INVERT

making theme parks accessible

Theme Park Accessibility Solution

by

Chadwick Dewey

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Supervisors: Dennis L. Kappen and Catherine Chong

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Abstract

Theme parks, the quintessential escape from reality, have been the haven for generations of people looking forward to escaping reality for a bit. However, these multi-million-dollar enterprises have overlooked large portion of our society, mainly paraplegics, amputees, and other mobile challenged individuals. River rapids ride attractions provide a quintessential example of this. By their nature, these rides have a lot of variables: free-flowing rivers (essentially track less), continuous motion, freely moving, and in constant contact with water to name a few. All of which pose a variety of problems for the mobility challenged. By investigating the user's needs through means such as videos, reviews and interviews new solutions can be created. Utilizing this data, solution found in related industries, the need for comfort from both disabled and non-disabled alike, and the intrinsic attributes of this attraction all come together to create a holistic, user focused, experience. Utilizing these findings INVERT and ACESS were created to solve the accessibility issues with river rapids ride system and in hopes that these design ideologies can be carried across all theme park aspects, making them a fully accessible experience.

Acknowledgments

` My most sincere thank you to my two supervisors and my supportive parents Randy and Christian without their knowledge, encouragement, and advice my journey these past four years would not have been possible. And to my late grandfather, Howard T. Pretty, who was and still is a never-ending source of encouragement and inspiration. He taught me to keep pushing myself until everyone thinks I am crazy because that's when you know you've made it.

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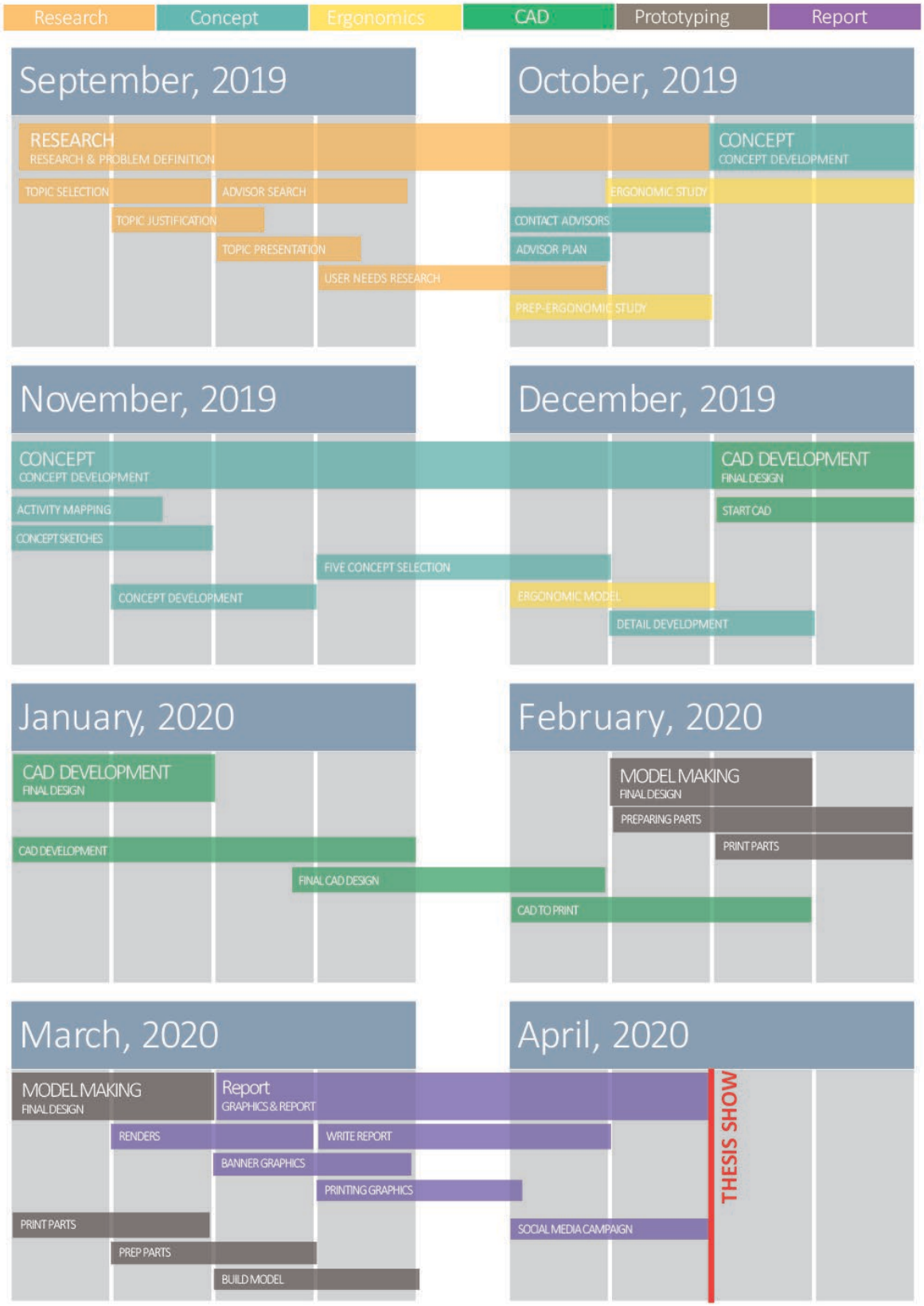
Project Schedule



1 Problem Definition

Figure 1.1 The Problem - Edit Composite

1.1 Problem Definition

River rapids rides are simulated white-water rafting experience that first appeared in 1979 (Intamin, 2017). Tubular rafts that have rides seated around the circumference of the boat facing inward are sent down a man-made river with a series of jets, fins, and other obstacles placed at the bottom of the river to create the white-water rapid experience. Riders are secure in their seat with either traditional over the head shoulder restrains or by lap bars. Their compact nature means it is hard to get in-and-out of the ride even with full mobility. By the design's nature it is impossible for wheelchair users to get in without the assistance of someone or something. Translating into the rider being carried or lifted into place, which often is time consuming, uncomfortable, and humiliating. Throughout this thesis report, the design process will investigate how by using human center design and taking both wheelchair and non-wheelchair users into the design consideration it is possible to design a river rapids ride that it truly an inclusive experience.

1.2 Investigative Approach

At the time of completion of this report, published researched on the topic of theme park accessibility was scarce. There for comparison were drawn from related industries, solutions, and activities such as other ride solutions and transferring from wheelchairs to other seating devices. This report's research data will rely heavily on video observation, target audience reviews and interviews in order to pinpoint the problems and unique challenges faced by users.

Key Research Areas	Key Questions
➢ River rapids ride characteristics ➢ User experience ➢ Human perception ➢ Ergonomics ➢ Human kinetics ➢ Wheelchair specific kinetics ➢ Ride attraction design ➢ Wheelchair design	➢ How to make river rapids rides more accessible? ➢ How to give more independence to lower limb disabled riders? ➢ How to speed up the transfer time from wheelchair to ride vehicle? ➢ Do riders have to transfer from wheelchair to ride? ➢ What are the physical barriers faced by wheelchair users? ➢ Is a way to make rapid ride more fun for everyone? ➢ How are current ride laws restricting inclusivity

Methods of Solution – User-Centered Design

General Design method for Industrial Design	Specific method used in this Thesis
Problem/Opportunity Statement	Needs Statement/Literature Review
Research	User Research - User Profile - User Observation - Expert Interview - Ergonomic Studies - Video analysis - User activity Mapping - Firsthand experience Product Research - Literature Review - Promotional Material Review - Product Benchmarking
Analysis	Analysis of Selected Criteria - User Needs - Usability & Functionality - Competitive Analysis - Frequency Analysis - Aesthetics - Materials
Ideation	Rapid Sketching Mind Mapping Final Sketches
Concept Development	Ergonomic Study Sketch Model Study
Concept Refinement	Detail Development CAD Development
Model Generation	CAD Model Hard Model

Table 1 - Industrial Design Method

Figure 1.2 Grizzle River Run

1.3 Background / History / Social Context

River rapids rides have been around for the past 40 years, first debuting at Six Flag's AstroWorld called Thunder River (Intamin, 2017). According to Intamin, world leader and inventor of the river rapids ride, it became so popular that Six Flags ordered six brand new ride layouts for their different parks within the following five years. Today out of the 200 rides built 180 are still in operations around the world as of writing this paper. (Wikipedia, 2019) This thrill-seeking family-style type ride became a smash hit for its unique almost natural feeling. Unlike traditional rides where the vehicles are kept on a track that can be clearly seen by riders, the rapid rides system uses a man-made water filled channel or river which essentially replaced the coaster track system. They are often coupled with scenic design elements to provide the illusion that you are flowing down a white-water river.

The original design was created to allow for the entire family to experience the fun together. All riders are placed within an oversized inner tube facing each other, so they can see each other experience the ride creating a communal experience. River rapids rides have been

quite revolutionary, bringing together a mix of simulated extreme sports, storytelling, thrills, and family fun all together in a wild watery experience. (MacDonald, 2019) This blending of storytelling and thrill was something only Disneyland, and the newly opened Walt Disney World had done. By nature, river rapids riders brought the theme park experience to the concreate and steel jungle of the modern-day amusement parks.

Disney has been the leaders in impressive story telling mixed with heart-stopping thrills since they open in 1955 (Klein, C. 2015). In 1999, Disney debuted their first river rapids ride, Kali River Rapids in Animal Kingdom. (Kali River Rapid, 2019) It quickly became a smash hit, and Disney went on to build Grizzly River Run in February 2001 (Disney Fandom, 2019) and Roaring Rapids in 2016 (Roaring Rapids, 2019). Disney Kali River Rapids features a unique separate loading dock for those in a wheelchair. However, it still relies on someone to carry the wheelchair user in and out of the ride.

Conclusion

Throughout theme park history, they have been a major source of escape and joy for millions of guests. Focused on bringing people together to enjoy quality thrills and fun without the problematic social constructs. Unfortunately, the following chapter will go into the short falls many theme parks have fallen prey to and how they have neglected to include the mobility challenged guest.

2 Research

Figure 1.3 – Infinity Falls

This subsequent chapter will focus on the research conducted to answer the top crucial question pertaining to the product and target market's specific challenges. Majority of parks are not accessible for wheelchair users however Disney theme parks have taken a number of measures to make it accessible for those who are mobile challenged there for allot of the follow data will be collected from and in Disney parks.

2.1 User Research

2.1.1 User Profile / Persona

User Type

Primary User: Wheelchair Users Full Lower Limb Paralysis

The primary users of this product would be wheelchair users, with a focus on those with partial to full lower limb paralysis. Those users who are unable to transfer from their wheelchair to ride vehicles or can transfer but only with great difficulty.

Secondary User: Theme Park Attraction Operators

Secondary users would be theme park staff and ride operators themselves. Theme park staff are always there to help and ensure safety for guest period but an added level of attention to those with disabilities. However due to liability issues they are often not allowed to physically help wheelchair users. This product aims to make their lives easier by creating a seamless flow when wheelchair users get on and off ride vehicles. Protecting both worker and theme park guest.

Tertiary User: Theme Park Support Staff, Security and Health Services

Third party users would be theme park support staff, health, and security. These workers are there to help wheelchair users in their experience during the theme park. Their to keep them safe and optimize their experience. This product would also focus on making wheelchair users overall experience great not just in relation to the attractions themselves.

Age and Gender: 15-50, all genders

The selected age group was due to the physical nature of theme park attractions: the high-speed GeForce, motion sickness, height restrictions for harness, etc. all these factors contribute to the fact that majority of theme park riders are between the ages of 15-50. Children under ages 12 are most prone to motion sickness according to the Center of Disease Control and Prevention (Chen 2016) therefor rides with higher GeForce are built for children over the age of 12. Reversely adults over the age of 50 begin having allot of health problems such as high blood pressure, heart disease, etc. In a CNN report to Aria Hangyu Chen Dr. Robert Nile said, “Riding a roller coaster is far safer than riding in a car to the park, but only if you don’t have any heart, neck or back conditions that might be exacerbated by the speed and stress of a coaster…” (Chen

2016) all of these tend to be problems people over 50. Consequently, to limit unrelated external variable the demographic in focus will be 15-50 years of age.

Education: basic cognitive awareness and special reasoning

The education of the users is not applicable; if you have basic mental awareness and special reasoning you are able to operate the wheelchair.

Income: $43,000 + (Roen, T. 2017)

According to recent studies the average American makes around $43k a year. Majority of theme parks are a perfect vacation destination despite some of them behind quite pricy people still make the time and effort to visit the parks

Ethnicity: All ethnicities

The idea of going to a theme park to have fun and escape from life transcend ethnic background. With theme parks located worldwide there is not specific ethnic background forced as may be seen in other industries.

Demographic Summery

The following data was pulled from (Appendix II – User Research)

Demographics		User Behavior		Personality		Cognitive Aspect	
Age	15-50 Years of age	**Frequency of use**	Theme parks are often milestone vacations done couple times a lifetime unless you live near one	'Locus of control'	↑	Technical Skills	↓
Gender	Mixed	**Duration**	6-day vacations	Self-Efficacy	↑	Pre-reg content knowledge	
Culture/ Ethnicity	Mixed	**Social/ Solitary**	Social and solitary function	Changeability	↑	Adaptability	↑
Income	$43,000+	**Level of Focus**	Low to medium	Uncertainty Avoidance	↑		
Educational/ Background	Inapplicable	**Location**	Inside river rapids ride vehicle				

Table 2 – Demographic Summary

Overall theme park attendance is quite mixed from a range of ethnic background, ages, social and economic levels etc. Theme parks are a place for people to escape reality from the rich to the poor everyone can come together and enjoy the experience of escaping reality and transported into fantasy.

User Persona

Name	Chris
Age	23
Job	Blogger
Education	Post-secondary
Family	Single
Location	Orlando Florida
Frequency	Avid theme park attendance
Duration	Frequent vacation
Social / Solitary	Average guy out of college building his career wanting to visit theme parks without the limitation of needing people to help him
Other Activates	Loves visiting theme parks and desires the freedom of going by himself whenever he wants.

Figure 2.1 Guy in Wheelchair

Table 3 – User Persona

Chris is a freshly graduated university student with his degree in English. He works at a large online media blog sight writing article. One of his favorite things to do is to do physical activity and go to theme parks. He enjoys the independent of not having to have someone go with him to help him get in and out of theme park rides.

User Behavior

When attending theme parks in the past he is required to stretch and warm up as well as do light fitness, so he can lift himself easily in and out of roller coasters from of angles. He then must mentally prepare himself for the eyes of other park guests because he knows that during the transfer everyone will watch his with indignation and frustration. (Hubbard, 2019)

Figure 2.2 Kali River Rapid Ride Boat

Chris's Experience at Disney World's Animal Kingdom

When arriving at the park Chris is first task is to visit the disability center located at the front of every park. Their he is informed about which rides, paths, attraction, etc. are accessible to him and to what level as well he is offered a tour guide. He is then giving the lowdown on the best methods to properly transferring into ride system and has all his questions answered. When he gets to the first ride, he must figure out how to get in with the guidance of ride operators however they are unable to physically help him in he is require getting himself in and out with the support of his friends.

When he gets to Kali River Rapid Ride, he realizes that he will need someone to lift him in unfortunately his friends are not able to safely carry him into the ride. And he must wait on the loading dock while his friends in join the ride without him.

2.1.2 Current User Practice

For the purpose of this report, the following investigation were taken from several videos uploaded by wheelchair users talking about how they transfer and the challenges they face. By taking the experience faced by Gem and Randy Tod the following section will pain the picture of what the challenges that are faced by wheelchair users.

User Behavior Summary

With majority of the world not living near a theme park majority of theme parks are destination vacations spots people travel to in order to visit. They are often milestone destination were people save and plan for a couple years between trips. Because of this there are allot of pressure for these vacations to be seamless and smooth.

Frequency

Theme parks are most often destination spots for vacation goers. With 20million guest visit Disney World a year (Shaw 2017) and with 2.13million living in the Orlando area this means that majority of theme park attendances are out of state if not country. This destination vacation means that allot of these attendees are spending allot of money on these big vacations.

Duration

According to Dorota a blogger with dadsguidetowdw.com the optimum duration to experience Walt Disney World is 4-5 days (1 to 2 days per park). Majority of theme park goers will spend about one week at Theme parks. (Dorota, 2020)

Social or Solitary

In the world of theme parks everyone is put on the same playing field. Except wheelchair users are provided an additional experience of having to be, often time awkwardly, accommodated while they attempt to enjoy their vacation.

Motivation

Everyone enjoys escaping from reality and enjoying the thrill of the attractions. Everyone at theme parks have one motive, having fun.

Live Style

Lifestyle can be quite different per park guest. However, majority of wheelchair users experience the same struggles, feelings, emotions, etc. So, they are quite familiar with all the challenges. However other aspects of one's life do not play a part in this study.

Focus and Exertion

Majority of the challenges faced are during the transfer. When leaving their wheelchair and placing themselves inside the ride vehicles. Which can prove to be both time consuming and dangerous since the person is having to manually lift their limp lower body into the ride.

Purchasing Power

With already spending enough on going to the parks the idea of spending a little more in order to have a smoother experience in theory would make sense.

2.1.3 Activity Mapping

Figure 2.3 – Activity Mapping

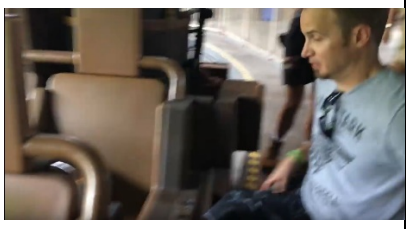
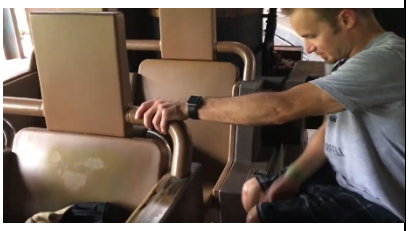
This section will go through several roller coaster transfer in order to showcase what the experience is like to transfer from wheelchair to ride vehicles. Since the current and only method of getting in and out of a river rapids ride is currently getting into rides is by having someone carry you in. Therefor this section will focus on how other rides have solved this problem in hope it will shine some light to what can be done for river rapids rides.

Note: see Appendix 1 – Discovery for more details

User Observations

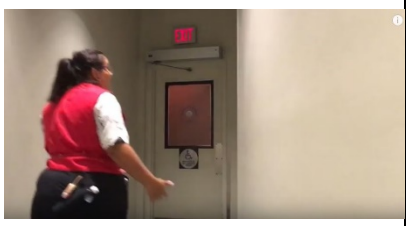
The User: Ted is in his early forties; he is a full paraplegic waste down. He uses affordable hand driven manual wheelchair. Being a roller coaster enthusiast and living near Walt Disney World, he frequently visits theme parks making him very adept at getting from his wheelchair to coasters seating.

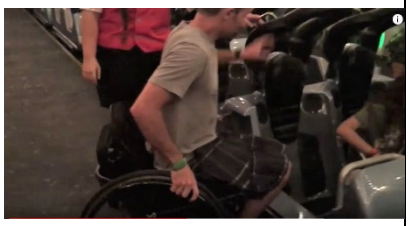
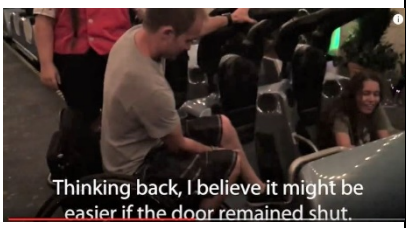
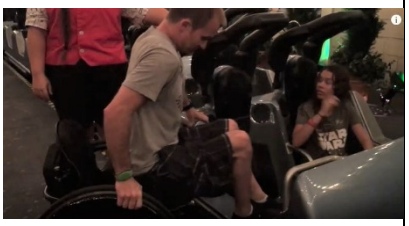
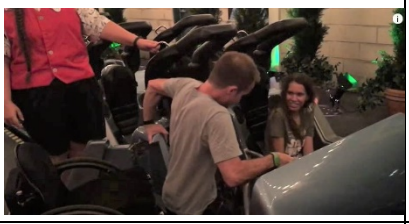
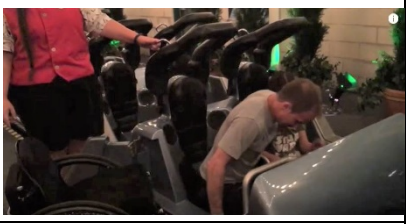
Number 1: Expedition Everest – Side Transfer Coaster

		
1. Ride operator slides seat side down to allow easy transfer 2. Ted roles his wheelchair up to ride vehicle on an angle 3. Locks wheelchair to prevent it from moving	4. Placing his left hand on bar and right hand on car size he pulls his body forward to edge of seat	5. Using right arm, he manually lifts his legs and places them inside car
		
6. Then he slides his body from wheelchair to ride vehicle		7. repositions his legs and pulls down restraint

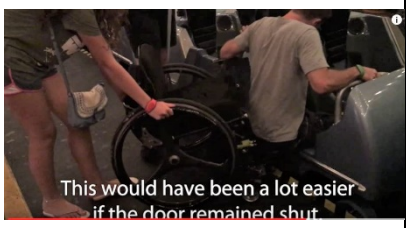
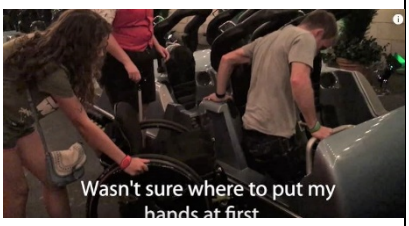
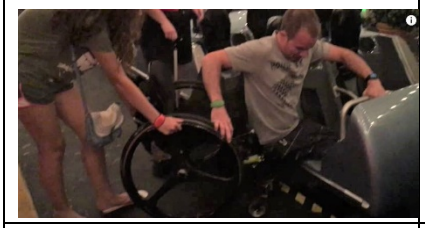
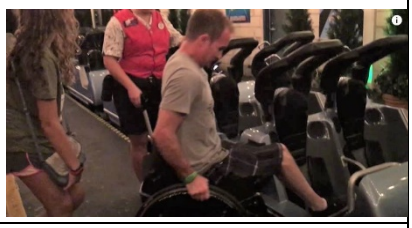
Number 2: Rock 'N' Roller Coaster – Side Transfer

Loading

		
8. wheelchair user load from separate loading dock	9. one guests have exited train wheelchair user is loaded on	10. door swings open 11. wheelchair users' roles up to vehicle

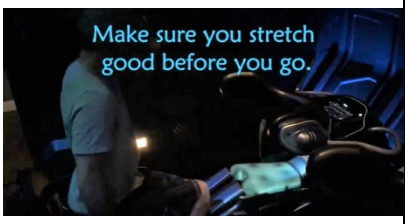
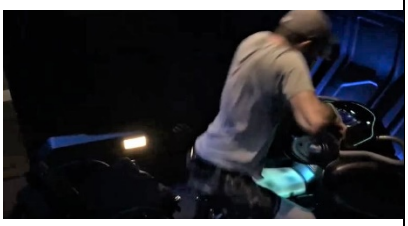
		
12. user locks wheelchair 13. slides himself forward	14. then places legs inside vehicle	15. lifts and lowers himself onto edge of ride vehicle
		NOTES: 16. the side of the vehicle should not have swung open it would have made it easier to get inside
17. then grabbing side and bar and lower himself into seat	18. then places his legs and pulls down restraint	

Unloading

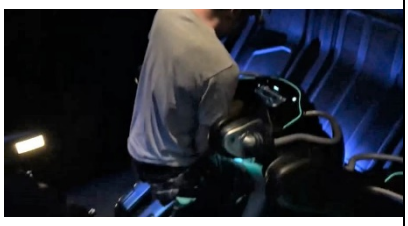
		
19. raises his body out of seat onto vehicle side	20. pushes himself right to edge of vehicle	21. raises body over gap between vehicle and wheelchair
		NOTES: 22. the side of the vehicle should not have swung open it would have made it easier to get inside
23. grabs wheelchair and bar of vehicle	24. lifts himself into wheelchair	

Number 3: WDW Flight of Passage – Simulator

Loading

		
25. wheelchair user role up to the rear of the link chair	26. you must try and place your legs on each side	27. you should be flexible its hard to do this without being nimble
		
28. took Tim about 3 tries	29. then he lifts and pulls himself forward (require allot of upper body strength)	30. with your body raise you try and inch your body forward
	Overall, quite difficult to get into despite appearing to be quite straight forward…on second attempt after stretching he found it easier	
31. then seat yourself place your legs and scoot forward		

Unloading

		
32. push yourself to back edge of seat	33. then grab wheelchair and fall back into seat	34. make sure your wheelchair is locked or someone is holding it, or you will fall flat on your back

Conclusions from Observation

Majority of the methods employed by Disney rides for transfer require a side slide transfer or lower into ride from wheelchair. This is often uncomfortable and requires a level of flexibility. As well the only way to get into a river rapid ride is to be carried by someone. (Gem, 2019)

2.1.4 Ergonomic Research – Existing Products

Figure 2.4 Kali River Rapid Ride:

Figure 2.5 - Screenshot of Rio Loco River Rapid Ride:

Currently river rapids rides are all design and manufactured by the same company, Intamin. This Switzerland based company first designer the technology behind river rapid ride back in 1979 (Intamin History, 2017) and it has remained relatively the same just changing per parks requests, local by-laws and ride theming.

Assessment of current benchmarked products

Health and Safely are the most important parts of these designs. Keeping their guest inside the ride vehicles at all time as well as preventing boats from capsizing are of paramount focus. The seats are specifically designed to hold guest during the ride and for easy entry and exit for non-mobility challenged. The most common method of restraint is just a cloth seat belt. However some more “wild” rides come with overhead shoulder restrains.

- Safety: keeping guests inside ride
- Use: ease of user: getting in and out, using for the first time
- Comfort: are you comfortable when inside ride
- Lap restraint bar for children and wheelchair users (to help stabilize them)
- Separate loading dock for wheelchair users (however you still need to be carried in)

2.1.5 Safety & Health Research

By their very nature theme parks must be really focused on health and safety since they operate rides that will push people to unnatural limits. In river rapids rides you have an added level that these ride vehicles are floating on water and you are using the water to manipulate them. This means they can be prone to capsizing, irregular paths, etc. So, designers must account for some of these things.

- Water not too deep to drown guest but deep enough to make rapid ride float
- Drainage system to filature out rainwater and debris and maintain water levels
- Seat belts that hold guest inside vehicle
    - Lap restrains for those who need it
- Proper boat drainage systems so that seats and boat are not filling up with waters.
- Large rubber blowup tube on the bottom to prevent the boat from hitting into each other

According to WHO there are 75 million people worldwide who need a wheelchair to get around (Wagner, 2019) that is around 1% of our population. In a 1994-95 study by NHIS-D a reported 10.1% of American were identified to have some type of mobility issue. (Lezzon, 2001) Of that 10.1% 32% of those were from age, 58-67year. (Lezzon, 2001) As of this paper there is around 330.5 million Americas (United, 2020) that is around 33.4 million America's with a mobility issue. In 2018 there was more than 500 million (7% of the global population) amusement park attendance worldwide (Robinett, 2019) and if theme parks were fully accessible that hypothetically could mean that around 50 million guests could identify with a mobility issue. However, due to the current level of accessibility that number is allow lower.

It was reported that around 7% of the global population visited a theme park in 2018 (Robinett, 2019) with 10.1% of America's having a mobility disability (Lezzon, 2001) that would mean around 55 million guests could possibly have a mobility. How majority of parks are grossly inaccessible which often discourages those in wheelchair's from attending theme park. That is where ACESS comes into the picture. By redesigning the wheelchair to not only be more comfortable, initiative, and efficient it also would eliminate allot of the dangers of transferring. According to a 1994 study in Nova Scotia with a study side of 577 participants 57.4% claimed to have fall or tipped over their wheelchair. (Kirby, 1994) To combat this unnecessary danger ACESS removes to transfer. Feature such as track system, weight distribution, and ergonomic posture control back work together to prevent glide-chair from typing during uses not to mention during transfers. INVERT in a way is a case study showcasing how ACESS can be integrated into a ride system. Taking the complex variables of a river rapids ride INVERT's unique design allows for one of the seats to transform allowing it to easily accept ACESS in locking it into place allowing

wheelchair users to easily load onto the ride without the need to transfer without effecting other rides' riding experience and allowing the glider chair users to the same type of experience as everyone else. All these features in both ACCESS and INVERT work together to make a complete user friendly and accessible experience.

2.2 Product Research

This next section will compare existing roller coasters, water attractions, river rapid ride etc. to see how they handled or neglected the need for accessibility.

2.2.1 Benchmarking – Benefits and Features

The target benchmarked focuses on similar attraction as well as how other ride vehicles solve the problem of accessibility.

Table 4 – Solution Comparison
Bench Marking Chart, Data obtained from Appendix III

Name	Description	Specification
Seven Dwarfs Mine Coaster	Steel roller coaster with customer swinging mine coaster seating	Vehicle side wall rotate down to create a ledge to allow user to slide from wheelchair onto ride with ease
Splash Mountain	Flume Ride	Wider than usual loading dock so the wheelchair user can role wheelchair up closer to the flume boat
Kali River Rapid	River Rapid Ride	Seat belt with lap restraint for extra stability however is currently unaccusable.
Slinky Coaster	Steel Coaster	Vehicle side wall rotates down to create a ledge to allow user to slide from wheelchair onto ride with ease
Flight of Passage	Flight Simulator	Motorcycle type seat where you must ride up behind it and pull yourself onto it

Features and Benefits

A variety of ride vehicles were analyzed, as seen in Appendix III – Product Research, to determine the current method of making ride accessible. The positive features and negative ones and to see where they fall short.

