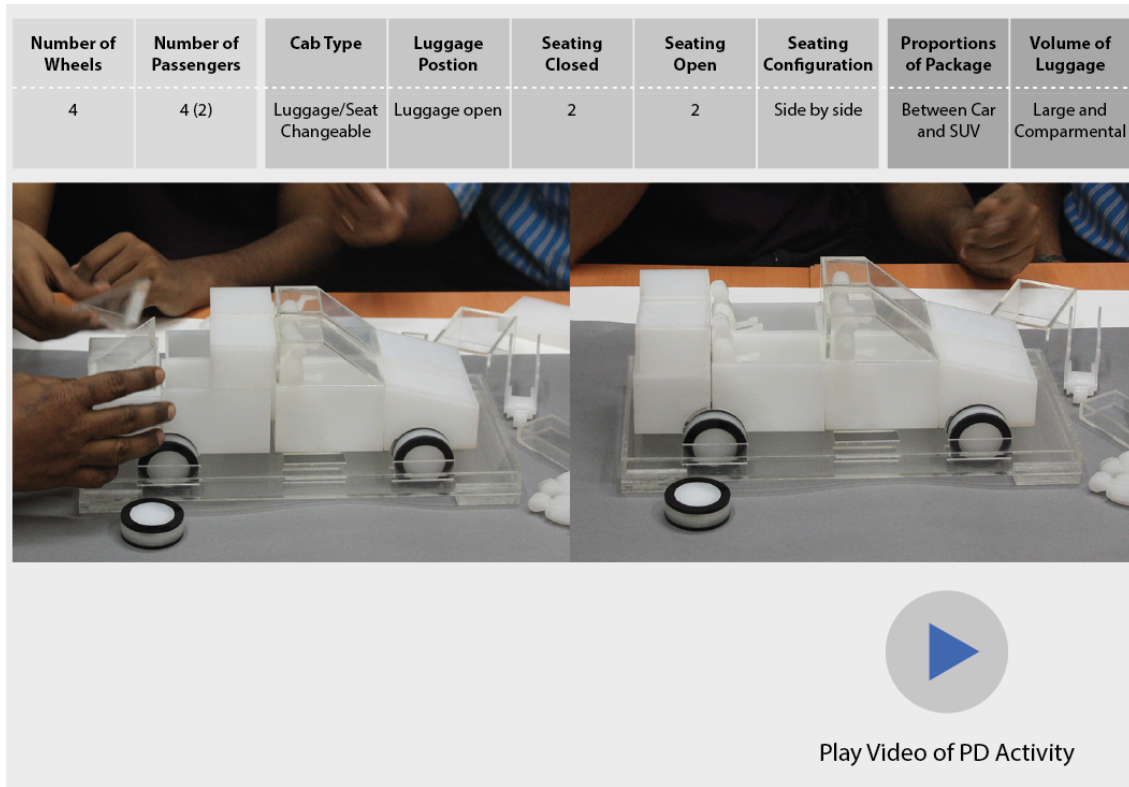


Figure 5.4: Visual brief

All entries (Figure 5.4) were read out to the designers and the attributes of the possible vehicle were discussed. The researcher also pointed out two images in the Figure 5.4 that were snapshots of participatory session. In conclusion, the researcher pointed out the availability of raw video data in case designers were interested in viewing the actual video and user conversation.

5.2.1.1 Task and Time Plan

The Tasks for the designers for collective form generation was outlined in the following manner:

- A. Conceptualizing' and sketching: 20 -30 min duration.
(A template with preliminary human packaging was given to them for reference).
- B. Presentation of sketches to each other: 5-7 minutes duration.
- C. Negotiation and evolving vehicle direction, then 'negotiation' for one form: 20-30 minutes duration.
- D. Joint sketching' and 'presentation: 30-40 minutes duration.

5.2.2 Conducting Session

Reviewing the video recording of the session helped to draw detailed notes of the process the designers underwent. The notes gave shape to analytic account of each stage of session with the help of technical and design understanding of the researcher.

5.2.2.1 Conceptualization

Participant expert group was shown visual representation to conceptualize vehicle forms in the participatory session. The schematic arrangement of the set up for the exchange between designers is shown below.

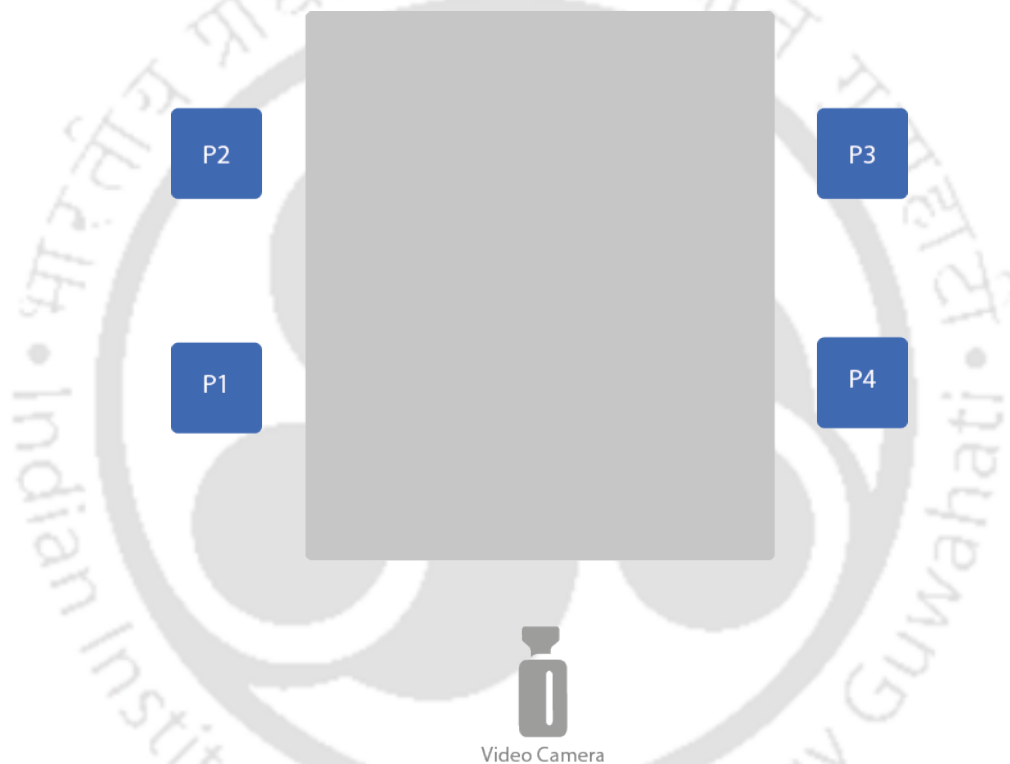


Figure 5.5: Seating schematics

Refer to Figure 5.5, participants were numbered from left to right in clockwise direction. Participant-P1 is on the left side close to camera, Participant-P2 sitting next to Participant-P1. Participant-P3 and Participant-P4 in clockwise direction there on.

5.2.2.2 Conversations:

Conversations started within the group with small thumbnails and doodles. Discussions were mainly on conceptual thinking towards new vehicle products. In the beginning, they started to discuss basic engine type, drive and packaged the volume of the engine in

order to establish the basic type of vehicle. They assumed conventional drive viz. front engine to be available in entry-level cars. While they talk about engine, pick-up trucks also came in discussion because of the possibility of having a large luggage as well as cab space. Luggage area occupied an important part in discussion and the group started to discuss about quickly sketching out various storage possibilities like stacking and modularity with basic usability options like sliding, rolling etc. While the discussion evolved from basic type of vehicle to luggage, they started to look at other problems like poor lighting condition in India and how this vehicle design could attempt to provide lights in the rear portion of the cab space while loading and unloading during night and low day light situations. An important situation of large seating cab also came along, where they discussed basic question of ingress and egress and through sketches started to communicate in the group. One of the examples was a roll-up door. Styling or looks of the vehicle came as a discussion point quite late in the session. They all showed their interest in powerful, sturdy and strong looks but at the same time emphasized on simplicity. Later they felt that input was good enough for sketching concepts. From here a silent and intense sketching session started.

5.2.2.3 Sketching:

Having a fuzzy idea on the type of vehicle, engine, volumes of cab and luggage, the participants started sketching. During sketching their discussions ranged from vehicle architecture, configurations to components and then to details that led them to clarify as to what an entry level cars should have in terms of engineering in order to solve context-sensitive issues. They began visualizing the integrated images of the vehicles through sketches. These images of the new vehicle that bridge the gap between two wheelers and cars, were diverse and different. Participant-P2 worked on modular idea with interchangeable cab and luggage modules (Figure 5.6). The whole module can be changed if one needs to do it for four passengers. Because of the bad nature of Indian roads, he conceptualized high ground clearance and to solve ingress and egress issues and also introduced foldable footboard.

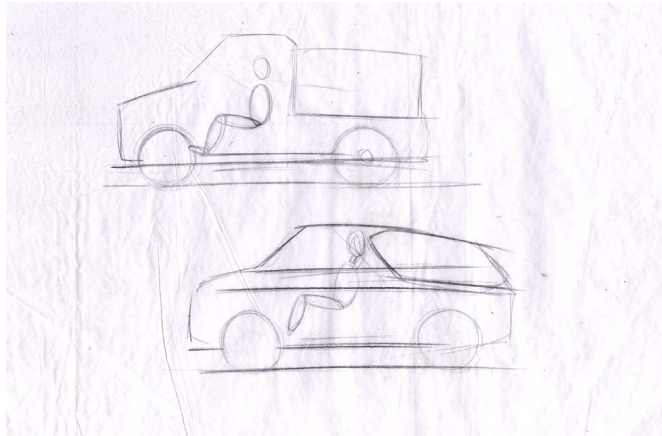


Figure 5.6: Interchangeable cab and luggage modules proposed by P2

Participant-P3 conceived a two-part vehicle having cab and cargo like long haul trucks. Attaching the modules when needed, to transport goods or people. Other designers jumped in with ideas of designing a ramp with rollers etc. Hydraulic jack was also considered for supporting the cab/cargo to connect with the driver's cab (Figure 5.7). Other alternative was to have a wheel at the front of the cab/cargo that is 90 degrees, touching down to drive the module out. P3 also discussed the use of high tail lamps and explored the possibility of low intensity lights.

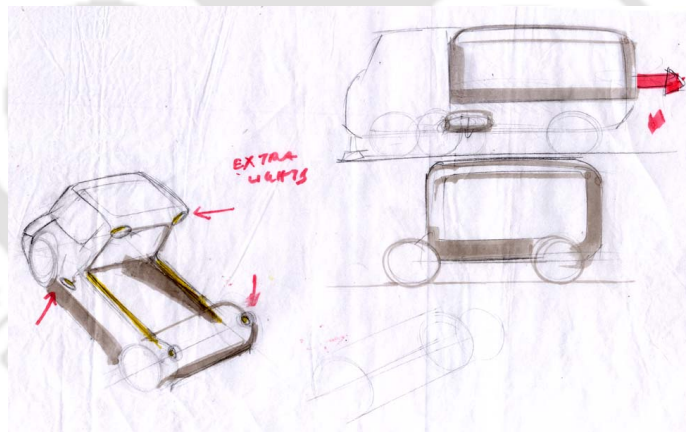


Figure 5.7: Participant-P3's two-part vehicle proposal

Participant-P1 suggested rollers as a way of attaching and detaching modules. Ramp can also be made at the rear of the door. (Figure 5.8)

They briefly talked about styling and jointly suggested to have standard and neutral one without any particular theme.



Figure 5.8: Participant-P1's Rollers as way of attaching modules.

5.2.2.4 Negotiations:

At this stage, designers had already sought the direction of the vehicle. From their earlier discussions, they choose modularity as the concept for cab & cargo space with the driver's cab. However, they seemed practical when they reflected on the cost of engineering another wheel. This led them to think about the size and volume of the cab and cargo modules. During the discussions, they pulled out the template that shows the basic human packaging (provided as a part of kit). They assumed and pushed the driver and co-driver space forward and cleared the rear space for cab and cargo space. (Figure 5.9)

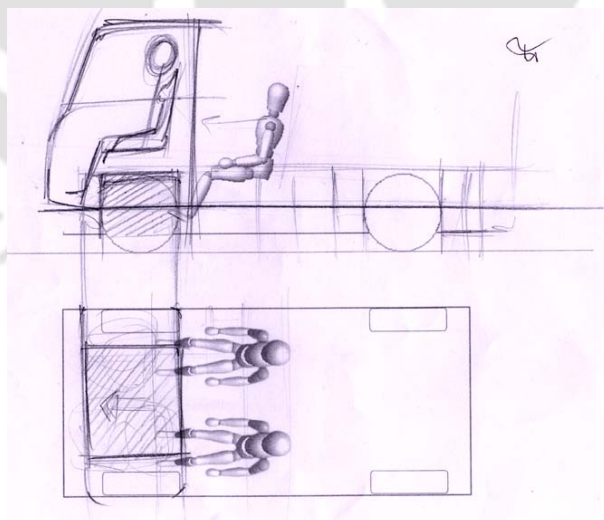


Figure 5.9: Sketching over the template and negotiating.

They also started to assign work to each member. Participant-P1 volunteered to integrate all sketches into an integrated holistic form. In order to sketch forms, they choose, through negotiations, a van-like front and continued discussion to clarify

certain elements like front and rear overhangs; ramps use and frequency; wheel size for proportions etc. While Participant-P2 and Participant-P3 worked on rear, Participant-P4 explored graphical details.

Form expressions: Form Expression was discussed and the keywords chosen were - Simple, Rugged, and Reliable. They also emphasized that vehicle should have steady & stable stance. The vehicle should have a solid kind of look that suits the cross over between car and mini truck. DLOs (Day Light Openings) can be conceived in the straight lines and planes. By this stage, Participant-P1 assumed the role of integrator and started to bring in everybody's ideas into vehicle form sketches. (Figure 5.10)

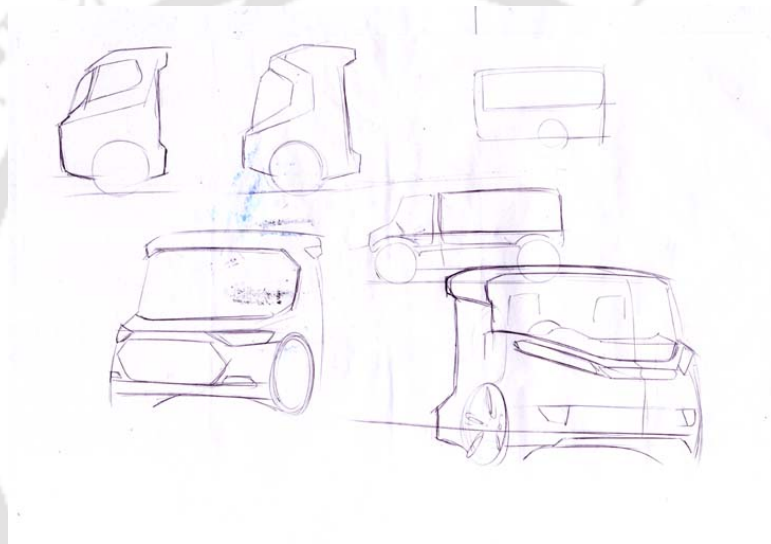


Figure 5.10: Sketch Integration undertaken by P1

5.2.2.5 Joint sketching and Presentation

Group decided to divide the task within the members. In the course of the discussion, they volunteered to sketch and render various parts of the vehicle. Participants P2 and P3 facing each other interacted in terms of volumes, spaces and attach-ability of cargo/cab with driver's cab. They also discussed on locking details of the two male and female parts.

JOINT SKETCHING

a) Participant-P2 sketched front perspective of cargo/ cab of the vehicle as shown in Figure 5.11.

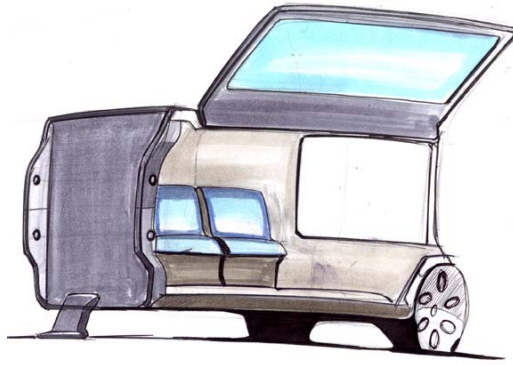


Figure 5.11: Perspective view of cargo/cab module undertaken by P2

b) Participant-P3 sketched the rear perspective view of the driver's cab conversing and referring to sketch of participant-P2 (Figure 5.12).

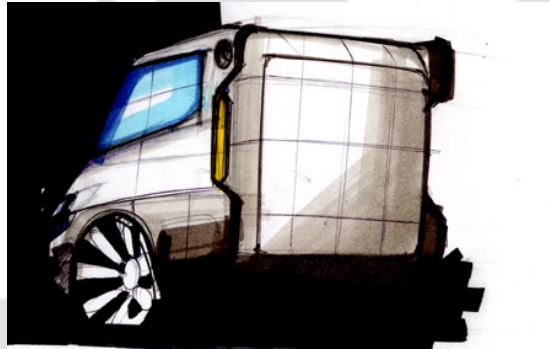


Figure 5.12: Perspective view of rear of driver's cab

c) Participant-P4 explored various graphic expressions in the side view with the aim of keeping the proportions intact. (Figure 5.13)

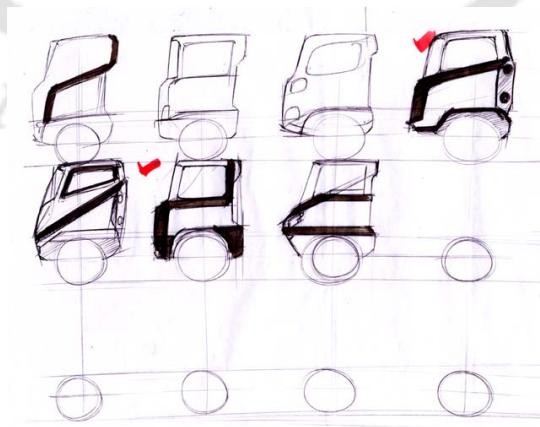


Figure 5.13: Various side view explorations undertaken by P4

d) Participant-P1 integrated his earlier form explorations with sketches of Participant P2, P3 and P4. Following is the output of the form in Figure 5.14.

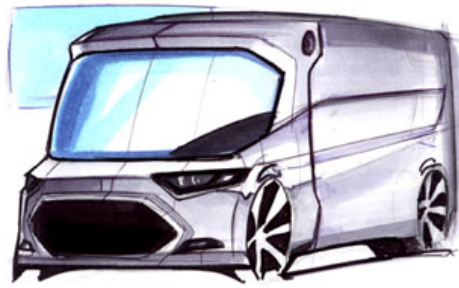


Figure 5.14: Perspective view of overall vehicle.

PRESENTATION

In order to improve the sketch in terms of proportions, stance and graphics, participants decided to co-render the evolved sketch. Refer Figure 5.15.

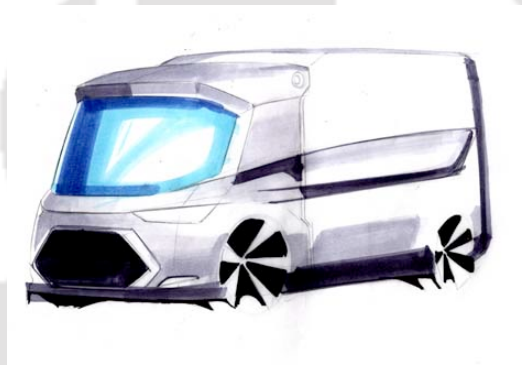


Figure 5.15: Sketch co-rendered

As they finished, they gave a presentation showing final rendering along with their sketches. In the presentation, the following points were highlighted.

Vehicle packaging and specifications: Given the packaging, it was quite important what volumes worked for them and how much they could shift in terms of spaces, as they needed to decide ground clearance and placement of engines and passengers.

Underpinning Theme: The theme that evolved though the session was the Concept of Modularity. The Drive unit being a single separate unit, offered the advantage that different modules could be attached to it. This offered flexibility to it.

Aesthetics: For an entry-level car, the visual look of the car was to be solid, steady and reliable. Cross over between trucks and van like vehicle with large DLOs (Day Light Openings) worked for them.

Detailing: Basic detailing was required to further enhance the expressions. In order to align cargo/cab with the driver's cab, details such as the placement of locking mechanisms (male and female) was critical. Extra lighting sandwiched (between cargo/cab and driver's cab) provide light when modules are attached or detached.

5.3 Analysis – Sketch as Mediator for Participatory Visualization

The researcher has already presented object mediated participatory research in chapter 4. The outcome of this study was presented as a research paper during the Participatory Innovation Conference, PIN-C 2013, Melbourne. It gave an opportunity to discuss the research approach and findings with Mr. Dennis Day, a researcher and analyst from Denmark. This resulted in agreeing to collaborate jointly on the research and further examine the phase of collective concept generation activity.

As presented in this section, this phase of the research had resulted in a collaboratively designed idea/concept of a vehicle product. The activity was highly sketching intensive and constantly mediated by sketches. This resulted in a keen interest to examine the process of participatory visualization further - how designers collaborated around 'the sketch'; given the sketch's physical placement, its own materiality, and its semiotic resourcefulness, how does it participate in such participatory activity? Will it allow us insights into participatory design as a democratic set of actions, relationships and outcomes? Video recording offered visual and auditory data of the activity with a focus on action around the sketch, resulting in a shot of a table, the sketch, as well as other papers, and the torso of the designers sitting around the table (Figure 5.16). The sketch being at the center of analytic gaze (Figure 5.16).

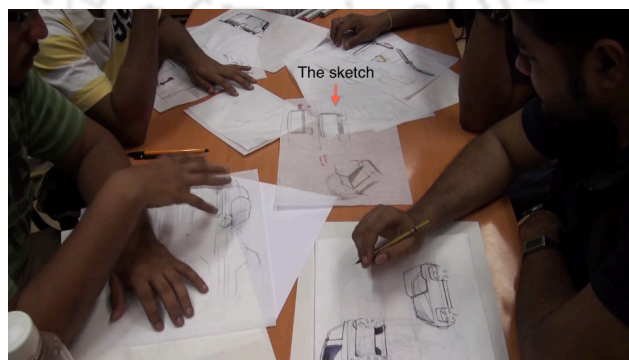


Figure 5.16: Sketch at center of analytic gaze

Presented here is the outcome of this collaboration with Dr. Dennis Day, who undertook to work with the researcher to help analyze the video recording of the process of visualization considering the sketch as the mediator for negotiating consensus among participating designers.

Presented in the following section is the detailed methodology and insights of the expert analyst's perspective.

The researcher sent video-recorded data of 'negotiation' phase of participatory innovation workshop to Dennis Day (collaborator in research). This is a 'maker/analyst' research, where a 'maker', in this instance the doctoral researcher, sent in five minutes' video-recorded data of design in participatory innovation workshop to Dr. Dennis Day an expert 'analyst' collaborator. A 5 minute clip of the video material supported by suitable transcriptions of the conversations in English was shared online using Dropbox. This was followed by series of Skype discussion. The outcome of the exercise resulted in co-authoring of a conference paper. He is to initiate an analysis of some interactive practices evident in the data. This section was particularly interesting because of negotiation aspect of the designers' collective form conversations. A 5-minutes transcription was made and the analysis is presented in this section. This section on analysis shows how a design sketch can play a role in design practice as a physical space for negotiation. Thus, researcher's focus in this section was on how this research can help us get better results in overall participatory approach (which will appear in Chapter 7).

The details of the literature reviewed and supporting theory; the data and the methodology; analysis and results which constitute a part of the research are reproduced below.

5.3.1 Literature and Theory

This perspective on sketches has its roots in Ethnomethodology, a radical form of sociology formulated by Harald Garfinkel (Garfinkel, 1967). Ethno-methodologists investigate the everyday methods people use in their social affairs. There is a focus on concrete activities, which are coeval with an intelligible organization that actors already provide and that is, therefore available for scientific analysis. Members of society

achieve this intelligible organization through actual, coordinated, concerted, procedural behaviors or methods and practices.’ (Maynard & Kardarsh, 2007)

Ethnomethodology studies generally include a variety of methods of inquiry; ethnomethodological ethnography (Wieder, 1974), conversation analysis (G Psathas, 1995), self-observation ((Rodriguez & Ryave, 2002)) and membership categorization analysis (Hester & Eglin, 1997). The present study uses conversation analysis as a technique for demonstrating the orderliness of talk-in-interaction. Additionally, our focus on ‘the sketch’ relies on recent developments within conversation analysis which have brought to bear the wealth of semiotic resources in interaction other than language.

5.3.2 Data and Methods

The data for the study comes from a set of vehicle design activities involving 3D tangible participatory toolkits (Nishant; Sharma, Day, & Puneekar, 2012). A 5-minute portion of one such activity comprises the main data for this study, with some 25 minutes more available for testing the generality of our findings. The activity in question was one in which 4 designers were to conceptualize vehicle forms. What is referred to as ‘the sketch’ is a proposed final visual representation to be used to conceptualize vehicle forms by the 4 designers.

As mentioned, the data consists of video recordings which have been transcribed following the procedures laid out in Jefferson 1990 (Gail Jefferson, 1990). See Appendix 10 for symbols and notations. With the help of the transcript, our analytic procedure consists of working sequentially through the informants’ actions, attempting to determine what sorts of actions they are made out to be by other informants. Determining, for example, that some action is a question hinges on being able to see and hear what follows it as an answer. In this way actions reflexively co-determine each other.

Actions are also considered as to their status as turns, which can be understood just as turns in a game, or waiting one’s turn in a queue. How does one get the right to the floor in order to deploy a particular action? If one has initiated some new business into the interaction, then one may, simply take the turn provided one isn’t disrupting someone else. Likewise, if one is finished with one’s turn, and no one takes a next turn,

then one is obliged to continue. Some actions, however, directly implicate someone else taking the next turn. Returning to the question-answer example above, it can be stated that how question is constructed, provides, either directly or indirectly, for who may take the turn in which an answer is deployed.

As mentioned above, our analytic gaze has been focused on the sketch. Thus, interest has in understanding how the sketch is involved in the informant's actions. To do this, it has been necessary to see the sketch as a space, a box if you like, as shown below:

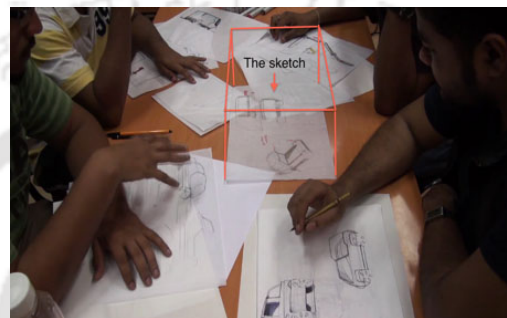


Figure 5.17: Illustration 2

Although the sketch is of course physically in 3 dimensions, informants' orientation to it 'thicken' it in the sense that an orientation to it does not imply actually touching it. The sketch is also, and most often, oriented to holding or moving one's hand 'in the box'.

5.3.3 Results

A very robust finding in our analyses is how the sketch is involved in turn taking. Simply put: For a set of actions, one important way of securing and holding a turn in which one will deploy an action is by having one's hand in the sketch space, as seen below:



Figure 5.18: Excerpt 1

Table 5.1: Transcript

13*AV:	so now we've got a palette of ideas on the
14*AV:	table like this
15*CH:	And I think then (1.5) since all of us
16*CH:	is thinking of
17*CH:	modularity [and it is] becoming and detaching
18*BM:	[yeah]
19*CH:	[off of the vehicle so]
20*BM:	[XXX one common thing is that
21*BM:	the [different modularity]
22*DP:	[XX this is really good yea]
23*AV:	so whatever the also uhmm ≈
24*DP:	≈XXX can
25*AV:	what kind of chassis are we talking about(.)thats
26*HD:	*****
27*AV:	thats the important thing because you have
28*HD:	*****
29*AV:	because if we are talking about a
30*HD:	-----X-----
31*AV:	conventional engine
32*HD:	-----
33*DP:	mmm
34*AV:	then uhm I don't know are we going the entire
35*HD:	-----
36*AV:	engine way up in the front and or the back
37*HD:	-----
38*AV:	cabin being fully fully put out or are we going
39*HD:	-----Z*****
40*AV:	for something which the which is similar to
37*HD:	*****
38*AV:	a pick-up ↓ or something (.5)because≈
39*HD:	*****
40	(1)
41*CH:	≈the engines were like mid as in mid-engine train
42*HD:	*****X-----
43*CH:	as in somewhere over here like in Omni↗
44*HD:	-----

In the transcript, you will note a line number, followed by either an informant/turn taker's name or the abbreviation 'HD' for 'hand'. The HD line indicates movement or

placement of the turn taker's hand. Asterisks signify movement of the hand outside of the sketch space. Hyphens indicate movement toward or in the space. An X indicates when the hand has entered the sketch space and a Z indicates the hand has left the sketch space.

The picture above is taken at the point in line 29 where AV has put his hand into the sketch space. While there, he moves his hand up and down in baton like fashion and in concert with his talk (lines 30 & 32), or moves his hand along the drawing of the vehicle on the sketch (lines 35-37). The action he is producing begins in line 25 where he begins, in a question like format, to speak of chassis as choice of chassis will affect choice of engine. His point is that if a conventional engine is to be used then its placement will depend on the chassis chosen. His main point is made with the example of a conventional engine with examples of two different chassis, lines 34-38 & 38-40. With the first chassis, his hand is in the sketch space, but not so with the second chassis. At line 41, CH self-selects as next speaker on the topic of engine placement and proceeds to move his hand into the sketch space (line 42).

Two things are worth noting with this brief example. First is that sometimes it seems to be the case that certain actions, such as discussing chassis-engine relations, where if one is to contribute, one's hand should be in the sketch space at some point. Second, what one does in the sketch space need not, but may have to do with what is physically represented on the sketch. AV uses his hand in the 'baton' gesture to mark his speech (lines 30-32), while in lines 34-37 his hand moves from front to back along the vehicle drawn in the sketch.

Generally, there seem to be 3 basic types of hand movements within the sketch space Figure 5.19. They are:

- 1) Pointing
- 2) Tracing or drawing
- 3) Baton, other iconic

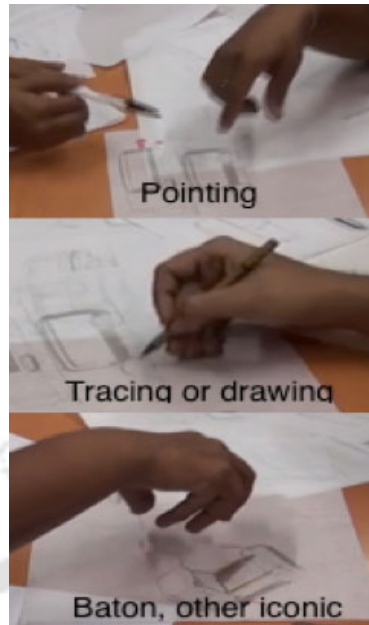


Figure 5.19: Illustration 3

In the example above, AV has, as mentioned, used a baton-like gesture in line 30-32. The movement of his hand in lines 35-37 is however, more of a pointing gesture. His hand moves from the front of the vehicle to the back as he utters those very words. Generally, it can be stated that pointing and tracing/drawing movement are concerned with and dependent upon the sketch as an iconic representation of the design object. The baton as well as other iconic gestures, for example such as a circle motion over the sketch, are concerned with the sketch as providing a space for actions and are not dependent upon, nor refer to, actual representations in the sketch.

As noted earlier, there are some actions where securing and holding a turn does not involve the sketch space. An example of this can be seen in the excerpt below.



Figure 5.20: Excerpt 2

Table 5.2: Transcript

15*AV:	∇lighting∇ (.) modularity is our top
16*AV:	priority anyway
17*CH:	∇mawd∇
18*DP:	yea
19*CH:	lighting
20*AV:	uhh um [op and] openings for the carriage
21*CH:	[modularity]
22*AV:	its
23*CH:	(xxx)ideal
24*AV:	yea and even in the modularity uh (.)
25*AV:	should we look at what kind of uh
26*AV:	«size»es of the cabin we're looking at
27*AV:	at least if some person could probably
28*AV:	work on
29*UNI:	mm
30*AV:	what kind of size and
31*UNI:	yea yea
32*AV:	these will carry
33*UNI:	yea
34*AV:	because if you're gonna provide options
35*AV:	and I think it's nice sort of if we can
36*AV:	probably design a options themselves
37*UNI:	ŸyeaŸ
38*BM:	or uh we [can] actually have
39*BM:	[for::]

Here the designers are listing details of their design work and who is to work with what. Some are noting the list down on their own drawings/papers, while others are merely taking part in the discussion.

A relevant question then is what are the differences between actions which take place in the sketch space and those which do not? From the two excerpts presented thus far, one might say that actions in the sketch space deal with design proper in the sense of figuring out what goes where in the best way, while action outside deals with design organization, in the sense of taking note of the design project's resources and constraints, division of labor and so forth. Also, noteworthy, as evidenced in excerpt 1,

an action outside the space may lead to a following action within the space. Thus, AV's initial point, outside the space, concerning the chassis-engine relationship can be heard as a particular constraint on design, while his example of this using the conventional engine and its placement is done within the space.

The distinction above seems to pan out fairly well as evidenced in the table below over some connected actions within and outside the sketch space.

Table 5.3: Actions outside and inside sketching space

Actions outside the sketch space	Actions inside the sketch space
noting the chassis-engine relationship	exemplifying engine placement with various chassis
evaluating the work on modularity thus far as not being possible	exemplifying various features of modularity in the design
expressing concern for engineering costs	demonstrating how feature can be designed more cheaply with regard to engineering
Making a list of details to design & division of labor	tracing out changes in the design as a way of fulfilling demands of the list

Thus, far only actions in the sketch space by solitary turn-takers have been exemplified. The space, however can be a much busier place, on occasion housing several participants at once. The next excerpt (Figure 5.21) exemplifies this.



Figure 5.21: Excerpt 3

Table 5.4: Transcript

12	*BM: [xxxxxxxxxxxxxxexactly]
13	*AV: [modularity in this sense]
14	*HD:*****X-----
15	*BM: [xxxxxxxxxxxxxx]
16	*DP: [xxxxxxxxxxxxxx]
17	*AV: [modularity in this sense is not not]
18	*HD: -----Y*****
19	*AV: possible]
20	*HD:*****
21	*BM:one more advantage of this modularity is that
22	*HD: X----
23	*UNI: mmm (.) uh::
24	*BM:you can attach whatever kind of~
25	*HD:-----
26	*DP: ~yeah
27	*HD:X----
28	*AV: cabins [cabins can be XX]
29	*BM: [second second] this can be named
30	*HD:-----
31	*BM: as a second~
32	*HD:-----
33	*DP: ~this can have a [lot of use]
34	*HD:-----
35	*BM: [xxxxxyeah]
36	*HD:-----
37	*CH: the same engine can be used
38	*HD:X-----Z
39	*CH: for more more modules

Within this excerpt (lines 29-34), BM, CH and DP are all in the sketch space performing all three types of hand movements mentioned above. The photo above is taken from this part of the excerpt. At others points only two of them simultaneously are in the space, and for a brief moment there is only one. In their talk, they are collaboratively offering an account of how a particular sort of modularity in the vehicle might be designed. The sketch space can thus be seen as a collaborative space where participants

orient to their collaboration, as well as, through their gestures, to the cadence of their talk and the iconic representations of the sketch itself. In this way, the sketch space enables inclusion into a common activity.

of course, you will have observed in the picture above that only 3 of the 4 participants are in this collaborative space. AV, though contributing to the discussion, is not physically in the sketch space with the others at all. A quick look at the transcript, however, reveals that he is at odds with the others with regard to the type of modularity being worked out. In his contribution in this excerpt (13-17), he claims this type of modularity is not possible. He is furthermore alone in the sketch space here. He is not in the sketch space again during this excerpt. That AV and the others are at odds is thus also indicated in their respective presences in the sketch space. AV's absence there or his not being there alone are part of his not being in agreement with them. The sketch space then can exclude as well as include.

5.3.3.1 Discussion

Although the term participatory design generally refers to the inclusion of many different stakeholders into a design process, for an interaction analysis whatever happens between people interacting is participatory. Our data is not data from a variety of stakeholders, though these were involved in the other activities of the workshop from which our data was extracted. Thus, it is only in the interaction analytic sense that what has been shown, has any bearing on participation in design. It is believed, however, that the notion of participation scales up coherently to more clear cut cases of participatory design. In other words, there is a level of empirical detail in participation qua interaction which, when analyzed, reveals findings generic enough to be interesting for participatory design as such.

And what are those findings in this case? Some very insightful research has been conducted into the role of sketches and sketching in design process which share our analytic frame of Ethnomethodology/Conversation Analysis. Specifically, the work by Murphy (Murphy, 2004). Their focus, however, has been more towards the representational qualities of sketches and sketching and how these qualities can only be understood in relation to the interactive work going on around and with them. What is

new in our study is the notion of a sketch functioning not only as a representational tool, but also a tool which anchors a physical space which affords not only representation but also the management of interaction itself. That a class of actions were found, which only occurred in combination with turn-takers 'being' in the space, and those actions not necessarily being of the 'representational' kind, brings to the fore this additional affordance. Moving even further from sketches as tools of representation, it is suggested that they may even work as arbitrators of turns of talk, and thereby participation in a very fundamental way. For interaction analysis, participation begins with people taking turns.

With regard to the maker/analyst process through which this study came about, the following can be noted. This research looks closely at very small interactional moments, finds some interesting actions, and then looks quickly through longer segments, though still little more than one fourth of the entire data set, to ascertain that and how these actions reoccur. The companion research, on the other hand, focuses on a flow of action through the 3-hour encounter in which artefacts, such as sketches, play an integral role. On the one hand, the micro-analyses in this research are rather well grounded in the data. But on the other hand, the amount of time and labor needed to follow the entire flow makes such detailed analyses well-nigh impossible for the entire data set. The companion research allows us to follow the flow, yet can realistically provide little in the way of empirical analysis.

Companion researchers do have some things in common, however and that is an interest in the role of artefacts in a design process and their role in creating cooperative spaces in which designers and users may participate. This research complements the companion research in that it addresses both of these issues through an analysis of a single artefact, the sketch. The sketches, as well as other artefacts, for the companion research are thought to be useful for their informational value and their representivity. This research then, adds to the usefulness to which an artefact can be put.

5.4 Concluding Remarks on the Participatory Research 2

Collective concept generation activity proves to be very important to be able to conceive of a comprehensive participatory approach as mentioned in hypothesis. The resulting

concept visualization outcome undertaken by expert designers following the participatory approach, clearly reflects and helps to confirm that a new conceptualizing approach can be adopted by designers that enables them to be more sensitive towards rich contextual user information (Nishant; Sharma et al., 2012). This clearly contrasts the conventional design process where such rich data is absent.

Communicating quickly and effectively rich contextual information (visual brief) to designers is vital and hence can become a precursor for such participatory activity with a group of designers. There are distinct advantages of having this kind of visual representation of the participatory data. It can facilitate designers to get quick and effective access to user-participatory-research data and ensure that it is reflected in features during their visualization for holistic vehicle design.

Designers tend to start from 'engineering criteria' before undertaking any task especially something that deals with 'entry level' vehicles. With this proposed methodology, designers can collectively evolve the integrated form of vehicle addressing various issues like vehicle architecture, new thematic directions, outlined aesthetic expression and basic details of the vehicle. Design group initiatives help to establish collective thoughts while they discuss ideas through sketches, and then re-establish them when responsibilities are shared.

Sketching can be used as a tool to discuss, conceptualize and negotiate concepts towards the final vehicle form. While sketching, designers discuss, ask, negotiate and seek consent from each other towards the final concept. The final concept can hold information that came from every member of the group that are openly and fairly negotiated and agreed upon by everyone.

From the view point of devising protocol of setting up the experiment in the evolved approach, the object (sketch) mediated participatory concept generation was analyzed. This was done in a companion research as makers/analyst research with Danish researcher Dr. Dennis Day (conversational analyst) that resulted in a joint conference paper. Though results are discussed above, in terms of this thesis, it helped us to focus on physical space for sketching where much of the interaction takes place. Interactions happen both inside and outside the sketching space (Day & Sharma, 2012).

This activity, as it was realized later, is difficult to bind with specific time. Being exploratory in nature with constant interactions with the group, our study took around two and a half hours.

Going forward, deliverable of this stage would be a collectively visualized concept sketch. At this stage, in order to go ahead in making practical solutions, such a visualized sketch needs to go through the styling process as described in chapter 1. Resulting renderings are practical and with proper dimensions.

The next chapter presents the evaluation of renderings by the novice users. This would be the final stage of the proposed comprehensive participatory vehicle design.



CHAPTER 6: PARTICIPATORY EVALUATION BY USERS

6.0 Introduction

In this chapter, focus is on the next phase of research where same user participants after a gap of three months, were again invited to participate in a session to validate the concepts created by designers (Figure 6.1).

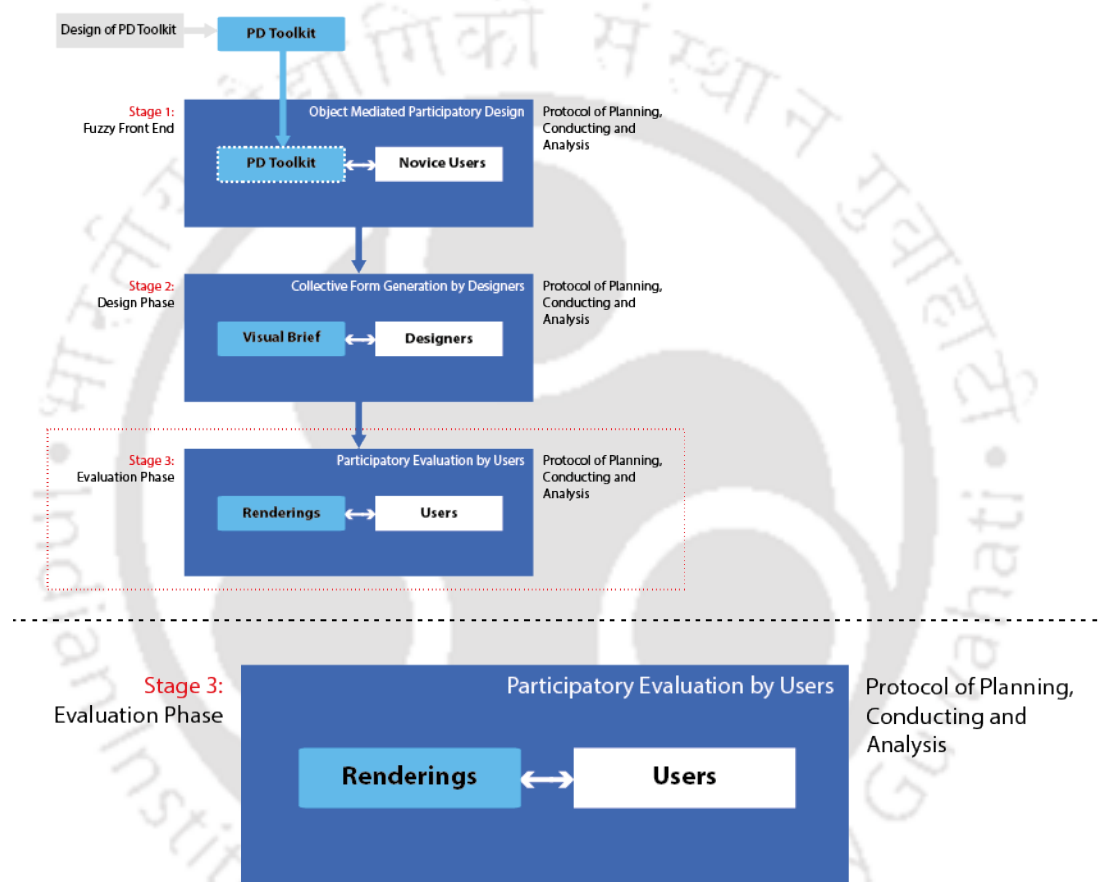


Figure 6.1: Participatory evaluation in evaluation phase

In the previous sections, by following PDM, users elicited aspirations for a vehicle that bridges the gap between two-wheelers and cars in India. 3-D toolkits were designed and tested as mediating aids to elicit this information from the participants through the four participatory experiments. Further an approach was developed to convert participatory data into visual brief (communicating results) to be used by a group of designers to collectively create vehicle product forms that bridge the gap between two-wheelers and

car segments. Using the outcome of their representations, designers are expected to integrate desired features and create concept sketches and renderings.

