Design Thinking within a 100-year-old Auto Manufacturing Company

Chris Chiaravalli

2019

Introduction

The auto industry in the US is said to be undergoing an extreme transformation. With quicker changing market forces, competition, and consumer preferences than ever before, the big auto companies are all trying to find ways to keep up and stay relevant. There have been investments by every large US automaker in new technologies like electrification and autonomous vehicles, new mobility solutions with urban focuses, and new partnerships with unexpected companies outside of the industry. One of the newest trends in the industry has been embracing the design thinking philosophy first pioneered by the Kelly brothers of IDEO. This framework has quickly been instituted among the large auto companies resulting in large investments in employee training, consultation, and practice of the methodologies in the philosophy.

The auto industry is not the only example of a seemingly non-conventional application of design thinking (furniture companies, city governments, ecc.), but it is one that has much to gain by doing it, especially financially speaking. Due to the large cost of purchasing and maintaining a personal vehicle (the second largest expenditure most Americans will make, behind the single family house), consumers are understandably scrutinizing of the design of these products, and not only aesthetically speaking. The auto industry has been trying to respond to this “new found” appetite for usability, and this piece details human centric design techniques as they are applied within a large US auto manufacturer. The goal of this study is to present a number of methodologies and techniques available to help companies understand their customers’, or users’ experiences with their products, and how to better serve the needs and desires of those users, as well as identify potential opportunity areas to solve problems within. The information is organized into the following four main sections:

- **Linguistic Analysis and Analogical Thinking**
- **Reflexive User Research Evaluation**
- **Design Thinking Application Workshop**
- **Design Science Curriculum Reflection**

Linguistic Analysis Analogical Thinking

Shortly after a corporate restructuring, aimed at reducing bureaucracy and management friction that took place at the large auto manufacturer, a project began to develop the new drive modes for a 2023 model year sports car employing Design Thinking methodology. In preparing for a presentation to an upper manager, the team crafted “Ask Yourself” questions, which is a term referring to guiding questions to keep in mind when moving along the transition from *Moments That Matter* (large auto manufacturer terminology for specific points in the user journey gleaned through design ethnography synthesis that they want to recreate for users with the new model sports car they are designing now) to concept generation. They are questions that are meant to work as a sort of filter for concepts generated going forward. They are meant to keep the team focused on the objective and avoid using energy or resources towards an end product which isn’t in line with the user insights.

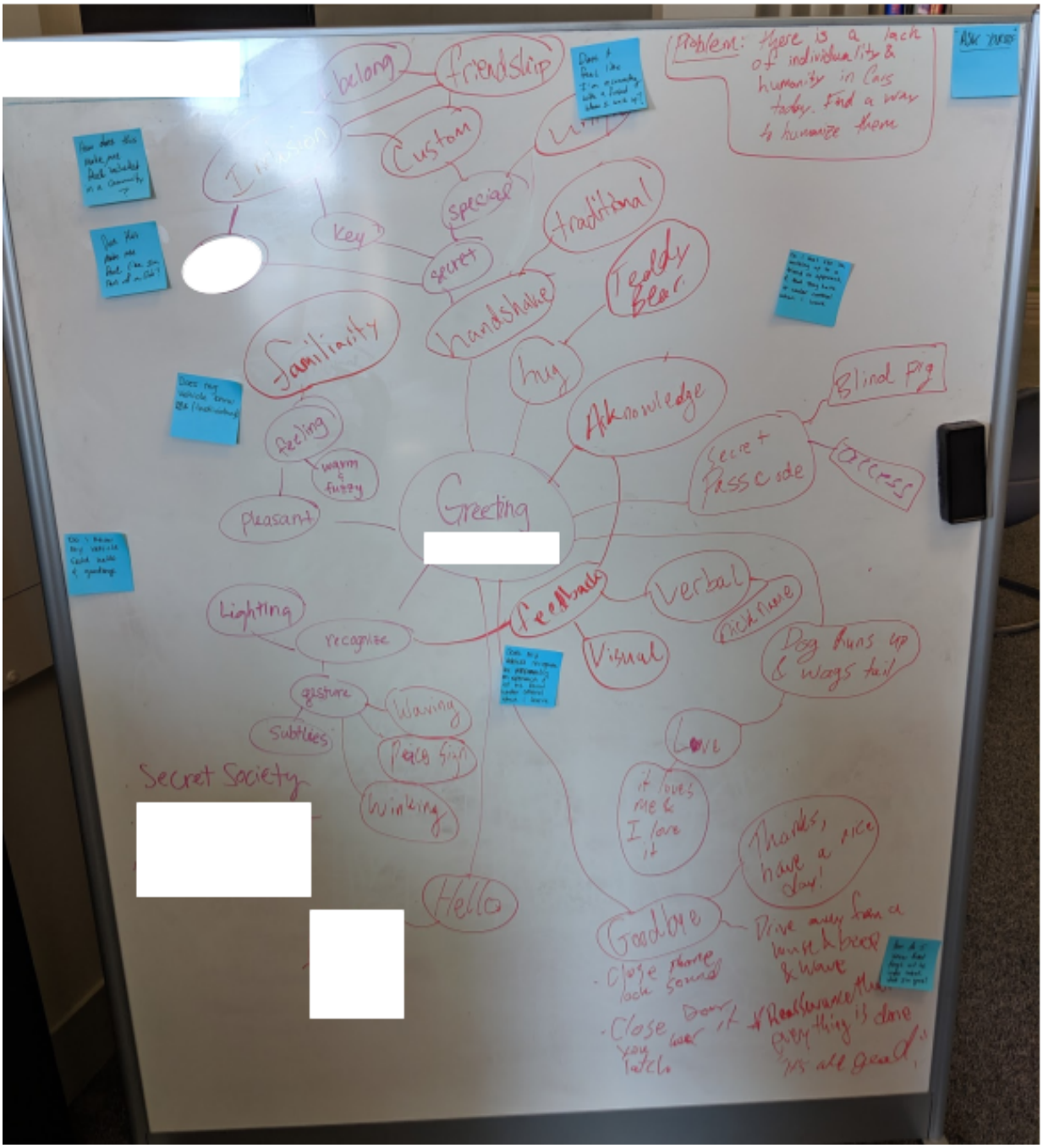
This company often struggles to stay true to user insights for a number of reasons:

- They are very committed to their managers and VPs, which can reduce the integrity of user insights being used or concepts generated which stay true to them.
- Many different teams with a lot of people involved need to interface in order to deliver a vehicle. Sometimes there is turnover within the teams before the end of the large auto manufacturer’s product development timeline.
- The ethnographic research is planned, carried out (to a large extent), and reported on by external “creative suppliers” to large auto manufacturer. Then the teams within large auto manufacturer in theory disseminate and absorb that information, although it is not unreasonable to suspect that in practice very little absorption actually happens, as it is much, much harder to understand user research at a deep enough level for people who don’t do that as their principal job than if they are involved in the research directly. This solution of direct involvement for everybody on the team obviously is very resource intensive, however dissemination of user research is a very common hurdle to overcome in big companies, and it seems some companies do it quite fluently, meaning their process for that should be studied by large auto manufacturer and implemented internally.

