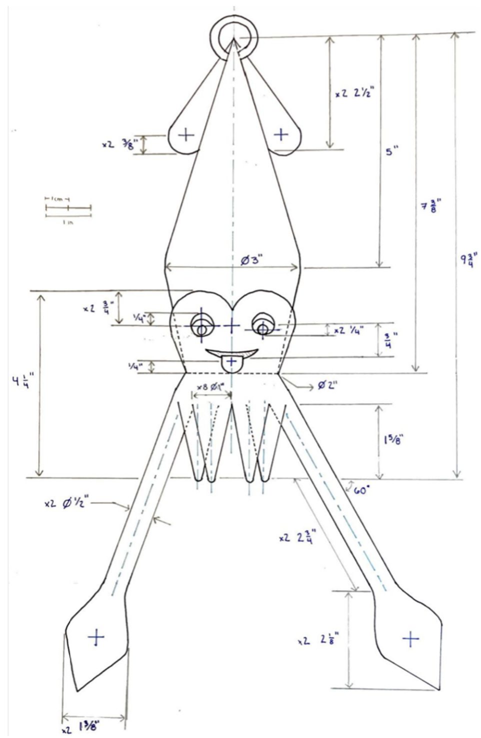
Project Management for Toddler-Compatible Car Toy



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Honors Capstone

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ABSTRACT

There is currently a lack of toys for toddlers that are both enjoyable and practical for travel applications. Most toys currently on the market either have too many components, get lost by the child, do not serve an educational purpose, are too loud thus causing safety concerns for the travelers, or possess other suboptimal qualities for travel purposes. Oftentimes, the most entertaining way to distract a toddler on a trip is to provide access to a phone or TV show, which many parents prefer not to do. While parents frequently travel with their toddlers, they do not have adequate toys available to entertain their children during car rides. The goal of this project is to gain experience in project management by taking leadership courses and supervising an ME450 team that will create a functional prototype of a car-compatible toddler toy. Additionally, analysis of the toy industry will be conducted and relevant patent and legal concerns will be reviewed to guide the ME450 team.

INTRODUCTION

This project was inspired by my two-year-old niece, Isla. Since she is now old enough to frequently travel by car, it has become increasingly clear to me how difficult it can be to travel with a toddler. She has a number of favorite toys that she will bring with her on trips, however none of them are engaging enough to entertain her for a full car ride. Additionally, other components of these toys make them generally incompatible for travel, such as: having too many parts that she either drops out of the car seat or loses, too shrill or loud of noise that distracts my sister and brother-in-law when driving, flashing lights that can be distracting, and beyond. After a matter of minutes, she consistently will ask to watch Cocomelon on an iPhone.

As a result, I decided to focus my Honors Capstone project on developing a toy that fulfills a clear need in the toddler toy market: car-compatible toys that are safe for independent use by toddlers aged 2-3. I originally planned to design, prototype, and build the toy myself, however my capstone advisor Professor Hulbert and I realized early on that a project management approach would be more beneficial for my long-term professional goals. I completed a nearly identical design process in Fall of 2022 for ME450, therefore replicating this process for my honor's capstone wouldn't offer me substantial new experience. However, learning about how to effectively manage another team that was working on the project would provide a new reference point of the ME450 experience and teach me valuable teamwork skills for my career in consulting. As a result, the basis of the project evolved into the project management of an ME450 team that would design a car-compatible toddler toy. While the team progressed through their class-specific deadlines for the project, I would serve as a mentor and offer weekly feedback and guidance to help develop their end product as well as the team's capabilities as engineers. I simultaneously would enroll in a 50-hour "Leading People and Teams" specialization created by the Ross School of Business on Coursera and attend in-person seminars on leadership presented by the Center for Positive Organizations at the Ross School of Business. Additionally, I would conduct background research on the toy industry as a whole, car-compatible toys currently being offered in the toddler market, and legal standards relevant to designing a toy for 2-3 year old children.

This project experience will be highly relevant to my full-time position. I will be working as a Product Development and Procurement Fellow at McKinsey & Company, where I will frequently work with teams to evaluate product designs and seek to effectively improve them. While I've had teamwork experiences throughout my experience at the University of Michigan, being the designated leader of a team and learning specific details about how to be effective in doing so would be a new and formative experience. It is essential to know the basics of being an effective leader before attempting to do so, especially in a professional setting. Learnings from this capstone will apply to the day-to-day experiences I have post-graduation, making them highly important and impactful. The primary deliverables of the project would be the intangible knowledge I gained and a finalized prototype of a toy designed by the ME450 team.

BACKGROUND RESEARCH

Before meeting with the ME450 team assigned to creating the toddler toy, I conducted background research regarding the toy industry, the most popular travel-compatible toddler toys, and relevant engineering standards. The results of this research are summarized below.

Toy Industry Analysis

I began my background research by researching the toy industry to gain a better understanding of the major trends and players.