This participatory evaluation session was planned to verify concurrence of concept sketches and renders designed by designers. It is aimed to verify if concept renderings embedded their user insights (Refer Figure 6.1). Further in this chapter it is explored how user participants, encountering new product forms, developed by designers, arrive at the acceptance of a concept sketch (and rendering). The objective of this exercise was to arrive at the accepted concept render and see if users were making any compromise in selecting the concept by leaving out some critical issues they had earlier indicated. If they were doing so, then to gain insights as to how to ensure robust overall approach that can prevent such problems.

The following aspects may be noted:

- 1) Since the different aspects of the research was evolving over time during the different phases of this research, it was not possible to ensure that the same group of users were available for evaluation.
- 2) The participatory toolkits were also introduced during this research as part of design assignments to master of design students in teaching generative techniques. They conducted research with potential user groups by reaching out to them (Refer Appendix 11). During these prototyping sessions the user participants had employed an abstract toolkit (Sharma, 2011) to come up with the following desirable design features for the new vehicle being developed:
 - *Three-wheeled vehicle.*
 - *Should not look like an auto rickshaw.*
 - *Should seat minimum three people.*
 - *Detachable side luggage spaces.*
 - *Can be covered with convertible or a hard rooftop.*

6.1 Planning The Participatory Evaluation Session

6.1.1 Selection of Participants

Aspirants for personal transport vehicle were identified and three were selected as the participants for the study. They were in the age group of 20 - 30 years.

6.1.2 Time Plan

The participatory session comprised of the following activities to be undertaken and the time for each activity.

Table 6.1: Time plan

Time	Activity	Goals
10 mins	Recap of earlier Participatory activity, presenting the evolved brief	Brush up their memories, presenting insights.
5 mins	Instructions	Goals and objectives of this research
15 mins	Participatory evaluation	Selecting the most suitable that conforms to their earlier insights in participatory activity 1.

6.1.3 Mode of Conducting

A group of three participants would participate and session is to be moderated by a moderator (researcher). The sitting plan is shown in the schematic in Figure 6.2.

Two video cameras were used to record the session. Camera 1 captured the bodily conduct of the user participants and their positioning in relation to each other and the table, and Camera 2 captured the sheets of paper on the table as well as the participant's manipulation of them (Figure 6.2). In addition to the three user participants, the moderator was also present but some distance away from the table. He cannot be seen on the video but his verbal contributions can be heard, when he asks them 'whether the final image of the vehicle product is same as they had imagined in PD activity?'

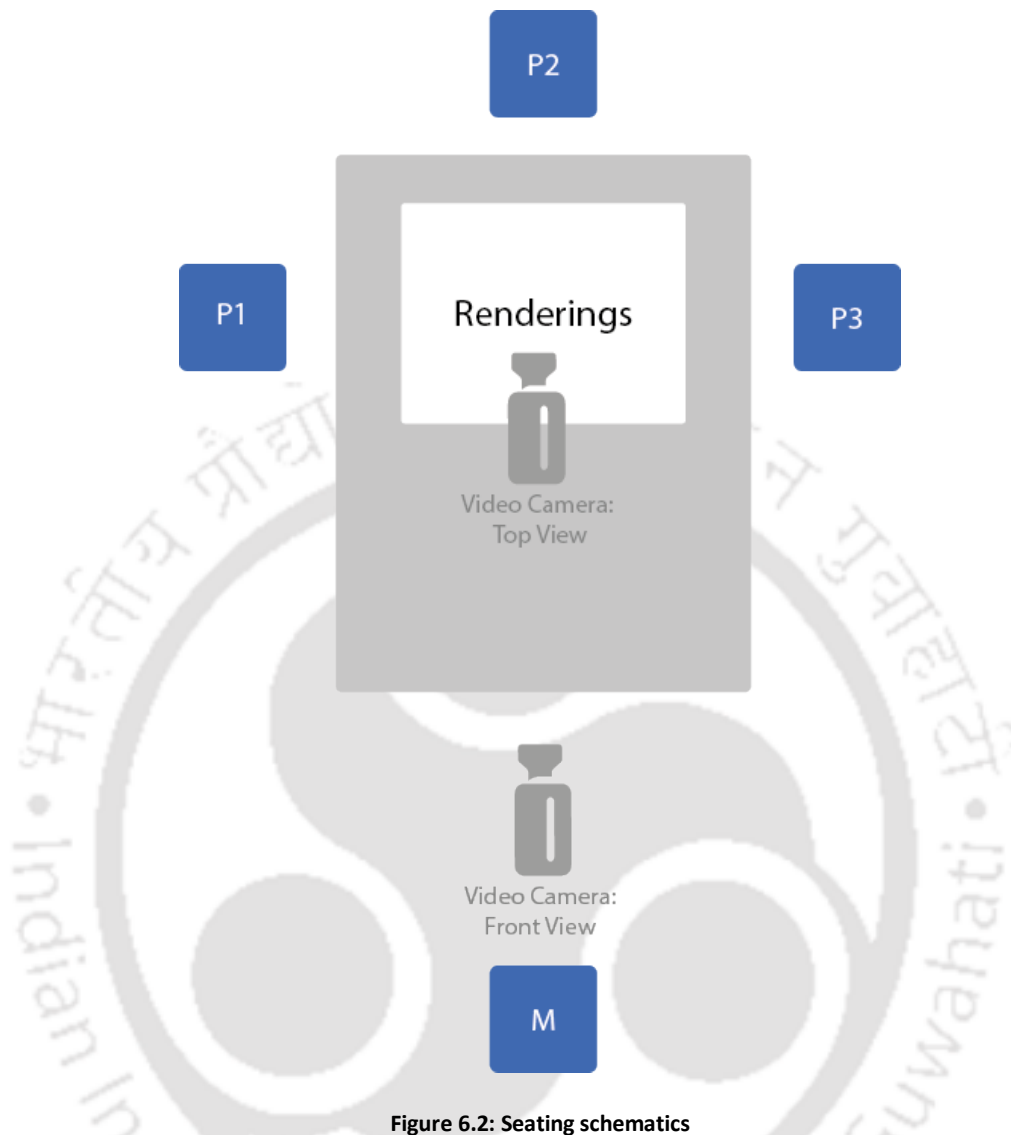


Figure 6.2: Seating schematics

6.1.4 Instrument of Data Collection

Data was assimilated using videography with audio recording to capture utterances while they participated in PD Session. Rendering sheets were placed freely on the table and not pinned up. This aimed to probe how renders play a mediating role in helping the participants to collectively shares their views and talk about them.

6.1.5 Data: Visual Renderings of Vehicle Concepts

Visual renderings comprising of Concepts, CAD representations and Scenarios of use of the vehicle design were shown to participants. (Figure 6.3, Figure 6.4, Figure 6.5, Figure 6.6). Detailed renders are in Appendix 14.

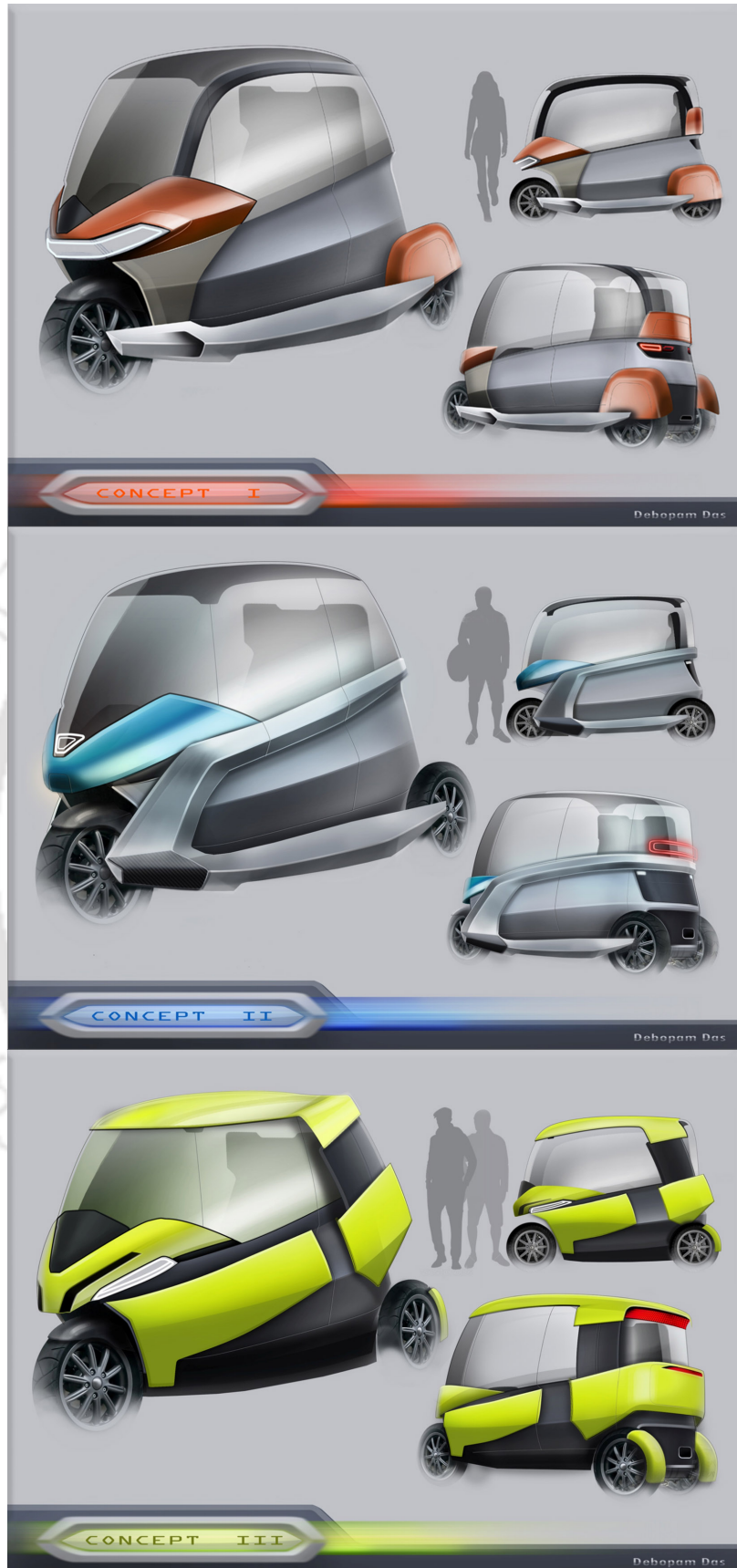


Figure 6.3: Renderings of concept 1,2,3



Figure 6.4: CAD renderings



Figure 6.5: Rendering with scenarios

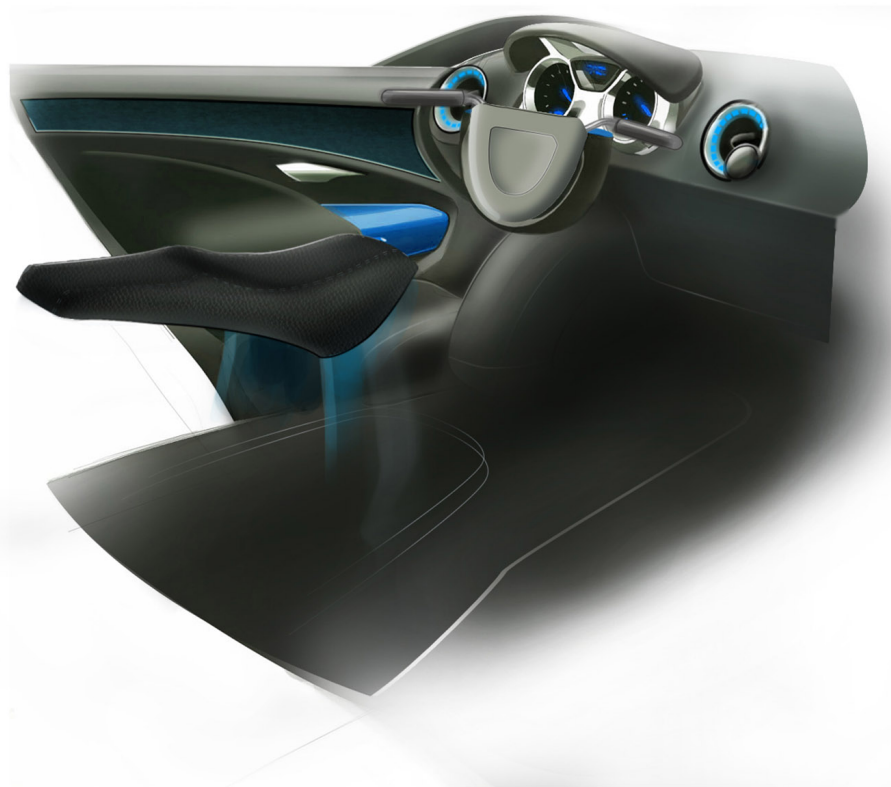


Figure 6.6 Rendering of dashboard of vehicle

6.2 Conducting: Participatory Concept Evaluation

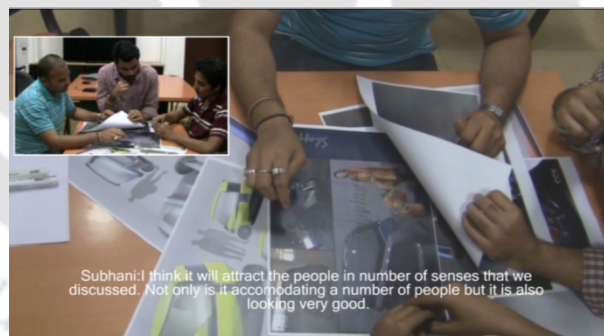


Figure 6.7: Evaluation of sketches

The concept validation session lasted 15 minutes (Refer to video in Appendix 15).

6.2.1 Observations on the Participatory Research 3

As the moderator overseeing the session, the researcher made the following personal observations:

- 1) It is significant to conduct concept validation session with the same set of users to see the deviations, if any, in the designers' concepts from the user data elicited in the participatory research.
- 2) There could be instances where users may select or like a concept primarily because of the appearances of the concept overlooking some important product features they had actually arrived at earlier. This analysis must consider these aspects as it may become useful in designing effective participatory validation sessions in the future.

6.3 Analysis Based On Conversation Analytics of Audio Recording

Audio recording of conversation during the participatory session with the user participants is one more data that offers good possibilities for analyzing and gaining insights about user views. In the domain of social sciences, there are trained specialists interaction researchers in this method of Conversation analytics. This researcher met Scottish interaction researcher Dr. Mirka Rauniomaa who agreed to collaborate in undertaking such a study to help analyze user response to the proposed vehicle concepts generated by the designers. The outcome of this collaboration resulted in a research paper of the findings of the conversation analytics in PDM that presented during the PIN-C conference, Lahti, Finland.

Following section outlines this part of the research that examines data drawn from conversation of the participants during the last couple of minutes of a concept validation session by the group of user participants. It examines how the participants felt that sketches and renderings of three-wheeled vehicles (i.e. images on sheets of paper) proposed as concepts by the designers have succeeded in turning the user participants' ideas into vehicle concepts. The user participants assess the appearance of one rendering in particular that in their view seems apt.

6.3.1 Methodology and Data Analysis of Conversation during Concept Validation

In the concept validation session, the potential user participants were initially shown the video recording of the earlier prototyping session to refresh their memories. After the video clip was shown, several printed sheets of paper were given to the user participants: these comprised of three 2D renderings of concepts, two 3D renderings of

the final concept and two 3D renderings of the final concept in a scenario. The sketches of the different vehicle concepts were deliberately not pinned up for display because the moderator (cum researcher) wanted to examine, which of the different sketches or renderings becomes the focus of the user participants' discussion, and how does the process of concurrence emerge during conversations.

Two video cameras were used to record the session: one captured the bodily conduct of the user participants and their positioning in relation to each other and the table, and the other captured the sheets of paper on the table as well as the participants' manipulation of them (Figure 6.8). In addition to the three user participants, the moderator is present but some distance away from the table. He cannot be seen on the video but his verbal contributions can be heard and can be subsequently transcribed along with talk by the other participants.

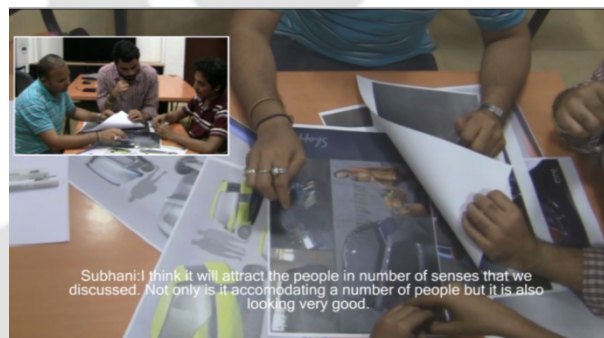


Figure 6.8: Two video cameras were used to capture the interaction

As a recap, during the earlier prototyping session, the user participants had employed an abstract toolkit (Nishant Sharma, 2011) and come up with the following desirable design features for the new vehicle being developed.

Three-wheeled vehicle.

Should not look like an auto rickshaw.

Should seat minimum three people.

Detachable side luggage spaces.

Can be covered with convertible or a hard rooftop.

The moderator (Researcher) suggested the user participants to examine the renderings, individually give feedback about the concepts and reach a common consensus or agreement about them through discussions.

In the concept validation session examined here, the user participants touch upon each of these features. They discuss and assess the different vehicle concepts, and in doing so they can be seen to pick up, handle and point at the various (parts of the) sketches and renderings that are laid on the table. The user participants select one particular rendering as best meeting their expectations and, in working towards a convergent assessment of it, highlight its appearance over any functional features.

The concept validation session lasted 15 minutes in total, and the present study deals with the last couple of minutes of the session. Here, the moderator elicits final round of responses from the user participants so as to sum up their discussion and conclude the session. The three user participants take turns in briefly reporting their individual and/or the group's shared views about the vehicle concepts.

Researcher made observations that the user participants seemed particularly impressed by how the product forms look, and the subsequent attempt by the interaction researcher (Rauniomaa) to provide a reasonable account of how such an interpretation emerges from the brief fragment of data. A conversation-analytic approach is adopted to explore the interactional event.

It was observed that during this process, the user participants kept shuffling the sheets of paper and conversing vis-à-vis the idea of a vehicle that they had talked about in earlier prototyping session.

6.3.2 Analysis

Following section identifies three aspects of the 2-minute fragment of interaction that make it to be about 'assessing appearances'. It shows that the moderator elicits a final round of assessments and, together with the user participants, sets it up to concern primarily the outward appearance of vehicle concepts. Relatedly, it is seen that all three-user participants draw on the same rendering, i.e. a visual representation of a particular vehicle concept, to highlight a shared basis for their individual assessments. These two

aspects lend support to an overall focus on appearances where positive assessments are favored over negative ones. Discuss here is each aspect in turn by presenting three fragments of the interaction as it unfolds in time.

The transcripts follow conversation-analytic conventions (G Jefferson, 2004), and relevant fragments of the user participants' bodily conduct are described using *italics* and with participant labels written in lower-case letters (e.g. *sub* for Subhani).

It may be noted that these are the real names of the participants whose prior consent to use their names and images has been taken.

In the section to follow detailed description of the analysis is given.

6.3.2.1 *Elicited round of assessments*

Please refer Table 6.2. When the discussion between the user participants reaches a lull, the moderator initiates the final round up of the session *does it go with the image that you had in your mind?* (Transcript 1, lines 1–2). This can be heard both as a general prompt to assess whether the designers have succeeded in turning the user participants' ideas into vehicle concepts or not, and as a more specific encouragement for the user participants to elaborate on their views on the outward appearance of the vehicle concepts, a feature that they themselves have highlighted in their discussion so far. Formatted as a yes/no interrogative, the prompt sets up an expectation of a type-conforming response, that is, a 'yes' or 'no' from the recipients (Raymond, 2003).

The user participants respond positively to the prompt: all three shake their heads from side to side in affirmation (producing so-called Indian head wobbles), and two of them also provide affirmative verbal responses (Transcript 1, lines 3–4). The responses are thus not only type-conforming but also delivered as preferred ones: produced immediately after the prompt and displaying clear agreement with the proposition conveyed in the prompt (Pomerantz, 1984).

The moderator then reformulates his enquiry into *is it uh m- exactly matching with what you*, (Transcript 1, line 5), inviting further elaborations from the user participants. Subhani, who is sitting at the right, provides an affirmative response, picks up a particular rendering from the table and goes on to point out—both verbally and

physically—certain elements in the rendering (Transcript 1, lines6, 8–9; Figures 2 and 3). After Subhani has responded at some length, the moderator also elicits responses first from Pratap and then from Rao with *how about you* (Transcript 2, line 1, and Transcript 3, line 1, respectively).

Table 6.2: Transcript 1: Moderator initiates and co-ordinates the final round-up.

01	MOD: does it go with the image that you had
02	in your mind?
03	SUB: [(yes sir.)
04	RAO: [yes.
05	MOD: is it uh m- exactly matching with what you,
06	SUB: yes sir.
07	RAO: [°yes.°
08	SUB: [the only thing is like uh, the< eh whatever,
	<i>sub reaches for rendering and picks it up</i>
09	SUB: the detachable, (.) (where-) we can keep
10	for luggage.
11	=but it is not even required actually.
12	(as it [is,)
13	RAO: [mm,
14	SUB: if you increase the length you can even
15	accommodate this small type of luggage.
16	=(we were going to use this one.)
17	I think this is good actually. (than,)
18	this is matching.
19	MOD: okay.

In this way, the concept validation session is gradually brought to a close with a round of assessments where the three user participants are each given an opportunity individually to reflect on their common understanding of how the introduced vehicle concepts meet their expectations. The round of assessments is elicited and coordinated by the moderator, whose initial inquiry reflects and further sets up an orientation to appearances.

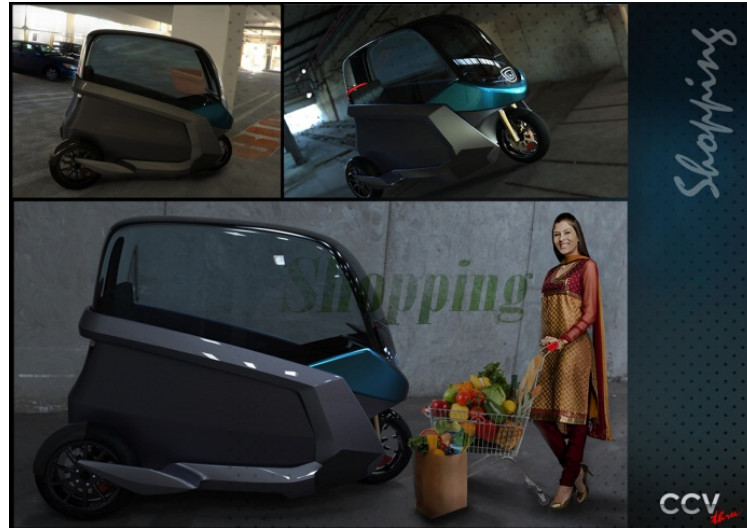


Figure 6.9: Rendering of a vehicle concept.

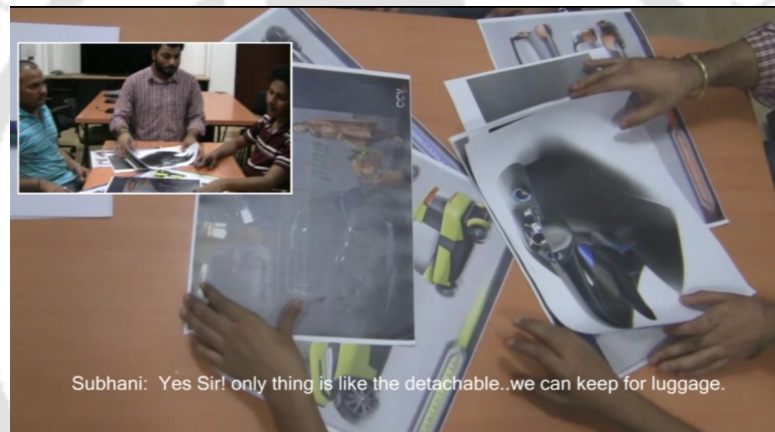


Figure 6.10: Subhani picks up the rendering.

6.3.2.2 Shared visual basis

During their discussion, the user participants have clearly established a favorite among the many renderings that are laid out on the table. Here focus is not on how participants select the particular rendering (Heinemann, 2011), but on how they employ it as a shared visual basis for their assessments. When Subhani began his assessment of the vehicle concept, he picked up from the table in front of him a rendering that they had dealt with earlier (Transcript 1, line 8; Figure 3).

When Subhani concludes his turn and the moderator moves on to address Pratap, Subhani releases his grasp of the sheet of paper and Pratap in turn picks it up (Transcript 2, lines 1–2; Table 6.3).

Table 6.3: Transcript 2: User participants circulate the rendering as they assess.

01	MOD: how about you?
	<i>sub lets go of rendering</i>
02	PRA: yes sir, the design, interior,
	<i>pra reaches for rendering and picks it up</i>
03	PRA: everything looks pretty good.
04	and this is exactly what we had in mind.
05	>I mean,< something.
06	(.) a vehicle in between,
07	(1.3) I mean, as per utility and the cost,
08	in between a bike and a car.
09	(0.8) and,
10	(1.7) I would say, (.) this is just that.
	<i>pra lets go of rendering</i>
11	PRA: (2.2) this is what we imagined.
	<i>rao reaches for rendering</i>
12	PRA: the design is actually, .hh >I mean,<
	<i>rao withdraws hands from rendering</i>
13	PRA: (2.8) this is much better than what we
14	imagined. (.) at least the looks.
15	RAO: °yes sir.°
16	(2.0)
	<i>rao reaches for rendering</i>
17	MOD: how about you.
18	RAO: actually it is very: weh:::, attractive sir.
19	in design-wise?

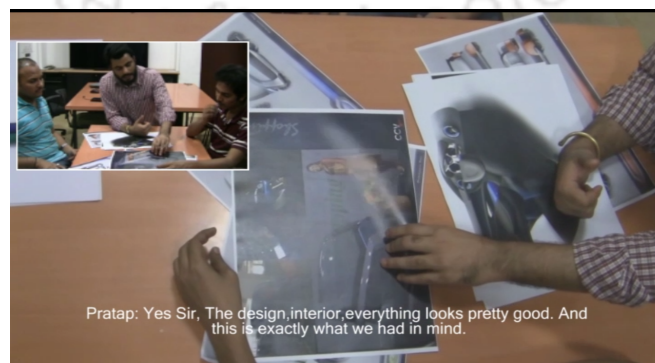


Figure 6.11: Pratap picks up the rendering.

Similarly, as Pratap releases his grasp of the rendering and summarizes his assessment, Rao prepares for taking a turn by reaching for the sheet of paper (Transcript 2, lines 10–11). Pratap, however, continues to talk and hold his hands on top of the document, and Rao withdraws his hands back to his sides (Transcript 2, line 12). The rendering and the opportunity to assess it are passed on successfully a moment later from Pratap to Rao, with an additional prompt by the moderator (Transcript 2, lines 13–19; Table 6.3).



Figure 6.12: Rao picks up the rendering.

In this fragment and within this activity, then, taking turns at talking is governed by the handling of the rendering: the participant who has a hold of the document gets to talk about it (Nishant Sharma, 2011), (Mortensen Christina, 2011). Moreover, in holding and moving the sheet of paper as well as pointing to and touching various elements in the images on it, the participants establish the document as a shared visual basis for their assessments and maintain their joint orientation to both the rendering and the activity.

6.3.2.3 *Favorable focus on appearance*

While taking their turns at assessing the rendering, all three-user participants refer to its appearance in a positive light. Pratap and Rao, who respond to the moderator's general prompt *how about you*, in effect begin with overall assessments that seem to target the way in which the vehicle concept is presented to them: Pratap with *yes sir, the design, interior, everything looks pretty good*. (Transcript 2, lines 2–3) and Rao with *actually it is very: weh:::, attractive sir*. (Transcript 3, line 2).

Table 6.4: Transcript 3: User assesses the rendering in favour of appearance.

01	MOD: how about you.
02	RAO: actually it is very: weh:::, attractive sir.
03	in design-wise?
04	because: it is in between a car and uh:
05	(.) bike. so::, it is good sir.
06	but we- actually we thought that in some
07	of the other<
08	some:: extra space for eh:: lu- for luggage,
09	but it is not required.
10	MOD: mhm,
11	RAO: now this: new is good.
12	MOD: okay.

At the start of the round-up, the moderator specifically prompts the user participants to compare the vehicle concepts now presented to them with the ideas that they conveyed to the designers during the first participatory session. As the round-up develops, however, the user participants constantly move between comparing two abstract notions, on the one hand, and assessing the rendering, an image that they have at their disposal in the present context, on the other hand (Brouwer & ten Bhömer, 2013). In a sense, then, the sketches and renderings provide the user participants with a point of reference on which to establish their shared understanding and evaluation of the vehicle concepts as well as with a source of distraction which draws their attention to how a particular vehicle concept is represented in a rendering.

Moreover, although the user participants do bring forward criticism about the vehicle concept in the final round-up, they tend to downgrade or dismiss such aspects of their contributions. The moot points that are mentioned concern elements that have been omitted from the rendering and may thus run counter to the expectations that the user participants had on the basis of the earlier prototyping session. Subhani, for instance, presents storage space as *the only thing* that possibly causes concern in the vehicle concept (Transcript 1, line 8), and the same issue is later taken up by Rao (Transcript 3, lines 6–8). Both in a sense sandwich their criticism between positive evaluations of the vehicle concept: they begin with an affirmative assessment that the vehicle concept meets their ideas to a sufficient degree, move on to voice their concerns and then finish

with another positive assessment or clear dismissal of those concerns (*I think this is good actually. (than,) this is matching.*, Transcript 1, lines 17–18, and *but it is not required. now this: new is good.*, Transcript 3, lines 9 and 11). Pratap does this balancing slightly differently: he provides a highly positive assessment, which he finally restricts to appearance only with *at least the looks* (Transcript 2, line 14).

The positive bias in the user participants' assessments may be established by the way in which the final round-up is elicited and organized, but it is certainly reinforced by each individual's contribution. The user participants may in effect be under a similar constraint as conversational participants in casual gifting occasions: with an obligation to provide a positive assessment of a gift that they have just been presented with (Robles, 2012). However, whereas the positively appraised appearances may now be considered as satisfactory and in no need of further development, the few features that are negatively assessed about this 'mutable object', a vehicle concept that is being developed, are likely to be taken up as proposals for further development and improvement (Fasulo & Monzoni, 2009).

6.3.3 Discussion

The last couple of minutes were examined of a concept validation session where a group of potential user participants draws on sketches and renderings of three-wheeled vehicles (i.e. images on sheets of paper) to convey how, in their view, the designers have succeeded in turning the user participants' ideas into vehicle concepts. In working towards establishing and maintaining a common user participants' perspective on the vehicle concepts, the user participants assess the appearances of one rendering in particular. There are certain aspects to the interactional moment that construct and support this: the fact that the final round-up is organized as an elicited round of assessments and that the participants have a shared visual basis on which to build their assessments may prompt the user participants to deliver their contributions in a way that clearly, and favorably, focuses on appearance over possible functional features of the vehicle concept.

As another perspective, it may be attributed to the selection of medium for the validation session. More realistic mediums like scaled down models or mock-ups may

work better. Model making however is expensive and time-consuming in the earlier part of the design process as compared to sketches. So, if sketches are to be the medium, researcher needs to play an important role in briefing the designers regarding the potential interpretation of the sketches while selecting the most appropriate sketch in the validation session.

6.4 Concluding Remarks on the Participatory Research 4

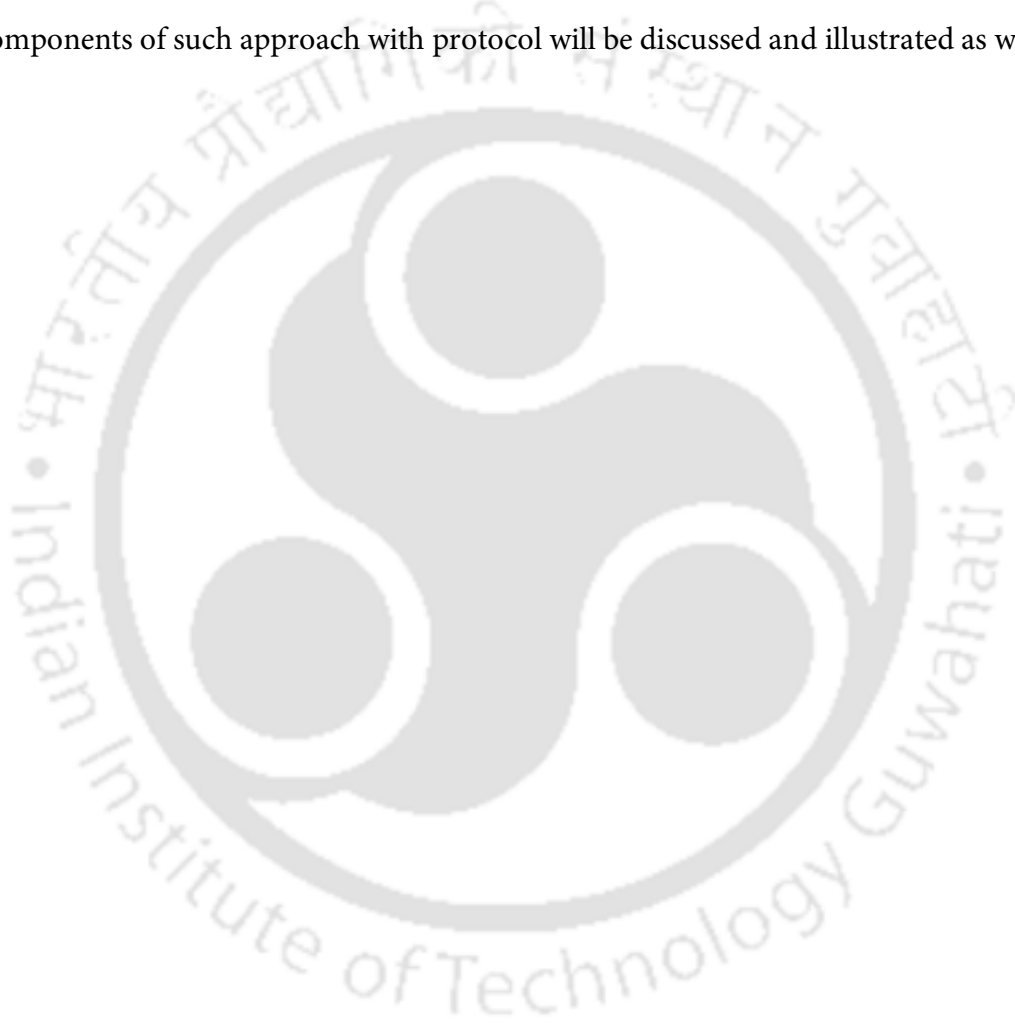
This participatory evaluation session worked effectively to see conformance of concept sketches/renderings designed by designers, which elicited deep user insights. Participants were invited again after a gap (in this case three months) for a concept validation session for arriving at the acceptance of a concept sketch (and rendering). The user participants were shown sketches and renderings and were asked to discuss different vehicle concepts. It is advisable to conduct concept validation session with the same set of users to see the deviations, if any, in the designers' concepts from the user data elicited in the participatory research.

As anticipated, there were instances where users selected or liked a concept primarily because of the appearances of the concept. An analysis of one such case was presented, where user participants selected a particular concept and were fine with absence of some important product features. This analysis would be useful in designing effective participatory validation session for the overall methodology. This will be discussed in chapter 7.

In the concept validation session, user participants evaluated sketches and renderings to verify if designers have succeeded in turning the user participants' ideas into vehicle concepts. Last few minutes were analysis of the final round-up that was organized as an elicited round of assessments with moderator. They appeared to maintain a common user participants' perspective on the vehicle concepts and mainly assess the appearances of one rendering in particular. It was concluded in the analysis that participants had a shared visual basis on which to build their assessments that prompted them to deliver their contributions in a way that clearly, and favorably, focused on appearance over possible functional features of the vehicle concept.

To ensure robust overall approach, more realistic mediums like scaled down models or mock-ups may work better. To retain sketches in the evaluation, a proper checklist could be part of this exercise for people to verify if designers have successfully translated functions without being deviated by other potential interpretation of the sketches.

This chapter resulted in the learning that making checklist for more robust and effective results may be more effective. Next chapter will consolidate all research results from various experiments into an evolved participatory approach for vehicle design. Various components of such approach with protocol will be discussed and illustrated as well.



CHAPTER 7: PROPOSED PARTICIPATORY DESIGN METHOD

7.0 Introduction

As seen in chapters 1 and 2, the focus has always been in the Fuzzy Front End of design process in order to access deep user insights and aspirations. Through case study, this thesis has holistically explored, toolkit mediated participatory design research with novice users in the Fuzzy Front End, participatory concept generation with expert design group and participatory evaluation with user participants. This chapter now attempts to crystalize all the learnings from previous chapters into an overall participatory method for vehicle design endeavors. All the activities in such a method must therefore be described with clear protocols.

It starts with the basic activity of designing a toolkit specific for the study in question. A toolkit design could obviously be done only when one has a good understanding of forthcoming participatory session with novice users. The focus naturally would firstly be on effective design and fabrication of toolkits. Chapter 4 covered user centric design of participatory toolkit. In the same chapter, toolkit design was followed by a method of planning, conducting and analyzing participatory session with novice users. Visual brief was generated for upcoming concept generation. It was followed by participatory session of 'collective form generation' with set of expert designers as discussed in Chapter 5. Along with the outcome of design as sketch/render, it also strengthened our protocol for participatory activity. Then participatory evaluation of vehicle rendering was conducted by novice users again to verify if those renderings accomplish their needs and aspirations. Chapter 6 covered participatory evaluation of outcome from designers. This study also helped us strengthen the protocol for a robust participatory method for vehicle design. These activities can spread over longer time, though each activity would feed into the next one. In all, it was attempted to cover all the facets of design process and the main purpose, of course, was to evolve a participatory design process for vehicle design.

The contours of complete planning of the protocol for the Participatory Design Method of four activities and details of their execution are described in this chapter. The four activities are:

- 1) Method for designing toolkit
- 2) Method for PD with novice users
- 3) Method for collective form generation
- 4) Method for collective evaluation

The later part of chapter will illustrate and place all four methods (stages) highlighting inflow and outflow of information.

7.1 Participatory Toolkit Design as Precursor to PD Research

7.1.1 From Subsection, I of Chapter 4

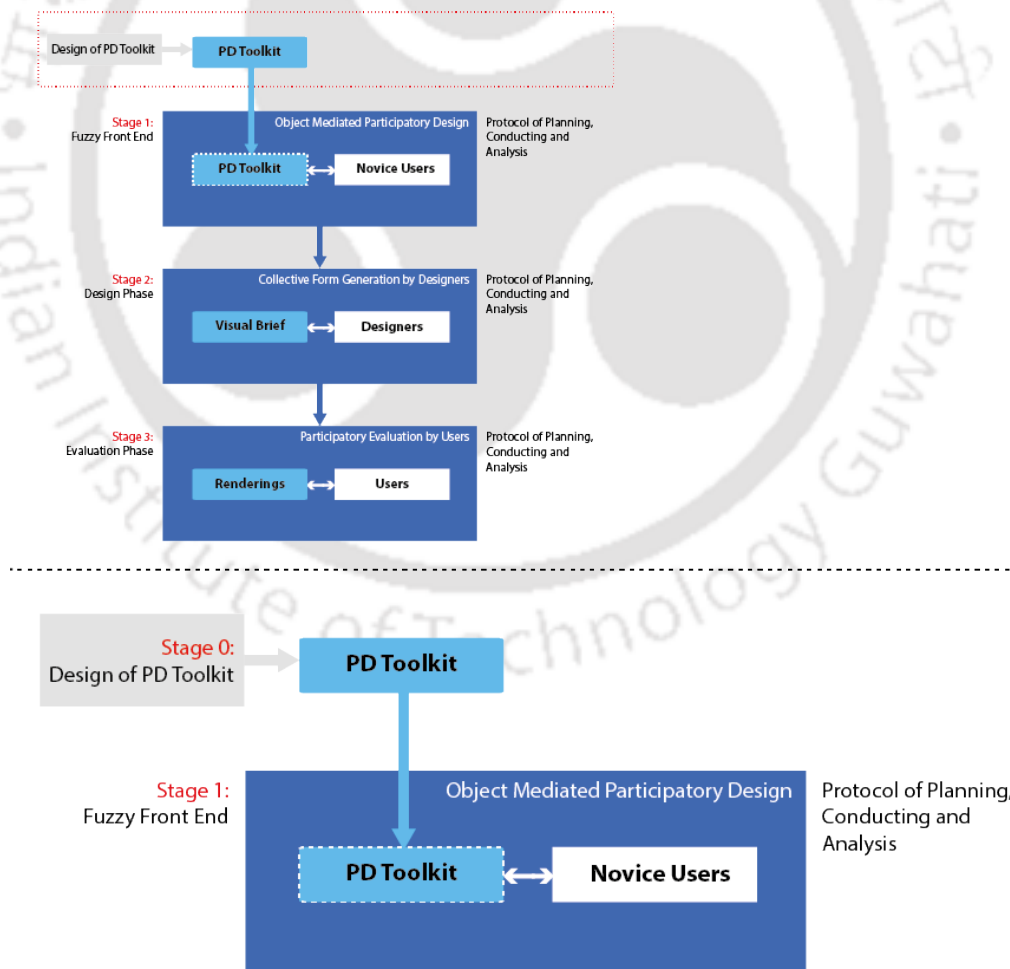


Figure 7.1: Stage 0: Designing participatory toolkit

The basic design of toolkit for Participatory Design is mainly determined by what is expected out of this activity and what level of ideas would be useful. For our experiment and vehicle design in particular, four different types of toolkits were planned (Figure 7.1). Materials, geometry and the way you regulate toolkit makes them specific for certain Participatory Design goals and objectives.

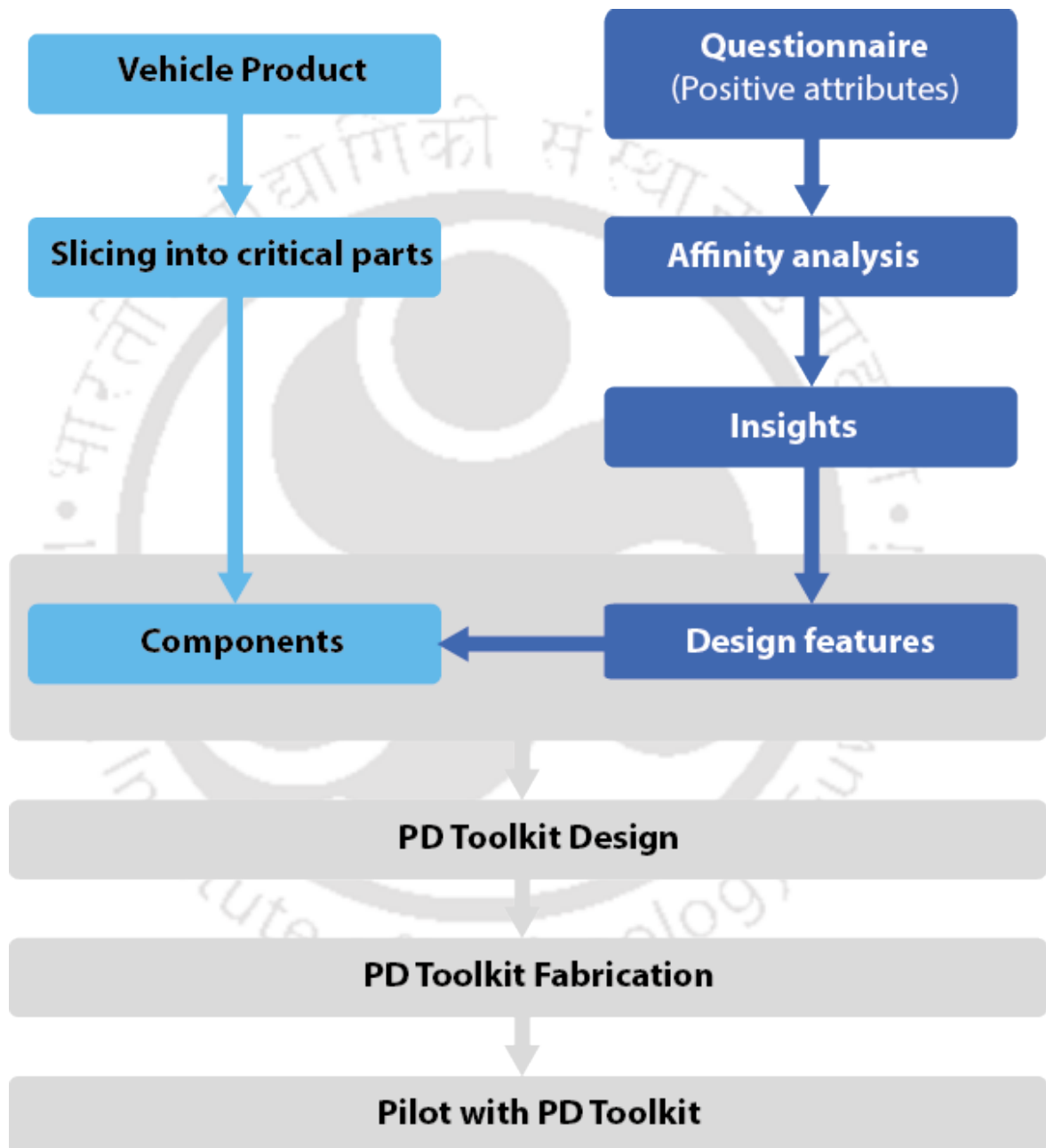


Figure 7.2: Process of designing and fabricating a participatory toolkit

Design of a toolkit encompasses two parallel activities (Figure 7.2). In the first activity, the designer's reflective knowledge helps in breaking down essential components of any product both in terms of numbers and scale. The second activity integrates design

features derived from basic user-research. When these design features are provided as attributes to the output of first activity viz. components, it results into toolkit design. The toolkits then are fabricated and tested by organizing a Pilot Test.