Table 5 – Key Features/Benefits of Comparable Products

Bench Marking Chart, Data obtained from Appendix III

Features	Benefits
Intuitive Design	Easy to use
Simple Design	Slight modifications to ride allowing it to be used by both wheelchair users and on wheelchair users
Accessibility	Overall, Disney ride were done well
Environmental Impact	Economic since the design was minimal different due to wheelchair users remained same as other seats relatively

2.2.2 Benchmarking – Functionality

Majority of the rides had amazingly simple modifications to allow for wheelchair users. Such as one loading bay lain was made wider for wheelchair users. Side of some cars fold down to allow wheelchairs to get in and out easier. Separate loading dock for wheelchair users (Rock 'n' Roller Coaster) These solutions prove to be quite simple and have a varying degree of success. For example, flume rides provide to be one of the most complicated to get in and out of however there is no accessibility provide beside wider loading area. Were other rides such as Seven Dwarfs Mine Coaster could not be simpler unless you remove the element of transfer from wheelchair to ride itself.

- The fact you transfer will always make things awkward
- Having vehicle transform to allow the ease of transferring or eliminating transfer speed up the loading process
- Designing the ride with both non wheelchair users and wheelchair users from the get-go prove to be the most effective. (e.g. Seven Dwarfs Mine Coaster, Flight of Passage, Slinki Ride. (appendix III))

2.2.3 Benchmarking – Aesthetic and Semantic Profile

Figure 2.6 – Hagrids's Coaster - Screenshot

The general aesthetic of these rides really depends on the theming. Since theme park rides area all about transporting you to their specific story they are telling. The general aesthetics does not really have a strong similarity. However, the gut tech is the same but the design motifs act as storytelling props. The gut technology they are for is quite straight forward and usually bough stock and then adjusted with costume shells over top to alter design and enhance story telling. Hagrid's Coaster is a perfect example of a standard platform coaster with customer transformative story element, motor bikes, added onto.

For the case of this report a look into the design of Disney Kali River Rapids Ride will be analyzed to get an idea of the type of relation between theming and basic ride tech.

Semantic Profile

Figure 2.7 – Kali River Rapids https://www.disneydining.com/5-reasons-why-you-should-not-skip-kali-river-rapids-at-animal-kingdom/

One of the best examples of this would-be Disney Kali River Rapid where you are taken on a white-water rafting adventure through the Kali River in India was firsthand the horrors of deforestation are flash before your eyes. Disney used several tricks to create the illusion of being in India. One of them is the long queue which starts out with a lot of themes as you walk up. Using buildings, tapestries, music, and sounds associate with India, they can draw you in and subtly setting the stage. The line then meanders down into a jungle with old runes and artifacts using this like a portal to transport you. All the while, they are playing animal noise, rustling of leave and the sound of loggers to in force this narrative. This is also mirrored in the river itself. Disney built a flowing river with themed rocks, work, mists, and geyser, and other elements that will make you feel as if your floating down a river rather an artificial ride.

Since these rafts would be running all day long for hundreds of hours, Disney needed to create a track and ride vehicle that could support the constant bumping, pushing, and water damage this ride would undergo. The large rubber lining on the boats protects it from damaging the concrete riverbed / banks or itself as well as making for a smooth riding experience. The boast seating is itself is made from fiberglass. A similar method is used when making pools. (Matyear, L) This provides the light weight and maximum strength Disney needed. Not to mention fiberglass also water resistant meaning it will be better protected from water damage. The theme is based off exploring. You can see this by all the travel equipment strapped to the back to your seats from: water canteens, travel backpack, to life saves. All of this helps enforce the seats that have been set.

Color Selection

Color pallets for river rapid rides remain quite varied because each one has a unique theming element. However, some seminaries they have are black rubber tube for the base and brightly colored seating areas. This helps set it apart from the water making it stand out. As well, the back rubber prevents it from getting stained by constantly being inside water.

In the case of the Kali River Rapid Ride at Disney, they are relying on color to also help further your immersive experience. The overall green of the boat helps it to blend into the bushes which seems almost fitting for an exploratory expedition when venturing into the jungle you do not want to attract attention. It also helps to set apart the brightly color matters on its sides, seating, and props to make it appear ethnic by nature. This blend of muted green to brightly colored oranges, blues, etc. work to create a balance. Too much it can look crafty and gimmicky just the right amount, and it will seem authentic.

Texture

Texture can also play a major part when it comes to designing, especially in theming. It can make or break the illusion. Majority of river rapid ride had the rubber tube and polish bright colored top. However, Disney Kali River Rapid deploys a lot of unique elements to help with theming. The hull of the boat has a nice smooth polished exterior with flat painted orange strip and blue texturing. Around this is wrapped in a zig zag is a piece of thick rope often seen in ship building. The rope is pure esthetic and makes it seem as if it is holding the bottom of the boat together with the top of the boat. The illusion it has been made by the Kali River village people rather than manufacture. The rest of the boat has the smooth mat satin finish except for the back of the seats which has meshed netting holding in the backpacks and other travel item. Making it seem like they are just strapping luggage on last minute.

Materials

Overall, the materials used are hidden by layers of main since it would break the illusion. The fiberglass hull is covered texture for better grip and pained over with the muted green color. And the rubber hull remains rubber boat as the appearance of a large tire. Making it look more repurposed rather than custom made.

In theme parks, design is everything. It’s the hallmark of their existence from creating thrill ri des that will nock the wind out of you to create enchanted fairly land's theme parks relying heavily o n both wording and the nature of form and how we interact with it. They are relying on using the des ign elements, colour, texture, material, form, and sound to manipulating our sense to make us secon d guess where we are.

2.2.4 Benchmarking – Materials and Manufacturing

Figure 2.8 – Materials | from: Shutterstock

The materials used in attraction design are quite standard throughout amusement parks and theme parks however theme parks add another level of complexity, scenic elements. By nature, river rapids rides are themed attraction therefore caring an added complexity. The way materials are selected are based off these categories: environmental conditions, ride specs, theming, materials moldability, durability, sustainability, longevity, material aspects (theming specific), and price. Another factor theme park must take into consideration is the volume of production. Many roller coasters will only have maybe 3-20 ride vehicles ever made in its lifetime there for small batch manufacturing is required. All these factors together will affect the type of materials and method of fabrication that are used.

Setting the Stage

Since the beginning ‘sustainability’ was a hallmark of theme park design. At the time, the 1950s, the term sustainability and its importance were not realized however sustainably was used as a way of decreasing fabrication and operation cost. A great example of this was in the designing and building of the first Monorail in North America. First built in Disneyland by Industrial Designer Bob Gurr. In the miniseries created by Extinct Attractions (David Oneal, 2013, 27:00-35:00) Bob Gurr explains that designing major of the vehicles at Disney from rides to monorail often started in car junk yards. He would repurpose old engines to build this historic attraction. The first monorail was designed using an old electric streetcar DC motor that was retrofitted to work as the monorail motor. The entire system was build using repurpose scraps. This was a common practice until the 70s-80s when regulations prevented such “crude” design practices. However, this idea of recycling and reusing continued just manifested itself in a different fashion.

Material’s Used & Manufacturing Methods Used– Boat

Each ride system has an added complexity unique just to its construction there for we will investigate the ride system itself and the specifications that are involved in the fabrication of the vehicles.

Tables 6: Common Material's Used – Rapid Rides Boat

The following data was pulled from (Appendix V – User Research)

INVERT Parts	Material	Manufacturing Process
Fender	NR/SBR Rubber (commonly natural Rubber) Marian grade high-abrasion-resistant rubber. (High impact, scratch resistant, puncture resistance, shock absorbing, and low toxin levels)	Press Mold
Structural I, C, and T-Beams	Grade 316 Stainless Steel	Depends on part (ex. Extrusion, punch, etc.)
Center Structure Support Beams		
Railings		
Water Proofing Hull	Fiberglass S-Glass (high tensile strength)	Open Mold Laminating Processes
Splash Shield Skirt		
Main Floor	Fiberglass E-Glass	Open Mold Laminating Processes
Seat Structure Support		
Seat		
Item Storage Container		
Lap Bar	Grade 316 Stainless Steel	Bent Tubular Steel
Seat Belt	Econyl	Wove

Manufacturing Methods Used

The Hull is created using a mix of Stainless-Steel manufacturing techniques such as whole punch, steel bending, etc. and basic Fiberglass manufacturing techniques. To create a hollow hull. Rubber Bumper is manufacturing using all-natural rubbers which do not degrade as fast or have toxics that are unnatural. This prevents them from-off gassing or entering the ground, planet life and air from water breakdown. Rubber is also easily recyclable.

The Shell is created using fiberglass since it is lightweight, strong, and water resistant. By nature, fiberglass is super efficiently and can easily be easily and efficiently manufactured. The seating system attached to the shell is created using some sort of PVC plastic which is water repellent, light weight and cheap to manufacture.

Material's Used & Manufacturing Methods Used– Boat

Wheelchairs materials are selected with three focused: strength, lightweight, weather resistant and in the case of the seat breathability.

Tables 7: Common Material's Used Wheelchair

The following data was pulled from (Appendix V – User Research)

INVERT Parts	Material	Manufacturing Process
Fabric Seat	Eco-nylon	Woven
Structural Tubular Steel	Aluminum	Extrusion and Bent
Foot Stirrups	Polypropylene	Injection mold
Arm Rest		
Brackets		

2.2.5 Benchmarking – Sustainability

Figure 2.9 – Sustainability | from: Shutterstock

Do to the fact the river rapid rides are in constant water, wind, and in constant contact with rock (track banks) material will begin breaking down which will off gas, wear and tear and will eventually make its way into nature. The hull is fabricated out of 316 Gaged Stainless Steel which is one of the most sustainable materials since it is corrosion resistant and strong. Also, Stainless Steel is 100% recyclable and does not lose its original structural integrity meaning the

hall could be made from 100% recyclable material and be resold and repurposed again and again. (Sustainability n.d.)

The bumper is created using NR/SBR Rubber which is a 100% natural marine grade rubber which does not off gas or release toxin when its breakdown. It is high abrasion resistant and provides cushion protecting the boat and providing a more comfortable riding experience. Ones it is complete it can also be fully recyclable. The main shell is created out of Fiberglass, Kevlar Plastic or PVC. Fiberglass is sustainable because of low embodied energy and longevity. Kevlar Plastic and PVC are both sustainable due to their high recyclability and resistance to marine conditions. Not to mention they are all light weight, long lasting, durable, and cheap to do small batch products. The seats could then be created using EVA instead of PVC since EVA does not have a high chlorine content. Which means as it degraded it does not release toxins into the environment.

Conclusion

River rapid rides are in constant contact with chlorine rich water and constant bumping and scrapping each other and the banks of the manmade channel by nature this causes them to degrade and break down over time there for nontoxic materials are selected in order to prevent contaminating the water.

3 Analysis

This next chapter will focus on tying together the previous two chapters researching and focusing it on the specific design problems of this project. Bringing the data together and focus on river rapids rides.

3.1 Needs Analysis

Majority of theme park rides, beside Disney rides, do not take wheelchair users into consideration if anything they are an afterthought. Disney rides however seem to put more effort into including wheelchair users however some of their older rides still provide to be difficult to get into. And not to mention their water rides. River rapids rides being the most difficult of all. They are 100% inaccessible to wheelchair users of the user does not have some mobility in their lower limbs in their current design format.

3.1.1 Needs/Benefits

Existing rides seem to just meet the bare minimum when it comes to taking into consideration wheelchair users. Wheelchair users and their needs are often an afterthought. However, by taking their need and putting them up against the needs of non-wheelchair users a designer that included both side of the equations can be created.

Table 8: Needs and Benefits

The following data was pulled from (Appendix V – User Research)

Needs	Benefits
User Experience	- Enjoyable ride experience
Ease of Transfer	- Ease of transfer - Comfortable - Safe - Fast
Comfort	- All round comfort from the transfer to the ride itself to the dismount
Safety	- Provides the standard safety of holding you inside the ride but with the added specific needs those with lower limb disables face
Social Independence	- The Need to Feel Independent and able to help themselves rather than need someone to help them

3.1.2 Latent Needs

Table 9: Latent Needs

The following data was pulled from (Appendix V – User Research)

Benefits	Fundamental Human Needs	Relationship with Benefits
User Experience	Safety, comfortable, independent	Medium
Comfort Ergonomics	Comfort Safety	Strong
Appearance	Aesthetically pleasing	Strong
Safety/Health	Provide basic ride safety and additional safety for specific wheelchair needs	Strong

User Experience

By creating a design that takes into consideration both parties an essence of safety is created across the board. By designing something specific to someone is need the element of customized safety is evoked assuring the rider that they will be safe. Curating the experience

from transfer to ride to dismount the entire thing is carefully orchestrated and designed users will be put at ease since they do not have to think. Everything has been though for them.

Comfort Ergonomics

No matter how thrilling, immersive or good a ride is if its uncomfortable you will not be able to thoroughly enjoy it. So, by creating a ride vehicle that is both immersive, transportive, and comfortable to all users you are creating an experience were the ride vehicle itself melts way and all you focus on is the experience of the ride.

Appearance

Appearance is quite important since these rides are heavily themed creating the balance of letting the rider know how to use it like a ride while still transporting them into the story being told.

Safety/Health

Since paraplegic and other wheelchair users often face several health risks by nature the need to create a design that not only allows them to experience the ride but also protects them is of paramount concern. By taking a holistic approach balancing the human limitation with the level of risk needed for thrill together to create a both immersive and safe experience.

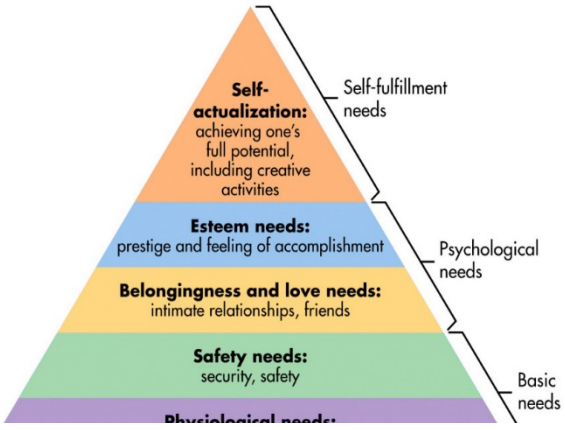


Figure 3.1 – Maslow's Hierarchy of Needs

3.1.3 Categorization of Needs

One of the biggest needs faced by wheelchair users is the ability to easily get into a ride themselves without the need of someone's assistance. This need for independence will not only increase speed but also increase happiness. They are for the need for an initiative design that will provide the tools to the users to help themselves into the ride is of most interest.

Tables 10: Wants & Needs

The following data was pulled from (Appendix V – User Research)

Needs	Benefits
Wishes/Wants	- Independence: being able to get themselves into the ride without need of others - Speed: getting in and out as fast as possible so they do not feel as if they are holding up everyone
Immediate Needs	- Remove the comfortability of getting into ride - The tools to help themselves - Safety - Remove the transfer completely or make it a seamless experience
Latent Needs	- Styling: make it look cool and immersive - Easy to replace - Easy to cleans and maintain

3.1.4 Needs Analysis Diagram

Desirability

Theme parks are on an ever rise in popularity with around 4.2% growth (Industry Market Research, Reports, and Statistics) and the fact that the world has become hyper focus on inclusiveness, equality, fairness, etc. The need for something to bridge the gap is at an all-time high. Not to mention 6.8 million American's use accessibility mobility device and 1.6 million are wheelchair bound University of California - Disability Statistics Center. (2018) and unfortunately this number is continually rising.

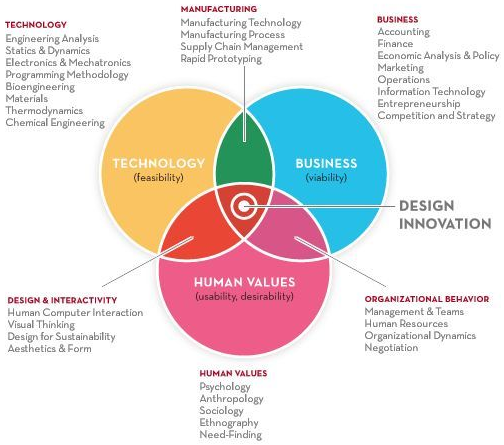


Figure 3.2 – IDEO'S needs analysis diagram

Viability

With more people wanting to be included and the need for everyone to be able to experience something if they desire the need for an accessible river rapid ride is of strong important. Because it will not only prove to the industry that something that was viewed as unchangeable can be change for the greater good and does not have to ostracize an entire group of people.

Feasibility

The fact that this has been done in other ride vehicle types not to mention done in other industries such as automotive. If a wheelchair user can drive a car, why would they not be allowed to ride a river rapid ride?

3.2 Functionality

This section will revisit the workflow experience on some Disney rides.

3.2.1 Activity/Workflow Mapping

Observation

After concluding this observation research three distinct design assumptions where created. Since there are no actual design solution for this topic an examination of similar ride vehicle and their methods of addressing this challenge will be analyzed.

Observation 1 – River Rapids Rides

River Rapid Rides have remained pretty much the same since they were invented in 1979 (Intamin, 2017). According to both Randy Todd and Gem Hubbard both attested to the fact that Disney's Kali River Rapid was impossible to get into without being lifted by someone into it. However, they did install a separate loading dock that holds the boat in place steading it, allowing you to take your time getting in and out. They also have a lap bar that comes down and helps you stabilize if need be.

Observation 2 – The Seven Dwarfs Mine Coaster

The second rider under analysis is The Seven Dwarfs Mine Coaster. This ride provides a perfect example of what a successful wheelchair accessible ride looks like. The side of the rear car on the train rotates down for easy access. User just must slide themselves from their seat onto the ledge and then into their seat. This provides easy access and little to no discomfort and optimum safety.

Observation 3 – Splash Mountain

The last ride to be looked at is Splash Mountain this ride is a classic example of an old design altered so that it become more accessible. First, they created gripped ledges on the sides so that one can properly lower themselves in and push themselves back up. They also widened the line-up gate so that you can role your wheelchair up close to the ride making it easier to transfer.

3.2.2 Activity Experience Mapping

Stages	Before Ride	Transfer	Ride	Dismount	Exit	
Actions	Driving Around the Park	Ride up to Ride Vehicle. Get into position. Plan Transfer. Transfer.	Enjoy the Ride	Plan how to get out. Begin Dismount	Ride Away	
Emotion		Hardest		Hardest		Discomfort
		Most		Most		Time
	moderate	Danger	safe	Danger	moderate	Safety
Finding	Traveling around the park and going through line up is relatives easy. Specific challenges are faced such as getting caught on texture flooring, limited ramp access, etc.	Majority of the difficulties is face during the transfer.		Majority of the difficulties is face during the transfer.	Traveling around the park and going through line up is relatives easy. Specific challenges are faced such as getting caught on texture flooring, limited ramp access, etc.	
Opportunities		By removing the transfer all together it will speed up the process, make things more comfortable, and easier on the wheelchair users		By removing the transfer all together it will speed up the process, make things more comfortable, and easier on the wheelchair users		

Table 11: Activity Experience Mapping

After analyzing the activity mapping it become quite apparent that by removing the need to transfer from wheelchair to ride majority of the problems faced disappear. When designing the next fully accessible River Rapid Ride the need for transfer should be removed. And the wheelchair just rolls into the ride, Lock in pace restraints come down and the ride is of. This

would eliminate allot of the headaches involved when transferring not to mention enhancing safety.

3.3 Usability – Ergonomics

Figure 3.3 Grizzle River Run

The following section goes into the unique ergonomic required by wheelchairs users. And how to find the medium ground between wheelchair users and non-wheelchair users.

3.3.1 Introduction

This two-part study first investigates the unique set of requirements associated with River Rapid Ride seating systems designed to keep the average guest safe and in the most comfortable position possible. Second part is looking into the specific challenges faced by wheelchair users and how they can be eliminated, and the exclusive issues associated with loading a guest onto the ride without transferring out of their wheelchair. Key factors in the ride system seat themselves include, provide adequate support for guest during the ride, draining water out of ride and seats, getting in and out of ride seats and the different type of restraints. Second part is looking into how to make wheelchairs more comfortable and durable to withstand

GeForce ride's GeForce while increasing safety for guest by examining full body human interaction. As well by addressing the common problem of fatigue, comfort ability, providing airflow for seat itself etc. The goal of the study was to look at the flow from riding around the park to boarding Kali River Rapid and what can be done to elevate and increase full body ergonomics to ride system using full body human interaction design.

3.3.2 Literature Review

When approaching this subject there was extraordinarily little technical information on ergonomics when it came to river rapid ride vehicles however the basic ergonomics of wheelchair users set out by Drefuss were used to create baseline dimensioning. (Wilcox, S. B. 2011) As well a look into existing wheelchair and vehicle seat designs were also taken into consideration. In a paper written about designing an electric wheelchair for those in a developing country it talks about the need to force the body into good posture since wheelchair users can sit for hours without manually moving this can cause several help problems. On the other extreme to much room will cause slouching so finding the balance was key. (Mejia-Gutierrez, 2013).

3.3.3 Methodology

The ergonomic evaluation and analysis of current River Rapid Ride vehicles and wheelchair was conducted with the following consideration

Objective(s)

There is a two part aim for this study on one side it is aimed to found out the specific need and requirements of full body human interaction and ergonomics of a River Rapid Ride, the specific needs, wants and desires and how it effect your body, in particular paraplegics. Second part to explore and better understand the full body human interaction with wheelchairs to be able to create a more ergonomic wheelchair that will increase overall park experience while being able to withstand the stress of roller coasters. For the point of this thesis we will be identify the three key body parts that will be interaction with ride.

Decision(s) to be made

The following interaction are the key body parts that are affected by the main activities. This fits in with the Thesis criteria.

1. Making transfer easier or eliminating (arms, shoulder, chest)
2. Increase comfortability in ride (full body)
3. Using Wheelchair easier (hands, upper body, arms)

Description of Users Targeted by Product

The target demographic are wheelchair users, mainly full lower limb paraplegics, who are between the ages of 15-50. They make average wages and can afford attending theme parks. The use of video observation of said demographic from online stores provided majority of the findings.

- Age: 15-50
- Sex: unisex
- Income: $43,000 +

- Education: Not applicable
- Location: Theme Parks

Evaluation process

The evaluation process consisted of acquiring a wheelchair (1:1) and laying tape down to simulate the roller coaster que and practice riding up and into the ride. This and just taking the wheelchair and riding around malls, hospital, and airport provide a wealth of data on the challenge associated with riding a wheelchair. This study was conducted using 3 people

Tables 12: Participants

The following data was pulled from (Appendix V – User Research)

Participates	Evaluation Process
- Person 1: 90th % women - Person 2: 5th % women - Person 3: 90% man	1. Observing how each user maneuvered around obstacles and daily activity 2. Observing how difficult it was for users to back into initial siding 3. Observed the discomfort the wheelchair provided for users 4. Observed the challenges faced when transfer 5. Identified the seemingly best dimensions for ride system and wheelchair

Description of Users Observation Environment Used in this Study

Walk through of existing Kali River Rapid Ride was done and observation on how guest got in and out of ride. As well as observation of other ride systems. This was then subsequently added on by video observation of wheelchair users doing the same thing via YouTube.

Location and Timeframe

Date of Observation(s): (Observation 1)

Location of Observation(s): Walt Disney World Animal Kingdom (Observation 1)

