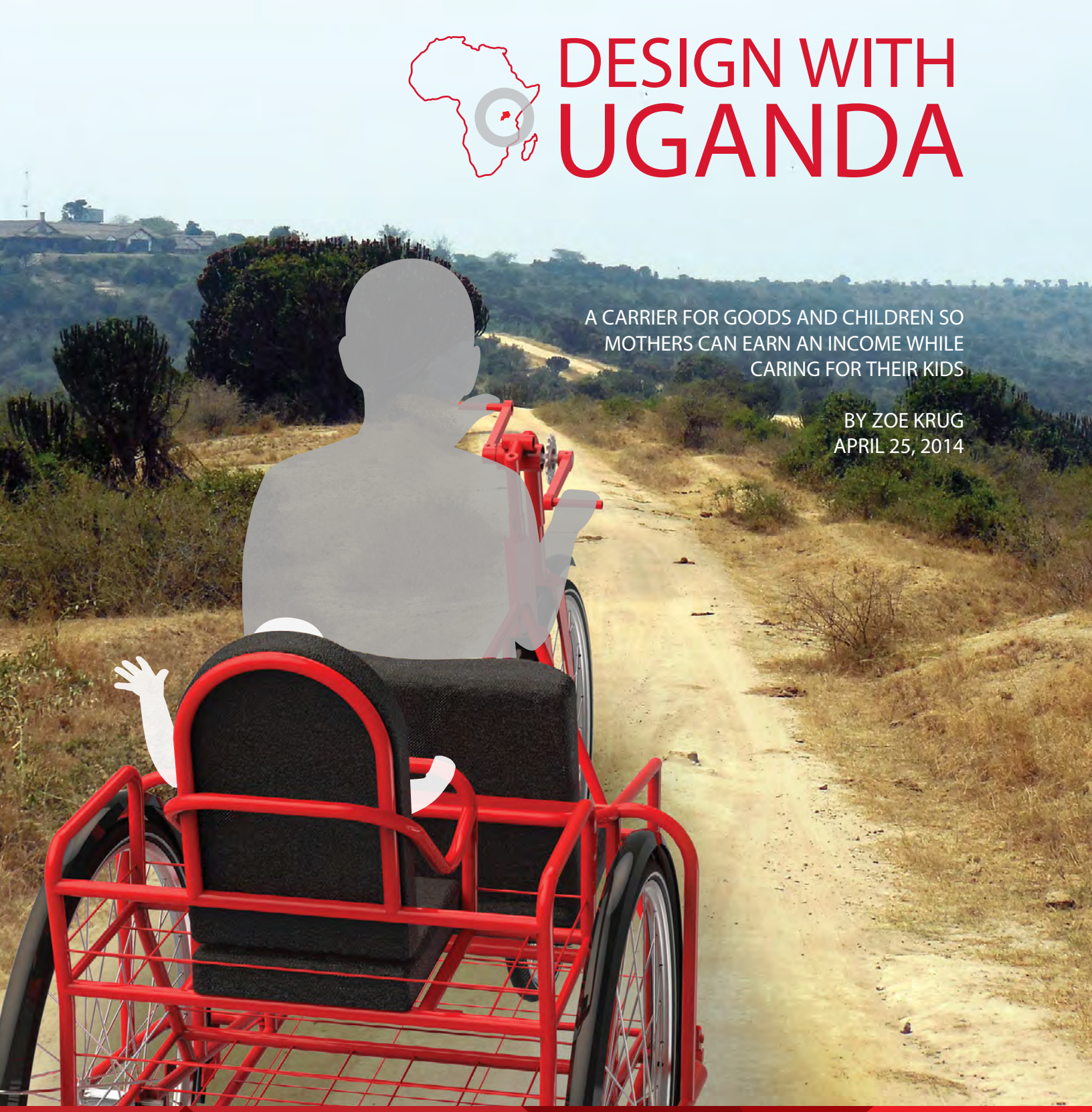
DESIGN WITH UGANDA



A CARRIER FOR GOODS AND CHILDREN SO MOTHERS CAN EARN AN INCOME WHILE CARING FOR THEIR KIDS

BY ZOE KRUG
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EXECUTIVE SUMMARY

THE BASIS OF THE PROJECT

Working With Uganda is a project based around improving mobility for people with disabilities in rural Uganda. It started with Navin Parekh of CanUgan, and Dean Mellway of the Carleton READ Initiative teaming up with the Carleton School of Industrial Design. CanUgan works with an organization called KADUPEDI based in Kasese, Uganda, who advocate for the rights of people with disabilities as well as distribute assistive devices to them. The READ Initiative work to increase accessibility on campus and on a larger scale as well. Together, the aim is to increase mobility, independence and empowerment for individuals who have a disability in Kasese.

Uganda is a lush country backed by a history of violence, civil unrest and displacement. This, paired with extreme poverty has made for a country which is home to many people with disabilities. Main causes are polio, cerebral palsy, land mines, and club foot. Citizens simply can't afford to have these treatable illnesses cured. Living in poverty also means that people with disabilities often can't afford to go to school, or own an assistive device. Additionally, social stigma also contributes to the inequalities faced by people with disabilities.

KADUPEDI paired with CanUgan distribute assistive devices to recipients they have chosen, the most popular of which being the hand pedalled tricycle. The tricycle is a great tool for people with disabilities to use to get around and be physically independent, however there are still more obstacles that these people face.

Through my research, I uncovered that women with disabilities face even more injustices than men with disabilities in almost every area of life: lower enrolment and graduation

from school, lower chances of attaining a job, poorer access to health care and assistive devices, poorer community and family support, and higher rates of abuse. I felt it would be valuable to focus on women with disabilities throughout my design process as this population is frequently overlooked.

The device I designed is a carrier for goods for the back of the existing hand pedalled tricycle so that women are able to carry products to and from the market setting so they can earn an income. The existing hand pedalled tricycle had limited storage and user could not carry heavy loads long distances. More importantly, however, the carrier has a seat for a child. Women in Uganda carry their babies with them to do chores on their fronts or backs until the child is old enough to stay home with relatives, usually around two years old. However users who take the tricycle to do chores have no room to carry a child currently. This means that anytime the mother has to leave the house, she must sacrifice taking her child with her as able bodied mothers do. Being a mother is such a basic right that shouldn't be taken away simply because she is disabled.

Initially, however, I wasn't completely set on designing for mothers. I was focused more on earning an income through selling handicrafts, with a work space and storage design. Visiting Uganda, women liked the design but were unsure of its success if it meant mothers would have to leave the home without their child. I received this feedback repeatedly which made me rethink my target user and use scenario. Women likely wouldn't take to using a device to sell handicrafts if an even more basic need wasn't being met. Because of this recurring theme throughout my trip to Uganda, I switched my focus to target the mother and her child being together.

Leaving Uganda, the most important overarching lesson I learned is that co-design is a crucial part of the design process. No matter how much of an expert you believe yourself to be, there are always aspects that go unnoticed. Only an end user can give you the insights needed to create a successful product, service or system.