As of 2020, the global toy industry was valued at over $129 billion.[1] In the US, the projected valuation for 2023 is $19.8 billion.[2] There are four main players that own the majority of market share, then a number of small and independent competitors assume the rest.[3] The four primary players are: Lego, Bandai Namco, Hasbro, and Mattel.[4] The toy industry is subject to changes in the economy, however Covid-19 actually increased demand by 22.3% worldwide.[5] This trend was largely driven by the increased amount of time that children spent at home instead

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[1] (*Toys Market Size, Share, Growth | Global Industry Trends [2028]*, n.d.)
[2] Ibid.
[3] (Tighe, 2022)
[4] Ibid.
[5] (*Toys Market Size, Share, Growth | Global Industry Trends [2028]*, n.d.)

of at school or elsewhere.[6] Other current trends in the industry include innovative packaging and materials, an increasing influence of social media marketing, and a growth in online/electronic gaming to threaten the market for physical toys.[7]

Conducting a Porter's 5 Force analysis revealed that the industry is attractive for a new entrant. There is high rivalry within the industry, since the large players dominate most of the market. Suppliers have limited bargaining power since most toy input materials are commodities or non-differentiable. There is low threat of substitutes, since toys have been a reliable tool for parents over centuries; few substitutes would entertain children in the same fashion or for the same amount of time while providing the same benefits. Buyers have low bargaining power as they are price-takers. The threat of new entrants, however, is high. Toys can take endless shapes and forms, therefore creating a new innovation is not challenging. While there are standards by which to abide, there are no formal barriers to entry for entrants. Additionally, there are no switching costs preventing consumers from purchasing a new item on the market. A new entrant could easily enter and exert high power over suppliers and buyers with no substitutes, making this industry extremely attractive.

Most Popular Travel-Compatible Toddler Toys Currently on the Market

There are several parenting blogs that summarize the best and most popular travel-compatible non-electronic toddler toys currently available on the market. I categorized these toys by their type and described their function below in Table 1.[8,9,10]

6 Ibid.
7 Ibid.
8 (*20+ Best Travel Toys for Toddlers (18 Months - 3 Years Old)*, 2023)
9 (*Best Screen Free Travel Toys for Toddlers*, n.d.)
10 (*30+ Fun Travel Toys for Toddlers 2023 | Affordable & Compact Toys*, 2023)

Table 1. Most popular travel-compatible toys currently available for toddlers. Toys are sorted by type and explanation of their functionality is provided. Toy names and their corresponding descriptions have the same number and row.

Category	Toy Name	Toy Description
Arts and crafts	1. On the Go Water Wow! 2. LCD Writing Tablet 3. Window Gel Clings 4. Coloring Books 5. Aqua Doodle 6. Magnetic Doodle Board 7. Playdough 8. Pipe Cleaners	1. Refillable pen with water-activated coloring sheets and games 2. LCD drawing activated by pen pressure 3. Gellys to put on windows 4. Books with black and white photos 5. Blank page that changes color with water 6. Stamps and pen to write on magnetic board 7. Clay for young children 8. Fuzzy bendable wires
Stickers	1. Reusable Sticker Pad	1. Five scenes with 150 reusable stickers
Fine motor skill refinement	1. Busy Board Toddler Backpack 2. Toddler Busy Board 3. Square Buckle Toy 4. Spike the Fine Motor Hedgehog 5. Magnetic Fishing Game 6. Wooden Apple Lacing Toy	1. Busy board with fine motor activities such as tying shoelaces and buckling, turns into backpack 2. Fourteen skills including buckles, zipping pockets, tying shoelaces, using buttons, etc 3. Fuzzy square with buckles and zipper pocket 4. Six fidgets attached to a hedgehog including spinning a wheel, turning a crank, pushing a button, etc 5. Felt fish and water animals with magnets in them and a magnetic fishing pole to pick them up 6. Wooden apple with holes in it and a worm attached to a rope that can be threaded through the holes
Educational	1. My Quiet Book 2. Take-Along Shape Sorter 3. Learning Friends 100 Words Book 4. LeapStart 3D Interactive Learning System 5. Felt Memory Game 6. iSpy Books 7. Oombee Cube Sorter	1. Fabric book with activities such as learning shapes, feeling textures, telling time, etc 2. Plastic shapes with sorting holes 3. Touch on pages to listen to how to say the word and hear relevant sound effects and fun facts 4. Over 700 activities for learning, counting, problem-solving, etc by tapping on pictures and words on pages 5. Felt shapes on squares that can be matched 6. Books with hidden items 7. Cube with different sized holes that correspond to shapes attached by a rope
Cause and effect	1. ZIPPEE Original Activity Toy 2. Fidget Spinner Toys 3. Pop Tubes Sensory Tubes 4. Rainbow Pop It Fidgets 5. Tegu Magnetic Wooden Block Set 6. Magnetic Maze Activity Board 7. Magnet Building Tiles	1. Silicone toy with cords that slide from side to side and can be bent 2. Can spin a wheel and it makes noise, also has pop buttons 3. Pull and compress noisy crinkly rods 4. Fidget toy to pop buttons 5. Magnetic wooden shapes in a carry case 6. Magnetic pen used to pull metal balls to different spots in a wooden maze 7. Magnetic plastic squares and triangles
Puzzles	1. Big Piece Puzzles	1. Puzzles with few but large pieces
Pretend play	1. MagMen Colorful Magnetic Fidget Toys	1. Small people with magnetic hands and feet that can connect to each other

	2. Wooden Take-Along Tabletop 3. Car Toys and Playmat Storage Bag 4. Finger Puppets 5. Mini Figurines 6. Wristband Stuffed Animal	2. Four themes of town/railroad/kingdom/farm with wooden case and play pieces 3. Soft storage bag with 6 push-and-go friction cars 4. Finger puppets of animals or princesses 5. Mini figures of animals, people, cars, etc 6. Stuffed animal with slap bracelet inside

As seen in Table 1, there are many types of toys that parents bring with them for travel, but few of the toys listed are particularly well-suited for travel. There is ample opportunity within this market. A new toy could fall within any of these categories, or define a new category of its own.