3.3.4 Results

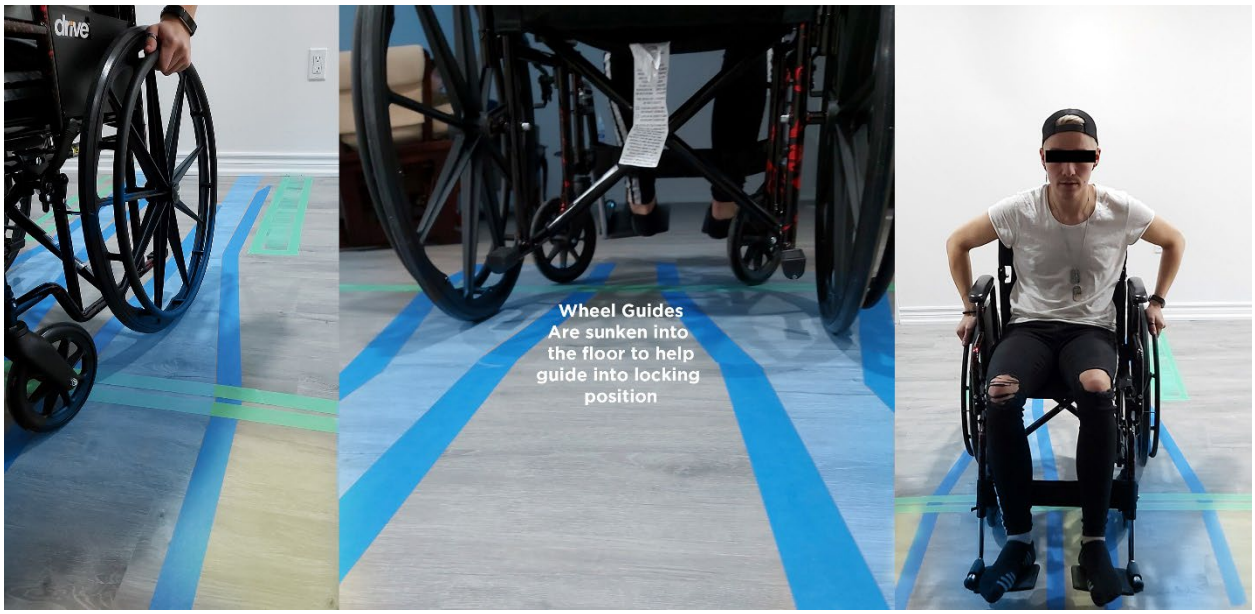


Figure 3.4 – 1:1 Ergonomics Model

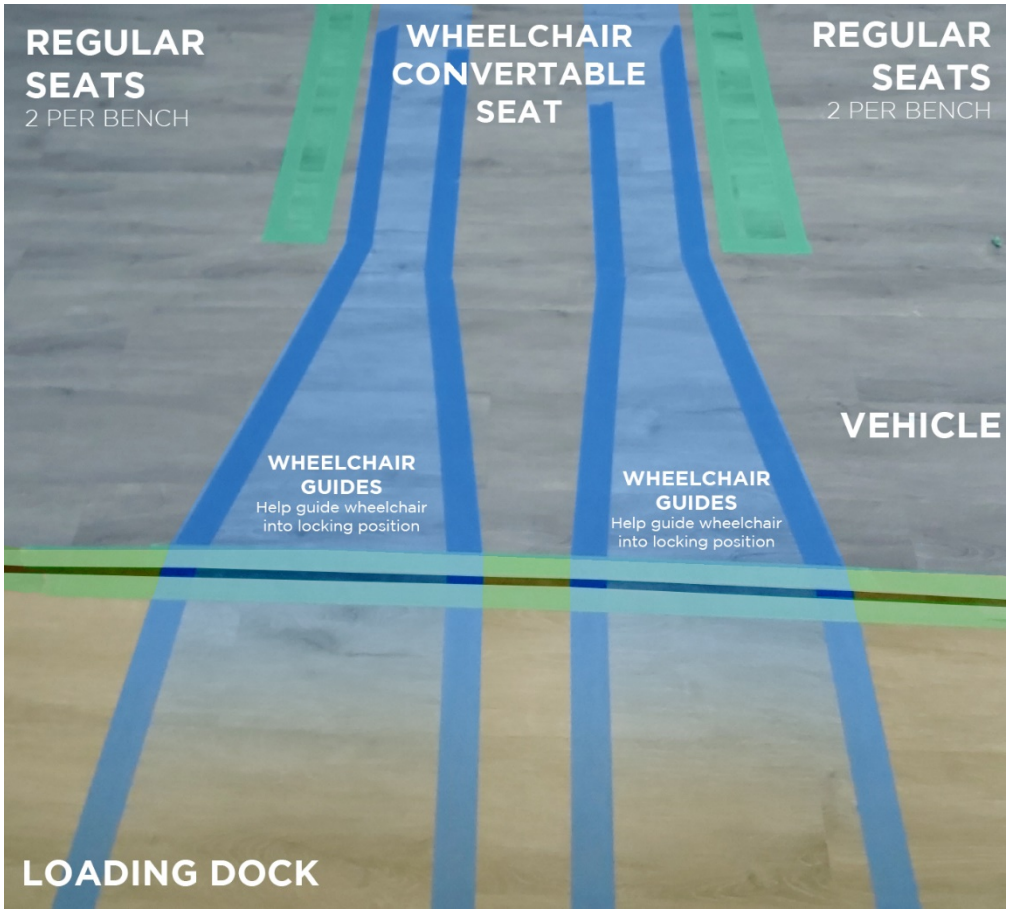


Figure 3.5 – 1:1 Ergonomics Model

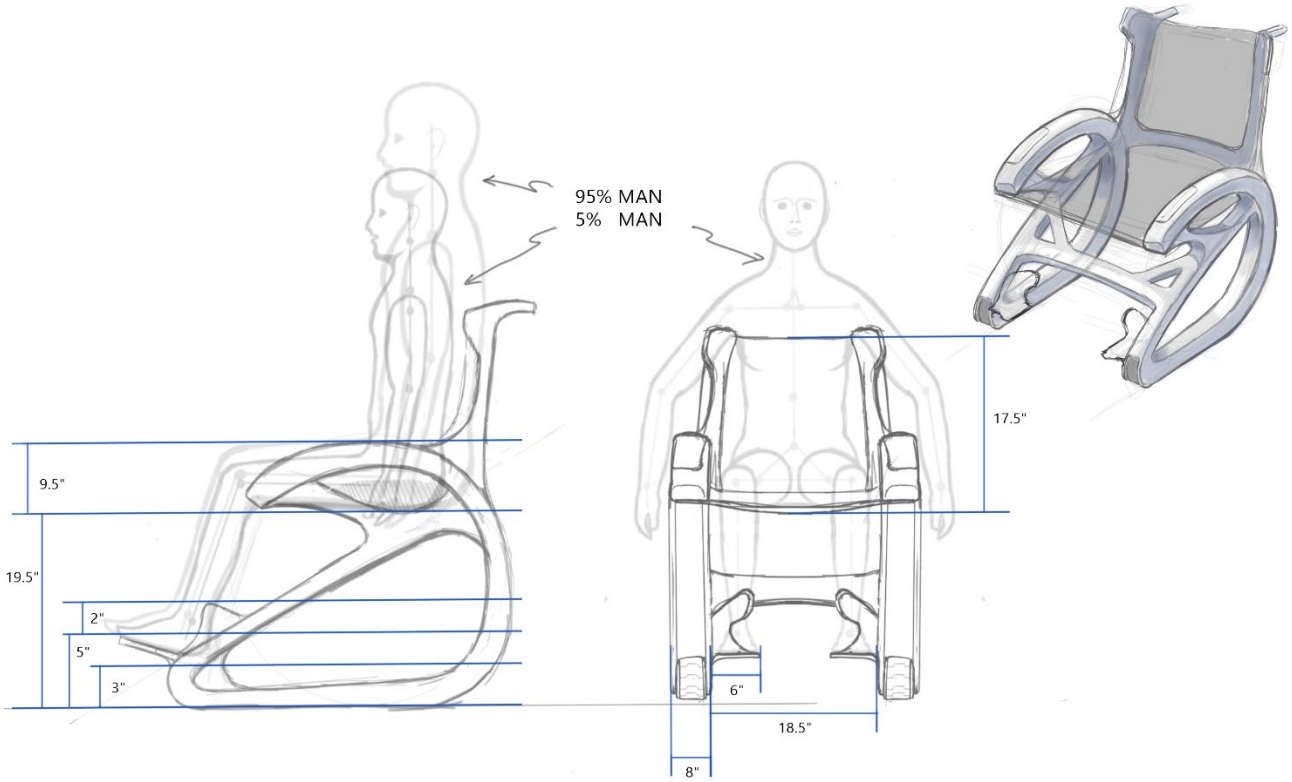


Figure 3.6 – Measurements – glide chair

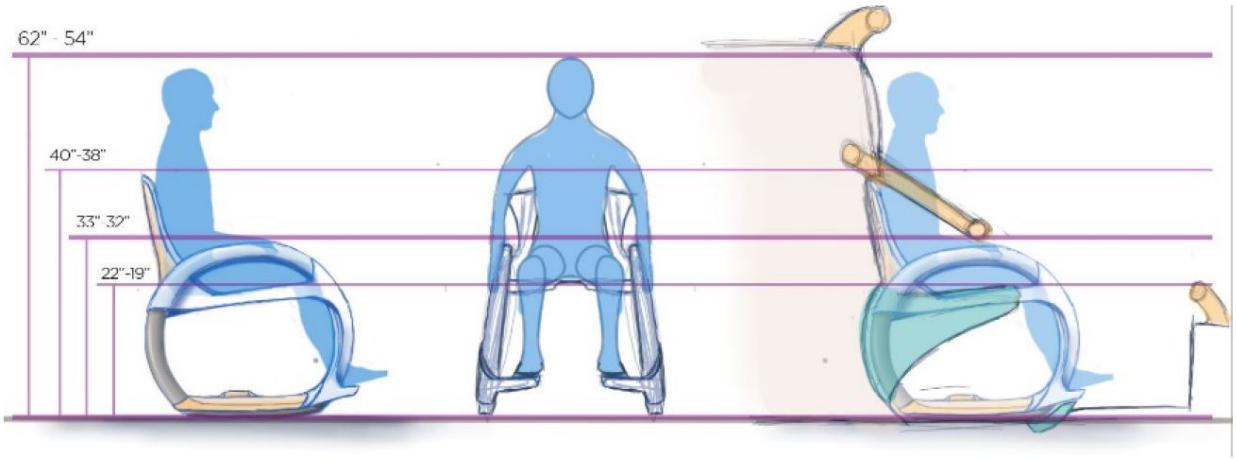


Figure 3.7 – Measurements glide chair - overall - 1

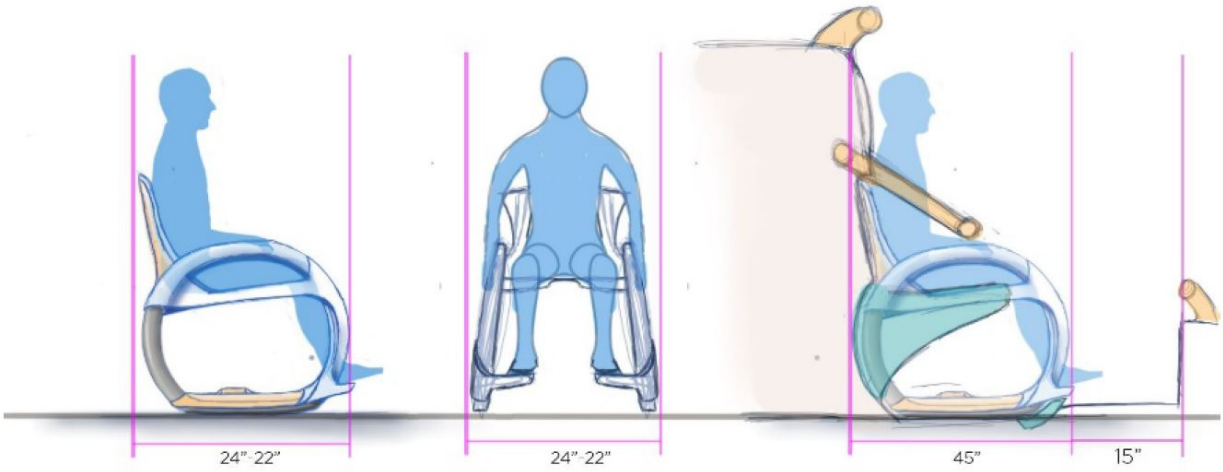


Figure 3.8 - Measurements glide chair - overall - 2

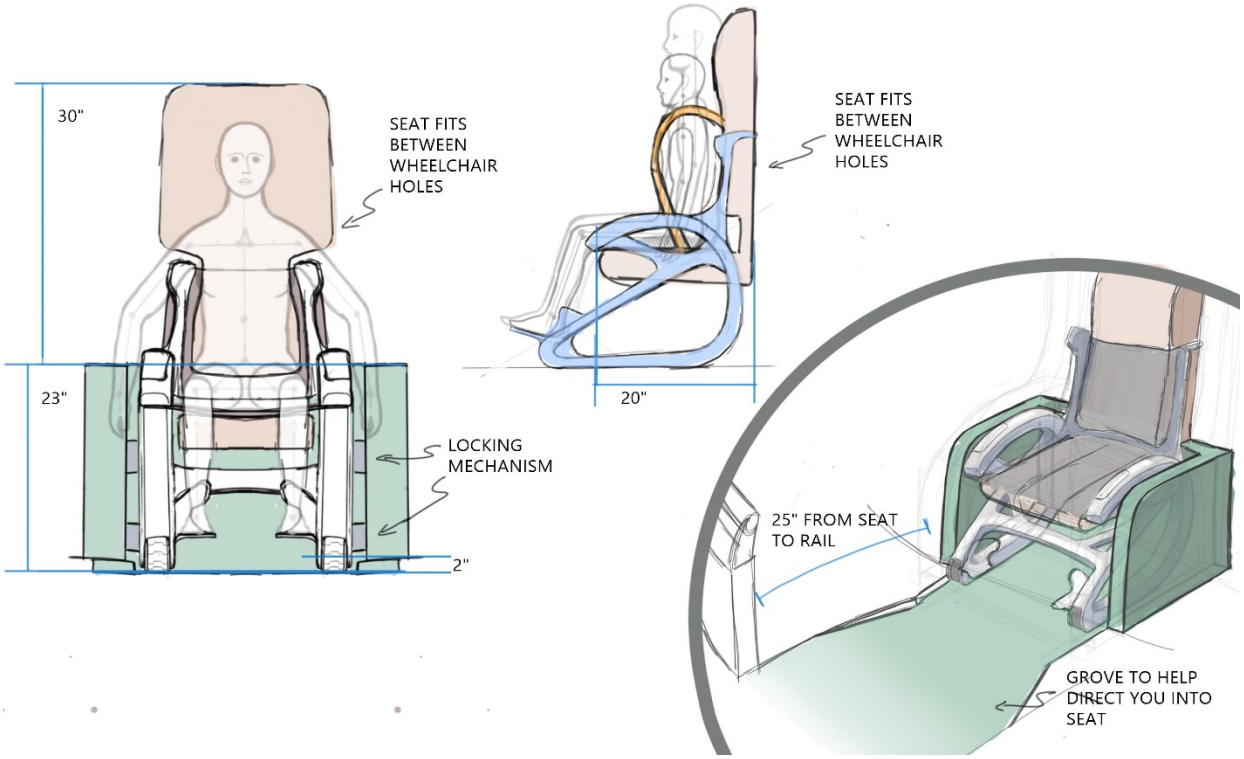


Figure 3.9 – Measurement - Chairs

3.3.5 Analysis

Interacting with the ergonomic buck from trying to transfer in from wheelchair to trying to board the "river rapid ride" on the wheelchair some preliminary measurements were constructed. *(see figures 3.7 – 3.10)* Taking measurements from a variety of users *(see table 9)* they were then cross analyzed research sources on ergonomic data.

Ride System Measurements

Users will be setting inside chair for roughly 5-10 minutes depends on ride length therefor they do not have to be overly comfortable they just have to provide the right amount of support and protection while riding. Overall measurements took into consideration bout 95th and 5th percentile users. According to Henry Dreyfuss' Measure of Man and Women, the optimum backrest high should be fixed at a 7-degree angle and the seat pan height was set at 16inches from floor. This allows for shorter users to have more likelihood of placing feet on the floor which helps with stability. The overall seat depth was 16in and overall width per seat was 18 or 36 in total (since each bench hold 2 guests).

Wheelchair Measurements

Using the existing wheelchair procured for the ergonomic model a measurement pulled from Henry Dreyfuss' Measure of Man and Women the following measurements were decided. Seat pan is elevated 19.5" above the ground and placed at a 3-degree angle from the floor. The back rest is placed at a 7-dgree angel from the seat pan. And the seat back is placed at 17" from the seat pan. The overall width of the seat is 18" this allows for ample movements room and a variety of sizes.

Wheelchair Inside Boat

Some of the things to consider when attaching a wheelchair into a ride vehicle is overall GeForce, loading and making it comfortable for both wheelchair users and non-wheelchair users. In order for the wheelchair to properly fit inside the river rapid ride system it would need about 20” room in front to allow for guest to maneuver around the wheelchair users and allow for ride operators to help them secure their wheelchair inside. This is converse to a normal seat which would require about 16” leg room.

3.3.6 Limitation and Conclusion

Best off of the current date the concept of bringing the seats close to the loading dock to help with transfer it a viable option however allowing the wheelchair to fit inside the boat system is also possible and would eliminate the hassle of transferring period. In order to speed things up removing the need to transfer is the most viable option for river rapid rides.

Top Challenges Faced

1. Lower Transfer Time
2. Raise comfortability
3. Added Safety
4. Overall Seating posture that help support and stabilize body is key

The ergonomic study aided in trying out the different configuration and understanding the challenges faced with maneuvering a wheelchair around. And the challenges of transferring out of one.

3.4 Aesthetics

Figure 3.10 – Kali River Rapid Ride Disney World |

The aesthetic is hard to pinpoint since majority of river rapid ride vehicles are heavily themed and themed differently per the parks specific request. However, this design thesis will be focusing on redesigning Disney's Animal Kingdom's Kali River Rapid ride. Which is set on the Kali river which will take you through a white-water adventure ride though the jungles of India. The current design (seen bellow) takes allot of design ques from cultural motifs and imagery. While mixing them with classic adventure style design elements. Like bottle water canisters, life savers, rope, etc.

3.5 Sustainability – Safety, Health & Environment

Safety

There are several potential challenges and safety concern associated with a ride system such as River Rapid Ride. Some of the concerns are keeping the guest inside vehicle at all time, g-forces experience by guest while inside the ride. These can be minimized by provide a comfortable seat with adequate support to the body and harness or lap bars that provide adequate restraint depending on the GeForce level of that track.

Health

Overall, the health risks are quire minimal since ride are design to cause mild force on the body however of riders have health conditions such as hearth problems, breathing problems, etc. they can cause issues and complications. Health association with materials is quite minimum however things such as toxic plastics, metals, paints, etc. can off gas or get into the environment cause potential complications.

Product End of Life

In this case products end of life are often ended up being repurposed for other rides systems, re-themed, and or broken down into the parts and recycled. Also, more exclusive but those memorable rides become collector items.

3.6 Commercial Viability

The following section hypothesize some of the follower materials and costs involved in creating the glide-chair and boat system.

3.6.1 Materials and Manufacturing Selection

Materials selected are based on both the roller coaster and marina industries. Using the common materials used in these industries and if needed more sustainable alternative to these materials and manufacturing methods were then selected. The follow section will be broken up into ride vehicle and glide-chair system.

River Rapid Ride Boat System

Figure 3.11 – Fiberglass Mold

Figure 3.12 – Fiberglass Gluing

River rapids ride boats are built in a small batch method using either standard size prefab systems or fabricating in a small batch method. The structure components are made from standard or customize extrusions such as I, T, and C beams. The main top structure is made from fiberglass which is fabricated like a pool or custom luxury sports cars are made. By taking a one-sided mold and placing the sheets of fiberglass then spraying each subsequent sheet with adhesive.

Wheelchair System

The Wheelchair are made from a series of standard tubular steel, custom plastic injection molded parts and woven fabric chair. Allot of these pieces are even standards pieces or can be custom made from simple 2-part injection molds.

3.6.2 Cost

Majority of theme parks do not release the exact cost of their attraction rather the publicly traded companies release the total cost of their parks annual expansions and estimate cost of each project. Using the data, a rough estimate can be configured as well as looking at similar "technological" products cost [similar size boats compared to river rapid ride boat a rough estimate of the cost can be formulated].

Tables 12: Cost Benchmarking

The following data was pulled from (Appendix V – User Research)

Participates	Evaluation Process	Cost
Shoot the Rapid Cedar Point	- Flume style coaster - Vehicles: ○ 10 fiberglass boards that seat 10 each - Uses 730,000 gallons of water an hour - Track is 2,100 ft in length	$10.5 million
Splash Mountain Disneyland	- Flume style coaster - Length 2640 feet - Duration: 9 mins - 32 boats x 5 passengers per boat	$75 million
Timber Mountain Log Ride Knott's Berry Farm	- Flume Style Coaster - Length 3,900 ft - Audio-Animatronics ○ 24 characters & 39 human figures	$3.5 million
Wild West Falls Adv. Ride Warner Bro's Movie World	- Flume Style Ride - Duration 6min	$18 million
Kali River Rapid Disney's Animal Kingdom	- River Rapids Ride - Boats: 20 boats: 12 each - Duration 5min	unknown

Ride System Price Estimate

Disney theme park rides tend to be heavier themed which means they are higher cost example Splash Mountain which is 2,640 feet coasted $75 million and Timber Mountain Log Ride coasted $3.5 million which is 3,900 feet in length. By examining Kali River Rapid's and Disneyland's Splash Mountain's footprint from google earth you can estimate that Kali River Rapid's footprint is almost double the size. However, it has allotted less theming and no audio animatronics. By analyzing similar attractions as with less theming, the all appear around the $10-25million price range. However, Disney's methods are notoriously expensive, so Kali River Rapid's is estimated to be around $50million.

Ride Vehicle Price

The average pontoon floating dock cost ~$3-30k for standard quality with premium running close to $50-75 to fabricate. Kali River Rapid boats are not as large as a docking system so taking that into consideration and the complexity of the ride boat system the estimated closets would be around $35k each this would mean the total costing of the boats would be $700k which would fit into the estimated $50 million budget of the ride

River Rapids rides are quite different from pontoon docks however both use similar floatation methods. There for the estimate for the average floating dock would be around ~$50k each. This would price the boats at around

Ride Vehicle Price

The average wheelchair retail around $5-15k each they are for the wheelchair estimated would be around $10k. With the average markup rate being 20% the wheelchair would be around $8k in total.

3.6.3 Design Brief

The overall goal of this design thesis is to make River Rapid Ride's fully accessible to everyone. By looking into full-body ergonomics and the unique challenges faced by wheelchair users find the best design that will not only become more inclusive but also enhance the experience the experience for everyone involved.

- o Mitigate user fears of transfer by removing transfer
- o Speed up the process between getting from loading dock to the ride
- o Comfortable riding experience
- o Increase sustainability
- o Bring awareness to accessibility

3.7 Design Brief

The overall goal of this thesis is to make theme parks more accessible those with mobility challenges. The follow list of objectives to be incorporated in the final design direction:

ACESS

- Reduce injury from transfer
- Make wheelchair user's experience more seamless and familiar
- Make loading onto a ride an effortless process
- Provide a comfortable driving and riding experience

INVERT

- Make the loading experience easier for all parties
- Enhance the riders experience (more thrills)
- Provide a comfortable solution for wheelchairs to fit inside invert

Conclusion

Armed with these realizations the follower characters will go through the design process. Drawing from the data and resolution in these previous chapter the design process will explore a variety of solutions.

4 Design Develop

The subsequent chapter goes into developing process for creating INVERT and ACESS. Rather than focusing on one product they were develop together as a case study showcasing how you can design a classic ride system, that was formerly inaccessible, and make it a fully accessible experience while also enhancing the experience. Overall ride experience does not have to be sacrificed for accessibility.

4.1 Ideation

Figure 4.1 – Ideation Sketch Solution for Kali River Rapids

The ideation phase was quite extensive as many different design solutions and styles were experimented with. From external aid to help in transferring, to wheelchair accessories, to reinvented wheelchairs to river boat systems themselves the variety of ideas was expensive. The key areas focused in this section was: enhance rider experience, story, accessibility, and technical limitations. Together these points lead to the following designs.

This face was crucial in getting much of the groundwork and ideas out on paper. Two most striking concepts was a boat system that allowed riders to drive their own wheelchairs onto the ride and the second was a system that had an enhanced transferability.

4.2 Preliminary Concept Exploration

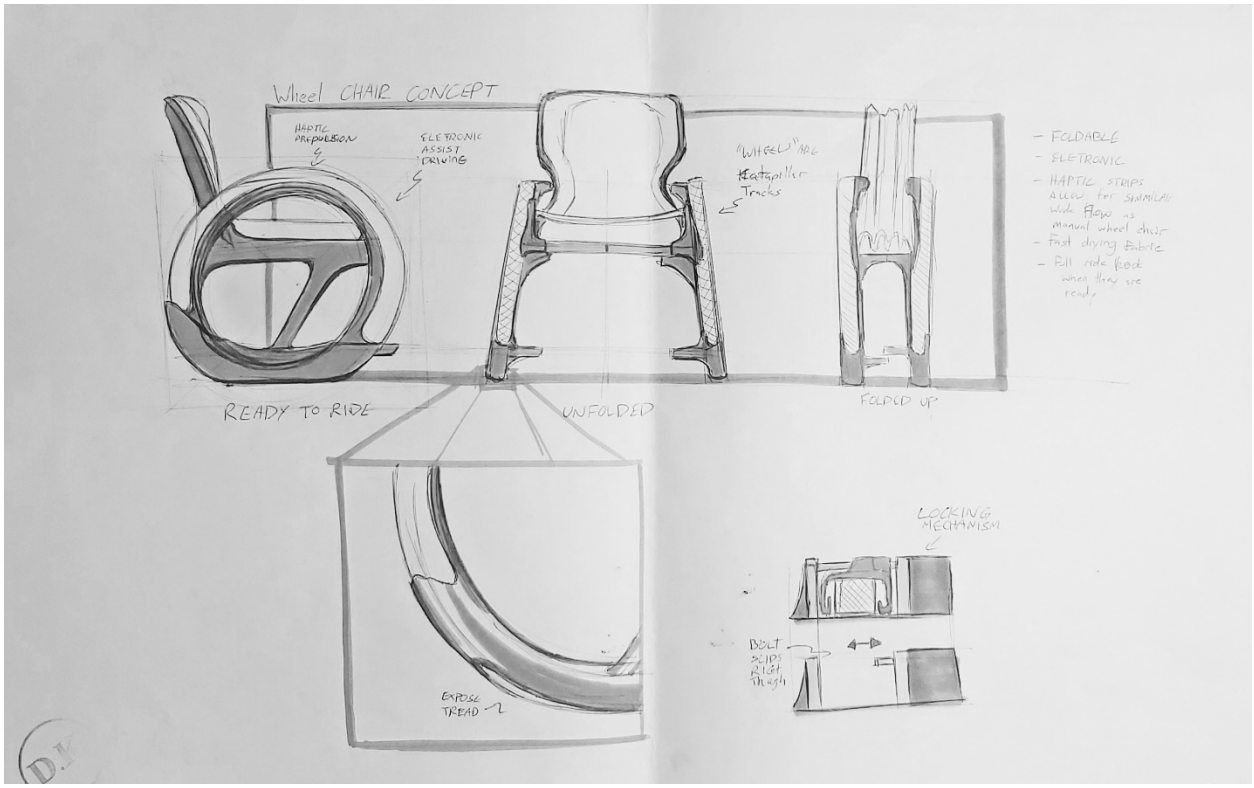


Figure 4.2 – Preliminary Concept ACESS

During this phase those 2 concepts were further explored. Continuous sketching and re-visiting and expanding research continued to feed the idea that followed. Some of the areas of focus right now are having a wheelchair that could raise or lower seat allowing for guest to get in and out easier. Ride seats that opens from the back allow you to slip down out of your wheelchair into it. To names a few.

4.3 Concept Refinement

During the concept refinement stage the concept of having a specifically reinvented wheelchair system, called glide-chair, that utilizes that rubber track system to pull itself along together with the inverted seating system that allow you to see where you are going for an enhanced experience. Up to this point the design process was either Glide-chair or river rapids raft. However, at this point it became apparent they needed to work together.

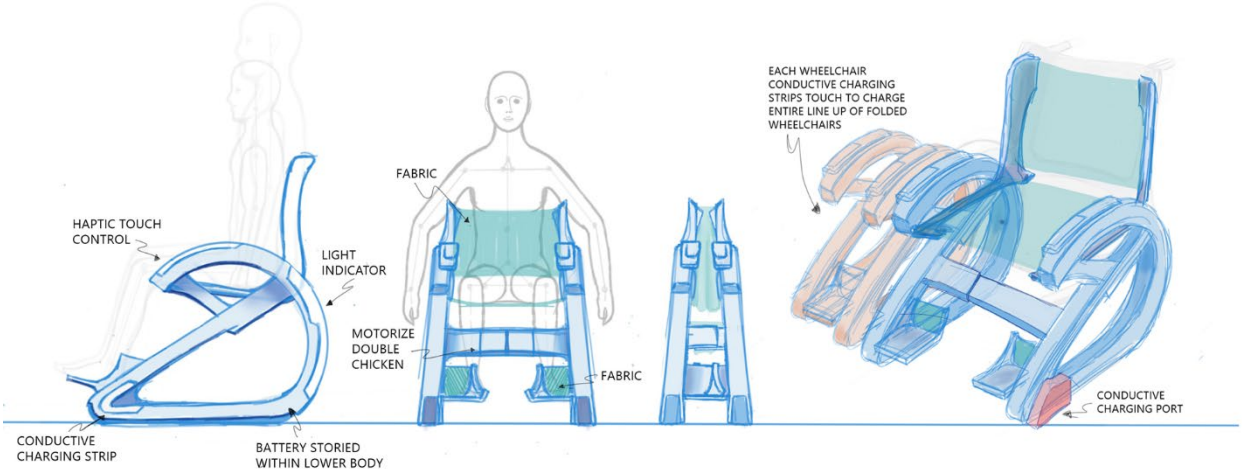


Figure 4.3 – Sketch

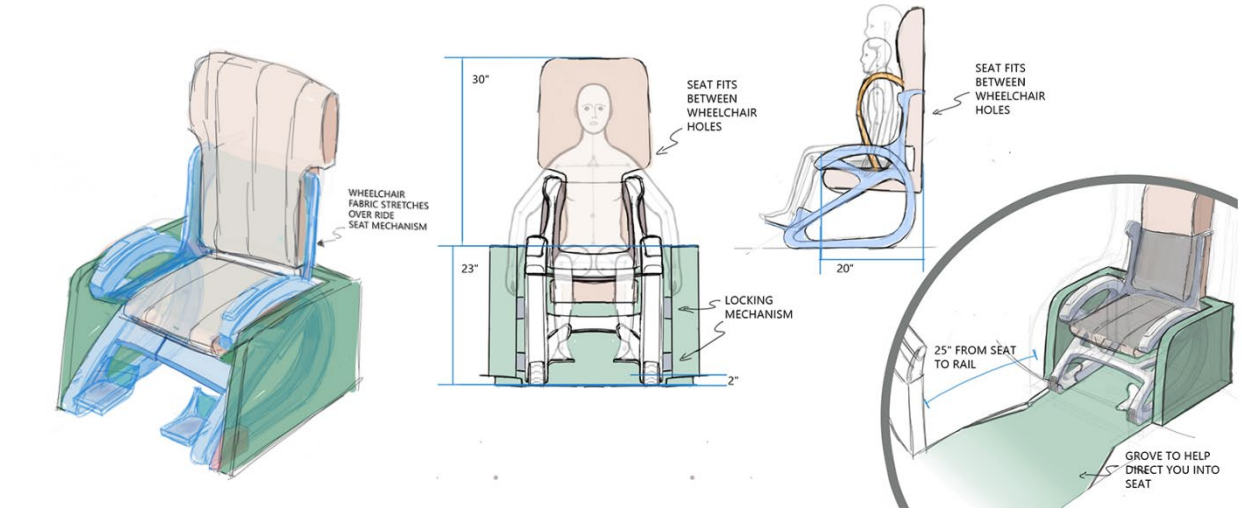


Figure 4.4 – Sketch

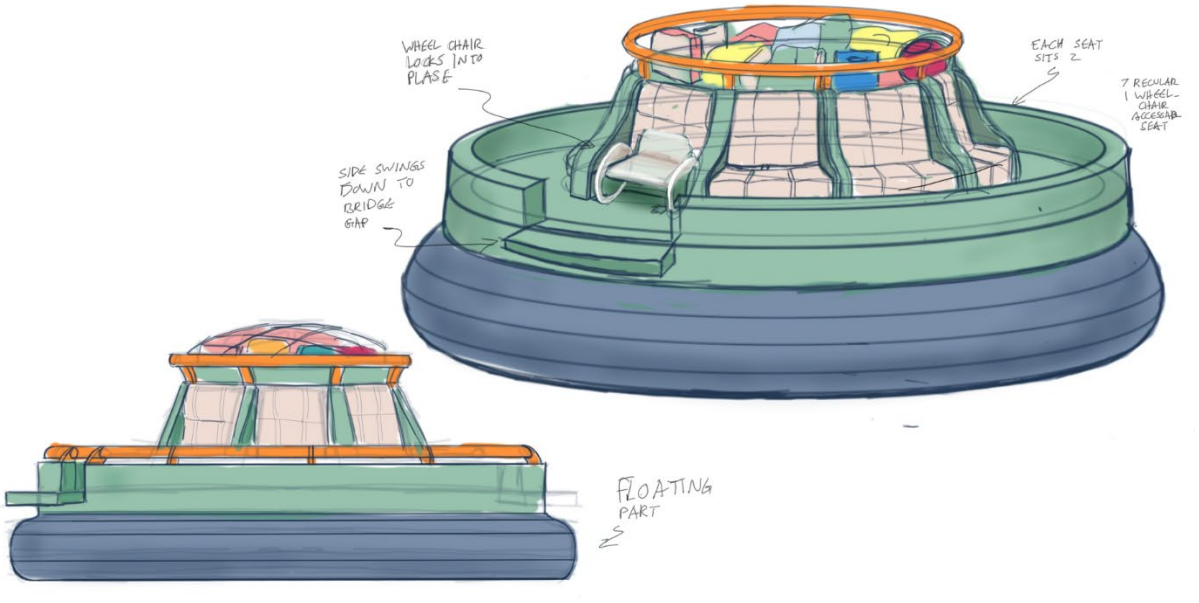


Figure 4.4 – Sketch

The concepts above show the exploration of how they would be working tandem. S

4.4 Detail Resolution

It is all in the details. This section explores some of the more concreate details at this point some preliminary CAD was as used to aid in working out the mechanic and feasibility of fitting a wheelchair inside a river rapid ride.

ACESS – Glide Chair

ACESS focused on creating something that everyone from a child to and adult could use with ease and comfort. During this phase significant effort was put into reinventing the way the use control's the wheelchair. According to most wheelchair users they would much rather use a

manual wheelchair for its dexterity and control (Schwartz, 2018) however with the reinvented track system that would no longer be possible. The solution of placing that curve arm rest with the haptic control strip ended up surfacing this would allow for the same muscle movements they were used to however instead the computer would drive the chair forward or backward or turn left or right by just rubbing their fingers along the inside of that arch. This would also allow them to control how sensitive the haptic were so no matter how week your upper body your is would not get fatigued throughout the day.

