Designing a Mounting Pulley Mechanism for Kawallu Hippotherapy Center

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Abstract

With limited access to support and treatment for individuals with disabilities in rural Cuenca, Ecuador, Kawallu Hippotherapy Center is one of the few non-profit organizations that directly gives individuals of all socioeconomic backgrounds direct access to hippotherapy and equine therapy. Kawallu expanded its clientele to include adults and needs to update their horse mounting and dismounting methods. Current mounting methods were explored through observations, interviews, and simulations. A methodology consisting of price evaluations, prototype modeling, and design iterations was implemented to create a mounting mechanism design that will allow Kawallu to mount adults onto a horse. A prototype of a pulley system was designed and modeled using 3D modeling software. A booklet of information, including installation instructions, testing and usage steps, price evaluations of materials, and contact information of contractors were presented to our sponsor.

Executive Summary

Overview

Thirteen percent of Ecuador's population has a diagnosable disability (Disability IN, 2020). Of that percentage, half of these disabilities are physical and affect the individual's ability to carry out daily tasks (National Council for the Equality of Disabilities, 2021). Despite these statistics, there is limited access to support and disability treatment for individuals in rural communities of Cuenca, Ecuador. Kawallu Center of Hippotherapy in Cuenca helps support these individuals by offering hippotherapy services to a wide range of clients with various cognitive, behavioral, and mobility issues. In recent years, Kawallu has expanded its client base to adults and has been looking for a new way to update its mounting and dismounting process to be safer and more comfortable for heavier clients.

Problem Statement

Currently, Kawallu uses a step stool of approximately one meter in height and two or three side walkers to aid the client on the horse. Many adult clients experience chronic pain, and the current mounting process puts added strain on the client's arms and torso, thereby further aggravating existing injuries. If the client is unable to walk unassisted, they are manually guided up the stool and onto the animal, as shown to the right. A new mounting method will help improve the mounting and dismounting process, and further allow Kawallu to continue expanding its client base.

Project Goal and Objectives:

The goal of this project is to discover or design a device that can successfully mount clients onto a horse while considering and accommodating the needs of both parties involved. Kawallu

is expanding to include adults in their hippotherapy services. This expansion adds difficulty to caretakers and physical therapists to mount clients with little aid. Implementing this device will help eliminate physical obstacles for clients who require hippotherapy and enable Kawallu to support a more significant client population by being more inclusive in their services.

1. Evaluate the facility and identify clients' constraints
2. Evaluate mounting methods at hippotherapy centers
3. Develop a mounting prototype for heavier clients

Project Methodology

First, we evaluated the opportunities and constraints of clients and facilities at Kawallu Hippotherapy Center using semi-structured interviews, observation, simulation, and data organization. We interviewed our sponsors, the volunteers, and the clients' family members to get details on the problem and the available facilities. We observed hippotherapy sessions to learn about the current mounting process and performed simulations to help us understand the need from the client's and therapist's perspectives.

Our next objective was to evaluate existing hippotherapy centers' mounting methods through semi-structured interviews and data organization. We reached out to several hippotherapy and equine therapy centers across the United States to assess their mounting methods and gain knowledge on other equine therapy equipment they use.

Our last objective was to design a prototype, make iterations, and analyze the feasibility of the device to be installed in the therapy arena of Kawallu. Due to financial constraints, the commercial products were ruled out, and since our sponsors owned equipment for a ceiling-mounted mechanism, we found that this style should be further investigated. We spoke to several fabrication and hardware stores to create a price comparison of mechanical parts for our sponsors. We modified the existing harness to have an anchor point at the lower torso rather than mid-back, and we modified the pulley and cable to be part of a multifaceted system. We later made iterations for the addition of an electronic winch as per a request from our sponsors.

Findings

In designing a mounting mechanism for Kawallu, we made considerations based on our findings:

1. **Kawallu Hippotherapy Center has a wide age range of clients with different mobility and cognitive abilities.** The clientele includes children from age one to adults as old as 70. They provide mounted sessions in distinct positions using a bareback pad with two to three side walkers depending on the mobility and balance of the client.
2. **Kawallu does not have an operational budget.** As a non-profit organization impacted heavily by the pandemic, Kawallu's most significant constraint is budget. Keeping this in mind through our price evaluations, we were able to find a cost-effective set of pulleys and ropes that Kawallu's employees and volunteers can install.
3. **A ceiling mounted system is the most workable mechanical prototype for Kawallu Hippotherapy Center.** Our sponsor already has access to a stable A-frame ceiling, harness, and cable. We can recommend modifications or replace what they have and give them the information to install and test our design directly in the facility.

- **A full body harness is necessary for client stability and comfort.** As clients were mounting the horse, the volunteers had to support them by holding their arms and waist. This mounting method caused aggravation of existing injuries, so we determined that a full-body harness must be used to raise the client in a seated position. This harness allows the force to be distributed away from areas of chronic pain.
- **An automatic retractor lock is highly recommended for client and assistant safety.** To make this mechanism safe for the clients and horses, we must ensure that the pulley system has an automatic lock mechanism that can catch a client in case the pulley loses support on the other side.

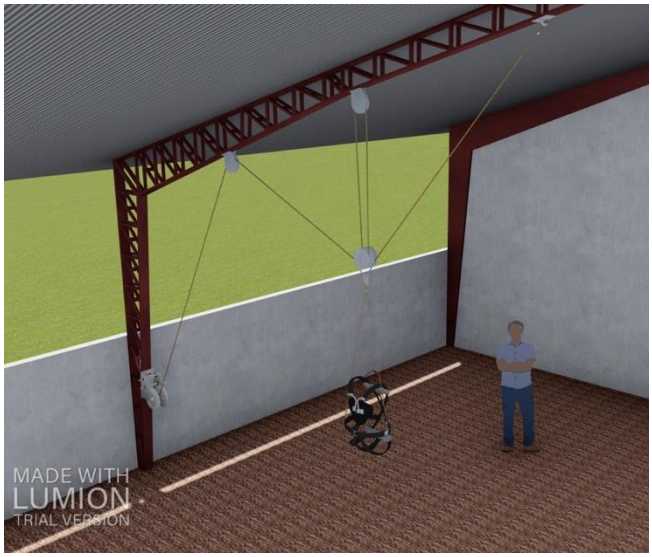
1. **Most United States hippotherapy centers expressed the importance of a platform ramp for their main mounting method.** It is essential for there to be a platform for the client that is high enough to allow the client to mount the horse. Kawallu possesses a ramp, but it is too unstable to be used for sessions.

We interviewed fabrication and hardware stores around Cuenca to gauge price points and availability based on these requirements. We found a pulley and rope system for the ceiling attachment, and we found a way to make an automatic lock pulley mechanism for the wall attachment. A depiction of our SketchUp 3D model of this design is depicted in Figure 29.

Proposed Solution

The mounting mechanism in development consists of a pulley system mounted to the ceiling and wall of Kawallu Hippotherapy Center. A series of pulley anchors placed along the facility's ceiling supports a paracord or cable. One side attaches to an automatic retractor lock (ARL) winch attached to the wall, while the other hangs in the arena. The client wears a harness and attaches at one point to the rope, and the winch cranks the cable as the client lifts above the horse for mounting. The client stays in the harness for the entirety of the hippotherapy session. A similar process I used for the dismount; the harness attaches back to the pulley system and the winch raises the client above the horse. The horse is walked away from under the client, in which the client is then lowered back to the ground.

A Feasible Mechanism for Mounting



The team presented a 3D model, via SketchUp, of the prototyped pulley system and detailed documentation for installation at Kawallu. The documentation included production selection, cost estimation, as well as installation and testing instructions. The final device design was a compound block and tackle pulley system powered by an electric winch containing a harness to secure the client. The device designed in SketchUp is depicted below. To reduce further physical strain by Kawallu employees, our final design consisted of 4 pulleys and reduced the force needed to lift the load by more than 70%. The final

system includes two ceiling-mounted pulleys, a double pulley, an electric winch, woven rope, and a full body harness.

Recommendations

We made additional recommendations for Kawallu to support their operations:

1. Build a New Ramp: 100% of all hippotherapy or equine-assisted therapy centers interviewed claimed a mounting platform was the most crucial element of their mounting process. The existing ramp at Kawallu is unstable and too steep for wheelchair accessibility. Herein lies the opportunity for a continuation of our current project.
2. Design a Saddle for Cerebral Palsy: Kawallu sponsors mentioned a secondary problem that they were facing in supporting children and adults with cerebral palsy on a horse. In talking with other hippotherapy centers, we determined that a saddle could be developed to help support clients while improving their ability to balance.
3. Introduce Hippotherapy Equipment: Throughout the interview process with other hippotherapy centers, we were introduced to a variety of tools and methods used to understand the clients' needs, hold clients on a horse, and in some cases, teach clients riding techniques. Kawallu may benefit from finding substitutes for these options and implementing them into their sessions.
4. Develop Unmounted Therapy Sessions: Many outside hippotherapy centers have a large base of clients who undergo unmounted sessions. Studies show that clients with autism benefit from hippotherapy and equine therapy to build social and emotional connections. Kawallu can benefit from designing unmounted programs to expand their clientele.

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Authorship

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Chapter 1: Introduction

Thirteen percent of Ecuador's population has a diagnosable disability (Disability IN, 2020). Of that percentage, half of these disabilities are physical and impact the individual's ability to carry out daily tasks (National Council for the Equality of Disabilities, 2021). Despite these statistics, there is limited access to support and treatment for individuals in rural communities of Cuenca, Ecuador. Kawallu Center of Hippotherapy in Cuenca helps support these individuals by offering hippotherapy services to a wide breadth of clients. According to Isabel Calle-Solis, 65% of Kawallu's clientele have intellectual, emotional and/or physical disabilities, while 35% do not. Clients without disabilities include classes of primary school students and parents of Kawallu clients.

In recent years, Kawallu has expanded their services to adult clients. The current problem that the Kawallu Hippotherapy Center faces is mounting adult clients onto a horse. As this treatment has traditionally been catered to young children, their facilities are not designed to accommodate mounting heavier clients on a horse. Now that their client demographic is expanding, and Kawallu is looking for a solution. However, post-pandemic life has created large financial strains on the center, preventing an expensive budget to implement such advancements. Our project goal is to assist Kawallu in expanding their clientele by presenting recommendations of a suitable prototype or product of a device that will safely hoist clients onto horses and keep them on the horse during therapy. To do this, we must understand the history and uses of hippotherapy, assess the current systems in place at Kawallu, as well as other hippotherapy centers, and learn about successful hoisting mechanisms at other hippotherapy centers.

Through a series of interviews, observations, and problem assessments of limitations, we provided options for a mechanical lift system to Kawallu Hippotherapy Center. Interviews assessed the realistic constraints and goals of the sponsors, and observation allowed us to assess the situation and think of solutions, while keeping limitations in mind. The product consisted of a list of commercial options for various hippotherapy equipment, as well as a plan and prototype that may be feasible for Kawallu to construct in the future.

Chapter 2: Background

In this chapter, we discuss the concept of hippotherapy and its effectiveness in treating sensory and cognitive disabilities. Next, we discuss the design requirements of a mounting apparatus and why it is essential by reviewing some existing commercial horse mounting designs on the market. We also discuss facilities limitations and how they may affect our goal. Lastly, we introduce our sponsors at the Kawallu Hippotherapy Center in Cuenca, Ecuador.

2.1 Importance of Hippotherapy

This section introduces hippotherapy and its importance as a treatment option for people with mobility, behavioral, and cognitive disorders. We discuss the background and experimental history of hippotherapy, as well as why it is a chosen treatment in particular contexts.

2.1.1 Hippotherapy Background

Hippotherapy is a form of occupational and physical therapy which uses equine movement to exercise neural activity. This form of therapy refers to the use of evidence-based practice of equine movement to engage sensory and cognitive systems. Hippotherapy is used because the gait, or manner of walking, of a horse is like a human. The horse's movement engages muscles needed for individual mobility and can enhance the patient's range of motion and stimulate neural pathways (Koca & Ataseven, 2015). The treatment's effectiveness varies depending on the patient's needs.