The team wanted to capture the essence of the user journey *Moments* the creative supplier had given us with one very simple question per *Moment*. The Linguistic Analysis for Analogical Thinking technique was the most applicable in that circumstance as the *Moments* were already phrased in relatively straightforward terms that would be a natural fit for a linguistic approach. There was a whiteboard in the work area and everyone received post-it notes and sharpies for later in the process. The process tends to follow this basic flow:

1. Decide on topic word to expand on with activity.
2. Have the group come up with verbs to describe that word.

3. After a couple degrees of separation from the topic word, have the group come up with analogous things (products, stories, spaces, entities) that do the verb.
4. Have the group use the post-it notes to put characteristics of those things up on the board.
5. Synthesis in the group, calling out patterns using dotted lines and sticky notes.
6. Generation of “Ask Yourself” questions is done by brainstorming and prototyping several different phrases among the group from the sticky notes and big ideas on the board until alignment occurs around a particular sentence which is central to the *Moment*.



The impact this output question has on the design of the product is to act as a guiding thought to which all decisions about concepts and ideas should align in some way. The designer should ask themselves (hence the name) the questions output when creating concepts and solutions for the *Moment* they're working on. This ideally verbal introspection will allow the designer to take a moment to double check that they are solving the right problem.

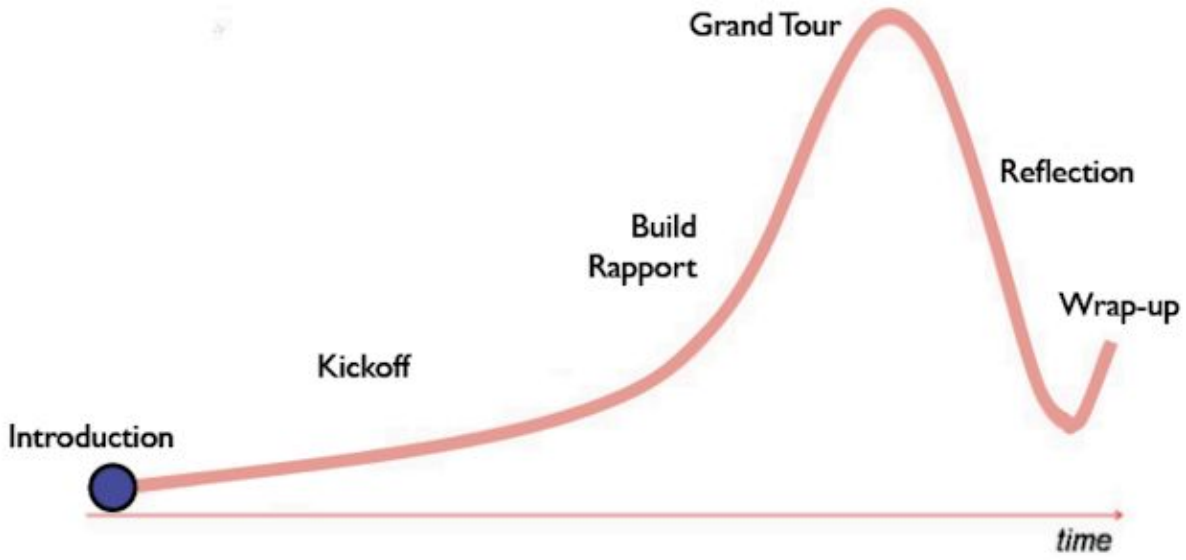
Reflexive User Research Evaluation

In an effort to help them better understand their execution of design research, an ethnographic approach to studying the user research within this large automaker's product development process for past and ongoing vehicle programs was carried out. The goal of the study was to offer an evaluation of the quality of execution. The product development framework at the company was composed of a set of timelines, deadlines, and processes that go into taking a vehicle from concept to mass production. Some of these deadlines end up being pushed back with some level of flexibility, while others (namely related to capital equipment expenditures/design and other manufacturing events) are more rigid. This means that there is a propensity for the company to carry out user research quite early on in the process, but it is not as common to do it later on in the process. With a list of the vehicle programs to investigate a plan of research was created. Interviews were conducted with each contact on the list in order to gain a well-textured qualitative look at their experiences in conducting user research on these programs. The goal was understand what their thoughts about user research were and what could have been done better. The goal was in part to begin to put together a process or norm for this large auto manufacturer's user research, in the sense that there would be a number of defined points throughout the product development process that user research of specific varying natures would be carried out. The project had a focus on the *Moments* generated from user research, in other wards, the specific types of events or experiences we wanted to research within the customers' journey in the product.

The goals for this study were as follows:

- Understand the when, where, and what type of user research was done
- Understand the employees' impressions of how the research went and what was most effective
- Understand what the teams were trying to iterate on in terms of the user journey *Moments*
- What are the processes for iterating on *Moments*? How does learning happen within iterations?
- Start to put together an image of what "good" and "bad" user research plans look like through evaluation of past programs and knowledge gained through the Design Science master's curriculum, including when it happens in the process
- Share the resulting synthesis with superiors and other user research decision makers, namely the consumer insights team leader

With this list of priorities developed,the interview protocol and questions could be developed. The questions followed a Socratic logic/philosophy, in other words questions which got at the “why” below each response. There should be much care taken in crafting questions to ask users. Questions should elicit a story or a more layered description. They should never be designed in such a way as to be answered by either “yes” or “no” solely, rather they should be *open-ended*, meaning they require more detail to answer. Interview questions are meant to get a qualitative, descriptive picture of the interviewee’s experience. Only once we know the base of their problems may we begin to truly design effective solutions. Care should also be taken in the ordering of the questions to be asked. The interviewer should start with and introduction of their background, why they’re doing the research, and briefing regarding the treatment of the information will collect. Following should come questions that build rapport as opposed to heavily technical questions. This allows the interviewee to build some confidence in the relationship and feel more comfortable answering the rest of the questions. One thing to note is that the interview may not cleanly follow this order. If the interview begins to veer off-course, the interviewer doesn’t need to worry, it may take the interviewer to information they may never had considered. Interviewers should be ready to pivot when interviewing people. After the interviewer let’s the tangent run its course briefly, they should calmly guide the conversation back on course with the questions they’ve written, re-entering in a spot which doesn’t disrupt the natural flow of the conversation.