Relevant Engineering Standards

I also conducted research on engineering standards relevant to toy design. These standards are in place to ensure the safety of the children using the toys. They are outlined in ASTM F963-17 entitled "Standard Consumer Safety Specification for Toy Safety."[11] I have included all of the standards that were potentially relevant for the scope of this ME450 project in Table 2 below.

Table 2. Engineering standards for toy design.[12]

Topic	**Engineering Standard**
Small Objects	● No toy (including removable, liberated components or fragments of toys) should be small enough without being compressed to fit entirely within a cylinder of diameter 1.25" and length 2.25", subject to requirements of 16 CFR 1501 ○ Excludes pieces of paper, fabric, yarn, fuzz, elastic, and string ● Toys that are intended to be assembled by an adult and contain potentially hazardous small objects in the unassembled state must be labeled
Accessible Edges	● Toys should not have accessible, potentially hazardous sharp edges ○ Toys intended for use by children under 8 years of age are subject to this requirement before or after use and abuse testing ● Toys intended to be assembled by an adult may contain unprotected potentially hazardous sharp edges in the unassembled state but must be labeled

[11] (ASTM International, 2022, 1-62)
[12] Ibid.

	● Potentially hazardous sharp metal and glass edges are defined in 16 CFR 1500.49 ● Toys containing potentially hazardous edges that are a necessary part of the function of the toy shall carry cautionary labeling if the toy is intended for use by children from 48 to 96 months
Cords Straps, and Elastics	● Cords, straps, or elastics attached to toys should be less than 12” when measured to the maximum length under a load of 5 lb. ● If cords, straps, or elastics or multiple cords, straps, or elastics can tangle or form a loop in connection with any part of the toy including beads or other attachments on the ends of the cords, straps, or elastics then the loop shall not permit the passage of the head probe when tested ● These requirements are applicable before and after use and abuse testing
Material Quality	● Toy must be made from new or reprocessed materials and visibly clean/free from infestation ● If a reprocessed material is used, it must be refined so that it conforms to FHSA
Flammability	● Materials other than textiles should not be flammable, refer to 16 CFR 1500.3©(6)(vi) under Federal Hazardous Substances Act (FHSA)
Labeling Requirements	● Potential hazards must have warning labels as outlined in ASTM F963-17
Sound-Producing Toys	● Close to ear toys should have A-weighted equivalent sound pressure of 65 dB or less, maximum A-weighted sound pressure of 85 dB or less, and a C-weighted peak sound pressure less than 110 dB ● All other toys should have A-weighted equivalent sound pressure of 85 dB or less, C-weighted peak sound pressure level by any toy excluding toys using explosive action should be less than 115 dB, and C-weighted peak sound pressure level by a toy using percussion caps or other explosive action should be less than 125 dB
Electrical Components	● Toys operating from nominal 120-V branch circuits should conform to 16 CFR 1505
Battery-Operated Toys	● Toy shall be marked permanently on the battery compartment or on the area immediately adjacent to the battery compartment to show the correct battery polarity using the polarity symbols “+” and “-” ○ Additional markings should indicate the correct battery size and voltage either on the toy or in the instructions ● Maximum allowable direct current potential between any two accessible electrical points is 24 V nominal ● Toys containing non-replaceable batteries should be labeled ● All batteries should not be accessible before or after testing without the use of a coin, screwdriver, or other common household tool in accordance with 8.5-8.10 ● Batteries of different types or capacities shall not be mixed within any single electrical circuit ● The surfaces of batteries should not achieve temperatures exceeding 71℃ after reasonably foreseeable abuse

I used the information on standards that I had researched to advise the ME450 team on safety information they were lacking and help them to guide their design decisions and tests.

PRIMARY TOPICS DISCUSSED IN COURSERA COURSE

The "Leading People and Teams" Coursera course in which I enrolled was a 50-hour intensive course on leadership skills. The course included lecture-style videos, links to external relevant videos, discussion boards, quizzes to check understanding, application projects at the conclusion of each subtopic, and a cumulative capstone paper. The four primary topics covered were: inspiring and motivating individuals, managing talent, influencing people, and leading teams. This course covered a wide variety of information on each topic, some of which was relevant to my specific project and some being more applicable for later stages in my career. The key lessons learned from the course are summarized below, grouped by course module.

Inspiring and Motivating Individuals

The "Inspiring and Motivating Individuals" module discussed how to develop a vision for a team, define success for a group, and use SMART goals effectively. A leader accounts for 31% of whether a team performs well or not, therefore it is essential that the leader has a clear understanding of the direction of the project and the ultimate goal. The leader is then responsible to create and communicate this vision with the team, structure the team with roles and responsibilities, and show consideration for individual team members. The vision should explicitly explain why the team does what they do, as this image will increase confidence and lead to stretch goals. A leader must also generate a clear description of what success looks like. An unclear definition of success amongst team members can lead to a project going off track and wasted time. Beyond defining success, the course also explained how detailing how the team must act to ensure success is also an important practice.