2.1.2 Hippotherapy Treatment

Hippotherapy is important to individuals who have both physical disabilities and neurological disorders. A study conducted by Lightsey (2021) explored how hippotherapy affected individuals with cerebral palsy. The study used measurement of gait speeds, the time it takes for someone to walk a specified distance over a level surface, as an indication of functional

mobility to determine the effectiveness of hippotherapy. The study consisted of performing gait speed tests before and after hippotherapy sessions and assessing the differences for improvement. The results showed that in eight therapy sessions, functional mobility in individuals with cerebral palsy had improved, gait speeds increased, and the horses' movements became more synchronous with the participants (Lightsey, 2021).

Hippotherapy also helps individuals with neurological disabilities, but the reasons for effectiveness vary. Studies show that hippotherapy can positively influence functional activities and increase the quality of life for individuals with neurological disorders; Cognitive development and stimulation of neural pathways increases in the act of maintaining balance on the horse (Giagtzoglou, 2012). Jackson-Maldonado presents an alternate reason for effectiveness. In his findings, hippotherapy, combined with traditional interventions, can improve a patient's communicative abilities (Jackson-Maldonado, 2021). Clients can practice non-verbal communication skills while guiding the horse during hippotherapy treatments, giving a sense of control and increased self-confidence. Results show that the participants' expressive language abilities increased faster than in typical language therapy sessions (2021).

2.1.3 Establish Need for Product

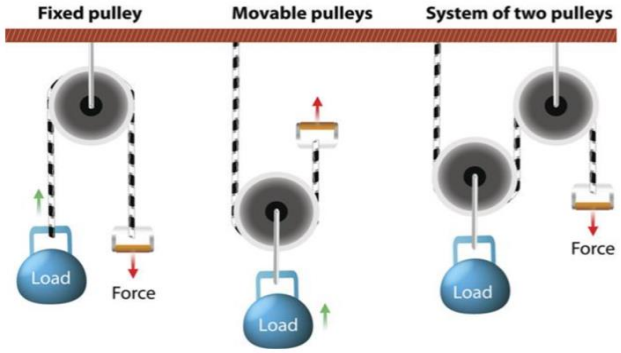
Although most current hippotherapy treatments cater to children with cerebral palsy, adults with mobility challenges have benefited from treatment. For example, one study assessed the effectiveness of hippotherapy on adults' cognitive rehabilitation needs due to an acquired brain injury. This review found that the treatment was safe and effective in long-term treatment (Marquez & Weerasekara, 2018). Additionally, horses are limited to carrying 20% of their body weight, so overweight adults cannot receive treatment in facilities that do not have the proper equipment. Thus, smaller hippotherapy centers without necessary devices need a cost-effective mounting machine that offsets physical strain on volunteers, staff members, and horses.

2.2 Lift and Mount Mechanics

2.2.1 Mechanical Background

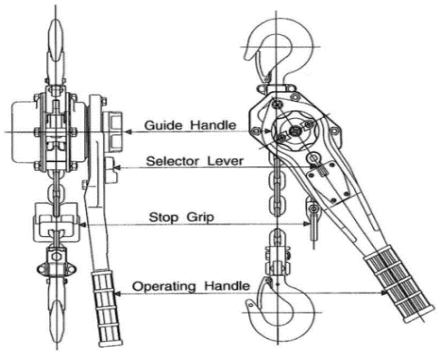
There are two types of simple machines that offset force for the carrier, the pulley and lever. The pulley system uses a wheel on an axle to support a cable or belt movement, including a directional change, as shown in Figure 1. The lever consists of a rigid beam pivoted at a fixed hinge, operated by applying forces at different distances from the pivot, as shown in Figure 2. The number of pulleys the cable acts on determines the amount of weight carried by the counterforce. Complex pulley systems consisting of more than two pulleys can carry high loads while allowing the carrier to hold less weight.

Figure 1. Pulley System



Note. Depiction of three different pulley diagrams, each with varying chords and wheels. From Examples of Pulleys in Our Daily Life, by Science Struck, n.d.

Figure 2. Lever System



Note. Components of a lever with corresponding labels. From Cable Ratchet Lever Hoist, by Gilmore-Kramer Company, n.d.

There are two types of motors, electric and hydraulic, used in hoisting machines currently on the market (Mobile, n.d.). The first is an electric mechanical motor, which has greater precision, accuracy, and control of the two motors. Electric hoisting machines are limited in load capacity and speed by the machine's engine, lifespan, and application (Ronquillo, n.d.). Hydraulic motors are less common in hoisting machines. However, they can produce a greater force and torque constant. Hydraulic motors are louder than electric motors, cover a larger footprint, and risk environmental leaks due to the compressed liquid within the cylinder (Ronquillo, n.d.). Electric motors are quiet and have a minor impact on the user's experience. Hoist machine frames are typically aluminum or aluminum alloy with a sling or rigid seat to hold individuals (Mobile, n.d.).

2.2.2 Existing Commercial Products

There are two primary commercial hoisting machines on the market: Horseplay Rider and SureHands. This section explains the details of both commercial products. The ability to implement these specific designs depends on the financial resources and space constraints of Kawallu facilities.

2.2.2.1 HorsePlay Rider

Horseplay Rider is a UK-based company that manufactures both stationery and mobile options of hoists. The general idea is that someone unable to mount a horse themselves can use this device to do so. Although the weight-bearing capacity ranges from 250 to 300 pounds, it is not marketed for adult use. The mechanical aspects of the device include a handlebar used for arm support and a seat that is used for easily spreading legs between the horse's back and sliding out of the hoist. Figure 3 depicts two installations of the Horseplay Rider. The device can be mounted to the ground or the side of a horse trailer, giving it more mobility.

Figure 3. HorsePlay Rider Lift

Note. Freestanding (left) and bus-mounted (right) Horseplay rider lift. From HorsePlay Rider, n.d.

2.2.2.2 SureHands

Figure 4. SureHands Lift for Handicapped Clientele

Note. SureHands lift used at the Spirit Therapeutic Riding Center. From Our Facility, by Spirit Therapeutic Riding Center, n.d.

SureHands systems are mobility devices found primarily in residences for individuals with physical disabilities and healthcare institutions such as nursing homes or hospitals to transport patients (*History*, n.d.). With the aid of SureHands, wheelchair users can bathe, use the restroom, and be transported easier to achieve their basic needs (*Solutions*, n.d.). SureHand also manufactures activity-specific lifts such as pool or horse mounting systems that aid wheelchair users in maximizing their access to treatment options (*Horseback Riding*, n.d.). SureHands lift systems are entirely customizable as baseline systems can be designed to fit the customer's specific needs and spaces. The baseline system includes a motor, ceiling or mobile lift, and body support element, which can be altered upon consultation. The contraption can be mobile or mounted depending on the space constraints of the facility. The product's flexibility has enabled SureHands to establish itself in the equine-assisted therapy industry as shown in Figure 4.

Spirit Therapeutic Riding Center (STRC), located in Ellensburg, Washington, uses a SureHands ceiling-mounted lift track system to mount patients safely and swiftly with mobility barriers onto horses (*About Us*, n.d.). According to David and Evelyn Jones, the owners of Spirit Therapeutic Riding Center, the lift system has helped "improve the safety of mounting and dismounting [their] riders" (*The Lift Helps Improve the Safety of Mounting and Dismounting Our Riders.*, n.d.). Handicapped clients of STRC can comfortably be lifted from their wheelchair to the back of a horse with the assistance of a riding instructor. The installation of the horseback riding lift has enabled the Jones's to expand their ridership beyond physically abled individuals and provide greater access to equine therapy (Mobile hoists. Living Made Easy, n.d.). Figure 5 depicts the SureHands ceiling lift at the Spirit Therapeutic Riding Center.

Figure 5. Horse-Mounting SureHands Lift at Spirit Therapeutic Riding Center

Note. Depiction of the SureHands lift for horse mounting. From Horseback Riding Solutions, by SureHands Lift & Care, n.d.

2.3 Potential Devices

This section describes the details of our device based on the characteristics of the commercially available hoist machines. Then, we investigate the product requirements based on the safety of everyone involved. Lastly, we discuss the anticipated limitations of the device onsite.

2.3.1 Product Description

Based on preliminary research, the team determined viable solutions. The envisioned device design included:

- Ceiling mounted
- A detachable harness for the client to be secured while transportation occurs from the ground level to the mounting.
- Pulley system with durable cable and self-locking carabiner
- Locking mechanisms within the pulleys to ensure client safety
- A crank for the lift to ease the lifting process for Kawallu employees
- Depending on budget, an electric component to reduce strain on Kawallu employees.

2.3.2 Product Requirements

The product design catered to helping physical therapists guide adults on a horse with minimal support from both parties (Kucera, 2019). On average, Ecuadorian adults stand approximately 5'5" tall and weigh 163.5 pounds. The average height of Ecuadorian children between the ages 5 to 18 years old ranges between 3' 7" and 5' 3", weighing between 35 and 150 pounds (Tarupi, 2019). The relative size of clients will also pose a physical challenge for the horses as they can only safely carry 20% of their body weight (Halliday, 2013). According to Moraes, the average horse performing hippotherapy weighs 1000 pounds and can comfortably carry up to 200 pounds on its back (Moraes, 2016). The product must be capable of hoisting a client of the horse's maximum carrying capacity to account for heavier participants. We

considered these product requirements in our design and ensured that the device was high enough to mount people of varying heights onto the horse's back. Onsite, we also learned that the device must accommodate various disabilities and not cause the client discomfort.

2.3.3 Product Limitations

Many limitations and opportunities present were evaluated before the design process began. Defining constraints and available resources allowed the team to create a suitable and attainable device. The first limitation we considered is how the animal will react when encountering the new device. The horse's ability to acclimate to many frightening stimuli reduces the danger to the rider or client and the frequency of accidents. Christensen's (2010) journal article explores the triggers that may cause horses to react negatively to a stimulus. It explores ways to acclimate horses to new stimuli and reduce the impulsive responses that pose a threat to the rider. The methods included habituation, desensitization, and counterconditioning. Results found that the horses needed fewer training sessions to reduce the negative response when trained using the desensitization method. Overall, desensitization may be necessary to ensure the client's safety when introducing our device.

The following limitation is remarkably like the first as the clients need to be comfortable with the device before undergoing therapy sessions using a new mechanism. Individuals with neurological disabilities may have abnormal behavioral characteristics, especially when introduced to new stimuli (Lydon, 2014). In the same way the animal may need to be acclimated, it is crucial to ensure that the client is comfortable with the proposed device for safe therapy sessions.

The size and layout of hippotherapy centers are carefully thought out as space for the practice and maintenance of the animals is especially important. Knowing the area and how much space is available was essential in the design process. The available space and layout of the area limited the device size and structure. As well as considering the facility, the budget also needed to be analyzed. As Kawallu is a non-profit organization, determining the funds allocated to this product was important. As a team, accounting for the materials we needed and determining what was viable with the funds provided, we proposed a suitable device.

2.4 About Kawallu Hippotherapy Center

Located on the outskirts of Cuenca, Ecuador, Kawallu Hippotherapy Center is a privately owned non-profit therapy center. Their mission has been “to offer a specialized hippotherapy center, with professionals who manage to exercise favorable therapy for those who require it, seeking a contribution to society, and working in favor of holistic stimulation" since its founding in June of 2017 by Isabel Calle-Solis and Carolina Larriva (Kawallu Centro de Hipoterapia, n.d.). Kawallu provides hippotherapy treatment to a diverse clientele with unique mental, physical, and emotional disorders. Kawallu primarily serves children and adolescent clients on a bi-weekly basis. Over the past four years, the center has expanded to include a large riding arena (Figure 6), 12x100 meters (about the length of a football field) in size, a handful of offices, and a few private sensory areas. Kawallu is run by its two co-founders, a 10-person team of caretakers and therapists, and 14 horses. Seven of these horses are used for hippotherapy, six of which are depicted in Figure 9, while the remaining seven are jumping horses. As of now, Kawallu supplies therapy to approximately 200 clients. Two of the horses are depicted in Figure 7 and Figure 8 during therapy sessions.