The interview should roughly follow a curve similar to stories (the peak is the “climax” of the story in a similar chart). The *Introduction* gives the participant some context for why the two (or more) of you are talking, as well as thanking them for agreeing to meet. Note, before even the introduction, when the interviewer invites the participant to the interview, the interviewer should make sure to give the participant an idea of how long the meeting will be, as well as where and when it will happen. The *Kickoff* verbally starts the interview, question-answering,

part of the meeting. *Build Rapport* is where the interviewer spends time on asking questions that are easier to answer and which make the participant feel more comfortable. *Grand Tour* (the peak in this diagram) is where the most detail can be gleaned by the interviewer with deep probing questions that inquire about the details of the stories the participant is telling by now. In *Reflection* the interviewer should summarize what they heard from the participant and discuss with them the insights they have. A note, it is preferable to incorporate some reflection during the course of the interview, as it helps to solidify it in one's mind better, and helps the participant know you're listening actively. Finally, the last uptick in this graph, the *wrap-up* is where the interviewer closes up the interview and asks the participant if they have any final questions, comments, or information that the interviewer should hear.

The question flow was as follows (note: Initially there were less questions than when the process was finished. Iteration between interviews occurred and questions were added to get information which was not considered in the earlier interviews.):

- What's your name?
- How long have you worked at [large automaker]?
- What is your experience with design thinking like?
- What research events happened and when did they happen in the timeline?
- What stimuli/provocations did you bring to the research event?
- What were *Moments* used for during user research?
- What were the goals of the research?
- What did you learn during the course of the research?*
- What do you think went well during the research and what could have gone better?*
- What does success look like to you in regards to user research? What about failure?*
- Tell be about what goes into planning and implementing a user research plan?*
- How does the team determine which level of fidelity they are looking for in the user research?*
- What would you change about the user research done for that program?*
- What does your dream user research look like?*

* Starred questions are those that were added in the course of the interviews carried out.

Around 10 interviews were conducted and notes taken with the participants. All of the contacts interviewed who were at some level involved with the user research were trained engineers who had been assigned to the Human Centered Design group, the longest having been in that group no longer than a couple years. They ranged in enthusiasm for Design Thinking practices from pessimistic to optimistic.

After the interviews, The handwritten notes were synthesized using a word cloud generated by entering the notes into a program. This was used as one visualization of the points to touch on in the evaluation report, an associative synthesis comprised of reading through the notes and picking out commonalities and patterns was also used to pull out insights. The report was structured with the following framework:

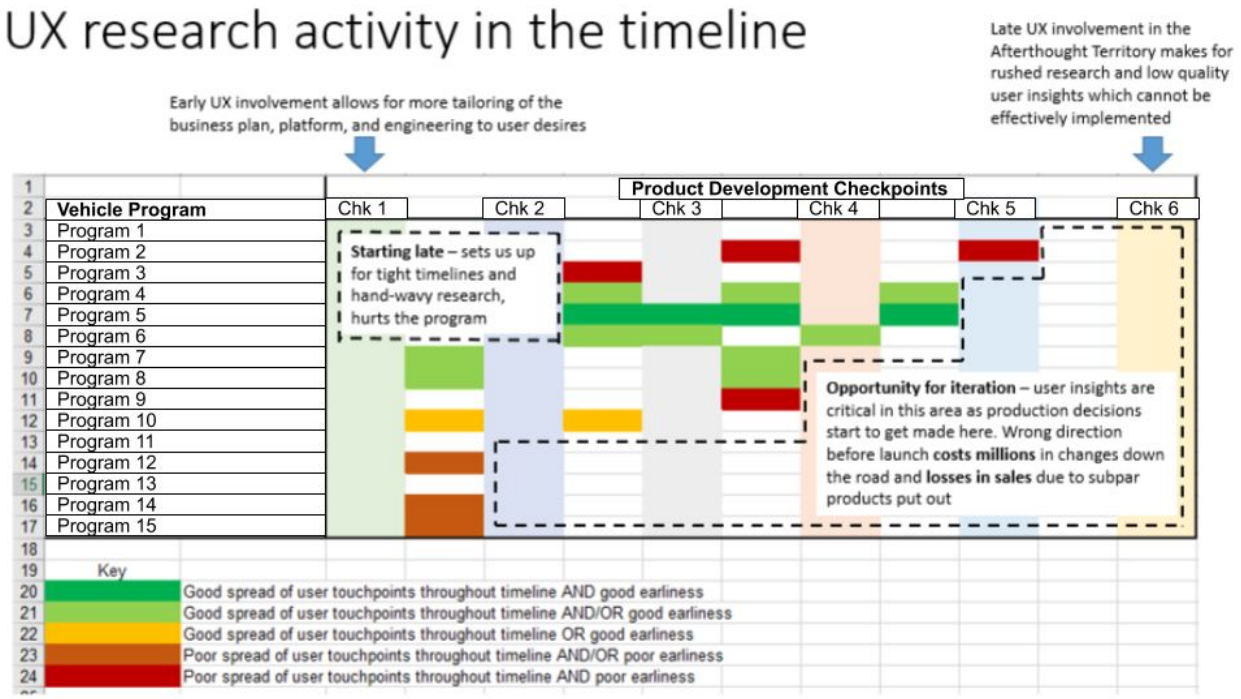
- Background/current state of research
- Methodology and goals of research

- “Good” research plans do:
- “Bad” research plans do:
- Visual representation of programs’ research quality
- Recommendations