7.1.1.1 Parallel Activity 1: Slicing Vehicle Product

Firstly, various essential components of a vehicle product need to be identified. Vehicle product is then sliced in such a manner that such components can be easily disassembled and assembled back and still provide flexibility in terms of scale and shape of components. There is no specific method to arrive at toolkit components and it largely depends on the experience of designer/researcher. However, following points must be covered:

- 1) Sliced components must allow them to go and fit anywhere.
- 2) It must offer variation possibilities.
- 3) Each module must also independently exhibit use-functions.

7.1.1.2 Parallel Activity 2: Questionnaire to Design Features

A brief questionnaire about the positive aspects of current product needs to be prepared. Positive aspects can come from user's experience, his/her aspirations or from any other external source. Positive aspects would essentially provide us with a wide variety of perceptions of needs and aesthetics. Negative aspects can be well known through media, and may also overshadow positives. Answers can be in the form of anecdotes, stories etc. Five questions is a good number as there are less chances of getting repetitive answers and boredom can be easily avoided. Responses must be coded and typed. An example is shown in Table 7.1

Table 7.1: Example of coded responses

Respondent Code	Observation/ Responses
US2WG06_001	When you ride a two-wheeler, you get to interact more with the environment

Coded responses should be taken ahead for affinity analysis. One needs to go through all responses one by one and allow them to cluster based on keywords generated. Clustered responses will form 'insights'. Insights when applied with researcher's

experience (reflective) would generate ‘design features’. Design features are the essential attributes of Participatory Toolkit.

7.1.1.3 Marrying Design Features + Module

In this step, various essential components are imparted with design features. As seen in the case study in chapter 4, each module had its corresponding attributes.

7.1.1.4 Toolkit Design

It is at this stage, degree the of abstractness must be considered. If more realistic components are there, the more they would start to look concrete. The solutions would be more for the near future (see chapter 4). The schematic as shown in Figure 7.3 shows various possibilities of attach-ability and configurability offering us a solution that can begin from any component. These kinds of toolkits yield very futuristic results.

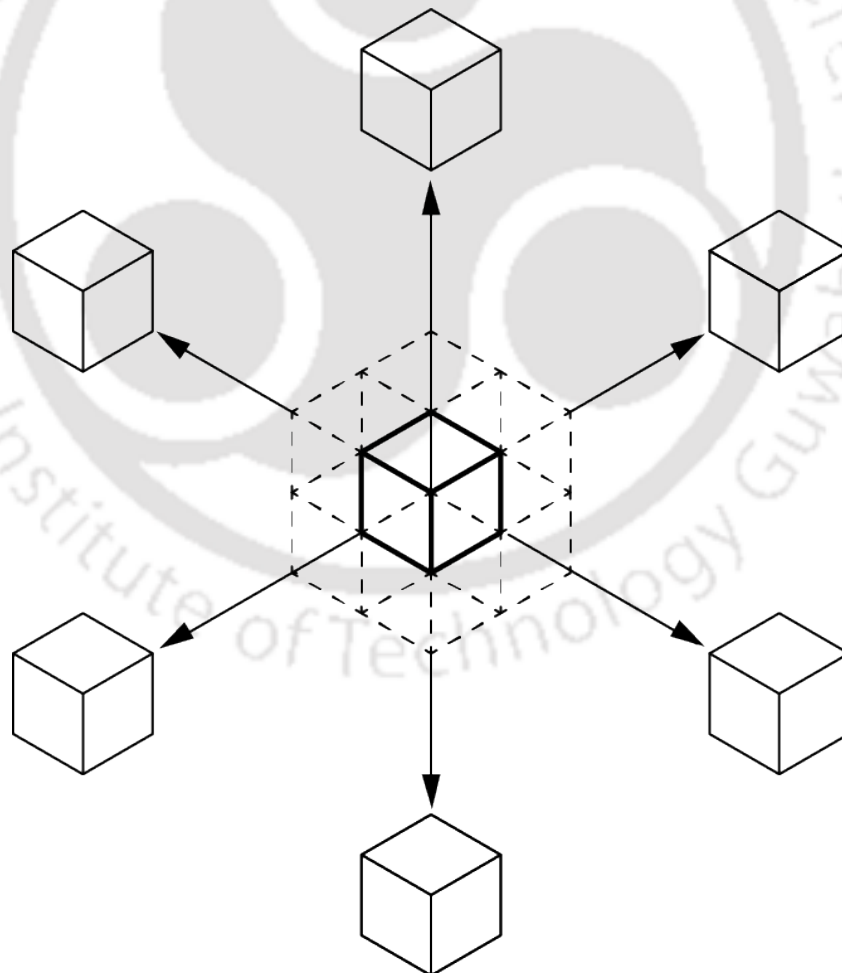


Figure 7.3: Multiple attach-ability and configurability

Toolkit schematic as shown in Figure 7.4 works on a principle of plug and play. There is a sequential build up and users can pick components from the library of variations of components.

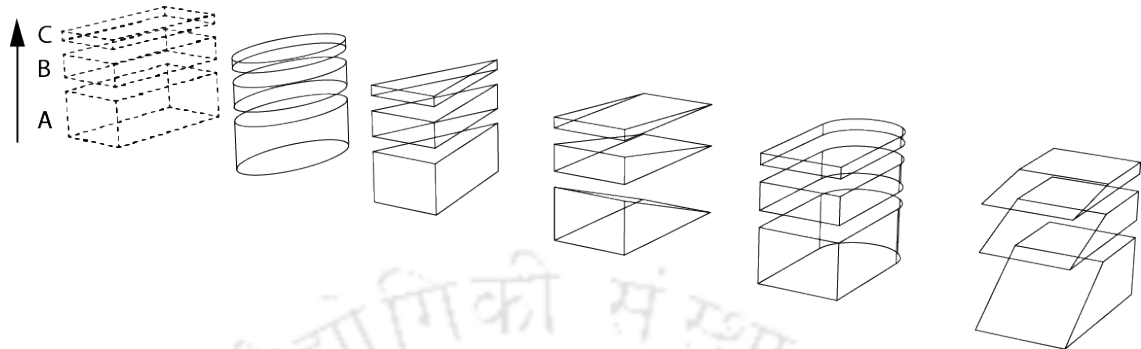


Figure 7.4: Sequential build up from array of components

This are termed concrete because starting point is chosen carefully. When users choose something, they consciously agree to it.

7.1.1.5 Toolkit Design and Fabrication

Toolkit design is done by the designer, by first making quick and dirty prototype. Once the mechanism starts to work in principle, it may be taken ahead for prototyping. Designers need to consider critical points- selection of material, scale, ease of use by novice users. Toolkit Fabrication: Laser cutting and pasting is used to make modules with different attributes and possibilities.

7.1.1.6 Pilot

A pilot with 3-4 users in a simulated situation, similar to real participatory design session, must be done to complete the design cycle and to verify if the toolkit is working fine. This is mainly for testing rather than any takeaways from such research.

7.2 PD Session With Novice Users

This section, as illustrated in Figure 7.5, will present a step by step protocol for conducting a Participatory Design session with novice users: This will involve planning of the entire participatory research to conducting the participatory design research.

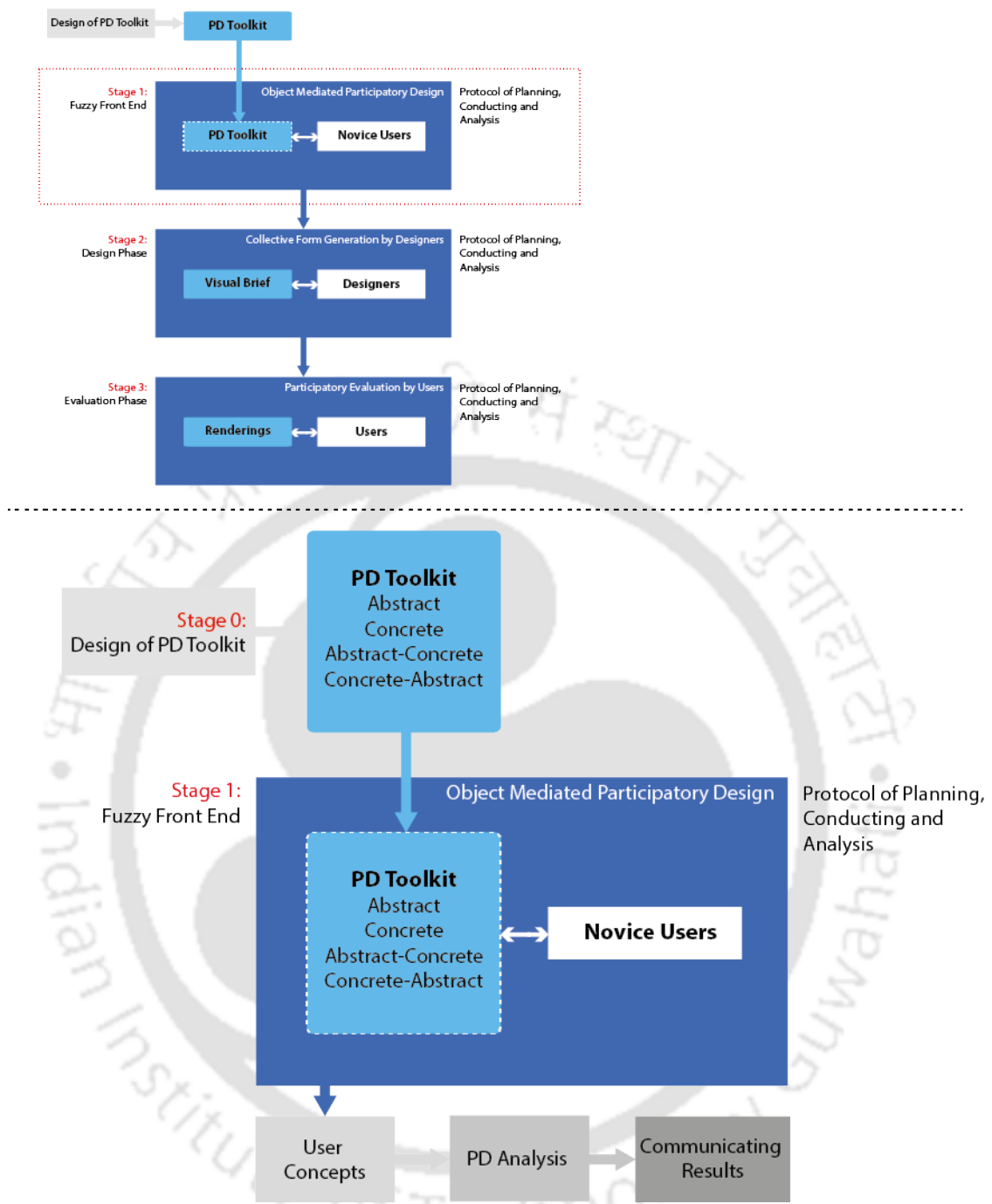


Figure 7.5: Object mediated participatory research: Stage 1

With reference to chapter 4, subsection II, users would ideate with the toolkit provided to them in participatory settings.

Two types of preparations are involved:

- Overall schedule of PD session with novice users as shown in Table 7.2.

b. Detailed schedule of each activity within PD session

Table 7.2: Overall schedule of participatory research

Week 1,2	Week 3	Week 4,5	Week 6	Week 7	Week 8
Planning	Sensitizing	Conducting	Analysis	Analysis	Communicating results: Context mapping

7.2.1 Planning of Experiments

7.2.1.1 Planning Schedule

This can range from one to two weeks. Planning for each stage would need more details (Table 7.3). Researchers can make a checklist.

Table 7.3: Planning with details

Preparing Sensitizing tool	Diary, Worksheet (See example in Figure 7.6: Journey map and time map of a journey)	- Look out for ways for them to reflect on their daily journey, chores etc. - Two things - First one to reflect on spatial, example- <i>journey map</i> in Chapter 4. - Second one to reflect on time taken, example in '<i>time map</i>' in chapter 4. - Worksheets should be playful and encourage them to respond easily.
Recruitment	Selecting 4-6 participants.	- Recruitment is a critical component of preparation. Focus is on making a diverse participant group. - At least one woman participant should be included to bring diverse perspective.
Sending sensitizing tool	Hand delivery/ post. Give complete instructions	Printing and sending sensitizing tool (with clear set of instructions)
Selection of toolkit for PD research	Selection from following: Concrete, Abstract, Concrete-Abstract, Abstract-Concrete	Selection of toolkit would depend upon goals and objectives of the participatory research



Figure 7.6: Journey map and time map of a journey

7.2.2 Sensitizing

Sufficient time for example, 2-4 days should be given. If journey is variable, more number of days are preferred with more number of worksheets. Clear instructions must

be given to participants regarding what's expected from this exercise. Covered in chapter4, typical examples of filled sensitizing worksheets (Figure 7.7) are shown below:

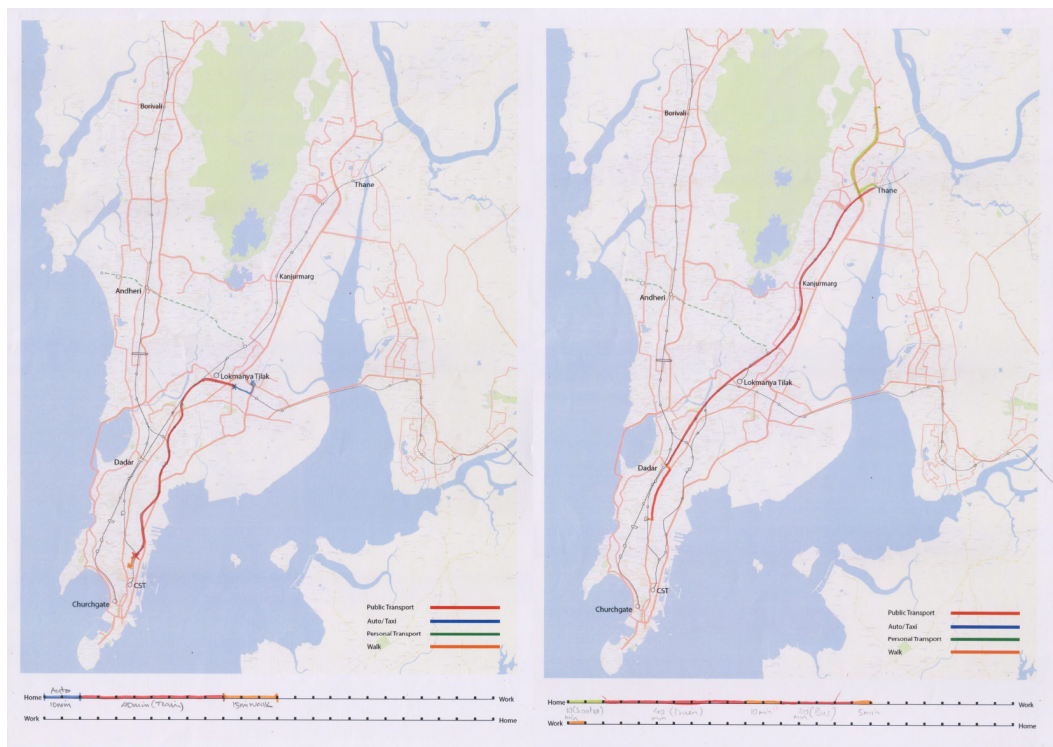


Figure 7.7: Examples of filled sensitizing worksheets

Users would present these filled worksheets in PD session that would be slated to come next.

7.2.3 Conducting Participatory Design (PD) Session

7.2.3.1 Before the session: Planning checklist

Table 7.4: Planning checklist

- Identify the space, where users can sit comfortably, without any disturbance and make themselves available to participate/ perform in PD session
 - Space for them to sit comfortably
 - Move around if required
- Design set up of PD
 - Make sure participatory space is accessible to all participants. They need to touch the toolkit. Need to take care of table size and chair arrangement.

- Make sure video camera is about to capture the entire scene. It is important to note that video camera should be arranged in such a manner that it not only captures human interactions, but also captures prototyping and what participants are making.
- A DSLR camera with time lapse settings can be arranged if there is a need.
- A microphone with output going into camera must be put on the table.
- The space should be sufficiently lit and hard shadows should be avoided. Avoid very bright light.
- Seating arrangement should facilitate eye contact with each and every person.
- Time Plan (revise before session)
 - _____ minutes for warm up
 - _____ minutes for instructions
 - _____ minutes for participatory prototyping

7.2.3.2 Protocol for Stages of Conducting PD session

INSTRUCTIONS I:

Welcome, Goals and Objectives. Trust on participants.

WARM UP

- I. Make participants sit comfortably in an adjacent space.
- II. Request them to introduce themselves, also explaining about their profession.
- III. Request them, one by one, to explain their filled sensitizing tools. This will help each participant to keep in mind their fellow participants' daily journey mode and time. This also helps in breaking the ice.

INSTRUCTIONS

(Take them to actual space)

- I. Re-state goals and objectives.

- II. Reveal Toolkit, explain its components functions, how to manipulate it.
Give demo.
- III. Request each of them to participate.
- IV. Inform them the duration of session.
- V. Show them the recording set-up.
- VI. Tell them that you, as a researcher, are there in that space but will only moderate. The group would mainly drive the session.
- VII. Suggest them to relax, feel comfortable. Instruct them to start.

CONDUCTION

- I. As a researcher, immerse deeply with them in the session.
- II. Make notes.
- III. Change tapes, batteries, memory sticks if required.
- IV. Thank everyone after the session.

7.2.4 Analysis

7.2.4.1 Organize data

- I. Move video data and DSLR still pictures (if used) to the computer.
Organize them in different folders.
- II. Label the folders for each PD Session.

7.2.4.2 Create Transcription

- I. Play back video to transcribe every utterance in textual format.
- II. Translate all statements into English.

Example of transcript is shown in Table 7.5.

Table 7.5: Example of transcript

18	Lakshmi	three wheeler personal use
19	Lakshmi	auto covered two wheeler
20	Patkar	advantage over existing bike or
21	Lakshmi	two wheeler which is covered
22	Rishi	storage box
23	Lakshmi	three wheeler to personal wheel mage.....boots space...you must take a Rickshaw to the station
24	Rishi	then you have additional vehicle also..
25	Lakshmi	additional vehicle.....additional trolley
26	Rahul	<i>three wheeler ase...ek minute</i> three wheeler... like this... one minute
27	Rishi	into the puddle puddle
28	Patkar	but magnet
29	Rishi	<i>mene socha ulta kiya</i> Was done opposite to what I said...
30	Patkar	<i>support lage....</i> It would need support

7.2.4.3 Create time-lapse video

Lineup all DSLR images (Figure 7.8) and play them at 4-6 frames per second.

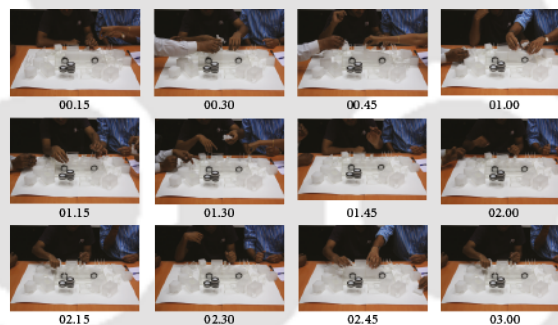


Figure 7.8: Example of still images for time lapse video

7.2.4.4 Concept description on Each Concept in Time Lapse Video

There may be many, ranging from 5-20 concepts made by users in PD session. In this analysis, objective is to find what's their tacit need that's surfacing collectively.

Go through transcription, seek patterns and provide insights. As the data will be fragmented, use your notes, use your reflective understanding of vehicle design, start defining ideas in terms of vehicle configuration, passengers, luggage etc.

Insert this short statement into the last slide of each concept of time-lapse video. Repeat it for each concept. You will now gain technical brief generated from intense users' PD research. For examples, please see chapter 4, section 4.3.

7.2.4.5 Visual Map of Brief

A visual brief would be made as shown in Figure 7.9.

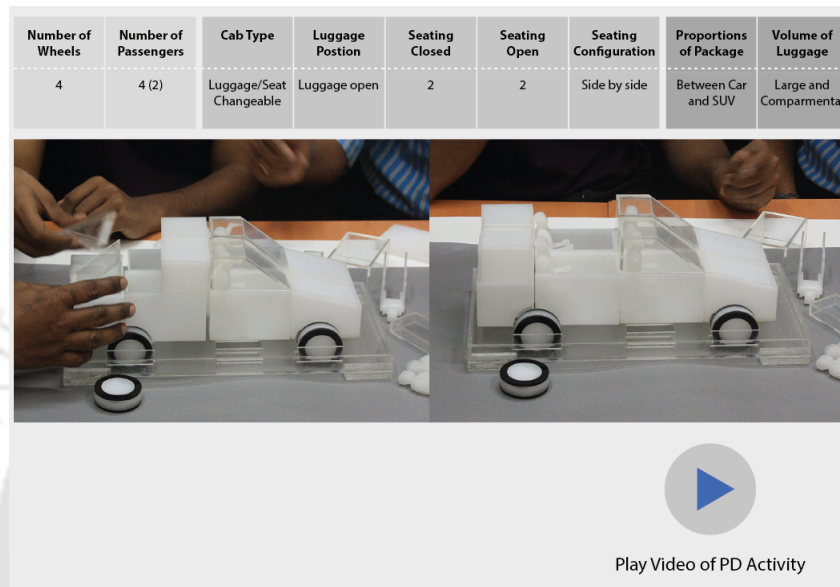


Figure 7.9: Example of visual brief

7.2.5 Communicating Results: Context Mapping

As mentioned in Chapter 5, designers need to get information of PD in a manner that helps them quickly understand requirements and start ideating. The following three things may be required for designers:

- 1) Design brief with vehicle configuration
- 2) Snapshot of what users made when they explained this design brief
- 3) Video of PD

This data can be creatively presented to designers preferably in digital format. Access to video by pressing a button can be given. Example of such a format is shown in Figure 7.9. Raw video should be made lighter and can be sent to the designer for his reference.

7.2.6 Final Process Flow

Final process flow for participatory activity with novice users is illustrated in Figure 7.10.

Stage 1 (FFE): Participatory Design Activity 1
Object mediated participatory design

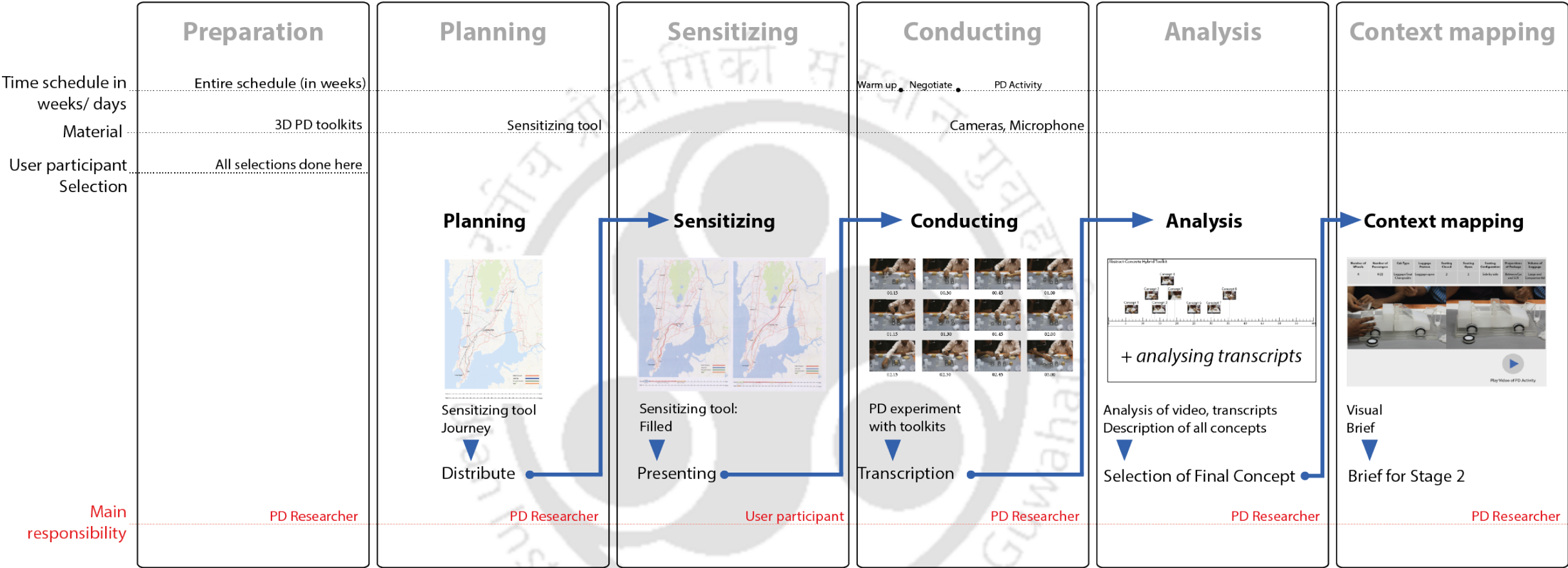


Figure 7.10: Complete illustration of participatory activity with novice users



7.3 Collective Form Generation By Group of Designers

7.3.1 Planning Document Checklist

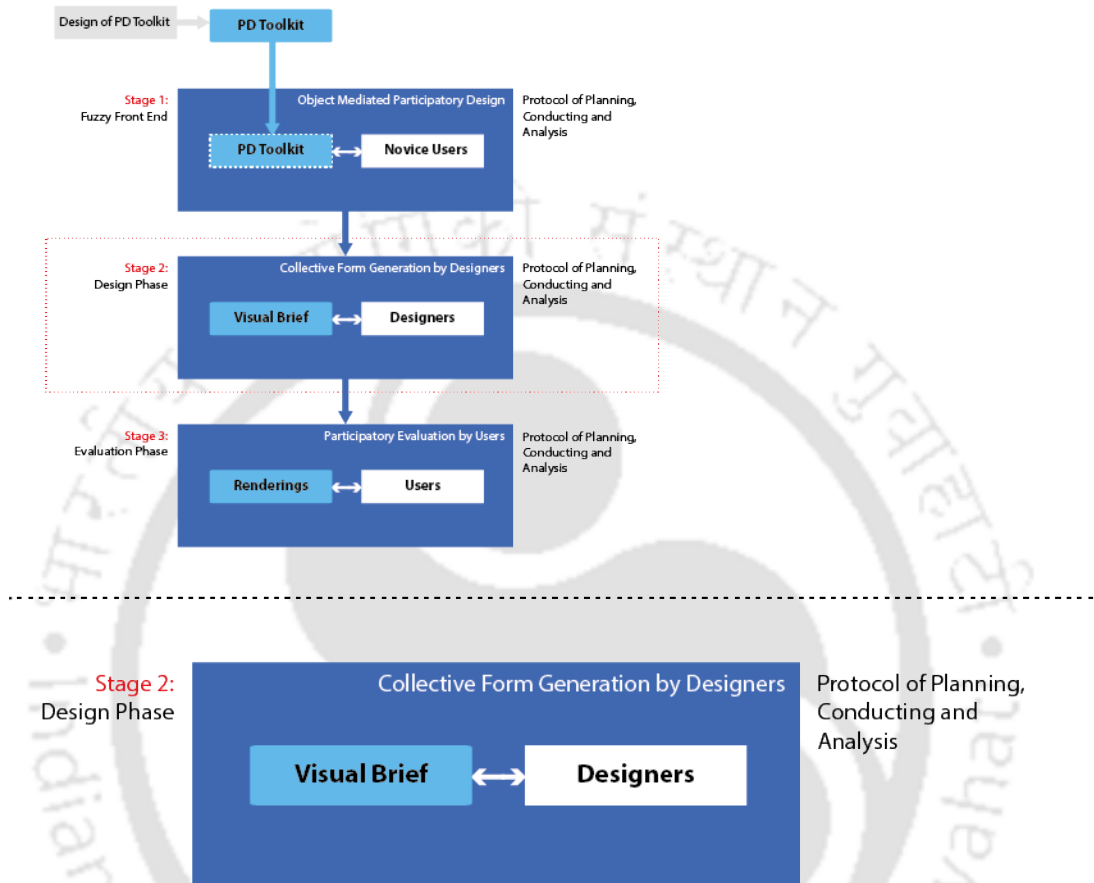


Figure 7.11: Collective form generation by designers: Stage 2

A checklist needs to be prepared (Table 7.6).

Table 7.6: Checklist for participatory activity with designers

- Identify designers who will participate. Companies themselves can do it.
- Identify space where around four designers can comfortably sit and sketch collaboratively
- Setup
 - Make sure they are able to see each other; they must be in close proximity.
 - Space between them must be enough to sketch and at the same time enough space to discuss and collaborate through sketches.

- Recording set up
 - One camera set up, focus can mainly be on their sketches being made by them (on the table essentially)
 - Microphone on table or hung from top to capture any discussion etc.
- The space should be sufficiently lit and hard shadows must be avoided.
- Time Plan
 - _____ minutes for 'conceptualising'
 - _____ minutes for 'negotiation'
 - _____ minutes for 'presentation'
- Planning Documents
 - Visual map (small thumbnail image) to be made ready in digital form
 - Basic human package with some flexibility to be made ready in the printed format. Side elevation is fine. (Add small thumbnail image)
 - Make checklist of brief. (Add small thumbnail image)

7.3.2 Conducting

7.3.2.1 Introduction

- a) Designers are shown a visual map with visuals and video of a specific concept
- b) They are then told about goals and objectives of this exercise.
- c) They are given access to visual map and video map for anytime reference.

7.3.2.2 Conceptualize

Each designer generates ideas about the prospective vehicle based on the understanding they gained in the introduction. Designers in that specific time may generate one or more sketches.

7.3.2.3 Negotiate

As the objective of this exercise is to gain a concept that has been collectively thought/agreed upon by a set of designers based on collective requirement elicitation by user group. Designers, at this point, bring in considerations of technology, manufacturing constraints etc. Sketches at this time are important entities for such collaboration. They assume themselves to be interaction spaces. The result of this session is a coherent sketch which has been agreed upon by all designers.

7.3.2.4 Present

At this stage, renders are to be made of the concept. It may be encouraged that all of them should participate in making renders.

- Repeat this process for all types of concepts.
- Check against checklist if the final renders capture the details of the brief. See if all the features are made.
- Close the session with thanks

7.3.2.5 Post sketching

- Put the recording in the folders, label them up. Though the result of this session is mainly concept renders (CR1, CR2, CR3.....), researchers may still have to see the video to find consistencies/inconsistencies in a group (designers) for future workshops. Notes by researchers are also fine.
- These quick concept renders are then taken up by individual designers for the sketching process. They should treat them as a basic criterion.
- Based on company to company, the concepts can go through hundreds of styling sketches before arriving at the final renders.

7.3.3 Final Process Flow

The process is self-regulatory as by the end of the session, one concept is chosen collectively and worked upon. Complete process flow is illustrated in Figure 7.12.



Stage 2: Participatory Activity 2
Collective form generation by
group of designers

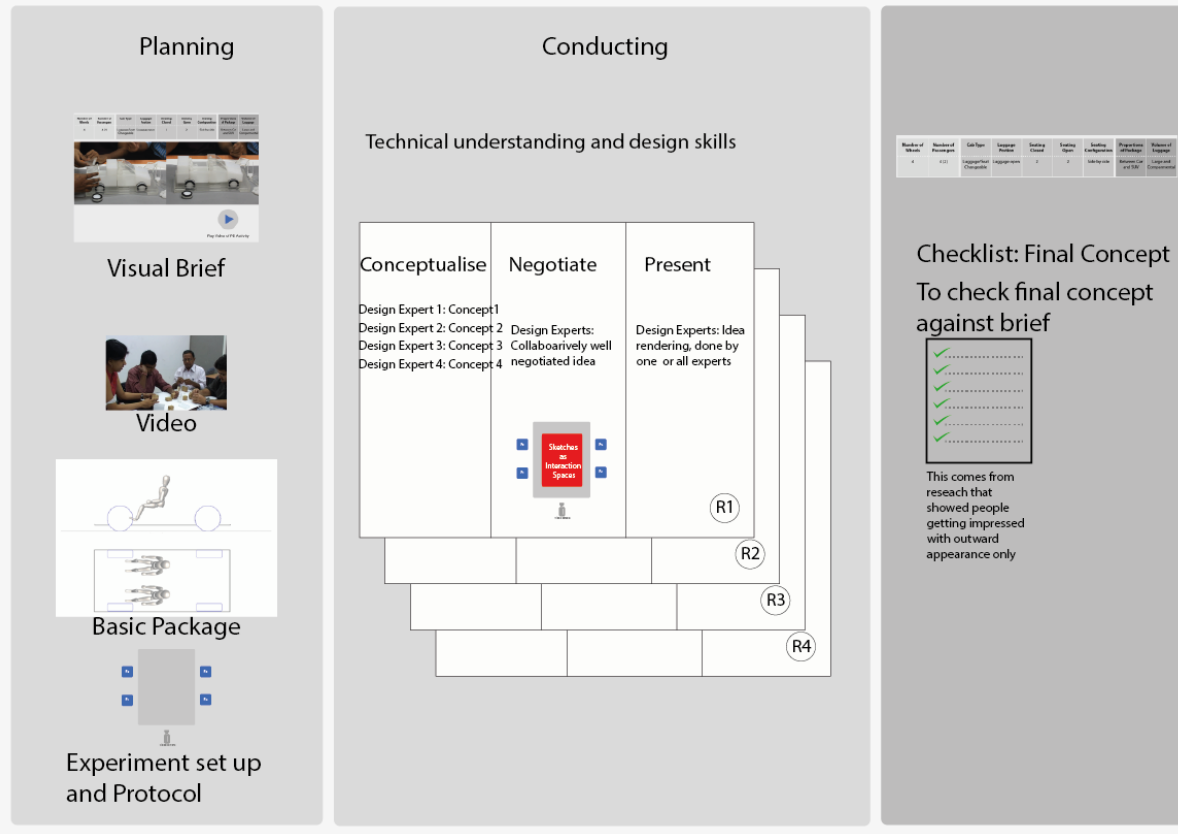


Figure 7.12: Complete illustration of participatory activity with designers



7.4 Participatory Evaluation

From chapter 6,

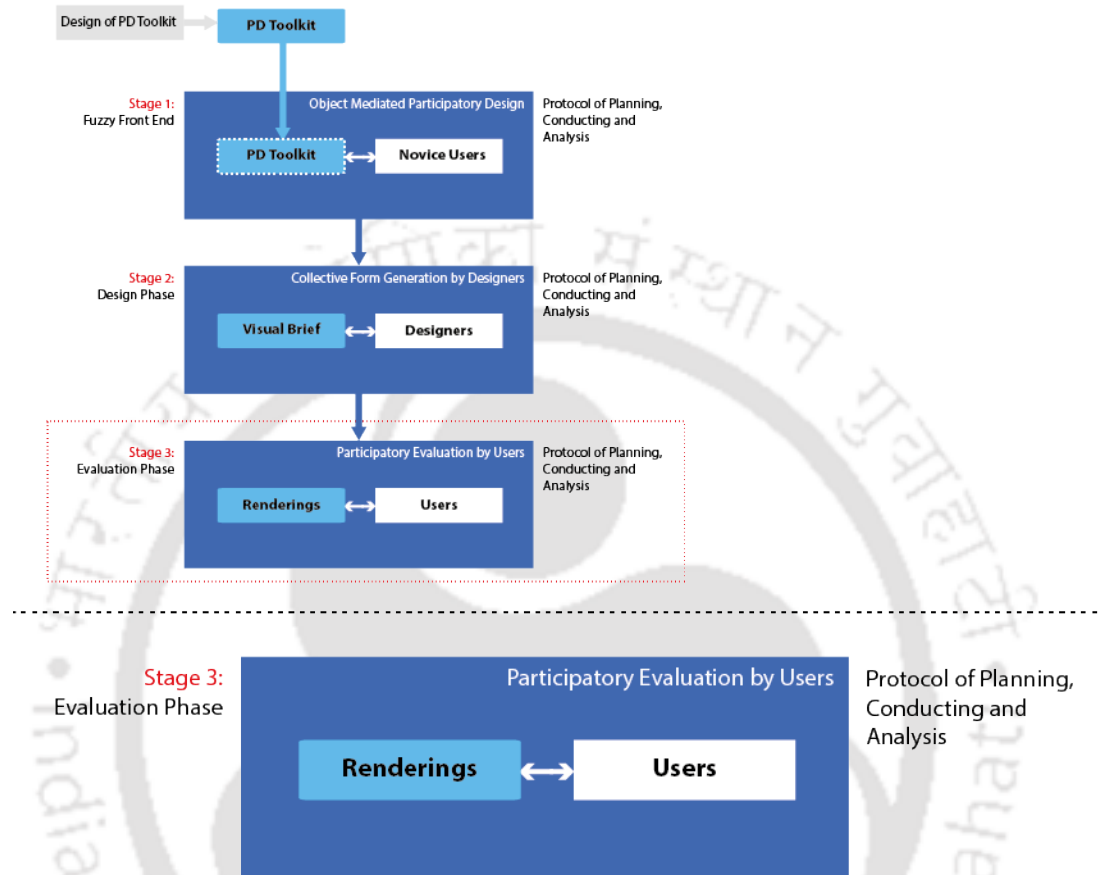


Figure 7.13: Participatory evaluation by users: Stage 3

7.4.1 A Checklist is Prepared Before Conducting Participatory Evaluation (Table 7.7).

Table 7.7: Checklist for participatory evaluation with users

- Recruit same participants who were part of PD session.
- Identifying a space where 4-6 participants can sit and browse through renders.
- Setup
 - Make sure space on table is enough to accommodate twelve renders.
 - Make sure they sit in such a manner that they make eye contact amongst themselves to be able to discuss in a group.

- Recording Setup
 - Notebook for researcher to note down
 - Video recording for session may also be useful later.
- The space should be sufficiently lit and hard shadows must be avoided.
- Time plan
 - _____ minutes for 'introduction'
 - _____ minutes for 'playing old video' (PD Session)
 - _____ minutes for 'conducting' evaluation.
- Renders R1, R2, R3: To be made ready. Each render will have three sheets.

7.4.2 Conducting Evaluation Activity

7.4.2.1 Introduction:

Welcome them. Articulate goals and objectives.

7.4.2.2 Video play back

Refresh their memories regarding what they said. Show them visual map of brief that users created.

7.4.2.3 Conducting

Give R1, R2, R3, R4 to participants. Allow them to shuffle each and every render. They will discuss and collectively try and arrive at one final concept.

7.4.2.4 Discussion

Engage in a discussion in the end with moderator to re-confirm if the chosen concept is fine.

The process is self-regulatory as by the end of the session, one final rendering is chosen collectively.

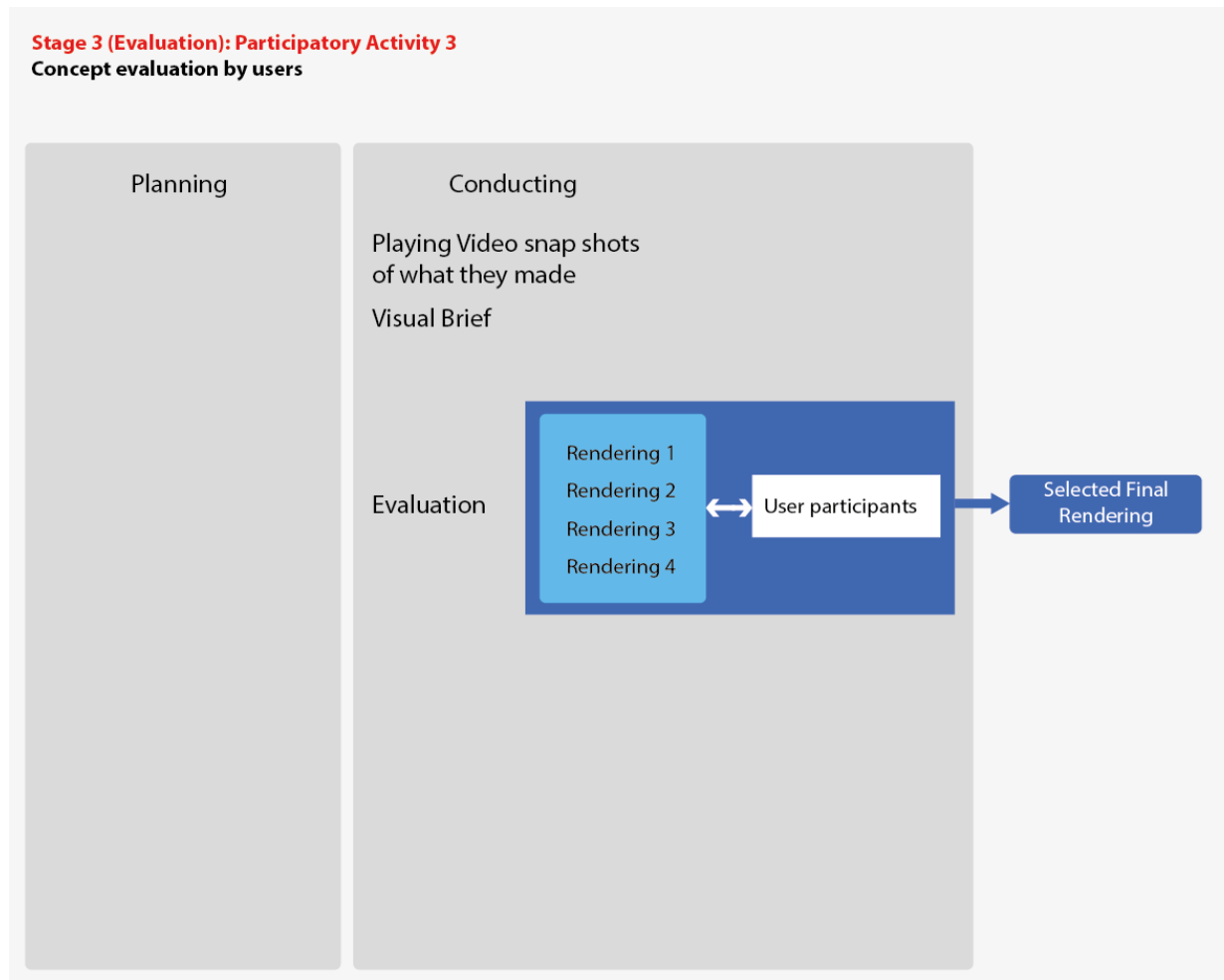


Figure 7.14: Complete illustration of participatory evaluation with users



7.5 Consolidating into an Overall Participatory Approach

Combining all of these above resulted into a comprehensive Participatory Design approach for Vehicle Design. As shown in Figure 7.15, the overall proposed approach consists of three design activities and three participatory design activities. It starts with the design of participatory toolkit and finishes with the evaluated final sketch.

7.5.1 Detailed Protocol

Figure 7.16 shows detailed protocol of all experiments of new participatory approach for vehicle design highlighting planning, design activity, conducting & analysis at different stages of participatory design research. The Figure 7.15 culminates into an overall methodology for personal transport vehicle design and addresses the research question- *What would be comprehensive participatory design methodology for vehicle design process?* This section reiterates the learnings and outcomes from each experiment that in turn led to the recommendations for the improvement of the protocols of participatory design methodology.

In this research, abstract and concrete toolkit (Nishant Sharma, 2011) has roots from Sanders's 'impromptu' and 'carefully designed' toolkits (E. B. –N. Sanders, 2013). Literature in participatory design research also mentions about low-fidelity and high fidelity prototypes (Rudd, Stern, & Isensee, 1996), their advantages & disadvantages. Ambiguity is purposefully introduced in the toolkits as the ambiguity raises question/topics and works as an inspiring resource for design (W. W. Gaver, Beaver, & Benford, 2003). As discussed in the Chapter 4, efforts were made to differentiate abstract and concrete to satisfy the goals of participatory design exercise, it was discussed that when you vary degree of abstraction, the output of participatory exercise also varies. The variation is from the perspective of readiness of concepts for future that can range from near future to very futuristic (Nishant Sharma, 2011). Such results from participatory design research would help organizations to choose appropriate toolkit. The chapter 4 specifically addresses four different kinds of toolkits with detailed view of usage of all toolkits. This new knowledge in turn underpinned the detailed protocol for participatory sessions with novice users. It is also important to note here that vast

efforts were spent on design of abstract and concrete toolkits for vehicle design and toolkit design thus is an important foundation for effective participatory research.