Figure 6. Kawallu Facilities

Note. Image of the indoor riding arena at Kawallu‘s facility. From Kawallu Centro de Hipoterapia Facebook Profile, 2020.

Figure 7. Therapy Horse, Tik-Tac, providing hippotherapy to 4-year-old client

Figure 8. Therapy Horse, Oscar, providing hippotherapy to 5-year-old client

Figure 9. Therapy Horses [Top Left to Right: Amira, Tic-Tac, Quilombo] [Bottom Left to Right: Mate, Felicia, Inti]

The goal of this project is to discover or design a device that can successfully mount clients onto a horse while considering and accommodating the needs of both parties involved. Kawallu is expanding to include adults in their hippotherapy services. This expansion adds difficulty to caretakers and physical therapists to mount clients with little aid. Implementing this device will help eliminate physical obstacles for clients who require hippotherapy and enable Kawallu to support a more significant client population by being more inclusive in their services.

Chapter 3: Methodology

Our project goal is to define a more accessible and comfortable way to mount Kawallu's heavier clients onto horses to undergo hippotherapy. To achieve this goal, we developed three objectives:

1. Evaluate the facility and identify clients' constraints
2. Evaluate mounting methods at hippotherapy centers
3. Develop a mounting prototype for heavier clients

3.1 Objective 1: Evaluate the Facility and Identify Clients' Constraints

Before prototyping the product, design and conducting a cost and feasibility analysis of materials, we evaluated what types of resources we have access to through the facility, as well as the constraints for both the product design and feasibility of use. We observed hippotherapy sessions through complete observation and simulations. We also interviewed Isabel Calle-Solis and Carolina Larriva using a semi-structured interview method to learn about the opportunities and constraints within Kawallu.

3.1.1 Semi-Structured Interviews: Key Informants

The goal of the semi-structured interview was to get more insight into Kawallu's work. We identified our sponsors, Isabel Calle-Solis and Carolina Larriva, Kawallu's employees, and clients' family members as key informants to help us understand the facility's innerworkings and client demographic. We adjusted our product description and product requirements by asking our sponsors precisely what they are looking for in an apparatus. We determined what our sponsors considered success and adapted them to their communicated constraints. The semi-structured interviews allowed us to research these limitations and apply them to our project plan.

Aside from the prepared questions and topics, our goal was also to invite the possibility of learning more and allow our team to temporarily set aside the guided questions to explore new conversations brought about by the participant (Beebe, 2014, 55). The divergences from the

prepared questions enabled our team to understand the work Kawallu does from a holistic perspective and avoided a tunnel-vision approach. It allowed the sponsors to take the lead in the conversation and give them the chance to ask us questions and criticize our ideas to form a collaborative team that optimized our product design.

We interviewed individual respondents and key informants to collect information about the structure of Kawallu. Individual respondents refer to people with firsthand knowledge of an experience whose interview will focus on their understanding of the subject. Key informants were participants, caretakers, and therapists, who could offer insight into the system (Beebe, 2014, 63). Interviews were conducted with our sponsors, Kawallu therapists and staff, and clients' family members to illustrate Kawallu's impact. The interview process took place during our first week working in the facility. Interviews took approximately thirty minutes and had two team members present. One or two team members led the interview and guided the conversations while the other recorded field notes. The interviews began by receiving written consent from the participant, see Appendix A, and followed the interview guides outlined in Appendices B, C, D, E, and M.

3.1.2 Observation and Simulation

We conducted observations on-site to learn more about the structure of Kawallu's hippotherapy centers and the current mounting and dismounting methods. The goal was to better understand the current problem to narrow the viable solutions.

After touring and thoroughly documenting the current facilities at Kawallu to understand their employment of resources and sources of limitation, the first phase of targeted data collection can begin. Our methodology took a multistep approach to two sequential observation methods: complete observation and participant observation. These methods were considered opposite sides along a continuum as completing one will inherently inform the other (Merriam & Tisdell, 2016, 142). The methods built upon each other as the information obtained through complete observation provided a foundation of questions and issues that require further exploration through our participation. Conclusions drawn from our observations during this data collection phase also informed our team on important topics to explore during subsequent

simulations and semi-structured interviews with stakeholders. The stakeholders for our project included anyone affected by the outcomes of our objectives (Beebe, 2014, 163).

3.1.2.1 Complete Observation

Complete observation aims at gaining the etic, or outsider's, perspective of Kawallu (Merriam & Tisdell, 2016, 144). During complete observation, the evaluator should only observe without interacting with participants. The evaluator allowed the systems within Kawallu to run without any interference.

The practice of complete observation followed a funnel method. Our observations started broadly and became increasingly specific. Comprehensive observations included evaluating the daily activities of Kawallu and the general structure of hippotherapy sessions. These preliminary observation sessions were unfiltered, and we documented all information to ensure that our general understanding of Kawallu was not skewed. Our team did not go into these sessions seeking observations about specific topics and documented all information relevant to hippotherapy as seen fit.

As our understanding of the existing systems within Kawallu progressed, our team began to conduct targeted observational sessions. These sessions focused on the behavior and relationship between the significant stakeholders during hippotherapy treatments: the client, the therapist, and the horse. To document these three stakeholders simultaneously and accurately, three evaluators observed an assigned subject. The evaluators were held responsible for monitoring the individual's behavior concerning the other two subjects and their actions and reactions to external stimuli. The observations spanned the entire timeframe of the lesson as well as before and after the hippotherapy treatment.

During observational sessions, field notes were taken on an observation guide as seen in Appendix F. As observations progressed, our team moved further down the list of observational goals from broad understanding to specific topics. Informational posters, as shown in Appendix G, were placed in central locations around Kawallu to notify the clientele and employees that observations are underway. The posters included our contact information to answer any questions and helped to ensure that the Kawallu community feels comfortable amidst our research.

3.1.2.2 Participant Observation

Once the external observations were completed and the findings were appropriately documented, our team identified ways in which the experiences of major stakeholders could be replicated. Experiencing the realities of those involved helped us to fully understand the process so improvements could be suggested. Participant observation began with the researcher observing target users before becoming one themselves (Munick, 1998). Participant observation aims to gain the emic, or insider's, perspective of Kawallu (Merriam & Tisdell, 2016, 144). Placing ourselves in a client's shoes forced us to observe various parts of the process that were not actively visible to the general observer or outsiders.

All team members took part in participant observation to replicate the client's experience on the horse. After general observations, it was our turn to learn from the client's perspective. Each team member mounted the horse with the help of a Kawallu therapist while restricting the movement of body parts. Limiting the movement of these body parts helped simulate the common disabilities of Kawallu clients, such as cerebral palsy or partial paralysis. While each team member was on the horse, one person from the team filmed and photographed the session, and the other two members recorded their observations and the observations of the participant. The field notes from all sessions were compiled and analyzed for patterns among the observations. The recorded video was highlighting the team member’s experience in hippotherapy and would require consent of the therapist by agreeing to the terms outlined in Appendix H.

3.1.2.3. Simulation

To gain a complete picture of the hippotherapy sessions, our team also experienced the role of the therapist and horse. Only our team members, a therapist, and a horse were involved during the participant observation to guarantee the safety of Kawallu's clients. Team members assisted each other in the mounting of a horse while simulating the specific injuries and mobility constraints of the clients (Figure 22). Each team member assisted in mounting a fellow team member onto a horse with the direction of a Kawallu therapist. The team member acting as the

therapist physically helped the team member act as the client mount the horse and stabilized them once on the horse. The third and fourth team members acted as support for the acting client in the mounting process. In addition, one of these team members led the horse for the simulated session. No Kawallu clients were present during the simulation. The Kawallu therapist was present the entire time to help direct us and ensure our safety. To take field notes, the team vocally described their observations during the process to avoid missing any observations by recording field notes manually (Rossman & Rallis, 1988). Additionally, photos and videos were taken throughout the process to be available for review. The simulations also required the written consent of the therapist by agreeing to the terms outlined in Appendix H.

Although experiencing the animal's perspective was not entirely possible due to our inherent differences, understanding the horse's perspective required us to simulate attainable aspects of their experience and stitch them together. Physically standing at the horse's eye level to visualize their field of vision and feeling the client's saddle are examples of how we can consider the horse's perspective. We also conversed with the horse trainers to talk about the horses' reactions to stimuli and how that will affect the motor volume and other aspects of the machine, as discussed above in 3.1.1 Semi-Structured Interview. Our method for organizing our data collected can be found in Appendix I.

3.2 Objective 2: Evaluate Mounting Methods at Hippotherapy Centers

We identified forty hippotherapy centers in the United States by inspecting their websites and analyzing their services. We contacted these centers to determine pre-existing methods used to mount heavy individuals onto and off horses for hippotherapy using the contact information in Appendix J. The template we used to email or call them is laid out in Appendix K. We conducted semi-structured interviews to determine all possible methods used to mount heavy clients for those who provided a timely response. We also contacted the previous IQP team to ask questions about their operations. These questions are listed in Appendix O. We presented many options to ensure that the most suitable to our sponsor.

3.2.1 Semi-Structured Interviews: Hippotherapy Centers

Research on hippotherapy centers like Kawallu was done, and these facilities were contacted through either an email or phone call where we explained our project and expressed our interest in interviewing them. If the facility consented to an interview, the team conducted semi-structured interviews as Objective 1 describes. These interviews provided information about the centers' mounting apparatuses and methods used when mounting heavy clients. The centers were also asked about their funding during the semi-structured interviews. Responses were used to determine if the equipment used was suitable for Kawallu, a non-profit facility. Detailed field notes were taken throughout the interviews to be referred to. See Appendix I for data organization methods.

3.3 Objective 3: Develop a Mounting Prototype for Heavier Clients

We developed a motorized pulley system with a full-body harness to meet our project goal. Using the information gathered in previous methods, we refined the prototype to make it the safest and cost-efficient option. We identified SketchUp as a potential software for modeling the prototype. This software is suitable as it enabled us to create three-dimensional video renderings and detailed depictions of individual parts. They will see all individual aspects of the pulley system and replicate the design while we are no longer on site.

3.3.1 Prototype and Design Iterations

Once the initial research and interviews were conducted, the prototyping process began. A prototype is an early model or release of a built product to test a concept or process. The prototyping process consisted of a brainstorming, sketching, and modeling process. During complete observation, participant observation, and simulation, a series of discussions were held amongst the team members and sponsors, in which key components of the prototype were determined. Incorporating facility, resource, and financial budget limitations into the design determined our options. SketchUp is a 3D modeling program available to us through Worcester Polytechnic Institute (WPI). The program allows the user to create specialized 3D tools unique to

the design. We used iterative design to improve the quality and functionality of our initial designs. Iterative design is the cyclic process of prototyping, testing, analyzing, and refining a product:

1. Modeling and computer simulation testing with SketchUp.
2. Examining the model with our sponsor.
3. Refining the model.

3.3.2 Semi-Structures Interviews: Fabrication and Hardware Shops

In the same manner that the semi-structured interview was conducted to understand the opportunities and constraints of Kawallu, we also implemented a semi-structured interview process to analyze the availability of costs. We interviewed our sponsor to understand the obtainable budget. Determining the budget allowed us to delegate money to the materials and labor needed to complete the design. Field notes were recorded both manually and technologically in the same fashion as described in 3.1.1 Semi-Structured Interview. These notes were referred to when analyzing the cost of materials and labor.

A semi-structured interview was also held with local fabrication shops as the participants. This included welders in the Cuenca area. To build our custom device, many factors such as safety were of the utmost importance. Conversing with several contractors with expertise in fabrication of structural components ensured a safe and durable device, as well as gave us a range of prices we should expect due to difference in material and labor costs. To determine which fabricators we interviewed, we analyzed google reviews and geographic location relative to Kawallu, creating a list of suitable participants. When determining which shop, if any, could be used to fabricate our hippotherapy device, three aspects were analyzed. First, we assessed if the shop has the technical skills to create the device. Next, we determined the cost of labor and materials for them to create the device. Finally, we checked that the shop is within a close enough vicinity to work and provide continuous repairs and support to Kawallu, ensuring sustainability for the hippotherapy center. The interview guides for the semi-structured interviews defined above can be seen in Appendix L.