The classification of the quality of the user research plans was according to how satisfied the colleagues interviewed were with the processes as well as how closely they adhered to the academic material studied in the Design Science master’s program curriculum. “Good” research plans tended to be carried out earlier and more often than “bad” ones, they were in general more agile. In the case of this large auto manufacturer, high quality research plans were also correlated to how closely the employees were involved in carrying out the design ethnographic methods. This large auto manufacturer uses a system of “creative suppliers” for almost all of their design ethnography and other user research. This both costs this large auto manufacturer a large amount of money (upwards of $500,000 for certain programs) and highly degrades the translation of insights to product design decisions, as the employees tasked with carrying out the design decisions of the program are only learning about the user desires and needs second hand through long .pdf deck documents. There is also a degradation of the robustness and integrity of the results, as this large auto manufacturer will often indicate to the creative supplier firms what results they are looking for which will often influence the type of questions and stimuli that they ask participants. This was both uncovered in several interviews as well as observed in the transcript of a user interview from research on a particular vehicle program. The phrase was something like, “That’s a nice big trunk, right? That’s the biggest trunk you’ve ever seen in an SUV, isn’t it?”. This is a very poor quality interview question, it is not an open-ended, Socratic question. It leads the user to the one answer of confirming the interviewers stated position. Due to the structure and model of user research at this large auto manufacturer (possibly other ones as well), it is not out of the realm of reasonability to infer that there are many other instances of this sort of interview protocol misuse. This particular occasion was not included in the report, but it is suggested that the teams involved investigate the research done involving interviews deeper.

Once the quality of the user research plans was evaluated in general terms, a more structured visual representation of the quality levels of specific program plans was generated. The graphic below was the result. It shows the particular programs profiled in the left-most column. The temporal “checkpoints” of the product development framework are listed in the top-most row. Each stage in the timeline is called out and signified with colors down the column. The columns before and after the colored columns signify the time before and after that checkpoint respectively. The colored in cells ranging in color from green to red represent user research touchpoints or activities, ranging from (but not represented on this visual) heavier, multi day, full ethnographic research carried out by creative suppliers to lighter events that explored smaller aspects of the program. The readers’ eyes are guided to two main portions of the visual using arrows and dotted lines boxing in particular zones, with short descriptions explaining the zone. One of the zones is the “Afterthought Zone”. This term is necessary to describe what may happen when a team, or managers, working on a vehicle program within the company are resistant to incorporating UX research early on and often in the product

development timeline, and so it gets applied at the end simply to check the box of having done it. This may be done because of a lack of faith or training in the Design Thinking philosophy or for reasons involving incentives and funding structures within the company. In any case, it is a zone that companies should aim to avoid starting research within or putting off important research until. It is a great zone for iteration on previously done research.



Design Thinking Application Workshop

In order to develop a set of unique and novel concepts for drive modes and a salutation sequence (ways that the vehicle would greet and “say farewell” to its driver) of a 2023 model year sports car, the large automaker chose to carry out a multi-day design thinking workshop with the entire team responsible for delivering the drive modes. A set of objectives was put together for the design thinking workshop. Principally, the goal was to output ideas for drive modes and salutation sequences for the vehicle that addressed the user needs, desires, and opportunity areas captured in the *Moments* after user research carried out by a creative supplier for the large automaker. It would then be necessary to create teams to deliver and implement those ideas. Secondarily, the goal was to teach design thinking concept generation methods and frameworks to the teams, give ownership of the outcomes to the engineers and designers who would be responsible for bringing them to fruition, and learn from past drive mode projects on other programs in order to achieve an inter-vehicle cohesion among the line-up.

It was necessary to think about a measure of success for this workshop. The team thought about a set of what successful outcomes would look like and wrote them down. In order of importance to success, those outcomes were:

- Delivery of drive modes and salutation sequences that fully serve the user need or take advantage of the opportunity areas individuated
- Creation of novel ideas which are different from competition and out of the box with respect to the rest of the industry
- Creation of a detailed and complete plan for the implementation of the concepts created
- Efficient execution of concepts, meaning:
    - Delivery of the technology to market without wasting time
    - Empowerment of employees to have fun and express their creativity in the products delivered

The largest project I did this summer was to design, set up, run, and follow up after a 3 day design thinking, user insight immersion, and ideation workshop in order to ideate new drive modes and a greeting and salutation sequence for the 2023 model year sports car. It was necessary to determine which key teams and people to include in the workshop. Parties (or, in a sense, stakeholders) included powertrain engineers, studio designers, interaction designers, and other vehicle architecture teammates. Tasks to be completed consisted of designing the flow, events, and activities for each day as well as inviting all participants, setting up the space, and following up afterwards with a steering team.

The days of the workshop were plotted out using a planning document in Excel. The rows were organized as time blocks while the columns were topics and resources, such as the actual materials needed for each activity, the activities, who was leading that part of the workshop, and the desired outcome of that activity. Each day was built out in this file. An example of one day in the organizing document can be found below.

Day	Time	Topic	Stuff needed	Activity	Lead	Desired outcome/output
	8:30 - 9	Icebreaker	?		Chris	Everybody is happy and thinking creativly
	9 - 9:10	Goal of workshop and Rules	PPT or Board		Mark	Everybody is aligned with the rules
	9:10 - 30	NDA	TBD		Shrinivas	Get background on what's been done/being done today
	9:30 - 10		TBD		Rob NDA	Get background on what's been done/being done today
	10:-10 :30	Analogous or other benchmarks	TBD	Maybe invite people to come up with one product/experience in everyday life which utilizes NDA before they come and then share with everyone.	Shrinivas	break out of auto-specific thinking into how other industries/products/experiences tackle the problem that NDA NDA
	10:30 - 45	Break				
	10:45 - 11:15	Why does a customer want NDA NDA	White board	TBD (may include a "5 why's" deep dive into exploring the problem space)	Chris	Groups of ideas that get closer to a full exploration of the solution space.
	11:15-11:30	Customer Profile	customer profile packet as basis (?)		Nick or John	Understanding of who the NDA customer really is - what drives them, what they care about, ecc.
1	11:30 - 12:30	NDA	Video, Boards (space for emotions, pain points, needs, opportunities), Postits, (might need a NDA ')	Watch video, Role Play, Capture thoughts about - what is the user need in that moment, and how do they want to feel ? - Group feedback and idenify and name main themes. "think about" How can NDA fit into this moment?	Chris or John ?	develop a deep empathy for the users and a full understanding of what the problem space looks like in each moment.
	12:30 - 1:15	Lunch				
	1:15 - 2:15	NDA	Video, Boards (space for emotions, pain points, needs, opportunities), Postits, (might need a NDA ')	Watch video, Role Play, Capture thoughts about - what is the user need in that moment, and how do they want to feel ? - Group feedback and idenify and name main themes	Chris, Leah	develop a deep empathy for the users and a full understanding of what the problem space looks like in each moment.
	2:15 - 2:30	Break				
	2:30 - 3:30	NDA	Video, Boards (space for emotions, pain points, needs, opportunities), Postits, (might need a NDA ')	Watch video, Role Play, Capture thoughts about - what is the user need in that moment, and how do they want to feel ? - Group feedback and idenify and name main themes	Chris, Leah	develop a deep empathy for the users and a full understanding of what the problem space looks like in each moment.
	3:30 +	Homework		Think about one of the moments on your way home, and imagine what a NDA user might want to experience ?	Chris	Spur individual thought and initial ideation before group ideation