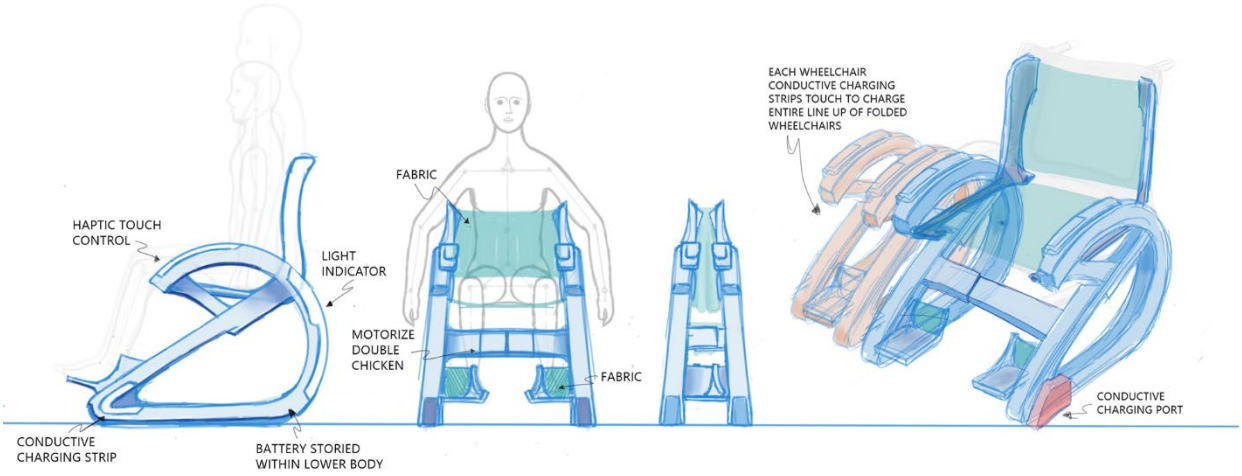


Figure 4.3 – Sketch

As well the concept of making it collapsible was also pass back and forth. However, was removed out of the design do to fact it would compromise the structural integrity.

INVERT – River Rapid Ride Raft

For the river rapid ride raft itself the focus was integrating ACESS into the seating system. During this phase, the idea that one boat out of the fleet would be wheelchair accessible. The main design would seat 12 guests where the accessible raft would seat 10 guest and 1 Glide chair or one guest (seat can transform back into normal single seater). The conclusion of this phase is a quite literal concept. The wheelchair would back into the seating where the seat

would have a perfect cutout to accept ACESS. As the user backs into the ride the floor of the boat is flat up to the seat itself then it sharply dips at a 10-degree angle (3 degrees more than the seat itself) this allow for the seats to support the users. Conversely ACESS has perfectly design cutout that allow the seat to slide up into the wheelchair. When n position everything lays flush allowing for the user to be completely support since the normal glide-chair seat is flexible it would not provide adequate support.

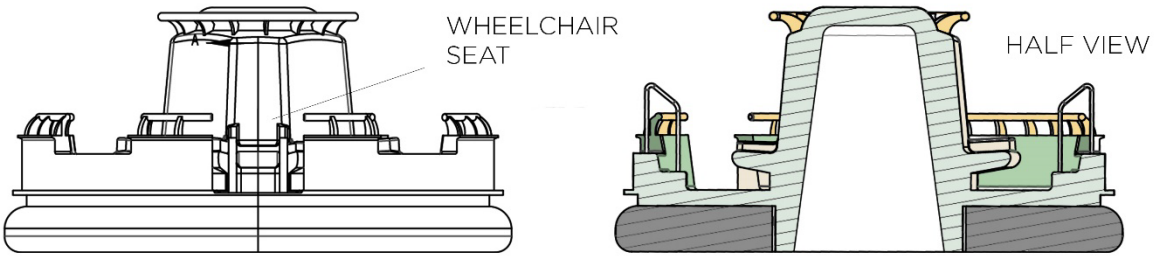


Figure 4.5 – Technical Drawing

Wheelchair locked it and user can enjoy the ride like everyone else. Then the guest is also locked in with a seat belt and a lap bar if needed (lap bar provides more support to the glide-chair users however they are secured mainly with a seat belt. In a way the wheelchair accidentally disappears into the seat so they can experience the ride like everyone else.

4.5 Sketch Model

The sketch model was fabricated out of foam cure and 3d printed parts this allowed for a literal representation of the design sizing and proving the concept that the glide chair would fit. After this phase was completely several problems arose:

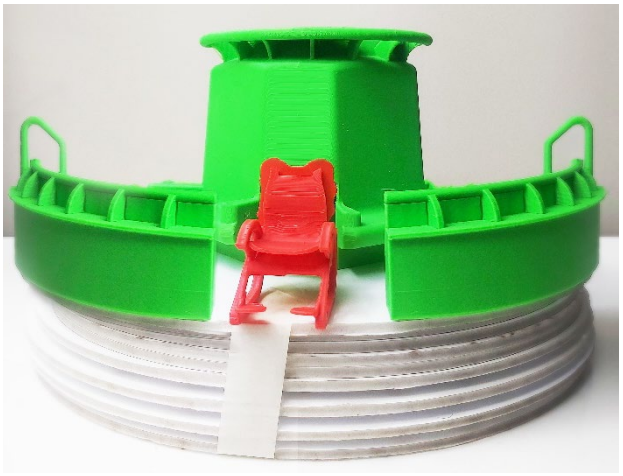


Figure 4.6 – Sketch Mockup

1) Ride raft was to large (the river would be unrealistic large)
2) Design appear clunky and needed to be streamlined for both cost and aesthetic purposes
3) Ride system's seat was to plain and needed both stylizing and more ergonomic consideration
4) More stylizing and interest

The concept was hypothetically proven to work. Now it needs to be trimmed down.

4.6 Final Design

At this point the final design had be realized. All that was left was not to bring it into CAD. Due to the nature of the complexity of this thesis the concept was still in the area since the dimensional size and ergonomic still need to be worked through.

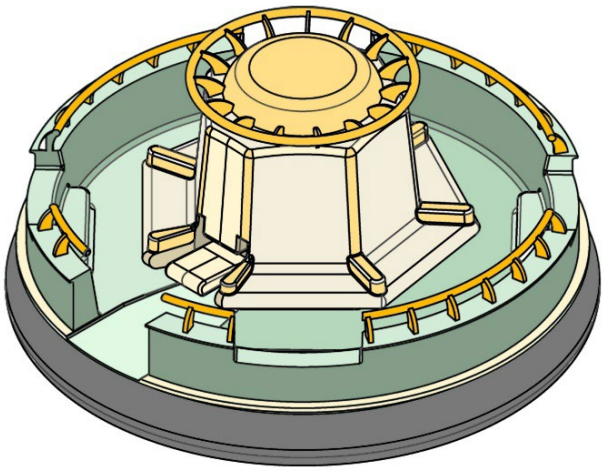


Figure 4.7 – Technical Drawing

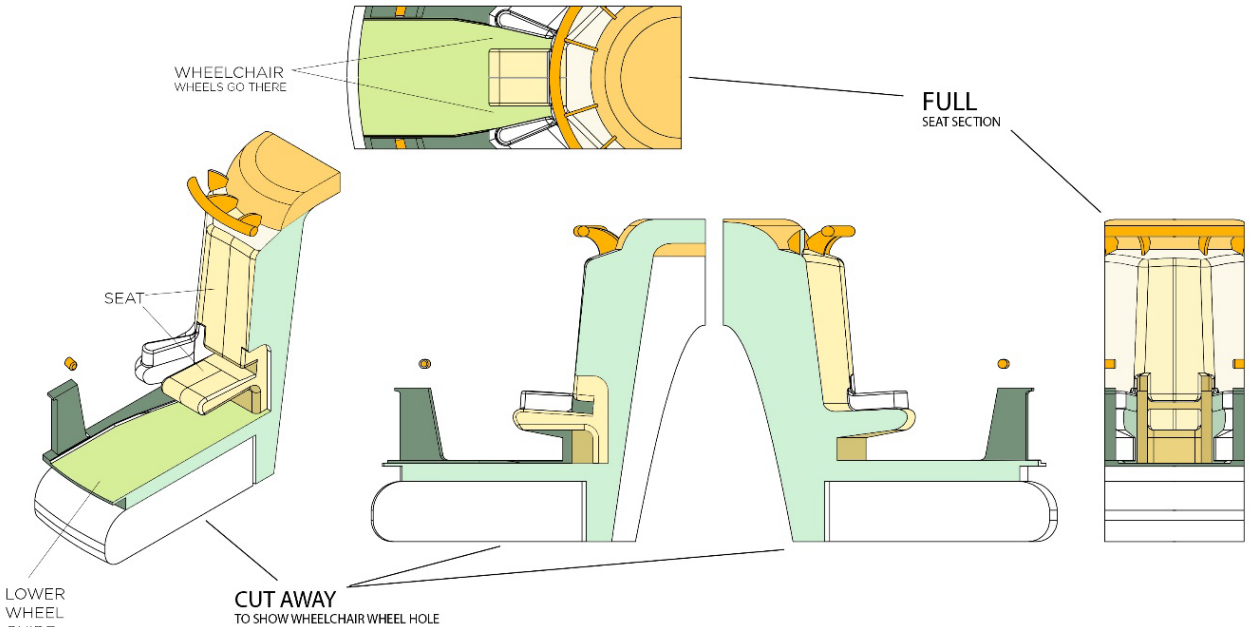
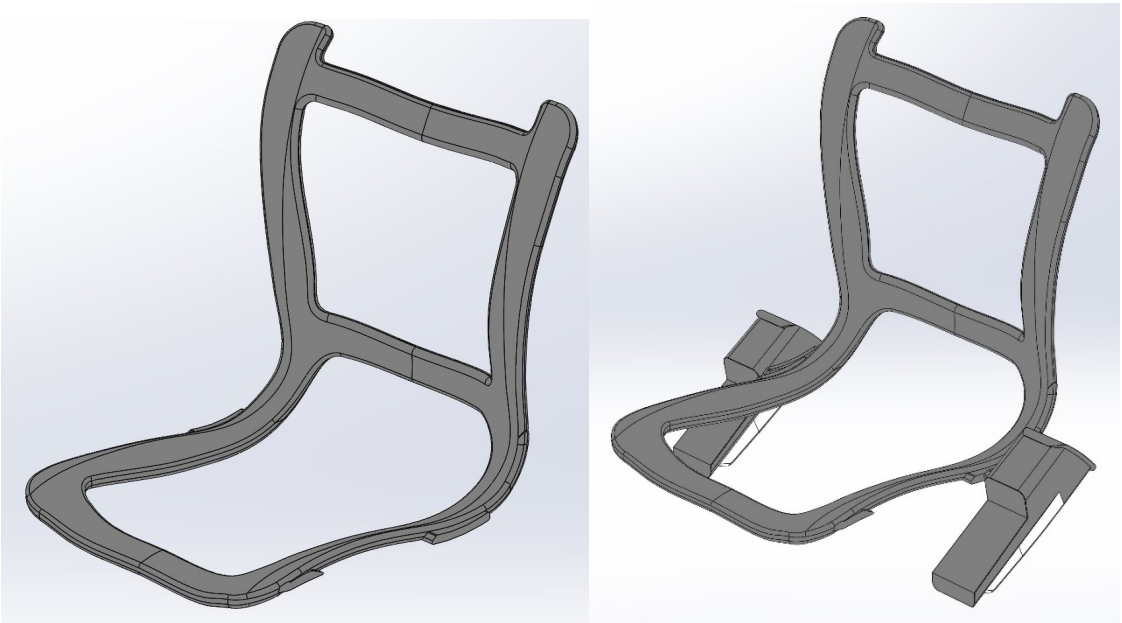


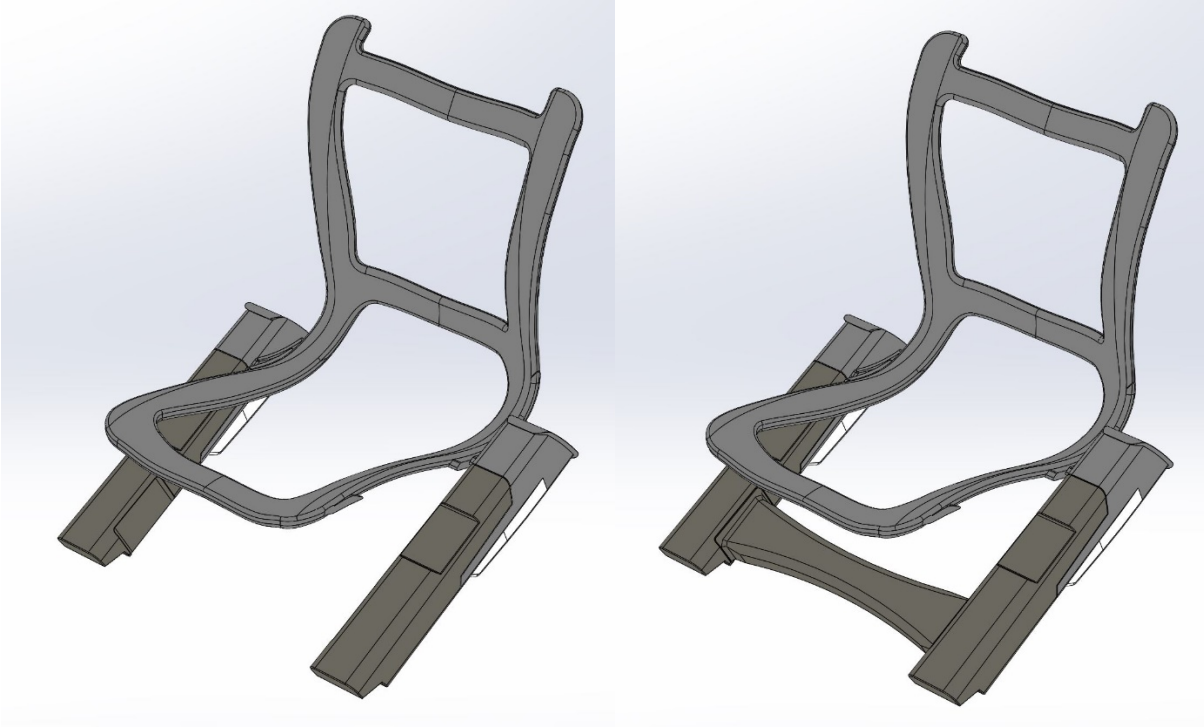
Figure 4.8 – Technical Drawing

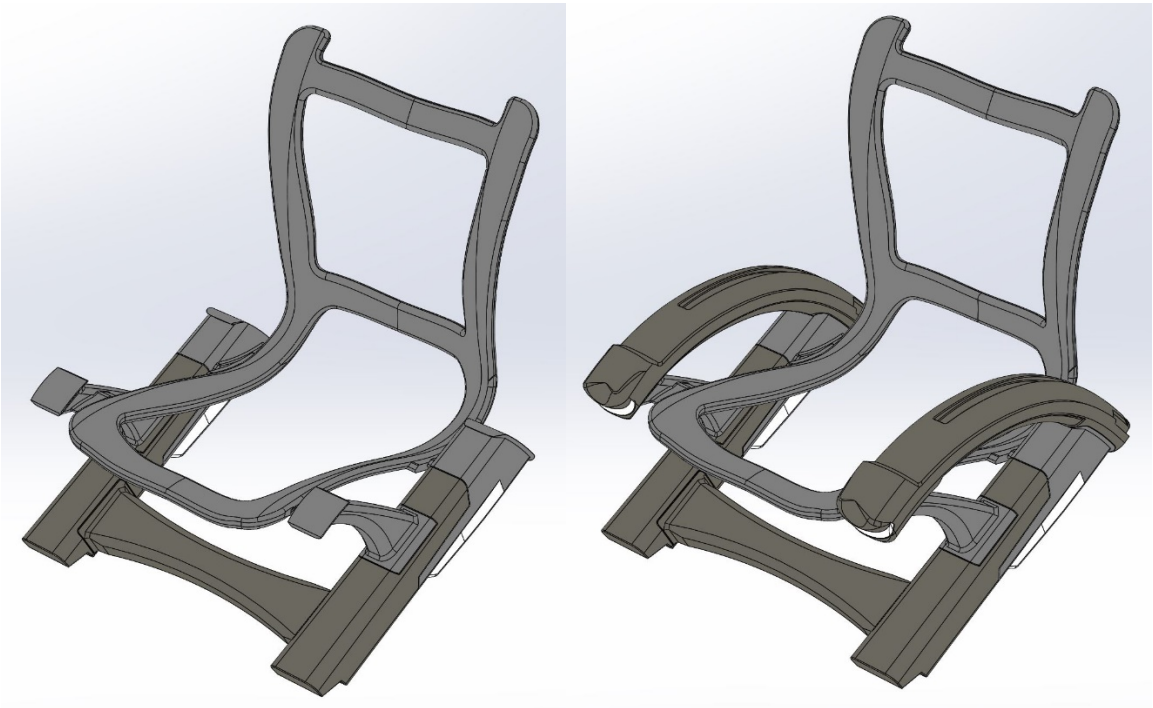
4.7 CAD Model

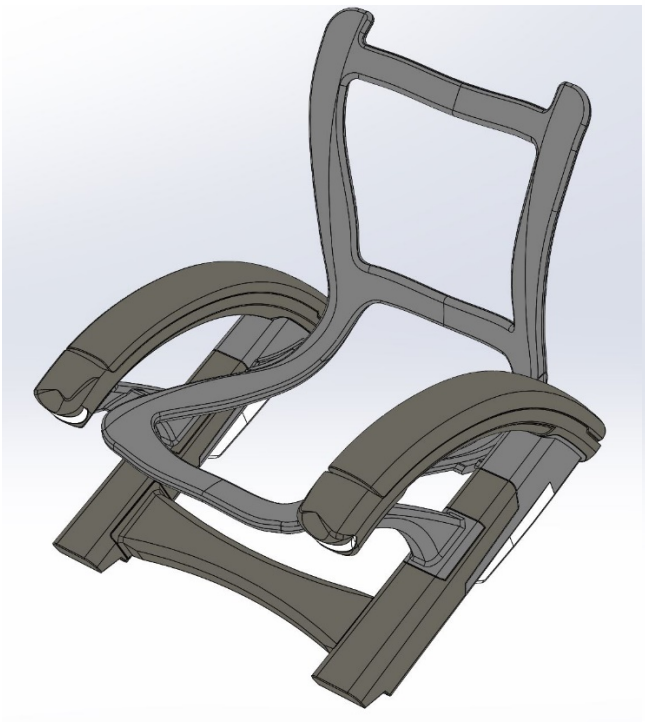
After concept and final aesthetic design was determined it was brought into CAD by adding measurement the design can be further tweaked and messaged into reality. All the components were created in Solidworks. The complex shapes utilized many different types of features of the software such as complex surfaces. The ergonomic shape of the glide-chair was a variety of complex shapes and surface to help curve along the human form. The ride system itself was relatively easy to create since it used many standard parts and dimensions.

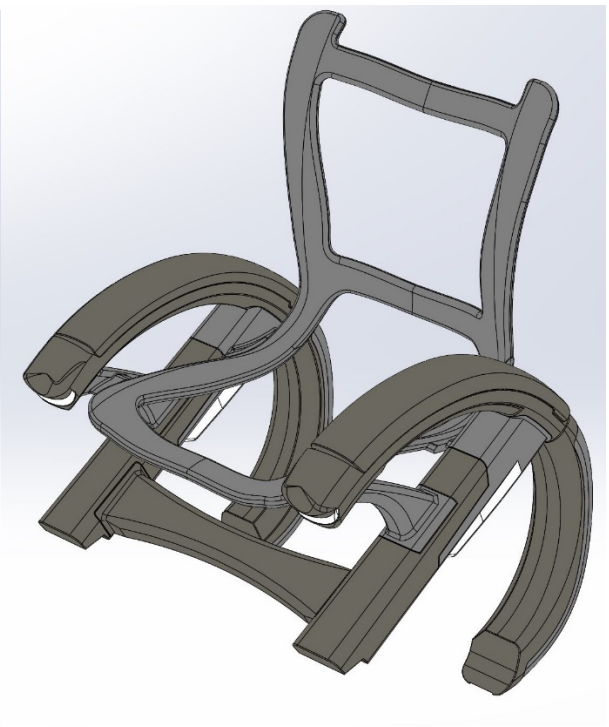
Individual Glide-chair Process

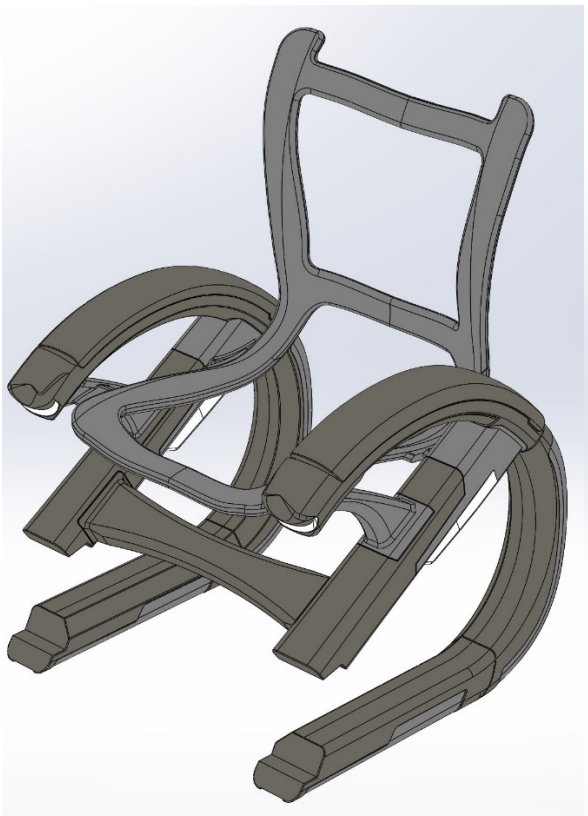


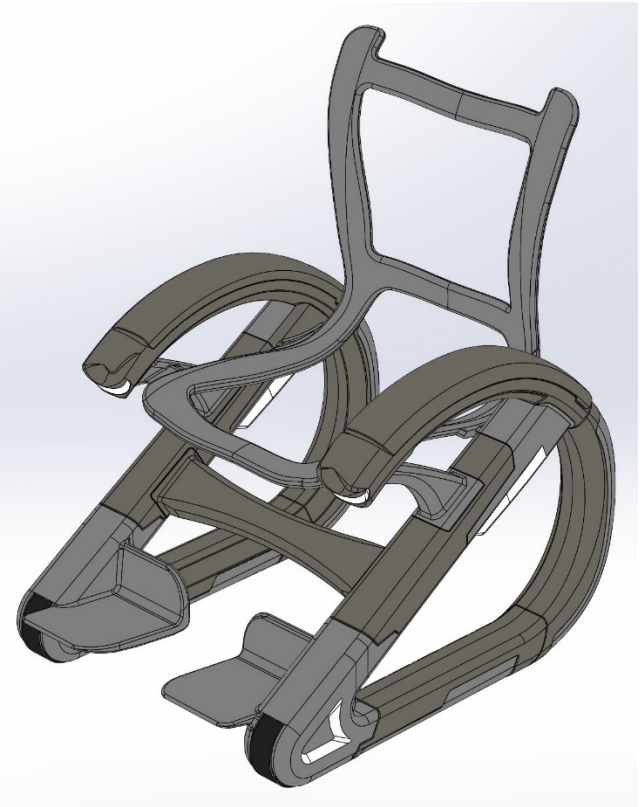






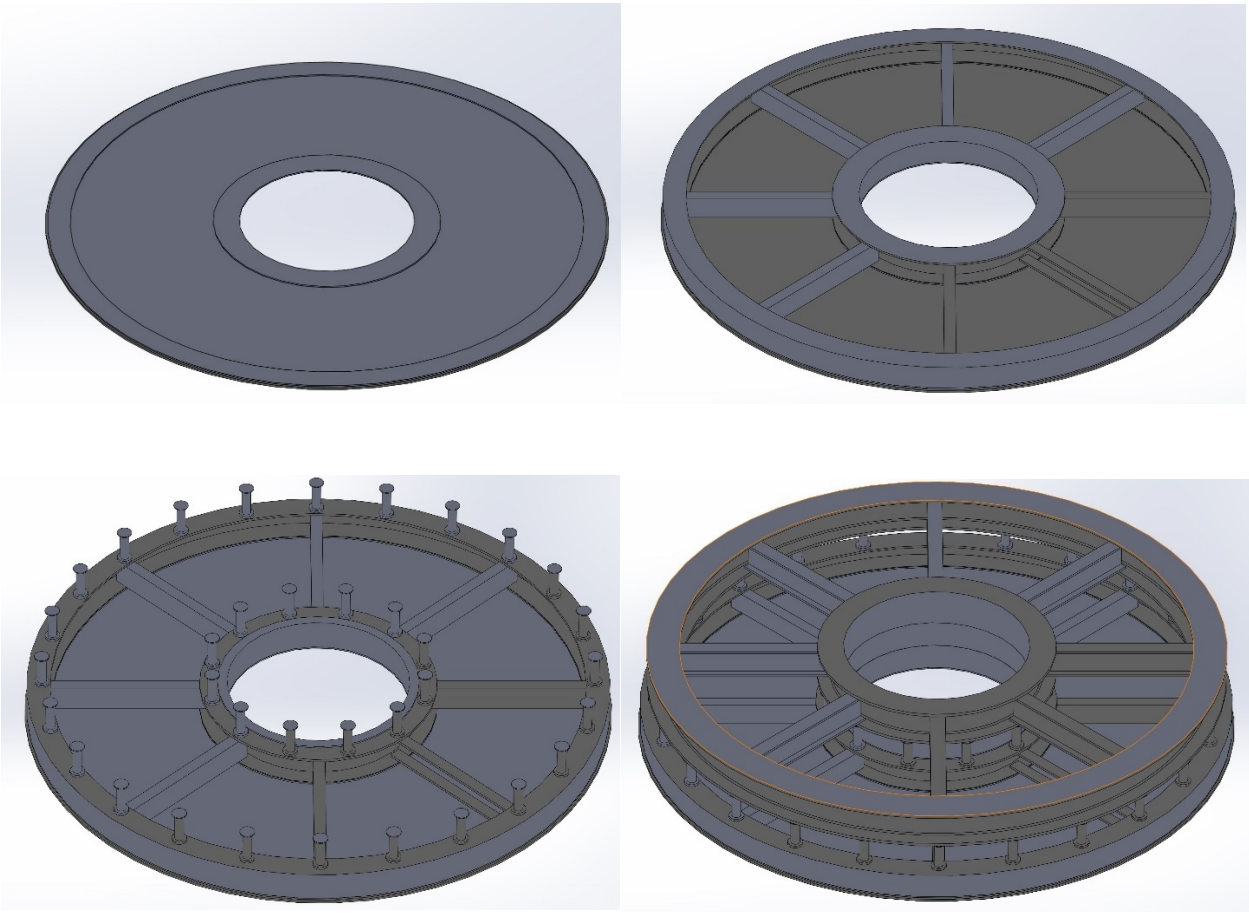


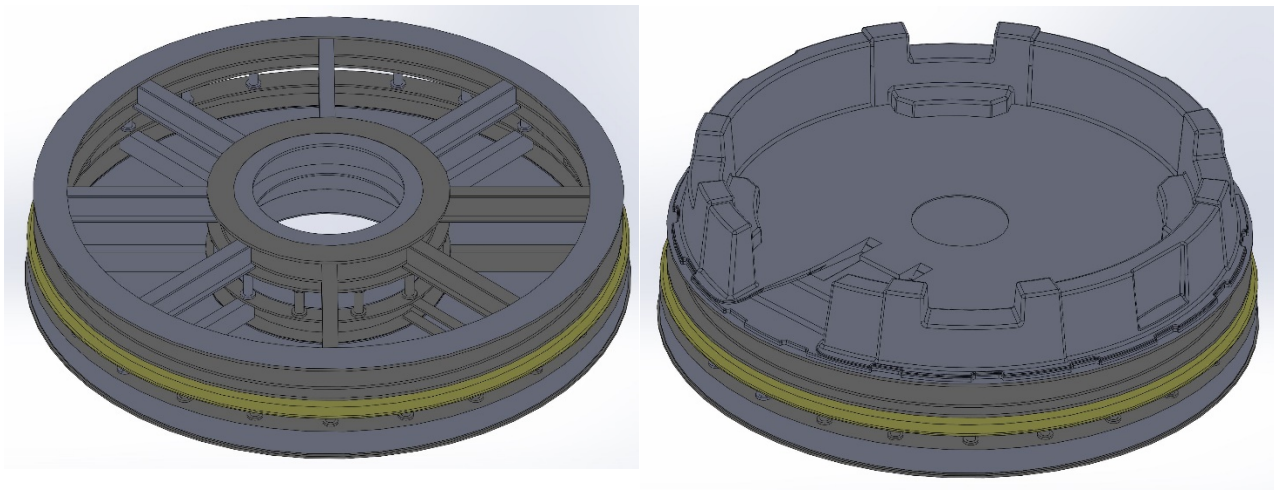


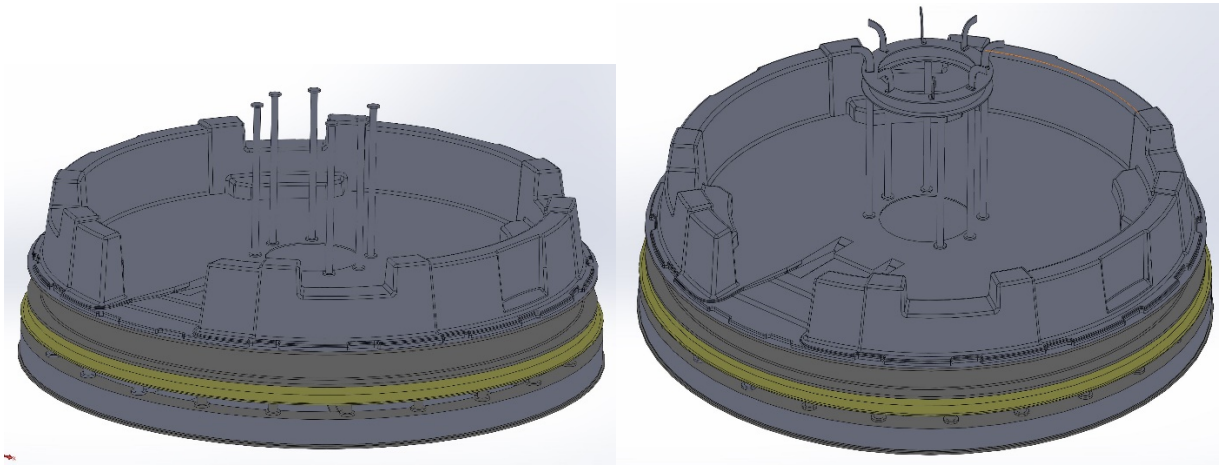


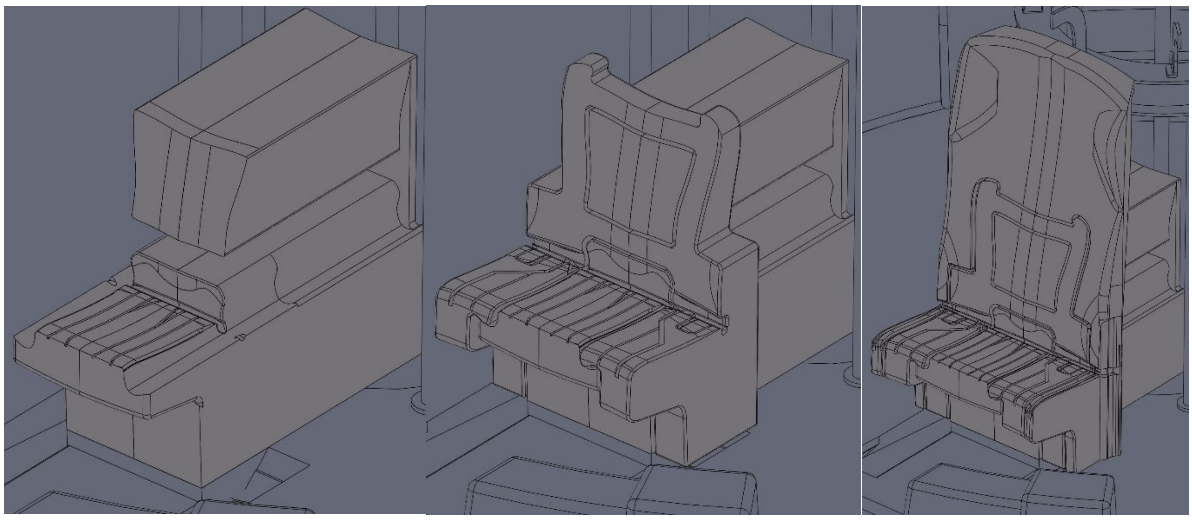
The wheelchair process was quite complex used a series of lofts, sweeps, curves, and surface extrusions in order to fabric the form of the chair. These forms where then extrusion cut and softened using fillets and chamfers.