When creating a vision, definition of success, and ways to ensure success, it is important to consider what would resonate with the audience receiving the message. Therefore, when delivering the message to the team, it is important to create a moral conviction of why their work matters, use inclusive “we” language, repeat key language multiple times, and provoke thought amongst the audience. It is also critical to hone your message as well as delivery; what you say is often just as important as how you say it, especially when trying to gain team traction. Smiling frequently, maintaining an open body posture, and varying delivery style all help to improve delivery. Up to 60% of the social-emotional meaning from a message is conveyed through these non-verbal messages. It is also important to reinforce fundamental values throughout a project by repeating the key message multiple times and thereby building community.

The course also explained research-supported information about the most effective leaders. These leaders (1) are empathetic and committed to seeing the world through others’ eyes, (2) are driven and routinely stretch to achieve challenging goals, (3) have integrity and are committed to doing the right thing even if it's not the popular thing, and (4) are courageous and consider risk and failure to be necessary for innovation.

This module also discussed SMART goals. Goals give direction and can be motivating if framed correctly, so it’s important to establish them early into the project. People will only accept goals that make sense and seem to be attainable; on the other hand, they tend to reject goals that seem too vague or far-reach. Adding structure to goals helps people to better comprehend and agree to them, ultimately making them more successful. SMART goals are specific, measurable, agreed-upon, reasonable, and time-bound. Their structure is easy to understand, more actionable, and progress is clear. Rather than developing goals independently and handing them off to a team, it is easier to gain team buy-in by incorporating them in the goal-forming discussion. Unethical behavior can potentially arise in pursuit of goals, especially stretch goals, therefore team values should be reinforced throughout a project.

Leading People and Teams

The "Leading People and Teams" module discussed providing feedback fairly and coaching team members to grow their strengths and improve upon their weaknesses.

When forming a team, it is important to effectively find, attract, keep, and grow human capital. Overall strategy should inform what positions are needed based on the value aimed to be created. These positions should be determined before looking for people to fill them. Data on attrition, product schedules and team project plan, forecasting, and program management should be consistently reviewed to ensure that the entire business is working together properly. As a leader, it is important to seek this quantitative data and to also spend at least an hour a day talking to the actual people on the team to hear their feedback. The team must have a clearly defined value proposition describing what makes it different and why team members should want to be a part of the team; the team can develop this vision together, or the leader can build one and discuss it with the team.

One of the best ways to be a good leader is to help develop your people. It is beneficial to spend some time with all team members to learn about their dreams and what they are hoping to gain from their role. Some additional key ways to engage people on a team are: keeping them informed of company news outside of their specific area, helping them to determine and create meaning within their work, and rewarding and recognizing good behavior. It is also important as a leader to help team members to improve on their weaknesses. People tend to have overrated impressions of their performance relative to peers due to inflated perceptions of self, therefore it can be challenging for people to identify areas in which they're lacking and to what degree. Providing a team with structured performance management can increase motivation and engagement, enhance learning and development, provide insight into your talent's competencies, give clarity regarding organizational goals, and create alignment of talent with the overall strategy. Successful leaders seek opportunities to learn, bring out the best in others, seek and use feedback, learn from mistakes, and are open to criticism.

When developing team members to become their best, the general structure should follow the ACS model of assessment, challenge, and support. The assessment portion can be quantitative or qualitative and allows the leader to understand the current strengths and weaknesses of the team. Typically the leader should also decide if they're going to focus their efforts on growing strengths, improving weaknesses, or both. Any approach can lead to positive results. Even if growing strengths is not selected as a path forward, it is important to ensure that team members feel as though their current strengths are being used. 80% of employees feel like they don't use their strengths everyday, but teams are scientifically proven to be better off when the team members do use their strengths. The challenge portion of the ACS model requires the leader to stretch team capabilities and take active steps to grow the abilities of the team. Finally, the support portion of the model encourages the leader to provide a network for team members to rely on for advice and guidance. The coaching process should include all of the following: building relationships, assessing needs, establishing goals and plans, co-creating strategies, taking action, evaluating, and adapting. The coaching relationship must be consistently maintained and enforced and can change over time. Structured reflection regarding what works and what doesn't can help guide this evolving relationship.

Another topic covered in this module was providing feedback. It is best to emphasize positive reinforcement over negative reinforcement or punishment, although these alternative forms of feedback do have their specific uses. Punishment should only be employed directly after a severely negative action. Providing negative feedback is a challenging but necessary skill as a leader. To do so effectively, the module recommended being proactive, focusing on a few key problematic behaviors, avoiding critiquing the person or their personality, being specific, not sugarcoating the feedback, confirming that the person understands the feedback, and following up with positive reinforcement when the desired changes are being made. It is best to provide a team with frequent feedback. If team members are seeking feedback, it is a positive behavior. It is also beneficial to seek feedback as a team leader.

There are different types of feedback based on the power relationship between the person providing and receiving the feedback. The most common form of feedback occurs between a superior and a lower ranked person. However, feedback can be given amongst peers or upwards, both of which are beneficial. In 360 degree feedback, many stakeholders other than just a manager will provide feedback, which can lead to an improved view of self and help managers to better welcome upward feedback. 360 degree feedback does involve potentially inexperienced raters which can cause discrepancies, lack of quality, misunderstandings, and low participation, therefore guidance is required to enact this feedback system.