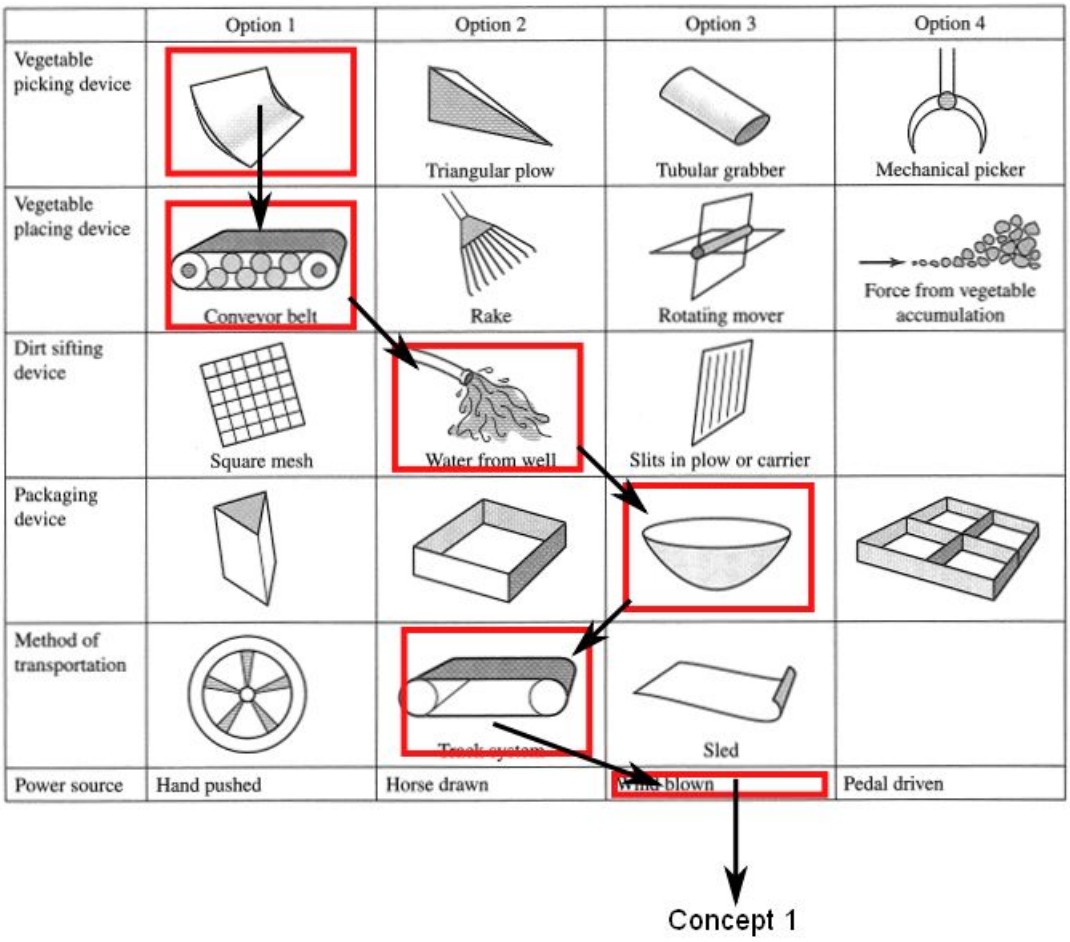
At first it was only a rough outline, in the form of a less granular presentation laid out in which the different techniques planned for the participants and how those would be useful to creating unique and novel drive experiences for users were explained to the leaders of the teams to be involved. These techniques included brainwriting, morphological thinking, analogical thinking, and design heuristic cards. In the initial call with the leaders of the teams, the preceding techniques were explained verbally and questions about how these could be used to generate drive mode and salutation ideas were answered. Rough ideas for how the days would go were laid out: first day would be all about user research immersion in which participants were to read through the *Moment* boards and "Ask Yourself" questions that had been crafted as well as some scenario role playing to get in the mindset of the users. Day two would be an idea generation day using the methods just introduced. Day three would be a concept development day in which the group would start to converge, eliminating ideas and deciding traits and concepts to move forward with. In-depth explanations of the different ideation techniques follow.

Brainwriting

Brainwriting is a collaborative ideation technique in which 3-6 people on a team sit around a table, each with a pencil and a piece of paper in front of them. A facilitator makes sure they are all on the same page about the problem statement and briefs them on the way the exercise works. Each person will sketch their ideas on their piece of paper, then after ~2-5 minutes they'll all pass their papers to the right. The person who receives the paper then has a couple options on what they can do: they can 1) add on to the concept they received, 2) take one aspect of that concept and create a new concept from it, or 3) create a whole new, unrelated concept, discarding the received one. This step is repeated for as many times as there are people participating in the exercise. Afterwards, there will be 3-6 ideas to talk about/consider when developing concepts further.

Morphological Thinking

Morphological thinking is another powerful idea generation technique. It uses a matrix approach where the rows are parameters that are required for the solution to have, for example, if the goal is to design a new way to deliver milk/beverages to small children, some parameters could be ability to hold liquid, doesn't spill, and durable to name a few. In the columns the participants write/sketch different means to accomplish those parameters, for the same liquid delivery goal these could be valves, steel casing, and balloon for spill proofing, durability, and holding liquid respectively. Shown in the diagram below (https://i.pinimg.com/originals/91/ce/4d/91ce4de0df1b232da2b2047cd79ea2ea.gif). Once the participant has filled out this matrix, they go about combining one concept from each row into a final concept. This leads to a concept which addresses each parameter in a combination that might not have been found otherwise.