RESEARCH

PUTTING THE PROJECT IN CONTEXT

UGANDA

Uganda is a developing country located in Eastern Africa. It has one of the fastest growing populations in the world, totaling 35.8 million, 49% of which are below the age of 15. Kasese is a district of Uganda that boarders the Congo, and the population totals roughly 74 300 (Population Reference Bureau, 2012).

Because of a turbulent history marked by conflict and violence, disabilities are more common in Kasese than is typically seen in other countries, or even other areas of Uganda. These disabilities tend to be lower body impairments due to polio, cerebral palsy, club foot and land mine accidents, among others. These disabilities are intensified by the extreme poverty, exemplified by the lacking health care, extremely low education enrollment, low food and clean water supplies, paired with the stigma surrounding disability in this area.

OUR PARTNERS

Navin Parekh founded CanUgan in 2010. It is a non-profit organization based solely on a volunteer basis and has partnered with KADUPEDI (Kasese District Union of Persons' with Disability) to protect, promote, and provide assistive devices to people with disabilities in Uganda. KADUPEDI is an organization located in Kasese that was founded in 1996 and has 9 members of the executive committee all of whom work on a voluntary basis and experience a disability.

The goal of KADUPEDI is to protect and improve the rights of all people with disabilities in the country. Their projects are district wide, and comprise both district level and grass-root activities that address the needs of various disabilities (CanUgan, 2013). I was also introduced to KADIWOD (Kasese District of Women with Disabilities) through KADUPEDI and CanUgan, who have a lot of the same goals but focus solely on women with disabilities.

The Carleton School of Industrial Design was introduced to CanUgan through the Carleton READ (Research, Education, Accessibility and Design) Initiative, directed by Dean Mellway. With funding from the International Development Research Center of Canada, the goal was to design products that not only assist these users but also create empowerment by allowing these devices to contribute to the quality of life of the user, their families, and the community.

This project was a continuation from the previous year's group who all created devices that were based on KADUPEDI's current tricycle design. Although the objective for this project is to design assistive devices for those with disabilities, the focuses have expanded from the tricycle to include other devices, users, and disabilities.

ASSISTIVE DEVICES

The most popular assistive device distributed through KADUPEDI and CanUgan is the hand pedalled tricycle. It works by allowing those with lower limb disabilities to sit in a tricycle that is hand powered by a bicycle chain drive. This device allows the large population of mobility impaired people to get around and be somewhat independent. It is both environmentally and economically appropriate in this context.

KADIWOD is an organization in Kasese, Uganda that works with women with disabilities

Kio, the manufacturer of the hand pedalled tricycle is a local artisan who is able to skillfully bend and weld the components together in an efficient and innovative manner. He is also able to personalize these devices for people with different types of disabilities. He does not always do things the proper way, per se, rather in a creative fashion using what materials and tools he has access to to complete the job. The context of manufacturing and creating tends to be quite an innovative and ingenious process as they may not have all the right resources but are still able to make what they need with what they have.

THE ENVIRONMENT

When thinking disabilities in Uganda, there are a number of aspects to consider. Firstly, the terrain is very rough. Kasese is a mountainous area with lots of hills to climb. Additionally, the majority of roads aren't paved. The small villages are barely accessible by vehicle, so this must be kept in mind when designing assistive devices. They need to accommodate rough roads and mountainous pathways.

Secondly, attitudes towards disabilities aren't what is seen in more developed countries. There is a big stigma surrounding those with disabilities, as they are seen as dependent and burdensome. Their legal rights are not equal to able bodied individuals and are often left unsupported by friends and family once a disability is acquired.

Because of this, those with a disability are likely to live below the poverty line. Of the roughly 3.6 million people that are classified as disabled, 2.4 million are classified as chronically poor. This research presents a clear link between disability and poverty in the country of Uganda (Lwanga-Ntale, 2003). When a disabled person lives in poverty it can be a hard cycle to break. In many cases the disabled person does not have a way of generating sufficient income. For curable disabilities, because they are poor in most cases, they don't have access to proper health care. For some conditions, lack of education about treatment can cause the disability to become worse. In many cases it is harder for someone with a disability to secure a job, which causes family members to try to support them or in some cases abandon them. For someone who is in poverty, they are unable to afford a mobility device (wheelchair, crutches, etc) without receiving aid. In some cases if a woman becomes disabled later in life they can be abandoned by their husband and family because they are seen as a financial burden.

TARGET USERS

As previously explained, the hand pedalled tricycle is used by people with a mobility impairment. The tricycle is a great tool for the physical independence of moving ones' self from place to place with efficiency and dignity, however, people with disabilities face additional obstacles.

Through my research, I started to notice a trend. Overall, people with disabilities living in Uganda face numerous inequalities compared to able bodied individuals, however, women with disabilities face even more injustice.

The gender inequality often starts when the child is young as able bodied and disabled boys are favoured to be enrolled in school over girls, especially disabled (Department for International Development, 2000). Attending school can also be costly for a family in poverty. These families often cannot afford to pay the school fees or for

mobility devices which would allow their disabled children to attend non-accessible schools (Ingstad & Whyte, 2007).

Disabled girls who lack an education grow into women who often cannot find purposeful work with which to support themselves (CBM; Kett, Trani, Lang, Wirz, Kembhavi & Groce). Further, disabled women in rural areas often have limited choices when it comes to income generation, due to their disability, as agriculture is the primary source of income in these rural areas, however is labour intensive and almost impossible to do with a mobility impairment (Ingstad & Whyte, 2007). Traditionally, women keep the home and care for the children in the village, and may fear losing their husband should they travel to the city to seek out more opportunities (Eide & Benedicte, 2011). A lack of job and consequently mobility device creates a lack of independence, which frequently leads the community and society to believe that these disabled women are a burden to their husbands and families who must care for and support them (Coleridge, 1993; Ingstad & Whyte, 2007).

Due to the notion that disabled women are burdensome, marriage rates among these women are low compared to similarly-abled men. By the same token, if a woman becomes disabled as an adult, it is not uncommon for her husband to leave her with their children and no source of income, as she is no longer useful to him (Ingstad & Whyte, 2007; Kett, Trani, Lang, Wirz, Kembhavi & Groce).

Women also have less access to preventative health care, rehabilitation, and basic information than men. Women living under the poverty line are more likely than men in poverty to acquire a disability due to a lack of access to health care facilities (Sok Chann, 2011). It is also harder for disabled women to make informed decisions due to a lack of access to basic information, and they are therefore subject to higher rates of diseases such as HIV/AIDS as well as unplanned pregnancies (Eide & Benedicte, 2011).

Women with disabilities are discriminated against even more so than men with disabilities

KADUPEDI gave me very important insights during the research phase of my project

Violence against women is also a big issue in Uganda, with violence and abuse against disabled women being an even larger problem. Violence against women is one of the biggest causes of disability in developing countries (United Nations, 2004). Further, violence and abuse rates are even higher among disabled women as these women are incredibly vulnerable and consequently are more likely to be abused, sexually, physically and emotionally (Sok Chann, 2011; United Nations Population Fund, 2008). Such abuse has profound psychological effects on the victim (Eide & Benedicte, 2011)

Lastly, as discussed, poverty and disability are two huge outstanding issues which intertwine, creating a vicious cycle. Because disabled women have a harder time finding work and access to a mobility device, they are more likely to be unable to support themselves, and poverty rates among these women are high, with poverty rates among unmarried disabled women being the highest (Kett, Trani, Lang, Wirz, Kembhavi & Groce). Women who become disabled after they have married face the possibility of losing their spouse as well as financial support from their family (Kett, Trani, Lang, Wirz, Kembhavi & Groce). All of these factors leave women with a huge disadvantage when it comes to standards of living and poverty (Kett, Trani, Lang, Wirz, Kembhavi & Groce).