Chapter 4: Results and Discussion

In this section, we discuss the current operations at Kawallu, the apparent opportunities and constraints of Kawallu, information gathered from existing hippotherapy facilities, and the prototyping process.

4.1 Current Operations of Kawallu

The current mounting and dismounting process is as follows:

If the client is light enough to be carried, an employee lifts them onto the animal while another employee leads the horse. If the client is too heavy to be manually lifted, a metal step stool, shown in Figure 10, is used to mount the horse. For the heavier clients, if they could walk unassisted, the volunteer or employee stood nearby to ensure they did not fall off while mounting the horse. For clients who could not walk unassisted, up to four people were needed to help the client onto the horse. These people included volunteers, employees, and the client's family members. Despite the assistance, it is still difficult for the client to advance up the stairs.

Figure 10. Existing Step Stool Used for Mounting at Kawallu

This mounting process took about thirty seconds for the lighter clients and over two minutes for the heavier clients.

Despite owning a metal ramp, shown in Figure 11, it is not used to mount or dismount clients. Employees make sure to be conscious of all clients' abilities and discomfort during the mounting process. There is a lot of pressure on the client's torso and arms during the mounting process. Clients dismounted the horse generally in the reverse of the mounting process. This process took about the same amount of time as the mounting process for each client.

Figure 11. Existing Ramp at Kawallu

The general structure of each session followed the same patterns:

Sessions of clients with autism focused on interactions between the client, horse, and employees, while sessions with physically disabled clients focused more on the client's range of motion. All sessions involved a leader, leading the horse, and at least two volunteers or employees walking on either side of the client. All sessions lasted forty-five minutes and started with two laps around the arena before briefly stopping at the sensory toy station.

The younger children's position on the horse changed throughout the session. Depictions of these positions are shown in Figure 12. All clients began the therapy session facing forward, and if the client were able to be moved without discomfort, the employee would change their directions to sit back as well as face both the right and left sides of the horse. The client's stability on the horse comes from the therapist walking alongside the horse. Kawallu only uses a bareback pad in place of a saddle so that the client can be as close to the horse as possible to experience the gait at its full potential. Due to how this pad is secured to the horse, it slides with the client's weight when they do not have proper balance, typically in the cases of partial paralysis or low muscle tone.

Acknowledging the current operations of Kawallu allowed the team to define the problem clearly and portray the way the designed mechanism will fit into the existing procedures.

Figure 12. [Top Left to Right: Forward-Facing, Backward Facing][Bottom Left to Right: Right Facing, Left Facing]

4.2 Resources and Limitations at Kawallu

4.2.1 Resources at Kawallu

Kawallu has a diverse clientele:

- Clients' ages range from two to seventy years old.
- Most clients were diagnosed with Autism Spectrum Disorder, Cerebral Palsy, or partial paralysis due to traumatic spinal cord injury.
- Most clients travel between 20 to 45 minutes to access hippotherapy weekly.
- Clients have either one or two sessions per week, depending on the severity of their condition.

Understanding the abilities and diagnoses helped us create a suitable mechanism for all clients. In particular, understanding the clients' mobility challenges allowed the team to create a device that Kawallu can use with ease and employ no additional discomfort.

Kawallu has equipment such as:

- A three-step stool used to mount heavier clients
- A mounting ramp that was gifted to them, but is unused
- Bareback pads used during all therapy sessions
- Stirrups used for clients with low core muscle tone
- English saddles used for clients with low muscle tone
- Montessori toys for cognitive stimulation; used with all clients

Taking inventory of the current facility within Kawallu assisted us in determining where the gaps were in Kawallu's mounting and dismounting methods. Once the resources were identified, we could introduce a new mechanism to best fulfil the facility's needs.

4.2.2 Limitations at Kawallu

Kawallu has no budget for the mounting apparatus.

- While some clients pay for their services, many do not.
- The center has previously afforded new additions to their program through campaigns via GoFundMe. Crowdfunding is their most viable option of fundraising.

Kawallu employees are physically constrained and have weight-bearing limits.

- The majority of Kawallu staff are women who struggle to support clients weighing more than 90 pounds.
- Mounting and dismounting processes require at least three employees to maneuver the client safely.

Having a clear definition of the constraints within Kawallu, both operationally and financially, directed the project scope toward a more viable final product.

4.3 Mounting Procedures at Outside Hippotherapy Centers

The mounting process described by the interviewees varied, but there were clear commonalities of:

- All centers use an ADA-certified ramp and platform. ADA-certified ramps are restricted to a maximum incline of ⅛" per foot. The ramp leads the client from ground level to a platform 3'3" tall, with the height further adjusted by additional steps as needed.
- A crest mount is implemented. The crest mount is when the client is brought to the horse's height using the ramp before being seated sideways on the horse. They then lift one leg over the neck of the horse with the help of a side walker on ground level. Though this mounting process is effective in most cases, some clients have challenges with abduction and cannot separate their legs enough to mount the animal comfortably. In these cases, an altered method would be used.

The team learned about commonly used commercial products used for clients with abduction challenges such as:

- Easy Hands Lift
- Handy Lift

The team learned about these mounting methods and equipment used by asking the interviewee, "What devices do you currently use to mount clients with [breakdown of client base]?" and "How have you adapted to serving heavier clients?"

4.4 Additional Equipment and Recommendations: Outsides Hippotherapy Center

Aside from equipment used for mounting, there is also a range of equipment used for stabilizing the client during a therapy session. These include:

- Gait belt: a device that helps prevent falls and ensures the clients' comfort during a session. It is strapped around the client's waist and provides a plethora of handles for the therapist to utilize for stability. For clients with low muscle tone in their upper body, there are gait belts that extend around the chest and back of the client. These two distinctive designs are displayed in Figures 13 and 14.
- A surcingle: a belt that wraps around the upper torso of a horse with a handle located on the horse's back for the client to hold and maintain balance. For clients with low muscle tone in their torso, it reduces the strain on the therapist. A typical surcingle is depicted in Figure 15.

Figure 13. Therapeutic Riding Harness and Gait Belt

Note. Image of gait belt with an attached harness for more upper body stability. From Freedom Rider, 2022.

Figure 14. SafetySure Walking Belt

Note. Image of a gait belt used solely around the waist of a client. From Freedom Rider, 2022.

Figure 15. Therapeutic Riding Surcingle with Triangle Handle

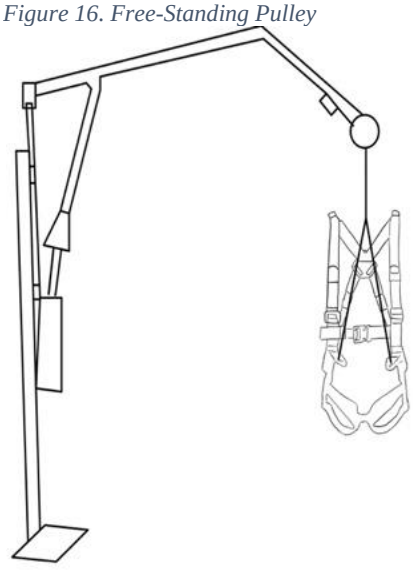
Note. Image of Freedom Rider, 2022.

Throughout the interviewing process, the team learned about other recommendations unrelated to the mounting device, such as:

- It is beneficial to match clients to horses who cater to their needs. The horse's temperament, gait style, and width must match the client's energy level, weight, and hip flexibility.
- Offering mounted and unmounted sessions can expand clientele. While mounted sessions assist clients with mobility challenges, more intimate interactions with the animal have been shown to help clients emotionally. Unmounted sessions aim to gain essential life skills and trust relationships through interactions with horses. Unmounted sessions include caring for, brushing, and tacking up the therapy horses.
- Galas or lavish events to increase awareness of their facility. These events also bring volunteers to the facilities.
- Applying for grants is another fundraising option. It is more demanding of a process, and it requires a grant writer, or someone dedicated to following up with the application process.

4.5 Design Iterations

Figure 16. Free-Standing Pulley



The prototyping process and interviews with fabrication shops supplied extensive information about many necessary elements of the device. We learned that the device needs to be ceiling mounted with a locking mechanism for client safety. We also understood that a form of paracord is the most suitable cable for the chosen pulleys. After analyzing the characteristics of different pulleys, including dimensions, pricing, weight limits, and ability to be mounted, we narrowed down our options. Key concepts were sketched and designed using SketchUp software to cohesively consolidate our information and present it to our sponsor. We included information about necessary components for the comfort and safety of the client, along with Kawallu's employees involved in the mounting process.

The preliminary designs modeled commercial designs from third-party companies; A free-standing pulley system, in which a large metal pole stands in the ground, attaches to a pulley on the top. A preliminary sketch of this design is depicted in Figure 16. The last option was a ceiling-mounted mechanism in which a motorized or manual pulley system is placed along the ceiling.

Observations of the facility's architectural design revealed a possibility to fasten a ceiling fixture to the ceiling support beams. The ceiling fixture implements a pulley system via a belay anchor and a rope-pulley. Sponsors confirmed that they had existing equipment to perform initial tests of this design. After a basic concept of the design was agreed upon, initial digital sketches of the system were drawn using the dimensions of the Kawallu arena, depicted in Figures 17 and 18.

Figure 17. Initial Sketch of Ceiling Mounted Pulley System

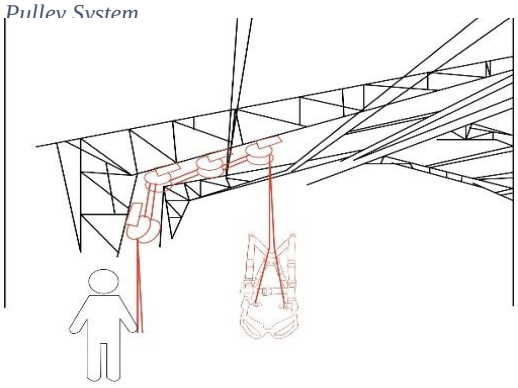
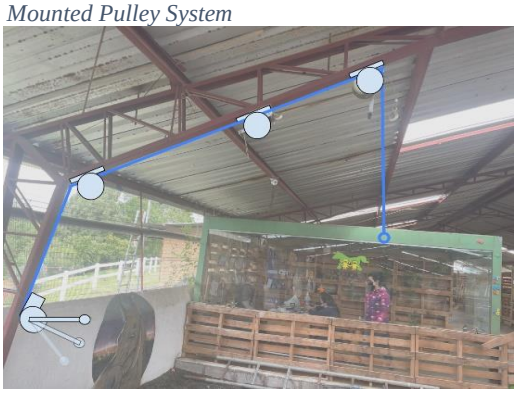
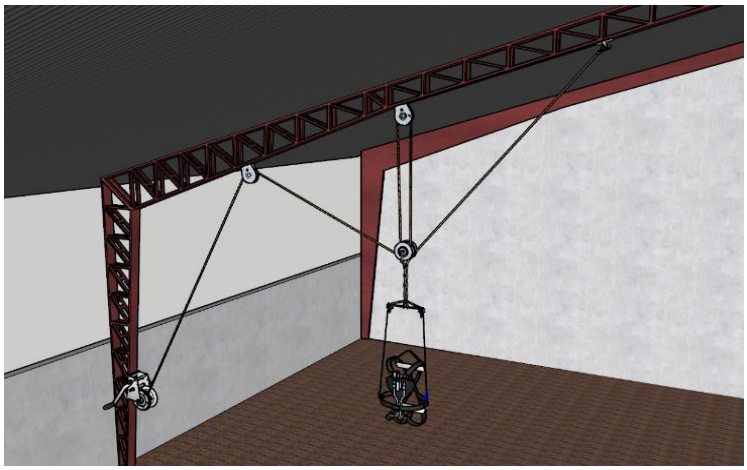


Figure 18. Dimensional Sketch of Ceiling-Mounted Pulley System



After discussing the initial design with our sponsor, we iterated the manual winch to be replaced with an added safety feature: the automatic retractor lock (ARL). This automatic lock activates when there is only force on one side of the pulley and stops it from retracting further, preventing the client from falling if no one is holding the rope on the other side. We also iterated our pulley layout to a double pulley design to offset more

Figure 19. Preliminary SketchUp Model of Ceiling Mounted Pulley System



weight from the winch. This version was converted into the final 3D SketchUp model (Figure 19). Later, our sponsors informed us that they preferred a motorized winch replacement for ease of use, and this modification lead to the creation of the final SketchUp design (Figure 20).