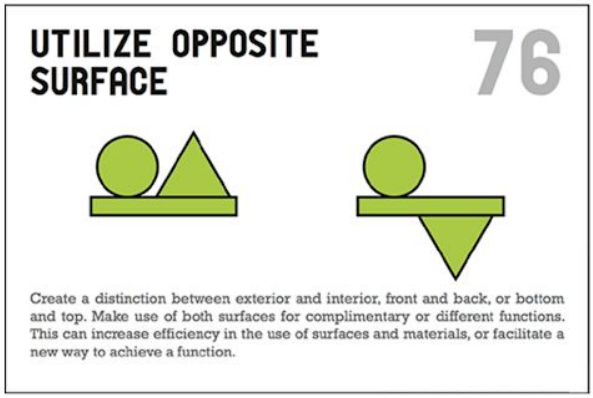
Analogical Thinking

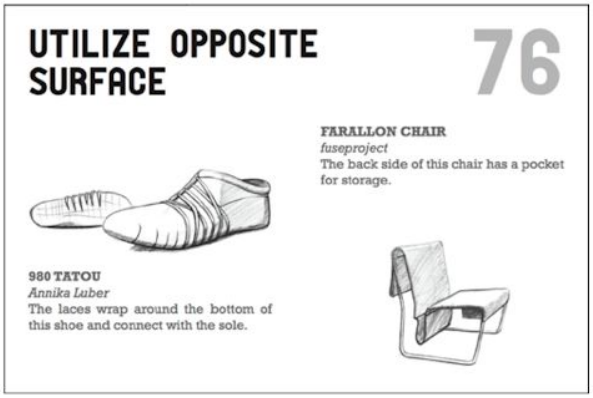
Analogical thinking used during the workshop differed from the smaller sessions led within the team to develop “Ask Yourself” questions in that it wasn’t focused on using as rigorous of a linguistic approach. Instead it was less tightly guided, where participants were encouraged to think of out of the box experiences or products from far away industries than the auto-industry. This activity was facilitated by a colleague who had learned how to do the linguistic approach with the team in the “Ask Yourself” questions exercise described above.

Design Heuristics

The last ideation technique used at the workshop was the Design Heuristic card deck (https://www.designheuristics.com/). This deck is comprised of 77 cards with a different “heuristic” on the front, and a corresponding application of that heuristic on the backside in a real product design. One way to use these cards in practice is to give a group of ~5 participants equal numbers of cards each, and they have to use them to come up with a concept. They can

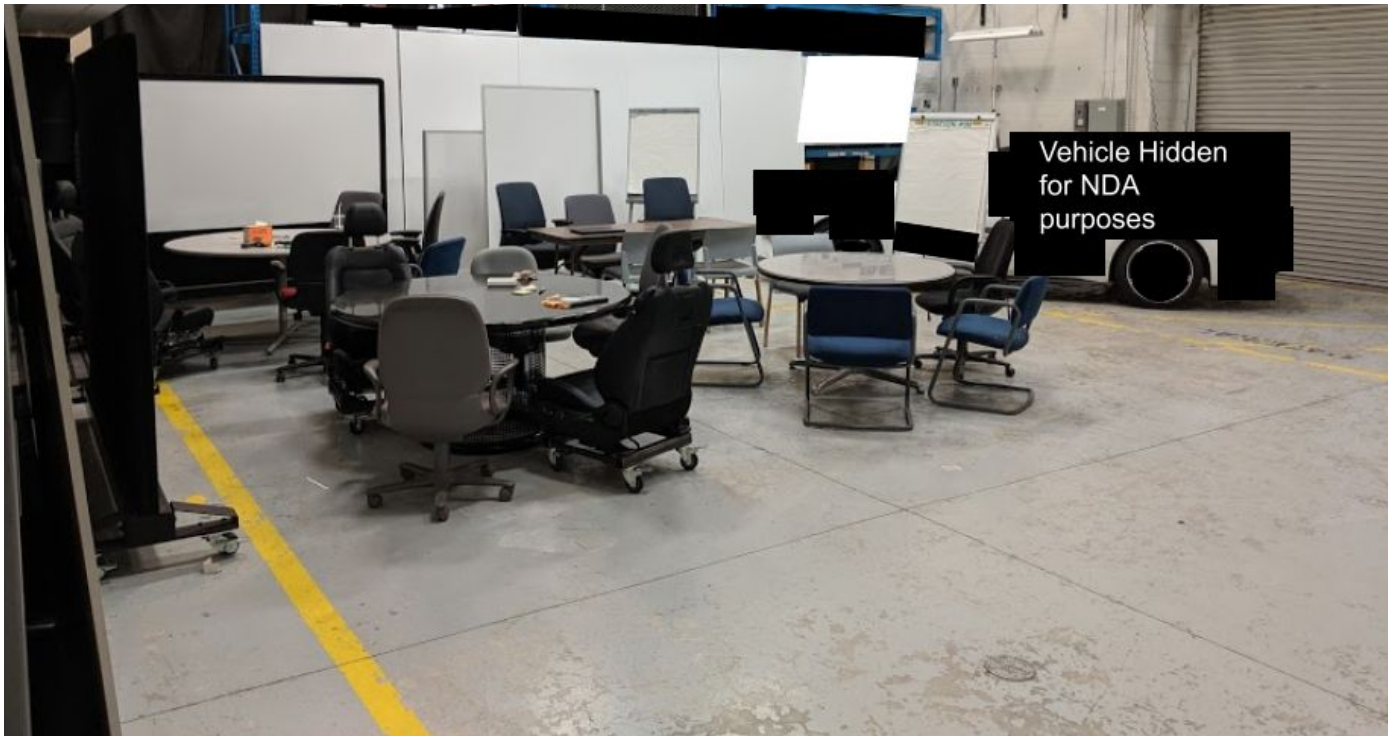
combine them, mix and match, or go off of one heuristic at a time. Alternatively, the cards can be picked up, go-fish style. Heuristics can also be used to develop concepts in subsequent rounds of ideation, by altering the concept to incorporate the heuristic into it in some way. An example of the cards is shown below.