INPUT FROM REAL PEOPLE

In addition to gaining insight through online articles and books, I had the opportunity to speak to real people with disabilities from Uganda. I spoke to Robert and Peter from KADUPEDI, as well as the manufacturer, Kiyo, in a video call as well as through e-mail which was extremely helpful in gaining some context to the issues they face there. However, I primarily communicated with Mary, director at KADIWOD, and Sylvia, a land-mine survivor.

INPUT FROM REAL PEOPLE

BIIRA MARY YALALA

- Director at KADIWOD.
- Women do handicrafts, from weaving bags and belts, to beading jewelery, to papier mache garbage bins and doll houses.
- Through KADIWOD, women may be trained to sew or knit clothing or repairs.
- Men often do not help women with household chores.
- Uneducated women with disabilities cannot find jobs because employers are concerned with limitations they have.
- Negative attitudes and discrimination is one of their biggest barriers which causes low self esteem.
- Women with disabilities are unable to carry heavy loads to markets or drive cars.

BIIRA SYLVIA

- Land-mine survivor.
- Sylvia attended (but did not complete) school, and experienced the challenges of her family paying school fees (she comes from a family of 13) as well as being displaced by the war.
- She does not have a job but volunteers with land-mine survivors in Kasese.
- Major daily challenges she faces are traveling to and from her volunteer position, and carrying heavy loads.
- In urban areas, women with disabilities will beg or do tasks for other people & business owners.

DESIGN OBJECTIVES

FACTORS TO KEEP IN MIND DURING THE DESIGN PROCESS

ACCESSIBILITY
Because this device is designed for disabled women, it must be accessible. It must be easy to use with a mobility impairment and in conjunction with the tricycle.

SAFETY
Safety is of the highest priority. This means operating the device in conjunction with and from the existing tricycle must be safe for the user to use with a disability.

AFFORDABLE
Poverty and disability often create a vicious cycle. This means people with disabilities in Uganda also often live below the poverty line, so this device must be affordable.

LOCAL MANUFACTURABILITY
This device must take advantage of local materials and labour. This will contribute to the affordability, and ensure the work is staying within the community. It also means the device will be locally repairable.

ENVIRONMENTAL ADAPTABILITY
The terrain in Uganda is often very hilly and mountainous. Additionally, the roads are not always paved. The device needs to work well on rough terrain.

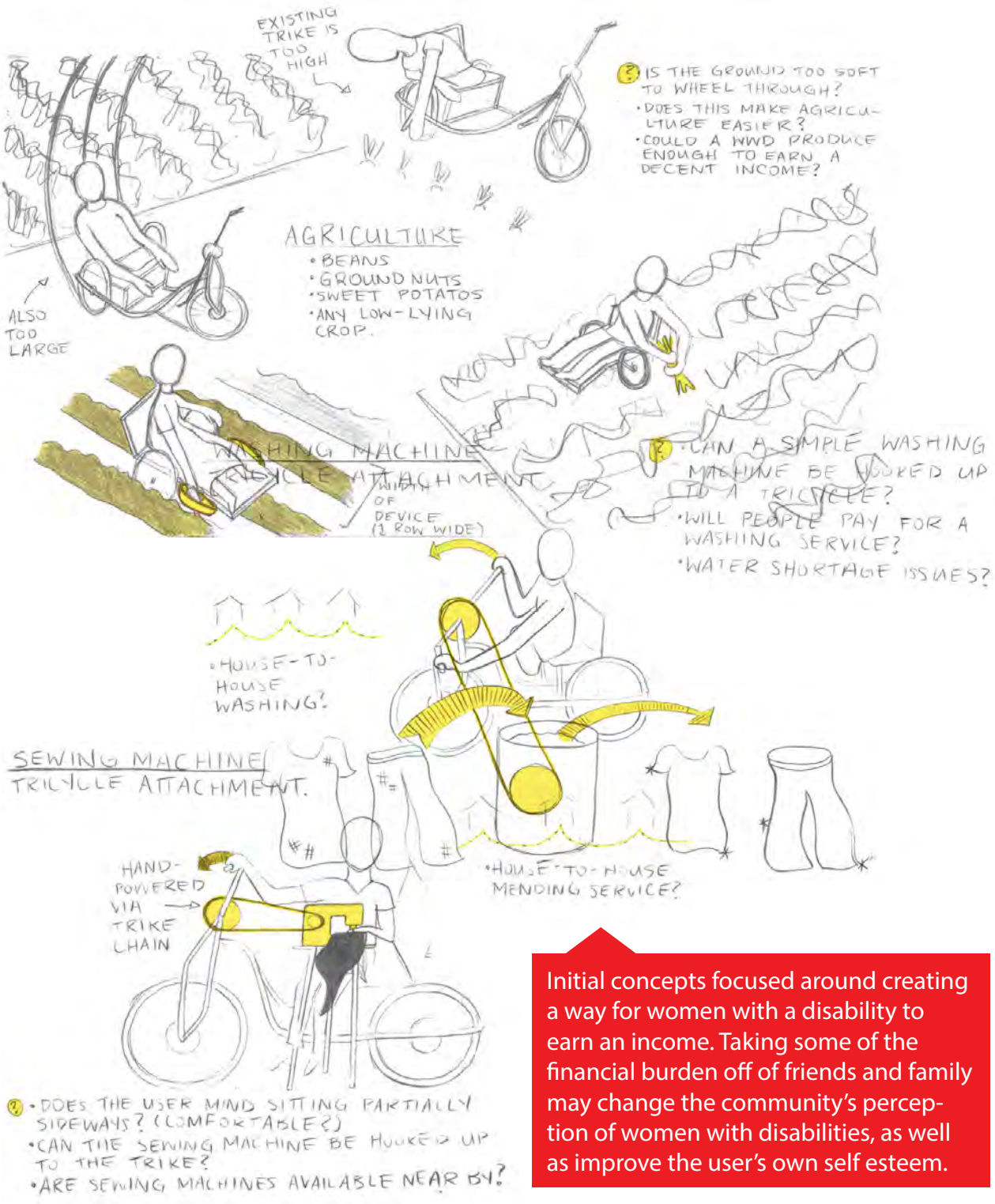
ERGONOMICS
This device needs to be comfortable enough for the user to use on a daily basis for long periods of time

EMPOWERMENT
The device must create a sense of independence, purpose and value while improving the users' self esteem and quality of life.