4.6 Locating Parts for Design

The most important characteristics of pulleys that the team was searching for are:

- Size
- Weight limit
- Ability to mount the pulleys.

After interviewing workers of large and local fabrication shops, the team found that:

- Coral Hipermercado, a large fabrication shops, had sufficient pulleys that were large enough to hold the correct size rope. They also had mounted and unmounted pulleys.
- Other small fabrication shops had pulleys that could be ceiling mounted, but could not hold the appropriate weight.
- A form of tightly woven paracord with a weight limit above three-hundred and fifty pounds is the most appropriate cord for the pulley system. This can be found at Comercial Guillen, a local fabrication shop.
- An appropriate full body harness, with adjustable sizing, can be located at Coral Hipermercado.
- The locking mechanism needed is called an automatic retractor lock. This technology is found in most manual and electric winches.

The team learned this information after using the questions in Appendix N. Employees then explained their product availability. We presented the models, alongside the price evaluations, to our sponsor.

Chapter 5: A Feasible Mounting Device for Kawallu

This chapter is an overview of our deliverables and future recommendations for Kawallu. These findings were determined through semi-structured interviews, observation, and research. The present findings aided us in creating the most suitable and feasible deliverables and making quality recommendations. The final deliverables included a 3D model design of a mounting device, product selection, and an installation manual.

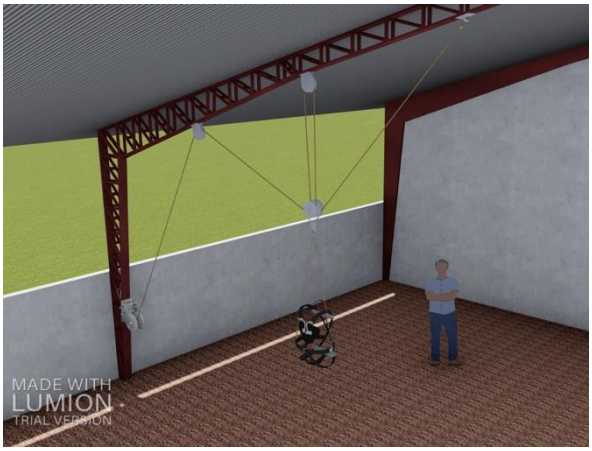
5.1 Final Deliverables

Due to Kawallu's financial constraints, the team and sponsors agreed upon the final deliverable. Our deliverable included a design and 3D model of a mounting apparatus. It also included sufficient documentation for the sponsors to easily replicate the model when the team is no longer on site.

5.1.1 3D Models of Mounting Devices

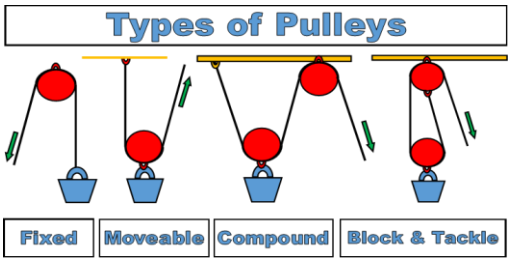
The final device design was a compound block and tackle pulley system powered by an electric winch containing a harness to secure the client. The device designed in SketchUp is portrayed in Figure 20. As illustrated in Figure 21, there are four types of primary pulley systems: linear, moveable, compound, and block and tackle. Pulley systems can combine multiple of these basic pulley design principles to fit the needs of the design best. While linear pulley systems redirect the work done, they do not change the force needed to lift the load. Compound block and tackle pulley systems reduce the force required to lift the rope—the more pulleys in a system, the less work required to lift the load. To reduce further physical strain by Kawallu employees, our final design consisted of 4

Figure 20. SketchUp Model of Mounting Device Design



pulleys and reduced the force needed to lift the load by more than 70%. The final system includes two ceiling-mounted pulleys, a double pulley, an electric winch, woven rope, and a full body harness.

Figure 21. Types of Pulleys

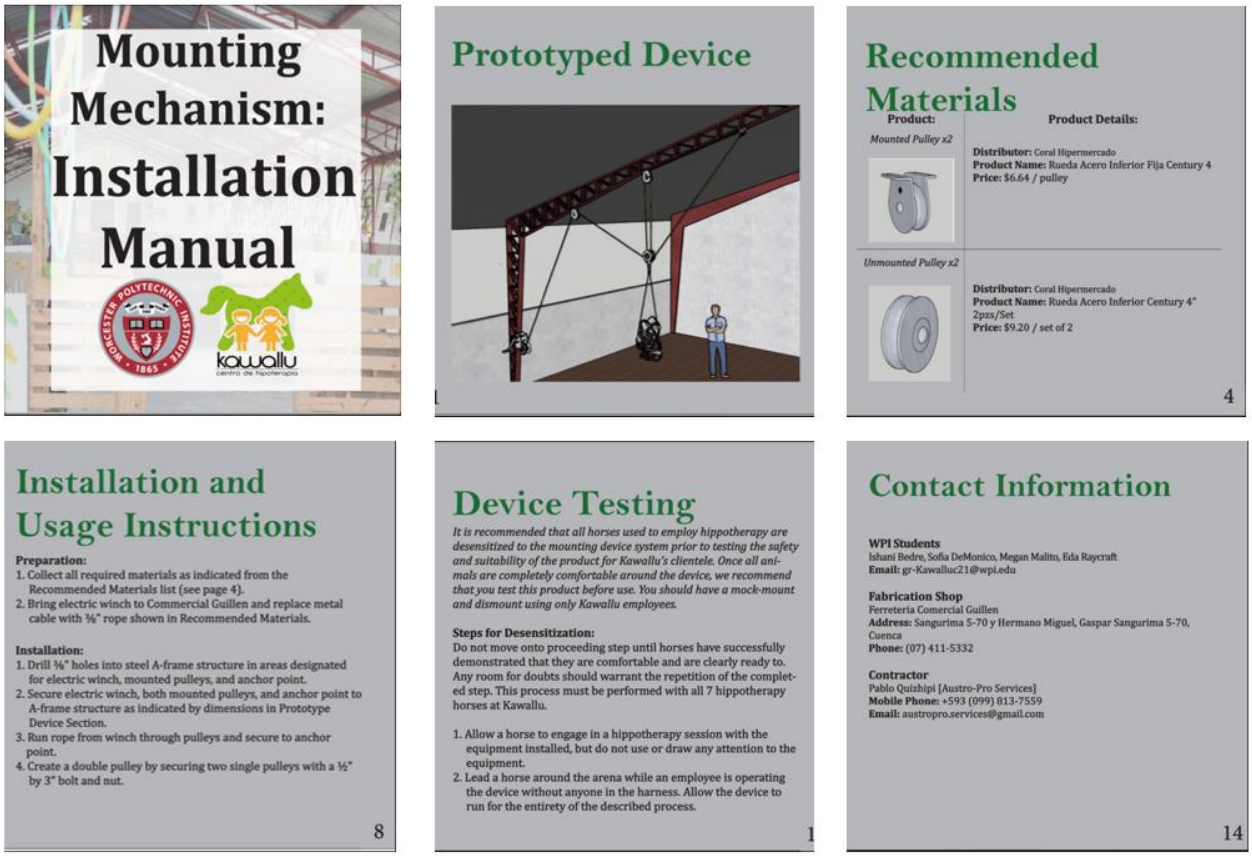


5.1.2 Mounting Mechanism: Installation Manual

To assemble the designed pulley system, we worked to select appropriate, locally accessible products and estimate the cost of installation.

This documentation was presented in the form of an informational booklet (Figure 22) and was divided into four sections: description of prototyped device, product selection of materials required to create the design, installation instructions, and testing methods. The first section illustrates the final model overview and includes detailed photos of different aspects of the design. The product selection section of the manual included the product name, estimated cost and a local distributor where the component could be purchased. The following section, titled installation and usage instructions, detailed the installation methods and contact information of a local contractor familiar with this type of work. The final section outlined methods of desensitization for Kawallu's therapy horses and testing methods involving employees to guarantee the safety of the device before client use. The instructional booklet was replicated in both English and Spanish version to ensure all parties involved with the fruition of the device could clearly understand the process. Both versions of the instructional booklet can be found in Appendix P.

Figure 22. Installation Manual



5.2 Conclusions

This project's main goal was to support Kawallu in expanding their clientele demographic by determining a mechanism to hoist larger clients on horseback. We gained an understanding of the importance of equine-assisted therapy in all aspects of clients' lives. Understanding this impact, the team acknowledged the importance of increasing the possible range of clientele. We provided Kawallu with recommendations for additional equipment to increase the clients' stability and inform them on successful fundraising methods through outside research and interviews with existing hippotherapy centers. We obtained a plethora of information regarding successful mounting systems and analyzed the mechanics of commercial mounting products. This information allowed us to create a device model suitable for Kawallu's facility and maintain awareness of their constraints.

After prototyping and iterating the design, we presented our sponsor with a physical 3D model of the intended apparatus. We conducted a feasibility analysis and cost estimation on materials and equipment necessary for the final design. We produced in-depth documentation on how to carry out the production of the apparatus.

Our recommendations include:

- From the documented materials, choose the most suitable materials for the financial resources available at Kawallu.
- Hire a contrator to implement the prototype at Kawallu.
- Work to desensitize therapy Kawallu's 7 hippotherapy horses to ensure that they are comfortable being around and interacting with the new device.
- Test the implemented device as described in the documentation before employing it on Kawallu clientele.

5.3 Recommendations for Kawallu

Kawallu's success is dependent on its ability to evolve with the needs of its clientele. Kawallu could benefit from offering more diverse sessions, stabilizing clients on horseback, and building upon the existing mounting processes.

Interviewing outside centers provided context about how Kawallu could evolve to serve their clientele better and revealed that most hippotherapy centers offer mounted and unmounted sessions. While mounted sessions target physical goals, unmounted sessions aim to improve psychological challenges through fostering a social connection between clients and horses. Unmounted hippotherapy sessions are commonly employed for individuals with autism spectrum disorder, accounting for a significant percentage of Kawallu's clientele. According to multiple sources of outside hippotherapy centers, this type of socialization with an animal has functional outcomes on this demographic as it provides skill building for emotional regulation. Unmounted sessions are also used to treat clients with depression and anxiety. Since the pandemic, Kawallu has observed an uptake in individuals seeking emotional support services. These sessions could provide Kawallu with another outlet to service clients and expand their clientele.

Additionally, talking to outside hippotherapy centers in the United States allowed our team to learn about different equipment used in hippotherapy, some of which Kawallu was not familiar with prior to our project with them. There would be immense value in assessing various horse-riding equipment and determining which can be implemented in hippotherapy sessions. Another major area of growth within Kawallu's mounted hippotherapy sessions is the general instability of clients with Cerebral Palsy. Kawallu's employees often overexert themselves to secure the client on horseback physically. There would be a significant benefit to creating a saddle attachment to stabilize clients with low muscle tone or adding a ceiling-mounted track to support clients with a harness throughout the entire therapy session. Additionally, our past research of gait belts can be used to combat this problem. The volunteers and therapists may put this on the client before mounting to help them stabilize throughout the process. The straps on the gait belt allow volunteers and therapists to hold the client by the waist and hips, reducing force on the arms and preventing them from being too handsy with the client.