In the second stage- 'Collective Form Generation by a Group of Expert Designers', sketching was used as a tool to discuss, conceptualize and negotiate concepts towards the final vehicle form. While sketching, expert designers discussed, asked, negotiated and sought consent from each other towards the final concept. Therefore, final concept held pieces of information that were fairly negotiated and agreed upon by everyone. Additionally, from the view point of devising protocol of setting up the experiment in the evolved participatory approach, the video of participatory concept generation session was further analyzed by using conversation analysis method. The results as discussed in chapter 5, brought focus on physical 'sketch space' for sketching where much of the interaction takes place. It was found that interactions happen both inside and outside the sketching space (Day & Sharma, 2012). Interactions happening outside sketch space notified concerns related to function, engineering, costs etc. and interactions happening inside sketch space notified vehicle packaging, design, features of vehicle etc. Thus, evolved protocol, as discussed in this chapter, recognizes the effective placement of 'sketch' in collective form design experiment because it has huge bearing on the outcomes of the participatory activity.

Going forward, deliverables of this stage would be collectively visualized concept sketches. These concept sketches mapped with functions & features are raw materials for designers to create numerous photo realistic renderings in the styling process. Selection of right kind of rendering fulfilling users' aspirations and needs, is crucial for organizations. In that direction, Stage 3-Participatory Evaluation by Users was undertaken as discussed in Chapter 6. It was concluded in the analysis that participants had a shared visual basis on which to build their assessments. These assessments prompted them to deliver their contributions in a way that clearly, and favorably, focused on appearance over possible functional features of the vehicle concept. It was therefore important to resolve this to strengthen the protocol for participatory evaluation. A proper checklist as shown in fig Figure 7.12 was incorporated in Stage 2- Collective Form Generation by a Group of Expert Designers. The designers check the boxes to make sure that all concepts are true to brief and accomplish all the functional

requirements and have similar features. Renderings will then become ready for final round of participatory evaluation by users.



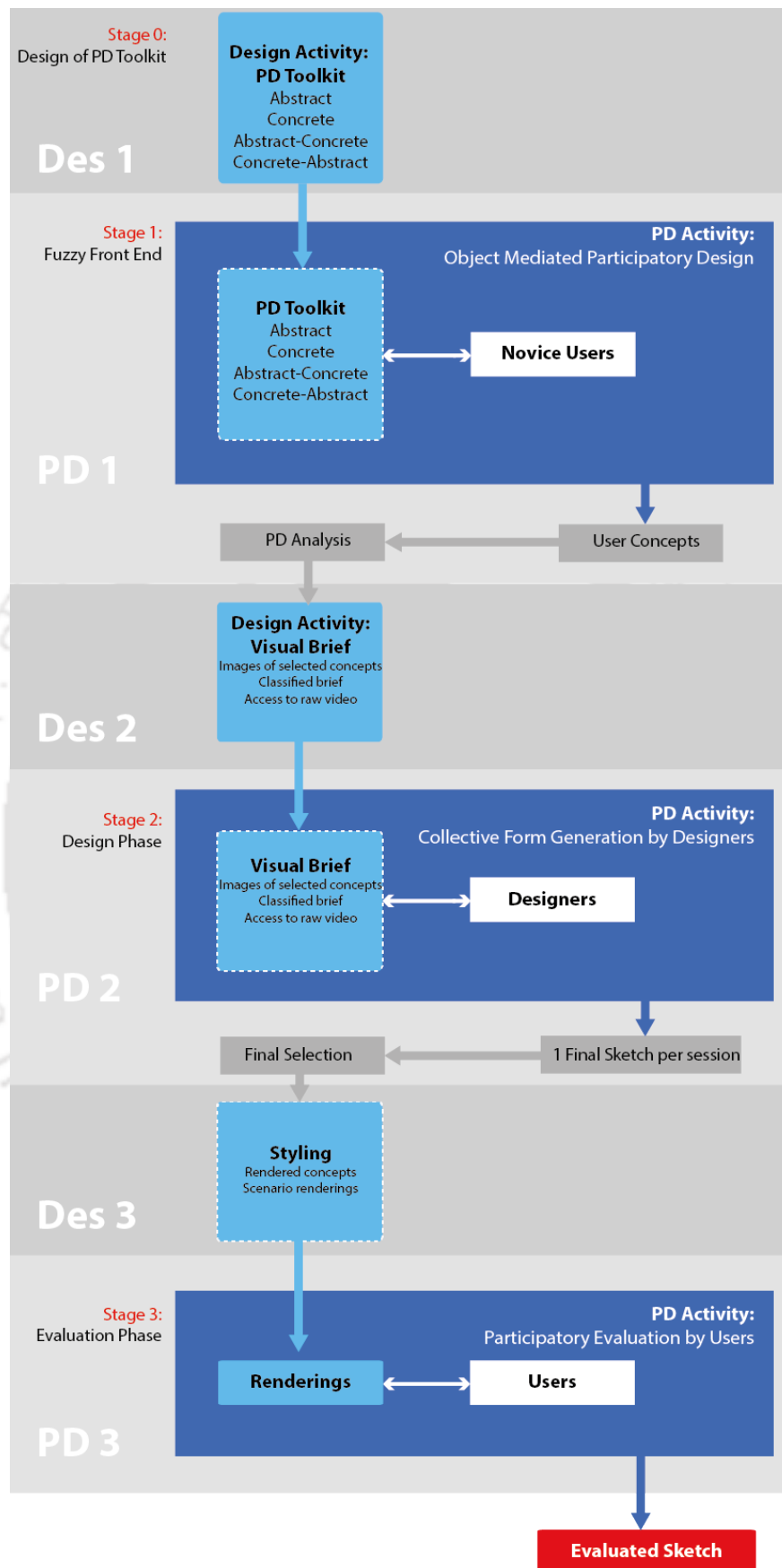


Figure 7.15: Overall participatory approach for vehicle design

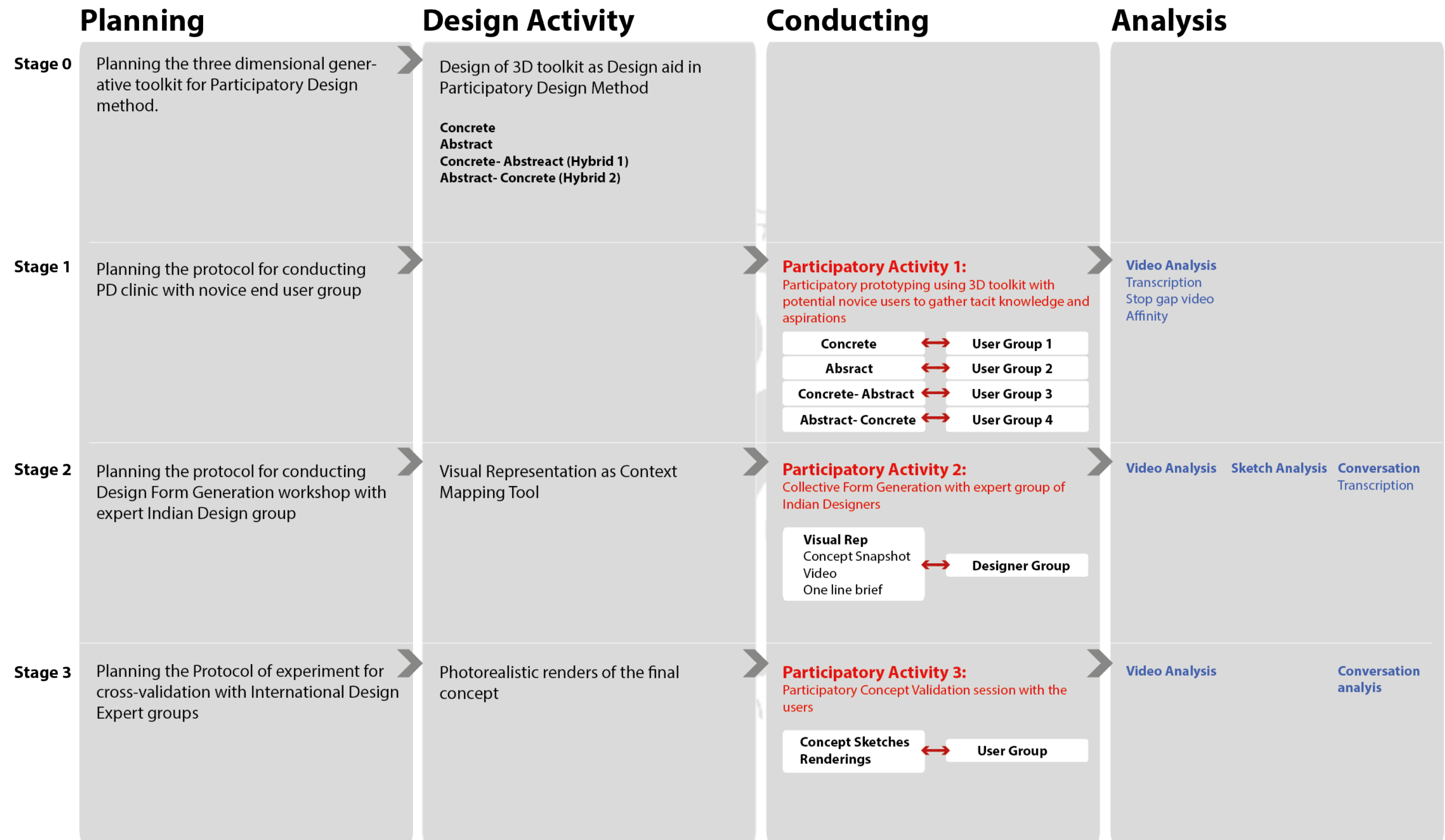


Figure 7.16: Detailed protocol of experiments



7.6 Concluding Remarks

This chapter successfully demonstrates the evolved approach/methodology for PD in vehicles. It has emerged from results of a series of experiments, outline of design methodology, consisting of three parts. It has a long trajectory from 'need understanding' to feature mapping on a render that can go ahead in Form Generation. Protocol of such methodology is actually based on planning; design activity, conducting, and analysis. So, essentially design is an inherent part of Participatory Design. Whether it is toolkit design, visual map design or renders. Designers and researchers are single and inseparable entity.

Decision making in each stage, is done by users or other stakeholders.

In conclusion, presented herein is the culmination of our research through a methodology for vehicle design. The next chapter will attempt to give conclusions of overall research, limitations and future scope.



CHAPTER 8: CONCLUSIONS OF RESEARCH, LIMITATIONS AND FUTURE SCOPE

This chapter presents the conclusions of the thesis. It then presents the limitations in this research followed by future scope.

8.0 Conclusions

As discussed in chapter 1, it was hypothesized that in order to design context-sensitive vehicle products for the diverse Indian market, an automobile designer must gain access to deep users' aspirations and tacit knowledge, for which, it would be required to evolve Participatory Design research methodology to be used in the Fuzzy Front End of the vehicle design process. A comprehensive participatory approach consisting of three participatory design methods has been illustrated in chapter 7. The research has been exploratory. It has evolved and contributed in exploring a new approach for vehicle design by which context-sensitive vehicle products can be designed. Research approach for evolving such a participatory method was mainly structured around a typical vehicle design process. The learning from one stage fed into the next. This research also offered an opportunity to collaborate with foreign experts and brought in a new insight from the point of view of protocol for video analysis and conversational analysis.

The key conclusions in evolving a context-sensitive participatory methodology in design of personal transport from this research are the following:

8.0.1 Evolved a Participatory Approach for Context-Sensitive Design

The purpose of research was to explore participatory design principles in the domain of vehicle design and arrive at a methodology for PD for vehicle design.

This thesis clearly established that a methodology for eliciting tacit and unmet needs must be mediated by a 3D toolkit in participatory session. A sizeable amount of effort and time was spent on a suitable design of toolkit. In that direction, it was found that variation in abstractness of toolkit resulted in variations in outcomes pertaining to future. A new methodology, based on objectives of product design and development, must give directions to a design suitable PD toolkit.

Proposed methodology is primarily based on three stages of design process viz. need analysis, conceptualize and evaluate, so it can be concluded, it doesn't deviate away from current design process.

This methodology has evolved after conducting experiments. Each experiment led to a new learning that helped to formulate this methodology.

Important features of this methodology are:

- 1) PD throughout the 'design phase' of vehicles: The elaborate nature of this methodology makes it useful for the entire design phase. This is a big leap in the domain of vehicle design which still uses traditional processes.
- 2) Simple and effective 'analysis': Designers taking notes and watching time-lapse video would provide quick understanding of PD session with novice users.
- 3) Simple and effective context map: Quick glance by the same designers (cum researchers) or new designers provide sufficient information for new vehicle concept generation. They may also use the provision of seeing the full video of novice participants.
- 4) Interactive concept evaluation and selection: Interactive nature of this session has merits in being free.

In addition, it also provides guidelines in planning, setups, checklists etc. The complete protocol is given. The methodology has four important components: planning, PD, analysis and design. It can be easily concluded that design and research are inseparable in this methodology. Those who believe that design and designers are actively important for research will be beneficiary of such a methodology.

8.0.2 Evolved Participatory Design Method that Integrates with Design Process

The proposed participatory design method integrates well within the framework of a typical design process that comprises of requirement capture, conceptualization, evaluation and implementation. This research, brings forth many opportunities of partnering with novice users in the critical stage of the design process. The main thrust of the proposed Participatory Design method is to use generative techniques with 3D generative toolkits with novice user group in the Fuzzy Front End to understand deep

user aspirations and tacit needs. It then displays the effective use of the rich user aspirations by expert design group in collective concept generation to arrive at embodied design concepts that have shared basis. Taking a step forward, the research proposes a PD approach to evaluate the design concepts with same users to determine the conformance of their elicited insights with the concepts designed by the designers.

8.0.3 Clearer Fuzzy Front End

The participatory research with rich tacit insights on contextual information enables the design and development team to gain more clarity in the Fuzzy Front End of a new product design assignment. In a way it formalizes an approach during FFE of the design process.

8.0.4 Process and Tools Empower Novice User Group and Expert Design Group

Proposed Participatory Design Method verifies to bring contextual information in product requirement capture. Three-dimensional participatory toolkits are found to be pivotal to the success of participatory activity and empower users to think, reflect and create in a group. Its degree of abstractness plays an enormous role in the nature of the output of the participatory session. The research proves the use of abstract toolkit for a very futuristic project and concrete for the near future. For explorations between very futuristic and near futuristic, hybrid toolkits can be used that are obtained by mixing elements of concrete and abstract. The proposed approach also empowers the designers with users' contextual information in the form of 'context map', thus enabling the designed products to be context-sensitive in nature.

8.0.5 Artifacts as Enablers in Catalyzing and Strengthening Participatory Design Process

In the entire proposed participatory design method, a lot of stress is laid on the use of artifacts as enablers in bringing forward the understanding of needs, sensitizing with needs and evaluating needs. The artifacts being *three-dimensional participatory toolkits* for participatory prototyping; *visual representation* (context map) for effective understanding of users' tacit needs; *sketches* for collective explorations and negotiations; and finally artifacts in the *form of sketches and renders* for the purpose of evaluation.

8.0.6 Synergy with Multi-Functional Teams

As displayed through the research, participatory research of this nature draws a lot of synergy from other fields like industrial design, psychology, social sciences, interaction design, conversation analysis etc. This was demonstrated in this research through the two international collaborations with foreign experts from two different professions.

8.1 Limitations of This Research

8.1.1 Limitation of Literature Because of Confidentiality

User research at all the stages is surely undertaken in the auto industry. However, there is a limitation in knowing exact methods being used by different industries due to the auto industry being highly confidential in nature. It may also be noted that a user centric approach may not be undertaken by all organizations. Some organizations may only undertake these in the initial part of the design process. While studying trends, our study mainly focused on international trends. Considering that the India automobile market is a follower market, only market trends have been articulated as there has been limitation in explaining vehicle design trends.

Again, vehicle design being confidential in nature, sporadic endeavors in participatory designs may have occurred in some organizations but there has been a limitation in finding published literature in print and on the Internet. In fact, case studies on vehicle designs pertaining to methods and processes are very limited.

8.1.2 Toolkit Limitations: Need More for Details

Generative toolkits are in their infancy stage and much of work happens while working on a project. Commonly known toolkits like Velcro, Lego were not available, therefore firsthand experience with such toolkits was not available. Toolkits are limited for 'main' or general needs, they may have limitations for eliciting specific outputs like grill design, DLO, styling, interior design etc. Toolkits are also physical in nature. So, if the study has to be done at multiple locations at same or similar time, then multiple copies need to be made.

8.1.3 Participatory Design: A Long Process from Planning to Analysis

Though it is important that all participants make and talk, there are chances that some of them remain passive. Transcripts are time-consuming for analysis, this has been a limitation in devising a quick analysis method for PD. Companies need quick and effective analysis because vehicle design process itself is very cost intensive, so analytical tools and methods must also be fast to save time and arrive at solutions. Planning PD is time consuming and may not be available to designers in design studios. It could be seen as a professional service that may be sought in a regulated manner from a competent agency outside to overcome this limitation.

8.1.4 Collective Form: Strategy Shift in Studios

More number of designers participating in collective PD session is a limitation. There may not be a possibility in industry to make four designers available for PD session. However it is desirable that a dedicated team may be put in place for this design research activity.

It is reasonable to say that organizations attain great clarity when such sessions are conducted. But there are limitations:

- a) Companies may change their strategy of introducing a product for the specific market.
- b) Some technological advancements come later, so the attained clarity may need to be revisited.
- c) It may not stay fully relevant, once designers take them further for styling if they don't consistently remain focused on it.

8.1.5 External Appearances may Hinder Real Evaluation in Participatory Settings

As the intention is that the entire group agrees upon the concepts presented, designers/researchers may encounter a situation where participants pick good-looking product that fulfills their requirements during the evaluation stage. This may nullify the objective of overall needs identified through prototyping that emerged during the PD session. The evaluation protocol may need to be refined further in the framework of the methodology by providing a checklist at the end of the PD session.

8.1.6 Limitations in Evolved Approach

The proposed approach works primarily with current straight forward, top-down design process. This may have limitations if the industry uses other design processes like Iterative Design Process etc. Designer (cum researcher) has to track the entire PD approach from planning to execution, this may add up extra work on him/her. Companies may see this as an added burden, may show some resistance in taking up this methodology.

This research has mainly focused on personal transport vehicles. This may have limitations for designing for public transport, commercial vehicles etc.

It may take longer time for real (live) case studies to surface since companies will mostly not share it because of most stringent confidentiality norms. They, however, may share after the successful launch or few years after the launch. Even when they release the case study, it may actually not provide a clear description. This would remain a limitation when researchers would need to see the efficacy of Participatory Design in vehicle design. It would however be interesting to conduct this kind of session with real designers in the automotive industry and propose it as an approach towards context-sensitive design of vehicles.

8.2 Future Scope of this Research

The outcome of the research gives us multimodal data to understand aspects of creativity of the human mind during the engagement of any problem-solving activity- be it novice end user or an expert designer. Technology will continue to rule the vehicle design. The current era also has a high level of usage of digital technology, internet etc. It is only natural that users will increasingly have more individuality or customization. Participatory design will anchor such customization.

This research opens up an interesting opportunity to make the same tangible manipulations with physical three-dimensional toolkit augmented by virtual reality, linked up with digital technology to take out virtual output. Interactive spaces on which these toolkit modules are manipulated could appear on the screen and be stored in the computer. In that way, there may not be any need to click pictures. People also become less conscious in the absence of camera and recording devices. At the end of each

exploration, the image closer to the image of the product appears on the screen. They may further manipulate it in the virtual environment.

This research has the capability of being conducted at multiple locations on real time basis. Computers could do 'analysis'. In the control room of design center of an organization, a computer can find patterns and look for the shared basis and arrive at the possible context-sensitive possibilities. The designers could take this information forward to design and impart form. This research would be of particular interest to companies that are constantly trying to understand variety of markets where they would like to enter and penetrate.

Virtually linked tangible toolkits along with computers can yield a compact methodology and a computer application or a program can be made. A research in this direction could be immensely useful and a designer's role can be mainly to design the toolkit and eventually give form to the concept. Web based tools linked up with these tangible 3-dimensional toolkits can facilitate effective customization in the area of furniture design, architecture and space design, vehicle design etc.

The proposed method has been designed with the case study on personal transport vehicles. Similar studies can be done for context-sensitive designs in public transport, vehicles for specific field based need (for e.g. 2 wheelers for Milkmen) and technology driven solutions for the future like electric vehicles. Context-sensitive will be far more relevant in future for other products like white goods, furniture design, trains design etc.

Future scope of research can be in the area of concreteness of the toolkit. By using 3D printing techniques, it may become possible in future to provide a concrete toolkit specific for these studies.

Another could be to tie this research with different other forms of design processes like iterative design process. Further research can explore and conduct experiments in the actual users' contexts.

Future research endeavors can be in the direction of interior design with Participatory Design Methodology. Technology has impacted interior design domain significantly

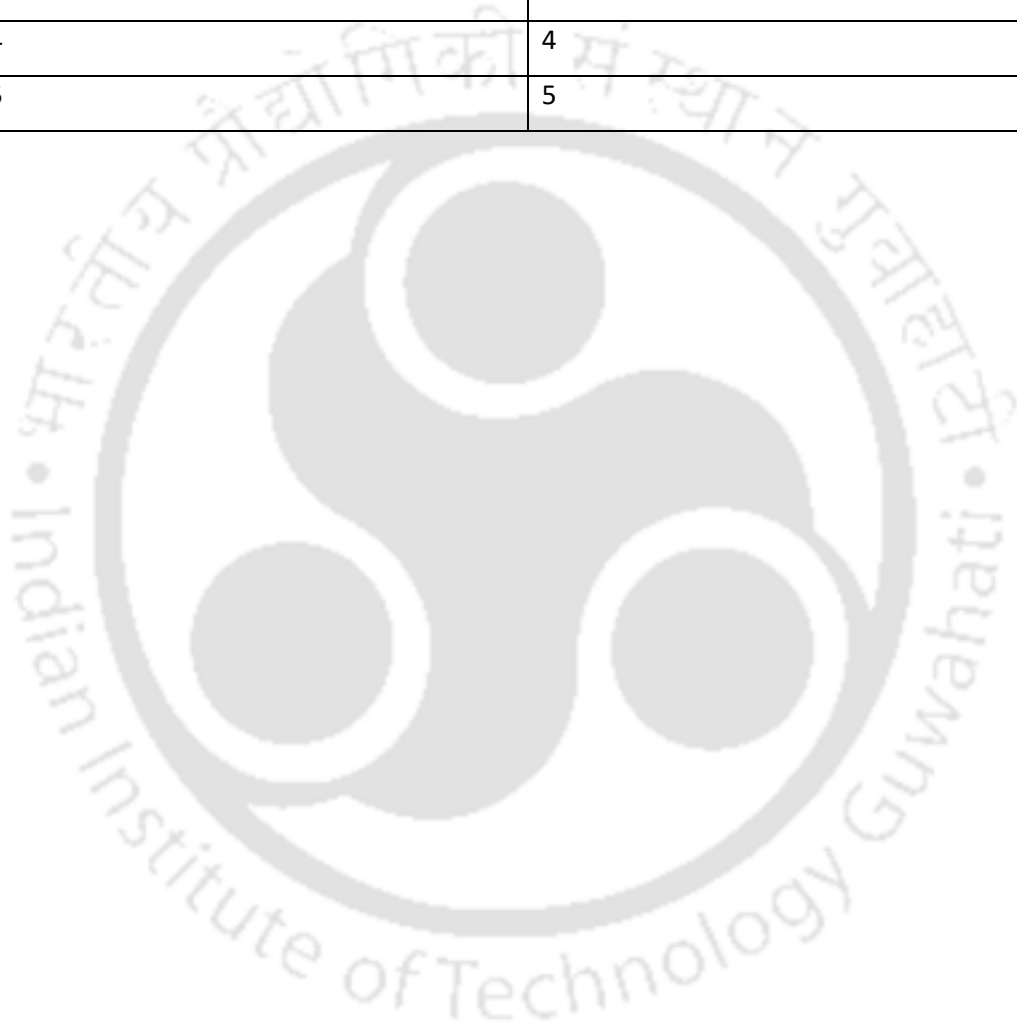
influencing experience of driving and riding. Using basic blue print as a base, a new approach can be built for such domains.

Though participatory styling wasn't a part of this research, collaborative styling has a potential to be explored. In a country where diversity is celebrated, auto industry can probably have participatory styling sessions. Designers (researchers) can create number of options and users can pick and choose and place them or there could be a way where they speak and form manipulation happens virtually.



APPENDIX 1: QUESTIONNAIRE FOR USER CENTRIC TOOLKIT:

From your own personal experience,	
List five positive attributes of use of two wheelers	List five positive attributes of use of cars
1	1
2	2
3	3
4	4
5	5



APPENDIX 2: USER RESPONSES WITH CODES FOR TOOLKIT DESIGN

Respondent Code	Observation/ Responses
US4WG01_001	A car is covered from all sides as it offers protection from the element.
US4WG01_002	A car is luxurious and plush
US4WG01_003	A car gives a feeling of security
US4WG01_004	Car gives the opportunity to travel together in a family in a comfortable manner
US4WG01_005	Some of the most vivid memories of childhood are associated with long drives etc.
US2WG01_001	Easy maneuverability especially in the crowded places.
US2WG01_002	Less maintenance cost
US2WG01_003	Speed is most thrilling experience on the two wheelers
US2WG01_004	You can actually feel the wind on your face
US4WG02_001	It is comfort zone both for driver and the passenger.
US4WG02_002	The seating is very comfortable
US4WG02_003	It gives great pleasure without any pressure of driving
US2WG02_001	The wind blowing from the front towards the face and the openness of the vehicle gives a close relation of moving in air with holding something in hand
US2WG02_002	I always feel that two wheelers give me a rationale to drive fast because I want to break the air and move as fast I can
US4WG03_001	Wind shield or the closed block (car) protects from dust and other climatic conditions
US4WG03_002	Carries more people (more than 2)
US4WG03_003	Comfortable sitting posture
US4WG03_004	More safe on highways
US4WG03_005	More speed
US2WG03_001	Easy and swift with respect to mobility
US2WG03_002	Easy to park (Takes less space)
US2WG03_003	Affordable for common man
US2WG03_004	Exposed engine celebrated technology
US2WG03_005	Less maintenance
US4WG04_001	You can shut yourself from the nonsense of the world outside
US4WG04_002	The entire group can travel together. Be it family or friends
US4WG04_003	It has a lot of conversation space
US4WG04_004	It is more or less comfortable and you can listen to music
US4WG04_005	Many luggage carrying possibilities
US4WG04_006	It is a very safe way of transportation
US2WG04_001	It is fun and thrilling
US2WG04_002	Easy to maneuver, cut traffic. So lower travel times
US2WG04_003	More fuel efficient, cheaper running costs
US2WG04_004	The feeling of oneness with the surroundings
US2WG04_005	Has sitting space for the occasional pillion
US2WG04_006	It has a lot of charm
US2WG04_007	I prefer it for solo getaways

US4WG05_001	It protected from external elements
US4WG05_002	It is easy to operate. It does not require much efforts to drive
US4WG05_003	It is robust and gives a huge amount of protection during an impact
US4WG05_004	It has an ability to transfer huge loads from point A to point B
US4WG05_005	One can indulge in it as much as he wants.
US4WG05_006	It is safer to drive
US2WG05_001	It is fast
US2WG05_002	It can easily be maneuverable
US2WG05_003	It is easy to park
US2WG05_004	Requires lesser force to operate
US2WG05_005	It is highly economical
US2WG05_006	More usable
US2WG05_007	It is more durable and reliable
US4WG06_001	Driving my car is something that I enjoy most
US4WG06_002	It makes you feel that you are very safe
US4WG06_003	A platform to interact with your family and friends
US4WG06_004	It is not so congested
US4WG06_005	You can always relax while driving
US4WG06_006	Makes the experience of driving very enjoyable
US2WG06_001	When you ride a two wheeler you get to interact more with the environment
US2WG06_002	You get to feel the speed in which you ride.
US2WG06_003	It is more of a freaky experience
US2WG06_004	You get to show off when you are on a bike
US4WG07_001	Shield against weather
US4WG07_002	Music
US4WG07_003	safer
US4WG07_004	You can eat, drink
US4WG07_005	More luggage
US4WG07_006	No need to buy sunglasses/ gloves
US4WG07_007	No back problem (You can adjust your seat)
US4WG07_008	Sometimes you need to travel in a group
US2WG07_001	Easy Navigation
US2WG07_002	Thrill
US2WG07_003	More in sync with nature and environment
US2WG07_004	Sometimes you need to go to a different place than your family
US2WG07_005	Faster(City)
US2WG07_006	In case of bad roads or no roads, 2W are better
US2WG07_007	Cheaper in terms of cost and maintenance
US4WG08_001	Better safety
US4WG08_002	Quality of space
US4WG08_003	Protection from external elements (& nature)
US2WG08_001	Economy
US2WG08_002	The experience of power speed and style
US4WG09_001	More protective measure- a feeling of safety as compared to bikes

US4WG09_002	More comfortable and customizable (like music etc)
US4WG09_003	Basically, balances on its own
US4WG09_004	Better for a long drive
US4WG09_005	Accommodates more people
US2WG09_001	More pleasurable as there is direct experience with wind power
US2WG09_002	Best in maneuverability
US2WG09_003	Easy to handle
US2WG09_004	Accommodates in small parking space
US2WG09_005	Shows up a personal character
US2WG09_006	The feel is better as compared to car while driving
US2WG09_007	Easy to transport if it fails
US4WG10_001	Closed and more privacy from Busts, Noise Pollution
US4WG10_002	Protects from Rain and Hot Sun
US4WG10_003	No Helmet Required in the car
US4WG10_004	Large luggage space
US4WG10_005	Can take full family
US4WG10_006	Remains always stable
US2WG10_001	Can easily take through traffic
US2WG10_002	More Economical- 2w
US2WG10_003	Adventurous- 2w
US2WG10_004	Experience the speed while driving, feel of wind, gives pleasure
US2WG10_005	Less capital and maintenance cost

APPENDIX 3: AFFINITY ANALYSIS OF DATA

Categories	Code	Sub Statement 1	Sub Statement 2	Sub Statement 3	Sub Statement 4
Luggage	US4WG04_005	Many luggage carrying possibilities			
	US4WG05_004	It has an ability to transfer huge loads from point A to point B			
	US2WG05_006			More usable	
	US4WG07_005		More luggage		
	US4WG10_004		Large luggage space		
	KEY INSIGHT	A vehicle should have ability to carry luggage from one point to another	Small to Large Luggage	High usability	
Cost	US2WG03_005	Less maintenance			
	US2WG05_005		It is highly economical		
	US2WG05_007	It is more durable and reliable			
	US2WG08_001		Economy		
	US2WG01_002	Less maintenance cost			
	US2WG03_003		Affordable for common man		
	US2WG04_003			More fuel efficient, cheaper running costs	
	US2WG07_007	Cheaper in terms of cost and maintenance			
	US2WG10_002		More Economical-2w		
	US2WG10_005	Less capital and maintenance cost			
	KEY INSIGHT	A low maintenance cost with high durability and reliability.	Cost of owning the vehicle should be low.	Operational cost of the vehicle should be low.	
Pleasure with environment	US2WG01_004	You can actually feel the wind on your face			
	US2WG02_001	The wind blowing from the front towards the face and the openness of the vehicle gives a close relation of moving in air with holding something in hand			

	US2WG02_002	I always feel that two wheelers give me a rationale to drive fast because I want to break the air and move as fast I can			
	US2WG04_004		The feeling of oneness with the surroundings		
	US2WG06_001		When you ride a two-wheeler you get to interact more with the environment		
	US2WG07_003		More in sync with nature and environment		
	US2WG09_001	More pleasurable as there is direct experience with wind power			
	US2WG10_004	Experience the speed while driving, feel of wind, gives pleasure			
	KEY INSIGHT	Experience of wind in the open vehicles give a pleasurable experience	Sync with nature is a pleasurable experience		
Maneuverability and Parking	US2WG01_001		Easy maneuverability especially in the crowded places.		
	US2WG03_001	Easy and swift with respect to mobility			
	US2WG04_002		Easy to maneuver, cut traffic. So lower travel times		
	US4WG05_002	It is easy to operate. It does not require much efforts to drive			
	US2WG05_002		It can easily be maneuverable		
	US2WG05_004	Requires lesser force to operate			
	US2WG07_001		Easy Navigation		
	US2WG07_006				In case of bad roads or no roads, 2W are better
	US4WG09_003	Basically balances on its own			
	US2WG09_002		Best in maneuverability		
	US2WG09_003	Easy to handle			
	US4WG10_006	Remains always stable			

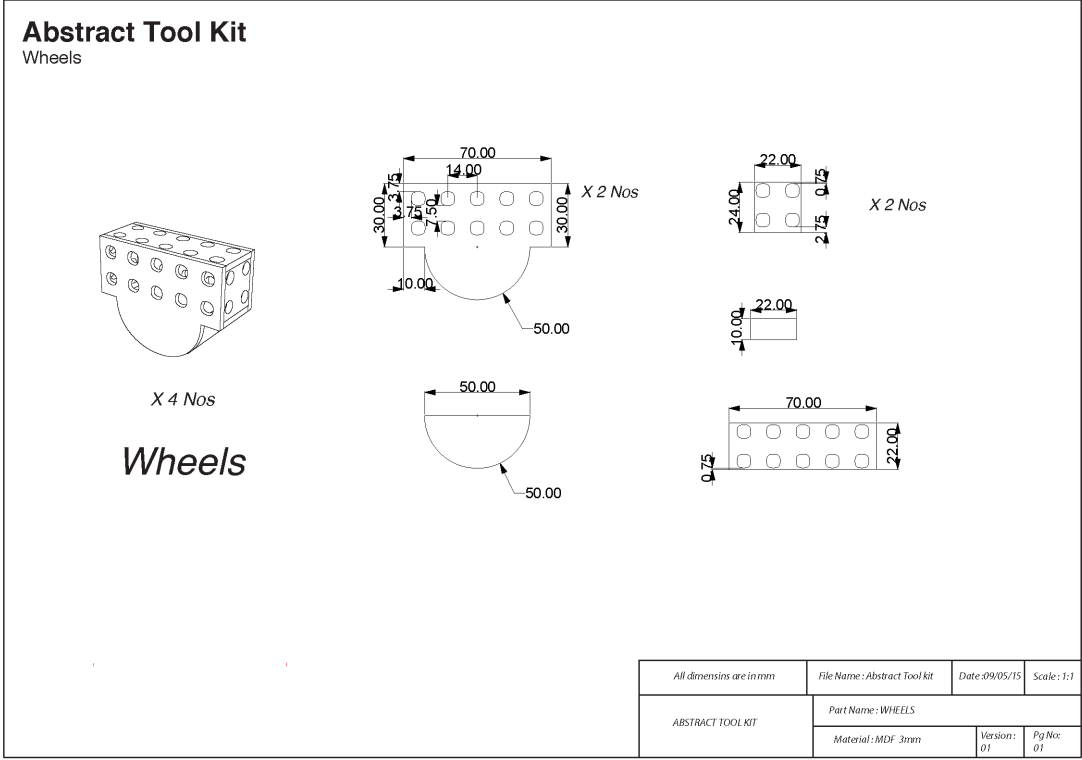
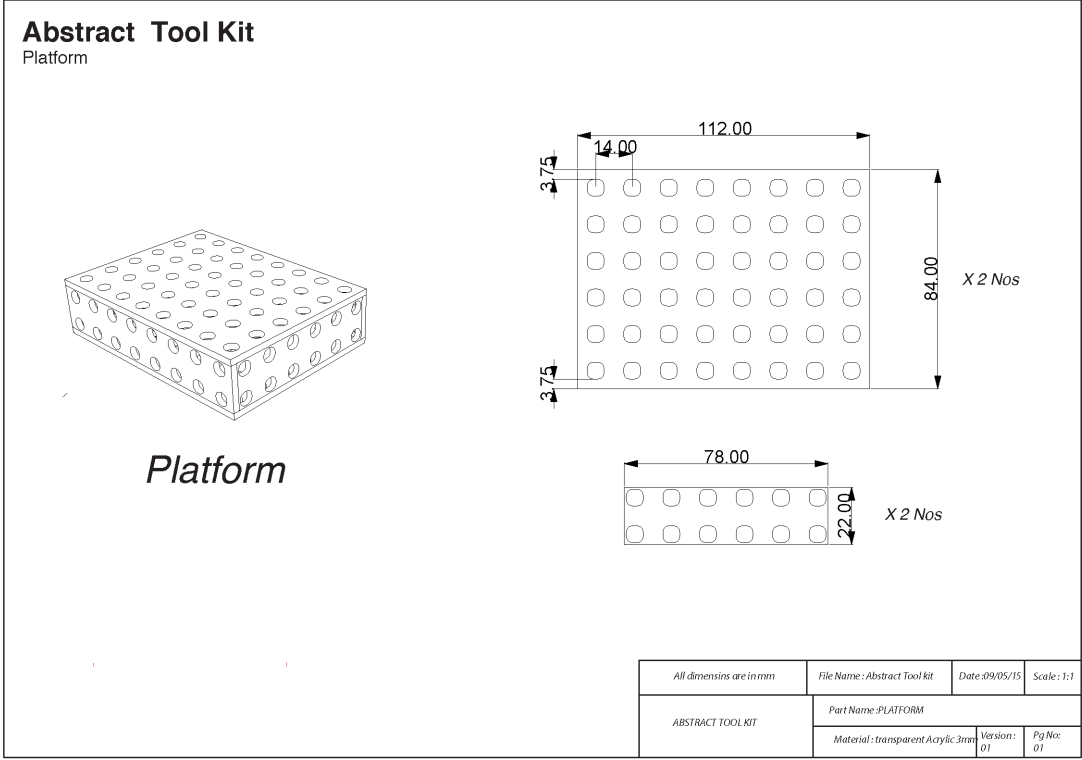
	US2WG10_001		Can easily take through traffic		
	US2WG03_002			Easy to park (Takes less space)	
	US2WG05_003			It is easy to park	
	US2WG09_004			Accommodates in small parking space	
	US2WG09_007			Easy to transport if it fails	
	KEY INSIGHT	A vehicles should be easy to operate and handle with least force.	The vehicle should have high maneuverability even in the crowded places.	The vehicle should be easy to park with least footprint.	
Speed and Thrill	US4WG01_005			Some of the most vivid memories of childhood are associated with long drives etc.	
	US2WG01_003	Speed is most thrilling experience on the two wheelers			
	US4WG03_005	More speed			
	US2WG04_001		It is fun and thrilling		
	US2WG05_001	It is fast			
	US2WG07_002		Thrill		
	US2WG07_005	Faster(City)			
	US2WG10_003		Adventurous- 2w		
	US2WG03_004				Exposed engine celebrates technology
	US2WG06_002		You get to feel the speed in which you ride.		
	US2WG06_004		You get to show off when you are on a bike		
	US2WG08_002		The experience of power speed and style		
	US2WG09_005		Shows up a personal character		
	US2WG09_006			The feel is better as compared to car while driving	
	KEY INSIGHT	Speed is usually associated with Thrill	Fun and thrill are often associated with speed	The feel of travelling in 4w is better than 2w.	
Family	US4WG01_004	Car gives the opportunity to travel together in a family in a comfortable manner			

	US4WG03_002	Carries more people (more than 2)			
	US4WG04_002	The entire group can travel together. Be it family or friends			
	US4WG04_003		It has a lot of conversation space		
	US2WG04_005			Has sitting space for the occasional pillion	
	US4WG06_003		A platform to interact with your family and friends		
	US4WG07_008	Sometimes you need to travel in a group			
	US2WG07_004			Sometimes you need to go to a different place than your family	
	US4WG09_004				Better for a long drive
	US4WG09_005	Accommodates more people			
	US4WG10_005	Can take full family			
	US2WG04_007			I prefer it for solo getaways	
	KEY INSIGHT	A vehicle should allow people to travel in a family or in a group	It allows people to converse and interact with friends and family	However, the vehicle should also allow to travel alone.	A vehicle should be suitable for long drive.
Protection and Safety	US4WG01_001	A car is covered from all sides as it offers protection from the element.			
	US4WG03_001	Wind shield or the closed block(car) protects from dust and other climatic conditions			
	US4WG05_001	It protected from external elements			
	US4WG05_003	It is robust and gives a huge amount of protection during an impact			
	US4WG07_001	Shield against weather			
	US4WG08_003	Protection from external elements (& nature)			
	US4WG10_001	Closed and more privacy from Busts, Noise Pollution			
	US4WG10_002	Protects from Rain and Hot Sun			
	US4WG10_003			No Helmet Required in the car	

	US4WG01_003			A car gives a feeling of security	
	US4WG03_004		More safe on highways		
	US4WG04_006		It is a very safe way of transportation		
	US4WG05_006		It is safer to drive		
	US4WG06_002			It makes you feel that you are very safe	
	US4WG07_003		safer		
	US4WG08_001		Better safety		
	US4WG09_001			More protective measure- a feeling of safety as compared to bikes	
	KEY INSIGHT	Closed vehicle should protect well from noise, pollution, hot sun and rain. It should also protect from mild impacts.	A vehicle should give a feeling of security		
Comfort	US4WG03_003	Comfortable sitting posture			
	US4WG04_004		It is more or less comfortable and you can listen to music		
	US4WG06_005	You can always relax while driving			
	US4WG07_002		Music		
	US4WG07_007	No back problem (You can adjust your seat)			
	US4WG09_002		More comfortable and customizable (like music etc.)		
	US4WG08_002			Quality of space	
	US4WG02_001	It is comfort zone both for driver and the passenger.			
	US4WG02_002	The seating is very comfortable			
	US4WG02_003	It gives great pleasure without any pressure of driving			
	US4WG06_004			It is not so congested	
	US4WG07_004		You can eat, drink		
	US4WG07_006		No need to buy sunglasses/ gloves		
	US4WG01_002		A car is luxurious and plush		

US4WG04_001			You can shut yourself from the nonsense of the world outside	
US2WG04_006				It has a lot of charm
US4WG06_001				Driving my car is something that I enjoy most
US4WG06_006				Makes the experience of driving very enjoyable
US2WG06_003				It is more of a freaky experience
US4WG05_005			One can indulge in it as much as he wants.	
KEY INSIGHT	A vehicle should give pleasure of riding with no pressure of driving even in the narrow lanes.	A vehicle should allow to have one's own private space to indulge.		