Many unconscious heuristics can impact feedback provided. Availability heuristic makes the most recent or vivid events seem most prevalent, therefore recording notes on intended feedback over time can help create a more holistic view. The leniency error creates overly positive reviews, therefore the reviewer should note negative feedback to share as well, even if the majority of feedback is highly positive. The attribution error occurs when people attribute other people's failures to their personal or moral deficiencies, whereas they attribute their own failures to external factors outside of their control. To mitigate this error, the reviewer must put themselves in the shoes of the person being evaluated to determine what may have been within their control and what wasn't. Feedback should never attack the person being reviewed. Men tend to be slightly favored in workplace ratings, which is a phenomenon to be aware of. Additionally, women tend to be penalized for using an autocratic leadership style, therefore it is best to review people independent of their gender if possible.

Influencing People

The "Influencing People" module discussed forms of nonverbal influence, psychological influencing tactics, and motivation.

This module began by discussing power dynamics. There are many types of power that vary based on how the power originated. Reward power rewards performance, legitimate power is a formal right to influence, coercive power punishes bad behavior, reverent power comes from a personal connection or identification, expert power comes from having expertise that is valued or rare, and information power comes from having information that is valued or rare. The culture and dynamics of a team determine which of these powers are most relevant. Regardless of the type of power someone possesses, the sign of an effective leader is the ability to influence others even without any formal authority over them. Power is relative and contextual, therefore the situation and people involved are always important in understanding the degree of power present. Power increases action, decreases conformity, and even has health benefits, but it has been known to have a number of negative effects as well, such as overconfidence and less open communication. Having power impacts interactions between individuals and a leader must be aware of what ways they're using the power that they have.

Power can also be built. To build structural power, a person can: use symbols or artifacts to emphasize legitimate power and provide others with non-monetary rewards such as support, benefits, or favors. To build personal power, a person can: develop knowledge in key areas of expertise, develop their ability to persuade others, or grow their charisma. To build cognitive power, a person can: use open body posture, challenge their beliefs and stereotypes about power, and recall instances in which they did have power and remind themself of how they felt in the situation.

Psychological heuristics can also contribute to the ability to influence people. Social proof shows that people are more likely to adopt an idea that many other people support, therefore gaining buy-in from others before presenting an idea to superiors can be helpful. The liking heuristic causes people to prefer ideas from people they like. As a result, a good appearance, drawing on interpersonal similarities, and engaging in friendly conversation before asking someone for a favor are helpful. The scarcity heuristic causes people to believe that scarce resources are more valuable. Therefore, it is good to emphasize uniqueness, limited quantities, time constraints, and other scarcities related to an idea or project. Finally, the reciprocity heuristic causes people to want to help others who help them, therefore extending favors to others can only lead to benefits down the road.

Influencing people also requires that the message being shared sticks with them. Some characteristics of messages that stick are: they are simple to remember, they unexpectedly capture the listeners' attention, they are concrete, they are believable, they are emotional so that people care about the idea, and they utilize stories to make the message more personable, memorable, and actionable.

Beyond what is being said to influence people, nonverbal communication is equally important. Some influential nonverbal tactics include: eye contact to increase likeability and credibility, mirrored behaviors of others to be seen as more confident and persuasive, hand gestures when speaking to seem more competent, and a firm handshake where appropriate. It is easiest to influence people early in the morning or after they've eaten a meal, so timing can also be impactful.

Leaders and team members alike require networks to support and inform them. A larger less connected network can increase a person's informal power, as the person becomes needed to connect branches that may not know one another. It is best to expand one's network outside of just immediate contacts. An easy way to do this is to meet someone new for lunch or a coffee chat once a week. The best relationships have high mutual dependence. It is bad to constantly rely on others and never have anything to offer in return.

Reputation matters on a team. It is best to build your own reputation as someone who is influential. People who don't advocate for themselves and their accomplishments are at a disadvantage; however, there is a balance between advocating and being seen as arrogant. With time, others will begin to share the person's accomplishments as well.

This module also discussed the importance of motivation, especially in pursuit of challenging goals. Motivation can be either intrinsic or extrinsic and explains 81% of the variation in job satisfaction among people. Generally speaking, types of motivation fall into the categories of achievement, recognition, the work itself, responsibility, advancement, and growth. Intrinsic motivators are internal feelings such autonomy, belonging, learning, and meaning in the work. Extrinsic motivators come from external sources, such as salary, badges, titles, and praise. While extrinsic motivators can be effective, in certain circumstances they can undermine tasks that are considered independently intrinsically motivating, so it is important to watch for this interaction. Motivation directly influences engagement which in turn impacts profitability, productivity, quality of service, and other value measures. Each individual may have different motivators, therefore asking them directly is highly recommended. There are four major traps for motivation, including: (1) assuming everyone is the same as ourselves and thus has the same motivators, (2) assuming extrinsic rewards like money directly lead to increased happiness, (3) misaligning rewards and desired behaviors, and (4) ignoring social and fairness concerns.