A successful design needs to be locally sourced and manufactured

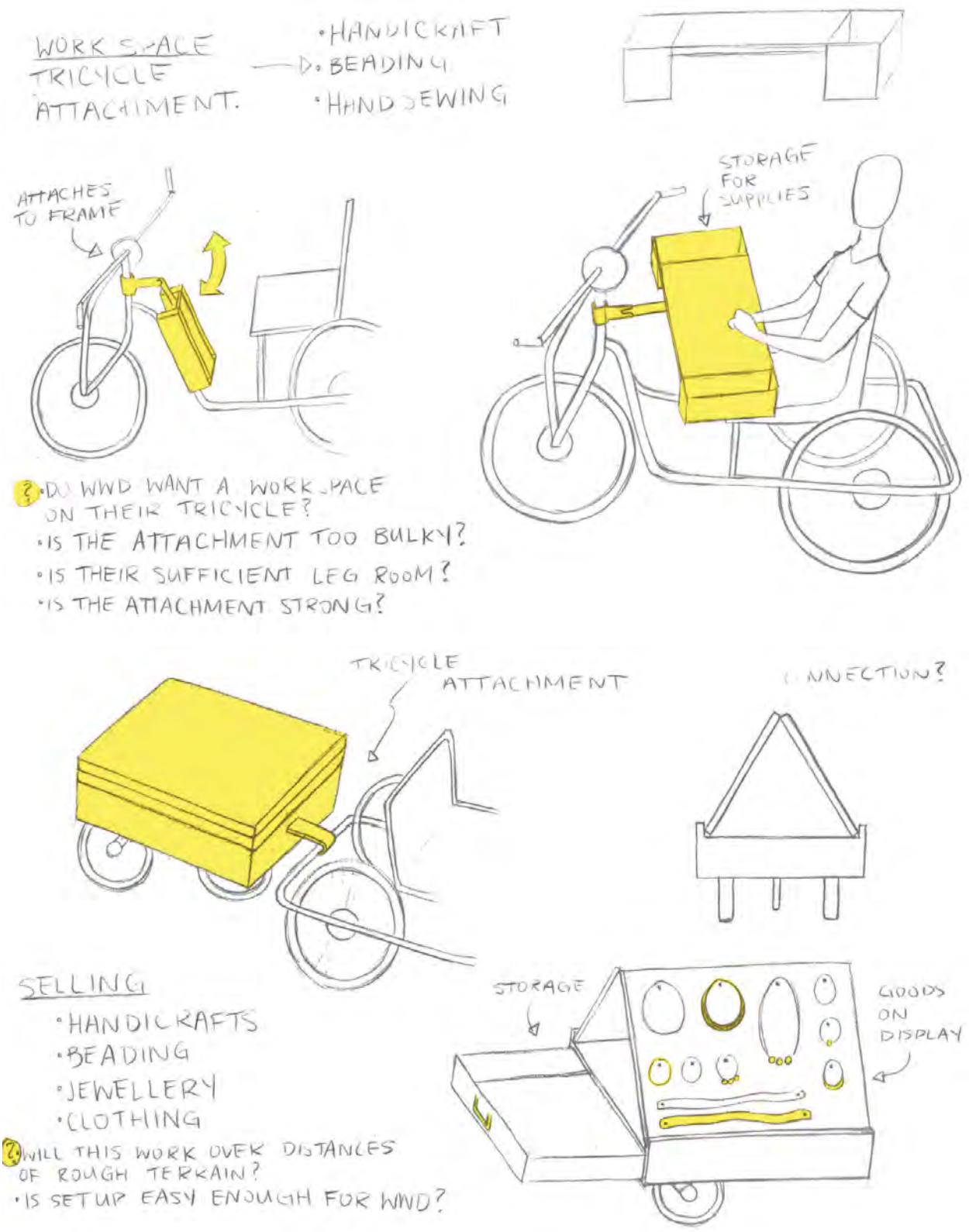
IDEATION

EARLY CONCEPTS INSPIRED BY MY RESEARCH



Initial concepts focused around creating a way for women with a disability to earn an income. Taking some of the financial burden off of friends and family may change the community's perception of women with disabilities, as well as improve the user's own self esteem.

I also focused on more basic tasks such as creating goods or doing work on a flat surface, and transporting heavy loads to and from the market.



SCENARIO

FOCUSING ON A SPECIFIC SYNOPSIS TO DESIGN FOR

Women often do handicrafts to earn an income. Disabled women face not only the challenge of traveling to the market, but also carrying the heavy loads containing the goods to be sold.

Additionally, these women have no way to organize or showcase the goods, which are typically stored and shown on the ground.

Some examples of beading and weaving that may be sold as handicrafts to earn an income.

EXISTING PRODUCTS

WHAT IS ALREADY OUT THERE?

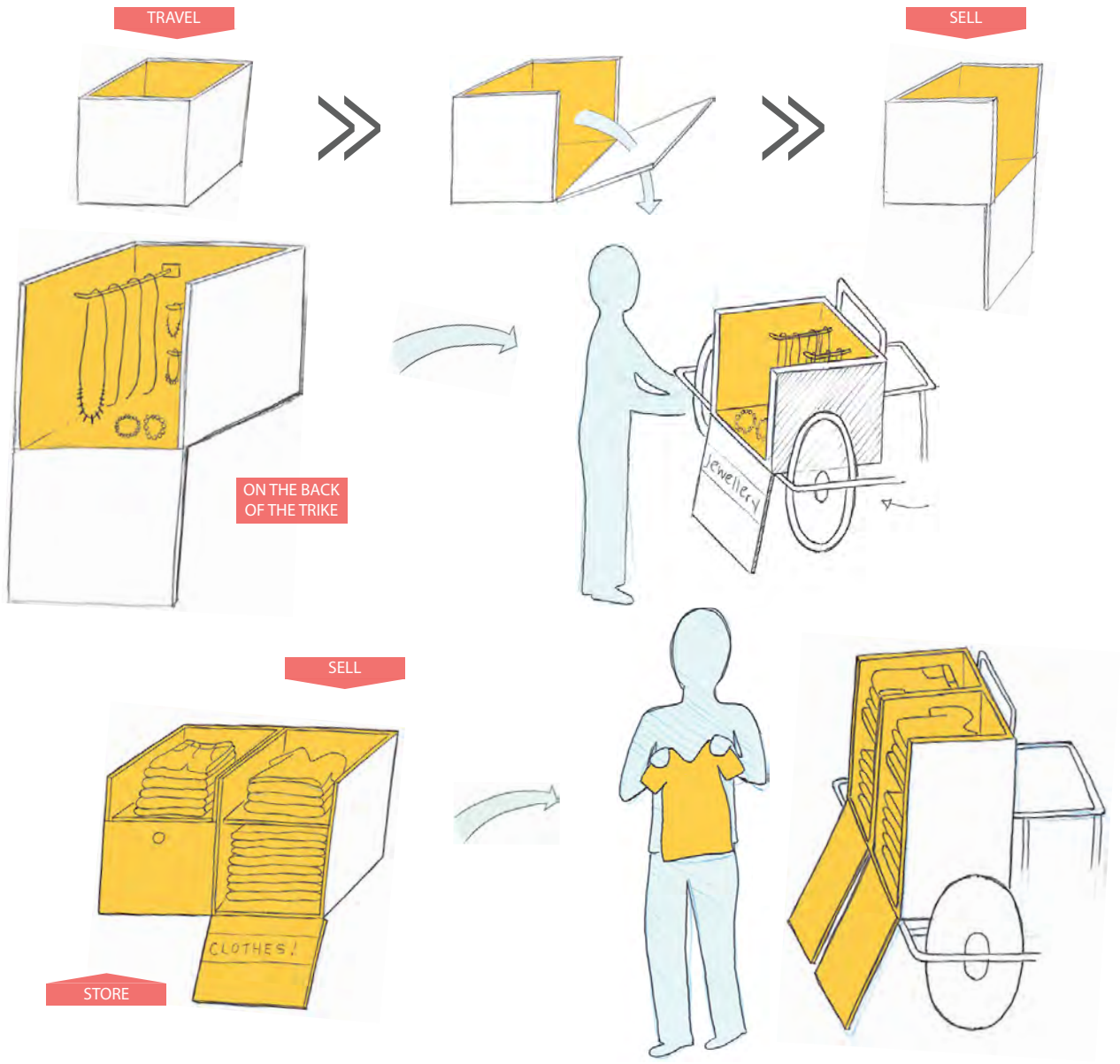
Bicycle and tricycle modifications that individuals have come up with on their own are extremely innovative. In developing countries individuals may be inclined to make a solution as these products are not always readily available. This approach is critical in creating a cost effective and appropriate product.