As previously mentioned, 100% of all hippotherapy or equine-assisted therapy centers interviewed claimed that a mounting platform was the most crucial element of their mounting process. The existing ramp at Kawallu is not used as it is unstable and too steep for wheelchair accessibility. While adding a mounting device will significantly improve the experience for clients with physical limitations, the mounting process could be updated to include a ramp and platform system. A platform would further benefit the lifting device as all clients would begin the mounting process from a higher position and travel a smaller vertical distance. Designing a new, custom ramp and platform system that caters to clients of all abilities would be an important future step for Kawallu.

References

About Us. (n.d.). Spirit Therapeutic Riding Center. Retrieved November 15, 2021, from https://www.spirittrc.com/our-facility.html

Beebe, J. (2014). *Rapid Qualitative Inquiry: A Field Guide to Team-based Assessment* (2nd ed.). Rowman & Littlefield.

Berg, B. L., & Lune, H. (2012). A Dramaturgical Look at Interviewing. In *Qualitative Research Methods for the Social Sciences* (8th ed., pp. 106-127). Upper Saddle River, NJ: Pearson Education.

Carter, Bryant-Leukosis, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum*, 41(5), 545–547. https://doi.org/10.1188/14.ONF.545-547

Christensen, J. W., Rundgren, M., & Olsson, K. (2010). Training methods for horses: habituation to a frightening stimulus. *Equine Veterinary Journal*, *38*(5), 439–443. https://doi.org/10.2746/042516406778400574

Disability IN. (2020). *Ecuador - Disability:IN | Global Directory*. Disability:IN | Private Portal |. Retrieved November 20, 2021, from https://private.disabilityin.org/global/ecuador/

Facebook. (2020). [Kawallu indoor riding arena]. Kawallu Centro de Hipoterapia Facebook Profile. https://www.facebook.com/kawallucentrodehipoterapia/

Facebook. (2017). [Kawallu logo]. Kawallu Centro de Hipoterapia Facebook Profile. https://www.facebook.com/kawallucentrodehipoterapia/

Freedom Rider, n.d. Retrieved March 1st, 2022. [image] http://www.freedomrider.com/Support-Therapeutic-Riding-Gait-Walker-Belt.html

Giagazoglou, Arabatzi, F., Dipla, K., Liga, M., & Kellis, E. (2012). Effect of hippotherapy intervention program on static balance and strength in adolescents with intellectual disabilities. *Research in Developmental Disabilities*, 33(6), 2265–2270. https://doi.org/10.1016/j.ridd.2012.07.004

Gilmore-Kramer Company (n.d.). *Cable Rachet Lever Hoist* [image]. https://www.gilmorekramer.com/more_info/cable_ratchet_lever_hoist/cable_ratchet_ler_hoist.shtml

Halliday, E., & Randle, H. (2013). The horse and rider bodyweight relationship within the UK horse riding population. *Journal of Veterinary Behavior, 8*, 2nd ser., 8-9. https://10.1016/j.jveb.2012.12.020

History. (n.d.). SureHands Lift & Care. Retrieved November 15, 2021, from https://www.surehands.com/about-surehands/history

Horseback riding. (n.d.). SureHands Lift & Care. Retrieved November 15, 2021, from https://www.surehands.com/solutions/horseback-riding

HorsePlay Rider Hoist. (n.d). [Horseplay rider two mounting systems]. https://horseplayriderhoist.com/

Jackson-Maldonado. (2021). Hippotherapy and the Communicative Abilities of Children with Down Syndrome: A Preliminary Study. *Communication Disorders Quarterly*, 42(2), 81–92. https://doi.org/10.1177/1525740119870769

Holman, J. P., & Holman, B. K. (2017). What Every Engineer Should Know about Excel. *CRC*. https://doi.org/https://doi.org/10.1201/9781315268583

Koca & Ataseven, H. (2015). What is hippotherapy? The indications and effectiveness of hippotherapy. *Northern Clinics of Istanbul*, 2(3), 247–252. https://doi.org/10.14744/nci.2016.71601

Kucera, K. L., Schoenfisch, A. L., & McIlvaine, J. (2019). Factors associated with lift equipment use during patient lifts and transfers by hospital nurses and nursing care assistants: A prospective observational cohort study. *International Journal of Nursing Studies*, (91), 35-46. https://0.1016/j.ijnurstu.2018.11.006

Lightsey, P., Lee, Y., Krenek, N., & Hur, P. (2021). Physical therapy treatments incorporating equine movement: a pilot study exploring interactions between children with cerebral palsy and the horse. *Journal of NeuroEngineering and Rehabilitation*, 18(1), 132-132. https://doi.org/10.1186/s12984-021-00929-w

Lydon, Healy, O., Reed, P., Mulhern, T., Hughes, B. M., & Goodwin, M. S. (2014). *A systematic review of physiological reactivity to stimuli in autism*. Developmental Neurorehabilitation. https://doi.org/10.3109/17518423.2014.971975

Marquez, J., & Weerasekara, I. (2018). Hippotherapy in adults with acquired brain injury: A systematic review. *Physiotherapy Theory and Practice*, *36*, 7th ser., 779-790. https://doi.org/10.1080/09593985.2018.1494233

Merriam, S. B., & Tisdell, E. J. (2016). Being a Careful Observer. In *Qualitative Research: A Guide to Design and Implementation* (pp. 137-161). Wiley.

Moraes, A. G., Copetti, F., Angelo, V. R., Chiavoloni, L. L., & David, A. C. (2016). The effects of hippotherapy on postural balance and functional ability in children with cerebral palsy. *Journal of Physical Therapy Science*, *28*(8), 2220–2226. https://doi.org/10.1589/jpts.28.2220

Mobile hoists. Living Made Easy. (n.d.). Retrieved November 18, 2021, from https://livingmadeeasy.org.uk/category/at-home/standing-transferring-and-positioning/mobile-hoists.

Munick, V. D. C. (1998). Participant Observation: A Thick Explanation of Conflict in a Sri Lankan Village. In V. D. C. Munick & E. J. Sobo (Eds.), *Using Methods in the Field: A Practical Introduction and Casebook* (pp. 39–54). AltaMira Press.

National Council for the Equality of Disabilities. (2021). *Estadísticas de Discapacidad*. Consejo Nacional para la Igualdad de Discapacidades. Retrieved November 20, 2021, from https://www.consejodiscapacidades.gob.ec/estadisticas-de-discapacidad/

Ronquillo, R. (n.d.). Understanding pneumatic and hydraulic lifts. Thomasnet® - Product Sourcing and Supplier Discovery Platform - Find North American Manufacturers, Suppliers and Industrial Companies. Retrieved November 15, 2021, from https://www.thomasnet.com/articles/materials-handling/understanding-pneumatic-and-hydraulic-lifts/

Rossman, G. B., & Rallis, S. F. (1988). Gathering Data in the Field. In *Learning in the Field: An Introduction to Qualitative Research* (pp. 180-194). SAGE Publications Science Struck. (n.d.).

Examples of Pulleys in Our Daily Life [pulley types]. https://sciencestruck.com/list-of-examples-of-pulleys-in-our-daily-life

Solutions. (n.d.). SureHands Lift & Care. Retrieved November 15, 2021, from https://www.surehands.com/solutions

Spirit Therapeutic Riding Center. (n.d.). *Our Facility* [SureHands lift system]. https://www.spirittrc.com/our-facility.html

SureHands Lift & Care horseback riding solutions. (n.d.). [SureHands lift for horse mounting]. https://www.surehands.com/solutions/horseback-riding

Tarupi, W., Lepage, Y., Hauspie, R., Félix, M., Monnier, C., Campbell, J., Roelants, M., Hidalgo, R., Vercauteren, M. (2019). Cross-sectional study of child and adolescent growth in Ecuador. *Argentine Journal of Biological Anthropology*, 21(2). https://10.24215/18536387e006.

The lift helps improve the safety of mounting and dismounting our riders. (n.d.). SureHands Lift & Care. Retrieved November 15, 2021, from https://www.surehands.com/what-users-say/the-lift-helps-improve-the-safety-of-mounting-and-dismounting-our-riders

What is Hippotherapy? (n.d.). American Hippotherapy Association, INC. https://www.americanhippotherapyassociation.org/what-is-hippotherapy

Appendices

Appendix A: Participant Consent Form

Informed Consent Agreement for Participation in Research Study (English)

Title of Research Study: Designing a Mounting Mechanism in Cuenca, Ecuador
Principal Investigators: Esther Boucher-Yip (efboucher@wpi.edu), Gary Pollice (gpollice@wpi.edu)
Student Investigators: Ishani Bedre, Sofia DeMonico, Megan Malito, Eda Raycraft
Team Contact: gr-KawalluC21@wpi.edu

Introduction: Hello, welcome to our interview and thank you for taking the time to participate in our research. We are part of a team from WPI conducting research on hippotherapy treatment and alternative hoisting methods.

Purpose of Study: The purpose of this study is to provide our team with a holistic understanding of Kawallu's work and existing systems. The data you provide us with will assist us in innovating the current mounting techniques of Kawallu's clientele.

Research Procedure: The interview will last approximately 30 minutes. During this time, you will be asked several questions ranging from your personal experience in the center, how it could have been improved and your current involvement with the program. With your oral consent, we will tape record the interviews to review for analysis. You can choose to skip any question that makes you feel uncomfortable and can withdraw from your participation at any time. Please let us know if you have any questions at any point during the interview. This is an opportunity to tell your story so there will be time allotted at the end to hear any feedback or additional topics you feel are relevant to our research.

Confidentiality: This research will be published, but no personal information will be included. All field notes and audio recordings will be stored in a Google Drive folder that only our

research team will have access to. All audio recordings will be deleted within a week of being recorded.

For more information about this research or about your rights as a research participant, please contact any of the investigators listed above.

By signing below, you acknowledge that you have been fully informed about the study described above, and consent to being an active participant in said study.

_____ _____

Study Participant Name (please print) Date

_____

Study Participant Signature

_____ _____

Researcher Signature(s) Date

Acuerdo de Consentimiento Informado para la Participación en el Estudio de Investigación (español)

Título de investigación: Investigación y diseño de un mecanismo de montaje de caballos en Cuenca, Ecuador

Investigadores Principales: Esther Boucher-Yip (efboucher@wpi.edu), Gary Pollice (gpollice@wpi.edu)

Investigadores Estudiantiles: Ishani Bedre, Sofia DeMonico, Megan Malito, Eda Raycraft

Información de Contacto del Equipo: gr-KawalluC21@wpi.edu

Introducción: Hola, bienvenido a nuestra entrevista y gracias por tomarse el tiempo para participar en nuestra investigación. Somos parte de un equipo de WPI que lleva a cabo una investigación sobre el tratamiento de hipoterapia y métodos alternativos de elevación.

Propósito del estudio: El propósito de este estudio es brindarle a nuestro equipo una comprensión holística del trabajo de Kawallu y de los sistemas existentes. Los datos que nos proporcione nos ayudarán a innovar las técnicas de montaje actuales de la clientela de Kawallu.

Procedimiento de investigación: La entrevista tendrá una duración aproximada de 30 minutos. Durante este tiempo, se le harán varias preguntas que van desde su experiencia personal en el centro, cómo podría haberse mejorado y su participación actual en el programa. Con su consentimiento oral, grabaremos las entrevistas para revisarlas y analizarlas. Puede optar por omitir cualquier pregunta que le haga sentir incómodo y puede retirarse de su participación en cualquier momento. Háganos saber si tiene alguna pregunta en algún momento durante la entrevista. Esta es una oportunidad para contar su historia, por lo que habrá tiempo asignado al final para escuchar cualquier comentario o tema adicional que considere relevante para nuestra investigación.

Confidencialidad: esta investigación se publicará, pero no se incluirá información personal. Todas las notas de campo y las grabaciones de audio se almacenarán en una carpeta de Google Drive a la que solo nuestro equipo de investigación tendrá acceso. Todas las grabaciones de audio se eliminarán una semana después de su grabación.