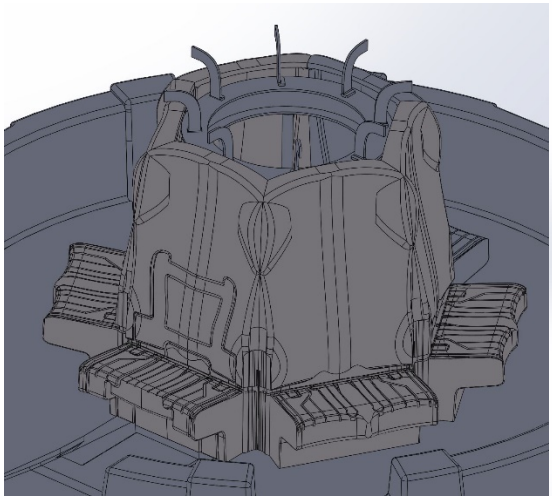
Individual Ride Boat Process

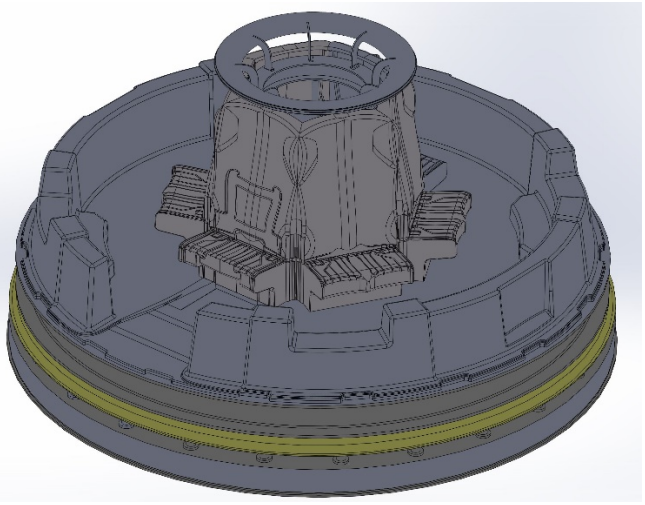


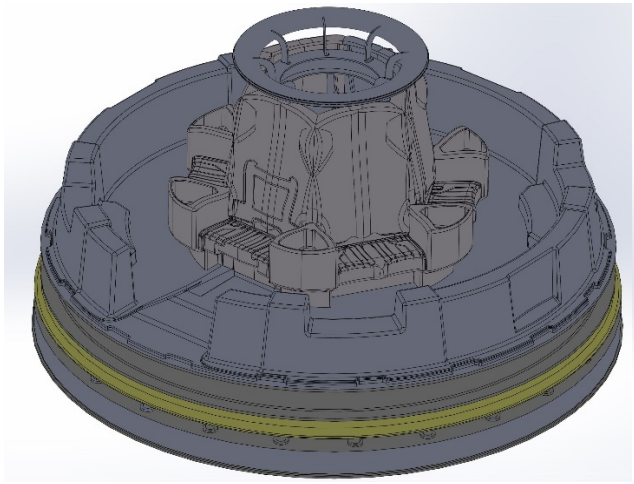


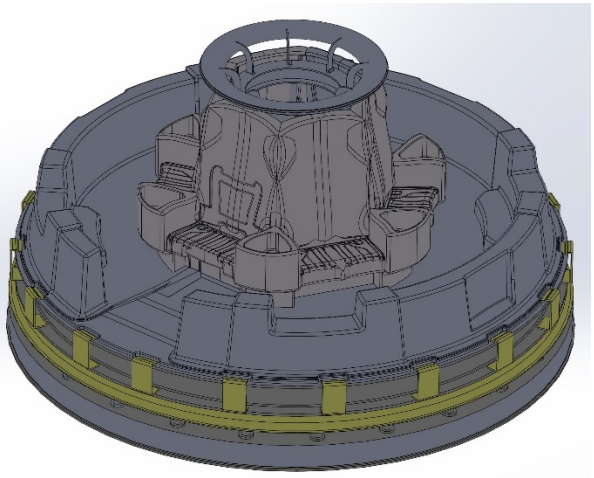


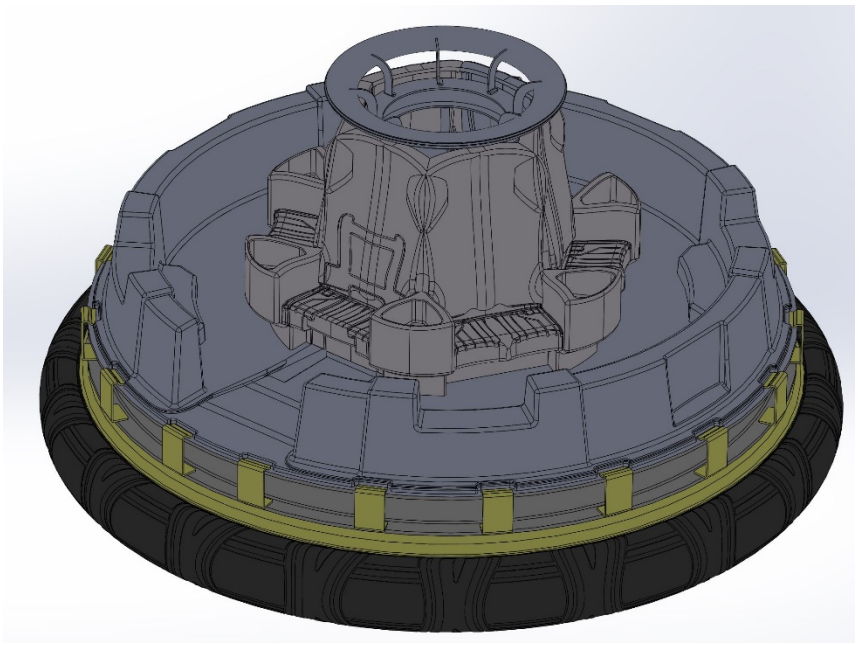












The boat was constructed using a series of rotational and linear extrusions. Utilizing a series of complex cuts in order to create a more complex form. The seat system was created using similar techniques as was used to create the glide-chair.

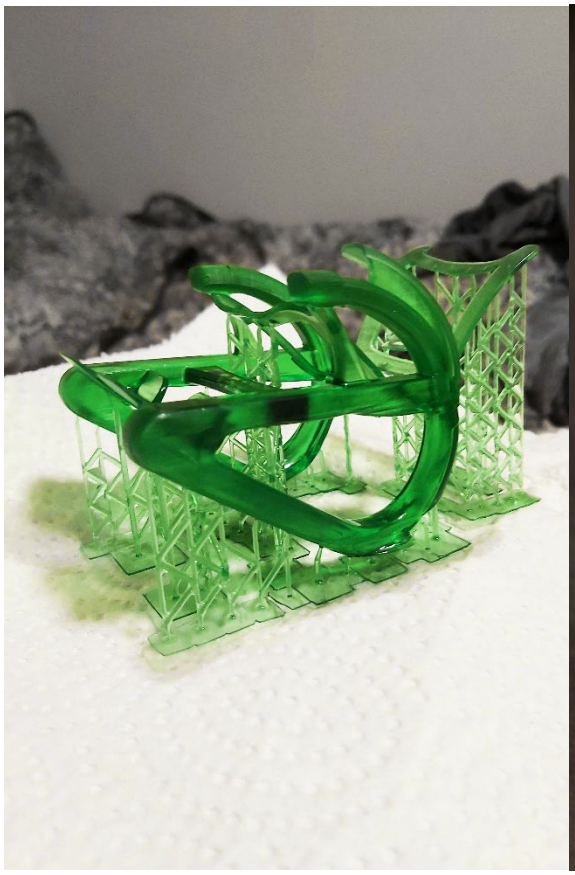
CONCLUSION

During this process, the overall dimension of the ride vehicle was significantly reduced. Not to mention another seat was adding making it a total of 12 guess or 10 guess 1 glide chair. This would allow for multiple boats in the fleet being accessible. Meaning more opportunity for access. As well the leg room was drastically reduced going back and altering the ergonomic physical mode the following the optimum spacing of 22” was figured out to be just enough room for guest to get around each other without nocking off their balance as well raining would be placed at a 31” high from the floor for them to hold on. (These railings also acted as splash guards against strong waves.

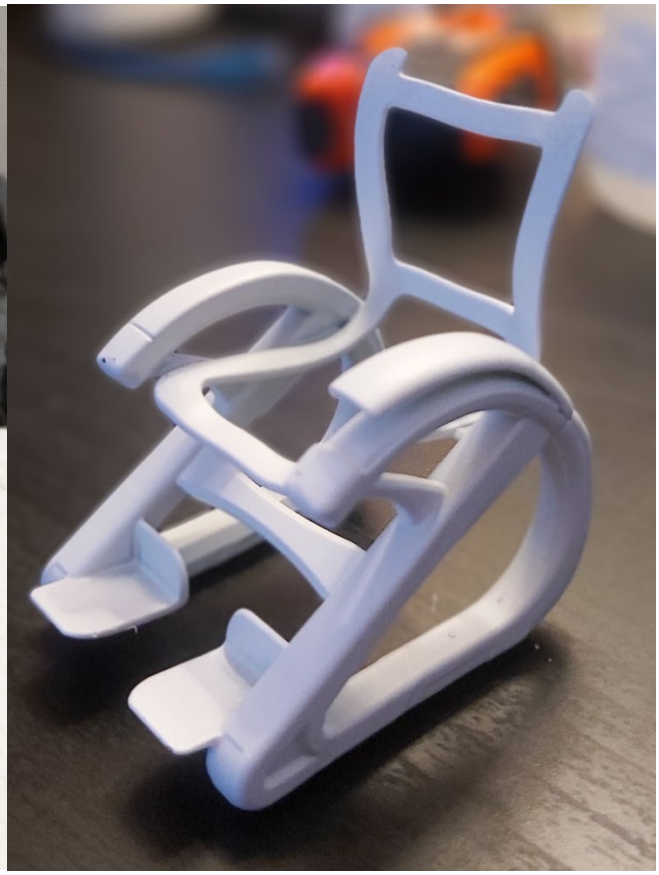
For access much stayed the same however stuff such as Tweaking of overall dimension. Hypothetically happing out the innards: where the motor, battery and track would fit. Also adding elements such as reflective strip and LED lights for nighttime use where also realized. In addition, the fine toning of the connection points between the ACESS and the ride system were fined toned

4.8 Hard Model Fabrication History

Ones the final cad was complete the model was scaled down to 1:12th scale and the addition of pegs, friction fit, and cuts were added to help with the fabrication and painting of the physical model. The pieces were then printed using SLA Resin and Recycled PLA. Ones each part was printed they were sanded down, and spray painted then glued and assembled.



Straight Out of the 3D Printer



After painted

5 Final Design

The following chapter will act as a cohesive summery of the previous chapter stringing together the research, data, ergonomic study, sustainability and link them together with the features and details of the design that will be illustrated using computer generated renders, CAD, technical drawings and hard model photography.

5.1 Summary

Description

INVERT and ACESS are to parts of a design solution to make theme parks more accessible. INVERT is a new perspective on a river rapids ride boat system. Flipping the direction of the seats allowing for easy access as well as added thrill. This reconfiguration allows for ACESS (a glide-chair system) to connect easily into the boat seating. ACESS is a mobility assistant design solution that utilizes a special glide track system, specifically designed for theme parks. Its unique design elements and added structural resilience remove the need to transfer allowing the devices to connect directly into ride vehicles.

Explanation

If amusement parks were accessible to wheelchair users an estimated 55 million mobility challenged guests would have visited parks in 2018 *(see appendix v)*. This is where ACESS comes into play. By re-inventing, the wheelchair to not only be more comfortable, intuitive, and efficient it also eliminates allot of the dangers of transferring. According to a 1994 study 57.4% of wheelchair users fell out of their chair doing daily activities. (Lezzon, 2001) To combat this unnecessary danger ACESS removes the need to transfer drastically eliminates the possibility of

injury. It is unique wheel-less and ergonomic posture control design allows for even weight distribution and added grip preventing tipping. It is reinforced structural design also allows it to with stand ride system GeForce provide a stable seating area for user during the ride. INVERT in a way is a case study showcasing how ACESS can be integrated into a ride system. Taking the complex variables of a river rapids ride INVERT's unique design allows for one of the seats to transform allowing it to easily accept ACESS in locking it into place allowing wheelchair users to easily load onto the ride without the need to transfer without effecting other riders' experience and allowing the glider-chair users to have a similar type of experience as everyone else.

Benefit Statement

ACESS is a reinvention of the dated wheelchair that works to eliminate allot of the ergonomic and physical struggles through its unique wheel-less design. The intuitive haptic control pad plays into the muscle memory of wheelchair making the new glide-system unique yet familiar. Adjustable armrest and posture correction back work together to provide comfort and equal weight distribution for added stability and comfort.

INVERT took an already fun experience and added an addition element of thrill by facing guest outwards they are no longer able to hide from the wall of water that will hit them. The redesigned splash guard prevents the most forceful water from hitting guess allow for just the perfect amount of splash. This reconfiguration also allows for ACESSS so slide right in allowing both glide-chair users and non-glide chair users to have the same type of ride experience Making INVERT the first thrill ride fully accessible to everyone.

5.2 Design Criteria Met

The following section will go in depth into the specific of the design explaining the purpose of each feature. Each sub-section will be broken into two to three areas of focus: INTVERT, ACESS and how they work together. Each subsection may have two to four min-sections depend on its complexity. This thesis is a design system solution so each part will explain its appropriate product, aka INVERT and ACESS, and how they work together to my a fully accessible system.

5.2.1 Ergonomics

ACCESS

SEAT BACK

ACESS's design is focused on aiding mobility challenges user mainly those with full upper body mobility. The backrest brace provides support in both the lumbar and mid upper back by having padded cross bars there to support. An inward curve is added to the brace to allow the body to nestle toward the center of the seat encouraging proper posture. Back rest sides have an outward curve allowing the use to rest their lower shoulder/back against it to provide a hard-physical support if the use's need that rest and the outward design ensure no hard edges are there to "cut" into the users back. Tension fabric is used stretch over the back rest to provide adequate support to all areas of the back while forming to the user's specific back form.

SEAT PAN

Tension fabric is used to make up the seat, it provides perfect form fitting support to the body and adequate airflow to allow proper cooling and drying for user. Inside the seat pan's fabric there is a plastic lattice structure sandwiched between two pieces of tension fabric this

flexible plastic provides added structural support and physical support to help the use balance themselves easier without effecting overall comfortability. The seat frame is design much like the back rest however the front brace is curve downward to prevent the cutting of circulation in the legs since fully paraplegic users would notice which could prove to be damaging.

ARM REST

Arm rest have a curve design that allow the hands to sit little higher than the elbows this allow them to proper themselves up using their elbows and still allows them to use their hands for other activities. A half-moon shaped padding design is added to the inward facing part of the armrest which provides cushioning for the users' arms. The arm rests are fully adjustable using a spring loading locking system. Users pull on arm rest and its life up locking in 1.5-degree increments. A little trigger is located on the front inside of the arm rest you pull it and it releases the spring allowing for armrest to close again.

HAPTIC CONTROL PAD

The haptic control strip is located on the bottom of the arm rest. It follows a curve, mimic the inside of a wheel. To control ACESS user reach outside around the armrest and slides their fingers across the haptic pad to control the glide chair. This mimic the same movement require to control a manual wheelchair, which is the most popular wheelchair. (Edward, 2018) User just as to reach around and slide their fingers across the haptic pad to control the glide chair. Haptic pad sensitivity can be adjusted via a physical slider located on the left arm rest. (*figure 5.1*) Haptic control pad act much like a manual wheelchair:

Tables 13 Haptic Pad Control

Needs	Benefits
Move forward and back	To move forward slide both hands across the haptic couch pad
Move Right	Slide right hand forward to turn wheelchair left (to do tight turn without moving forward move left hand for backwards while right hand forwards)
Move Left	Slide left hand forward to turn wheelchair right (to do tight turn without moving forward move right hand for backwards while left hand forwards)

In order to properly simulate the feeling of a manual wheelchair in board software simulate the rolling aspect of a chair so when consistently driving forward all you have to do is slide your hands across repeatedly ones you stop slide you will continue to roll a few feet (overall distances depends on how fast you were driving forward) before stopping to stop faster press and hold the haptic slider and you will slow down to a stop. Harder you press the faster you stop. All of this works together to simulate the same feeling of a manual wheelchair which is something that all wheelchair users are very adapt as using. However, you will not fatigue do to the fact that you are not having to push your own weight the motor is driving you forward essentially.

INVERT

Boarding

You are on a rotating loading dock and step into the boat from one of 4 steps with a railing down the center of each step. For loading ACESS the raft is stop before it hits a loading dock. This loading dock is a little lower than the regular one. The raft is rotating around until the wheelchair seat is facing the loading area. The doors are unlocked and opened. And wheelchair

rap is swung forward allowing ACESS to back up into the ride. The floor has an inch lower guides that help direct the glide chair into the seat. Ones in the seat the chair is locked in and the ride is ready to go.

Seat Bench

The seats have half inch-wide groves in it that help direct the access water from the seat into drainage areas in the boat this prevents the seats from popping up with water. The back is angled at a 7degrees with slight curve and lumbar support to help support guest of all heights. When access is in the ride the seat has a cut out that slide backwards and locks allowing the wheelchair to slide in the wheelchair seat pan's structure lights up directly with the ride seats this provide the rigid seat that that is require for a ride. With the added GeForce and bobbing around a hard seat is require helping support the user.

Restraints

The help hold in the guest in a lap bar is swung down. It kept around 2-4" away from guest body allowing them to hold onto it to help stabilize them. If you do not meet the height requirements or are in ACESS a seat belt is place around your waste as well to help hold you in.

5.2.2 Materials, Processes & Technologies

ACESS

Materials

ACESS is structural is created using injection model automotive grade Polyamide or Polyethylene due to its low cost to performance ratio. The armrest, seats and other non "load bearing elements are creates using Polypropylene. The track system is made from a mix of bio-sourced materials (ex. Natural rubber, sunflower oil, limonene, etc. (Michelin, 2018)) and

synthetic for its resilience. The seat is created using an Eco-nylon fabric which is both strong and breathable. The support is creating using ssteel wool that is woven into the fabric providing support while still allow airflow.

Tables 13: Common Material's Used – Wheelchair

INVERT Parts	Material	Manufacturing Process
Fabric Seat	Eco-nylon	Woven
Structural Tubular Steel	Aluminum	Extrusion and Bent
Structure	Polyethylene	Injection
Arm Rest		
Treads	Rubber	Press Mold
Reinforced Steel Thread	Steel Wool	Woven

Processes

Most of the plastic are injection molded due to its efficiency and flexibility in form. The fabric so woven and the ribbing is extrusion.

Technologies

Overall access is quite simple the unique part of this design is the wheel-less track system and the haptic touch pad. The haptic touch scrip works remarkably like your click less laptop track pad picking up your hands movements as it moves along the surface. It also requires you figures to teach the pad by picking up the electrical disturbance of your fingers touching the surface, same way your smartphone pics up your fingers verses your pocket. This prevents objects from accidentally causing your glide-chair from moving forward.

The glide-chair moves forward and backwards using a track system like those using by tanks however instead of being bade from steel it is made from rubber. This provide grip and allows for a quite driving empierce as well as cushioning to prevent bumping. The track system follows a guide inside the leg, it is driving by an electric motor hidden inside the cross bar. The

electric motor uses similar technology as electric cars where when you remove your foot off the peddle it flips to a generate that uses the kinetic energy to charge the batter. This also work as the main braking system if you need to stop suddenly there are traditional pad breaking that are active by you grabbing and press the haptic pad long and hard. The battery is stored inside the horizontal cross board using a clip cartage system letting you quickly switch it out for an already charge battery bar. Also on board software pick up the information from the haptic pad and runs it through a simulator so that the system drive's just like a traditional manual wheelchair this way the user know how to use it and it feels familiar right of the bat.

Also, the yellow strip is made from highly reflective paint like those used on microbead technology to reflect light. As well as LED strips to light the bath ahead. This reflective paint design allows users to be able to be seen despite the uneven lighting conditions of a theme park.

INVERT

Materials

Tables 6: Common Material's Used – Rapid Rides Boat

The following data was pulled from (Appendix V – User Research)

INVERT Parts	Material	Manufacturing Process
Fender	NR/SBR Rubber (commonly natural Rubber)	Press Mold
Structural I, C, and T-Beams	Grade 316 Stainless Steel	Depends on part (ex. Extrusion, punch, etc.)
Center Structure Support Beams		
Railings		
Water Proofing Hull	Fiberglass S-Glass (high tensile strength)	Open Mold Laminating Processes
Splash Shield Skirt		
Main Floor	Fiberglass E-Glass	Open Mold Laminating Processes
Seat Structure Support		
Seat		
Item Storage Container		
Lap Bar	Grade 316 Stainless Steel	Bent Tubular Steel
Seat Belt	Econylon	Wove

The following table shows the materials used to fabricate the ride system.

Processes

The structural support is created using majority of extrusion molded I, C, and T beams. The Rubber fender is created using a press molded then screwed into the boat. The main boat bottom is created using a fiberglass it is manufacturing just like a pool bottom is by using a one-sided mold that layers of fiberglass are laid and then sprayed with adhesive to hold together Then popped off using injector pins. The seats are created using a similar method. This method is selected due to its low cost and durability of the material.

Technologies

Majority of the technology is quite simple it is just a floating device. However, the way the glide-chair attaches into the boat is quite unique. The seat is cut out in the exact shape to except the ACESS. The ride operator pulls a lever underneath the seat that unlocks it and slide it backwards and locks it into place. When ACESS slides into the ride then locks into place using a to horizontal clips that clamp onto the side.