Two other more industrial products have also been valuable as well. Worksman Cycles has a line of Mover Tricycles with a variety of storage options. They are designed to be durable with a robust frame. They are used for transporting goods over large properties. Additionally, they are used as urban delivery vehicles for restaurants and other businesses. A variety of trailer attachments means any number of goods can be carried. Translating these products into something that uses locally sourced materials and labour is the goal.

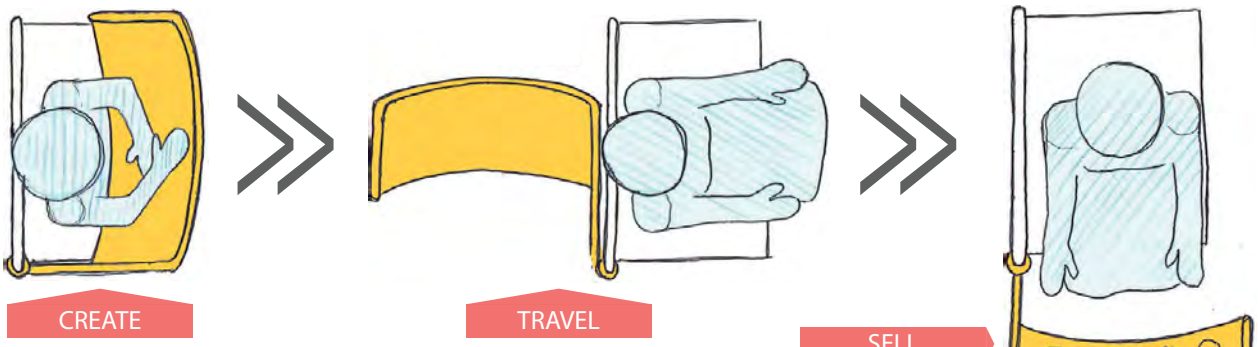
Additionally, Amos Winter has been teaching a class at MIT on wheelchair design for third world users. Students design wheelchairs and attachments based on user needs. A number of the students' projects have had similar focuses to what is being researched regarding disability in Uganda. For example, one team looked at wheelchair accessories for women and designed a wheelchair attachment to enable women to easily carry items. Another team focused on small business attachments and came up with a desk attachment with storage. Though the solutions they have come up with are not necessarily the exact same, they clearly have very similar goals. Researching the evolution of their projects and thought processes will be helpful to apply as the intent and users overlap a great deal.