Para obtener más información sobre esta investigación o sobre sus derechos como participante de la investigación, comuníquese con cualquiera de los investigadores mencionados anteriormente.

Al firmar a continuación, reconoce que ha sido completamente informado sobre el estudio descrito anteriormente y acepta ser un participante activo en dicho estudio.

_____ _____

Nombre del participante del estudio (en letra de imprenta) Fecha

Appendix B: Preliminary Sponsor Interview Guide

Questions for Kawallu Sponsor:

4. Describe the problem you would like us to research?
5. What are your expectations for us?
6. What would you consider success?
7. Can you describe the organizational structure of Kawallu?
8. How long is each session?
9. Who is involved in a typical session?
10. Can you describe the general clientele of Kawallu?
11. What are the most common physical and intellectual diagnoses among clients?
12. What challenges does the typical client face?
13. How does the sponsorship program work?
14. How does this transaction occur? What is the form of payment?
15. How do you decide whether to lift or use the stairs to mount the client?
16. What classifies a client as heavier?
17. What is the average height and weight of an adult client?

Preguntas para la Patrocinadora de Kawallu:

1. Describe el problema que te gustaría que investiguemos.
2. ¿Cuáles son sus expectativas para nosotros?
3. ¿Qué considerarías éxito?
4. ¿Puede describir la estructura organizativa de Kawallu?
5. ¿Qué tan largas son las sesiones?
6. ¿Quien está implicado?
7. ¿Puede describir la clientela general de Kawallu?
8. ¿Cuáles son los diagnósticos físicos e intelectuales más comunes entre los clientes?
9. ¿Qué desafíos enfrenta el cliente típico?
10. ¿Cómo funciona el programa de patrocinio?
11. ¿Cómo ocurre esta transacción? ¿Cuál es la forma de pago?
12. ¿Cómo determinar si levantar o usar las escaleras para montar al cliente

13. ¿Qué clasifica a un cliente como más pesado?
14. ¿Cuál es la altura y el peso promedio de un cliente adulto?

Appendix C: Staff & Volunteer Interview Guide

Questions for the Kawallu Staff:

1. Describe your role within the context of Kawallu.
2. Describe your role during hippotherapy lessons.
3. How do your responsibilities change depend on the physical or intellectual abilities of the client?
4. What would you define as the main challenges you face while working at Kawallu?
5. What changes would you like to see made?
6. Can you describe the general clientele of Kawallu?
7. What are the most common physical and intellectual diagnoses among clients
8. What challenges does the typical client face?

Preguntas para los Trabajadores de Kawallu:

1. Describe tu papel en el contexto de Kawallu.
2. Describe tu papel durante las lecciones de hipoterapia.
3. ¿Cómo cambian sus responsabilidades en función de las capacidades físicas intelectuales del cliente?
4. ¿Cuáles definiría usted como los principales desafíos a los que se enfrenta mientras trabaja en Kawallu?
5. ¿Qué cambios le gustaría que se hicieran?
6. ¿Puede describir la clientela general de Kawallu?
7. ¿Cuáles son los diagnósticos físicos e intelectuales más comunes entre los clientes?
8. ¿Qué desafíos enfrenta el cliente típico?

Questions for Kawallu Volunteers:

1. How did you begin volunteering at Kawallu?
2. How many days and hours per week do you volunteer?

3. Have you ever had a hippotherapy session?
4. Can you describe the general clientele of Kawallu?
5. What are the most common physical and intellectual diagnoses among clients?
6. What challenges does the typical client face?
7. Describe your role within the context of Kawallu.
8. Describe your role during hippotherapy lessons.
9. How does this role differ from Isa and Caro's roles?
10. What can be done to make your role easier?
11. How do your responsibilities change depend on the physical or intellectual abilities of the client?
12. What would you define as the main challenges you face while volunteering at Kawallu?
13. What changes would you like to see?

Preguntas para las Voluntarias de Kawallu:

1. ¿Cómo empezó a trabajar como voluntario en Kawallu?
2. ¿Cuántos días y horas a la semana trabaja como voluntario?
3. ¿Ha tenido alguna vez una sesión de hipoterapia?
4. ¿Puede describir la clientela general de Kawallu?
5. ¿Cuáles son los diagnósticos físicos e intelectuales más comunes entre los clientes?
6. ¿Qué desafíos enfrenta el cliente típico?
7. Describe tu papel en el contexto de Kawallu.
8. Describe tu papel durante las lecciones de hipoterapia.
9. ¿Cómo es tu papel diferente que el papel de Caro e Isa?
10. ¿Qué se puede hacer para facilitar su papel?
11. ¿Cómo cambian sus responsabilidades en función de las capacidades físicas o intelectuales del cliente?
12. ¿Cuáles definiría usted como los principales desafíos a los que se enfrenta mientras trabaja como voluntario en Kawallu?
13. ¿Qué cambios le gustaría que se hicieran?

Appendix D: Kawallu Therapist Interview Guide

Questions for Kawallu Horse Therapists:

2. What are your primary responsibilities at Kawallu?
3. What does a typical workday look like for you?
4. What are the most challenging parts of your job?
5. How do your responsibilities change depend on the physical or intellectual abilities of the client?
6. How does Kawallu currently hoist adult patients on horses?
7. What are the main problems with this system?
8. What works well?
9. From your experiences, what part of the hippotherapy treatment process affects the horse the most?
10. How do you work to mitigate this?
11. What do you recommend we keep in mind when designing a device for hoisting Kawallu's clientele?
12. What aspects are most important from the horse's perspective? Least important?
13. What aspects are the most important from the hoisters or therapist's perspective? Least important?
14. What does an ideal solution look like to you? What do you hope to see in our model?

Preguntas para los Terapeutas de Caballos de Kawallu:

1. ¿Cuáles son sus principales responsabilidades en Kawallu?
2. ¿Cómo es una jornada laboral típica para usted?
3. ¿Cuáles son las partes más desafiantes de su trabajo?
4. ¿Cómo cambian sus responsabilidades en función de las capacidades físicas o intelectuales del cliente?
5. ¿Cómo montar Kawallu a los pacientes adultos en los caballos?
6. ¿Cuáles son los principales problemas de este sistema?
7. ¿Qué funciona bien?

8. Según sus experiencias, ¿qué parte del proceso de tratamiento de hipoterapia afecta más al caballo?
9. ¿Cómo trabaja para mitigar esto?
10. ¿Qué recomienda que tengamos en cuenta al diseñar un dispositivo para elevar a la clientela de Kawallu?
11. ¿Qué aspectos son más importantes desde la perspectiva del caballo? ¿Menos importante?
12. ¿Qué aspectos son los más importantes desde la perspectiva del hoister o del terapeuta? ¿Menos importante?
13. ¿Qué le parece una solución ideal? ¿Qué esperas ver en nuestro modelo?

Appendix E: Family of Clients Interview Guide

Questions for Families of Clients:

1. Where are you from?
2. How far do you travel to Kawallu?
3. How often do you come to Kawallu?
4. How are you related to the client?
5. How long has Client X been a client of Kawallu's?
6. Why did Client X choose to pursue hippotherapy?
7. What goals are being pursued by hippotherapy treatment?
8. How has hippotherapy had any significant impact on Client X?
9. Have you witnessed improvements?
10. Can you describe you and Client X's experience at Kawallu?
11. What would you change about Kawallu?

Preguntas Para Familias de Clientes:

1. ¿De donde es?
2. ¿Qué tan lejos usted viaje para llegar aquí?
3. ¿Con qué frecuencia viene aquí?
4. ¿Cómo está relacionada con el cliente?

5. ¿Cuánto tiempo ha sido un cliente de Kawallu?
6. ¿Por qué el Cliente X eligió seguir con la hipoterapia?
7. ¿Qué objetivos persigue el tratamiento con hipoterapia?
8. ¿Cómo ha tenido la hipoterapia un impacto significativo en el Cliente X?
9. ¿Ha sido testigo de mejoras?
10. ¿Puede describirnos su experiencia y la del Cliente X en Kawallu?
11. ¿Qué cambiarías de Kawallu?

Appendix F: Complete Observation Guide

General Structure of Hippotherapy Session:

Before:

Approximate client age:

What is the client's observed range of motion?

How would you classify the client's mobility?

Using an apparatus for daily mobility?

Able to hold themselves up on the saddle without assistance?

Describe mounting process:

1) How long does it take?
2) How many people are involved in the process?
3) How effective is the existing ramp? (1 not effective, 3 makes no difference, 5 effective)

   1 2 3 4 5
4) Was anyone visually uncomfortable?

The client:

1 2 3 4 5

The therapist(s):

1 2 3 4 5

The volunteer(s):

1 2 3 4 5

5) What parts worked well?
6) What other kinds of apparatuses are being used to secure the client from the horse?

7) Additional notes:

During:

1) Describe the outline of the hippotherapy session?
2) How long does the session last?
3) How many people are involved in the entire session?
4) How is the therapist interacting with the horse and client?
5) Are there any volunteers present? What is their role?
6) What types of exercises are being performed?
7) How did the supporting parties adjust to better support the client's needs?
8) Additional notes:

After:

1) Describe the dismount process.
2) How long does it take?
3) How many people are involved?
4) How does it differ from the mounting process?
5) Additional notes:

Appendix G: Signage for Kawallu Facility

	RESEARCH IN-PROGRESS BY UNIVERSITY STUDENTS	
Title of Research Study:	Designing a Mounting Mechanism in Cuenca, Ecuador	**Title of Research Study:**

Hello! We are a team of college students from Worcester Polytechnic Institute in the United States conducting research on hippotherapy treatment and alternative hoisting methods at Kawallu Hippotherapy Center. We will be observing hippotherapy sessions and conducting interviews with consenting participants beginning early January and ending mid-March.

Left to Right: Ishani Bedre, Megan Malito, Sofia DeMonico, Eda Raycraft

Please contact gr-KawalluC21@wpi.edu with questions or concerns.

kawallu centro de hipoterapia	**INVESTIGACIÓN EN CURSO POR ESTUDIANTES UNIVERSITARIOS ESTAUNIDENSES**	WORCESTER POLYTECHNIC INSTITUTE · LEHR UND KUNST · 1865
Título del Estudio de Investigación:	Investigación y Diseño de un Mecanismo de Montaje de Caballos en Cuenca, Ecuador	**Título del Estudio de Investigación:**

¡Hola! Somos un equipo de estudiantes universitarios del Instituto Politécnico de Worcester en los Estados Unidos que realizan investigaciones sobre el tratamiento de hipoterapia y métodos de elevación alternativos en el Centro de hipoterapia Kawallu. Observaremos las sesiones de hipoterapia y realizaremos entrevistas con los participantes que hayan dado su consentimiento a partir de principios de enero y terminaremos a mediados de marzo.

Izquierda a Derecha: Ishani Bedre, Megan Malito, Sofia DeMonico y Eda Raycraft

Comuníquese con gr-KawalluC21@wpi.edu si tiene preguntas o inquietudes.

Appendix H: Video Consent Form

Informed Consent Agreement for Video Recording in Research Study

Title of Research Study: Research and Design of Horse Mounting Mechanism in Cuenca, Ecuador
Principal Investigators: Esther Boucher efboucher@wpi.edu, Gary Pollice gpollice@wpi.edu
Student Investigators: Ishani Bedre, Sofia DeMonico, Megan Malito, Eda Raycraft
Team Contact: gr-KawalluC21@wpi.edu

Introduction: Hello, thank you for taking the time to assist us in our research. We are part of a team from WPI conducting research on hippotherapy treatment and alternative hoisting methods.

Purpose of Study: The purpose of this study is to provide our team with a holistic understanding of Kawallu's work and existing systems. The data you help us collect will aid us in innovating the current mounting techniques of Kawallu's clientele.

Research Procedure: Our team will be conducting participant (observation/simulation) at Kawallu's facilities. With your signed consent, we will video record the data collection method to review for analysis. You will not be the focus of the video but will be within the frame for a part of the recording.