APPENDIX 4A: DETAILED CAD DRAWINGS OF ABSTRACT
TOOLKIT

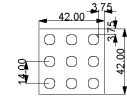


Abstract Tool Kit

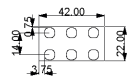
Luggage



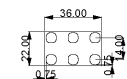
X 2 Nos



X 2 Nos

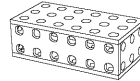


X 2 Nos

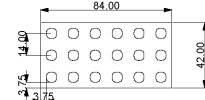


X 2 Nos

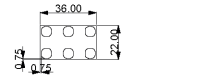
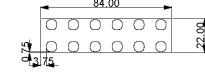
X 2 Nos



X 2 Nos



X 2 Nos

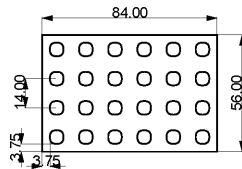
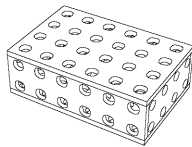


Luggage

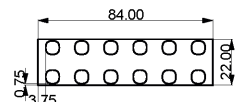
All dimensions are in mm	File Name : Concrete Tool kit	Date :19/10/14	Scale : 1:1
ABSTRACT TOOL KIT	Part Name : LUGGAGE		
	Material : MDF 3mm	Version : 01	Pg No: 01

Abstract Tool Kit

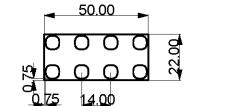
Chassis



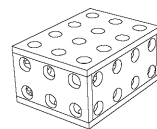
X 2 Nos



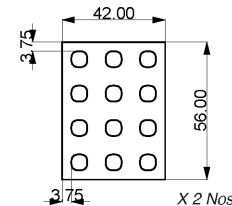
X 2 Nos



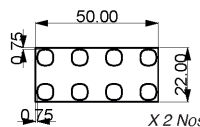
X 2 Nos



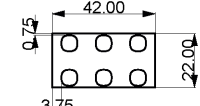
X 2 Nos



X 2 Nos



X 2 Nos



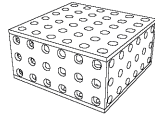
X 2 Nos

Chassis

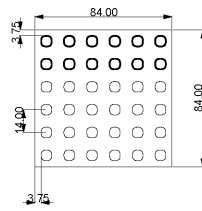
All dimensions are in mm	File Name : Concrete Tool kit	Date :09/05/15	Scale : 1:1
ABSTRACT TOOL KIT	Part Name : CHASSIS		
	Material : MDF 3mm	Version : 01	Pg No: 01

Abstract Tool Kit

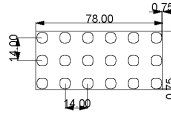
Passenger



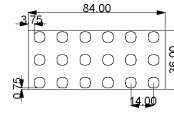
Passenger



X 2 Nos



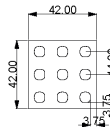
X 2 Nos



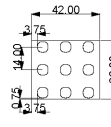
X 2 Nos



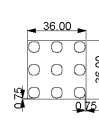
X 2 Nos



X 2 Nos



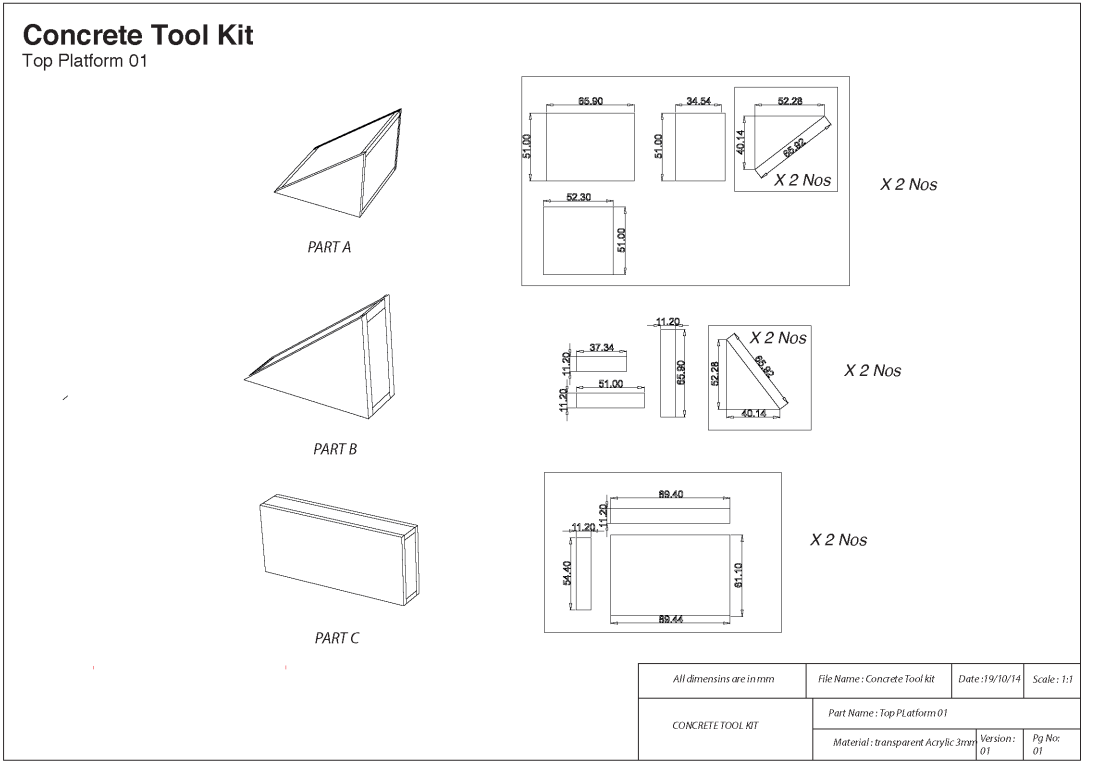
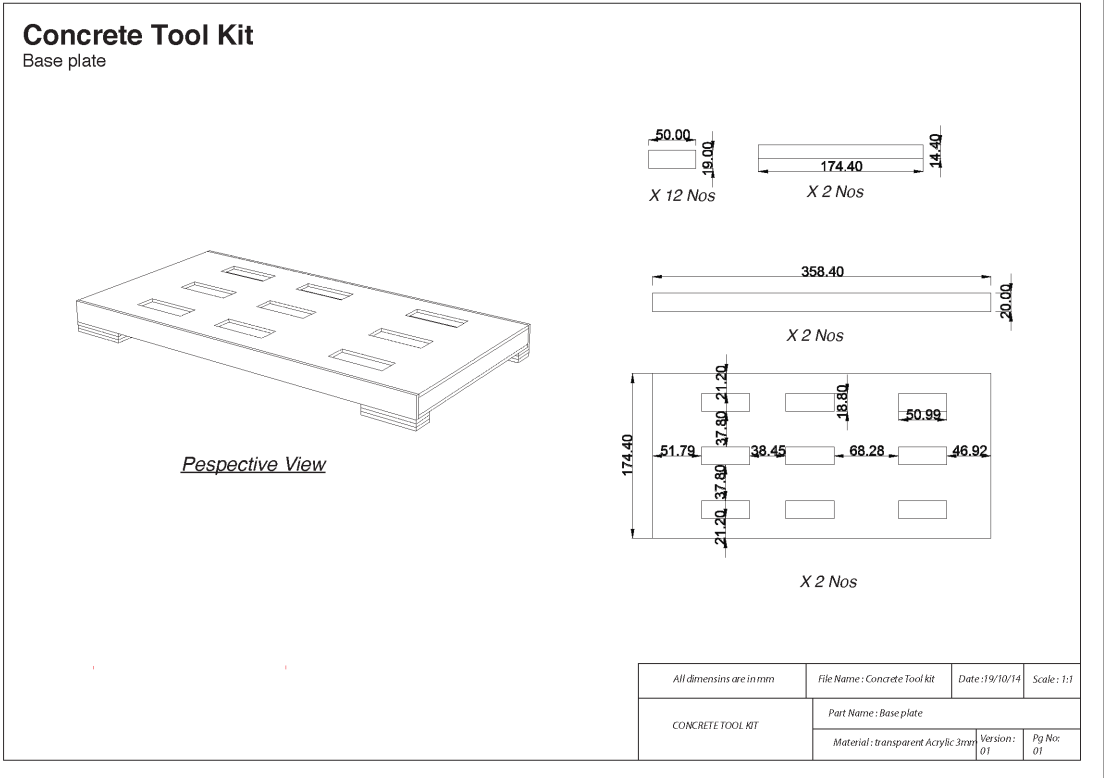
X 2 Nos



X 2 Nos

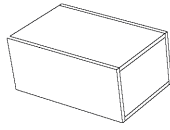
All dimensions are in mm	File Name : Concrete Tool kit	Date : 19/10/14	Scale : 1:1
ABSTRACT TOOL KIT	Part Name : PASSENGER		
	Material : MDF 3mm	Version : 01	Pg No : 01

APPENDIX 4B: DETAILED CAD DRAWINGS OF CONCRETE TOOLKIT

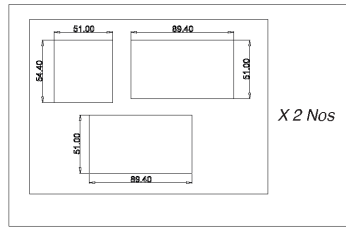


Concrete Tool Kit

Top Platform 02

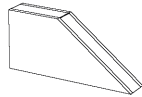


PART D

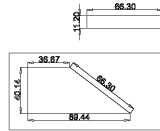


X 2 Nos

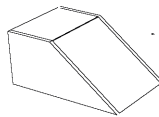
X 2 Nos



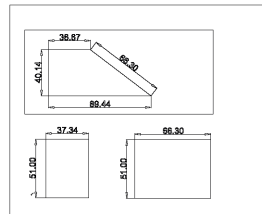
PART E



X 2 Nos



PART F



X 2 Nos

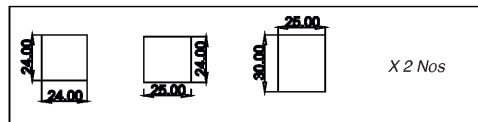
All dimensions are in mm	File Name : Concrete Tool kit	Date :19/10/14	Scale : 1:1
CONCRETE TOOL KIT	Part Name : Top Platform 02		
	Material : transparent Acrylic 3mm	Version : 01	Pg Nos : 01

Concrete Tool Kit

Seat and Bottom Platform 01

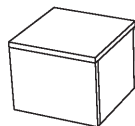


X 4 Nos

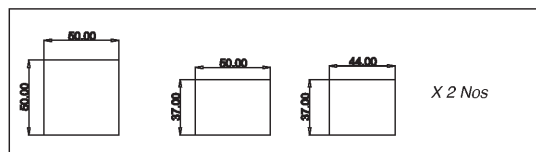


X 2 Nos

X 4 Nos



X 2 Nos



X 2 Nos

X 2 Nos

PART A

All dimensions are in mm	File Name : Concrete Tool kit	Date :19/10/14	Scale : 1:1
CONCRETE TOOL KIT	Part Name : Seat and Bottom Platform		
	Material : transparent Acrylic 3mm	Version : 01	Pg Nos : 01

Bottom Platform 02



All dimensions are in mm		File Name : Concrete Tool kit		Date : 19/10/14	Scale : 1:1
CONCRETE TOOL KIT		Part Name : Bottom Platform 02			
		Material : transparent Acrylic 3mm	Version : 01	Pg No : 01	

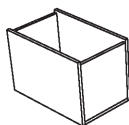
Bottom Platform 03



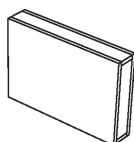
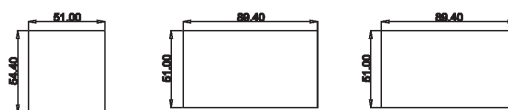
All dimensions are in mm		File Name : Concrete Tool kit		Date : 19/10/14	Scale : 1:1
CONCRETE TOOL KIT		Part Name : Bottom Platform 03			
		Material : transparent Acrylic 3mm	Version : 01	Pg No : 01	

Concrete Tool Kit

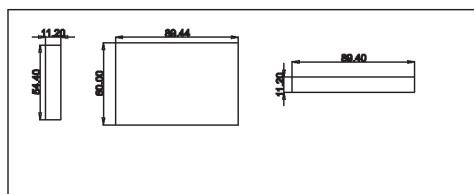
Top Platform 04x



PART F



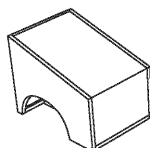
PART G



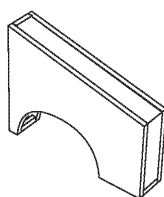
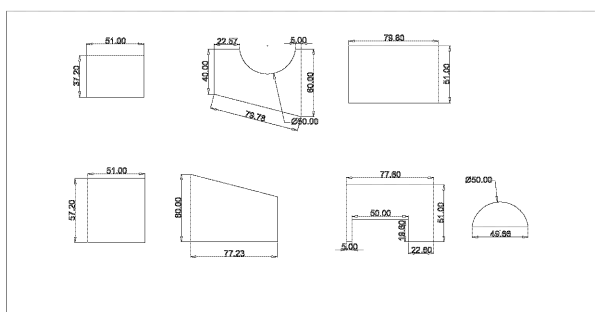
All dimensions are in mm	File Name : Concrete Tool kit	Date :19/10/14	Scale : 1:1
CONCRETE TOOL KIT	Part Name : Bottom Platform 03		
	Material : transparent Acrylic 3mm	Version : 01	Pg No: 01

Concrete Tool Kit

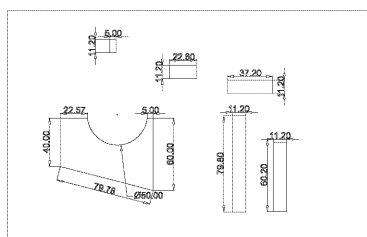
Bottom Platform 04



PART H



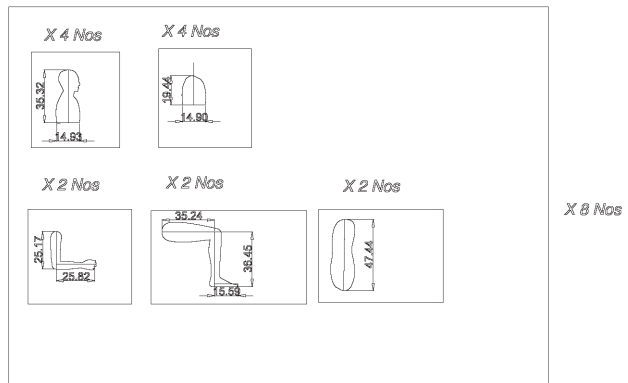
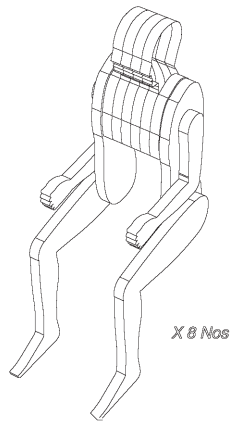
PART H



All dimensions are in mm	File Name : Concrete Tool kit	Date :19/10/14	Scale : 1:1
CONCRETE TOOL KIT	Part Name : Bottom Platform 04		
	Material : transparent Acrylic 3mm	Version : 01	Pg No: 01

Concrete Tool Kit

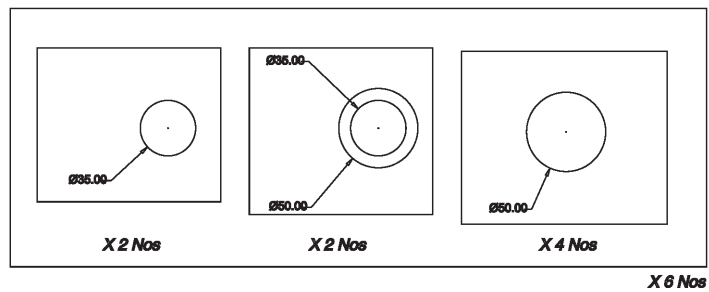
Passenger Model



All dimensions are in mm	File Name : Concrete Tool kit	Date :19/10/14	Scale : 1:1
CONCRETE TOOL KIT	Part Name : Passenger Model		
	Material : transparent Acrylic 3mm	Version : 01	Pg No: 01

Concrete Tool Kit

Wheels



All dimensions are in mm	File Name : Concrete Tool kit	Date :19/10/14	Scale : 1:1
CONCRETE TOOL KIT	Part Name : Wheels		
	Material : transparent Acrylic 3mm	Version : 01	Pg No: 01

APPENDIX 5: VIDEOS OF PARTICIPATORY ACTIVITY

Videos are in CD in following folders.

- 1) Abstract: CD/Folder name (Concrete)
- 2) Concrete: CD/Folder name (Abstract)
- 3) Concrete- Abstract: CD/Folder name (Concrete-abstract)
- 4) Abstract- Concrete: CD/Folder name (Abstract-concrete)



APPENDIX 6: PICTURES FOR TIME LAPSE VIDEO

Pictures taken at 15-second intervals for time-lapse video



Concrete Participatory Toolkit

CONCEPT 1

Two Wheeler, Four Seater, Long Vehicle, Small Luggage



00.15



00.30



00.45



01.00



01.15



01.30



01.45



02.00



02.15



02.30



02.45



03.00

CONCEPT 2

Three Wheeler, Two Seater, Compact Vehicle, Large Luggage space



03.15



03.30



03.45



04.00



04.15



04.30



04.45



05.00



05.15

CONCEPT 3
Four Wheeler, Front Covered, Rear Open Seating/ Luggage



05.30



05.45



06.00



06.15



06.30



06.45



07.00



07.15



07.30



07.45



08.00



08.15



08.30



08.45



09.00

CONCEPT 4
Four Wheeler, Six(Open) + Two(Closed), Flexible Luggage



09.15



09.30



09.45



10.00



10.15



10.30

CONCEPT 5
Four Seater, Compact Vehicle, Two(Closed) + Two(Open)



10.45



11.00



11.15



11.30



11.45



12.00



12.15



12.30



12.45

CONCEPT 6
Four Seater, Eight Seater, Flexible for Opening/ Closing, Face to Face Seating



13.00



13.15



13.30



13.45



14.00



14.15



14.30



14.45



15.00



15.15



15.30



15.45



16.00



16.15



16.30



16.45



17.00



17.15



17.30



17.45



18.00



18.15



18.30



18.45



19.00



19.15



19.30

CONCEPT 7 Six Wheeler, Very Long Vehicle for Family Use, In-Tandem Seating



19.45



20.00



20.15



20.30



20.45



21.00



21.15



22.30



22.45



23.00



23.15



23.30



23.45



24.00



24.15



24.30



17.00



17.15



17.30



17.45



18.00



18.15



18.30



18.45



19.00



19.15



19.30

Participatory Prototyping 2
Abstract Participatory Toolkit

CONCEPT 1

Two Wheeled High and Compact Module, Possibility of Joining two sideways



00.15



00.30



00.45



01.00



01.15



01.30



01.45



02.00



02.15

CONCEPT 2

Very Compact Three Wheeled Vehicle



02.30



02.45



03.00



03.15



03.30



03.45



04.00



04.15



04.30



04.45



05.00



05.15



05.30



05.45



06.00



06.15



06.30



06.45



07.00



07.15



07.30



07.45



08.00



08.15



08.30



08.45



09.00



09.15



09.30



09.45



10.00



10.15



10.30



10.45



11.00



11.15

CONCEPT 3

Single Wheeled High and Compact Module, Possibility of Joining two sideways



11.30



11.45



12.00



12.15



12.30



12.45



13.00



13.15



13.30



13.45



14.00



14.15



14.30



14.45



15.00



15.15



15.30



15.45



16.00



16.15



16.30



16.45



17.00



17.15



17.30



17.45



18.00



18.15

CONCEPT 4
Four Wheeled, Two Seater, One Bed for Longer Distances



18.30



18.45



19.00



19.15



19.30



19.45



20.00



20.15



20.30



20.45



21.00



21.15



22.30



22.45



23.00



23.15



23.30

CONCEPT 5
Four Wheeler, Compact and High Four Seater Vehicle



23.45



24.00



24.15



24.30



24.45



25.00



25.15



25.30



25.45



26.00



26.15



26.30

CONCEPT 6
Four Wheeler, Compact and High Four Wheeler



26.45



27.00



27.15



27.30



27.45



28.00



28.15



28.30



28.45



29.00



29.15



29.30



29.45



30.00



30.15



30.30



30.45



31.00



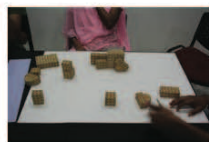
31.15



31.30



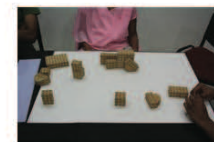
31.45



32.00



32.15



32.30



32.45



33.00



34.15



34.30



34.45



35.00



35.15



35.30



35.45



36.00



36.15



36.30



36.45



37.00



37.15



37.30



37.45



38.00



38.15



38.30



38.45



39.00



39.15



39.30



39.45



40.00

Participatory Prototyping 3
Concrete-Abstract Participatory Toolkit

CONCEPT 1

Two Wheeler, Two Seater(Different Levels), Compact Vehicle



00.15



00.30



00.45



01.00



01.15



01.30



01.45



02.00



02.15



02.30



02.45



03.00



03.15



03.30



03.45



04.00



04.15



04.30



04.45



05.00



05.15



05.30



05.45



06.00



06.15



06.30



06.45



07.00



07.15



07.30



07.45



08.00



08.15



08.30



08.45



09.00

CONCEPT 2

Four Wheeler, Two Seater, Enclosed Bi- directional Vehicle



09.15



09.30



09.45



10.00



10.15



10.30



10.45



11.00



11.15



11.30



11.45



12.00



12.15



12.30



12.45

CONCEPT 3

Three/ Four Wheeler with Spring Bound Cab for Protecting against Accidents



13.00



13.15



13.30



13.45



14.00



14.15



14.30



14.45



15.00



15.15



15.30



15.45



16.00



16.15



16.30



16.45



17.00



17.15



17.30



17.45



18.00

CONCEPT 4
Four Wheeler, Two Seater, Very Large Luggage Space



18.15



18.30



18.45



19.00



19.15



19.30



19.45



20.00



20.15



20.30



20.45



21.00



21.15



22.30

Participatory Prototyping 4
Abstract-Concrete Hybrid Toolkit

CONCEPT 1

Three Wheeler, Four Seater(2 in-tendem, 2 sideways), Wide Rear Luggage



00.15



00.30



00.45



01.00



01.15



01.30



01.45



02.00



02.15



02.30



02.45



03.00



03.15



03.30



03.45



04.00



04.15



04.30



04.45



05.00



05.15



05.30



05.45



06.00



06.15



06.30



06.45

CONCEPT 2
Three Wheeler, Two Seater, Very Large Luggage Space



07.00



07.15



07.30



07.45



08.00



08.15



08.30



08.45



09.00



09.15



09.30



09.45



10.00



10.15



10.30



10.45



11.00



11.15



11.30



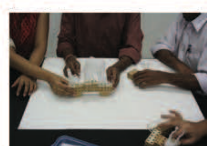
11.45



12.00



12.15



12.30



12.45

CONCEPT 3

Wide Two Wheeled (Segway-Type), Two Seater With Middle luggage space



13.00



13.15



13.30

CONCEPT 4

Four Wheeled, Four seater(Back to Back Seating), Large Luggage Space



13.45



14.00



14.15



14.30



14.45



15.00



15.15



15.30



15.45



16.00



16.15



16.30



16.45



17.00



17.15

CONCEPT 5

Four Wheeled, Four seater, Compact, Large Luggage Space



17.30



17.45



18.00



18.15



18.30



18.45



19.00



19.15



19.30

CONCEPT 6
Compact Width, Four Seater Vehicle



19.45



20.00



20.15



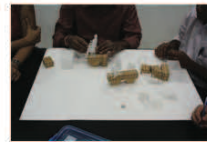
20.30



20.45



21.00



21.15



22.30



22.45



23.00



23.15



23.30



23.45



24.00



24.15



24.30



24.45



25.00

CONCEPT 7

Three Wheeler, Two Wheels in Front, Luggage Modules can be Separated



25.15



25.30



25.45



26.00



26.15



26.30



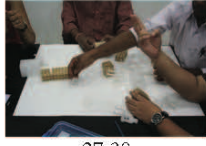
26.45



27.00



27.15



27.30



27.45



28.00



28.15



28.30



28.45



29.00



29.15



29.30



29.45



30.00



30.15



30.30



30.45



31.00



31.15



31.30



31.45

CONCEPT 8
Three Wheeler, Single Seater, Large Luggage Space



32.00



32.15



32.30



32.45



33.00



34.15



34.30



34.45



35.00



35.15



35.30

APPENDIX 7A: TRANSCRIPTION: PD WITH CONCRETE TOOLKIT

1	Mohan	<i>dono use kar sakta hai</i> both can use it
2	Devekar	vehicle is lengthy
3	Mohan	see, in rickshaws, two people can sit easily
4	Devekar	four people should sit
5	Ruchin	four cannot sit
6	Mohan	but is it possible that 3 people can sit?
7	Devekar	<i>abhi to baith te hai, teen baith te hain, chaar baithe ge, aur kya hai?</i> now let's seat three, four here, what more do we want
8	Ruchin	<i>3 aaram se baithege</i> 3 can easily fit here
9	Mohan	this should have rear portion
10	Mohan	this already has na, see see...so why don't you use one more
11	Devekar	this ...this...
12	Mohan	<i>ye theek hai</i> this is fine
13	Nancy	<i>ye theek hai</i> this is fine
14	Devekar	<i>isko bhi peeche chahiye thoda</i> this also needs something at the back
15	Ruchin	<i>yeh?</i> this?
16	Devekar	<i>haan...nahin</i> ok... no
17	Mohan	<i>who chota wala chahiye</i> we need that small one
18	Ruchin	<i>nahin wo chota waala chahiye</i> no we need that small one
19	Devekar	same...same like front
20	Mohan	<i>nahin...nahin, hai nahin, itna bada nahin ayega, kyunki ek aur bhi hai</i> no no not this big...there's another one
21	Mohan	<i>nahin</i> no
22	Devekar	<i>chalega</i> that'll work
23	Mohan	ok...this our concept
24	Devekar	but four will sit here
25	Ruchin	if we have this, then four will sit here
26	Mohan	yeah
27	Ruchin	this can come here...
28	Mohan	yeah
29	Ruchin	but then, his legs are going into the wheel
30	Mohan	yes
31	Devekar	but gap is there in between
32	Ruchin	but they have to sit comfortably

33	Mohan	<i>comfortably! Na</i> comfortably! Isn't it?
34	Nancy	here..
35	Mohan	they cannot sit here...
36	Nancy	three can sit comfortably
37	Devekar	see...it will be steering here..
38	Ruchin	<i>yahan par luggage</i> here the luggage goes
39	Mohan	keep some small luggage here
40	Devekar	<i>who to abhi bhi hai</i> this now right
41	Devekar	<i>abhi 2 wheeler hai par chaar log baith jaate usme..</i> now it's a two wheeler but 4 people sit on it..
42	Mohan	<i>ye theek hai....iske baad four wheeler banayenge</i> this is good, let do a 4 wheeler after this
43	Ruchin	haan...
44	Ruchin	<i>achcha theek hai</i> ok right...
45	Mohan	see, small one is there...
46	Ruchin	what is it like, what people should travel, 2/3 wheeler
47	Mohan	only...only..three
48	Nancy	two
49	Ruchin	this will not work...ok ...we will start
50	Devekar	four should go in that
51	Mohan	we will try for 3 na
52	Ruchin	<i>ok then we will...chalo theek hai..ye aisa...yeh aisa</i> ok then we will. ok that's right . this is like this, that is..
53	Mohan	<i>chota wala...yeh dekh</i> small one... see here
54	Ruchin	<i>ye ye...</i> this one
55	Mohan	nahin no
56	Ruchin	<i>this one is i think here...nahin...yeh aisa hai...who aage</i> this one is i think here... no. this is like this .. that one in front
57	Mohan	<i>yeh aisa</i> this, like this
58	Ruchin	we need one of this...
59	Mohan	what about this?
60	Ruchin	this one?...no! ..this we can fit here.
61	Mohan	keep in it something na...!yes
62	Ruchin	<i>wo aisa chahiye usko</i> she needs it like this
63	Nishant	<i>4 banana hai ki 3 banana hai...?</i> you want to make 4 or 3
64	Ruchin	3 wheeler
65	Nishant	<i>haan!</i> Yes

66	Ruchin	<i>haan! yeh wala!</i> Yes! This one!
67	Mohan	<i>yes...ok!/? you can keep something. baithne do na</i> yes ... ok!/? you can keep something .let them sit
68	Nancy	<i>baithne do na!</i> let these sit!
69	Ruchin	let me put in this...
70	Nancy	seats
71	Mohan	<i>seat hai na...one more seat is there na that side</i> there is seat... one more is there...it is on that side
72	Devekar	here also, actually, two people can sit
73	Mohan	no...no...they will be uncomfortable
74	Ruchin	<i>wahan pe engine hai</i> there is the engine
75	Devekar	<i>driver will be here....centre pe baithta hai...theek hai..but we can have it here na</i> the driver will sit in the center..ok . but we can have it here
76	Nancy	<i>congested ho jayega</i> it might get congested
77	Mohan	<i>congested hoga</i> it will be congested
78	Devekar	<i>congested nahi....yeah agar square type hai...</i> not congested... yeah if it is square type
79	Mohan	<i>yeh to ho gaya na...doosra bana sakte hain.</i> this is done. lets do another
80	Ruchin	<i>ye open vehicle hain...</i> this is an open vehicle
81	Mohan	<i>two seater hai....abhi close kar sakte hain...dppsra kidhar hai...?bas..close ho gaya...ok..?</i> it's a two seater which we can close(searches for the second piece and closes the model)
82	Ruchin	luggage?
83	Mohan	why don't you keep something here...small luggage.
84	Devekar	but here is a space in front
85	Mohan	<i>front always, you cannot keep anything, idhar kuch nahi kar sakta</i> always front, you cannot keep anything here.. nothing more can be done about it
86	Devekar	actually engine to neeche hota hai....driver ke actually isn't the engine below the rider
87	Ruchin	<i>car mein kahan?</i> where in car?
88	Devekar	no, its not a car...
89	Ruchin	rickshaw..?
90	Devekar	3 wheeler hai na..
91	Mohan	then what you can do, you can make jeep after this..same with four...
92	Devekar	yes
93	Mohan	something that side na?
94	Ruchin	yeah...that boxes
95	Mohan	nahin ...nahin no no
96	Ruchin	this box
97	Mohan	yeah.

98	Nancy	this cover..?
99	Mohan	this..
100	Devekar	<i>actually, gap hai udhar..</i> actually there's a gap
101	Mohan	<i>only problem is...in 2 wheeler itna...</i> only problem is that in two wheelers....
102	Ruchin	<i>yeh 3 wheeler hai</i> this is three wheeler
103	Mohan	<i>3 wheeler...na</i> 3 wheeler... it is
104	Nancy	3 wheeler
105	Mohan	<i>aur lengthy ho jayega na...idhar kitna ja raha hai?</i> this will geth lengthy ... how much is going over here
106	Ruchin	<i>actually...who ek empty box hoga.</i> actually that would be an empty box
107	Mohan	to idhar bhi baith sakte haina..no...ismein bhi baith sakte haina... so people can sit in both of the boxes
108	Nancy	<i>aur ek</i> one more
109	Devekar	<i>aur ek hai.</i> there's one more
110	Mohan	<i>bas!</i> enough
111	Ruchin	<i>abhi isko..</i> now for this
112	Mohan	<i>abhi isko close kar denge.</i> now let's close this
113	Ruchin	<i>haan</i> yes
114	Mohan	<i>aisa kar denge...</i> let's do it this way
115	Ruchin	<i>yeha chcha hai...par yeh car nahi hai..</i> this is good .. but this isnt a car
116	Mohan	<i>yeh ek long vehicle banta hai na...</i> but this will become a long vehicle
117	Ruchin	<i>yeha actually aisa chahiye..</i> here actually you need it like this
118	Devekar	<i>actually yeh bhi upar chahiye..</i> this also actually should be above
119	Ruchin	nahi...jeep..gypsy no...jeep(as a brand) ... gypsy (as car by maruti suzuki)
120	Mohan	gypsey
121	Nancy	<i>gypsey car hai..</i> this is like gypsy (as a car by maruti suzuki)
122	Mohan	gypsey car mein pooche who open rehta hai
123	Ruchin	<i>yeh bada adventure type vehicle lagta hai..</i> this looks like an adventorous vehicle
124	Mohan	<i>yeh acha hai..bahut badhiya</i>

		this is good. very good
125	Ruchin	<i>aur zyada luggage k liye usko supportk liye...</i> this support for extra luggage
126	Mohan	<i>yeh mahindra mahindra jeep hai...abhi latest jungle m ein jata hai na...</i> <i>ok...ho gaya...abhi chota jeep bhi bana sakta hai.</i> mahindra (car brand) the latest cars can go off roads.. now they can make smaller jeep(brand)
127	Devekar	<i>kaise</i> how?
128	Mohan	<i>idhar...idhar do wheel daalne ka....idhar ek wheel idhar ek wheel</i> here put one of the wheels, and the other here
129	Ruchin	<i>idhar yeh baitha rahe to....actually this can be a luggage vehicle</i> if this sits here then this can actually be a luggage vehicle
130	Mohan	<i>yeh bhi luggage...yeh poora...poora luggage ho sakta hai..</i> this can be complete area could be for luggage
131	Ruchin	like this...
132	Mohan	<i>yeh nikalo na..</i> remove this
133	Devekar	<i>luggage ka hai na...</i> this is for luggage right?
134	Mohan	<i>yeh open luggage...you can close also.</i> this is for open luggage, but can be closed
135	Ruchin	this can be point (?) truck.
136	Mohan	<i>close kar sakta hai....nahin..? iske level ka nahi kya?</i> we can close it right? is this of this level?
137	Ruchin	<i>woh bada hai...</i> that is bigger
138	Devekar	<i>to aisa kar do..</i> so do it this way
139	Ruchin	<i>yeh better hai.</i> this is better
140	Mohan	<i>peeche bhi admi ko baitha sakta hai..</i> we can bget people to sit behind
141	Mohan	<i>wo baith nahi sakta hai</i> he can't sit
142	Ruchin	<i>usko baithayege</i> tell him
143	Mohan	<i>baithao na....kidhar kidhar bitha sakte hai...</i> <i>abhi kanpur mein jayega to kidhar bhi baithayega</i> come on tell, where all we can sit? kanpur- place in maharashtra
144	Mohan	correct?
145	Devekar	<i>top mein acha nahi lagta hai...</i> top side doesn't feel nice
146	Mohan	<i>nahi...yeh to game hai....yeh game hai...it is a game...</i> this is the game . how many people can you accommodate
147	Devekar	<i>fevicol ka advertisement yaad aa raha hai..</i>

		i remember fevicol advertisement
148	Mohan	<i>adjust na..</i> adjusted. It is.
149	Ruchin	<i>comfortably 8 can...9 can sit aise...ekdam train jaisa nahi karna hai.</i> comfortably 8 can.. 9 can sit like this ... i don't want to make it more like a train
150	Devekar	two are here
151	Mohan	<i>already hai...abhi kaun sa hai?</i> already exists... which one is it now?
152	Ruchin	<i>yeh 4 wheeler ho gaya</i> this 4 w is done
153	Mohan	<i>4w jeep ho gaya...</i> this is a like 4w jeep(brand)
154	Mohan	<i>car jaisa hona chahiye..</i> it should look like a car
155	Devekar	<i>wo already hai..</i> that it already is
156	Ruchin	<i>pehle usne wohi banaya..</i> firstly he has done that
157	Mohan	<i>who shoot nahi hua...</i> that didn't shoot
158	Mohan	<i>yeh chota nahi hai....aisa hum ko design karke dekhenge.</i> this isnt false.. they'll try to design for us
159	Devekar	<i>gap aa raha hai na...</i> gap is occuring here
160	Mohan	<i>gap aa raha hai na..</i> gap is occuring here
161	Ruchin	<i>nahin... wo nahi kar sakte.</i> no ... we cannot do that
162	Mohan	<i>nahin yeh nahi hai...because tyre is coming....yeh nahi hona chahiye..</i> no this isnt the one, tyre is coming .. this cannot be done
163	Ruchin	<i>nahin kar sakte..</i> no we cannot do this
164	Devekar	<i>aur ek hai na...who haina...</i> we have one more.. there it is
165	Nancy	<i>yeh beech mein rakh sakte hain...</i> we can keep this in between
166	Ruchin	just for...because we don't have anything here..
167	Devekar	<i>ho gaya..?</i> are you done
168	Mohan	<i>haan!...aise aayega...</i> yeah, it will come like this
169	Ruchin	<i>kyunki yeh...aisa aayega...lamba nahi aayega</i> because, it will come like this, it wont come long
170	Devekar	not like this..
171	Ruchin	<i>yeh kaisa aayega...actually aise bhi kar sakte hain..</i> how will this come? actually we can do it this way too
172	Mohan	<i>aise...ye..</i> like this...

173	Ruchin	<i>nahin...nahin...barabar hai...yeh aisa barabar hai...yeh hi barabar hai</i> no no this is right .
174	Ruchin	<i>yeh chahiye..</i> this is needed
175	Mohan	<i>yeh nahin...</i> not this
176	Ruchin	<i>nahin...yeh hai na...ye barabar hai</i> no, this one right here, this one is right
177	Devekar	fill this gap.
178	Ruchin	<i>nahin wo beech mein aayega..</i> no that will come in between
179	Mohan	<i>beech mein daal ke bhi...space you can make..</i> you can do it making space in between
180	Ruchin	<i>ok..yeh ho gaya...abhi..? baithana hai...</i> ok this is done, more two have be placed
181	Devekar	<i>fir se yeh two seater ho gaya,....</i> this again has turned out to be a two wheeler
182	Mohan	<i>2 seater hi bana sakta hai</i> we can make it two seater
183	Ruchin	nano...2 seater hai.. nano (car from Tata company) is a two seater
184	Devekar	it's not like this..itna bada hai...is show(?) ki hisaab se bahut... it's not like" this is this big and its just for show ...and out of proportions
185	Mohan	<i>nahin...wahan seat nahin hai.</i> no .., theres no seat there
186	Ruchin	<i>haan...wahan seat daalna hai...</i> yeah, we need to put a seat there
187	Ruchin	<i>isko bitha o na...</i> seat this thing
188	Nishant	this is family or what?
189	Ruchin	can be a public vehicle...
190	Devekar	<i>to...kyunki humko jo chahiye access chahiye...we are not getting that..</i> so what access we need we arent getting it
191	Mohan	<i>for eg. front jyada hona hi chahiye</i> for eg. front has to be big
192	Devekar	we are getting less space...as per ratio, the blocks are not fulfilling the requirement
193	Mohan	<i>who kehna chahiye...ki yeh bhi itna lamba chahiye</i> he should even tell how long he wants
194	Devekar	<i>for eg. this block...if i keep this ulta...it was supposed to be like this and this</i> <i>curve here, it would have come here....and yahan par bhi do admi baith sakte hain...</i> for eg. this block... if I keep it opposite... it was supposed to be like this and this curve here, it would have come here.... and here we can make two people sit.
195	Devekar	<i>actually upar baithaane se ye problem solve nahi hota hai...</i> <i>it is creating more problems, accidents ka problem ...it should not be like this..</i> actually making people sit on the top doesn't solve the problem... in fact, it is adversely increasing the problems of accidents
196	Nishant	<i>to agar accidents ka problem solve hota hai...to upar....</i> <i>cover kiya jaata hai...to...then it is fine kya..?</i>

		so to solve the problem of accidents, we can cover it...it that ok?
197	Devekar	yeah...it should be ok
198	Mohan	nahin...upar uthake aap cover kaise kar sakte hain... how can you just a put a cover and be done with it
199	Devekar	you can make small vehicle...two storeys...is it?
200	Mohan	aisa wala hai na..? like these ones right?
201	Ruchin	<i>yeh hai.</i> yeah this one
202	Mohan	<i>yeh</i> this one
203	Ruchin	<i>iske beech mein ja sakta hai</i> this can go in between
204	Mohan	<i>aisa.?</i> like this?
205	Ruchin	<i>aisa?</i> like this?
206	Mohan	<i>aisa?</i> like this?
207	Nishant	<i>but apka group kya bolta hai? zyada log travel karne chahiye?</i> so what do you think? Should many people travel together?
208	Nancy	zyada more
209	Nishant	family
210	Devekar	<i>what i find...once i travelled in this veh. wagon r...bahut chota space hai... comfortable nahi hai...bcause of packing and material...i prefer it should be less</i> what I find...once I travelled in this vehicle wagon r (car brand)... it has narrow interior space... it is not comfortable...because of packing and material.. I prefer it should be less
211	Nishant	ok
212	Devekar	<i>spongy hai...yeh hai...woh hai...it should be less</i> is it spongy ? it should be less
213	Nancy	<i>yeh beech mein daal sakte hai na..</i> this can go in between
214	Nishant	<i>zyada width mil jaye aapko</i> you might get more space
215	Devekar	<i>haan!</i> yeah!
216	Mohan	so you can carry...
217	Nancy	good vehicle
218	Mohan	goods vehicle..
219	Mohan	<i>saaman leke jaane k liye..</i> for taking the goods
220	Mohan	see every day you are goinng with your family, suppose you want to carry something, consumable...to thus, then you can make...
221	Ruchin	<i>to jayda..</i> so more
222	Mohan	<i>samaan leke ja sakte hain na..</i>

		we can take luggage
223	Ruchin	<i>yeh bhi daal sakte hain..</i>
		we can put this one also
224	Mohan	<i>beech mein...jagah hai na..</i>
		there is space here right
225	Ruchin	<i>aur ek!</i>
		one more!
226	Ruchin	<i>aur baitha do..</i>
		make sit more...
227	Mohan	bithayenge ya samaan....samaan hai kya aapke paas?
		sitting or goods....do you have more goods?
228	Ruchin	<i>samaan..</i>
		goods
229	Mohan	<i>rakho na...</i>
		keep it there
230	Mohan	<i>nahin yeh nahi aayega...</i>
		no this won't come
231	Ruchin	<i>who aage baith....drive kar rahe...</i>
		let him sit there, he is the driver
232	Nishant	<i>yeh samaan hai na aapka?</i>
		this goods is yours?
233	Nancy	<i>peeche...peeche...</i>
		back ...back..
234	Nishant	haan...theek hai..
		ok ... its fine..
235	Mohan	you can sit...
236	Devekar	<i>yeh to pehle kar diya na?</i>
		this was done earlier also right?
237	Mohan	<i>nahin ye nahin....woh alag type ka tha</i>
		no this way, that was different
238	Ruchin	<i>ismein 6 tyres hai?</i>
		in this there are 6 tyres
239	Nishant	<i>aapko kya lagta hai ki samaan k liye bhi flexibility honi chahiye?</i>
		what do you think? there should be flexibility for goods?
240	Mohan	<i>hona chahiye....</i>
		should be there....
241	Nancy	<i>hona chahiye...</i>
		should be there...
242	Mohan	<i>zaroor</i>
		sure
243	Nishant	<i>zyaada samaan ke liye kabhi zyada zaroorat pade to</i>
		if we ever need or extra space for goods
244	Mohan	<i>to kabhi-kabhi ho jaata hai to apna luggage jyada jaayega</i>
		so sometimes it happens then large luggage will go
245	Ruchin	<i>yeh apna samaan ka isko bhi samaan kar sakte hai....aisa chahiye?</i>
		you want this to swappable space for goods?
246	Mohan	<i>ho sakta hai na? normally you are carrying luggage...</i>
		that can be done... normally you are carrying luggage

247	Ruchin	it can be....same vehicle can be used as a family vehicle as well as for luggage also
248	Mohan	<i>dono kar sakte hain...</i> do it for both...
249	Ruchin	so, then in that case this area should be very flexible.
250	Ruchin	<i>idhar to baithega...idhar to driver seat (area) hai...par idhar baithne ke liye bhi chahiye aur luggage ke liye bhi chahiye..</i> this is only for sitting but and this is driver seat ... but here there needs to be space for both luggage and seating
251	Mohan	<i>luggage to already thoda thoda hai...usmein bhi ho sakta hai na....</i> luggage is already there .. and it can be done in this too
252	Devekar	again height of this should be maximum
253	Nishant	<i>height zyada chahiye?</i> you want more height
254	Devekar	<i>height zyada chahiye...</i> need more height
255	Devekar	<i>air circulation ke liye...suffocation nahi hoga...if it is not with ac</i> for air circulation... there wouldn't be suffocation... if it is not with ac (air conditioner)
256	Nishant	to non ac chahiye kya gadi? so do you want non-air conditioned vehicle?
257	Devekar	<i>non ac....ac koi problem nahin hai</i> non ac...ac is not a problem
258	Mohan	ac is always comfortable
259	Devekar	<i>fir bhi...if it is not with ac, i should have that..</i> even then... if it is not with ac, I should have that..
260	Ruchin	supposing we consider this as luggage, to yeh luggage wala ho gaya..
261	Mohan	<i>close kar sakte hai na...</i> we can close it...
262	Ruchin	<i>yeh aise dikhega...</i> this will look like this...
263	Nishant	can you indicate what is luggage in this?
264	Ruchin	this is luggage...when the car is used for luggage ...this is the luggage..
265	Mohan	and suppose if you do not want the luggage, you can remove it and sit.
266	Nancy	sit there
267	Mohan	this is without luggage and people can sit there
268	Ruchin	so, it will be an open car
269	Mohan	<i>ismein do baithao</i> make two sit in this
270	Nancy	seat...seat...
271	Mohan	<i>seat hai?</i> is there any seat
272	Nishant	so this is when people are sitting inside...perfect
273	Devekar	2 people
274	Mohan	so, you can sit comfortable as this is inly design
275	Ruchin	in the lap
276	Devekar	<i>abhi bhi to lap pe baith ta hi hai....in autos 4 people are sitting at the back</i> some people do sit on laps and go like autos, 4 people sit in the back and go
277	Devekar	<i>face to face bhi baitha sakta hai..</i> people can also sit face to face

278	Mohan	yeah, this is comfortable...
279	Devekar	<i>so, we have manage six people...so upto 8 hona chahiye....</i> so, we have managed 6 people... there can be upto 8 people
280	Mohan	<i>so aapko kanpur...udhar jaayengey....to idhar bhi baithta hain....</i> <i>agar aap iit kanpur railway jaaye hai to aapko aise bhi mil jaata hain bahut.</i> so if you go to IIT Kanpur, you get to to see this in Kanpur railway station... if you go there... you will see they sit here also
281	Nishant	<i>yeah...yeah...woh tempo mein...</i> yeah they are in a vehicle (tempo- brand)
282	Mohan	<i>nahin...train mein sir...haan...train mein jo jaate haina who..</i> yeah it's there on train in iit
283	Nishant	<i>doodh wala aata hai jo</i> the train that comes?
284	Mohan	yes
285	Ruchin	<i>yeh ac?</i> this ac?
286	Mohan	<i>yes dono ko safety hai to what these people will do?</i> yes both the people have safety, what these people will do
287	Ruchin	they will have this
288	Nancy	admit the people
289	Devekar	<i>these people are car owners and yeh bahar ka hai...</i> these people are car owners, and these are outsiders
290	Nishant	<i>unko ac...unko non ac</i> for them with a/c .. and for them non-a/c
291	Mohan	<i>yeh logo ka koi value nahi hai....</i> these people don't have value?
292	Mohan	see, they are taking their own risk
293	Devekar	again one more we can add
294	Mohan	<i>nahin...nahin..ye nahin aayega</i> no no theese will not come
295	Ruchin	<i>ye try karen..</i> let's try this
296	Mohan	<i>to bada vehicle hi ho jayega...goods train jaisa...ek cover hona chahiye..</i> then it'll become a big vehicle... just like a goods train
297	Ruchin	<i>to yeh aise karenge....apnarickshaw type....ho jayega</i> then we will do this like this.. it'll be a autorickshaw type
298	Mohan	<i>we should cover with something here...aisa cover hona chahiye..</i> we should cover with something here... some cover like this
299	Ruchin	<i>fir ye ayega...who beech mein khada (?) nahin hoyega....</i> then this will come .. he will be standing in the middle?
300	Mohan	<i>bahut open ho gaya....same ho gaya na....last time jaisa ho gaya...</i> its opened too much... it is the same just like last time
301	Devekar	<i>gap to nahin aana hai na..</i> there shouldn't be any gap
302	Mohan	<i>fir bhi aise ho gaya....same ho gaya....same hi ho gaya...pehle haise lamba ho gaya....</i> <i>woh sab correct hai</i> its come out just like before...long like before... same it is ... all that is correct
303	Ruchin	<i>lamba....par?</i>

		but long?
304	Ruchin	<i>par yeh family vehicle nahin rahega</i> but this wont family be vehicle
305	Mohan	<i>nahin aayega..aayega?</i> will not come?
306	Ruchin	this is little difficult
307	Nishant	see, if you feel that this kit is not allowing you to make the vehicle you want to make, you can just organize and you can just tell us what you wanted to do....
308	Ruchin	aise...ye.. like this...
309	Nishant	haan...you can just keep it there...
310	Mohan	here last two...yahan bhi...bada ja raha hai...you cant keep there...these area all.. here last two...here also...big is going here... you cant keep there...these area all..
311	Ruchin	it is a little weird
312	Devekar	yeh ulta ho raha hai...it should be like this this is opposite it should be like this
313	Ruchin	<i>sir, yeh idhar hoga</i> sir., this will be here
314	Mohan	<i>nahin...nahin</i> no...no
315	Ruchin	<i>yeh idhar aayega...yeh kidhar jayega...</i> where will this come...
316	Ruchin	<i>aise hoga actually</i> this will be like this
317	Mohan	<i>aur beech mein hai na</i> and in between like this
318	Mohan	<i>nahi...chota hai...</i> no that is small...
320	Ruchin	actually we have used we have used this space...
321	Mohan	<i>iska bada hai na udhar...</i> there is bigger version of this...
322	Nancy	yeh ismein hai.. this is in this...
323	Devekar	this is there..
324	Nishant	so, this is the longish vehicle you want..
325	Devekar	but how to cover this?
326	Nishant	that's ok...if you are not able to cover, no problems
327	Ruchin	just an indicator
328	Nishant	yeah...
329	Nishant	you can just place itlike this...yeah...that should be fine..
330	Devekar	how to keep this..?
331	Mohan	<i>bas...bas...</i> that's it... that's it...
332	Mohan	<i>nahi aayega..</i>
333	Nishant	so?...so what is the idea? it is a single seater is it?
334	Ruchin	no..no..its actually..more people can sit in line and may be you can have somemore, it is more like a public transport.
335	Nishant	they sit in tandem..