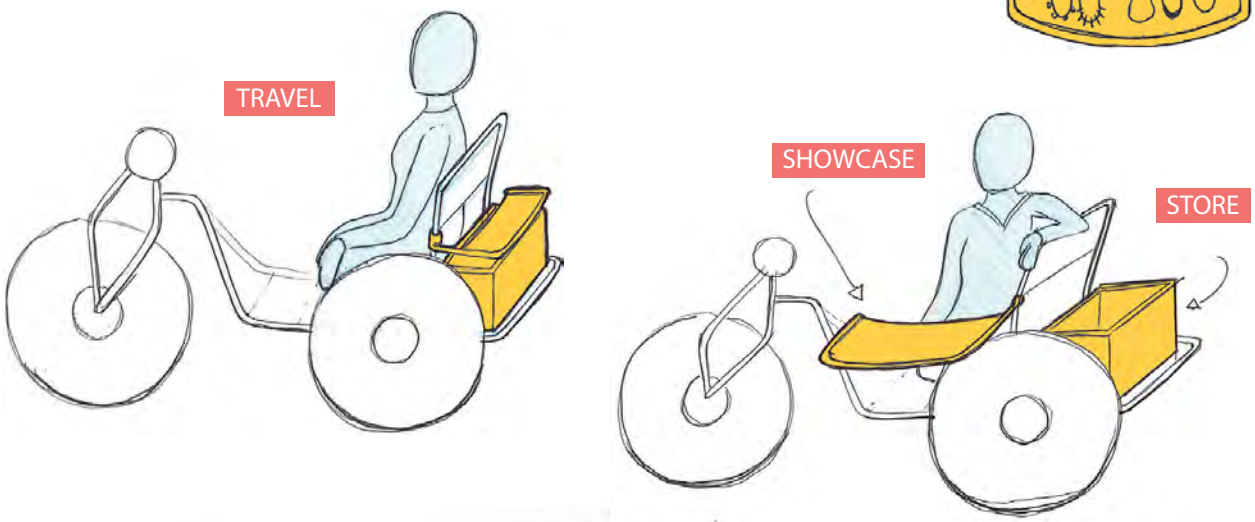
PRELIMINARY DESIGN DEVELOPMENT

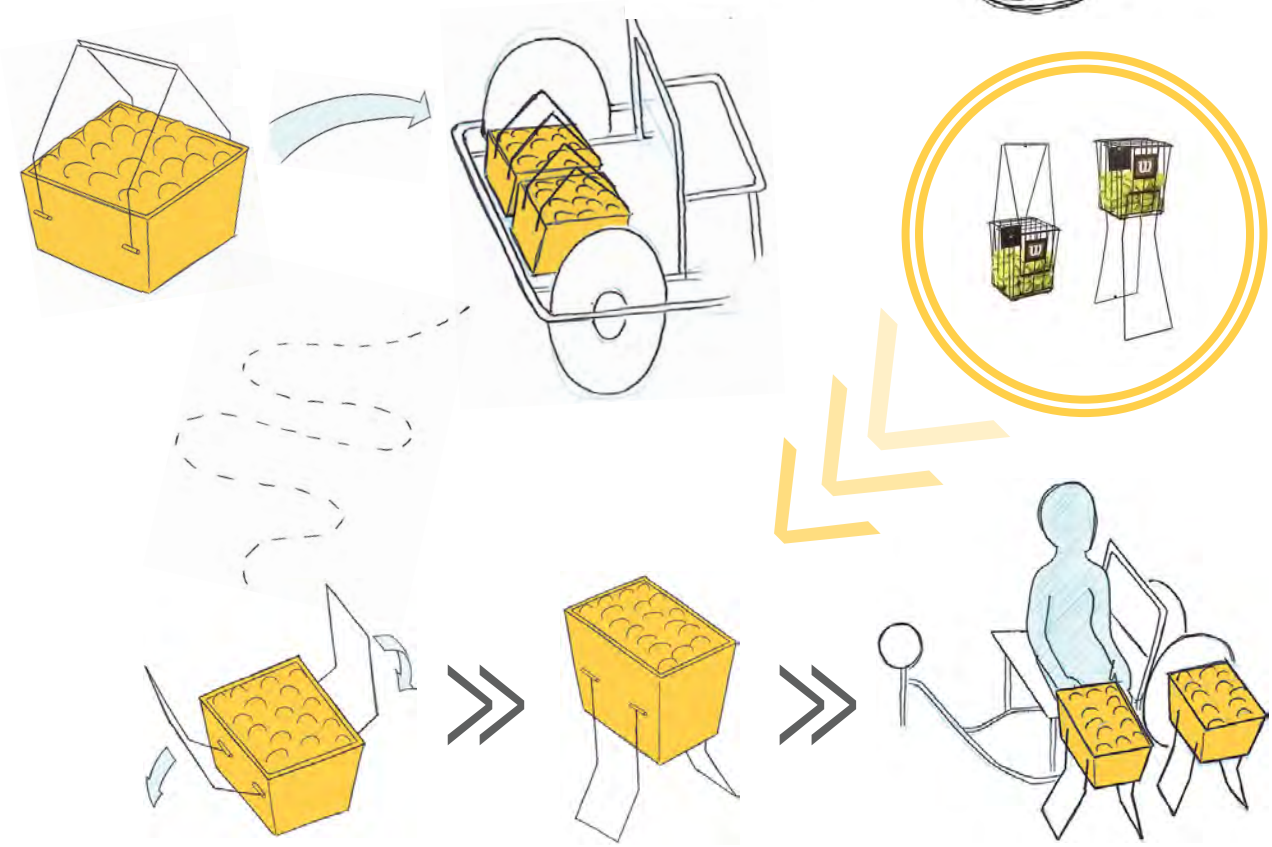
IDEATING USING THE INSIGHTS GAINED THROUGH THE RESEARCH PHASE



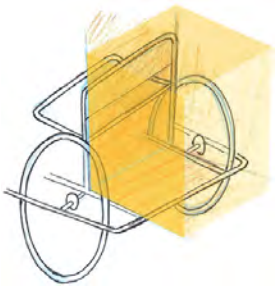
I started ideating with my target scenario in mind. I experimented with different storage mechanisms, different goods, and various ways to display them. As explained, I felt this would be a valuable tool as currently there is not an efficient way of carrying or displaying goods for women with a disability.


CREATE
TRAVEL
SELL

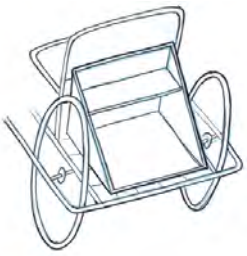

TRAVEL
SHOWCASE
STORE



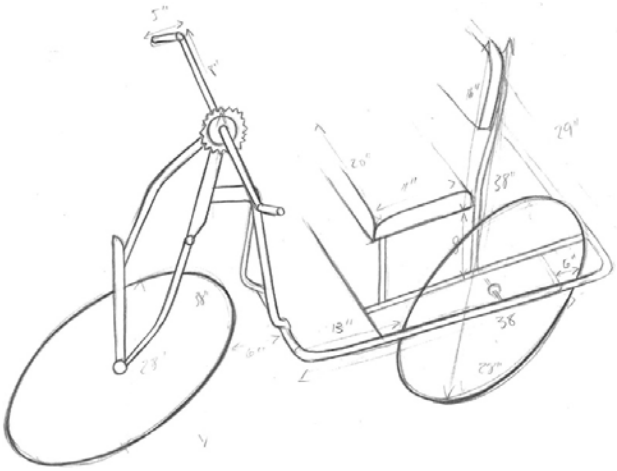
I also weighed the pros and cons of various connections as well as analyzed different materials' strength, functionality and availability. This ensures the final product will be best suited for the context of living in Uganda with a disability.



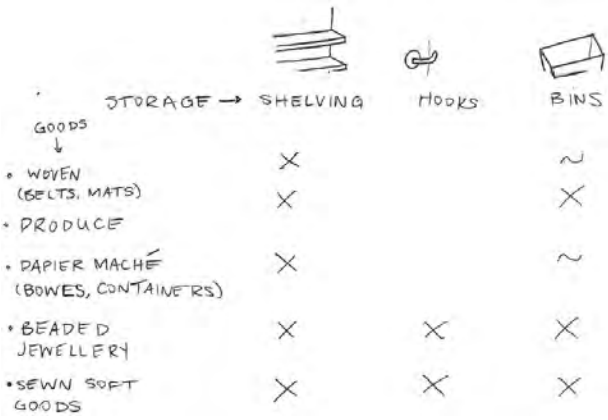
space on the back of the trike?