Setting up the Workshop Space

After getting buy in from the teams, it was time to prepare for the workshop. There was a garage/storage area for the vehicle team open to use for the workshop. It was full of extra furniture, miscellaneous foam core boards, and other prototype pieces strewn around as well as some tables and chairs. In order to make this space more conducive to creativity and design thinking it would need to be de-cluttered and given a less distracting visual feeling. This meant cleaning the space up and covering all the shelves with junk on them. White foam core boards were put up around the room, covering the cluttered shelves to create a clean, white, room effect as in the photos below. A vehicle was placed in the room to allow the participants to more readily empathize with the users in role playing as well as two racing seats on wheels with fake steering wheels. Four tables with about 5 seats each for teams to work together during the workshop were placed in one section of the room, and there was a main screen upon which to project information for different topics within the workshop. white boards and markers were placed around the room near each of the tables, as well as sticky notes and pens at each table. Snack and water at each table so that the participants could keep their blood sugar and morale up, it is a good idea to provide food when possible during events like this. Once the white background was achieved, boards with user research insights and the 5 focus *Moments* we were supporting with the workshop from the creative supplier were placed around the room. The boards followed the curvature of the space and readers flowed easily from one to another, they were also intentionally placed in a section of the room separate from the tables in order to make the participants walk around to get to them as well as mentally separate the two spaces in order to create some variety during the experience of the workshop. This was in an effort to keep the participants from becoming too sedentary or bored during the workshop. Engagement is key to helping participants output creative concepts.

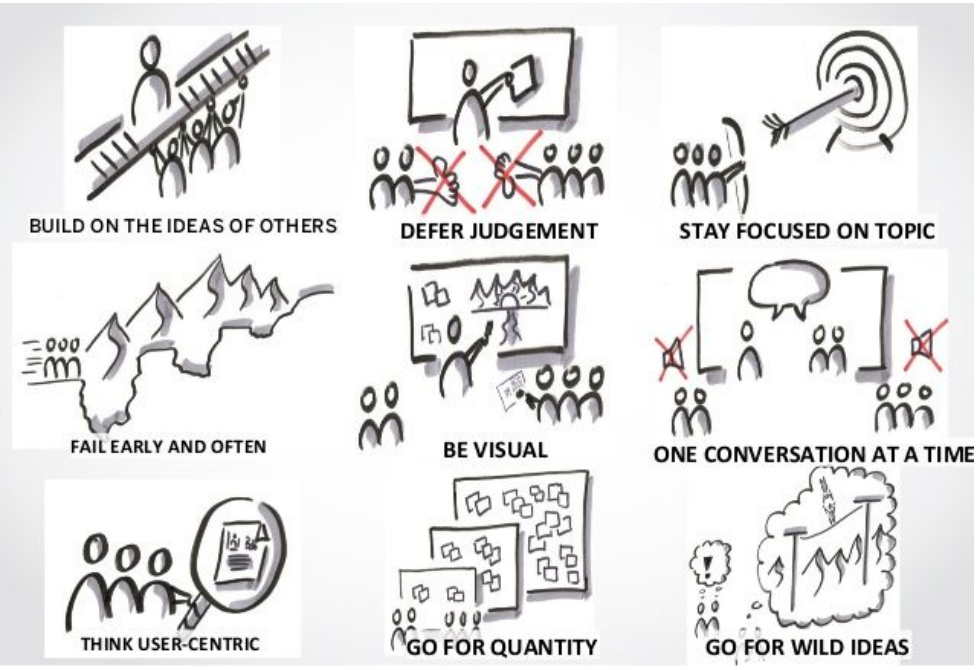

Vehicle Hidden
for NDA
purposes

Before the Workshop

Before the event, it was a good idea to reach out to colleagues who had delivered similar drive modes on other vehicle programs to explain to the whole group a little bit about how drive modes work and how powertrain properties affect what's possible to achieve in regards to power and acceleration on the engineering side. They were contacted and asked what parts of their work might be the most useful in the workshop being planned and their parts were incorporated into the presentation shown to participants. The days of the workshop they came in person and explained what they had been involved in.

Icebreakers

During the event, it was important to start each day off with an icebreaker. The icebreakers served to open up participants' minds to divergent and "out there" thought, as well as build rapport among the participants and facilitators. The icebreaker used each day was "1000 uses". An everyday object was projected on the screen, in this workshop the objects were a pencil and a paperclip for day one and two. The participants were told by the leader that they had 5 minutes to come up with as many ideas for uses of the object on the screen as possible, and whichever table had the highest number of ideas won the game. Each table was assigned a scribe who wrote down all the members' ideas. Before the ideas started flowing, the facilitator made sure that the group knew that the crazier, out-of-the-box ideas, the better. This was one of the several rules for idea generation that were taught to the group the next day, including think outside the box, crazy ideas, build on other peoples' ideas, withhold all judgement on other peoples' ideas. A more complete graphic describing these rules can be seen below.



Cofacilitators

There was a need for a team of facilitators during the workshop due to the quantity of content to be digested and produced. Three coworkers served as the team of co-facilitators in this case. They helped lead participants through the user insight immersion and empathy exercises the first day, and they helped facilitate the ideation techniques at the different tables the second day. The most important part of using co-facilitators during the workshop was to clearly define and communicate to them the responsibilities they were to have. This prevented the paralysis that can happen when the team is unsure of what to do in the moment, it also better equipped the co-facilitators to answer questions raised by the participants.

Engaging Participants Actively

During a workshop like this, which involves a large amount of ideation with a large group of participants, it is likely that there will be some number of participants who will need extra attention or an extra push. A couple of participants in the group at this large automaker were not very comfortable during the ideation sessions. They were not used to thinking divergently and non-conventionally, and it is important to let those participants know there's nothing wrong with that. In order to get participants out of their comfort zones when ideating the facilitators should actively listen to the participants and embody the "yes, and" mindset. Words of encouragement are useful in these situations to get participants excited about their own ideas. If a facilitator notices a participant who seems to be having trouble or is maybe being recalcitrant, they should talk with them more about their ideas, take interest in their ideas. Ask simple questions to which the answers to help them build out their ideas more.