336	Devekar	see, it will have balancing problem
337	Ruchin	no...no...we are assuming that it is balanced
338	Devekar	but this block should...
339	Mohan	this is just temporary...
340	Nishant	do you all agree with this kind of concept?
341	Mohan	yeah...it is ok
342	Nishant	this should help as you see that width of road is too narrow and probably can..
342	Mohan	yes
343	Mohan	see, heavy vehicle...there are many heavy vehicles... only problem is turning the vehicle from one side to another... if you are going straight..i do not think there is any problem.
344	Devekar	turning will create problem
345	Mohan	turning is the only problem you see,,
346	Devekar	we should have big turning otherwise it can not..
347	Mohan	there are many vehicles
348	Ruchin	<i>limousine wagherah bhi bahut lambi hoti hai but they turn... they manage...you cannot manage ek dum lanes mein but... limousines kind of vehicles is too long but they turn... they manage... you cannot manage them in proper lane but...</i>
349	Mohan	<i>big vehicles...turn...ho jata hai...</i> big vehicle... turn... fine
350	Ruchin	i think a lego set will help...because it is very flexible... so different sizes of tyres different parts

APPENDIX 7B: TRANSCRIPTION: PD WITH ABSTRACT TOOLKIT

1	Anupama	<i>we should not feel ke jo direction me chahiye.... vo direction mein jaye.... if you want to go here.... edhar handle dabakar you can go there.... to uske baad wapis aana chahiye we shouldn't feel that it goes in any direction it wants. there is a handle which can be controlled to go in any direction and come back</i>
2	Ashish	<i>achacha idea hai that's a good idea</i>
3	Anupama	<i>because naye logon ke liye thodaspecialized new cars for new users because for new people specialised new cars for new users</i>
4	Ashish	<i>apko abhi ke cars mein kya aaisa lagta hai.... ke yeh nahi aata ...vo nahi aata what do you think is absent in the cars now a days</i>
5	Ashish	<i>aapko aisa darwaza khol kar darwaza kholke seat par beetha diya ... to kya kya aap dekhoge usme if you are made to sit a car would you look at it?</i>
6	Ashish	<i>to wahi na aisa bol rahe hai ...left mein kiya to left mein ghoom jaye... aisa kiya to right mein ghoom jayega so that's what i am trying to say, if we turn it to left, it goes left and vice a versa</i>
7	Anupama	<i>brake hai...some buttons, computer mein jaise hai...buttons hai brake is present. some buttons just like in a computer</i>
8	Rajan	<i>without gears...</i>
9	Anupama	<i>aisa sub button pe hoona chahiye everything should be controlled by buttons</i>
10	Rajan	<i>hai na aaj kal automatic yeah there are few offerings in automatic</i>
11	Yatin	<i>mein to soch raha hun aisa hona chahiye i was thinking it should be this way</i>
12	Anupama	<i>naye logon ke liye aisa hona chahiye.. jisko confidence nahi ke hum itna handle kar sakte hai... it should be present for newer people who have lower confidence, who think that they cannot handle it</i>
13	Sudeep	<i>matlab controls aise skills par nahi hone chahiye... meaning, the controls shouldn't matter on skills?</i>
14	Anupama	<i>we should not be afraid...</i>
15	Sudeep	<i>matlab driver ke skills par rehna hai ki...yeh acha driver yeh bura driver.. so that means it's all dependant on drivers skills, whether they are a good or a bad driver</i>
16	Anupama	<i>hum logon ko lagna chahiye ke hum log kar sakte hai...aisa nahi ke in the middle of way we people should feel that we can do it.. it's not like in the middle of the way....</i>
17	Yatin	<i>yeh fayda karega kya..aise chaar aur jod diye jaye will this be beneficial if we join these four</i>
18	Anupama	<i>aisa koi slow medium fast button.. if we press slow, automatic fast...middle ...fast... aisa just press buttons...so that apne ko problem nahin hai there should be some button controls such as - slow, medium, fast... so that it won't be that difficult</i>
19	Yatin	<i>isme aisa nikal jayega this will come off like this</i>

20	Rajan	<i>who to nikal jayeega definitely...</i> that will come off definitely
21	Yatin	<i>maybe agar dono rahenge to dono atak kar denge</i> maybe if both of them were present they would be stuck together
22	Toussef	<i>us lane mein... gaadi ki speed girne ..suppose sab gaadi 80 ki speed se ja rahi hain</i> <i>aur tum 60 se ja rahi haintoh kuch announcement ya indication hona chahiye...</i> <i>tum left mein aa jao</i> so if you are going at the speed 60 and a passerby comes at 80 then there should be some indication for us to move
23	Anupama	<i>scale ka nahin ...jaisa tum logon ka mixer mein rehte hai na...</i> <i>wise buttons....wohi speed mein jayega na...there has to be ..we we don't know...</i> <i>driving a new corner, they will not come to know kitna speed hai...</i> <i>mixer mein 1,2,3,4,5, ..ya fan mein...1,2,3,4,5,..</i> <i>who button press karega to gaadi age jaane chahiye..aisa kuch hona chahiye</i> the car should have preset speeds just like in a ceiling fan or mixer . you just have to press the buttons and it will go. this will be helpful when you are cornering some turn for the first time, you don't know how the curve is, so you set the speed and the car will go automatically
24	Ashish	<i>fir aapko 5 hi speed milenge usme</i> then you will get only 5 speeds in that
25	Anupama	<i>tum log kuch ...ye thodi fix. i am just giving you example</i> <i>i am not giving you...just giving you an example... ki aisa kuch speed ka buttons banao</i> i am just trying to give one example of a scenario.. that such button systems can be made
26	Anupama	<i>slow ...to medium fast high... aisa kuch ...to</i> from slow to medium to fast. something like that
27	Anupama	<i>agar slow press kiya to slow jayenge ...</i> <i>apko sochne ka zaroorat bahin hain ki kya speed kya hai</i> you just have to press one buttons and it will go accordingly. you don't have to worry about the speed
28	Toussef	<i>hey...usme aisa daalne ka na ...market ride ...high ride..</i> hey there should be modes like - market rides, highway rides
29	Anupama	<i>we can take an example of fan and mixer..abhi hum housewives...</i> <i>ghar ka kaam kate hain to wohi speed mein masala banake hain na...</i> <i>abhi zyada soft chahiye to jyada speed..thoda medium chahiye to medium....</i> <i>to buttons ho to new logon ko problem nai honi chahiye.. ye mein mereliye bol rahi hun</i> (gives example of housewife working with mixer) and states that it won't be a problem for new users to adjust to speed buttons
30	Tousse	<i>factually muze bhi driving nahi aati....to</i> actually even i do not know to drive
31	Toussef	<i>gaadi powerful honi chahiye ..tho ke bhi chalni chahiye</i> the vehicle should be powerful, it should run even after meeting with an accident
32	Ashish	<i>sab safety bol rahe hain</i> is everyone talking about safety?
33	Rajan	<i>air bags aaya to....crash karga to... kabhi experience kiya kunki....</i> with the advent air bags, during accidents they inflate up..... have you ever experienced it?
34	Ashish	<i>air bags ke saath bhi etne accidents hote hain... lekin bachte bhi utnehi log hai....</i> <i>woh hai...</i> there are so many people who meet with an accident even with an airbag,

		but he rate of survival has also increased
35	Sudeep	<i>air bags mein bhi kabhi kabhi suffocation hota hai</i> air bags also might cause suffocation sometimes
36	Toussef	<i>accidents ...matlab...thokenge to sahi par tab tak air bags se bach jayenge....</i> even if someone meets with an accident, they will be saved by the airbags
37	Sudeep	it's like a ballon which is pressing around your face
38	Yatin	<i>mein aisa soch raha hun ki ye ek rahega individual...</i> <i>yeh yeh ek aur rahega ..aur agar tumhe ye join karna hai...</i> <i>you can just family ke liyeconnecter ..se connect kar diya ...</i> <i>yeh join hoke ...join ho gaya.....to familykki family ja sakti hai</i> so what i was thinking was that this is an individual unit and if you want to go for an family outing, you can connect individual units to make a family vehicle
39	Toussef	<i>yeh abhi bhi seedha nahi khada reh raha</i> this isnt standingup straight
40	Rajan	<i>abhi mera isme....</i> now my turn
41	Toussef	<i>yeh done haath pakd hue hai kya....</i> are you holding it with both hands?
42	Rajan	<i>double dekkar sa bhi kar sakta hai na... some steps ...you can go up ...</i> you can do it somewhat like a double decker bus. few steps that leap upstairs
43	Anupama	<i>wohi bola na ...sone ke liye...that is for long drive</i> that's what i have been saying. ..to sleep during long drives
44	Toussef	<i>ek car uske peeche extra tractor ya trailer type</i> one car which can carry a trailer and tractor type
45	Ashish	<i>banaa do toussef</i> get it done toussef
46	Ashish	<i>usme to kitne bhi log so sakte hai.....aata hai na bada gaadi....</i> <i>jisme saamaan wamman ate hain</i> numerous people can sleep in this, just like the goods carrier
47	Toussef	<i>machchli pakadne wali... badi badi machchli wali.....</i> trucks that carry fishes . just like that
48	Yatin	<i>kis liye bana raha hai ye</i> for whom are you trying to make this for?
49	Ashish	<i>trailer bana raha hai ye?</i> are you making a trailer?
50	Yatin	<i>cargo ke liye..</i> for a cargo
51	Toussef	<i>zyaada... lamba</i> too... lengthy..
52	Yatin	<i>nahin waise mat nikaal ...</i> no don't take it off like that
53	Toussef	<i>gaadi mein stepniee bhi hona chahiye...</i> there has to be a spare tyre too
54	Yatin	<i>paanch wheel ka bana raha hai na...steppnie bhi use ho jayegi....</i> let's make it a 5 wheeler . that means it is using the spare wheel too
55	Toussef	<i>yeh main vehicle ho gaya ..ab iske peeche...tractor lagte hain...iska wheel...</i> <i>single wheel ka chalega</i>

		so the main vehicle is done. now lets work on the tractor.. this can run on a single wheel
56	Anupama	<i>bahut bada ho gaya na</i> isn't it too big
57	Rajan	<i>bada hi hai</i> it is big
58	Toussef	<i>idhar se kaat dena ...yahan driver baihega....</i> cut it from here here driver will sit
59	Sudeep	<i>driver ka block rakh</i> keep the block for the driver here
60	Toussef	<i>yeh</i> this
61	Rajan	<i>yeh</i> this
62	Toussef	<i>aage aur jagah le sakte hai....</i> we can take more space form here
63	Rajan	<i>idhar ek aadmi... luggage ki liye idhar,for sleeping</i> here one person ... this is for lagguage, this one for sleeping
64	Rajan	<i>thoda height wise hona chahiye</i> it has to be a little high though
65	Toussef	<i>ye char ho gaye ..idhar ...peeche luggage..idhgar ek space.. yahaan teen</i> here 4 are sitting .. back is for luggage .. there is little space here.. here for three
66	Ashish	<i>to yeh family ke liye ya tourist k liye ??</i> is this for family or tourist
67	Toussef	<i>pata nai kuch ban gaya</i> i don't know, it's come up as something
68	Ashish	<i>qualis wale wohi karte na ..qualis family ki car ka kam khareeti hai..au travel agent</i> (qualis - reference for a vehicle by toyota) ... qualis is used more as tourist vehicle than as a family car
69	Toussef	<i>travel agent le sakte hain ...aur jo peeche walle trailer lagaye hain na...</i> <i>yahan par saman ki bajaye sleeping ka arrangemnent</i> this vehicle can be meant for a tourist vehicle. the trailer that's behind can be used as luggage or sleeping
70	Rajan	it can be removed also
71	Toussef	can be removed
72	Toussef	<i>haan ! yeh ek aur ...trailer ka wheel hai yeh... yeh hai.. assume kar raha hun</i> i am assuming this to be the wheel for the trailer
73	Toussef	<i>to yahan par so sakta hain ..par lekin ...ek aadmi...do aadmi..aur</i> <i>yahann 1,2,3, seats kitne log ho gaye ? 6,6+2 'chalo shirdi'</i> explains seating arrangement (shirdi - refernce to holy place in maharashtra)
74	Toussef	<i>luggage kihin pe to adjust ho jayega..to adjust ho jayegi...</i> <i>to iska faida hai...waise wheels neeche jaane chhahiye na ?</i> luggage can be adjusted somewhere are the wheel supposed to be at the bottom
75	Ashish	<i>daal na neeche</i> put it underneath
76	Yatin	<i>wheels sab dikh jayega ...side pe rakh de</i> wheel will be seen ... keep them on the side
77	Toussef	<i>karte hain ...eke ek karke karte hain</i> let's do it, let's do it one at a time

78	Yatin	<i>theek hai who samaj h gaye</i> that's ok, we got that
79	Ashish	<i>jo badi gaadi banayenge</i> the big vehicle we will make
80	Toussef	parking...?
81	Ashish	<i>gaadi chalti aise ho... par aise hoti ho...</i> the vehicle should run like this but it stays like this
82	Toussef	parking...
83	Ashish	<i>gadi chalti aise ho... park aise hoti ho...</i> the vehicle should run like this but it is parked like this
84	Toussef	<i>haan who ho sakti hai na...</i> yeah that can be made
85	Toussef	<i>agar hum lambi doori k gaadi bana rahe hai...highway mein side me hota hai</i> if we are making a longer vehicle, like the ones that are on the side of the highway
86	Ashish	<i>hai na</i> yeah right?
87	Toussef	1,2,
88	Rajan	<i>idhar ek aayega..</i> here one will come
89	Toussef	<i>haan 3,4, yeh do hain log aa gaya</i> here number 3 and 4 will come
90	Toussef	<i>yahan par seats nahin rakhe ge...yahaan par bed rakhge...</i> <i>aur city main aaye..to ise nikal ke rakh diya ghar pe.... ab itna bacha hai ...sirf logon ka</i> here there will be a bed instead of a seat which can be kept away while in city ride
91	Toussef	<i>yeh car pool bhi kar sakte hain</i> this can be used as a car pool
92	Yatin	<i>madam aap bolo</i> madam, what would you say?
93	Ashish	<i>madam ne to bola ek dam chota waala...pahiye to gir jayenge</i> madam has told that it has to be small. the wheels ight fall off
94	Anupama	<i>auto ka size banao office ke liye</i> make it for an office use in the size of an auto
95	Toussef	<i>mahindra ka auto dekha hai kya3 wheel 2 seat</i> (mahindra as a brand) have you seen the autorickshaw
96	Toussef	<i>ye nahin kya sports mein rehta hai...chota sa shik karke jata hai..woh bhi ...</i> <i>par speed apna normal speed</i> it should be like one of those sports vehicle .(gives a reference for car speed)... but the vehicle goes at normal speed
97	Yatin	<i>mein ek aisa soch raha tha</i> i was thinking it should be this way
98	Toussef	<i>acha hai f-1 type</i> its good, like f-1 car
99	Rajan	<i>mera idea hai ki height mein zyada hona chahiyye to upar bhi ...</i> <i>so sakte hain to space zyaada ki zaroor nahi</i> i feel that the vehicle should be tall . so there will be enough space for sleeping
100	Yatin	<i>to ek bada... sa engine isko wheels ...bade bade ...</i> <i>yeh main,,mera dost yahan pe khade hain...</i> <i>to mera vehicle hai wo isko chipak jayega...ye chipak gaya ...aur gaya</i>

		this one with big engine and wheels is mine and this one is my friend's ... so he can connect to mine and off we go
101	Toussef	<i>acha</i> ok
102	Yatin	<i>yeh ghoomte hai</i> they roam around
103	Yatin	<i>iska station ayega ye eedhar jayega</i> so when his stop has arrived, he gets off
104	Toussef	<i>ye max kitne logon ko le jayega ? 10-15</i> how many people can he take at once? 10-15
105	Yatin	<i>yahan se chaheen to hum apni gaadi khud le ja sakte hai</i> we can take our vehicle on our own if want
106	Yatin	<i>yeh 3w rahega sabmein</i> this will be 3 wheeler
107	Ashish	<i>auto jaisa... madam ne bola na ..dombivli se kanjur marg ...</i> <i>tak aa gaya mein dabba,kanjur se sraight, ghatkopar side ja raha hai, apna nikal ke le aaye</i> it's like what madam said, just like an auto, i get off and take my vehicle when my station arrives
108	Yatin	<i>ye log jayenge isko ...continous moving rahega poora circle ghoomta rahega ...</i> <i>mujhe jahan utar jaoonga, yeh nikal jayega beech mein se to ye chipak jayega</i> explains how the system works
109	Toussef	<i>accha</i> ok
110	Yatin	<i>yeh din bhar ghoomta rahega ...slow matlab ekdam slow,30-40 k speed se</i> this will be spinning very slowly at around 30- 40 speed
111	Toussef	<i>lekin station pe to niklega easy</i> but it will go off the station easily
112	Yatin	<i>station hai hi nahin</i> there won't be a physical station
113	Toussef	<i>to fir ye niklega kaise?</i> so where will he get off
114	Yatin	<i>to kya hua ..woh to technical bola na ...</i> <i>who magnet sa kar sakte hain..release kar diya to who nikal jayega</i> he already told about the technical stuff., they are connected by magnets... when he reaches his destination he releases and gets off
115	Toussef	<i>ya fir use uda diya dhoom ejection</i> so he ejects from the other vehicle
116	Yatin	<i>ye kaisa laga</i> how did you like this
117	Toussef	<i>acha</i> ok
118	Yatin	<i>yeh sirf main engine ghoomta rahega ...aur yeh aakar chipak jayega</i> only the main engine will be roaming around, we just connect to it and that's that
119	Toussef	<i>ye apne ghar se lao</i> you get that from your home
120	Yatin	<i>haan ye personal hai usme generator bhi rahega...charge ho gaya ...</i> <i>nikal na road pe hi chalegamain road pe jaana hai...nikal jao...</i> this will be standalone unit very personalise with its own generator ...

		it will work fine normally ... so if you wanna go alone that's also fine
121	Toussef	<i>ye samaj le apna train type ho gaya badasa engine...</i> <i>aur yeh battery powered chote chote vehicles hai....kanjur tak aa gaye, kanjur se</i> <i>iit aana hai to apni battery vehicle se aa jao...</i> <i>kanjur se battery itni charge rahegi ki idhar aa jayega</i> so it will work like a train where everyone gets off where they want
122	Yatin	<i>ye aur add ho jayega</i> so this will just add on
123	Toussef	<i>baki log chale jaenge aage</i> rest of the chain will just head off
124	Ashish	<i>abhi bachon k school se laane k bus k bare mein sochte hai</i> now let's concentrate on making a bus to get kids
125	Anupama	<i>bus is fine ...jo abhi hai present woh accha hai..usme changes nai chahiye</i> the current bus is just fine, no need for changes for that
126	Toussef	<i>are abhi jo bus aati hai na uski seat badi hoti hai.. bacche to chote hai na ...</i> <i>seat se pair neeche nahi touch karte,</i> the current bus seats are very big . kids are too small for those. they cant reach the floor on those
127	Anupama	<i>interior change karne chahiye</i> interiors must change though
128	Toussef	<i>choti seat lagani chahiye 2 ki jagah 3 aa jayengi</i> we can fix smaller seats . instead of 2 3 kids will sit
129	Ashish	<i>par jo special school ke liye hai ...who aisa nai banate</i> but the school for the special, it's not made like this
130	Toussef	<i>school bus jaisi bhi ho..ek general bus rehti hai...jaisi apni...tum tum hai</i> let the school bus be .. let's talk about general buses that are there (tum tum - local buses that run inside iit bombay campus)
131	Anupama	<i>haan school ke liye ek separate bus kar sakte hai</i> yeah we can make a separate bus for school
132	Ashish	<i>side side mein kuch pakadne ke liye ...jo bachcha first baith ta hai...</i> <i>jerk ho gaya...kuch ho gaya...he should not fall ...aisa kuch hona chahiye,</i> <i>side mein door type nikalne ke liye..</i> the kids sitting on the first seat, there should something on the side for them to hold on to in cases of jerks
133	Toussef	<i>utarne ki seedi choti choti chahiye...</i> the step size should be small
134	Anupama	<i>har ek seat mein ek door hona chahiye...aane ke liye aur jaane ke liye...</i> <i>but chote bachche ke liye hain...bol nahin sakte</i> every seat has to have its own seat, but for smaller kids.. cannot be said though
135	Ashish	<i>jaisa essell world mein hota hai na...baandh dete hain...</i> just like the ones in theme park, there is a separate harness for each seat
136	Toussef	<i>upar hota hai na...seat ka handle ...</i> the ones that re on top . seat handle
137	Anupama	<i>nahin pakad sake to problem nahin hai...kahan bhi jayenge...</i> <i>woh log udhar hi jayenge na...aur kahan jaane ka chance nahin hai...seat nahin...</i> <i>down leg ka hi problem hai..</i> no they won't be able to move as they always move around in the bus... so if there are individual seats there won't be a problem for height

138	Toussef	<i>saame cartoon rakhe hai...seat ke peeche...</i> put some tv cartoons behind the seats
139	Ashish	<i>taaki...ghar pe aake naa dekhe...sear ke peeche hi dekh le...</i> so that they won't watch tv at home
140	Anupama	<i>school ka buses kuch alag hi design hona chahiye...</i> yeah, school busses should have different design altogether
141	Anupama	<i>samjho yeh seat hai...yeh door... sudden jerk hoga...</i> <i>brake hoga all of a sudden to problem nahin hai...this is seat...chota sa door...</i> <i>jerk ho gaya...first bachcha baithega...rickshaws...otherwise first bachcha 'dammm'</i> <i>se neeche ayega...</i> the kid sitting on the first seat will always end up falling during hard brakes
142	Ashish	<i>aap rickshaw ka baat kar rahe ho?</i> are you taking about rickshaws?
143	Anupama	<i>bus mein bhi</i> no even in busses
144	Toussef	<i>bus mein ekdum brake lagti hai...</i> when busses brake hard
145	Anupama	<i>to first bachcha jo baithe ga...girme ka chance hai usko...</i> then the kids on first seat have chances of falling down
146	Ashish	
147	Anupama	<i>every seat mein first bachchaside meinhar ek seat seat ke side pe khamba,</i> <i>rod type pakadne ke liye....first bachche ke liye..</i> there should be a rod on the outer edge of the seat for the kids to hold on to
148	Anupama	explaining to Rajan
149	Anupama	<i>wo buses ka colour wonderful hona chahiye...aisa normal buses ke jaisa nahin</i> the colors have to be wonderfulnot like normal busses
150	Yatin	<i>abhi...ye bus hai...bus ko dono side door hona chahiye...</i> <i>yahan se bhi chad sakte hai...wahan se bhi...</i> now... this bus...both sides should have doors in bus... you can board from here and here
151	Anupama	<i>nahin nahin...one door is ok</i> otherwise one door is fine
152	Anupama	<i>regular mein 2 doors are fine...</i> in regular 2 are fine
153	Yatin	<i>main ye sochta hun, ek side poora bus ka...khul jaana chahiye...</i> i feel that one side of the bus should open completely
154	Toussef	<i>us se achcha karte hain na...neeche ka gir gaya...</i> let's make it even better, let the bottom part fall down
155	Ashish	<i>sab ke sab girenge baad mein</i> everyone will fall off then
156	Yatin	<i>bus ka wheel idhar hai, tera door yahan tak khula...tera poora patch open ho jaata hai na...</i> <i>wahan se utar sakte hain....agar door ko andar se stairs kar diya to wahan se utar sakta hai...</i> this is your wheel, this is the door
157	Toussef	<i>aur jo samaan rakha hai upar...</i> what about the luggage up top
158	Ashish	<i>wo wahan rahega...uske neeche se khulega...</i> that will be right there. the door will be form below that
159	Yatin	<i>poora nahin....bas itna sa...khidki ke neeche panel tak, wo neeche jayega...</i> not completely . only below the window panel, that will go down

160	Toussef	<i>to fir neeche kaise jayega...to khidki ke saath adeg...</i> then how will it go down with the window?
161	Yatin	<i>to upar khul jayega...khulna chahe khul jayega...wahi bol raha hun...</i> <i>technically ho sakta hai...kya karna hai...wohi pata hona chahiye...</i> the top will open and below will open down... that's what i am telling, it can be done technically
162	Toussef	<i>hydraulics se ho jayega</i> it can be done by hydraulics
163	Rajan	<i>i am making a double decker type so that space thoda zyada... upar....upar</i> i am making a double decker bus so that space would be more..
164	Yatin	<i>vertical ho jayega...</i> it can be made vertical
165	Rajan	<i>thoda flat bhi hoga, do jan baithega....suppose two persons can sit here...</i> <i>suppose two persons can sit here...upar ek....spaciousspace...luggage...</i> even if it is little flat,two people can sit, and on top one more, it would be spacious on top
166	Ashish	basically luggage space ko you are making a cabin...so that people can sit also or sleep...
167	Yatin	<i>aur mera ek idea aisa tha....bus mein seats nahin hai...</i> i had one more idea for a bus.... no seats inside
168	Ashish	<i>sirf khade rehne...</i> only standing?
169	Yatin	<i>seats hum leke ayenge ...ghar se...</i> we will get the seats
170	Toussef	<i>ghar se?</i> from home?
171	Yatin	<i>bags jaise!</i> like a bag
172	Yatin	<i>bus mein chado aur baith jao...seat mein...</i> just get on the bus and sit down
173	Rajan	<i>aisa idc mein chair banaya....83 mein...85 mein kuch...aise peeche daal ke</i> <i>ja raha hai....wherever you go...spread karo....uska....e....e karo...metal</i> <i>hoega to bhi chalega....baithe ga...kidhar abhi picnic gaya....udhar baithne</i> <i>kko nahin hai... you can fold and all...pehle ka chairs banaya tha,</i> <i>kitna beautiful tha...kidhar bhi jayega...fold it and take it anywhere...</i> <i>kidhar bhi baith sakta hai...</i> a chair like this was designed in idc in 1983 or 85 where you can just spread it around wherever you want and sit .. it could have even be made of metal. the earlier designs were so beautiful. you can fold it anywhere and go, and unfold it to sit anywhere
174	Nishant	<i>interaction</i>
175	Rajan	one way is double decker...other one is separate module....if two persons are going ... you can remove rest of it....detach the things....
176	Toussef	one was the big vehicle for six people....and there was a trailer ... where two people can sleep... for highway....
177	Anupama	long distance
178	Toussef	they can sitand when you come to cityremove that bed thing ... regular mein...six people can...
179	Nishant	what was insufficient?
180	Toussef	we were thinking of interior of a bus...

181	Yatin	2w, 3w, 4w....single wheeler bhi kiya.....
182	Toussef	ek engine and five ppl are coming ...they can come with their vehicles and connect with the engine....and go...
183	Yatin	it will be a slow speed constant moving vehicle...



APPENDIX 7C: TRANSCRIPTION: PD WITH CONCRETE- ABSTRACT TOOLKIT

1	Ashish	<i>uski need bhi batayee ye</i> tell us the need for this
2	Devanuj	<i>bana lenge to usaki need bhi bata denge</i> if done we'll give the explanatin for it
3	Truveni	<i>main kya soch rahi thi ki,two wheels hota, to yahan par ek pahinya aur laga kar....</i> <i>to may be jagah kam lagegi our passengers bhi zyada ho sakte hai</i> what i was thinking was that if we provide one more wheel here more passengers can be incorporated in less space
4	Devanuj	<i>matlab, ek extra wheel lagane se koi fayada ho raha hai kya?</i> meaning, one extra wheel is it beneficial?
5	Truveni	<i>nahin.. nahin.. magar length bhi badh rahi hai</i> no no, but the length is increasing
6	Vinay	she is increasing the length so that it will be tapering at the end we can...
7	Devanuj	<i>chalo...</i> come on
8	Ramdas	<i>problem ahe na...shteering....</i> but problem is there na. steering
9	Truveni	<i>karun tak na....</i> finish it then
10	Vinay	<i>steering hai na</i> steering, it's there
11	Truveni	<i>concept hai na....</i> it's a concept
12	Truveni	<i>aur ek chahiye</i> i need one more
13	Vinay	<i>flat...nahin hai</i> it's not flat
14	Vinay	<i>aur ek hai na aise</i> is there one more of this?
15	Vinay	<i>aise tbhi thik hai</i> it's fine like this also
16	Truveni	<i>iske upar bhi bitha sakte hai</i> we can place it on top also
17	Devanuj	<i>ok...yein bhi laga sakte hai... this is interesting</i> it can be placed here also
18	Vinay	<i>golmaal 3</i> (gives reference to the movie "golmaal 3")
19	Devanuj	<i>par ye thisara wheel ka kya advantage bola tha aapane</i> what was the advantage of the third wheel that you had mentioned
20	Truveni	<i>length badh jayegi</i> length will be increased
21	Vinay	you can increase that no of people sittingthis for example... is a bike...basically
22	Truveni	three wheeler
23	Ashish	trike

24	Vinay	<i>sahi hai</i> this is correct
25	Devanuj	<i>aur kya</i> what else?
26	Vinay	<i>anything else.... this was one ..aur banete hain na</i> anything else?.. this was one... let's make more
27	Ramdas	three wheeler
28	Vinay	<i>woh ek tha ... woh bhi bana sakte hai</i> that was one, we can make the that one too
29	Devanuj	<i>ek aadami ke liye konsa hai 3w</i> which 3 wheeler is meant for one person
30	Ramdas	<i>3w...ek adami ke liye?</i> 3 wheeler, for one man?
31	Vinay	<i>ek aadami ke liye ho sakta hai...magr space jyada lega...</i> vehicle can be for one person but will take a lot of space
32	Devanuj	<i>ab?</i> now?
33	Ashish	<i>yeh wale aur pass aage ke jo do(2) rpws hain na ..slot ke.. woh agar pass main hain...</i> <i>to usme 3w aur achha banega</i> if these two slots are closer, the a good thre wheeler can be made out of it
34	Devanuj	<i>agar asymmetric arrangement hoga to kya?</i> what if we use asymmetric arrangement?
35	Ashish	<i>yeh bhi achhya idea hai ...</i> this is also a good idea
36	Vinay	<i>hmm. .. aisa bhi hai ...</i> it can be made this way too
37	Devanuj	<i>aisa kuchh... wah.. wah..</i> somewhat like this.....(appreciates)
38	Vinay	<i>amazing ...yeh ho sakta hai aisa..aisa hai</i> amazing, this can be done
39	Truveni	<i>aisa bhi ho skat hai... ki hum saare ke saare pahiyae use karen...</i> <i>aur family ek sath travel karenaur agar half family agar jaye ...</i> <i>you can divide the can into two</i> it can be used depending on number of family members
40	Devanuj	<i>ok, divide the car?...to kya configuration kaise hona chahiye?</i> ok, divide the car?... the which configuration will you use
41	Truveni	<i>sare....</i> all
42	Vinay	<i>saare sath main le to yeh idhar le le to...</i> if you take all of these here, take that there
43	Devanuj	<i>lekin saaare ... ke bina bhi ho sakta haiconfiguratuin with....</i> but configuration can be made without all of them
44	Vinay	that's just a concept no!
45	Truveni	just a concept
46	Devanuj	no...no.. one becomes this...
47	Truveni	so 3...
48	Devanuj	<i>that's what i am saying....matlab yeh do (2) part hain lekin)...? dikhte hain....</i> that's what i am saying ... meaning these 2 parts can be seen

49	Truveni	than we can take this and put like this...
50	Devanuj	<i>main yeh keh raha hoon, ki ek gaddi do gaadi ban jayegi..</i> what i am trying to say is that, from one vehicle we'll get two
51	Truveni	<i>haan... wohhi... mujhe bhi wohi kehna hai...</i> yes, even i was trying to say the same
52	Devanuj	<i>so, to pehle full gaadi banate hai ... then we will see divide into two..</i> so we'll first make a whole car then see how to divide it
53	Vinay	<i>full ban gaya...</i> its completed
54	Devanuj	<i>hmmm... eske upae kaisa?...ek....</i> how about this on top?
55	Truveni	<i>ek...gaadi iska half yeh... aur next yeh.. matlab.. ek ko yeh ya doosri gaadi ko lagega.</i> one vehicle will be this half and the other half is another vehicle
56	Vinay	<i>jo tum try kar rahe ho... woh possible nahi lag raha hai....ek main...</i> <i>ek side se aa rahe ho... doosre main doosri side se...</i> i don't think this will work.im coming from one side and you are coming from the other
57	Truveni	<i>jaise 3 w ka concept hai useke jais ahi hai... yeh wal apeechhaye jayega,...</i> <i>sirf tyre change karana hai</i> this will be the same the 3 wheeler concept,only this wheel will change
58	Vinay	<i>ek tyre change to thik hai ...yeh. kaise divide hoga?... how the vehicle is going to divide?</i> if one tyre is changed then its ok, but how will it be divided?
59	Vinay	<i>is it going to divide like this? ...yeh part idhar..yeh part idhar</i> is it going to divide like this? ...this goes here and that goes there
60	Truveni	hmm...
61	Vinay	<i>kaise hoga... this will go here and this...</i> how will this work out ? this will go here and this...
62	Vinay	basically we can make this this way... this 3 here and this 3
63	Ramdas	<i>main kuch try kar rah ahun,</i> i am trying something
64	Devanuj	<i>kariye...</i> go ahead
65	Ramdas	<i>yeh do karna hai is yeh eske upar bhi ...aise aa skta hai kuch...</i> this two have to be done on top too, somewhat like this
66	Ramdas	<i>yeh 3 w aur yeh 3w</i> this three wheeler
67	Vinay	<i>ho sakta hai...</i> yeah it can be
68	Vinay	<i>yeh main aisa bol raha tha....</i> i was telling it this way
69	Ramdas	<i>yeh join hone ke liye to..</i> for this to join...
70	Vinay	<i>inhone jo bola, whi bhi tha ...separate kar ke.</i> what he said, that also works by separating
71	Truveni	<i>matlab aisa existing concept hai</i> meaning this concept exists?
72	Vinay	<i>this is just a concept</i>
73	Truveni	no...no...I am just asking
74	Vinay	<i>he has given idea ki aisa bhi ho sakta hai</i>

		he has given the idea of a possibility
75	Devanuj	<i>ho gaya na .. to concept ho gaya na...</i> it's done right.... so one concept is done
76	Truveni	<i>decision chhiye tha kyoon ki aisa lagta hai 2w and 4w do type ke hote hain usme...</i> <i>4w is generally ... matlab families travel together ..hm... aur jab 2w matlab</i> <i>individual ho jaati hai</i> decision is needed for 2w and 4w as generally 4w is preferred for family travels and 2w for individual use
77	Ashish	<i>to like.. woh gher se hi alag alag chal sakte hain .. to ek liya to saath chal sakte hain...</i> so if they are leaving home, they can go seperately or if they want to go as one they can do that too
78	Truveni	<i>haan..</i> yes
79	Vinay	any point of time you can divide
80	Truveni	you can travel together
81	Vinay	<i>abhi 4 log hain.. 4 log idhar jaane wale hain 2 office ... other are going</i> <i>somewhere else....kabhi bhi divide kar sakte hain...it's detachable....tu jaise bol</i> <i>raha hai....2 raste alag</i> for eg. 4 people going to two different offices, they can divide anywhere they want. it's detachable like you were saying it
82	Ashish	wahi.. i was just going it as a scenario..
83	Vinay	even if there is some problem with parking ... divide and park...
84	Ashish	divide and park...
85	Vinay	<i>haan!</i> Yes!
86	Vinay	<i>woh bike ka to already bol diya...parking ka hai..they can carry more no of people...</i> so he has already spoken about the parking
87	Truveni	<i>one more thing i thought of it now is ki... 3w se hum log may be...</i> <i>jaise hum logon ne pehale kiya tha ...verticle type kiya tha...arrangement taki</i> <i>uska length badh jaye.. and again we can ...ek wahan ka nikal ke..ek woh nikal dijiye na...</i> one more thing i thought of (shuffles around the pieces and gives reference two previous configuration)
88	Ashish	<i>ek nikal de?..</i> remove one?
89	Truveni	<i>ek nikal de ...vertical aur horizontal ...unhi teen pahinyon ko use kar kr...</i> removing one and using three wheels in vertical and horizontal direction
90	Ashish	<i>taki... kya hum zyada....</i> so what is the end result?
91	Truveni	<i>taki ... woh jaise pahile tha ... haan!</i> so everything will be the same as before
92	Ashish	<i>ho sakta hai, pehale ek ke pahiye ek baith le..then ... dadhane ke liye, ek baaju nain</i> <i>ek baith sakta hai...</i> it can be such that one can sit one after the other and now we can make them sit side to side so as to increase interaction between
93	Vinay	adjacent..
94	Ashish	<i>haan..! aisa ho sakta hai....</i> yeah it can be
95	Vinay	<i>only thing is ... wagarah ke liye ..which taking turn wagarah lete hue... thoda...</i>

		the only thing is while taking a turn ...
96	Devanuj	<i>just for that matter .. stackable gadi ho sakti hai? double decker kabhi single decker?</i> just for that matter .. can it be a stackable vehicle? two tier bus and single tier bus
97	Ashish	hmm...
98	Truveni	<i>rakh sakte hainuske uper...</i> can be used
99	Truveni	<i>haan.. ab tak hum sirf.. horizontal.... ek hi level tak sochate hain.. abhi uske floor rahe hain...</i> till now we have thought only in one direction
100	Devanuj	<i>ya to ye size chota hai tumhare modules ka!</i> either your module sizes are small
101	Ashish	manufacturing defect
102	Ashish	<i>isme bhi char log aayenge</i> even in this 4 people will come
103	Truveni	<i>isme bhi char log aayenge....</i> and even on this four people can come
104	Devanuj	<i>jab nahin use kar raha</i> whenever you don't want to use it then we can
105	Vinay	<i>kaha hatana hai?</i> where to remove it?
106	Devanuj	<i>nahin...jab nahin use hai to kahe ko rakhana hai?</i> no, when there is no use for it why to keep it?
107	Vinay	<i>you can consider it na?.. ki ek channel diya hai.. isme select kar diya..</i> you can consider it na? one channel is provided and you have to select in that
108	Ashish	<i>ya fir woh luggage...gaya.. channel ban gaya ki...</i> or that has become a channel
109	Vinay	<i>main soch raha hoon... channel le sakte hain.... two channel and ek...ja raha hai</i> <i>you can sit on it along with the chair ... kabhi bhi chahiye to nikal sakte hain...</i> <i>matlab agar ye concept le rahe hain to...</i> if we are considering this concept, we can keep swappable chairs ... which can be removed whenever you want
110	Ashish	ok...ok...
111	Vinay	<i>matlab ek admi ya do aadmi ho bhi hai.. agar baith sakte hain...</i> meaning it can be one or two persons sitting
112	Devanuj	this the space created for four people
113	Ashish	correct..
114	Devanuj	<i>suppose i am not carrying four people.. i want to make it for one person...</i> <i>jab zaroorat nahin ho to the person ke liye kitna...kiya ja sakt ahi... kitna infrastructure...</i> when it is not necessary why to put extra amount of infrastructure
115	Truveni	<i>do pahiyे nikalane se...</i> by taking out two wheels
116	Ashish	<i>khada kar do usko...</i> make it stand
117	Devanuj	<i>yeh to log hain..</i> these are people
118	Ashish	<i>4 hain na.. khada karo...</i> there are 4 right? keep them aside
119	Ramdas	<i>aise....</i>

		like this
120	Ashish	<i>aise... isme do (2) baith sakte hain .. isko aise kar doge to ek aa jayega...</i> by doing this two can sit and then get place one more
121	Devanuj	collapsible?
122	Ashish	<i>hmm... aisa kuch...</i> something like this
123	Ramdas	<i>aise hi complete laya to...</i> complete it just like that
124	Ashish	6 wheel
125	Ramdas	hmm..
126	Vinay	<i>kya plna kar rahe ho?</i> what are you planning on?
127	Ramdas	<i>zyada length wali gadi</i> too lengthy vehicle
128	Vinay	<i>aur aisa nahin hai kya?</i> and is it not like this?
129	Ashish	<i>to is se kya milega length se?</i> so what will it get due to the length
130	Ramdas	<i>traffic ke under aisa car rahega to... nikal sakte hain na....</i> it can avoid traffic...this kind of car
131	Ashish	<i>matlab 'patla' car rahega to nikal sakte hai...</i> meaning if we have thinner car it can avoid traffic
132	Ramdas	<i>single.... single baith sakte hain...</i> everyone can sit in single rows
133	Vinay	<i>idhar bhi ek lagao na...!</i> add one over here too
134	Devanuj	<i>nahin.. woh to ho jayega.. yeh dono detach to sakte hain kya do directions main</i> <i>yeh dekh raha huun...</i> no, that can be done, im trying to see whether both of these can be detached
135	Vinay	<i>detach ho sakte hain... only thing is ki... yeh space nahin hona chahiye</i> it can be detached but this space shouldn't be there
136	Devanuj	<i>arc main ye kya bana raha hoon</i> what are you trying to make in this arc
137	Ashish	auto..?
138	Devanuj	<i>auto to thik hai, par breakable fir se aa raha tha..</i> auto is still fine, but breakable is still coming
139	Devanuj	<i>re design karo ye bhaiya tum...</i> redesign this thing
140	Devanuj	<i>pata nahin kya kar hoon main?.. kuch kar raha hoon...</i> i do not not what i am trying . I'm doing something
141	Truveni	<i>ye ..jaise hamne pahile concept banaya tha..</i> like we had tried making the first concept
142	Devanuj	<i>waise hi hai kooch</i> something just like that
143	Vinay	<i>similar kind hai.. but only thing is that ki uska wheel kidhar, kaise use hoga detach hone</i> <i>ke baad</i> similar kind but how are we going to use the wheel once it is detached
144	Devanuj	<i>kuch to unconstrained design bana ne do na..har cheese main condition hoga to kya hoga....</i>