A key driver of motivation can be rewards, therefore the module discussed this topic in depth. It is essential that rewards promote desirable behaviors, therefore it is important to investigate exactly what behaviors the reward structures put in place are encouraging. The team must also value the rewards being provided otherwise they will be ineffective. Equity in rewards is also important, as a lack of equity can cause stress and burnout.

Leading Teams

The "Leading Teams" module discussed favorable team attributes, team norms and structure, and task vs relationship conflict.

The first topic covered in this module was ideal team sizing. Larger teams tend to be more innovative since there are more people available to brainstorm ideas; however, groupthink in which everyone on a team grasps onto a single idea and discourages creativity can be very harmful. Beyond groupthink, brainstorming in a team setting can also be hindered by production blocking, evaluation apprehension, anchoring, and social loafing. Regardless of team size, it is best to always allow team members to brainstorm and provide ideas independently to ensure everyone's voice is heard. The optimal team size for team satisfaction is 4 to 5 members, but an increase in members can increase effectiveness. Teams should never be larger than 10 people.

Team members should vary in their backgrounds and abilities. Surface level or observable differences will be immediately noticeable, but deep level differences will appear with time. A leader is responsible for monitoring whether subgroups form within a team. These subgroups are typically built along fault lines, which are dividing lines within a team based on group members' demographics. These fault lines negatively impact cohesion and must be prevented. Diversity is always a positive attribute of a team, but it can cause conflict which also must be monitored.

When beginning to lead a team, it can be helpful to map the personality profile of all of the members. Team members can be extraverted or introverted, agreeable or not, open to experience or not, conscientious or not, and emotionally stable or not. The most ideal team members are confident extraverts with an openness to experience. However, since it is highly unlikely that all members on a team will have this personality profile, it is best to map them out to be aware of the personalities present and predict likely conflicts. Everyone on a team is equally important and should be made to feel that their contributions matter.

It is important to introduce task-related diversity on a team as well. When all team members perform all of the necessary tasks, they lack the ability to specialize and take specific ownership over their work. This generalist structure can be beneficial in a vague or new scenario, but otherwise it is best to enable team members to specialize in a particular area. It is much easier to transition specialized individuals into generalists than vice versa. Ideally, each team member should have a different role within the team. It is important to discuss these roles and ensure that all areas are covered. The structuring of these unique tasks can vary. Pooled interdependence has many tasks that separately lead to a desired outcome, sequential interdependence has a row of tasks, and reciprocal interdependence is more cyclical where outputs of one individual become the inputs of another. Any of these styles can be effective. The best option can be selected based on the tasks being performed. When dividing tasks, it is important to have clear goals. The division of labor should be focused on the ultimate goal of the group. The most important task should not be given to the least committed team member.

Team norms naturally arise within newly formed teams. These norms may relate to competition vs cooperation and other basic beliefs that will shape the behaviors that are seen on the team. Having established norms increases satisfaction, performance, and compensation. The earlier these norms are established, the better. The team leader can have a high influence on team norms when they're not yet well-defined, but it is hard to change established norms. The leader should work with the team early on to determine the norms that the team would like to form and the team's goals and expectations. All of this information can be outlined in a team charter.

Conflict is to be expected on any team and, depending on the type, can be beneficial. Task conflict arises when team members disagree on how a task should be done. This type of conflict increases creativity and productive debate, therefore it can be helpful. As long as the conflict is centered around the task being discussed and does not venture to attack the people providing the ideas, it is considered a positive. Relationship conflict, on the other hand, is a disagreement between people on a team. It could be based on a personal disagreement, differing personalities, conflicting perspectives, or other issues. This type of conflict is harmful to team dynamics and causes tension; therefore, it is best to avoid relationship conflict as much as possible. Using a mediator to limit conflicts can be helpful.

Team performance can be evaluated based on whether the team obtained its objective goals, whether there was satisfaction with group interaction, and whether there was learning by the teammates. A successful team enables everyone to contribute and gain from the experience. Psychological safety, or the belief that everyone can speak up on a team without fear of criticism, is a key indicator of a successful team. Psychological safety can be built by getting to know team members beyond their role on the team, asking questions, never saying an idea or question is bad, owning up to personal mistakes, and showing appreciation for all contributions.

PRIMARY TOPICS DISCUSSED IN CPO WORKSHOPS

In addition to completing the Coursera leadership course, I also attended workshops presented by the Center for Positive Organizations through the Ross School of Business. These provided additional techniques to increase engagement among team members and better refine personal purpose. The key lessons learned from the workshops are summarized below.

Accelerate Engagement

The Accelerate Engagement workshop was led by Monica Worline and Betsy Erwin on January 19th. This session sought to provide detailed information on ways to increase engagement among team members. The workshop used an acronym, STARS, to list the 5 key areas to address to increase engagement.

The first ‘S’ stands for safety. Psychological safety, or promoting an environment in which team members don’t fear judgment for sharing their ideas, increases engagement in teams by encouraging participation. A psychologically safe environment should be established as soon as possible. Some ways to increase safety include having team members show-and-tell something important to them, discussing individuals' biggest failures and learning points, and discussing what factors lead each team member to feel the most safe in a team.

The 'T' stands for task. Individuals become more engaged in tasks about which they feel passionate and proud. Improving in this domain can be done by having team members publicly share what in their work has made them the most proud or passionate and creating new work assignments based on what motivates each team member the most.