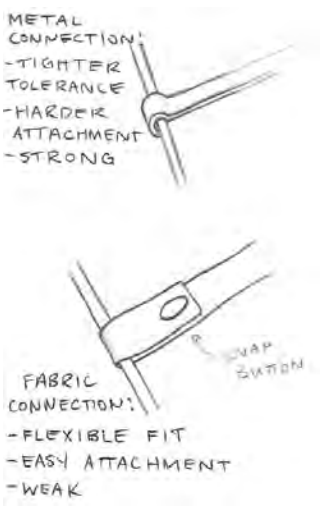
existing tricycle measurements



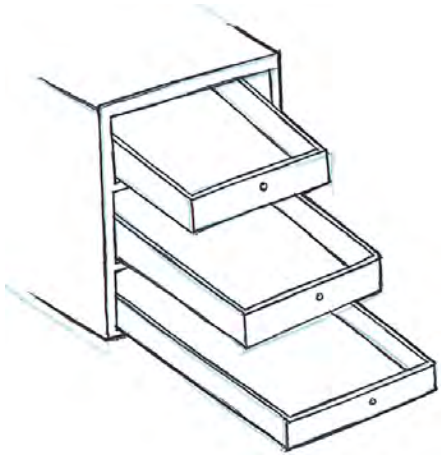
configurations

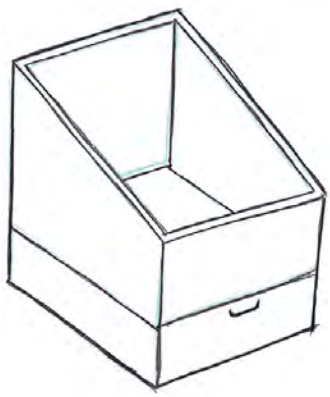


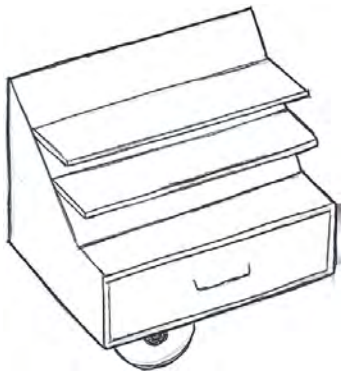
types of storage



connections & materials

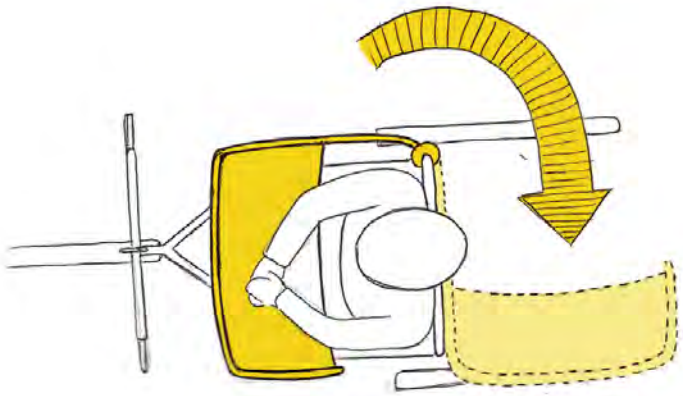


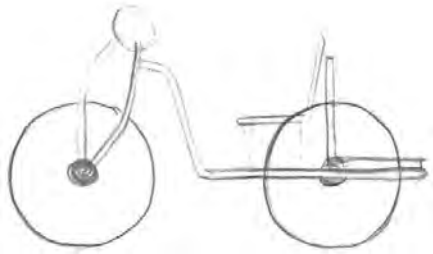


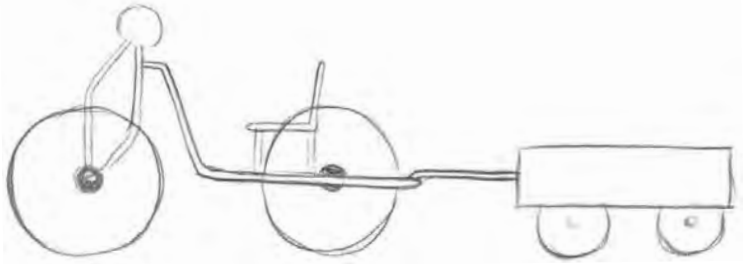


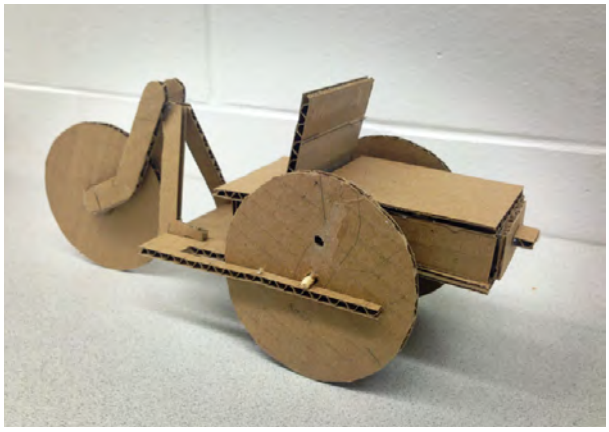
FOCUSING

PHYSICAL MODELS OF CONCEPTS





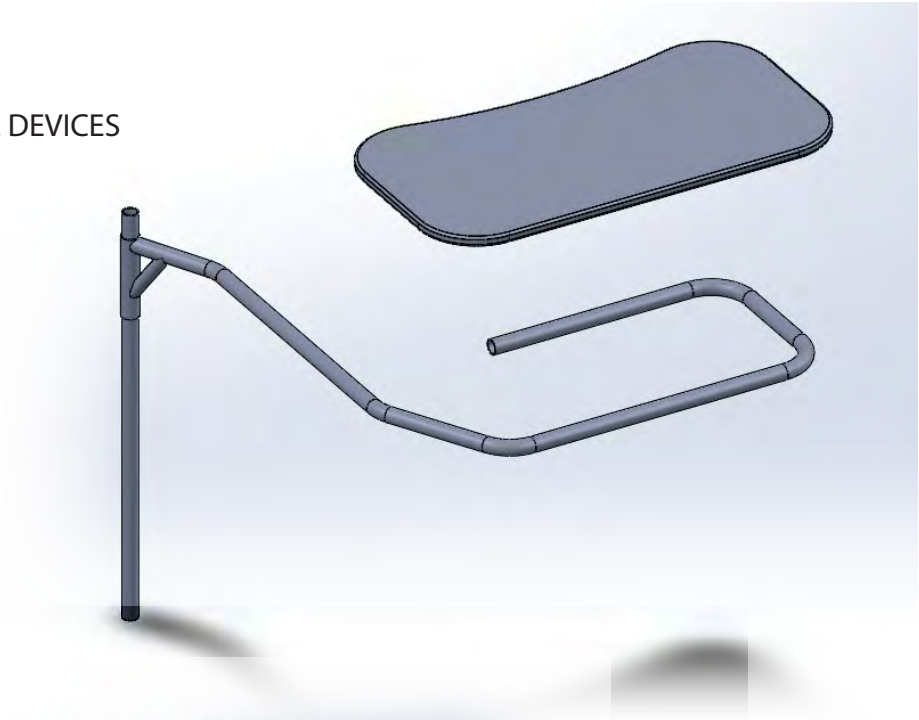




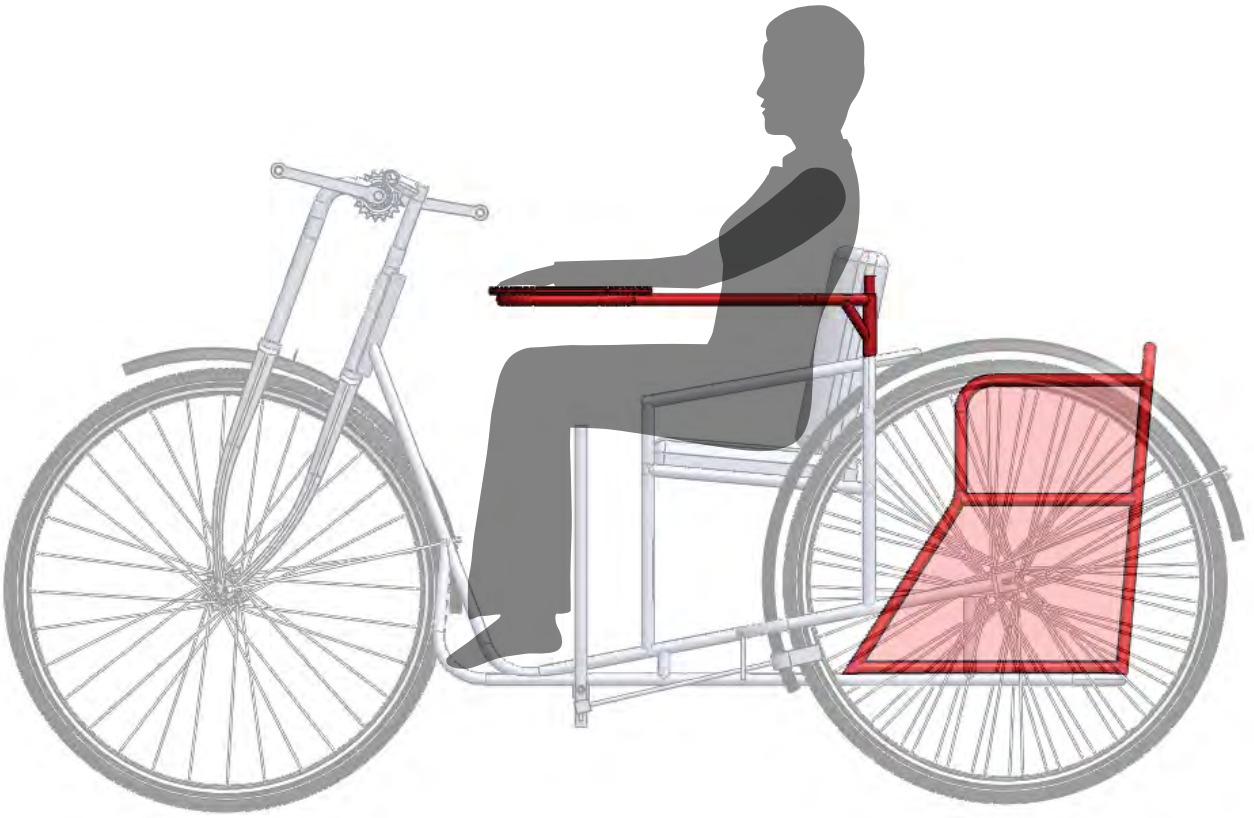
Prototypes help to determine what sizes might be appropriate. Further, they give a good visual of different configurations and modifications. On the left, the market