		let us design something without constraints .. what is going to happen if there are conditions on everything
145	Ashish	<i>woh chod do ... hata do..</i> leave that, remove that
146	Vinay	<i>laga dijiye... dekhate hai kaisa lagta hai...</i> just put it, let's see how it looks
147	Devanuj	<i>haan... yeh 1/4 length hai iska.. aise lagate hain ... lets play with forms...</i> <i>iska counterpart kidhar hai?</i> yeah this quarter the length of this, let play with forms, where is the counter part for this
148	Devanuj	see. .. there is one interesting thing ..if i have some space here.. how is going to affect function?
149	Vinay	space means what?
150	Devanuj	<i>khali jagah.. matlab aage ka jo bonnet hai na .. kaat diya beech main se... kuch bhi hi sakta hai... dekhate hain ... kya hota hai....</i> cut at the middle of bonnet and let's see what happens
151	Devanuj	<i>aa raha hai ye? ..is case main nahin hai ye isme nahin hona chahiye... aage se kata hua hai... does it? are yaar, kuch to advantage aat hai yaar .. main jabardasti ka soch raha hoon yaar... i think there is an advantage, a person can see through 'n' through.. it is a tough exercise..</i> talks to himself and tries to figure out what he can do to progress
152	Nishant	<i>jam nahin raha hai?</i> can't handle it ?
153	Devanuj	<i>one thing is ki... if we start with precondition, then playing with form does not become..... the problem is with modularity of kit... we need more number of shapes as well as more shapes.... abhi main yeh dekhana chah raha hoon ki age bonnet main, main volume nikal deta ahoon .. kyo kya ho sakta hai us se main bahut soch me tha.. pata nahin.....</i> now i want to see how to take out volumes from the bonnet area
154	Nishant	<i>baki log bhi sehmata hain... jo yeh bol raha hai...</i> everyone seems to agree with what he is saying
155	Vinay	<i>main unka concept design hone ke liye ruka tha .. i am just waiting....</i> I am waiting for their concept to complete
156	Devanuj	<i>nahin ... maine... poocha....</i> no, i asked...
157	Vinay	<i>main bhi wohi soch raha hoon.... let him do...</i> I am also thinking the same
158	Ramdas	<i>bonnet main agar beech main ____ rahega to aerodynamics ka problem ho sakta hai...</i> is there is something in the middle of the bonnet, will it affect the aerodynamics?
159	Devanuj	<i>haan .. woh bhi hai.. par city ke liye .. kitna aerodynamics...?</i> yeah may be but how much aerodynamics will be affected in city?
160	Ramdas	<i>do gaddi kar ne ka hai.. to ek.. ka do...</i> two vehicles are to be done
161	Devanuj	<i>yeh kis ke liye hai?... yaar wheels bhi nahin jaate isme .. nahin to pillion samajh hoon ise..</i> what's it for?... wheels also don't go in....otherwise I can assume it as pillion...
162	Nishant	<i>baki aur deko...</i> check out every one of them
163	Devanuj	<i>haan... dekhe..dekhe...</i> yeah I am looking
164	Devanuj	<i>i have reaches my limits...i am asking her to...." do teen ho gaye.... ipr ka issue...)</i>

		i have reached my limit, i am asking her to i have done two or three, now there will be an ipr (intellectual property) issue
165	Truveni	<i>jaise aapne yeh chaar rakhe the .. to waise hi hum go (2) gadiyon ka baat kar rahe hein...</i>
		just how you have kept these four we are talking about this two vehicles
166	Devanuj	<i>beech main kahan...</i>
		where in middle
167	Truveni	so may be this can turn ... to four people...means...can you give thatpiece again..... so maybe we are travelling together
168	Vinay	still what about the wheels?
169	Truveni	one unit is good for bicycling
170	Devanuj	2w x4
171	Vinay	then we need to use something slimmer ___ to proper design
172	Devanuj	<i>one more thing ... chalo theek hain.... can we have better protection against accidents? .. in some way? waise to yeh hota hi hai aapka comfort zone itna bada lekin kya hai aadmi ko yahan bitha sakte hai..</i>
		there is his huge crumple zone in midlle. but can we place humans here
173	Vinay	<i>woh ho pehla concept tha na apna..</i>
		that first concept of ours
174	Devanuj	<i>kaun sa?</i>
		which one
175	Vinay	<i>woh...ek level... upar diya tha...</i>
		that one where we had given extra level on top
176	Devanuj	<i>neeche ..storage space neeche rehta hai...</i>
		down there is storage space
177	Vinay	<i>haan !.. usme i think... there are more chances ..ki woh bach sakta hai...</i>
		yeah i think there is more space to save
178	Devanuj	<i>actually woh jo ...main ...wala bol raha tha ... na... nahin... nahin... nahin ho payega...woh aap jo kar rahe ho... abhi upar baithe ga ... to toote ga... to neeche wala main hi girega...</i>
		actually that one... that I was telling...not that one...that's not possible...that you are trying to make... it will surely break...
179	Vinay	<i>see.. apne channel rakha hain...</i>
		see you have kept a channel
180	Devanuj	i mean... the basically the impact will happen at the frontal if the vehicle is two level high...so... for example... bull dozer type vehicle... or tractor kind of vehicle... perdon is sitting high...whatever impact happens...it happens here..
181	Vinay	<i>still there is a matter of speed also ... jo speed se ja raha hai ..woh bhi hai.</i>
		the speed with which you are going is going to affect
182	Devanuj	<i>jo bhi hai ..par problem hai ki.. jyada tar.. it is physical impact... isme... it is not physical impact..isme some things crushes and this falls down...</i>
		whatever it is most of the times it is not the physical impact, there are some crashes and they fall they down
183	Vinay	<i>wohi... wohi bol raha hun....</i>
		exactly, that's what im trying to say
184	Devanuj	but the head on impact is...
185	Vinay	"explain concept in marathi"
186	Truveni	<i>sarri gaadiya waisi hi honi chahiye...</i>
		all the vehicles have to be of this sort

187	Vinay	this is one case, we are just conceptualizing.
188	Devanuj	see.. this is what we are thinking
189	Vinay	<i>so if he feels ki accident hone wala hai, normally bags ate hain ek side se ...from four side.. bags aate hain if at all niche impact aa raha hai .. aage ja ke girta hai ... chances hain ki woh bach sakta hai...</i> so usually bags activate when there is an accident but this design is different
190	Devanuj	<i>ya fir, ye jo cheez hai na, yeh....gadi bahut high speed par ja rahi hai, here you have something matlab...something of back resist karne ke liye shock absorber ya kuch bhi... this fellow goes and comes back, impact le leta hai ... kyunki yeh to speed se ruka,, yeh par aage jayega na.. par ye bhi rukega to impact badhega ... slide kar jaata ho...</i> you can have some systems that pulls or acts like shock absorber (explains a scenario)
191	Truveni	<i>aage wali gadi ka kya hoga?</i> what will happen to the vehicle upfront
192	Devanuj	<i>aage wali gadi pe to waise bhi lagti hai .. woh neeche ghoose jayegi ...ek bada hypothetical hai...ki ager dono aisi gadiyan impact hoti hain to kya hota hai?</i> the same will happen with the vehicle in front
193	Ashish	<i>to upper...dono aake "dhoom"</i> shows physically on the model on what could happen... it will make some sound of dashing
194	Devanuj	<i>see...see... aisa nahin hoga ..kyoonki.. what will happen ki.. yeh dekho impact ho raha hai.. theek hai...yeh dono ruk gaye.... neutralize karenge ...yeh aage ayenge aage ayenge but this ill after shock absorbing na..... impact ho bhi to... by this time impact will be reduced...the kinetic force will be reduced ...</i> explains the shock absorber system and justifies that the crash won't be big due to reduction of kinetic force
195	Vinay	<i>agar waise aap ... hain to what do you think ...kitne...rate se woh ayenge jo speed se woh ayenge.....</i> what do you think what will be the speed when they crash
196	Devanuj	<i>see, at the level of impact.... both will have final velocity, in this case..to speed hain yeh to cancel ho gayee... yahan pe cancel nahi hai kyonki hamne rigid nahi banaya isko .. yeh joint rigid nahi hai ...spring.. to isme speed dhire dhire reduce ho jayegi.....yahann tak...par ...spring ka kaam kya hota hai..poora ekdam se rokata nahi na...dheere se chodana hai..agar yahan impact hota bhi hai to kafi kam ho jayega.. aur jab tak ye max position par...aur ye wapas jaana shuru ho jayega..aise..aise kar ke ... agar..impact ho bhi gaya to kam hoga....nahi hoga to waise jaake y estable ho jayega ...aadami ke upar nahi padega...</i> tries to explain the mechanism of his system by placing a spring to hold tension
197	Vinay	<i>that depends on this distance yaar! aap agar bol rahe hai... jo jitna distance rakha rahega na aapne ... kitna jayeg... akitna nahin.....</i> that depends on on the distance,
198	Devanuj	<i>woh, mathematical calculation main karne laga to Nishant kya karega..</i> if i sit making the mathematical calculation what will Nishant do
199	Vinay	<i>aise dekh ke to nahin hone waala hai</i> it won't happen just like that
200	Devanuj	<i>all this engineering.... this engineering is...bad ki baat hai....</i> all this engineering topics can be thought of later
201	Vinay	<i>woh, barabar hai aap ki baat</i> yeah you are saying the correct thing
202	Devanuj	<i>nahin to, woh nahi rakho ge to topple ho sakta hai, ki moment ... ager yeh joint weak hai ... to moment of... hi jayega</i>

		it might topple if you don't keep that. if this joint is weak
203	Vinay	<i>charon ki izzat nikal rahi hai</i> our respects are fading away
204	Devanuj	<i>yeh kya hai yaar .. yeh nahi samajh aaya..</i> what is this? I'm not understanding this
205	Ashish	<i>woh basically gap fill karne ke liye tha ...</i> this was basically to fill the gap
206	Devanuj	oh,....o...o
207	Ashish	as now .. now think.. yeah..
208	Devanuj	<i>ab mujhe samajhana hai</i> now i got it
209	Ashish	<i>ise iss side le aa o...</i> get this over here
210	Devanuj	<i>iq test ho raha hi, bahane se... bata raha hoon,</i> iq test is being carried out .. im letting youll know
211	Ashish	<i>uske neeche ke liye hai na plastic wala ... dekho right</i> there is this plastic one for the bottom one
212	Vinay	<i>aap kijiye ... sab log aapke peeche hain....</i> you go ahead, we are right behind you
213	Devanuj	<i>4 log baith gaye to aaramse.. plus storage space bhi aa gayee.. they can divide into woh...</i> <i>kya..</i> 4 guys have been seated comfortably plus there is storage space. now they can be divided
214	Vinay	<i>woh neeche le lo n...</i> take that down
215	Vinay	<i>iska speciality kya hai..?</i> what's the speciality of this?
216	Devanuj	<i>pata nahi...desig ko explain karane ki koshish kar raha hoon main ..</i> i do not know, i am trying to explain my design
217	Ramdas	<i>sab kuch use kar ke kya bus banega</i> what bus will happen if i use everything
218	Ashish	<i>kya pata!</i> who knows!
219	Devanuj	<i>see woh double decker example maine diya tha ..usme visibility ka bada wohh hai</i> <i>advantage...</i> the double decker idea i gave, that will have the advantage of visibility
220	Ramdas	<i>double decker kya?</i> Is it double decker?
221	Devanuj	hann! double decker ka!
222	Ashish	<i>saamaan wamaan sab upar lpg uper..... piche dicky space...</i> everything including goods and lpg (cooling gas) goes on top, plus there is storare space behind
223	Devanuj	see... once my prof. in arch. told ." if you do not have space... go vertical....
224	Ramdas	<i>"transformer idea"..... "parking problem..... only"... banane ka parking ke liye.....</i> <i>"transformer idea"..... "parking problem..... only"... should make for the parking.....</i>

APPENDIX 7D: TRANSCRIPTION: PD WITH ABSTRACT- CONCRETE TOOLKIT

1	Nishant	<i>mien yeh bathein ja rhea ki actually this is a hybrid kit ...ismein do kit ka combination banker diye</i> <i>ok actually acrylic hein ekh separate kit hein or wood ka ekh separate kit hen ..apne edam sahi pakda ki kahi pe hein khi pe nahi hein...so jo is se pehle experiment hua usme abstract or concrete tools di gayi thi...ok.. uske andhar definitive forms ..ekh definitive thi ekh thud abstract thi..thud wooden is a very abstract ...tho sir abstract di jathi tho apne mind sir conceptualize karate nay nay cheezein tho apne abhor abhor kiya tho...but use human ka bhi abstract hen ...tho unko woh block diye jo human walla.. apko unka human diye ok....toh yeh mien...i deliberately did this to see how people respond to this new kind of kit.....ok tho hybRishid ko khi na khi pe...ya tho hybrid.. ya tho phir ada iska idhar and ada uska udder...teek hein...tho do thrash ke kits se log kyse respond karthe hein wo mujhe jaana tha.</i> <i>tho mere ko interesting lagne laga ki ismein bhi conceptualize ho reha hein....ismein bhi nayi cheezein nikhal rahi hein...tho kitne ease se nikalthi hein who mujhe study karoonga tho mujhe samaj mein aayega...</i> <i>hennawho jo easiness hein... who kyse aarahi hein..who kismein aah rehi hein... ok..char tharah ki toolkits hota hein jo mere pass ek pooRishi abstract ...ekh poori concrete ...ekh hybrid one.. aaur ekh hybrid two.</i> <i>tho but i am very interested in very....enhhhh you know still this one also as given you chances to explore.</i> so what i was trying to say is that this a two part combination . so this acrylic kit is a separate kit and and wooden is the another. so you caught it right that some things in the kit abstract and some are not. so before this experiment a concrete kit and an abstract kit was provided where are definitive and abstract shapes like wooden is a very abstract thing, so if we give anything more abstract then mind starts conceptualize new things just like you did but in this even the human is abstract, so i gave him the wooden block equaling to a human and i gave him the concrete human did this deliberately to see how people respond to new kind of things. so i wanted to see how you'll respond to the hybrid idea but the interesting thing is the even in this system you all are able to conceptualize and get new things. so when i study this i ll understand with how ease you are able to conceptualize these ideas. I want to know easiness in each of the four systems . what i am impressed that this has also give you chances to explore
2	Rishi	<i>sir ekh point...yehaan ki eisa hen ke ..there is nothing definitive which we are going to..</i> sir one point, so here it is like there is nothing definitive which we are going to...
3	Nishant	you might be interested ki definitive form kya thi?..
4	Rishi	i think mobility solution on the whole what different type of vehicles...if we can.... just one kind of vehicle as you have to just design..
4	Nishant	you might be interested ki definitive form kya thi..
5	Rishi	very definitive form.....
6	Rishi	three wheeler one person can be possible
7	Lakshmi	three wheeler bana di
8	Patkar	<i>centre pe rakh do</i> keep it in centre

9	Lakshmi	drawbacks of the current three wheelers... <i>kya pun dekh sakta hen tho</i> but you can see through these...
10	Patkar	three wheelers
11	Lakshmi	bullock cart
12	Patkar	personal vehicle.
13	Lakshmi	<i>choti kar lo</i> make it small
14	Rishi	three wheelers ok..
15	Lakshmi	it need to be longer
16	Lakshmi	this is not staying well
17	Patkar	<i>thoda thoda set karenge</i> we will set it in small packets
18	Lakshmi	three wheeler personal use
19	Lakshmi	auto covered two wheeler
20	Patkar	advantage over existing bike or
21	Lakshmi	two wheeler which is covered
22	Rishi	storage box
23	Lakshmi	three wheeler to personal wheel mage.....boots space...you must take a Rickshaw to the station
24	Rishi	then you have additional vehicle also..
25	Lakshmi	additional vehicle.....additional trolley
26	Rahul	<i>three wheeler ase...ek minute</i> three wheeler... like this... one minute
27	Rishi	into the puddle puddle
28	Patkar	but magnet
29	Rishi	<i>mene socha ulta kiya</i> Was done opposite to what I said...
30	Patkar	<i>support lage....</i> It would need support
31	Lakshmi	if fingers are caught
32	Rishi	<i>ital hua tho chale</i> its ok if it is this much
33	Patkar	<i>aage done se baad...pude tho chale la</i> after both these two... it would move forward
34	Rishi	two wheelers for daily commutation
35	Rishi	<i>woh nishant sharma sir ka headache</i> that's headache to nishant sharma sir
36	Patkar	<i>ase a block be lovla</i> need a block like this
37	Lakshmi	two wheeler where three people can sit comfortably
38	Lakshmi	when you go for trip...two wheeler for the family of four
39	Patkar	<i>do bage asle luggage</i> two more luggage blocks like these
40	Patkar	<i>balance kya hoga</i> how will it balance
41	Rishi	<i>woh nishant sir ka headache</i> that's nishant sir's headache

42	Lakshmi	that concept is already there wheel rotate 180 degree sorry 90 degree
43	Rahul	lots of accidents in bombay...regular accidents
44	Lakshmi	locally made toys
45	Rahul	2010 started the metro and mono..i think mono trains chambur to vashi..
46	Rishi	monorail type
47	Rahul	mono rail type
48	Patkar	this is four wheeler for what?
49	Rahul	family, friends, nephews...safety 90% accidents nahi hota hai 4 wheeler se
50	Rishi	if traffic comes people can drive in any direction
51	Rishi	<i>char goda...if goda is going through flyover it is called flying horses</i> four horses... if horse goes over flyover, it would be called flying horses
52	Lakshmi	uni wheeler
53	Rishi	single mobility
54	Rishi	this is a combination for four bikes, mono parts, mono wheels, six then
55	Nishant	<i>individual unit kya hein iska ?....each person will have its mono wheel</i> how is the individual unit of this?... each person will have its mono wheel
56	Rishi	this is one mono wheel, you an join one side by side or can joined together to be a family
57	Nishant	<i>aisa india mein gadi lagega kya</i> will this kind of vehicle be necessary in india ?
58	Rishi	<i>haanhaan two people are going in the same route a b common location kithna tho join</i> <i>karlo tho khi ka engine tho doosra ka engine sir ketch rah hen</i> yes yes two people if going along the same route a b, the two vehicle can work along in tandem to pull each other
59	Nishant	<i>eisa jagah mein har ekhi ka paas ekh skooter rehta hein yaa two wheeler rehta hein so two</i> <i>wheelers ko oin karke family ka outing ho jaye tho sab milke ja sakte hein</i> in places like these, everyone will have two wheeler or a scooter, so they can join two wheelers and go for an family outing all together
60	Rishi	uska ekh fyda hen ki if one wheel doesn't move then what, then if you have to go somewhere you have to share it, you have to share with some person with single wheel so that you can move to one distance. <i>udhar ke bath he can pair with someone else you benefit someone else and you go.</i> <i>ha ha ha....car pulling ya bike pulling ya transportation pulling zabardasti kar reha hai... we</i> <i>pulling zabardasti ho jayega</i> the advantage of this system is that if you have broken system you can pair your vehicle along with someone who is going on the same route and upon reaching if you want to reach the next destination, you can pair with someone else. but this would cause forced sharing with people
61	Patkar	three wheeler commercial use
62	Lakshmi	three wheeler without carrier
63	Rishi	<i>not a commodity us se acha aage ek wheel hothe hen piche do hota hein, dho wheel aage</i> <i>piche ek wheel</i> not a commodity carrier, two wheel in front and one wheel back is better option instead of one wheel front two wheel back
64	Lakshmi	how will you maneuver
65	Rishi	<i>four wheel you can maneuver right, peach ka wheel turn hog, who chaltha hen na peeche</i> <i>sein bhi.</i> just like how you maneuver four wheeler, you can manuever with the back wheel that can run ... (explains again in marathi)

66	Lakshmi	ok ok ...hah..ha there will more number of wheels at back
67	Rishi	toeing vehicle nakechna ka...what happens engine is in back and the direction is given in front it is like toeing vehicle... it can pull... what happens engine is in back and the direction is given in front
68	Lakshmi	why not double decker
69	Rishi	<i>ulta</i> opposite
70	Patkar	<i>aisa</i> like this
71	Rishi	left hand driver and right hand commercial box at back
72	Lakshmi	<i>tractors eisa hen tho</i> so it's like a tractor
73	Rishi	<i>haan</i> (yes) he is the driverno its a three wheeler
74	Lakshmi	<i>auto-rickshaw jaysa apun khade karte tho..haan parking</i> like how we park an auto-rickshaw
75	Rishi	<i>wheely maar reha hein</i> like performing an wheeley (bike stunt)
76	Nishant	he he he he..... oh very nice
77	Patkar	<i>aisa gira tha</i> yeah it fell like this
78	Rishi	<i>ulta gira tha</i> it had fallen upside down
79	Lakshmi	the toe rider
80	Rishi	<i>to this is the luggage area.....who admi ethar sein betega</i> this is the luggage area.... the people will sit together here
81	Patkar	two wheels in front and one in back
82	Rishi	yes two wheels in front and one in back
83	Patkar	<i>manoeuvring peeche</i> back manoeuvring
84	Rishi	<i>haan manoeuvring peeche</i> yes back manoeuvring
85	Patkar	<i>ab sahi betha</i> now its placed in the right way
86	Rishi	exhausted
87	Nishant	<i>tum exhaust ho gaya thumarahbiwi hua tho hogaya kya,.....ha ha ha ha</i> <i>you've also gotten exhausted? ...ha ha ha</i>
88	Nishant	<i>ha ha yeh acha laga uska suicide zabardast tha ha ha ha ...yeh reverse wheely ..he</i> <i>he...human wheelytho rah ka ye banathe hen ...if your exhausted ... aapko banana</i> <i>hein ekh</i> (everyone laughing) his suicide was forceful, this is reverse wheely.. (laughing) ..human wheeley so we'll make Rahul do this.... if you are exhausted.... do you want to work on one?
89	Lakshmi	<i>sir mien ne banaya</i> sir i have done this
90	Nishant	<i>exhausted tee hein good....chalo lets stop</i> if everyone is tired, let's stop
91	Lakshmi	i think all of us instead of thinking creatively we were trying to overcome those permutation

		on whatever we did designing first and then thinking creatively.so like
92	Nishant	but creatively hua
93	Lakshmi	<i>haan</i> (yes) Rishi like here single wheel coming and forming a vehicle that came after two three attempts
94	Nishant	ok...
95	Lakshmi	for the first instance is to overcome the existing limitations
96	Nishant	limitations
97	Rishi	sir actually the thing is in that particular conceit if i did basic structure of the vehicle is to what it is. how you implement but what is the other strategy which is going into it does make a change in the mobility in the scenario so rather ...
98	Nishant	<i>but user ko apna ekh dream batha ne ki... mera yein dream heinas a user u are saying ki mien chahtha hoon ki ek module hon aur char mere family members milke jaa sakate hein</i> but for a user to be able to convey a certain dream, that "this is my dream" ;as a user you are saying that " i want a module with which i can take four family members with me
99	Rishi	family member or just random any person
100	Nishant	<i>it depends upon kitna configuration...toh aaplog ka ekh dream tha ki eisa kiya ja saktha hein. is a possibility i think you wouldn't have come up without this kit</i> it does depend on what configuration you are using, so you had a dream that something like could have been done and it is a possibility that you wouldn't have come up with this without the kit
101	Lakshmi	<i>haan</i> yes
102	Nishant	<i>that is the possibility that you won't have explored if this kit was there.....eisa mujhe lagtha hen....but i made your inputs on it ki whether kit would have helped you visualize new things.</i> that is the possibility that the you won't have explored if this was there, i thought it this way, but i made your inputs on it whether the kit would help you or not
103	Rishi	the kit has helped in visualizing but there are lot of limitations with this kit asnt jo block; when you expect a wheel or when you are talking about a wheel that is to be actually expect a wheel to be there rather than the..... this is the kit where very abstract form of a wheel architecture...so sometimes it help you explore the possibility but sometime when you feel like...that you have a thing in ..and you don't get the direct...you know object..
104	Lakshmi	component
105	Rishi	component then you feel somewhere restricting what you were really intending to think.
106	Nishant	right...right
107	Lakshmi	i thing for us the designers will have the tendency to sketch out everything but this is useful to those who are not comfortable with drawing
108	Nishant	<i>in fact it is essentially designed for the users... thaki who quickly apna ekh thought jo process hen usko batha sake sir aapko kuch kehna hen...</i> in fact it is essentially designed for the user so that they can easily translate their thought process quickly
109	Patkar	<i>meh toh photographer hoon...lehkin mere koh acha laga alag alag shape karne ke liye...enke saath bhi interaction ho gaya ...</i> i am just a photographer, but i liked how all different new shapes, and also interacting with each other
110	Nishant	very good
111	Rahul	people are different about design of vehicles two wheelers and four wheelers different users start-up...

APPENDIX 8: TIME LAPSE VIDEO MADE WITH STILL IMAGES

CD/ Folder (PD Analysis Time lapse video)



APPENDIX 9: VIDEO OF EXPERIMENT WITH FOREIGN EXPERTS

CD/ Folder (PD experiment in Sonderborg Denmark)



APPENDIX 10A: TRANSCRIPTION OF CONCRETE PD ACTIVITY IN SONDERBORG, DENMARK

1	Mod	You have seen the video
2	Person 4	Yah
3	Mod	And this particular slots; If you see the six slots, are designed in such a manner that it can create car or two wheeler, three wheeler or anything of that sort.
4	Mod	You know. And these are the wheels. of course; Very big it is.
5	Person 4	Yah
6	Mod	of course; Very big it is. And these are the various other combinations. Look at these human beings
<i>All Laughter</i>		
7	Mod	These human beings. They are slotted as well as non-slotted.
8	Mod	So, if you are thinking of a two wheeler or a three wheeler, you can just place it like this and see man sitting on a two wheeler.
9	Mod	These two designs are a hybrid. You can design as a community whatever you wish.
10	Mod	I am leaving these things with you. You can choose. You can play with the things.
11	Mod	If you want this person to sit, you can use this as a seat and just allow him to seat like this
12	Person 2	OK
13	Mod	And so; Then you can start building up
14	Person 4	You can only sit, Right?
15	Mod	Yah
16	Person 3	Wow, they can also
<i>All Laughter</i>		
17	Person 4	I see some good reasons for that. I mean...
18	Mod	Interesting thing would be, I know. I have done this experiment with the small group in India
19	Mod	And that's their way of looking between the gap between windows of a car
20	Mod	Might be very interesting to see your way of looking at the gap
21	Mod	And so very interestingly diversely. You know. How you sort of look at this gap between two wheelers and cars.
22	Mod	And that can be your interpretation to the user.
23	Person 2	This is the definition of car, we are looking at making an economic car
24	Mod	Its actually more of utility. Its little different shown in India. As I showed you that image
25	Person 2	Yah
26	Mod	It's a little different. Lots of people also have a. I should have shown you more images but I don't have so much time.
27	Mod	There's a lots of people who have these mopeds and then they carry their..... Lots on stuffs on that

28	Person 4	Yah a lot of...
29	Mod	And then they take it to the market, sell off the stuff and come back
30	Mod	So, it also source of their livelihood. Everyday
31	Mod	And if they take their wife and kids to places
32	Mod	So one particular vehicle does a lots of roles
33	Mod	So the utility, the way you will be visualizing would be probably different than it is there so.
34	Mod	But then, the tool, it is more less.
35	Person 4	So you want us to make something that would be used there or
36	Mod	Whatever, information and knowledge you have, you can sort of design and ...
37	Person 1	It doesn't have to be on Indian context and
38	Mod	You can choose to be.... Its very difficult though because Indian context; I don't know whether you are aware of
39	Mod	So maybe, you do it for this context. You know.
40	Mod	Maybe, do it for yourself. Now there is a community; how...
41	Person 3	I think it should be more like for us
42	Mod	Yes as a group, what do you think. You know. What is your expression that would be.....
<i>Mod exists</i>		
43	Person 4	I have three cars
44	Person 3	You have three cars, I don't have a driving license
45	Person 1	Things happen. You wanna buy one ?
46	Person 1	I have one car and its there on the ... Station car...so
47	Person 4	What irritates me really is that there are a lot driving around in that car which is way too big
48	Person 1	Yeah
49	Person 1	We have a staking car, we don't. I mean. We have two and we never use it
50	Person 1	And then we have a small car with only two seats and lots of room on the back
51	Person 1	So you can have a Christmas tree and take the and that's the one we use the most
52	Person 1	And now we have got our another own car which have a couple of more seats. So that, you know, if they have to take somebody somewhere, we can still do that
53	Person 1	So that, you know, if they have to take somebody somewhere, we can still do that
54	Person 4	Also you know that there is a very much of western problem.
55	Person 4	People buy a bigger car because there are some occasions where they need a big car
56	Person 4	And if they are not in occasion or they have to buy a Christmas tree...
57	Person 4	They have money only to buy one big car. So it has to Everything
58	Person 4	So we should have some kind of flexibility
59	Person 1	Flexible car
60	Person 2	And then I go to work most days. Which is with my laptop, but you to carry luggage or furniture or
61	Person 3	That's also a kind of one volume car like the Picasso and all these. You can just flip flip and then.

All: Yeah yeah

- 62 Person 4 Its not still a very big car
- 63 Person 3 Not still a very big car. It doesn't look big but it is big
- 64 Person 4 So would you have an experiment. The problem with the trailer is also, You know, If you have to go to the moto-rail, Maybe this may be the reason that people want to have space in the car...
- 65 Person 2 things to come, trail mopped one
- 66 Person 1 Like the catavault, like it goes flip...
- 67 Person 2 Nobody seems
- 68 Person 2 There would be the same problem with and
- 69 Person 1 Expandable car where
- 70 Person 1 Why would break up their arches ?
- 71 Person 1 Like if we have an expandable car and you use the solution where to put the fringes in and at least you would have to have some place to put those fringe when you are using the big car and if you don't have a garage and you live in a hut or something then what gonna do
- 72 Person 4 That have to be collapsible
- 73 Person 1 there would be a probably a car....but thereproblem is that, there is no storage place
- 74 Person 3 If you have transversible cars, where the hood is open, then you just pump it at the back and sit on it. It will close on the storage place
- 75 Person 2 It's
- 76 Person 3 Then you put the things on the back side, I mean on the back seat
- 77 Person 1 There might be a security issues as well
- 78 Person 2 It depends on the...I mean you know using
- 79 Person 1 As long as I don't have to sit on the seat like that..how hard is
- 80 Person 2 You can have return through...have something which would be moving. Let's put a...
- 81 Person 3 I would like to see how convenient it is
- 82 Person 2 What would suppose if its a small car
- 83 Person 4 Convenient
- 84 Person 2 Do you certainly know Rollai Rotwan ?
- 85 Person 4 About what ?
- 86 Person 2 About Rotwan...It is a car and it is a British car...Mr Bean's car
- 87 Person 3 The one that has flat at the front...
- 88 Person 2 No no its
- 89 Person 3 Not the fiat car
- 90 Person 2 It could 3 rules
- 91 Person 3 What's that Seattle, the Italian one
- 92 Person 4 Yeah, that opens around
- 93 Person 3 Oh sorry
- 94 Person 1 That's pretty cool...It quite a few years back

- 95 Person 2 It's lot about where you come from...Oh sorry
- 96 Person 3 For me, them. For example this is why the...car should be symmetric...off course its for the...driver...Because I don't drive so I don't consider this is working
- 97 Person 2 I mean you...Well do we realize that we don't sit in the middle of the car ...I mean
- 98 Person 4 Or maybe we could make something...where we can sit in the middle
- 99 Person 2 Alright...Because, well I have something which may be focusing on the wrong sets of rules here, so I don't drive in Denmark
- Laughter*
- 100 Person 3 So for example if these you sit here on the top on these, but then if you are...if you have less people and let's put this and you sit here. But the problem is something...
- 101 Person 2 You and the driver needs to be at the same place actually...Considering the you get used to...so that's my sort of country
- 102 Person 4 That doesn't matter which side of the country
- 103 Person 1 Could you have like a, the person who is driving could...have be in front of flexible steering board that can move around
- 104 Person 3 Yeah but the thing is...do you...you gonna left around things to the real or the to the size of the thing...I really don't know, but that might be the thing...but when do you turn after the front
- 105 Person 1 It might cause a lot of accidents...if we move it around
- 106 Person 4 You have to have idea about how you are
- 107 Person 3 of course you need to know how it is gonna turn
- 108 Person 4 Available of proper space depending on when you are driving and turn on. I guess it has to be rooms for engine right
- 109 Person 2 You can put the engine anywhere
- 110 Person 3 For example you can put the engine on the wheels...If you have a electric car...like they do it trains now
- 111 Person 1 Ok...
- 112 Person 3 So...
- 113 Person 1 So if this is the engine, we don't need that...
- 114 Person 3 Okay
- 115 Person 4 So just do you know it have this like....bo..bo..bo...(making sound) it comes slightly to the top...People in the circus like they do it
- 116 Person 2 We have a
- 117 Person 3 Like a tent...
- 118 Person 4 No it's not a tent...it's a stand...you drive with it but when you are stationaries and pulled out and give it much more space and move in
- 119 Person 2 Its really big that we can move, its big in particular... size tubed thing...so that's the thing and it make even longer space
- 120 Person 4 off course the chariot system make something...something that is expandable
- 121 Person 2 What if we draw vertical straight room thing...

- 122 Person 1 If just track head band things like....if you have a front of the truck depending on the applicable load, they drive on, or drive with...if you put two pieces...they put down there sets of wheels while on the 2 sets of wheels
- 123 Person 1 They are just on their own but like just in front of the truck like the two sets of wheels...like 4 wheels and then they put lower....and then they put load for you
- 124 Person 4 If you have personal car . you amend like this...like I am afraid which one will work
- 125 Person 1 I don't know
- 126 Person 2 But you can have dimension, see one at the back...
- 127 Person 4 What if the small wheels stays but cannot make a small car
- 128 Person 1 Oh...yeah... yeah..., we could have a 3 wheel car
- 129 Person 4 You can't steer this ...
- 130 Person 2 I will throw...
- Laughter*
- 131 Person 2 So we are just...
- 132 Person 3 So then we have to move it like this... well, I think in case of wheels, we suppose to use excessive space.
- 133 Person 2 Yeah...yeah...
- 134 Person 4 Yeah...yeah...
- 135 Person 1 Because if you don't do that then you are losing the space
- 136 Person 2 What about the driver
- 137 Person 3 I am wondering if the third man, what is hsi position
- 138 Person 1 Like that...
- 139 Person 3 Or just like that...
- 140 Person 2 Or driving around with it...or this
- 141 Person 3 Or I have slide it out...
- 142 Person 1 Then you can around as the casing will out. Yeah you need car like this...
- 143 Person 2 Then just this like something coming out and put like a car...Then let's put this into side of this...
- 144 Person 3 What's gonna be this for ?
- 145 Person 1 This for the people...
- 146 Person 4 You could place two people...
- 147 Person 1 And the driver...
- 148 Person 3 So this driver is actually a...
- 149 Person 4 It like an mopped...
- 150 Person 3 It is a new way of driving and the driver is relaxed
- 151 Person 1 I think this is because, I wanted to see...
- 152 Person 2 Wait can you just exchange the person. Put that guy...
- 153 Person 1 So this could be the either the storageof the people...
- 154 Person 2 In this case, it has comfortable seats

155 Person 1 Or may it can go just like that...That looks like a tractor...

156 Person 4 Well one thing is, off course if you are driving in daily and you have people sitting in the back then there is some kind of biuld between or its gonna be awkward

157 Person 4 There will in some kind of socio-economic acivity...May be we can have some compartments there...But what if you go somewhere with family ?

158 Person 1 As because she said something there...

159 Person 3 Now there's nothing

160 Person 4 Yeah ! now there's nothing...I was talking about the foreman

161 Person 1 But what if we have in between a driver, that was pretty cool

162 Person 2 But when you have a wider car, there is a zoning

163 Person 4 You put the driver at the front of the car...This is also forefront of multiplex...

164 Person 1 It would be nice if we have 8 people sitting in the car...its always like the one sitting in the back, come and follow the between two. And, if the two thing in the back the car will always the time looking elsewhere...

165 Person 2 Not concentrating on the road

166 Person 3 It can just bit like this ot cannot be in line...so this way you can reduce the space a bit

167 Person 4 So it becomes a pointy car...

168 Person 1 I mean it could be around

169 Person 1 It might cut some of the...

170 Person 2 It could be present before aerodynamics...so I would like go around

171 Person 4 Like it will like be the multi-planner...It like level...It can forms like a this direction

172 Person 3 It can be dolphin kind of stuff or a shark...

173 Person 2 It could really beautiful...

174 Person 4 These are the wings...The bat mobile

175 Person 3 We are inventing then in front of us...

176 Person 1 Actually it doesn't the way are...right...Doesn't the bat will do that kind of things...it might not have that kind of...

177 Person 4 Yeah

Laughter

178 Person 3 It has wings, I think

179 Person 4 It have something that comes out... You know even in Greece, if you remember...you are not old enough for Greece

180 Person 4 I have seen

181 Person 3 Why it doesn't fit here ?

182 Person 1 It probably because of this...

183 Person 3 Yeah, but the other one is moving... Yeah so that one is stage two transformations...but can it be we use well like this

184 Person 2 Or will it be more sensible if we have in between which is like

185 Person 3 Or you can have it in different sorts... You know...may be like this

186 Person 2 You can have several

187 Person 1 You could use the wiser things if you need...could be a slide on like this...right

188 Person 2 Yeah...

189 Person 1 You could probably do it with just one...You have one over here and over here...Will probably screw up the balance

190 Person 3 No but the thing is that...Yeah may be big but there's actually not that much...

191 Person 1 It is something like yeah...not it could be like motobikes having a side thing...That works so yeah that way it probably could work...

192 Person 1 The thing is driving in one wheel could be a problem because the only is that you have consider that longer thing...

193 Person 4 But I was also thinking that if you are thinking about train...And how they make them longer and shorter... Yeah, well I was thinking about who really wants the part... You know that is expandable to...And now the train have this...and you know the train have this thing, which will have some space to keep it

194 Person 3 So its the same like the other car

195 Person 4 I think there is a choice to make whether something that you pull down and that is something still be part of the car or that you have something in because...The thing is that environmentally is just no if you just choose to expand the car then it's a bigger car but its still is heavy when you drive it in a way

196 Person 3 Can you just put it together

197 Person 4 Or dynamics to make it affordable

198 Person 1 Sustainably to get some

199 Person 2 An also be making very light weight compacts but if this is just storage you know the people it will quite light weight

200 Person 4 Actually they said about the trains, actually the trains Are mini trains together with trains so actually this could be on run...And this could another car...could like PLUP !!(making sound)...And you glue them and put them to have a bigger car

201 Person 2 Not concentrating on the road

202 Person 3 It can just bit like this ot cannot be in line...so this way you can reduce the space a bit

203 Person 4 So it becomes a pointy car...

204 Person 1 I mean it could be around...It might cut some of the...

205 Person 2 It could be present before aerodynamics...so I would like go around

206 Person 4 Like it will like be the multi-planner...It like level...It can forms like a this direction

207 Person 3 It can be dolphin kind og stuff or a shark...

208 Person 2 It could really beautiful...

209 Person 4 These are the wings...The bat mobile

210 Person 3 We are inventing them in front of us...

211 Person 1 Actually it doesn't the way are...right...Doesn't the bat will do that kind of things...it might not have that kind of....

212 Person 4 Yeah

Laughter

- 213 Person 3 It has wings, I think
- 214 Person 4 It have something that comes out... You know even in Greece, if you remember...you are not old enough for Greece...I have seen
- 215 Person 3 Why it doesn't fit here ?
- 216 Person 1 It probably because of this...
- 217 Person 3 Yeah, but the other one is moving... Yeah so that one is stage two transformations...but can it be we use well like this
- 218 Person 2 Or will it be more sensible if we have in between which is like
- 219 Person 3 Or you can have it in different sorts... You know...may be like this
- 220 Person 2 You can have several
- 221 Person 1 You could use the wiser things if you need...could be a slide on like this...right
- 222 Person 2 Yeah...
- 223 Person 1 You could probably do it with just one... Will probably screw up the balance
- 224 Person 3 No but the thing is that...Yeah may be big but there's actually not that much...
- 225 Person 1 It is something like yeah...not it could be like motobikes having a side thing...That works so yeah that way it probably could work...The thing is driving in one wheel could be a problem
- 226 Person 4 But I was also thinking that if you are thinking about train...And how they make them longer and shorter... Yeah, well I was thinking about who really wants the part... You know that is expandable to...And now the train have this...and you know the train have this thing, which will have Some space to keep it
- 227 Person 3 So its the same like the other car
- 228 Person 4 I think there is a choice to make whether something that you pull down and that is something still be part of the car or that you have something in because...the thing is that environmentally is just no if you just choose to expand the car then it's a bigger car but its still is heavy when you drive it in a way
- 229 Person 3 Can you just put it together
- 230 Person 4 Or dynamics to make it affordable
- 231 Person 1 Sustainably to get some
- 232 Person 2 An also be making very light weight compacts but if this is just storage you know the people it will quite light weight
- 233 Person 4 Actually they said about the trains, actually the trains are mini trains together with trains so actually this could be on run...and this could another car...could like PLUP !!(making sound)...and you glue them and put them to have a bigger car
- 234 Person 2 When you taking an engine now so its necessary...
- 235 Person 3 You could have your own car...I have my car and "hey" I need more space...Can you lend me your car and then I put them together
- 236 Person 4 When I will go vacations for four weeks and I will be more bored
- 237 Person 3 But might be you can just go to...you can't rent it
- 238 Person 2 Perhaps that makes sense

239	Person 4	That you choose you do, then you make difficult types of compartments so you could use big ones for heavy loads
240	Person 1	For passengers
241	Person 3	Yeah because this one here actually this all the cart...I mean in this way, this will be another cart, this part, and this one for containing them so its your pick-up
242	Person 1	So this is because I don't have any kids so I have small like that she have this because she have kids
243	Person 3	And then what we do is to put them together then we have like a 3 person or 4 person car with 2 compartments for stuffs
244	Person 2	But there is short sider in that...that you need to have lot of different people who lived near you, I mean you like to have different kinds of
245	Person 1	Somebody like me, we kind if more or less need two pass anyway because the way line...right so we could have that one and that one
246	Person 3	And then one day we can go with the family and with the Christmas tree together and then the other, it can be you and Christmas tree together
247	Person 4	The idea...the starting point was, the people have only one car and have to use it for several purposes, so if you gonna have two cars anyway, so you have just 2 cars
248	Person 2	For couples it makes sense, because you know if you have either you have already two cars it to have too small
249	Person 1	You would still have to find somebody who could supply the product
250	Person 3	It like the Norway people actually share their cars ride to go to work so be actually can be linked that to another one....but that's just one more to working so at least you reduce the consumption of energy
251	Person 3	But is it possible to connect cars like that...it would be fun
252	Person 1	There might be some mechanism of the wheels because these would have to build in the other, I mean normally would be going that way right, except when you are reversing and if you connect it like that way
253	Person 3	If it is like front wheeled powered then the one that you drive from are that going to be powering...and then the other one be one it would just like going...it might going up
254	Person 2	For me, if I wanna drive by myself it from where we are driving, I don't even need 2 seats there, like it extra way for me...
255	Person 3	To have the 2 extra seats, so you would matador and other car...So it could a matador and other car...
256	Person 1	Right, have you seen those, the trikes...it like the free wheel multiplex, and then they put on the trailers, mopohomes and all sort...it's not a car, not a moto-bike, its a trike
257	Person 4	It has been decided in other words
258	Person 3	But what happens, what has been it like
259	Person 1	It's for different kinds of purposes as well
260	Person 2	I feel the crucial thing is always the difference between a trike, bike and mopped. If I am driving in Denmark in December. I don't wanna be driving mopped...