The 'A' stands for appreciation. Providing team members with recognition for their work increases confidence, makes the team more efficient, and better equips the team to handle uncertainty and anxiety. Appreciation should be given daily whenever strengths are noticed in teammates. When providing this appreciation, it is important to explain what was observed and what value the behavior added to the team. This feedback can be given individually or as public recognition.

The 'R' stands for role. Having a team member who is responsible for monitoring engagement helps engagement increase since it is being observed. This type of observation should be done at the beginning, middle, and end of a project. The person in this role should model a high level of engagement and provide outlets to help other team members to emulate the same behavior. Some of these potential outlets include shaping the culture to be more conducive for engagement, calling out sources of gratitude from the project, and being aware of when a break would be beneficial.

The final 'S' stands for stamina. It is important to manage the energy on a team and provide breaks where necessary to help increase engagement. Team stamina should be considered during every team work session. Some ways to spend the break time include going for a walk, getting coffee, meditating, watching a quick video, and more. It is also good practice to encourage team members to become aware of their energy levels throughout the work session so that everyone is more aware of when a break would be beneficial.

Accelerate Your Purpose

The Accelerate Engagement workshop was led by Monica Worline and Betsy Erwin on April 6th. This session sought to help participants to identify their personal purpose to guide interactions with others and become a more effective leader.

The workshop first taught us to be aware of our intended impact: a good leader should be able to summarize their overall goal for a project in only 6 words. When sharing this shortened purpose statement, it should be clear to others what you're trying to accomplish in your role. This purpose should then guide all future decisions to ensure that all actions align with your overall values and goals. It is encouraged to modify the scope of any role to ensure it aligns with your strengths, values, and intended contributions. When in a leadership role this can be easily done, but if reporting to a supervisor, it can be productive to schedule a meeting to share your goals and plans. Beyond the scope of a role, tasks should also follow suit in aligning with your strengths, values, and intended contributions. Mentors and co-workers can be very helpful in pushing you towards achieving your goals, so confiding in trusted others is often beneficial.

Finally, creating a purpose map can help to better define one's purpose if unclear. This map should trace all of the significant events in your life and connect them based on how you felt or what led one into the other. The mapping of these events can give better insight into what is important to you and why you pursued the path you did/are. If further assistance is needed to determine a purpose, thinking about things that you're proud of, what you'd do if money wasn't an object, and your most meaningful items and memories can be a good starting point.

EXPERIENCE LEADING ME450 TEAM

I was able to apply everything I'd learned over the course of the semester by sponsoring the ME450 team. My experience is summarized below.

Application of Learnings

In our first meeting, I began by meeting each of the 4 undergraduate mechanical engineering students that would be working on the ME450 team. I sought to learn more about them, such as their hometowns, interests in engineering, why they chose to work on this project, etc. It was important to me as a leader to demonstrate to the team that I genuinely care about getting to know them beyond just their project progress, so I laid this foundation early on. I also smiled often and tried to come across as welcoming as possible. While the power dynamic was slightly unusual since I am at the same age and level as the students on the project, I still wanted to set a standard for how we would interact. We discussed the best ways to reach me, the frequency at which we planned to meet, and in what ways I could be most helpful to the team. I directly acknowledged that I was a student of their same age who had taken the course and wanted to support them, which helped to develop a friendly supervisor relationship.

I next discussed the scope of the project with the team. I shared as many details as I could provide and repeatedly stopped to welcome questions. Using "we" language and an open body posture, I welcomed engagement from the team. After answering initial questions, I invited the team to come up with additional questions as they reflected on the project so they could ask them when we met next.

I also shared my vision, definition of success, and values to guide behaviors on the team, all of which I had created prior to the meeting. They are included below.

Vision:

"*We are filling a need in the toddler toy market to better entertain children on car rides. We are helping improve travel for parents, children, and passengers going with them. Our toy will directly serve my niece and sister. We are seeking to create joy through our toy and grow as creative engineers."*

Definition of Success:

"Our team will generate a functional prototype that keeps my niece happy and entertained. Our team will each feel they learned new engineering skills and are satisfied with their 450 capstone experience."

Values:

"We compromise and continue to innovate despite setbacks. We support one another in accomplishing our goals. We plan ahead and keep track of schedule. We ask questions and encourage others to do so."

After discussing these topics, we discussed team expectations and team norms. I tried to be more of a listening facilitator than a participant in the discussion since I recognized that the team would be spending ample time together without me present. We also developed SMART goals for the semester that felt reasonable and achievable.

While still early into the semester, I wanted to understand the team members' motivations for participating in the project, so I sent them a Google form to get their feedback. I would later use these motivators to encourage them when feeling stressed or burnt out.

As the team began to conduct their background research on the project, I was able to assist them having done my own research previously. I answered all questions related to the toy industry and engineering standards relevant for toddler toys, as well as provided resources for areas in which they needed to conduct a deeper dive. When questions were asked to which I did not have an answer, I admitted my lack of knowledge to build psychological safety and followed up with the team when the information was available to me.

The team and I continued to meet weekly over the course of the semester. I always began our meetings by asking the team members about their personal lives and interests to continue to build a bond beyond the scope of the project. They often would bring questions regarding the current stage of the project they faced. I would frequently provide insight from my personal experience with the course. When the team conducted each of 3 formal design reviews for the ME450 course, I attended and recorded my feedback on the presentation. I also marked down all of the comments and questions that the team's professor and classmates presented for us to debrief together.