Concept Selection and Ownership

At the end of the second day (the workshop ended up being 2 days due to the cadence of work running faster than anticipated) an evaluation framework was used to sort the concepts and move ahead with 5 of them and build the teams who would be responsible going forward. The framework used for evaluation was a set of axes (Emotional Value vs. Feasibility) after a round of voting in which each participant had a sticker to place on their favorite concept from each ideation table. A note, this was a result of a possible lack of foresight during the planning of the workshop, the axes "Feasibility vs Desirability" might have been a slightly clearer way to organize the concepts. The winning concepts were placed on the axis in order to evaluate them against each other and understand when they might be able to come to market. After a large group discussion 5 concepts were decided on to move forward with. Teams were chosen for the development of the concepts based on the expertise of the different participants present as well as their own interest in the ideas. This way, each team was made of people who were invested more than average in the concepts and felt some ownership over that aspect of the product.

That was an important component of the delivery of these drive modes, without it, the drive modes would be just another top-down assignment that the engineers and designers would have to complete. A steering team was also assembled before the end of the workshop.

Following up after the Workshop

There was a weekly “steering” meeting set up with leaders from each of the project teams put together out of the workshop to report on their progress. Three members of the human centered design group working on the vehicle program were usually present each week at the meetings. The presence was mostly to advocate on the part of the users so that their needs were being addressed by the teams. The team members were also able to answer the steering team leaders’ questions regarding user research and the specific insights that were supposed to be driving the product’s design. The team members also served as a resource for the other teams if they needed design thinking work to be carried out for a new aspect of the ongoing project. Storyboards or other prototypes could be provided by this group for the steering team if they wanted a way to better understand how the outputs would be used in practice.

Subsequent User Research Planning

Luckily in this case there was extra funding available for more user research studies for the vehicle program, so potential research plans needed to be generated to give to the managers for approval to contract a creative supplier. The research would be to validate the new drive modes and salutation sequences with users and get feedback on what they would change in a co-creative process, what they liked and resonated with, what they disliked, and if they would add anything. Four different research plans ranging in fidelity thoroughness, robustness of results, and cost were developed in the form of a rough presentation. It was necessary to consider which stimuli to bring along, location, questions, provocations, and other ways of how we could convey the ideas of our new concepts to participants for feedback. Communication between team members, managers, and potential creative suppliers is a very key aspect of this step. Expectations of capabilities, budgets, and other details are essential to clarify in this step in order to start the research off on the right foot.

Coordinating with New Creative Suppliers

Often at the end of working relationships between team members and their teams or creative suppliers (which can happen several times within the delivery of a single vehicle program) it is necessary to share knowledge accrued up to that point by the team member with the new creative supplier. This transition may even sometimes have to be done in parallel situations, i.e. for several research projects on the same vehicle program, increasing the

complexity of the work as a whole. Nonetheless, it is necessary in order to create a comprehensive collage of the research efforts being done for that vehicle program. This is one of the most fragile points a project can go through, so extra care should be taken in the sharing of files, explanations, and coordinations of the new components of the team.

This transition had to happen during the course of the research for this particular vehicle program. All data, files, write-ups, and other outputs were shared with the new creative supplier, and several sit down meetings among several team members and them were necessary to try and get them on the same page. These meetings gave them the opportunity to ask questions about methodology, goals of research, and ideas the team may already have regarding the future direction of the project.

It appears that this habit of contracting user research related work to a network of different creative suppliers, even within the same vehicle program, can be a monkey wrench for the success of the project often times. It strongly weakens the efficacy of the initial design ethnographic research done, as each new party introduced must be acclimated to the existing body of research almost before subsequent work can be done so that they understand the landscape of user research they will be working within. In practice, quite a lot of important information and considerations can be blown away from the scope of the project due to a simple lapse in memory of the team if each part is not documented in an extremely comprehensive way. This acute documentation may, in the process, bog down the team's agility in carrying out user research, as bureaucracy is sometimes known to do. The "handoff" of information results in a significant loss of experience and information equal to a large, corresponding loss in potential revenue to the company.

Design Science Curriculum Reflection

Upon reflection of the courses I chose to pursue in my master's program, I can draw some connections between what I did with the large auto manufacturer and the content I was taught. I took the following classes during my Design Science program:

- Front End Design (ME 499)*
- Analytical Product Design (DESCI 501)
- Usability Evaluation and Needs Assessment (SI 622)
- Scripting Future Urbanisms (ARCH 509)
- Urban Entrepreneurship (ENTR 490)
- Design Process Models (DESCI 502)
- Collaborative Planning (URP 522)
- Bargaining and Influencing Skills for a Global Market (MO 512)
- Citizen Interaction Design (SI 538)
- Creativity and Design (ENTR 599)

* This course, taught by Shana Daly, was not completed during my enrolment in the Design Science master's program, but it is quite central to the topic and practice of Design Science.

I think the repertoire of content I learned during my graduate program strongly lended itself to the work I did in the large auto manufacturer. I directly pulled ideation techniques from Shanna Daly's Front End Design course (ME 499) to put into practice during the workshop. Another exercise taken from that course and applied at the large automaker was Analogical Thinking through Linguistic Analysis. This course was composed of methodologies and frameworks from the fuzzy front end of the design process. Before/during that course, I had no idea about the true nature of how design works out in bigger auto manufacturers. This class led me to the belief that there were people hired to carry out the whole design process, but it seems a bit more compartmentalized in practice. I got involved in and exited projects at widely varying points within the process.

We learned Design Ethnography, Ideation and Concept Generation, as well as Concept Development and many other techniques/parts of the design process. One of the ways we actualized this learning was through carrying it out on a problem statement that Prof. Daly gave us, or we could elect to come up with our own to carry out. This was the class in which I developed a large part of my conceptual knowledge of Design Thinking and was able to officially carry out Design Research on my own. I discovered a propensity towards interviewing and working with people to co-create solutions for and with them during this project, which involved urban farming in Detroit.

I used interview techniques learned in ME 499 and Usability Evaluation and Needs Assessment (SI 622) for the project I did evaluating the user research methods used at the large manufacturer for different vehicle programs. I used principles from Scripting Future Urbanisms (ARCH 509) during my brief engagements with the team at the large auto manufacturer which was focused on urban solutions to mobility challenges through a competition model, employing them to co-facilitate a community engagement and interview a neighborhood subject matter expert where they were operating.

I am glad to say that the Design Science Master's program has prepared me to do this type of work in many different sectors with confidence.