261 Person 3 But you use the BMW one that look like cartoon, like the Japanese cartoon with the thing on top...no that comes like a cover shape...That was some popular at some point but now they disappeared, I have not seen them again

262 Person 2 Yeah Because kind of between them or nothing

263 Person 3 You should also be able to close the and then it becomes a really strange thing you know, if you can close the top most part and then your legs are out

264 Person 2 And other thing is that the condensation is sufficient actually functional. Now I think the most interesting one is most probably which... was one which have 3 people...

265 Person 3 And then we take this out...

266 Person 2 It was then a good part of idea when coming to end

267 Person 3 I don't see what I am doing

268 Person 4 This was the attachable car

269 Person 2 I suppose this trending at back...So we now address several different problems

270 Person 1 No its different illusion right...It could be like a retractable one but when you said that CO₂, the environment thing then we still have to wait

271 Person 1 Then the rental option, the joining option, well that still be joining option, but the sharing options or the other options

272 Person 4 So basically the question is whether you have expandable thing in the car or external

273 Person 2 So I think we all agree that there are several situations where you have a external to the car then it saving cash then or it will be like from here like this

274 Person 3 You remember the car Wazel, the car Balchea. I don't know that the way so you say it be in English, but it Italy they say different. Which the back then was actually flat, like completely flat so they could just like (Pluck- making sound) connect them straightway...Or the innovator really work out like the Fiat, Chipenthanto and other first version also have flat back, the way you could just connect them

275 Person 2 There is something I see about the having joining two parts, it may be you can carry much heavier stuffs than a small car

276 Person 1 Yeah, that's true

277 Person 2 If you could join the two engines together especially directly joining to wheels, because you are limited by electric

278 Person 4 I know its sound like something really intresting

279 Person 3 You missed out

280 Person 2 So its was to becoming two cars together, you can carry much heavier stuffs, with two engines, which would be able to use

281 Person 3 And then you synchronize them or something or have like double the horse power

282 Person 2 If it is like a n electric car, then actually it will lead with plug. But few plug put together, then there is also an engine plug

283 Person 4 The plug...that sounds something really good

284 Person 3 That's what that have been doing...the plug.

285 Person 2 They come in many different styles you know...this is the family patient...this is the

286 Person 1 What if people have to stand here

287 Person 4 Where in the car ?

288 Person 3 That will be Italy or France...They said they want to make the people stand....I don't know if the that was a joke

289 Person 2 There was a Bush's commentary, so common about we four but you know it's a 100% joke

290 Person 3 I think that they written about the joke, because the people will think what the fuck this is. They say it will be for free or really cheap but then I have to start

291 Person 2 You can't be dangerous also

292 Person 4 And you don't want a safety jacket...

293 Person 2 They also need it like deep ingrain process like 10 hours....Because you are all packed....

294 Person 4 You stand enough enough and you don't get food or drink...You conquer... the tower

295 Person 3 You just be there...

296 Person 4 In playing fashion...you are the last man to play And you cannot have a...

297 Person 2 How many times do we drive a car less than a speed of 100, like more than 20 min I think it is 20 min

298 Person 4 Probably...

299 Person 2 Or if I am travelling in bus you know, I would start feeling grumpy So I think car and standing idea with lot of people...

300 Person 4 But could may be have different types of sitting

301 Person 1 Oh, Yes...What if people are lying down in a Matador

302 Person 2 I am just thinking about families, kids...Who don't want to sleep due to much of noise moving around actually when I was a kid, I always, I know its not legal but I was lying on the right side of the car so that's the back seat and then you this thing...I was lying here

303 Person 1 You have land rover...right and it has these kind of seats...My dad actually pulled, he pulled the moat to put on the seat so you put all kind of storage underneath, the layer and then put mattresses and the kids always lying down there, going to France lying down there...We were probably very quite...you know we were leading and sleeping

304 Person 2 Yeah ! My dad say that he used to have morses long back and when my mom was pregnant she smoked with me

305 Person 3 Okay, I think we are done...

306 Person 2 I am speechless

307 Person 3 What time we are gonna have lunch

308 Person 1 Because they wanna bathe this morning...

309 Person 3 Lunch is a bit heavier...

310 Person 3 We made it open the castor not on this, big enough to sit on it...

311 Person 1 Its covered...

312 Person 4 We have imagine that was abstract...

313 Person 1 No what we were trying to do...is at least at present my version of things...we customize, it firstly with the pieces of the and then to rebuild the car. So you can have the car like that is working

314 Person 3 Then you can connect with you know more cart. No no you have it like a leader car for 4-3 people. Like the lion shaped car, but then also have needle that one supposed to have 3 wheels, but what the wheel conduct together like the back as it shown and then it becomes like a car with 3 seats or with 4 seats and storage so that we can share with our neighbours or the people you want to so you don't have to buy like a big thing

315 Person 1 You can just having one car for most of the thing

316 Mod So were you open to translate this idea through this kit...

317 Person 1 Somehow...

318 Mod Somehow...Ok

319 Person 1 Somehow because we needed to have the 2 cars join together, that was the big difficult...

320 Mod Because the slots were pretty defined...

321 Person 4 Actually I think for this for this two pieces because I think didn't have enough pieces

322 Person 1 And some pieces may you can may be reshape a bit so that they can put in slots...On you take the shape like that...If you have not spit the piece and gonna on actual part like that...and more wheels

323 Person 4 You know you can re-shape that...

324 Person 1 Hello...

325 Mod How are you can comparing the size ?

326 Person 1 That also for example, these become, the will become the flat and then you take it, then it becomes smaller...also things could be like one durable one to stop

327 Person 7 So the complete body should be excellent and if see a

328 Person 1 That fabric would have painted here...For me I think we were concentrating to the make

329 Person 4 We just talked about it...

330 Person 1 But we imagine in way, that there could be a wheel here, that could actually put it up

331 Mod But how did you initiate, how did you conceive that thought...Tell us, that "this help me receive the thought..."

332 Person 3 I think because, she has 3 car

Laughter

333 Person 1 I think am very shocked that...So we had to find a solution...

334 Person 2 I mean the problem came out speaking about the solution

335 Person 4 Sometimes the point social backdrop matter more than talk

336 Person 2 We are run this car right, because we were doing once we were doing more

337 Person 3 In the video, we just looked that the table is approximately like this very much closer and difficult for you to move it because it is very...Are you all watching the video...No really...not really (All)

338 Person 6 But it's the same thing, the people close to model ...touch it and the people all way didn't touch it

339	Person 3	That could be a nice thing...If you are at sitting and then the eyes are on, the video and then now you came and then...Because actually I though you did it...
340	Person 2	Yeah, that would have been...you know I am still thinking lets start over there
341	Person 4	It started there...I lost my grip
342	Person 1	I win...I remember getting up at some point because that was only was I could kind off
343	Person 7	So its different because of the video, they don't sit at same place
344	Person 4	So...so the table actually...
345	Person 2	There should be different way we fix the marble if they not very convenient
346	Person 4	So you say its an idea once in a while to sit with people and you have to get up and cancel it...
347	Person 3	Or just turn it...
348	Person 2	Or a turning table like a small or something
349	Person 4	Or might be the Chinese desk around..
350	Person 3	For example for me, I always at it like this...
351	Mod	So for you perspective is different...
352	Person 4	And I have seen it this way...
353	Person 3	And if I look at in this way...its completely different...It's really really different. I mean for me the shapes of objects...constrange but go over it but thus view thing, now its the perspective is like much stronger, that affects me much more I mean look at this now, its completely
354	Person 4	So may be see it wide now, may you can fix the base in a way so it could move
355	Mod	Yeah sure...Either the table move or the people are soft around you
356	Person 3	Or they know can move it, because for us, you move a bit to see the wheels
357	Mod	Or its to make it a circular so that it doesn't sort of gives you this kind of edge so it has to align like that. Or you can just make it circular...
358	Person 2	But then it's also like room and two headed surface and used to be a part of the global space
359	Person 3	Yeah, what I said it may be its also has wheels on the rims so there people will see that you remove because now it can moved, but you don't, you don't even realized that, it looks more like a volume
360	Person 4	Stationary...but if you put like 3 more wheels even if they don't do anything or something like a wheel the people will start turning

APPENDIX 10B: TRANSCRIPTION OF ABSTRACT PD ACTIVITY IN SONDERBORG, DENMARK

1	Person 4	its actually wont very concrete , do they stand for something?
2	Moderator	these are.... they just stand for something.. for e.g. this has circularity built into it..... it's a reflect... it talks about the wheel so the whole proportion of this built around the basic wheel unit. so once you start building it you will realise how important this
3	Person 4	so i can make this into front or the back of a car.....
4	Moderator	you can do whatever
5	Person 3	it can be a driver or ..(unclear audio)
6	Moderator	so this can be you bag or whatever
7	Person 4	so this are secretly not abstract .. because this is the wheel... not as abstract as that
		<i>moderator leaves</i>
8	Person 2	what if i use this here...
9	Person 1	i think you can do it...(everyone laughs)..... how much time do we have
10	Person 4	important question(everyone turns to moderator)... how much time do we have
11	Person 1	how long do we have
12	Person 4	why do you do this nonverbal communication
13	Person 3	i think it's very different for us i guess.. like the two wheeler and four wheeler... i have never seen five people sitting on a scooter here but...
14	Person 1	not here but .. i came back from India last week...two talk about their experience in Vietnam in a tuk-tuk (auto rickshaw)
15	Person 1	i was once in a tuk-tuk where there 2 Persons sitting inside ...and they were still trying to get more people inside... i think for them, the one of the issue is flexible unit ... so they can transport one or two person.. or 5-6 person with luggage .. in a way we can corresponding issues in our society with the coming of smart cars and other small cars .. and we can redesign orientation towards other smaller cars
16	Person 4	are you perhaps be interested in looking at .. if you make a very sustainable car that lasts for 60 years , then you would need.. the same car would need to serve different sphases of life...so you need your first car when you are graduating ..and then you need your first child car... the second and the next child car ...in the end they do that with houses...
17	Person 1	and also ecologically if you are doing an activity you don't need an enormous car... but if you are doing the same with a family we can have expandable unit ... something that makes sense
18	Person 4	so this is a community car and this are other personal little cars , and you can just connect your car to it .. and take it for a holiday ... otherwise it just sits there .. you can drive your car without it.. or maybe something
19	Person 2	so maybe we can borrow from each other
20	Person 1	maybe if you have a camper which you don't need all the time.. so it can a common shared facility but the same thing

- 21 Person 4 this two boxes just make this real time and each day you build your car
- 22 Person 2 i like sharing idea but first i was thinking if you have all the parts you can make it yourself .. but in India you don't have money to do it .and you don't really need it... i like the idea of sharing...
- 23 Person 1 but from the ecological problem...we have the same problem but we don't have the same economical problem ..
- 24 Person 2 i always use the bike for shorter places but if you are moving furniture you will need like a car or something
- 25 Person 1 that's interesting I am also a biker and i have only the bike but i don't have a car .. so for me cars are strange ...
- 26 Person 4 we bought the first car when we had our first son it proved to be difficult not to use.. but there were concrete circumstances especially the stuff you need around the kids(diapers)
- 27 Person 1 therefore you can imagine also that there is this concept of sharing car where you go borrow the car when you need a car .. you can imagine that the small unit can be borrowed and the additional unit you can borrow ... various other units if you need them...
- 28 Person 4 and i think some people would like to have something of their personal because people put their stuff in their car , for us the house is small so the car for us is additional storage space .. but if you borrow , you have to clean it before giving it back.. it would be like a hotel ..
- 29 Person 3 yeah yeah ... it's true...for a rental car
- 30 Person 2 why did you place the big parts...
- 31 Person 4 assuming that you wouldn't need it over time...
- 32 Person 1 the other question is what would be the unit.. how big or how small .. that would be the basic unit i would ,.. like ... that's my car
- 33 Person 4 symbolically it would be something where the steering wheel is ..because its your .. you are free to go.. that's what people also want to drive a car...they want to not sit in a train and let someone else drive.. you could say "what non sense" but it is strongly felt emotion
- 34 Person 1 i would say that it is the interior of the vehicle but i don't know whether it will it make sense from a design perspective... but it would be interesting consider that the power would be separate...in the sense that if you drive a little bit.. without the big thing then you won't need much power.. but if you do a long trip with the camper then you would need more power... so it would be interesting to think of variations in terms of engine so that you can have a minimum engine , and you can add engine parts
- 35 Person 4 may be you add engines, parts or change , in a gas station , they say that they drive a little bit and you think i have ... go further and instead of adding gasoline, you can change the engine, better engine.
- 36 Person 2 but could we put(everyone jokes).....but i am just thinking' about the unit , i am thinking as small as possible... but may be that's not
- 37 Person 4 you were thinking about what kind of thing you want ... and you were thinking about the dimensions
- 38 Person 1 i was thinking a living space that could be eventually be separated from the engine.. so that you more than just rise... but...the living space can be expanded and modularised

- 39 Person 2 it is a bit difficult because they are a bit..... it's hard for me make anything small compared to everything
- 40 Person 4 i would use this this , this would be the central unit somewhere here... i am already going beyond
- 41 Person 1 this would be for example be the living space
- 42 Person 4 in the car?
- 43 Person 1 uhhhhh
- 44 Person 4 why would you not think of this as the garage in a square where you can get your stuff.....(everyone laughs)... let's put the lid on we have to design a car
- 45 Person 1 so may be the basic unit even if it has to be this
- 46 Person 2 so the basic unit does not have wheels.
- 47 Person 1 no
- 48 Person 2 how would you use .. if this is just this box.. you can use it before you go, and you are gonna .. you see .. how do... it to move...
- 49 Person 1 you have a minimal mechanical part that you can use ,which you can change, which has minimal mechanical ...
- 50 Person 4 wheel and a something ...with a one wheel thing ...and you would have to find at least two different people driving to the same destination ... otherwise you cannot build car...because you have only one wheel
- 51 Person 1 a collective instance of irony.. so how many minimum wheel do we need to
- 52 Person 4 Person 2 for a bike and Person 3 ... for a car
- 53 Person 1 if you have living unit may be you need Person 3 wheels ... it is the personal space that you would.. put all your personal stuff in it and you can sit
- 54 Person 2 like a bag pack...
- 55 Person 4 that it is pretty big piece... you think this is the real dimensions of the wheel and then this is the one
- 56 Person 1 but even conceptually i think... i know we have this and this is a bag pack, or we have something like this and this which is more like a room where people can sit , so how big it has to be , it has to be just container or is that something like a living space where you have space to sit
- 57 Person 4 i think there two thing, there's the living room and then there is the minimal car parts like steering wheel where you can sit behind and say that this is my car... this is my basic car unit .. if it would just be bag pack the it wouldn't be a transportation device yet. it would just be a box... i think everyone will want to have their own ... even if you don't get all of the other things , if you don't borrow any of the things today then you can still go somewhere.. but the question then is it would be only for one person , one seat like a motorcycle.. or is it already for two people
- 58 Person 1 i don't like this .. this looks like a motorcycle but small box .. and it's not really ...
- 59 Person 4 suppose everybody has this ... a scooter and then you could make it into a car ... and you could ... then there's the issue of personal space .. but maybe we drop that ... what would

- be the most important in car .. just space to put things in or to have at least a thing in front of the door that is your own way of transportation or just none of the above
- 60 Person 3 i just need a car ... no
- 61 Person 4 ... what is it in the car that you want at least ...
- 62 Person 3 i need at least a transport , to go somewhere and it's nice to have space for yourself that you can leave in car , like i have my ice skates , summer and winter . there is a outdoor ice skating so when i am going back from work i might go ice skate .. but i don't need it in my car .. it is convenient.. to have it in the car always ..
- 63 Person 4 are those the only thing that are essential to car , space and transportation or doing this .. but if we look at this
- 64 Person 1 but a lot of people using a car love the mess of the car, in the sense they the cars with seats and the mess that they can leave... the things that are...because if you have just a container you put in everything in order .. send what people i think like also in order to to make this space personal , everyday mess, things that you leave so it can be a bigger vehicle
- 65 Person 2 can it be that it is part of your home..
- 66 Person 4 the front part of your house .. yeah but i was thinking .. always the day before ... lot of times we go to France for summer holidays... and we have a big tent and every year we have the same conversation, are we back in the car , late in the night or we do it the very early in the morning like 5 or 6 o'clock... so we can get on the driving belt.. but if we pack it a day before then there is possibility that your car is stolen and we have nothing and there is all the expensive equipment and the tent in there, so every year i pack it in the evening and unpack everything so that i know that for sure that it fits.. because that's important too i don't have to worry that everything will fit in i'll redo it in 6 am morning .. and there are nights i don't sleep at all..
- 67 Person 3 a garage can be simple solution to this problem
(unclear conversation)
- 68 Person 1 if this is the car , i think that it would be back of the car that you could just ...
- 69 Person 4 like it's a part of your home and the next moment you would connect it to your car and the i would really like it
(unclear conversation)
- 70 Person 1 the rear of the car can be the front of the home.. like how would you use the space of car when we are at home, for e.g. we can transform the space of the car into a cinema room where we look at movies because we need to sit like this for watching the movie, so we could imagine that we could use the space of the car at home
- 71 Person 4 like a couch
- 72 Person 1 yeah yeah .. sort off
- 73 Person 2 what if the part of the family uses the car and the other part wants to use ...
- 74 Person 1 you have the back of the car which is detachable and stay home but we can imagine more thing that can stay home and be part of the home and multi functions...
- 75 Person 4 ok you have mobile home, so we are talking about mobile homes. almost
- 76 Person 2 is it like a oak bound home which we can take pieces and...

77	Person 3	so instead of putting things to your car, you can put parts for your house
78	Person 4	and the n you have to decide how big part of your home do you want to take todaytoday
79	Person 3	and the hope that no one takes your place when you come back....



APPENDIX 11: VIDEO OF COLLECTIVE FORM GENERATION

CD/ Folder (Collective Form Generation video)



APPENDIX 12: TRANSCRIPT SYMBOLS AND NOTATIONS

<u>symbol</u>	<u>meaning</u>
↑	shift to high pitch
↓	shift to low pitch
↗	rising to high
↗	rising to mid
→	level
↘	falling to mid
↘	falling to low
≈	+≈ continuation within speaker
≈	+≈ continuation across other speaker
·	inhalation
⌈	top begin overlap
⌋	top end overlap
⌊	bottom begin overlap
⌋	bottom end overlap
Δ	ΔfasterΔ speech
∇	∇slower∇ speech
*	*creaky* voice
??	??unsure??
°	°softer° speech
●	●louder● speech
—	—low pitch—
—	—high pitch—
☺	☺smiley voice ☺
ξ	ξbreathyξ
ff	ffwhisperff
Ÿ	Ÿyawn Ÿ
♫	♫singing ♫
'H	laugh in a word
(.)	micro-pause (less than 0.2 sec.)
-2	timed pause (in seconds)

APPENDIX 13: PARTICIPATORY STUDY IN MDII ON WHICH EVALUATION IS BASED.

As a part of the initial stages of the project we conducted a direct and participative user research in which the users were given two different types of toolkit. One **abstract** and one **concrete**. With the problem statement derived in the previous stage we went on along with these toolkits. Our group chose the abstract toolkit in which the parts do not resemble an actual automotive part.

Then we gave a group of 4 users (3 males, 1 Female) the abstract toolkit along with the **brief** – which was **to find a design solution** which according to them should **solve** their transport **problems** and should fit in **the budget** to fill the gap between the entry level cars and 2 wheelers.

The users

Age: 23- 26

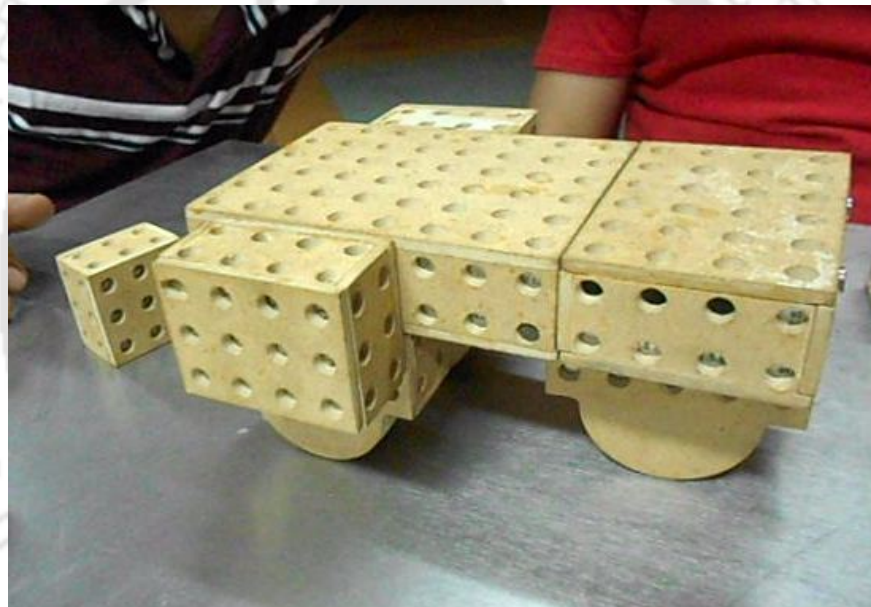
Occupation: Master of Design Students

No. of participants: 1 female (E), 3 males (F, G, H)

The discussions of the users

G – like for example Nano, its small, that's why its cheap and cost-effective. And for the same reason sedans which are longer go out of budget.

Space should be for at least 2-3 people and minimal luggage.



E – we can also try changing the placement of the wheels in the three-wheel format itself like placing two wheels in front and one at the rear as opposed to a conventional opposite arrangement.

H – this kind of arrangement with one wheel in the rear may cause swaying and fishtailing during motion of the vehicle. (it might have stability issues.)

E- if the cost of the materials needs to be decreased then the body can be open-roof rather convertible. i.e. it will have a canvas roof to make it cheaper.

G- I think the looks are not a prime concern when we are looking at a economical utility vehicle. If I can get a three-wheel vehicle in one lacs then why not?

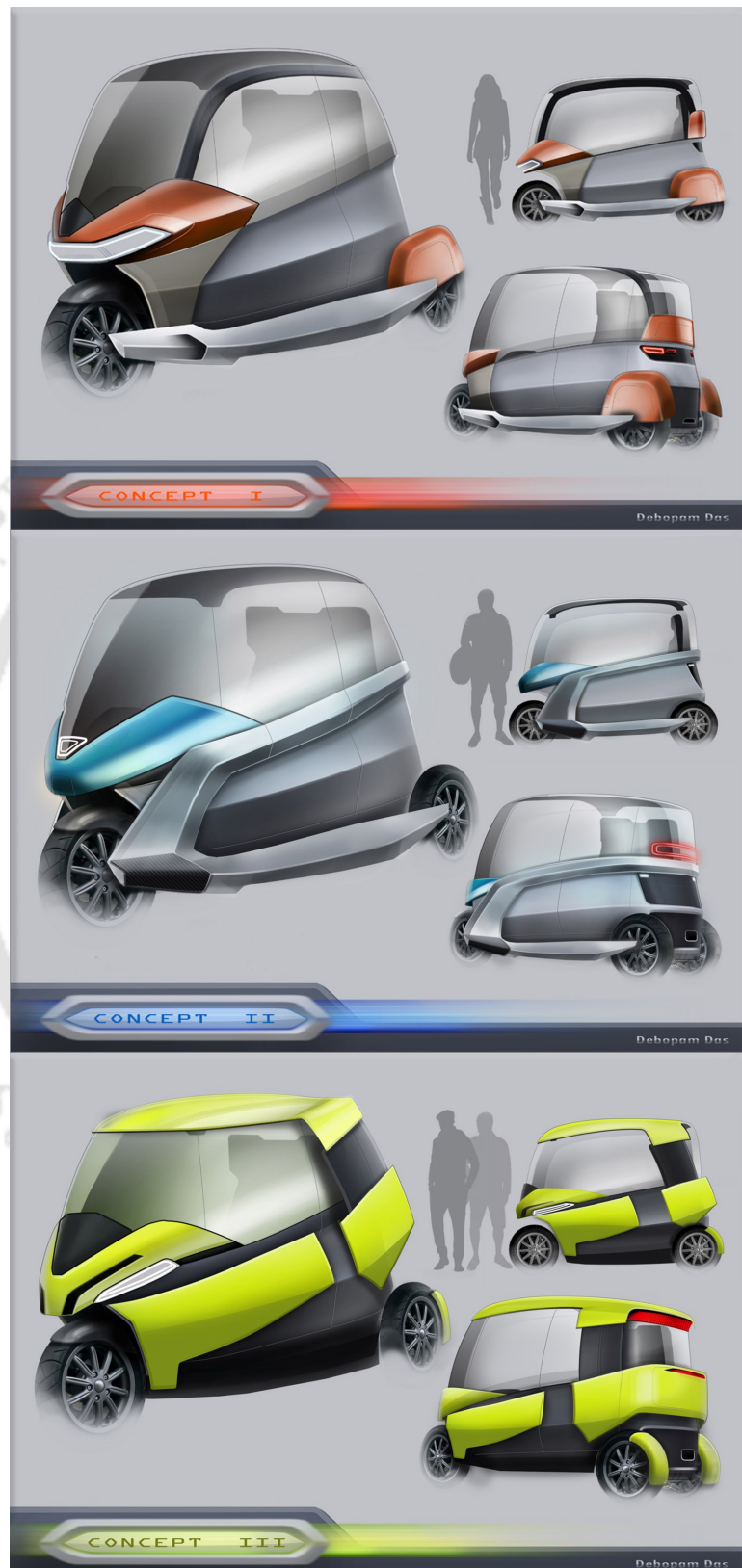
E – the engine can be placed at the rear also.

G – We can also add a detachable trunk, when we need fix it, otherwise detach.

Judging by what the users had to say and looking at the situation from their point of view the design brief can be jotted down into the following points.

- Three wheeled vehicle.
- Should not look like an auto rickshaw.
- Seats minimum of 3 people.
- Seats at least 3 people
- Can be covered with convertible or a hard roof top as well.
- Should perform well.

APPENDIX 14: RENDERINGS FOR EVALUATION









APPENDIX 15: VIDEO OF EVALUATION, EXCERPT OF VIDEO FOR ANALYSIS

CD/ Folder (Participatory Evaluation Video)



APPENDIX 16: LIST OF CONFERENCE PAPERS

Sharma Nishant, Rauniomaa Mirka, "Chasing the Participatory Dream: Assessing Appearances In A Concept Validation Session," proceedings International Conference Participatory Innovation Conference PIN-C 2013, June 18 – 20, 2013 at Lappeenranta University of Technology, Lahti School of Innovation (LUT LSI) and University of Southern Denmark, Sønderborg Participatory Innovation Research Centre (SPIRE), Lahti, Finland

Day Dennis, Sharma Nishant, "Sketches as Interaction Spaces," proceeding, International Conference Participatory Innovation Conference PIN-C 2012, held during January 12 – 14, 2012, at Swinburne University, Melbourne, Australia

Sharma Nishant, Day Dennis, "Collective Form Generation through Visual Participatory Representation: A Case Study," proceeding PIN-C 2012, International Conference Participatory Innovation Conference PIN-C 2012, held during January 12 – 14, 2012, at Swinburne University, Melbourne, Australia

Sharma Nishant, "Concrete, Abstract or Hybrid Participatory Toolkit," proceedings, International Conference Participatory Innovation Conference PIN-C 2011, held during January 13 – 15, 2011, at University of Southern Denmark, Sønderborg, Denmark.

REFERENCE

- Alexander, C. (1963). The Determination of Components for an Indian Village. In J. C. Jones & D. . Thornley (Eds.), *Conference on Design Methods*. New York: Oxford Pergamon Press- The MacMillan Company.
- Alexander, C. (1964). *Notes of the Synthesis of Form*. Vasa. <https://doi.org/10.2307/1573476>
- Archer, B. L. (1965). *Systematic Method for Designers*. London: Council of Industrial Design.
- Archer, B. L. (1984). Systematic Method for Designers. In N. Cross (Ed.), *Developments in Design Methodology* (First, pp. 57–82). Chichester: John Wiley & Sons.
- Armi, C. E. (2003). *American Car Design Now: Inside the Studios of Today's Top Car Designers*. Random House Incorporated.
- Ashish K. Mishra. (2011). Saving the Nano. Retrieved August 10, 2017, from <https://www.forbes.com/2011/01/11/forbes-india-ravi-kant-tata-motors-saving-nano.html>
- Autoblog. (2005). 2004 Volkswagen New Beetle Information. Retrieved June 19, 2017, from <http://www.autoblog.com/buy/2004-Volkswagen-New+Beetle/>
- Beyer, H., & Holtzblatt, K. (1998). *Contextual Design. Defining Customer-Centred Systems*. Morgan Kaufmann.
- Blasco, D. (2010). RoyalEnfields.com: Royal Enfield motorcycles in India: can you pick out the differences? Retrieved August 15, 2017, from <http://www.royalenfields.com/2010/06/royal-enfield-motorcycles-in-india-can.html>
- Bodker, S. (2000). Scenarios in user-centred design-setting the stage for reflection and action. *Interacting with Computers*, 13(1), 67–75.
- Boeriu, H. (2014). Do you remember the BMW GINA Concept? Retrieved August 15, 2017, from <http://www.bmwblog.com/2014/09/29/remember-bmw-gina-concept/>
- Brandt, E. (2007). How Tangible Mock-Ups Support Design Collaboration. *Knowledge, Technology & Policy*, 20(3), 179–192. <https://doi.org/10.1007/s12130-007-9021-9>

- Brandt, E., Binder, T., & Sanders, E. (2012). Ways to engage telling, making and enacting. *Routledge International Handbook of Participatory Design*.
- Brouwer, C. E., & ten Bhömer, M. (2013). Imagining the prototype. In *PIN-C* (Vol. 3, pp. 18–20). Lahti: Technische University Eindhoven.
- Bürdek, B. E. (2005). *Design : history, theory and practice of product design*. Birkhäuser-Publishers for Architecture. Retrieved from <https://books.google.co.in/books?hl=en&lr=&id=LWHRAAAAQBAJ&oi=fnd&pg=PA7&dq=burdek&ots=suL3sABMTl&sig=HIWmg5qzF50OuEerr-cuBXWwCJw#v=onepage&q&f=false>
- Buur, J., & Andreassen, M. (1989). Design Models in Mechatronic Product Development. *Design Studies*, 10(3), 155–162.
- Buur, J., & Bagger, K. (1999). Replacing usability testing with user dialogue. *Communications of the ACM*. <https://doi.org/10.1145/301353.301417>
- Car Dekho. (2017). Maruti Swift VDI Glory Limited Edition Pictures | CarDekho.com. Retrieved August 15, 2017, from https://www.cardekho.com/pictures/Maruti_Swift_VDI_Glory_Limited_Edition
- CBS. (2017). Almanac: The “Father of Streamlining” - CBS News. Retrieved November 9, 2017, from <https://www.cbsnews.com/news/almanac-raymond-loewy-the-father-of-streamlining/>
- Colvin, A. C. (2007). Managing Innovation : How Collaborative Design Visualisation Can Facilitate Teamwork, (September), 1–6.
- Corbin, J., & Strauss, A. (1990). Grounded Theory Research: Procedures, Canons, and Evaluative Criteria. *Qualitative Sociology*, 13(t). Retrieved from <https://link.springer.com/content/pdf/10.1007%2F00988593.pdf>
- Coulter, R. A., Zaltman, G., & Coulter, K. S. (2001). Interpreting Consumer Perceptions of Advertising: An Application of the Zaltman Metaphor Elicitation Thchnique. *Journal Of Advertising*, 4. Retrieved from <http://www.tandfonline.com/doi/pdf/10.1080/00913367.2001.10673648?needAccess=true>
- Crilly, N., Moultrie, J., & Clarkson, P. J. (2004). Seeing things: consumer response to the

- visual domain in product design. *Design Studies*, 25(4), 547–577.
- Day, D., & Sharma, N. (2012). Sketches as Interaction Spaces. *Participatory Innovation Conference Melbourne Swinburne University*.
- Desmet, P. (2002). *The Product Emotion Measurement Instrument (PrEmo)*. Document.
- Djajadiningrat, J., Gaver, W., & Fres, J. (2000). Interaction relabelling and extreme characters: methods for exploring aesthetic interactions. *Proc. of the Designing Interactive Systems Conference (DIS)*, 1–7. <https://doi.org/10.1145/347642.347664>
- Dunne, A. (1999). *Hertzian Tales: Electronic Products, Aesthetic Experience and Critical Design*. London: The MIT Press.
- Ehn, P., & Kyng, M. (1991). Cardboard computers: Mocking-it-up or hands-on the future. In *Design at Work: Cooperative Design of Computer Systems*. <https://doi.org/10.1017/CBO9781107415324.004>
- Fasulo, A., & Monzoni, C. (2009). Assessing mutable objects: A multimodal analysis. *Research on Language and Social Interaction Pp*, 42(4), 362–376.
- Fischer, G., & Giaccardi, E. (2006). Meta-design: A Framework for the Future of End-User Development. *End User Development*, 427–457. https://doi.org/10.1007/1-4020-5386-X_19
- French, M. J. (1985). Conceptual Design for Engineers. *London Design Council*.
- Garfinkel, H. (1967). Studies in Ethnomethodology. *Englewood Cliffs PrenticeHall*.
- Gaver, B., Dunne, T., & Pacenti, E. (1999). Cultural Probes. *Interactions*, 6(1), 21–29.
- Gaver, W. W., Beaver, J., & Benford, S. (2003). Ambiguity as a resource for design. *Proceedings of the Conference on Human Factors in Computing Systems - CHI '03*, (5), 233. <https://doi.org/10.1145/642651.642653>
- Giouze, A. (2009). *An Introduction to Conversation Analysis. Journal of Pragmatics* (Vol. 41). <https://doi.org/10.1016/j.pragma.2008.11.009>
- Goodwin, C. C., LeBaron, C., & Streeck, J. (2011). *Multimodality and human activity: Research on human behavior, action, and communication*.
- Gordon, W. J. J. (1961). *Synectics*. New York: Joanna Cotler Books.

- Grudin, J., & Pruitt, J. (2002). Personas, Participatory Design and Product Development: An Infrastructure for Engagement. *Pdc*, 144–152. <https://doi.org/10.1.1.92.687>
- Heinemann, T. (2011). First came the egg: The positioning and shaping of competing design proposals. *Participatory Innovation Conference PINC Pp Snderborg University of Southern Denmark*, 51–57.
- Hero Corporate Website. (2017). Hero Super Splendor Bike, New Super Splendor Price, Mileage - Hero MotoCorp Ltd. Retrieved August 15, 2017, from <http://www.heromotocorp.com/en-in/the-bike/super-splendor-57.html>
- Hester, S., & Eglin, P. (1997). *Culture in action : studies in membership categorization analysis*. International Institute for Ethnomethodology and Conversation Analysis & University Press of America.
- Hill, R. J., Osgood, C. E., Suci, G. J., & Tannenbaum, P. H. (1958). The Measurement of Meaning. *American Sociological Review*, 23(2), 227. <https://doi.org/10.2307/2089024>
- Hippel, E. V. (2005). Democratizing Innovation.
- Hoffmann, H., Leimeister, J. M., & Krcmar, H. (2010). TOOL SUPPORT FOR THE PARTICIPATORY DESIGN OF END USER ORIENTED APPLICATIONS IN THE AUTOMOBILE. *Information Systems*, (2010).
- Huang, J. C., & Krawczyk, R. (2007). A Choice Model of Consumer Participatory Design for Modular Houses. *25th International Conference Aided Architectural Design in Europe, Germany*, 679–686.
- Jefferson, G. (1990). List Construction as a Task and Interactional Resource. In G. Psathas (Ed.), *Interaction Competence* (pp. 63–92). Washington DC: University Press of America.
- Jefferson, G. (2004). *Glossary of transcript symbols with an introduction*.
- Jones, J. C. (1966). Design Methods Reviewed. In S. Gregory (Ed.), *The Design Method*. London: Butterworths.
- Jones, J. C. (1984). A Method of Systematic Design. In N. Cross (Ed.), *Developments in Design Methodology* (First, pp. 9–31). Chichester: John Wiley & Sons.

- Jones, J. C. (1992). *Design Methods* (Second). New York: John Wiley & Sons.
- Keinonen, T. K., & Takala, R. (2010). *Product Concept Design: A Review of the Conceptual Design of Products in Industry*. Springer London.
- Krippendorff, K. (2006). *The Semantic Turn: A foundation for Design*. Boca Raton: Taylor and Francis group.
- Krippendorff, K., & Butter, R. (1984). Product Semantics: Exploring the Symbolic Qualities of Form. *The Journal of the Industrial Designers Society of America*, 3(24).
- Lewin, T., & Borroff, R. (2010). *How to design cars like a pro*. Motorbooks.
- Maruti Alto 800. (2012). New Maruti Alto 800: Photos of Variants in all Colour | Maruti Alto 800. Retrieved August 15, 2017, from <http://maruti-alto-800.blogspot.in/2012/10/new-maruti-alto-800-photos-of-variants.html>
- Mattelmaki, T., & Battarbee, K. (2002). Empathy probes. *Participation Design Conference Pp Malmo*, 266–271.
- Maynard, D. W., & Kardarsh, T. (2007). Ethnomethodology. In G. Ritzer (Ed.), *The Blackwell Encyclopedia of Sociology* (pp. 1483–1486). Oxford: Blackwell.
- Ministry of Heavy Industries & Public Enterprises, G. of I. (2006). *Automotive Mission Plan 2006-2016*. New Delhi.
- Mondada, L. (2006). Participants' online analysis and multimodal practices: projecting the end of the turn and the closing of the sequence. *Discourse Studies*, 8(1), 117–129.
- Mono, R. (1997). *Design for Product Understanding*. Stockholm: Liber.
- Mortensen Christina, K. L. (2011). Preliminary notes on “grooming the object.” *Partipatory Innovation Conference*, 1–8.
- Muffatto, M. (1999). Introducing a platform strategy in product development. *International Journal of Production Economics*, 60, 145–153. [https://doi.org/10.1016/S0925-5273\(98\)00173-X](https://doi.org/10.1016/S0925-5273(98)00173-X)
- Murphy, K. M. (2004). Imagination as Joint Activity: The Case of Architectural Interaction. *Mind, Culture, and Activity*.

https://doi.org/10.1207/s15327884mca1104_3

Norman, D. A. (2004). *Emotional Design: Why we love (or hate) everyday things*. New York: Basic Books.

Orsato, R. J., & Wells, P. (2007). U-turn: the rise and demise of the automobile industry. *Journal of Cleaner Production*, 15(11–12), 994–1006.
<https://doi.org/10.1016/j.jclepro.2006.05.019>

Polayni, M., & Gloucester, M. A. (1983). The Tacit Dimension. *Peter Smith*.

Pomerantz, A. (1984). *Agreeing and disagreeing with assessments: Some features of preferred/dispreferred turn shapes*. (J. a. Atkinson, Ed.) *Structures of Social Action: Studies in Conversation Analysis*, .

Psathas, G. (1995). *Conversation Analysis*. Thousand Oaks Sage.

Raymond, G. (2003). Grammar and social organization: Yes/no interrogatives and the structure of responding'. *American Sociological Review* ., 68, 939–967.

Rittel, H. (1972). The DMG 5th Anniversary Report. *Design Methods Group*.

Robles, J. S. (2012). Troubles with assessments in gifting occasions'. *Discourse Studies* ., 14, 753–777.

Rodriguez, N., & Ryave, A. (2002). *Systematic self-observation*. Sage.

Rudd, J., Stern, K., & Isensee, S. (1996). Low vs. high-fidelity prototyping debate. *Interactions*, 3(1), 76–85. <https://doi.org/10.1145/223500.223514>

Sabatini, J. (2010). Forgotten Concept: 2002 GM Autonomy - Autoblog. Retrieved August 16, 2017, from <https://www.autoblog.com/2010/09/24/forgotten-concept-2002-gm-autonomy/>

Sanders, E. (2006). Design Research in 2006. *Design Research Quarterly*, 1(September), 1–25.

Sanders, E. B.-N., & Stappers, P. J. (2014). Probes, toolkits and prototypes: three approaches to making in codesigning. *CoDesign*. Taylor & Francis.
<https://doi.org/10.1080/15710882.2014.888183>

Sanders, E. B. (2000). Generative Tools for Co-Designing. *Collaborative Design*, 3–12.
https://doi.org/10.1007/978-1-4471-0779-8_1

- Sanders, E. B. –N. (2013). Perspectives on Participation in Design. *Wer Gestaltet Die Gestaltung? Praxis, Theorie Und Geschichte Des Partizipatorischen Designs*, 61–75. Retrieved from <http://www.maketools.com/articles-papers/Sanders2013Perspectives.pdf>
- Sanders, L., & Stappers, P. J. (2012). *Convivial design toolbox: generative research for the front end of design*. *Orbis Litterarum: International Review of Literary Studies* (Vol. 61). Retrieved from <http://www.gbv.de/dms/bowker/toc/9789063692841.pdf>
- Schön, D. A. (1983). *The reflective practitioner: how professionals think in action*. New York: Basic Books.
- Schuler, D., & Namioka, A. (1993). *Participatory Design: Principles and Practices*. Hillsdale NJ: L. Erlbaum Associates Inc.
- Seybold, P. B. (2011). *Outside Innovation: How Your Customers wil Co-design your Comapany's Future*. *Harper Colline e-books*. Retrieved from <papers://b09e1ca9-3ba5-4aa3-86bf-a8c843d607e1/Paper/p70>
- Shannon, C. E. (1948). A mathematical theory of communication. *The Bell System Technical Journal*, 27(July 1928), 379–423. <https://doi.org/10.1145/584091.584093>
- Sharma, N. (2011). Concrete, Abstract or Hybrid Participatory Toolkit. In *International Conference in Participatory Innovation PIN-C*. Sønderborg: University of Southern Denmark.
- Sharma, N., Day, D., & Puneekar, R. M. (2012). Collective form generation through visual participatory representation: A case study. In *Participatory Innovation Conference (PIN-C) 2012*. Melbourne: Swinburne University.
- Sharp, H., Preece, J., & Rogers, Y. (2011). *Interaction design : beyond human-computer interaction*. *Beyond human-computer interaction*.
- SIAM. (2017). DOMESTICS SALES TRENDS. Retrieved August 15, 2017, from <http://www.siamindia.com/statistics.aspx?mpgid=8&pgidtrail=14>
- Singleton, W. (1966). *Current Trends Towards Systems Design*. London: Ministry of Technology.
- Sleeswijk Visser, F., van der Lugt, R., & Stappers, P. J. (2007). Sharing User Experiences in the Product Innovation Process: Participatory Design Needs Participatory

- Communication. *Creativity and Innovation Management*, 16(1), 35–45.
<https://doi.org/10.1111/j.1467-8691.2007.00414.x>
- Sleeswijk Visser, F., & Visser, V. (2006). Re-using users: Co-create and co-evaluate. *Personal and Ubiquitous Computing*, 10(2–3), 148–152.
<https://doi.org/10.1007/s00779-005-0023-x>
- Sparke, P. (2013). *An introduction to design and culture: 1900 to the present*. Routledge.
- Stappers, P. J., & Sanders, E. B. (2003). Generative tools for context mapping: tuning the tools. *Van Erp D Gyi Eds Design and Emotion The Experience of Everyday Things Pp London Taylor and Francis*, 77–81.
- Stappers, P. J., & Visser, F. S. (2007). Bringing participatory techniques to industrial design engineers. *Design Engineering*, (September), 1–6.
- Stigh, D. (2012). MoMA | Five for Friday (Plus One): MoMA's Car Collection. Retrieved August 15, 2017, from https://www.moma.org/explore/inside_out/2012/04/06/five-for-friday-plus-one-momas-car-collection/
- Thomas, J. (2005). Toyota's i-unit Personal Mobility Concept : TreeHugger. Retrieved August 16, 2017, from <https://www.treehugger.com/clean-technology/toyotas-i-unit-personal-mobility-concept.html>
- Tzonis, A. (1990). Huts, Ships and Bottle Racks: Design by Analogy for Architects and/or Machines. *Research in Design Thinking*.
- Visser, F. S., Stappers, P. J., van der Lugt, R., & Sanders, E. B.-N. (2005). Contextmapping: experiences from practice. *CoDesign*, 1(2), 119–149.
<https://doi.org/10.1080/15710880500135987>
- von Hippel, E. (1986). Lead Users: A Source of Novel Product Concepts. *Management Science*, 32(7), 791–805. <https://doi.org/10.1287/mnsc.32.7.791>
- WDO. (2017). WDO | About | Definition of Industrial Design. Retrieved September 10, 2017, from <http://wdo.org/about/definition/>
- Wieder, D. L. (1974). Language and social reality: the case of telling the convict code. *The Hague Mouton*.