5.2.3 Manufacturing Cost Report

During the research process a variety of cost benchmarking where done in order to set a reasonable parameter to the project. In order to create the estimates a benchmarking list was created by analyzing similar wheelchairs, boats, and ride systems. As well as using online data base of similar parts to create a rough estimate of costing. The following chart is a composite of the benchmarking data found in (appendix)

Tables 15: Manufacturing Cost Chart - ACESS

Overal Part	QTY	ACESS - Parts	Material	Estimated Cost	Cost Per (X)	Total
Seating	2	Seat Fabric	Nylon stretch fabric	$8.25	per yard	$16.50
	1	Seat Support Material	Steel thread	$1.80	per roll	$1.80
	2	Seat Structure	Polypropylene	$1.00	per piece	$2.00
Structure	2	Arm Rest	Polypropylene	$0.50	per piece	$1.00
	12	Structural Parts	Polyethylene	$4.00	per piece	$48.00
Moving	2	Rubber Tread	Rubber	$25.00	per piece	$50.00
	1	Eletric Motor	Haptic Pad	$257.00	per sq. inch	$257.00
Details	75	Hardware	Polypropylene	$0.03	per piece	$2.25
	0.13	Padding		$60.00	per yard	$7.50
	1	Refective Paint		$12.25	per yard	$12.25
	1	Powder Coatting		$400.00	per yard	$400.00
	2	Random Other		1.25%		$997.88
					Total: + hst	$997.88

Tables 16: Manufacturing Cost Chart - INVERT

Overal Part	QTY	INVERT - Parts	Material	Estimated Cost	Cost Per (X)	Total
Protection	1	Fender	NR/SBR Rubber	$300.00		$300.00
Non Contact Structure	3	Structure i-beams		$350.00	per roll	$1,050.00
	1	Structure t-beams		$275.00	per piece	$275.00
	1	Structure c-beams		$275.00	per piece	$275.00
	1	Fiberglass Hull	Fiberglass S-Glass	$277.84	per piece	$277.84
Contact Structure	1	Fibergass Floor	Fiberglass E-Glass	$277.84	per piece	$277.84
	6	Fibgerglass Seating	Fiberglass E-Glass	$54.00	per sq. inch	$324.00
Safety	12	Seat Belt	Nylong Fabric	$4.00	per piece	$48.00
	6	Lap Bar	Aluminum	$12.00	per yard	$72.00
	1	Other details and variences		1.25%		$3,624.60
					Total: + hst	$3,624.60

5.3 Final CAD Renderings

ACCESS

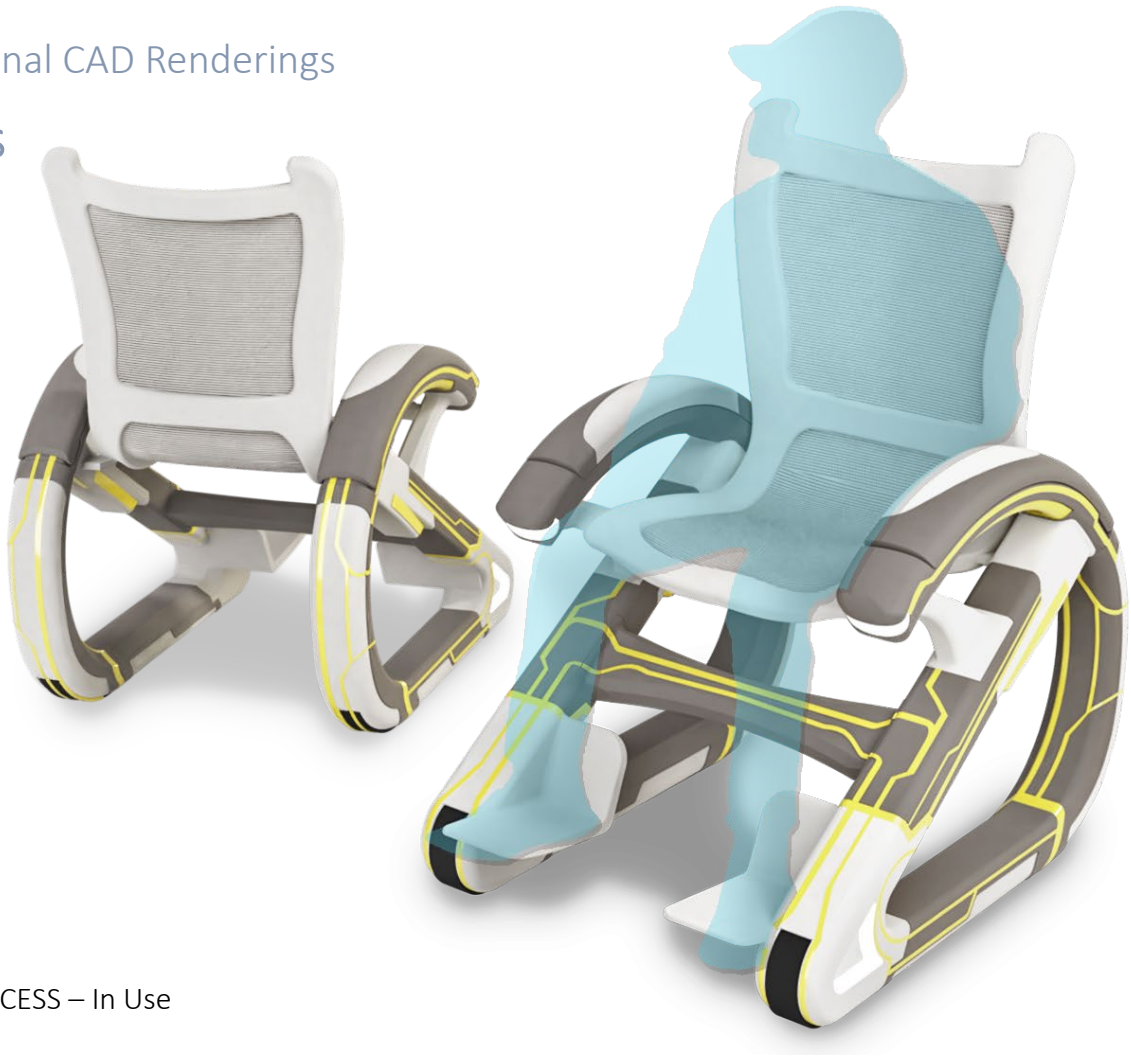


Figure 5.3.1 – ACESS – In Use

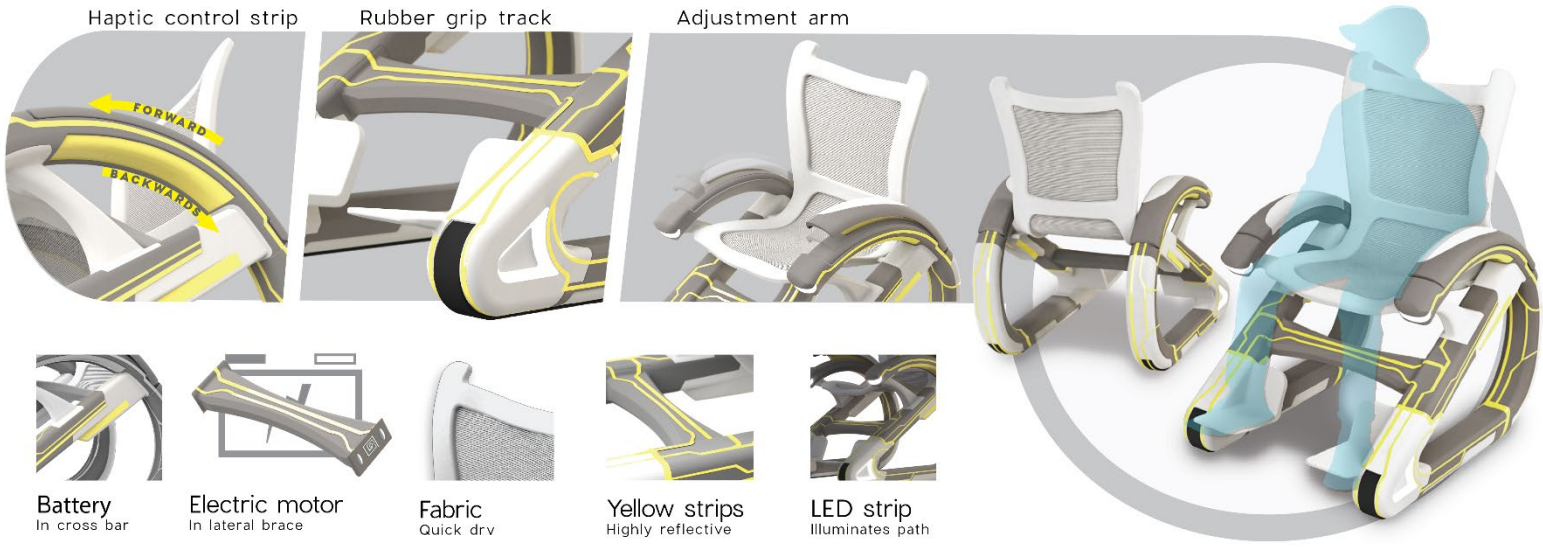


Figure 5.3.2 – ACESS - Features

INVERT

Figure 5.3.3 – Institution – Waterfalls

Figure 5.3.4 – At Loading Dock

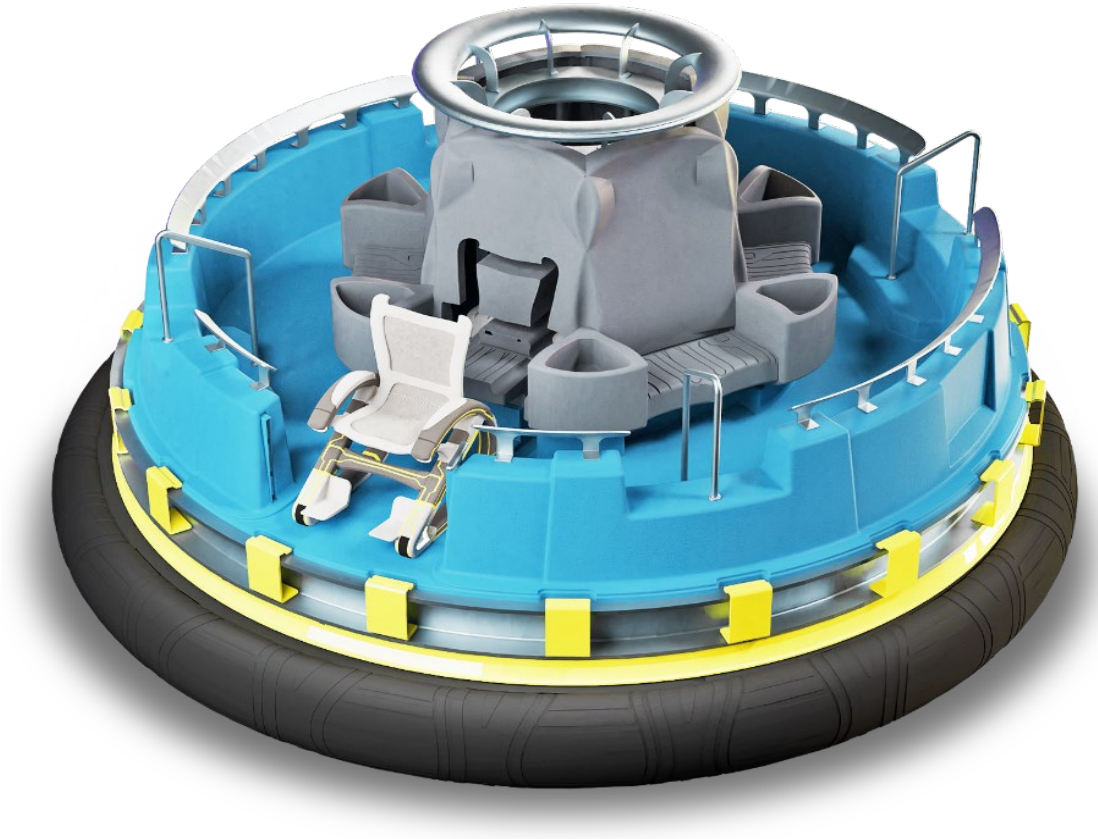


Figure 5.3.5 – Overall Boat with Wheelchair Driving In

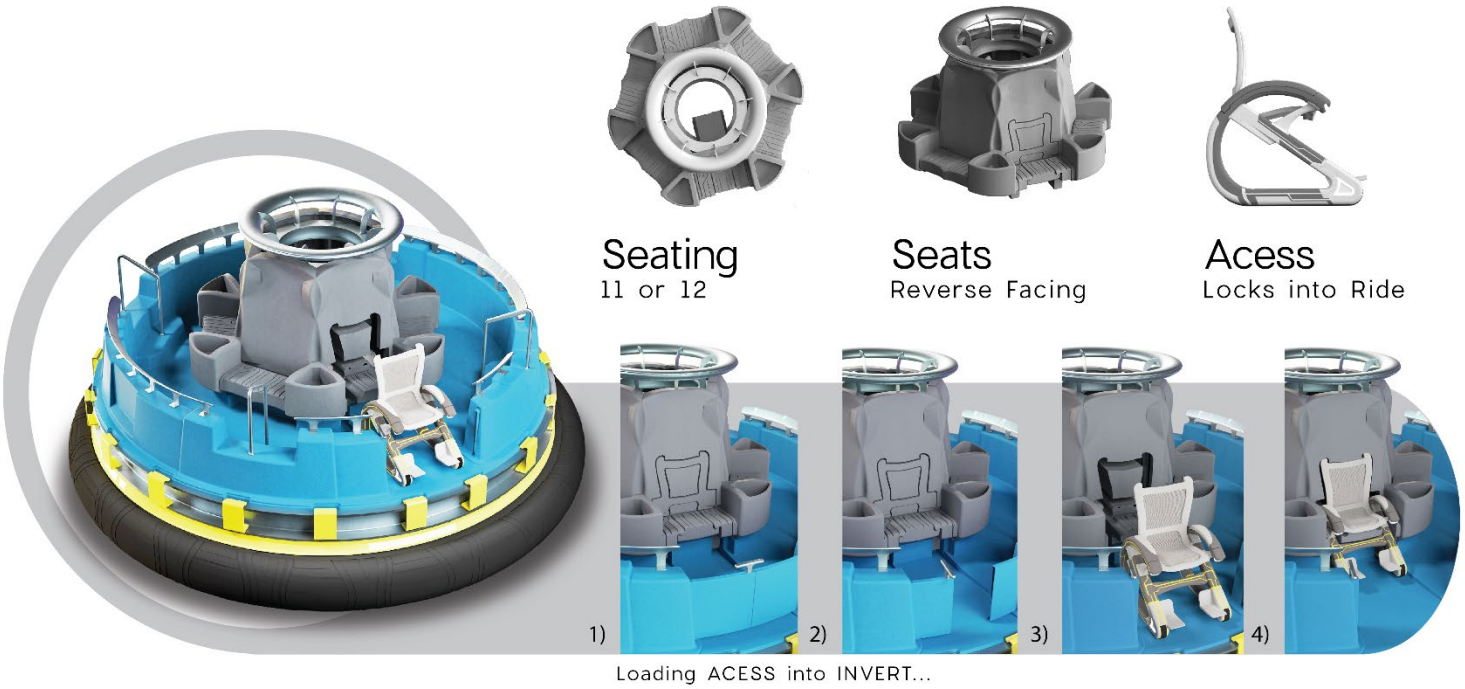


Figure 5.3.6 – Invert Features

5.4 Hard Model Photographs

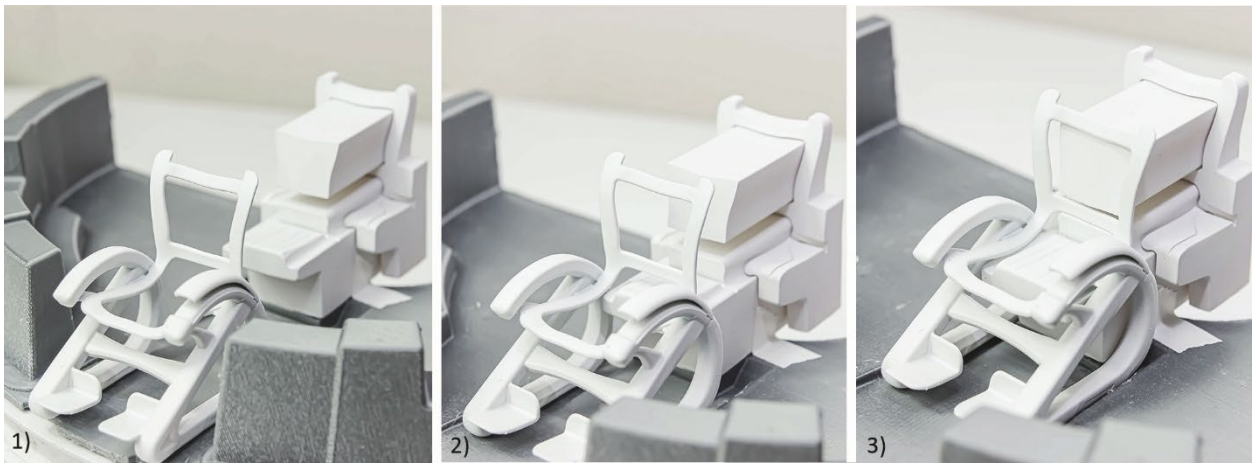


Figure 5.1 – ACESS loading into INVERT

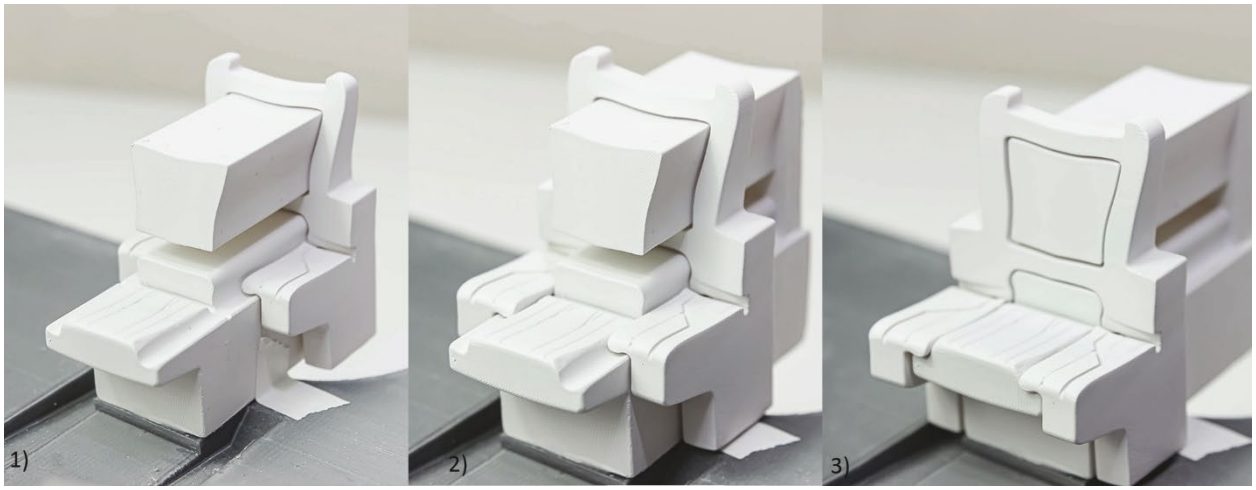


Figure 5.2 – INVERT chair transforming to accept ACESS

5.5 Technical Drawings

ACESS – Glide Chair System

Dimensional Drawings

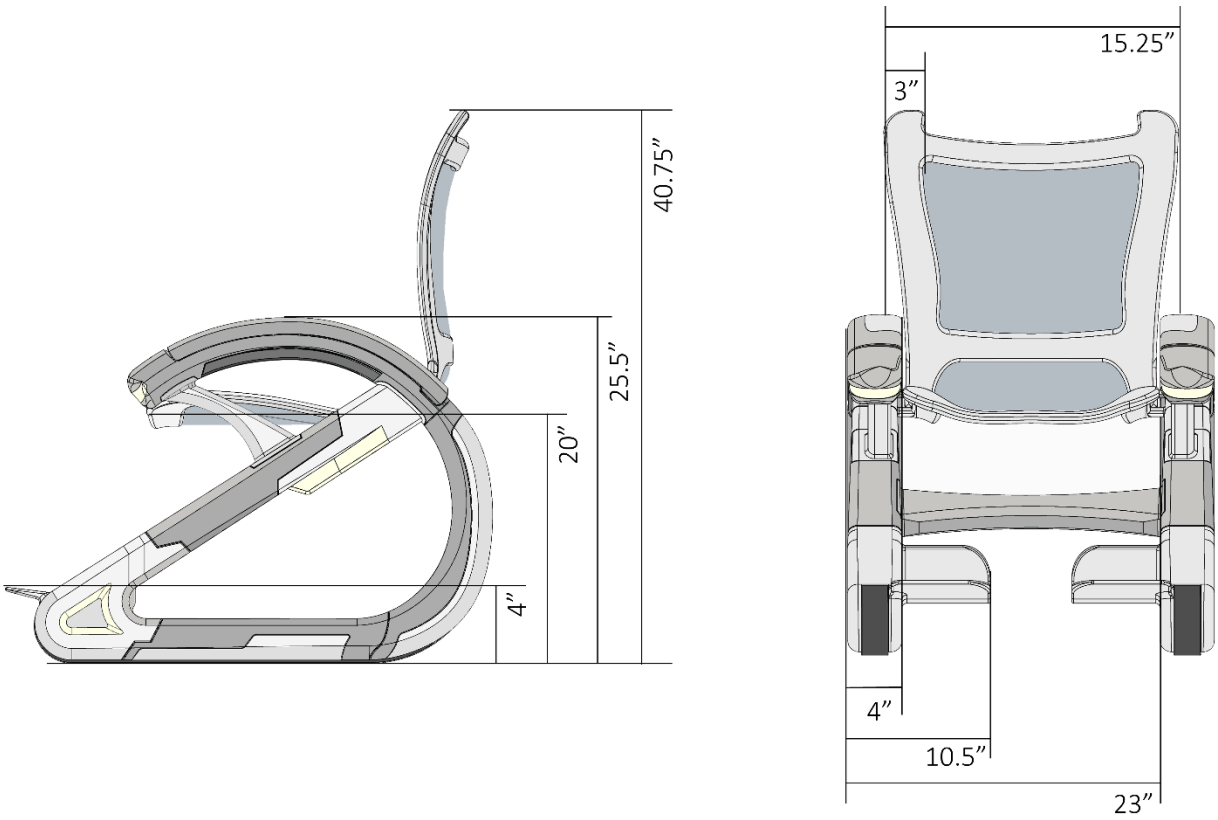
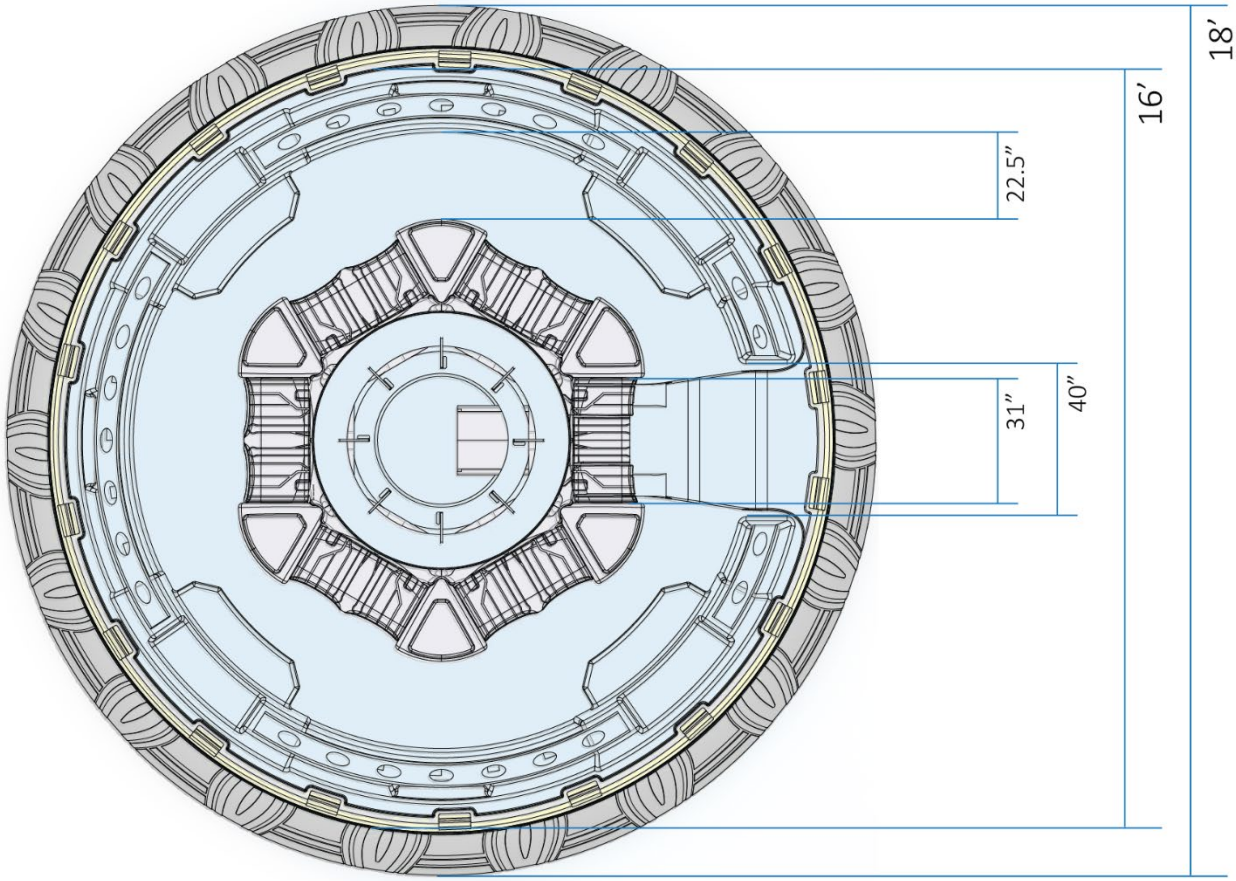
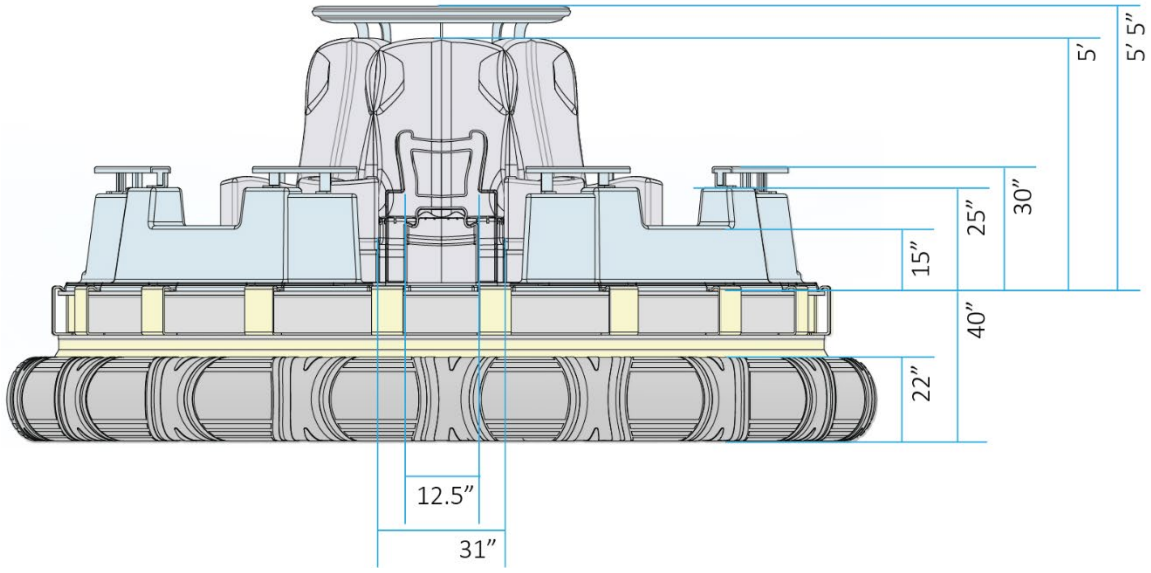


Figure 5.5 – Technical – ACESS

INVERT – River Rapids Ride System

Dimensional Drawings





5.6 Sustainability

The most basic form of sustainability is from the materials and practices associated in creating these products. An example of this would be like in sections 2.2.5 Benchmarks – Sustainability the following materials are selected for both their physical and sustainable factors.

Grade 316 Stainless Steel – INVERT

Stainless steel is a perfect choice for portions of the hull due to its relative lightness and strength. Not to mention it is 100% recyclable without scarifying any structural integrity. (2020, sina)

Fiberglass: E & S Glass – INVERT

Fiberglass is chosen for several reasons. Its overall easy of manufacturing especially on the small batch scale. It is also sustainable in the sense that it has an exceptionally low embodied energy. It also lasts a long time and is not prone to degrading or off gassing making it of little harm to its surroundings. (AAMA, n.d.)

EVA –INVERT and ACESS

PVC is often used in manufacturing roller coaster seating do to the fact that it is water repellent, cheap, light, and durable. However, it is highly toxic so EVA will be used as an alternative since it lacks the high chlorine content that PVA has. (acetate, 2020)

Eco-nylon - Nylon – ACESS and INVERT

Nylon is not biodegradable however it is recyclable works to extend the life of this material. Using eco-nylon lowers the products overall carbon footprints and help to close to life

to death cycle of these products. As well eco-nylon still has the durability, structural integrity, and life span of nylon.

NR/SBR Rubber - INVERT

NR/SBR Rubber is a marine grade rubber using a mix of bio-sourced rubber and recycled synthetic for resilience. This material has a low level of chemical toxins since it is made to be used in saltwater ocean which breaks down materials over time. It is fully recyclable and is made mostly of natural materials.

Rubber Tread - ACESS

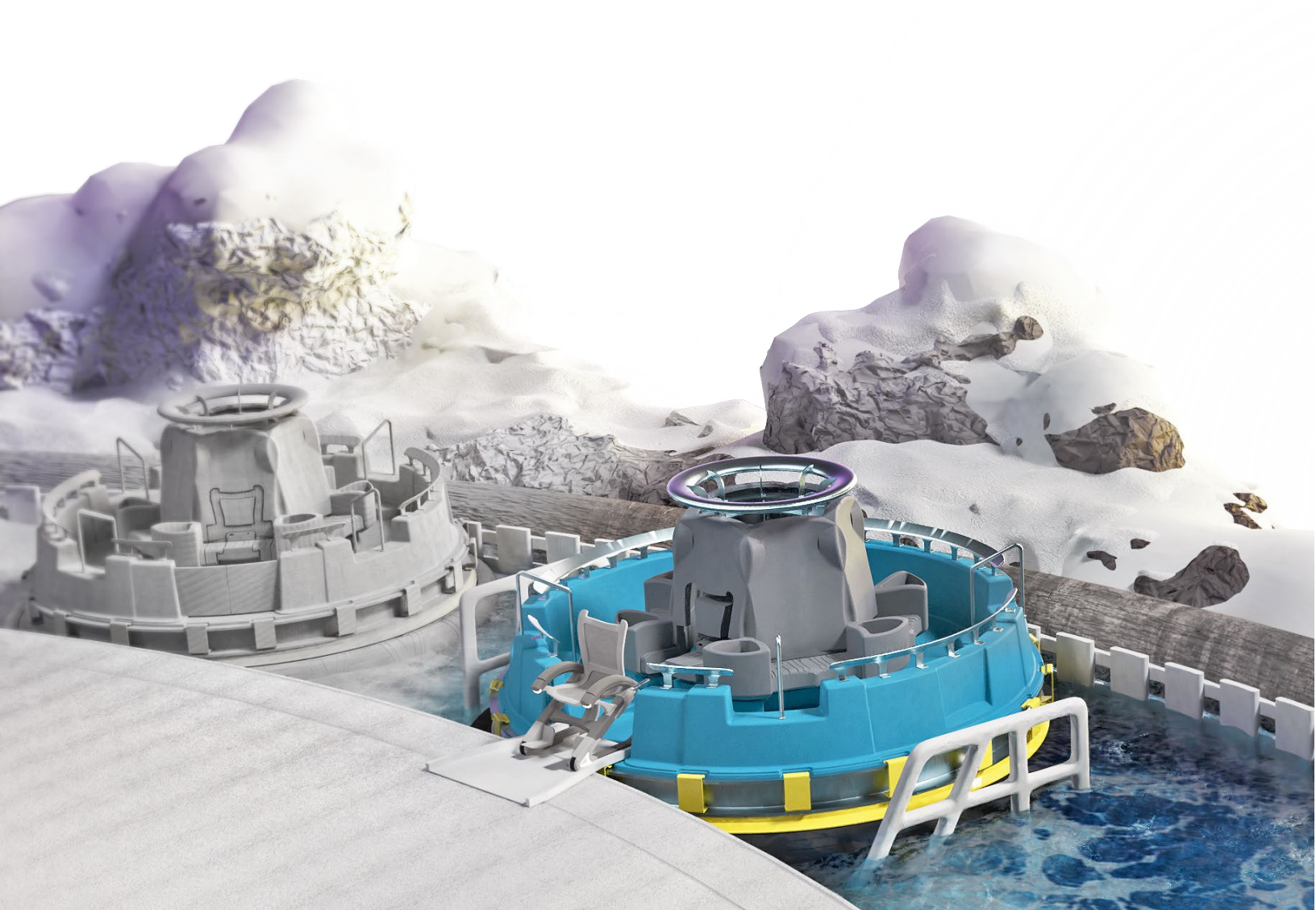
The track system is made from a mix of bio-sourced rubber (ex. Natural rubber, sunflower oil, limonene, etc. (Michelin, 2018) and synthetic for its resilience.