Confidentiality: This research will be published, but no personal information will be included. All field notes and video recordings will be stored in a Google Drive folder that only our research team will have access to. All video recordings will be deleted at the termination of our research by March 12th, 2021.

For more information about this research or about your rights as a research participant, please contact any of the investigators listed above.

By signing below, you acknowledge that you have been fully informed about the study described above, and consent to being recorded during our research.

_____ _____

Study Participant Name (please print) Date

_____

Study Participant Signature

_____ _____

Researcher Signature(s) Date

Acuerdo de Consentimiento Informado para la Grabación de Video en un Estudio de Investigación

Título del estudio de investigación: Investigación y diseño de un mecanismo de montaje de caballos en Cuenca, Ecuador
Investigadores principales: Esther Boucher efboucher@wpi.edu, Gary Pollice gpollice@wpi.edu
Investigadores estudiantiles: Ishani Bedre, Sofia DeMonico, Megan Malito, Eda Raycraft
Contacto del equipo: gr-KawalluC21@wpi.edu

Introducción: Hola, gracias por tomarse el tiempo para ayudarnos en nuestra investigación. Somos parte de un equipo de WPI que lleva a cabo una investigación sobre el tratamiento de hipoterapia y métodos alternativos de elevación.

Propósito del estudio: El propósito de este estudio es brindarle a nuestro equipo una comprensión holística del trabajo de Kawallu y de los sistemas existentes. Los datos que nos ayude a recopilar nos ayudarán a innovar las técnicas de montaje actuales de la clientela de Kawallu.

Procedimiento de investigación: Nuestro equipo llevará a cabo participante (observación / simulación) en las instalaciones de Kawallu. Con su consentimiento firmado, grabaremos en video el método de recopilación de datos para revisarlo y analizarlo. Usted no será el foco del video, pero probablemente estará dentro del marco de una parte de la grabación.
Confidencialidad: esta investigación se publicará, pero no se incluirá información personal. Todas las notas de campo y las grabaciones de vídeo se almacenarán en una carpeta de Google Drive a la que solo nuestro equipo de investigación tendrá acceso. Todas las grabaciones de vídeo se eliminarán al término de nuestra investigación el 12 de marzo de 2021.

Para obtener más información sobre esta investigación o sobre sus derechos como participante en la investigación, póngase en contacto con cualquiera de los investigadores mencionados anteriormente.

Al firmar a continuación, reconoce que ha sido completamente informado sobre el estudio descrito anteriormente y da su consentimiento para ser registrado durante nuestra investigación.

_____ _____

Nombre del participante del estudio (en letra de imprenta) Fecha

_____

Firma del participante del estudio

_____ _____

Firma (s) del investigador Fecha

Appendix I: Organization Methods

Data Organization: Objective 1

After conducting all the methods of data collection, the team analyzed the recorded data before beginning the prototyping process. Data analysis encapsulated the opinions, experiences, and personal observations of Kawallu (Berg, 2012). The data was in the form of field notes, videos, and interview recordings taken while the methods were underway. Coding the information received through observation, participant observation, and semi-structured interviews allowed our team to determine patterns to deduce essential factors that needed to be included in our design to make it as suitable and efficient as possible for Kawallu.

Once the coding process was complete, we combined and synthesized the categorized data. Triangulation formed cohesive information from the coded data to solve our objectives. The goal of triangulation is to use data collected from different methodologies to create

reinforcement and prove that the collected information is valid (Carter, 2014). We used method triangulation, as we combined data from multiple different methods within our first objective. This allowed us to better understand the data received and make the data most applicable to our goal.

Data Organization: Objective 2

The hippotherapy center interview process supplied extensive information about many elements of equine therapy. We learned that hippotherapy is a multifaceted and comprehensive approach to the treatment of a wide breadth of problems. Key concepts were represented in a brief PowerPoint presentation to consolidate our information and present it to our sponsor in a cohesive manner. Information was included about common horse-riding equipment, such as the gait belt and surcingle (Figures 17, 18, and 19). Other methods of stability, such as uneven stirrups and customized horse selection, were included as suggestions to add to sessions. We also included information on unmounted sessions for clients with autism. Most hippotherapy centers that were interviewed are non-profit organizations, so information about galas, public fundraisers, and grant applications were also communicated to Kawallu as a means of funding their facility.

Once the interviews were conducted, the field notes were organized for future reference. The first category we created concerns the facilities' funding. Depending on if the facility regularly receives funding, we categorized the apparatuses and methods used under a category. These options could be reviewed for their mechanical properties as they may not be in our sponsor's budget. The facilities that are considered non-profits were categorized separately as their methods were seen as more feasible for Kawallu. This information was organized in Excel.

Data Organization: Objective 3

When completing a cost analysis, it is key to organize your data so future comparisons can be made. When formatting collected data, it is important to organize it in a manner that makes later analysis simple. It should be easy to understand without having to refer to field notes. Using Excel allowed our team to make tables that displayed each necessary expense, and

how much money we were delegating to it (Holman, 2017.) Giving multiple various products for each expense, with a ranging price provided our sponsor with a multitude of options for the device. Data organization ensured that our sponsor would be able to follow through with our proposed design, even after we finished our project term in Cuenca.

Appendix J: US Hippotherapy Centers Contact Information

American Hippotherapy Association Address: 2537 Research Blvd. Suite #203 Fort Collins, CO 80526 Phone: +1 (970) 818-1322 E-mail: info@theahainc.org	Little Bit Therapeutic Riding Center Address: 18675 NE 106th St. Redmond, WA 98052 Phone: +1 (425) 882-1554 E-mail: littlebit@littlebit.org
Windrush Farm Address: 479 Lacy St, North Andover, MA 01845, United States Phone: +1 (978) 682-7855 https://www.windrushfarm.org/contact-us/ E-mail: info@windrushfarm.org	Therapeutic Equestrian Center Inc Address: 537 Northampton St, Holyoke, MA 01040, United States Phone: +1 (413) 532-1462 https://tecriders.org/contact/ E-mail: contact@tecriders.org
Greenlock Hippotherapy Center Address: 59 Summer St, Rehoboth, MA 02769, United States Phone: +1 (508) 252-5814 E-mail: greenlocktrc@gmail.com	Strongwater Farm Address: 500 Livingston St, Tewksbury, MA 01876 Phone: +1 (978) 851-5540 E-mail: maria.antonioni@strongwaterfarm.org
Bina Farm Address: 207 Union St, Natick, MA 01760 Phone: +1 (508) 651-2462 E-mail: info@binafarm.org	Sundance Circle Hippotherapy (not yet) Address: 16520 92nd St E, Sumner, WA 98390 Phone: +1 (253) 863-0654

Appendix K: Communication with US Hippotherapy Centers

EMAIL TO OUTSIDE HIPPOTHERAPY CENTERS

Subject: Seeking Information on Hippotherapy in Rural Areas

Dear [Name of Hippotherapy Center],
Hello, we are juniors at Worcester Polytechnic Institute in Worcester, Massachusetts. We are currently working on a project in Cuenca, Ecuador alongside a local hippotherapy center. We are working to create a mechanism to lift heavier clients on and off horses. This device would expand their client base and overall accessibility to hippotherapy treatment in rural areas. We are also researching ways to create a saddle which comfortably secures clients with mobility challenges, such as cerebral palsy, to the animal throughout the hippotherapy session.

If possible, we would love to set up a time to video chat so we can learn about the existing systems within [Name of Hippotherapy Center] and gain insight into hippotherapy and how we can overcome challenges present in a rural location. If you feel more comfortable contacting via email or do not have time to chat, that works too, just let us know!

Thank you,
Ishani Bedre, Sofia DeMonico, Eda Raycraft and Megan Malito

CALL TO OUTSIDE HIPPOTHERAPY CENTERS

Hi [Name of Hippotherapy Center],

I am calling to learn more about the current hippotherapy practices at your center. I am a part of a team of juniors at Worcester Polytechnic Institute who are currently working alongside a local hippotherapy center in Cuenca, Ecuador.

We are working to create a mechanism to lift heavier clients onto and off the horses. This device would expand their client base and overall accessibility to hippotherapy treatment in rural areas.

We are also researching ways to create a saddle which comfortably secures clients with mobility challenges, such as cerebral palsy, to the animal throughout the hippotherapy session.

If possible, we would love to set up a time to chat so we can learn about the existing systems within [Name of Hippotherapy Center] and gain insight into hippotherapy. If you feel more comfortable contacting via email or do not have time to chat, that works too, just let us know!

Thanks!

Appendix L: US Hippotherapy Centers Interview Guide

Questions for US (United States) Hippotherapy Centers:

1. What is the breakdown of your current client base? Typical age range? Typical ability classification?
2. What typically brings a client to seek your services?
3. What is your organization's biggest obstacle in serving clients?
4. Can you break down the typical structure of a hippotherapy session?
5. What devices do you currently use to mount clients with [breakdown of client base]?
6. How have you adapted to serving heavier clients?
7. What other options did you consider aiding clients?
8. Why did you choose this option?
9. What are the pros and cons?
10. If you have ever had to modify a hippotherapy session for a client?
11. If so, how? How did it work?
12. What improvements do you still need to make to improve the client experience?
13. What future goals do you have?
14. How do you operate?
15. Are your services sponsored (free), covered by insurance, or paid for?

If they are a non-profit…

1. How have you been able to successfully fundraise?
2. What types of fundraising options have you explored?
3. What has been your biggest challenge in running your organization?
4. What have you been able to do to overcome this challenge?
5. How has social media impacted your fundraising?

Appendix M: Kawallu Sponsor Interview Guide

Questions for Kawallu Sponsor:

1. Does Kawallu have monetary constraints? If so, what are they?
2. How are you currently funded?
3. What are your current methods of fundraising?
4. How have they been impacted by COVID?
5. Do you have any future fundraising plans?
6. How much has been budgeted for this project?
7. How do you believe this money can best be spent?

Preguntas para la Patrocinadora de Kawallu:

1. ¿Kawallu tiene restricciones monetarias? Si es así, ¿Que son?
2. ¿Cómo se financia actualmente?
3. ¿Cuáles son sus métodos actuales de recaudación de fondos?
4. ¿Cómo se han visto afectados por el COVID?
5. ¿Tiene algún plan futuro de recaudación de fondos?
6. ¿Cuánto se ha presupuestado para este proyecto?
7. ¿Cómo cree que se puede gastar mejor este dinero?

Appendix N: Ferreteria Interview Guide

Questions for Fabrication Shops:

We have prototyped a mechanical device to mount clients onto horses,

1. What materials are available to manufacture this device?
2. How much would it cost for these materials to be used in production?
3. Are there any limitations that come to mind when determining if this device can be manufactured?
4. Do you have an estimate on the labor cost of producing this device?
5. How long do you estimate it will take for this device to be manufactured?

Preguntas para los Talleres de Fabricación:

Hemos prototipado un dispositivo mecánico para montar clientes en caballos,

1. ¿Qué materiales están disponibles para fabricar este dispositivo?
2. ¿Cuánto costaría que estos materiales se utilizaran en la producción?
3. ¿Hay alguna limitación que se te ocurra a la hora de determinar si este dispositivo sepuede fabricar?
4. ¿Tiene una estimación sobre el costo de mano de obra de producir este dispositivo?
5. ¿Cuánto tiempo estima que tardará en fabricar este dispositivo?

Appendix O: Kawallu C21 (Previous IQP Team) Interview Guide

Questions for Kawallu C21:

1. Can you describe for us your original project goal?
2. What was your original scope and how did it evolve throughout the project?
3. What were Kawallu's expectations vs. your own?
4. What was your thought process in producing your final deliverable?
5. Which other ones did you consider but decide against?
6. What did Kawallu say about their budget?
7. Do you have one to work with?
8. Were they pleased with the final project, or were they expecting more?
9. How did you navigate those conversations?
10. What was Kawallu's response to your project?
11. Do you have any general advice for our team as we move forward?

12. If you were present in Cuenca, what would you have done differently?

Appendix P: Final Deliverable

English Version

Versión Español