When the team began their concept generation phase of the project, I explained to them the importance of independent brainstorming which I had learned from the modules. Rather than a lecture-style discussion where I told them what science says, I shared from personal experience about mistakes my ME450 team had made and how a different approach would have changed our outcome. This discussion also advanced the psychological safety of the team by emphasizing that I too had made mistakes during my ME450 experience.

About half way through the project, I sent the team a Google form where they could provide feedback on how they felt I was performing as a team leader. I made the form anonymous so they would all feel comfortable sharing their honest opinions. Most of the questions were phrased as a scale of 1 to 10 to rank how well I was performing in certain leadership areas. I analyzed the results and used the rest of our time together to improve in the few areas the team felt I was lacking. I also used the form to confirm that the team had a solid understanding of the direction, vision, and goals of the project.

As the team progressed into later phases of the project, I began to try to coach them on growing their strengths and strengthening their weaknesses. I would frequently ask the team which members were responsible for which portions of the project and encouraged them to alternate responsibilities so they were exposed to different skills. We discussed the importance of the different tasks of the project and how even minor interaction with them could be beneficial.

At this point in the semester, the team began to feel swamped with their expectations and other coursework. I used one of our meetings to discuss some of the key motivators that the team had previously told me were important to them. We discussed ways to more easily remember these key motivators to help drive a final push toward the end of the semester. I helped to guide them through their burnout and provide suggestions. Finally, I attended their design expo to see the final prototype and support them on this celebratory day.

RESULTS FROM TEAM EVALUATION

The ME450 team provided the following feedback regarding my leadership through an anonymous Google form. The form asked the ME450 team members to rate how much they felt each statement applied to them by providing a score from 1 to 10, with 10 being very accurate and 1 being very inaccurate. The prompts asked in the survey and their average results are summarized in Table 3.

Table 3. List of prompts provided in Google assessment form and their corresponding average scores.

Prompt Provided	**Average Score**
"I feel like my voice is heard on the team"	10
"I feel like we have the right level of communication with Sarah"	10
"I feel like I know what is expected of me in this project"	10
"I enjoy working on this team"	10
"I think that the goals we have for this project are attainable within the span of the semester"	9.25
"I feel motivated to work on this project"	9.5
"I feel like I belong on this team"	10
"I feel comfortable sharing my concerns and ideas"	10
"Sarah is respectful"	10
"Sarah has effectively created and communicated a vision for our team project"	10
"I feel like Sarah gives me/us the ability to guide our project design and results"	10

I was confident with the results from the survey. I scored an average of 10 points on 9 of the 11 questions that I asked the team, which meant they all agreed that I was performing well in those areas. There were two prompts for which I had room for improvement. The first was "I think that the goals we have for this project are attainable within the span of the semester." The second was "I feel motivated to work on this project." They received scores of 9.25/10 and 9.5/10 respectively.

After reviewing the data, I sought to improve the team's opinions on these two prompts. Instead of directly discussing the survey results, I chose to guide our conversation toward goal setting and motivators; bringing up the survey results may have come across as slightly invasive, so I aimed to accomplish the same goal without connecting the dots for the team. To address the concerns regarding the goals we had set, I led the team through a discussion about the engineering specifications and requirements. We collectively determined the specifications that we considered to be the most challenging and created back-up testing plans should time run short. While the team had the same number of responsibilities before and after the conversation, they had a greater peace of mind having emergency plans in place.

To address the lack of motivation within the team, I engaged in another discussion with the team at a later meeting. I had previously surveyed their key motivators for the project on a Google form, so I reviewed this data to see what motivators to emphasize. The team had described many motivating factors, including: grades, autonomy over the project, relationships with their other team members, relationships with me, learning new things, practicing skills for their full-time jobs, and creating value for the end user. The team members varied in which motivators they selected, however all prioritized creating value for the end user. In our discussion, I therefore chose to emphasize the importance of our project for my niece, the end user, and share more details about her since they were interested to hear more about their potential impact. We decided as a team that they would all have the opportunity to deliver the completed toy to my niece themselves after completing the project to be able to witness the impact they made.

RESULTS FROM ME450 PROJECT

The ME450 team was able to successfully produce a working prototype within the span of the semester. On the following page in Figure 1 is a photo of the team members presenting their work at the Mechanical Engineering Design Expo.

Figure 1. Team presenting their project at the ME Design Expo.

Additionally, the team was able to personally present the finalized toy to my niece, Isla, at the Ann Arbor Public Library. Figure 2 shows Isla learning about the toy, Figure 3 shows her carrying it with her to lunch, and Figure 4 shows her using the toy in the car.

Figure 2. Isla learning about her new toy at the library.

Figure 3. Isla carrying her toy squid to lunch.

Figure 4. Isla using her toy in the car.

CONCLUSION FROM CAPSTONE EXPERIENCE

My capstone project taught me a number of leadership skills that will be applicable for my career. While many of these skills were applicable in sponsoring the ME450 team, others will apply in later experiences. It was very beneficial to have the opportunity to practice the skills that I'd learned in the lecture series in this real application. It was also very exciting to see the ME450 team progress throughout their project and deliver a final prototype. I greatly enjoyed my experience.

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