Aluminum Support – ACESS

Aluminum is used in the material of ACESS some of these included structural bracing, brackets, and housing for the mechanical portions. Aluminum is used because like most metal it is highly recyclable and does not degrade from rust.

6 Conclusions

INVERT and ACESS are two innovative design solution aimed at **making theme parks accessible** using a variety of features allowing glide-chair users to be able to board the river rapids ride without needing to transfer out of their wheelchair. INVERT works to reinvent a 40-year-old ride technology adding a fun new twist to this classic attraction while making it accessible for everyone. ACESS is a one of a kind mobility assistant for the mobility challenged which blends the familiarity of manual control wheelchairs with this new technology to make a seamless experience that is both unique yet familiar. Together they work to make the theme park experience seamless.



7 References or Bibliography (if any)

Intamin. Our History. (2017). Retrieved October 2019, from https://www.intaminworldwide.com/our-history/

Wikipedia. River Rapids Ride. (2019, November 17). Retrieved November 19, 2019, from https://en.wikipedia.org/wiki/River_rapids_ride

MacDonald, B. (2019, May 17). Review: Calico River Rapids blends storytelling with thrills to bring new life to aging Knott's water ride. Retrieved November 19, 2019, from https://www.ocregister.com/2019/05/16/review-calico-river-rapids-blends-storytelling-with-thrills-to-bring-new-life-to-aging-knotts-water-ride/

Klein, C. (2015, July 17). Disneyland's Disastrous Opening Day. Retrieved November 19, 2019, from https://www.history.com/news/disneylands-disastrous-opening-day-60-years-ago

Dorota. (2020, February 14). How many days to spend at Walt Disney World? Retrieved from https://www.dadsguidetowdw.com/how-many-days-to-spend-at-walt-disney-world.html

Davies, A., & Christie, N. (2017). An exploratory study of the experiences of wheelchair users as aircraft passengers – implications for policy and practice. IATSS Research, 41(2), 89–93. doi: 10.1016/j.iatssr.2017.05.003

Schwartz, D., Schwartz, D., Kayla, Owens, H., Preston, & Chase, R. (2018, May 16). The Choice of Mobility: Manual vs. Power Wheelchairs. Retrieved from https://homepromedical.com/blog/2015/10/28/the-choice-of-mobility-manual-vs-power-wheelchairs/

Chen, A. H. (2016, July 22). Can you be too old to ride roller coasters? Retrieved from https://www.cnn.com/2016/07/22/health/roller-coaster-age-limit/index.html.

Shaw, R. (2017, November 15). Disney Fun Facts: How many people go to Disney World a day? Retrieved from https://disneyorlandoandbeyond.co.uk/disney-fun-facts-how-many-people-go-to-disney-world-a-day/

Roen, T. (2017, April 24). Theme park demographics changing: Higher incomes and more millennials. Retrieved December 1, 2019, from https://orlando-rising.com/theme-park-demographics-changing-higher-incomes-and-more-millennials/

Welage, N., & Liu, K. P. Y. (2011). Wheelchair accessibility of public buildings: a review of the literature. Disability and Rehabilitation: Assistive Technology, 6(1), 1–9. Doi: 10.3109/17483107.2010.522680

Michelin 2048 goals: tires made with 80% sustainable material and 100% tire recycling. (2018, May 31). Retrieved from https://www.greencarcongress.com/2018/05/20180531-michelin.html

Hubbard, G. (2019, July 28). Retrieved from https://www.youtube.com/watch?v=L4MPcu5MHIc&t=164s

Randy, T. (2017, August 7). Retrieved from https://www.youtube.com/watch?v=ZWI1efCm2Bo4

Randy, T. (2017, August 7). Retrieved from https://www.youtube.com/watch?v=titqxjhc69I

Randy, T. (2017, September 9). Retrieved from https://www.youtube.com/watch?v=Pd55BGsfAGg

Bennett, S., Kirby, R. L., Bennett, S., Kirby, R. L., & Macdonald, B. (2009). Wheelchair accessibility: Descriptive survey of curb ramps in an urban area. Disability and Rehabilitation: Assistive Technology, 4(1), 17–23. doi: 10.1080/17483100802542603

Thapar, N., Warner, G., Drainoni, M.-L., Williams, S. R., Ditchfield, H., Wierbicky, J., & Nesathurai, S. (n.d.). A pilot study of functional access to public buildings and facilities for persons with impairments. Disability and Rehabilitation, 26(5), 280–289. Retrieved from https://www-tandfonline-com.ezproxy.humber.ca/doi/ref/10.1080/09638280310001649543?scroll=top

Ript, J., Borisoff, J. F., Grant, L. E., & Chan, F. H. N. (5AD). Patterns of community participation across the seasons: A year-long case study of three Canadian wheelchair users. Disability and Rehabilitation, 40(6), 722–731. Retrieved from https://www-tandfonline-com.ezproxy.humber.ca/doi/full/10.1080/09638288.2016.1271463

Archambault, P. S., Blackburn, E., Reid, D., Routhier, F., & Miller, W. C. (27AD). Development and user validation of driving tasks for a power wheelchair simulator. Disability and Rehabilitation, 39(15), 1549–1556. Retrieved from https://www-tandfonline-com.ezproxy.humber.ca/doi/full/10.1080/09638288.2016.1226423

Intamin: Our History: Rollercoaster Supplier & Amusement Ride Manufacturer. (2019). Retrieved from https://www.intaminworldwide.com/our-history/#.

Wagner, L. (2019, October 24). Disabled People in the World in 2019: facts and figures. Retrieved from https://www.inclusivecitymaker.com/disabled-people-in-the-world-in-2019-facts-and-figures/

Lezzoni, L. I., McCarthy, E. P., Davis, R. B., & Sieben, H. (2001). J Gen Intern Med. Mobility Difficulties Are Not Only a Problem for Old Age, 235–243. doi: 10.1046/j.1525-1497.2001.016004235.x

United States Population (LIVE). (2020). Retrieved from https://www.worldometers.info/world-population/us-population/

Robinett, J. (2019). Global Attractions Attendance Report. Theme Index Museum Index 2018. Retrieved from https://aecom.com/content/wp-content/uploads/2019/05/Theme-Index-2018-5-1.pdf

Edward. (2018, September 19). Do people prefer manual or electric wheelchair? Retrieved from https://www.karmanhealthcare.com/blog/2018/09/22/do-people-prefer-manual-or-electric-wheelchair/

Marine Rubber Arch Fenders. (n.d.). Retrieved April 6, 2020, from https://therubbercompany.com/rubber-fenders/arch-fenders

Fender (boating). (2020, March 6). Retrieved from https://en.wikipedia.org/wiki/Fender_(boating)

Kevlar Chemistry, (2013). Sustainability and recycling [online], Available at: http://kevlarchemistry.neocities.org/about3.html [accessed 01/10/2016]

Prezi, (2014). Impact of Sulphur Acid Industry of the Environment [online], Available at: https://prezi.com/rlbykvgjtxvz/impacts-of-the-sulphuric-acid-industry-on-the-enviroment/ [accessed 01/10/2016]

Oneal David, (2013, October 8). Extinct Attraction: Disneyland Monorail Documentary with Bob Gurr. Retrieved February 4, 2020 from https://www.youtube.com/watch?v=o-HAIygiOQs.

Environmental Impact and Sustainability. (2016, October 3). Retrieved from https://kevlarweb.wordpress.com/environmental-impact-and-sustainability/

Editors, H. (2016, November 21). How is Seat Belt Webbing Woven? Retrieved from https://handwovenmagazine.com/seat-belt-material/

DiGiovine, C. P. (2016, April 28). Wheelchair. Retrieved from https://www.britannica.com/topic/wheelchair

Donahue, A. B. (2017, June 2). Is Your Wheelchair Back Upholstery Important? Retrieved from https://www.passionatepeople.invacare.eu.com/wheelchair-back-upholstery-important-fabric-function/

6 eco amusement parks to take your kids. (2018, March 22). LifeGate Retrieved from https://www.lifegate.com/people/lifestyle/eco-amusement-parks

BessetteApr, W. (2020, January 6). Materials Used in Roller Coasters. Retrieved from https://www.azom.com/article.aspx?ArticleID=11958

(n.d.). Retrieved from https://www.piedmontplastics.com/applications/amusement-and-theme-park-rides

Roller Coaster. (n.d.). Retrieved from http://www.madehow.com/Volume-6/Roller-Coaster.html

Sustainability. (n.d.). Retrieved from https://www.ssina.com/value-propositions/sustainability/

Sustainability Stainless Steel. (ssina). Retrieved February 4, 2020, from https://www.ssina.com/value-propositions/sustainability/

Fiberglass Sustainability: AAMA Fiberglass Material Council. (n.d.). Retrieved from https://aamanet.org/pages/fiberglass-green-and-sustainability

Ethylene-vinyl acetate. (2020, January 31). Retrieved from https://en.wikipedia.org/wiki/Ethylene-vinyl_acetate

Trent, A. C. T. C., & Trent, C. T. C. (2020, January 25). Walt Disney World Thrill Rides for Pooh Sized People. Retrieved from https://www.wdw-magazine.com/walt-disney-world-thrill-rides-for-pooh-sized-people/

Environmental Impact and Sustainability. (2016, October 3). Retrieved from https://kevlarweb.wordpress.com/environmental-impact-and-sustainability/

Editors, H. (2016, November 21). How is Seat Belt Webbing Woven? Retrieved from https://handwovenmagazine.com/seat-belt-material/

DiGiovine, C. P. (2016, April 28). Wheelchair. Retrieved from https://www.britannica.com/topic/wheelchair

Grizzly River Run. (Disney Fandom, 2019). Retrieved from https://disney.fandom.com/wiki/Grizzly_River_Run.

Kali River Rapids. (2019, November 10). Retrieved November 19, 2019, from https://en.wikipedia.org/wiki/Kali_River_Rapids.

Roaring Rapids (Disney). (2019, August 27). Retrieved November 19, 2019, from https://en.wikipedia.org/wiki/Roaring_Rapids_(Disney).

7.1 Image References

- Figure 1.1: The Problem – Edit Composite
    - Archive, T. P. (n.d.). Kali River Rapids at Disney's Animal Kingdom. Retrieved from https://www.themeparkarchive.com/parks/disney's-animal-kingdom/kali-river-rapids
    - WATKINS/XPOSURE - BERETTA/SIMS/REX/SHUTTERSTOCK
- Figure 1.2: Grizzle River Run
    - Disneyland (n.d.) Grizzle River Run. Retrieved from https://disneyland.disney.go.com/en-ca/attractions/disney-california-adventure/grizzly-river-run/
- Figure 1.3: Infinity Falls
    - Viaval. (n.d.). Orlando, Florida. January 20, 2019 People having fun river attraction ride Infinity Falls at Seaworld Marine Theme Park (5). Retrieved from https://www.shutterstock.com/image-photo/orlando-florida-january-20-2019-people-1336023239
- Figure 2.1: Guy in Wheelchair
    - Studio, A. (n.d.). Man in wheelchair with service dog indoors. Retrieved from https://www.shutterstock.com/image-photo/man-wheelchair-service-dog-indoors-1007024701Figure 2.2: Kali River Rapid Ride Boat
    - Figure 2.2 Kali River Rapid Ride Boat: Photo by Judd Helms
- Figure 2.3: Activity Mapping
    - Forgem. (n.d.). Tourist, man and woman with backpacks and a map looking for a trip in a mountain landscape with forest, trees and flying birds under the sky with clouds - vector. Retrieved from https://www.shutterstock.com/image-vector/tourist-man-woman-backpacks-map-looking-1057424456Figure 2.4: Kali River Rapid
- Orlando. (n.d.). Retrieved from https://www.undercovertourist.com/orlando/disneys-animal-kingdom/kali-river-rapids/
- Figure 2.5: Screenshot of Rio Loco River Rapid Ride
    - Screenshot of Rio Loco River Rapid Ride. (n.d.). Retrieved April 14, 2020, from https://www.youtube.com/watch?v=dLsAODRWBdM
- Figure 2.6: Hagrid's Coaster
    - Hagrids's Coaster - Screenshot . (n.d.). Retrieved April 14, 2020, from https://www.youtube.com/watch?v=i15LQyNQJ8g
- Figure 2.7: Kali River Rapids
    - Cassie. (2018, January 31). 5 Reasons Why You Should Not Skip Kali River Rapids At Animal Kingdom - Disney Dining Information. Retrieved from https://www.disneydining.com/5-reasons-why-you-should-not-skip-kali-river-rapids-at-animal-kingdom/
- Figure 2.8 – Materials | from: Shutterstock composite

    - Hxdbzxy. (n.d.). Steel rods or bars used to reinforce concrete. abstract macro with shallow depth of field. Retrieved from https://www.shutterstock.com/image-photo/steel-rods-bars-used-reinforce-concrete-57924724
    - Serato. (n.d.). Hand builder with trowel leveling concrete, spreading poured. Some motion blur present. Vintage style. Retrieved from https://www.shutterstock.com/image-photo/hand-builder-trowel-leveling-concrete-spreading-743046340
    - Faboi. (n.d.). Detail of carpenter's hands filing the edge of a fiberglass part with a Dremel tool. Fiberglass processing: worker manually realizes a component in glass fiber. Retrieved from https://www.shutterstock.com/image-photo/detail-carpenters-hands-filing-edge-fiberglass-1615554148

- Figure 2.9 – Sustainabiltiy | from: shutterstock
    - Flegere. (n.d.). Scrap of copper wire recycling industry materials. Retrieved from https://www.shutterstock.com/image-photo/scrap-copper-wire-recycling-industry-materials-1418041079
- Figure 3.1 – Maslows Maslow's Hierarchy of Needs
    - Collaborative Divorce and Maslow's Hierarchy of Needs - Westchester Divorce Lawyer: Arnold D. Cribari. (n.d.). Retrieved from https://www.westchesterdivorcelawyer.com/collaborative-divorce/collaborative-divorce-and-maslows-hierarchy-of-needs.html
- Figure 3.2 – IDEO'S Needs analysis diagram
    - Infographic Design - venn design innovation drawing from that classic IDEO diagram: Design thinking process, Innovation design, Design thinking. (n.d.). Retrieved from https://www.pinterest.ca/pin/787426316074173875/
- Figure 3.3 – Grizzly River Run
    - Disneyland (n.d.) Grizzle River Run. Retrieved from https://disneyland.disney.go.com/en-ca/attractions/disney-california-adventure/grizzly-river-run/
- Figure 3.10 – Kali River Rapid Ride Disney World | pg56
- Figure 3.11 – Fiberglass Mold
    - Taser. (n.d.). process for spray resin on to the fiberglass. Retrieved from https://www.shutterstock.com/image-photo/process-spray-resin-on-fiberglass-1340125247
- Figure 3.12 – Fiberglass Gluing
    - Taser. (n.d.). Process fiberglass composite by using brush for FRP products. Retrieved from https://www.shutterstock.com/image-photo/process-fiberglass-composite-by-using-brush-1209729937
- Figure 8.1: Studio, A. (n.d.). Man, in wheelchair with service dog indoors. Retrieved from https://www.shutterstock.com/image-photo/man-wheelchair-service-dog-indoors-1007024701

- Figure 8.2: My son is disabled and in a wheelchair was wo... (2018, October 14). Retrieved from https://disneyparksmomspanel.disney.go.com/question/son-disabled-wheelchair-wondering-rides-allow-stay-chair-384226/
- Figure 8.3: Trent, A. C. T. C., & Trent, C. T. C. (2020, January 25). Walt Disney World Thrill Rides for Pooh Sized People. Retrieved from https://www.wdw-magazine.com/walt-disney-world-thrill-rides-for-pooh-sized-people/
- Figure 8.4: Slinky Dog Dash Ride Page. (n.d.). Retrieved April 13, 2020, from https://disneyworld.disney.go.com/en_CA/attractions/hollywood-studios/slinky-dog-dash/
- Figure 8.5: Nomads, L. (2019, December 17). Disneyland Tokyo blog - The fullest Tokyo Disneyland guide & Tokyo DisneySea guide for a great trip to Tokyo Disney Resort - Page 2 of 2. Retrieved from https://livingnomads.com/2019/08/disneyland-tokyo-blog/splash-mountain-disney-tokyo/
- Figure 8.6: Kali River Rapid Ride Page. (n.d.). Retrieved April 13, 2020, from https://disneyworld.disney.go.com/en_CA/attractions/hollywood-studios/rock-and-roller-coaster-starring-aerosmith/
- Figure 8.7: Helms, J. (2020, February 14). How to stay dry at Walt Disney World. Retrieved from https://www.dadsguidetowdw.com/how-to-stay-dry-at-walt-disney-world.html
- Figure 8.8: Rock N Roller Coaster pg. (n.d.). Retrieved April 13, 2020, from https://disneyworld.disney.go.com/en_CA/attractions/hollywood-studios/rock-and-roller-coaster-starring-aerosmith/
- Figure 8.9: Wheelchair Swimming: Snapshot - Retrieved April 13, 2020, from https://www.youtube.com/watch?v=ZMOBMW72bZM
- Figure 8.10: Pool Lifts. (n.d.). Retrieved from https://wheelchairliberty.com/collections/pool-lifts

8 Appendix

8.1 Appendix 1 – Discovery

Objective:

To obtain firsthand accounts of the experience and challenges faced by wheelchair users when interacting with theme park rides.

Scope:

The scope of the interviews was based on three important criteria: ease of use, comfort, safety, challenged, and social expectation. These criteria were investigated utilizing online blog and video how-to/reviews.

Findings:

Video Review #1	
User 1	Randy Todd
Age:	Late 30s
Basis of Expertise:	Avid Theme Park Attendant
Disability Level	T7/T8 (Complete Paraplegic from waste down)
Date	September 9, 2017

All video texts are direct quotes or descriptions.

Attraction 1.1			
Attraction:	Flight of Passage	Seat Type:	Motorcycle Link Chair
Type:	3D Flying Simulator	Mount Time:	65 seconds
Location:	Disney's Animal Kingdom	Dismount Time:	20 seconds

Link: https://www.youtube.com/watch?v=Pd55BGsfAGg

MOUNT	Description	• Flight of Passage is a 3D Flying Simulator with a motorbike style seating chair system with pressure adjusted lumbar, and calf restrains with forward arm bars. • Wheelchair user rolls up hind motorbike style seat then must pull himself up and onto seat using his upper body
	Comments	• "Make sure you stretch good before you go." • "I did not stretch at all before I went, and my legs were very stiff."
DISMOUNT	Description	• Scoot towards back of motorbike then lower arms to wheelchair armrest then lower yourself into • Make sure wheelchair is locked or it will roll back
	Comments	• Scoot towards back of motorbike then lower arms to wheelchair armrest then lower yourself into • Make sure wheelchair is locked or it will roll back

Attraction 1.2

Attraction:	Rock N Roller Coaster	Seat Type:	Overhead restraints
Type:	Dark steel enclosed launch roller coaster	Mount Time:	65 seconds
Location:	Disney's Hollywood Studio	Dismount Time:	20 seconds

Link: https://www.youtube.com/watch?v=titqxjhc69I

MOUNT	Description	• Loading and unloading dock (wheelchair users load on unloading dock) • Roll up besides, parallel to roller coaster, side swings open then you lower yourself in • Needed help placing legs inside
	Comments	• "Thinking back, I believe it might be easier if the door remained shut"
DISMOUNT	Description	• Scoot towards back of motorbike then lower arms to wheelchair armrest then lower yourself into • Make sure wheelchair is locked or it will roll back
	Comments	• "This would have been a lot easier if the door remained shut." • "Wasn't sure where to put my hands at first."

Attraction 1.3

Attraction:	Expedition Everest	**Seat Type:**	Lap Bar restraints
Type:	Steel roller coaster	**Mount Time:**	6 seconds
Location:	Disney's Animal Kingdom Lodge	**Dismount Time:**	6 seconds

Link: https://www.youtube.com/watch?v=ZWI1efCm2Bo

MOUNT	Description	• Loading and unloading dock (wheelchair users load on unloading dock) • Ride operator opens side panel on ride • Roll up perpendicular to roller coaster, lift and slide body onto seat
DISMOUNT	Description	• Ride operator swing arm rest open • Slide body to edge • Lift body into wheelchair

Video Review #2

User 1	Glem Hubbard
Age:	Mid 30s
Basis of Expertise:	Theme Park enthusiast and wheelchair activist
Disability Level	T10 (incomplete spinal cord injury)
Date	July 28, 2019

All video texts are direct quotes or descriptions.

Attraction 2.1

Attraction:	Splash Mountain	**Seat Type:**	Flume
Type:	Log Flume Ride	**Mount Time:**	20 seconds
Location:	Magic Kingdom	**Dismount Time:**	25 seconds
		Rating:	Hard

Link: https://www.youtube.com/watch?v=L4MPcu5MHIc&t=164s

MOUNT	Description	• Ride up parallel to log, lock wheelchair. Using arms pull yourself onto the edge of the log then slip backwards into the bench. • She is thin and flexible which mains transferring allot easier than a larger, stiffer person
	Comments	• "…this is one of the harder rides to transfer into…slipper, and you can't get your wheelchair right up because of those barriers" • "I did not stretch at all before I went, and my legs were very stiff."
DISMOUNT	Description	• getting back out was hard because you had to crank your arm way back to push yourself up and into your wheelchair • Water makes it slippery which makes things difficult • Requires a little bit more upper body strength then normal

Attraction 2.2

Attraction:	Space Mountain	**Seat Type:**	Bobsled
Type:	Dark tubular bobsled ride	**Mount Time:**	65 seconds
Location:	Magic Kingdom	**Dismount Time:**	20 seconds
		Rating:	Hard

Link: https://www.youtube.com/watch?v=L4MPcu5MHIc&t=164s

MOUNT	• Large access doors make it allot easier to transfer into • Difficult is lower your body from your wheelchair onto the armrest and placing your legs inside the ride vehicle • Also conversely raising yourself back out of the ride system is quite hard if you do not have the upper body strength

Video Review #3

User 1	Kristen
Age:	Mid 30s
Basis of Expertise:	Avid Theme Park Attendant
Disability Level	Osteogenesis Imperfecta Not Able to Transfer
Date	May 11, 2018

All video texts are direct quotes or descriptions.

Animal Kingdom – Challenges Faced

Link: https://www.youtube.com/watch?v=aob55VhVVCc

- Could only ride attractions that are wheelchair non-transferable possible
    - Finding Nemo, The Live Musical (Theater Show)
    - Wheelchair accessible paths through animal cage (zoo type experience)
    - Festival of the Lion King Live Show
    - Gorilla Falls Walking Trail (zoo type experience)

- Rafiki's Planet Watch (Ride a train to zoo type area (petting zoo)

- Unable to ride any ride with high level of GeForce even if she could attach her wheelchair inside because her condition causes her to have brittle bones

8.1.1 Conclusion

1. Transferring
    a. Requires allot of upper body strength (something not everyone has)
    b. Likely hood of injury is increased
    c. Fatigue is an issue (at end of day user was exhausted and by end of vacation was even worse)
    d. Stretching and warming up before heading to the parks was key
    e. Transferring was okay if it was fast and easy
    f. Felt awkward when everyone in the train or in the lineup was looking at them annoyed waiting for them to get on (speeding up transfer is optimum)
2. Non-Transferring
    a. Some wheelchair users cannot transfer because their it can be physical damaging to them both during the transfer or from the GeForce and shaking of the ride
3. Some wheelchair users are recovering from an injury so they should not be riding rides it is key to check with the person on the reason they are in a wheelchair before recommending the rides they are able to ride.

8.2 Appendix 2 – User Research

Objective

The objective of this following section is to identify the users for the proposed problem as well as how their profile can inform the final design.

Scope

The following data will determine the primary, secondary, and tertiary users to aid in the creation of a flushed-out users' profile to help narrow the field of research and bring relevance to the related data.

8.2.1 Findings:

User Profile Report

Age and Gender: 15-50, all genders

The selected age group was due to the physical nature of theme park attractions: the high-speed GeForce, motion sickness, height restrictions for harness, etc. all these factors contribute to the fact that majority of theme park riders are between the ages of 15-50. Children under ages 12 are most prone to motion sickness according to the Center of Disease Control and Prevention (Chen 2016) therefor rides with higher GeForce are built for children over the age of 12. Reversely adults over the age of 50 begin having allot of health problems such as high blood pressure, heart disease, etc. In a CNN report to Aria Hangyu Chen Dr. Robert Nile said, "Riding a roller coaster is far safer than riding in a car to the park, but only if you don't have any heart, neck or back conditions that might be exacerbated by the speed and stress of a coaster…" (Chen

2016) all of these tend to be problems people over 50. Consequently, to limit unrelated external variable the demographic in focus will be 15-50 years of age.

Education: basic cognitive awareness and special reasoning

The education of the users is not applicable; if you have basic mental awareness and special reasoning you are able to operate the wheelchair.

Income: $43,000 + (Roen, T. 2017)

According to recent studies the average American makes around $43k a year. Majority of theme parks are a perfect vacation destination despite some of them behind quite pricy people still make the time and effort to visit the parks

Ethnicity: All ethnicities

The idea of going to a theme park to have fun and escape from life transcend ethnic background. With theme parks located worldwide there is not specific ethnic background forced as may be seen in other industries.

Demographic Summery

The following data was pulled from (Appendix II – User Research)

Demographics		User Behavior		Personality		Cognitive Aspect	
Age	15-50 Years of age	**Frequency of use**	Theme parks are often milestone vacations done couple times a lifetime unless you live near one	'Locus of control'	↑	Technical Skills	↓
Gender	Mixed	**Duration**	6-day vacations	Self-Efficacy	↑	Pre-reg content knowledge	
Culture/ Ethnicity	Mixed	**Social/ Solitary**	Social and solitary function	Changeability	↑	Adaptability	↑
Income	$43,000+	**Level of Focus**	Low to medium	Uncertainty Avoidance	↑		
Educational/ Background	Inapplicable	**Location**	Inside river rapids ride vehicle				

Table 2 – Demographic Summary

Overall theme park attendance is quite mixed from a range of ethnic background, ages, social and economic levels etc. Theme parks are a place for people to escape reality from the rich to the poor everyone can come together and enjoy the experience of escaping reality and transported into fantasy.

8.2.2 User Type

Primary User: Wheelchair Users Full Lower Limb Paralysis

The primary users of this product would be wheelchair users, with a focus on those with partial to full lower limb paralysis. Those users who are unable to transfer from their wheelchair to ride vehicles or can transfer but only with great difficulty.

Secondary User: Theme Park Attraction Operators

Secondary users would be theme park staff and ride operators themselves. Theme park staff are always there to help and ensure safety for guest period but an added level of attention to those with disabilities. However due to liability issues they are often not allowed to physically help wheelchair users. This product aims to make their lives easier by creating a seamless flow when wheelchair users get on and off ride vehicles. Protecting both worker and theme park guest.

Tertiary User: Theme Park Support Staff, Security and Health Services

Third party users would be theme park support staff, health, and security. These workers are there to help wheelchair users in their experience during the theme park. Their to keep them safe and optimize their experience. This product would also focus on making wheelchair users overall experience great not just in relation to the attractions themselves.

User Persona

Name	Chris
Age	23
Job	Blogger
Education	Post-secondary
Family	Single
Location	Orlando Florida
Frequency	Avid theme park attendance
Duration	Frequent vacation
Social / Solitary	Average guy out of college building his career wanting to visit theme parks without the limitation of needing people to help him
Other Activates	Loves visiting theme parks and desires the freedom of going by himself whenever he wants.

Figure 8.1 Guy in Wheelchair - https://www.shutterstock.com/image-photo/man-wheelchair-service-dog-indoors-1007024701

Table 3 – User Persona

Chris is a freshly graduated university student with his degree in English. He works at a large online media blog sight writing article. One of his favorite things to do is to do physical activity and go to theme parks. He enjoys the independent of not having to have someone go with him to help him get in and out of theme park rides.

User Behavior

When attending theme parks in the past he is required to stretch and warm up as well as do light fitness, so he can lift himself easily in and out of roller coasters from of angles. He then must mentally prepare himself for the eyes of other park guests because he knows that during the transfer everyone will watch his with indignation and frustration. (Gem, 2019)

Chris's Experience at Disney World's Animal Kingdom

When he arrives to the park he first goes and speaks to the disability center located at the front of all theme parks. They provide information, maps, guides, and whatever kind of services he needs. He is then running through a quick explanation on what will happen when he is require transferring to ride vehicle. When he gets to the first ride, he must figure out how to get in with the guidance of ride operators however they are unable to physically help him in he is require getting himself in and out with the support of his friends.

When he gets to Kali River Rapid Ride, he realizes that he will need someone to lift him in unfortunately his friends are not able to safely carry him into the ride. And he must wait on the loading dock while his friends in join the ride without him.

8.2.3 User Observation Report

Objective

With only 12% of the population having a disability (Davies, Christie 2017) not a lot of people have direct interaction with a paraplegic this means a lot of people are out of touch with what it means to have a physical mobility disability. This paper will take a deep dive into what it means to have a disability and how it challenges you when getting in, and out of the roller coaster and simulators ride vehicle. Furthermore, touch on the demographic and how they are affected by people.

Scope

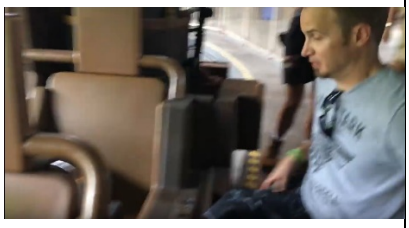
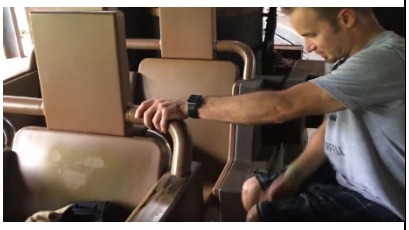
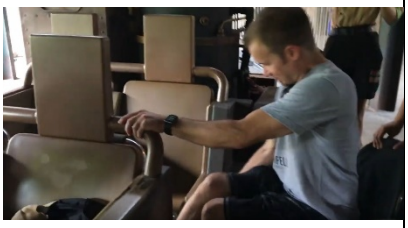
Unfortunately river rapids rides are completely in accessible so analyzing it would provide no data as to current type of solution there for using a series of video on youtuber of paraplegics

transferring in and out of a variety of different types of rides at Walt Disney World in Orlando a general idea of how to transfer can be drawn.

8.2.4 Preliminary Scoping – About the Video Subject

Ted is in his early forties; he is a full paraplegic waste down. He uses affordable hand driven wheelchair. Being a roller coaster enthusiast and living near Walt Disney World, he frequency theme parks quite often so he is very adapting at getting from his wheelchair to coaster.

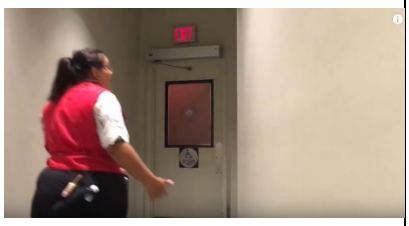
8.2.4.1 Observation 1

<table>
<tr><td colspan="3">Expedition Everest - Link: https://www.youtube.com/watch?v=ZWI1efCm2Bo4</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>- Ride operator slides seat side down to allow easy transfer
- Ted roles his wheelchair up to ride vehicle on an angle
- Locks wheelchair to prevent it from moving</td><td>- Placing his left hand on bar and right hand on car size he pulls his body forward to edge of seat</td><td>- Using right arm, he manually lifts his legs and places them inside car</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>- Then he slides his body from wheelchair to ride vehicle</td><td>-</td><td>- repositions his legs and pulls down restraint</td></tr>
</table>

8.2.4.2 *Observation 2*

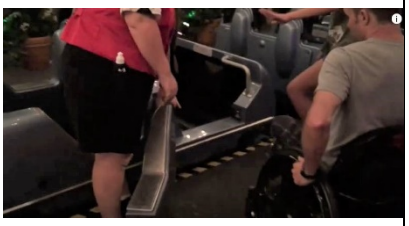
WDW Rock 'N' Roller Coaster - Link: https://www.youtube.com/watch?v=titqxjhc69I

L O A D I N G

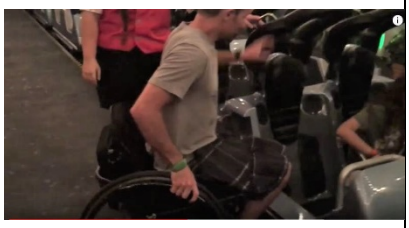


35. wheelchair user load from separate loading dock

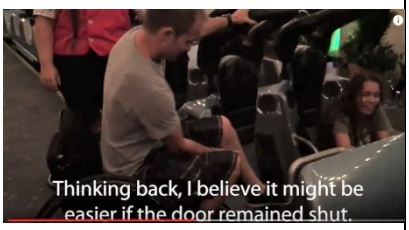
36. one guests have exited train wheelchair user is loaded on



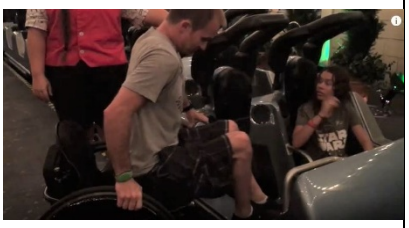
37. door swings open
38. wheelchair users roles up to vehicle



39. user locks wheelchair
40. slides himself forward



41. then places legs inside vehicle



42. lifts and lowers himself onto edge of ride vehicle

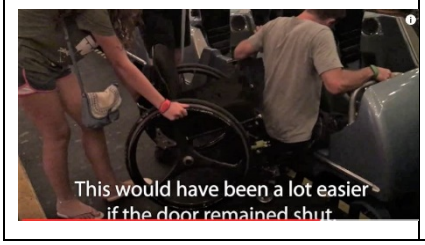
44. then grabbing side and bar and lower himself into seat

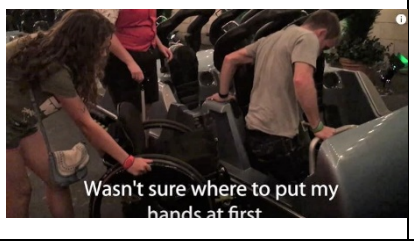
45. then places his legs and pulls down restraint

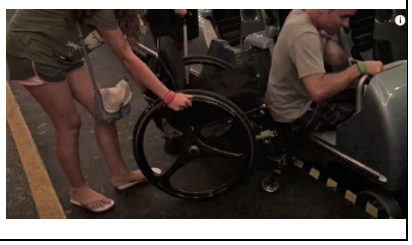
NOTES:

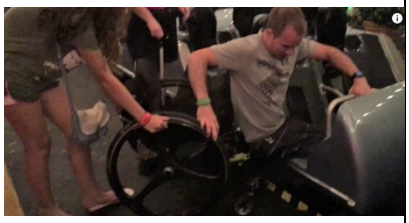
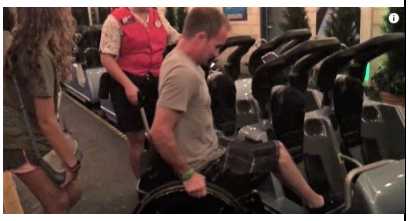
43. the side of the vehicle should not have swung open it would have made it easier to get inside

U N L O A D I N G

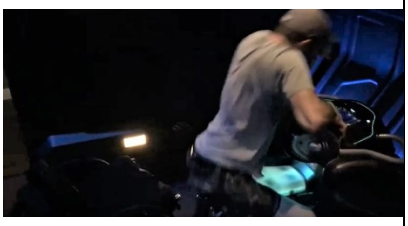




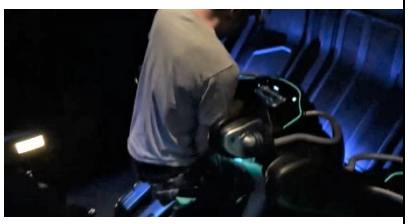


46. raises his body out of seat onto vehicle side	47. pushes himself right to edge of vehicle	48. raises body over gap between vehicle and wheelchair
		NOTES: 49. the side of the vehicle should not have swung open it would have made it easier to get inside
50. grabs wheelchair and bar of vehicle	51. lifts himself into wheelchair	

8.2.4.3 Observation 3

WDW Flight of Passage - Link: https://www.youtube.com/watch?v=Pd55BGsfAGg		
L O A D I N G		
		
52. wheelchair user role up to the rear of the link chair	53. you must try and place your legs on each side	54. you should be flexible its hard to do this without being nimble
		
55. took Tim about 3 tries	56. then he lifts and pulls himself forward (require allot of upper body strength)	57. with your body raise you try and inch your body forward

 58. then seat yourself place your legs and scoot forward	Overall, quite difficult to get into despite appearing to be quite straight forward…on second attempt after stretching he found it easier

UNLOADING		
		
- push yourself to back edge of seat	- then grab wheelchair and fall back into seat	- make sure your wheelchair is locked or someone is holding it or you will fall flat on your back

Majority of the methods employed by Disney rides for transfer require a side slide transfer or lower into ride from wheelchair. This is often uncomfortable and requires a level of flexibility. As well the only way to get into a river rapid ride is to be carried by someone. (Gem, 2019)

8.2.5 Direct User Observation

8.2.5.1 User Experience Map

First challenged faced by wheelchair users is getting from main area to attraction loading dock. Wheelchair cannot fit inside line-up queue like most guests. So, they must use the exit which is usually a ramp (since after a ride guest is often dizzy so ramps are used in order to prevent people falling from stairs) or a separate entrance for them, specifically.

Once at the ride, some place has special cars for them to get onto usually located at the back of the train where they can remove the guard raise. However, this is often like a patch fix and does not properly meet the requirements and is difficult for the wheelchair user to get in.

Now often getting back out is just as difficult it requires a lot of upper-body strength something not all wheelchair users have. This means guest can eventually end up stuck or worse, fall.

User Experience Mapping

Stages	Before Ride	Transfer	Ride	Dismount	Exit	
Actions	Driving Around the Park	Ride up to Ride Vehicle. Get into position. Plan Transfer. Transfer.	Enjoy the Ride	Plan how to get out. Begin Dismount	Ride Away	
Emotion		Hardest		Hardest		Discomfort
		Most		Most		Time
Safety	moderate	Danger	safe	Danger	moderate	Safety
Finding	Traveling around the park and going through line up is relatives easy. Specific challenges are faced such as getting caught on texture flooring, limited ramp access, etc.	Majority of the difficulties is face during the transfer.		Majority of the difficulties is face during the transfer.	Traveling around the park and going through line up is relatives easy. Specific challenges are faced such as getting caught on texture flooring, limited ramp access, etc.	
Opportunities		By removing the transfer all together it will speed up the process, make things more comfortable, and easier on the wheelchair users		By removing the transfer all together it will speed up the process, make things more comfortable, and easier on the wheelchair users		

Table 5: Activity Experience Mapping

8.2.5.2 Potential User Experience Improvement Chart

There is a plethora of areas that could be altered to help paraplegic. However, the top 7 would be:

Common Challenges Faced

1) Narrow loading docks preventing easy transfer
2) Vehicle/track to lower difficulty in lowering themselves in and raising themselves out
3) Getting lower limbs inside and placed
4) Keeping lower limbs inside ride
5) Stabilizing body during ride
6) Social awkwardness because of holding everyone up
7) Unsafe transfer

Figure 8.2 – Expedition Everest

If there was a way to get a guest from a wheelchair to ride vehicle fast and efficiently with as little pain as possible with an enhance level of safety it would not only allow guest to focus on enjoying the ride but also allow them to feel independent and responsible. Rather than a burden to everyone: workers, another guest in line, and family/friends

User Experience Analysis

Key Activity	Steps	Current User Exp.	Potential Improvement
Navigating the line up	Getting from main path to the ride loading dock	Often not to bad just enter through the exit	Better signage and winder exit paths
Get into place to transfer	Getting from queue/exit into place from the transfer	This can be tricky often there is not allot of room and the pressure of everyone wanting you to complete the transfer	Wider loading docks to allow for easy transfer or separate loading docks to hide from judgmental eyes
Transfer	Lock wheelchair and begin to transfer (specific transfer type depends on ride see Activity Mapping)	This can be dangers, painful, and tiresome since you must lift your body out of your wheelchair and into the ride vehicle without the help of others often since there is no room for them to help	Removing the element of transfer or creating an easier slide into rather than lifting yourself
Locked Straights	Reorganize your legs using your arms and bring down restrains	This can be difficult since you must position yourself in manually with your hand then bring the restrains down	
Ride	Using your upper body to stabilize yourself	Often it is hard to keep yourself stable since our lower body cannot help you	Creating a specific restrains that will help hold you inside better (keep wheelchair users in mind not as an afterthought)
Unlock Restraints	Remove restraint and prepare for transfer	Relatively easy	
Retrieving Wheelchair	Getting friend or ride operator to bring wheelchair over	A ride operator will bring over your wheelchair to help you	
Getting Out of Ride	Transfer yourself (see Activity Mapping)	This can be either the hardest part if getting in is easy then getting out is hard or vice versa	Removing the element of transfer or creating an easier slide into rather than lifting yourself
Exiting Ride	Navigate from loading dock out of the ride	Fairly easy just exit like everyone else	Better signage and wider exit paths

8.3 Appendix 3 – Product Research

Objective:

The following section will investigate bench marking and the current methods deployed by Disney theme parks to meet the needs of wheelchair users. Look into their strong points vs their weak point to better understand what is working verses what is not working.

Scope:

Will be analyzing six unique ride systems and how they were able or unable to be accessible. Using these finding can generate a educated assumptions of what could be improved.

Findings:

Six Comparable Products	
Seven Dwarfs Mine Coaster	Slinky Dog Dash
Splash Mountain	Rock N Roller Coaster
Kali River Rapids	Flight of Passage

Seven Dwarfs Mine Coaster

Where: Walt Disney World Orlando
Type: Steel coaster with custom swinging mine car seating attachments

Figure 8.3: Seven-Dwarfs Mine Coaster

Slinky Dogs Dash

Figure 8.4: Slinky Dog Dash

Where: Walt Disney World Orlando

Type: Steel family launch coaster

Splash Mountain

Figure 8.5: Splash Mountain

Where: Walt Disney World Orlando

Type: Flume Ride

Rock N Roller Coaster

Figure 8.6: Rock N Roller Coaster

Where: Walt Disney World Orlando

Type: Steel Family Launch Coaster

Kali River Rapids

Where: Walt Disney World Orlando

Type: River Rapid Ride

Figure 8.7: Kali River Rapid

Flight of Passage

Where: Walt Disney World Orlando

Type: Flight Simulator

Figure 8.8 Avatar

8.3.1 Comparison

	Product Names	Entre / Exit / Loading	Seat Type	Accessibility Feature	Accessibly Rate According to (Gem, 2019) and (Randy 2017,2019)	Price
1	Seven Dwarfs Mine Coaster	Enter threw exit & load on separate dock	Bench with lap bar	Side of car slide down for easy transfer	Difficulty: 0 Comfortability 5	$550 Million (Category)
2	Slinky Dog Dash	Enter threw exit & load on separate dock	Bench with lap Bar	Side of car slide down for easy transfer	Difficulty: 0 Comfortability 5	
3	Splash Mountain	Enter Through Exit	Bench with Lap Bar	Wider Loading area	Difficulty: 5 Comfortability 3	$80 million (wikipedia, 2019)
4	Rock N Roller Coaster	Load on exit Dock	Seat with overhead restraints	Side swing out for easier access	Difficulty: 5 Comfortability 3	
5	Kali River Rapids	Load on special accessibility loading dock	Seat with seat belt	Not accessible	Difficulty: 5 Comfortability 4	
6	Flight of Passage	Enter through exit load on specific simulator bay	Bicycle Style seat with pressure sensitive calf claps, chest braise, lumbar support	Easy pull yourself into designed to be accessible	Difficulty: 3 Comfortability 5	$500 million (Realjimmyim 2018)

It is difficult to analyses these rides since they are quite different the prices use for these rides vary since for example Flight of Passage was built on an 11 acre piece of land with an entire theme section of the park for this ride hence the $500 million price tag same as Seven Dwarfs. How by looking at their accessibility scores we and the methods they use to be accessible or not accessible we are able to see where their strong points are and where their weak points are.

Overall, the ride systems with the least amount of transfer time or complexity have the highest accessibility rating. Also using the data from the video research according to Gem removing the need to transfer would mitigate allot of the challenges involved. (Gem, 2019)

Table 4 – Solution Comparison

Bench Marking Chart, Data obtained from Appendix III

Name	Description	Specification
Seven Dwarfs Mine Coaster	Steel roller coaster with customer swinging mine coaster seating	Vehicle side wall rotate down to create a ledge to allow user to slide from wheelchair onto ride with ease
Splash Mountain	Flume Ride	Wider than usual loading dock so the wheelchair user can role wheelchair up closer to the flume boat
Kali River Rapid	River Rapid Ride	Seat belt with lap restraint for extra stability however is currently unaccusable.
Slinky Coaster	Steel Coaster	Vehicle side wall rotates down to create a ledge to allow user to slide from wheelchair onto ride with ease
Flight of Passage	Flight Simulator	Motorcycle type seat where you must ride up behind it and pull yourself onto it

Table 5 – Key Features/Benefits of Comparable Products

Bench Marking Chart, Data obtained from Appendix III

Features	Benefits
Intuitive Design	Easy to use
Simple Design	Slight modifications to ride allowing it to be used by both wheelchair users and on wheelchair users
Accessibility	Overall, Disney ride were done well
Environmental Impact	Economic since the design was minimal different due to wheelchair users remained same as other seats relatively

8.4 Appendix 4 – Needs Analysis

Objective:

To make getting into attractions at theme parks easier for people with lower limb disabilities. Something that will allow lower limb disabled people to help themselves into rides themselves.

Scope:

Objective of the Needs Report was to establish a general idea of what the user's needs are to better understand how to solve their problems.

Findings

Preliminary Needs Statements

Device to help guests with lower limb disabilities to get into rides themselves. - Make it easier for guest with lower limb disabilities to get into ride.

Purpose	Recreation
Section	1) Initial Needs Assessment 2) Linking Benefits to Fundamental Human Needs 3) Generate a Needs Statement

What the product does: Help's lower limb disabled people help themselves in and out of ride vehicles.

360 Initial Inquiry

Who are you target market group?	Adults with lower limb disabilities
What does it do?	Help them get themselves in & out of rides
Where will it be done?	In theme park ride loading docks (in & outdoor)
When is it done/used/needed?	During park operating hours
Why is it needed?	Make theme parks more accessible to lower limb disabilities

Why Would Someone Buy This Product?

- To help their guest get in and out of ride

- To make riding all attraction accessible for guest with mobility disability

- Speeding up loading dock for people with accessibility issue

Links Benefits to Human Needs

Benefits with Product are following

- Create more accessibility for people with physical disability in theme parks

- Create more enjoyable experience for lower limb disabled guests

- More comfortable experience

Determining Products which Bracket Key Benefits for the Thesis Topic

Allow a guest with lower limb disability easily get themselves in and out of roller coaster vehicle without the aid of cast member.

Existing Product Comparison

- Human scissor lift
- Bath Lowering Arm
- Stair Lift
- Elevator
- Human Chair Pool Arm
- Ramps
- Hospital Sling Mover

Selected Product for Examination

Aqua Creek Ambassador Pool Lift

Specs

- 350 lbs. capacity
- Seatback of up to 38 inches
- Setback range 18-38”
- Pull-out leg rest comes standard
- Stainless Steel Construction
- Adjustable lap belt
- Flip up arm rest

Cost: $3,799.00

Figure 8.9

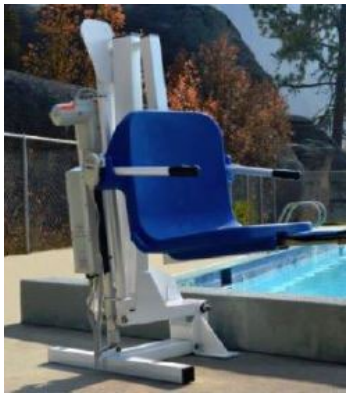


Figure 8.10

Benefits	Cons
Can be installed anywhere	Weight restrictions
Can fit anyone inside it	Expense
Strong	May need a second person helping you in
Varies in size and installation	

Benefit #1 - Summary Table

Product:	Scissor Lift Aircraft	
Linking Benefit:	Carry passenger to seat	
Needs – long term	**Needs** – short term	**Benefits**
Security	Safety	Loads guest safely into seat Removes strain from flight attendance Limits contact between fight attendance and passenger
	Security research	Value (price) Reliability
	Control over environment (tasks)	Convenience: Ease of use - Easily use (limited back pain) - Speeds up process - Makes things easier for all involved
	Convenience: Flexibility (multi-use)	Convenience: Flexibility (multi-use)

Statement of Needs *(transport only)*

A method helping guest with lower limb disabilities get into roller coaster

- Allow them to help themselves into and out of ride vehicles

Specific needs to be considered included:

- Safety
- Speed
- Ease of use
- Cost

Benefit #2 – Comfort for Lower Limb Disabled Individuals

Product that affords wheelchair

Product Description

- Comfortable for user
- Helps them get around
- Varies in expenses
- Some are motorized some are not

Technical Specifications

Benefits	Features
Allows user to get from a to b	
Comfortable	
Easy to use	

Benefit #3 - Benefits

Product:	Bassinet	
Linking Benefit:	Comfort of infant	
Needs – long term	Needs – short term	Benefits
Basic Needs		Helps them get from point a to point b
Security		Allows them to feel secure because they are controlling where they go…controlling their environment
Social Belonging	Control over environment (tasks)	It allows them to identify with other group of wheelchair users, so they have a sense of bellowing

Statement of Needs *(comfort only)*

Carries user from a to b in a safe and timey manner. Allows them to get around without the need of someone carrying them around. Give them independence.

Statement of Needs *(transport and comfort)*

A device that allows them to experience roller coasters like everyone else while also allowing them to independently get in and out of a roller coaster without the need of a group of people helping them.

Specific needs include:

- ease of use, comfort, safety, independence.

Fundamental Human Needs

Need	Being *(qualities)*	Having *(things)*	Doing *(actions)*	Interacting *(settings)*
subsistence	physical and mental health	food, shelter, work	feed, clothe, rest, work	living environment, social setting
protection	care, **adaptability, autonomy**	social security, health systems, **work**	co-operate, **plan, take care of,** help	social environment, dwelling
affection	respect, sense of humour, generosity, sensuality	friendships, family, relationships with nature	share, take care of, make love, express emotions	privacy, intimate spaces of togetherness
understanding	critical capacity, **curiosity,** intuition	literature, teachers, policies, educational	analyze, study, meditate, investigate,	schools, families, universities, communities,
participation	receptiveness, dedication, sense of humour	responsibilities, duties, work, rights	cooperate, dissent, express opinions	associations, parties, churches, neighborhoods
leisure	imagination, tranquility, **spontaneity**	**games, parties,** peace of mind	day-dream, remember, relax, have fun	landscapes, intimate spaces, places to be alone
creation	**imagination,** boldness, **inventiveness, curiosity**	abilities, skills, work, techniques	**invent, build, design, work, compose,** interpret	spaces for expression, workshops, audiences
identity	sense of belonging, self-esteem, consistency	language, religions, work, customs, values, norms	get to know oneself, grow, commit oneself	places one belongs to, everyday settings
freedom	autonomy, passion, self-esteem, open-mindedness	equal rights	dissent, choose, **run risks,** develop awareness	anywhere

Common benefit and the correlating fundamental human need

Commonly cited product benefits are the following: easy, efficient, convenient, comfort These are related to control over one's environment. Correlating needs are (Max-Neef model):

Protection: **autonomy**, adaptability, work, planning, take care of

Freedom: **autonomy**, self-esteem

Another group of benefits are experiential: e.g. exciting, stimulating, exhilarating These are related to experiences. Correlating needs are (Max-Neef-model) are:

Leisure: **autonomy**, games, have fun, imagination

Freedom: **autonomy**, self-esteem, risk-taking

Beauty and style are important categories not specifically addressed by either the Maslow or Max-Neef models.

Benefits and Corresponding Fundamental Human Needs

The fundamental human needs corresponding to the product benefits (reference Product Research REPORT) was determined and displayed in the Table below. The relative strength of relationship (strong/moderate/week) was also indicated.

Table: Benefits and Corresponding Fundamental Human Needs
Infant Transportation

	Benefits	Possible Corresponding Fundamental Human Needs (FHN)	Relationship between Benefits and FHN
1	Comfort	Control, security, self-esteem (mastery)	Strong
2	Style	Esteem, belonging, aesthetically pleasing	moderate
3	Efficiency	Accomplishment, autonomy, self-esteem	Strong
4	Ease	Accomplishment, autonomy, protection, security, control, self-esteem, (mastery)	Strong
5	Fun	Leisure (excitement), Participation, Belonging (shared fun)	strong

Comfort allowing the person to get into the ride with as little discomfort as possible

Security something that allows them to feel safe and in control not like they are being loaded on like some cargo

Style if something looks inviting and cool the people will be more at ease to use it

Efficiency as this point you have waited in line for the ride getting you onto the ride as fast as possible on everyone's mind…also getting wheelchair user onto the ride faster will make them feel more like everyone else

Ease is it easy to use because if not it will take time for the person to get adjusted to it…they need to understand it right at first glance

Fun the device does not have to be fun, but the end goal is fun

Statement of Needs

A device that allows lower limb disabled people to help themselves (independence_ safely (safely) in and out of ride vehicle without the help of a team. (no singling them out as a spectacle)

Allot of disabled people avoid situations that single them out they feel wield and on display. Also, because things take longer for them, they feel like a nuisance.

The device needs to be easy to use fast and get them from the loading dock to the vehicle as fast as possible.

8.5 Appendix 5 – Sustainability Report

Objective

This paper will go into the variety of sustainability efforts deployed by theme parks in their rides systems

Findings:

Sustainability in theme parks is a relatively difficult subject to get into by nature the theme park industry is not a high production industry producing small batch production that will only be produced again when needed for repairs. Some of the efforts deployed by Disney have been using already existing stuff. For example, Animal Kingdom tree was built from an oil tanker rig. The first monorails were built from repurpose light rail train electric motors bought from a scrap yard (Bob Gurr, 2007).

Majority of the materials used at Disney theme parks are made from plastics, concrete, and metal. They must stand the test of time and the harsh weather. When demolishing a ride Disney will break down the cars and store them on large sights were, they are often repurposed for other attractions or actioned off where collectors will use them. A good example of repurposing is for the Finding Nemo Ride at Disney Land (Year of a million Dreams, 2008) where they repurposed the old 20,000 League Under the Sea submarines for the new Finding Nemo Ride.

Benchmark Material Used in Current Products

Problems

Some of the potential problem are that these materials may degrade over time and not be safe anymore. However, companies like Disney have put effort into testing their materials and

make sure they are not off gassing, degrading, etc. toxic chemicals inter the environment. Especially since they joined the Disney Conservation Fund which require them to meet a few high idealistic goals of sustainability.

The waste, miss use and illegal use of materials is often seen in other parks such as Six Flags however the amount of data on this is spotty since Six Flag puts allot of money and effort into covering up their lack of quality, safety risk and etc.

Benchmark Sustainability

Safety

There are several potential challenges and safety concern associated with a ride system such as River Rapid Ride. Some of the concerns are keeping the guest inside vehicle at all time, g-forces experience by guest while inside the ride. These can be minimized by provide a comfortable seat with adequate support to the body and harness or lap bars that provide adequate restraint depending on the GeForce level of that track.

Health

Overall, the health risks are quire minimal since ride are design to cause mild force on the body however of riders have health conditions such as hearth problems, breathing problems, etc. they can cause issues and complications. Health association with materials is quite minimum however things such as toxic plastics, metals, paints, etc. can off gas or get into the environment cause potential complications.

Product End of Life

In this case products end of life are often ended up being repurposed for other rides systems, re-themed, and or broken down into the parts and recycled.

The most basic form of sustainability is from the materials and practices associated in creating these products. An example of this would be like in sections 2.2.5 Benchmarks – Sustainability the following materials are selected for both their physical and sustainable factors.

Grade 316 Stainless Steel – INVERT

Stainless steel is a perfect choice for portions of the hull due to its relative lightness and strength. Not to mention it is 100% recyclable without scarifying any structural integrity. (2020, sina)

Fiberglass: E & S Glass – INVERT

Fiberglass is chosen for several reasons. Its overall easy of manufacturing especially on the small batch scale. It is also sustainable in the sense that it has an exceptionally low embodied energy. It also lasts a long time and is not prone to degrading or off gassing making it of little harm to its surroundings. (AAMA, n.d.)

EVA –INVERT and ACESS

PVC is often used in manufacturing roller coaster seating do to the fact that it is water repellent, cheap, light, and durable. However, it is highly toxic so EVA will be used as an alternative since it lacks the high chlorine content that PVA has. (acetate, 2020)

Eco-nylon - Nylon – ACESS and INVERT

Nylon is not biodegradable however it is recyclable works to extend the life of this material. Using eco-nylon lowers the products overall carbon footprints and help to close to life to death cycle of these products. As well eco-nylon still has the durability, structural integrity, and life span of nylon.

NR/SBR Rubber - INVERT

NR/SBR Rubber is a marine grade rubber using a mix of bio-sourced rubber and recycled synthetic for resilience. This material has a low level of chemical toxins since it is made to be used in saltwater ocean which breaks down materials over time. It is fully recyclable and is made mostly of natural materials.

Rubber Tread - ACESS

The track system is made from a mix of bio-sourced rubber (ex. Natural rubber, sunflower oil, limonene, etc. (Michelin, 2018) and synthetic for its resilience.

Aluminum Support – ACESS

Aluminum is used in the material of ACESS some of these included structural bracing, brackets, and housing for the mechanical portions. Aluminum is used because like most metal it is highly recyclable and does not degrade from rust.

Final Sustainability Summary

River rapid rides are in constant contact with chlorine rich water and constant bumping and scrapping each other and the banks of the manmade channel by nature this causes them to degrade and break down over time there for nontoxic materials are selected in order to prevent contaminating the water. This material also must be resilient and have a long shelf life since they will be in constant use for hundreds of hours for years at a time. They are for you cannot only look at the product ready sustainability but also its life length.

9 THESIS DESIGN & TOPIC APPROVAL FORM

NAME:

Chadwick Dewey

TOPIC TITLE (BRAND)

Making theme parks accessible for the mobility challenge.

PS: Ensure that the visualization of the final design, side views and front views in Illustrator or Photoshop are required to be shown to us for securing an approval

Thesis design approval to proceed for the following:

 Topic Approval

 CAD Design Phase

 Rapid Prototyping and model building phase

Signed

Catherine Chong / Dennis L. Kappen