cart is attached directly to the back of the trike. On the right, the market cart is more of a trailer which follows the main trike.

CAD

DIGITAL MODELS OF THE DEVICES

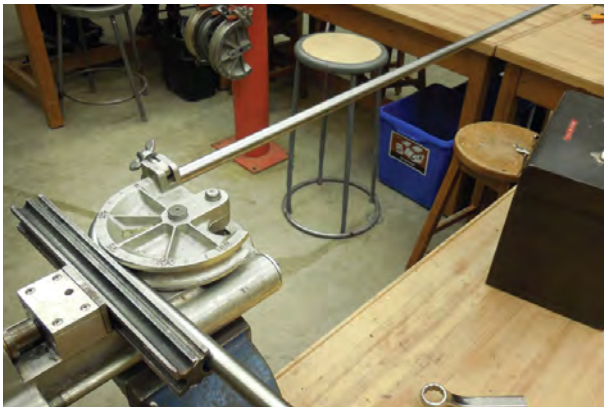


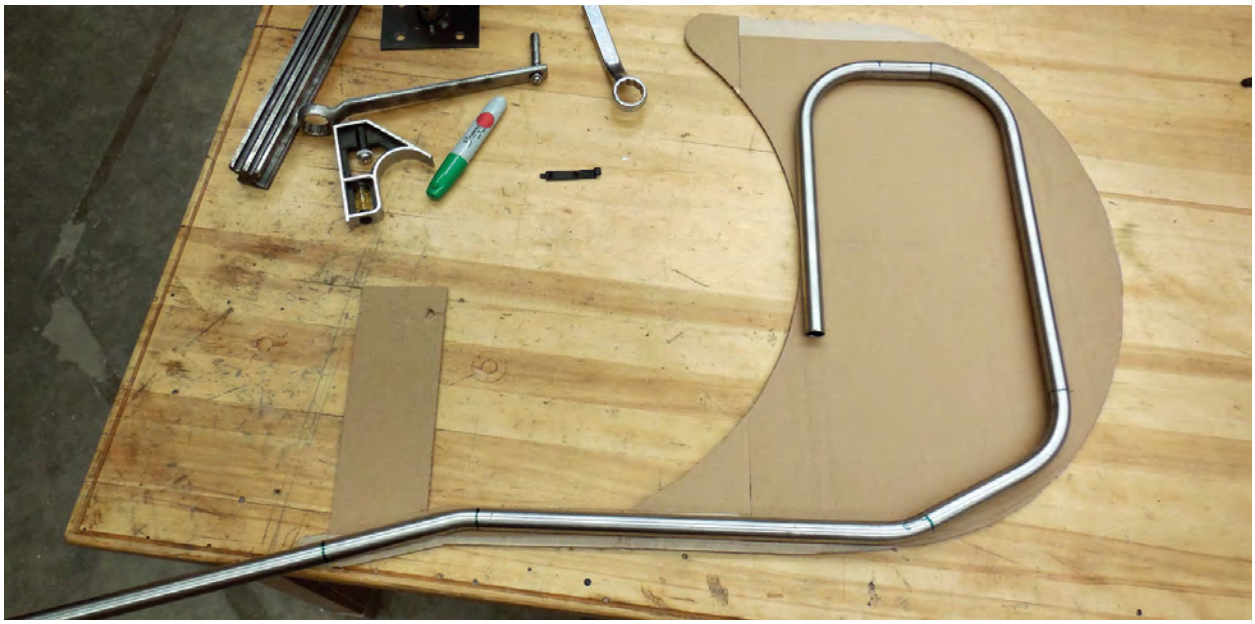
After experimenting with and analyzing various configurations, I modeled the one I chose. I thought a multi-functional storage unit on the back, and a work space attachment on the front would be of most value to women with disabilities. Women could create in an organized and efficient manner on the work space, and store, transport and display the goods created in the storage unit.

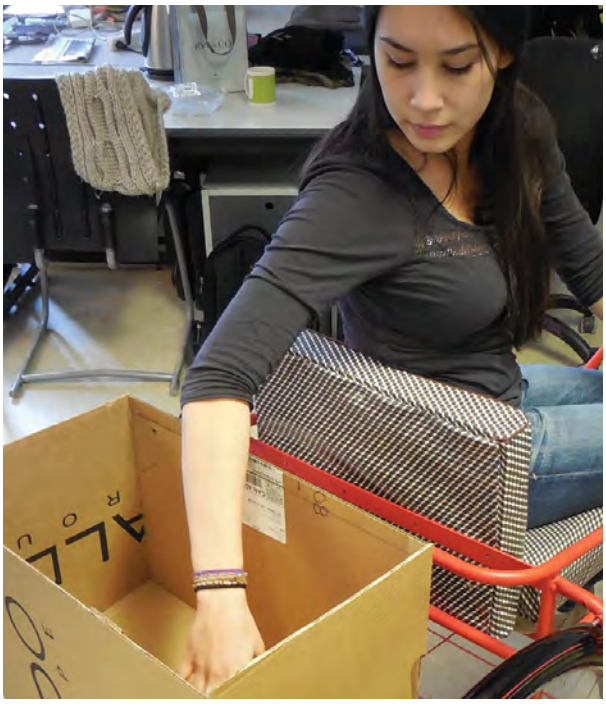


PROTOTYPING

BUILDING SCALE MODELS



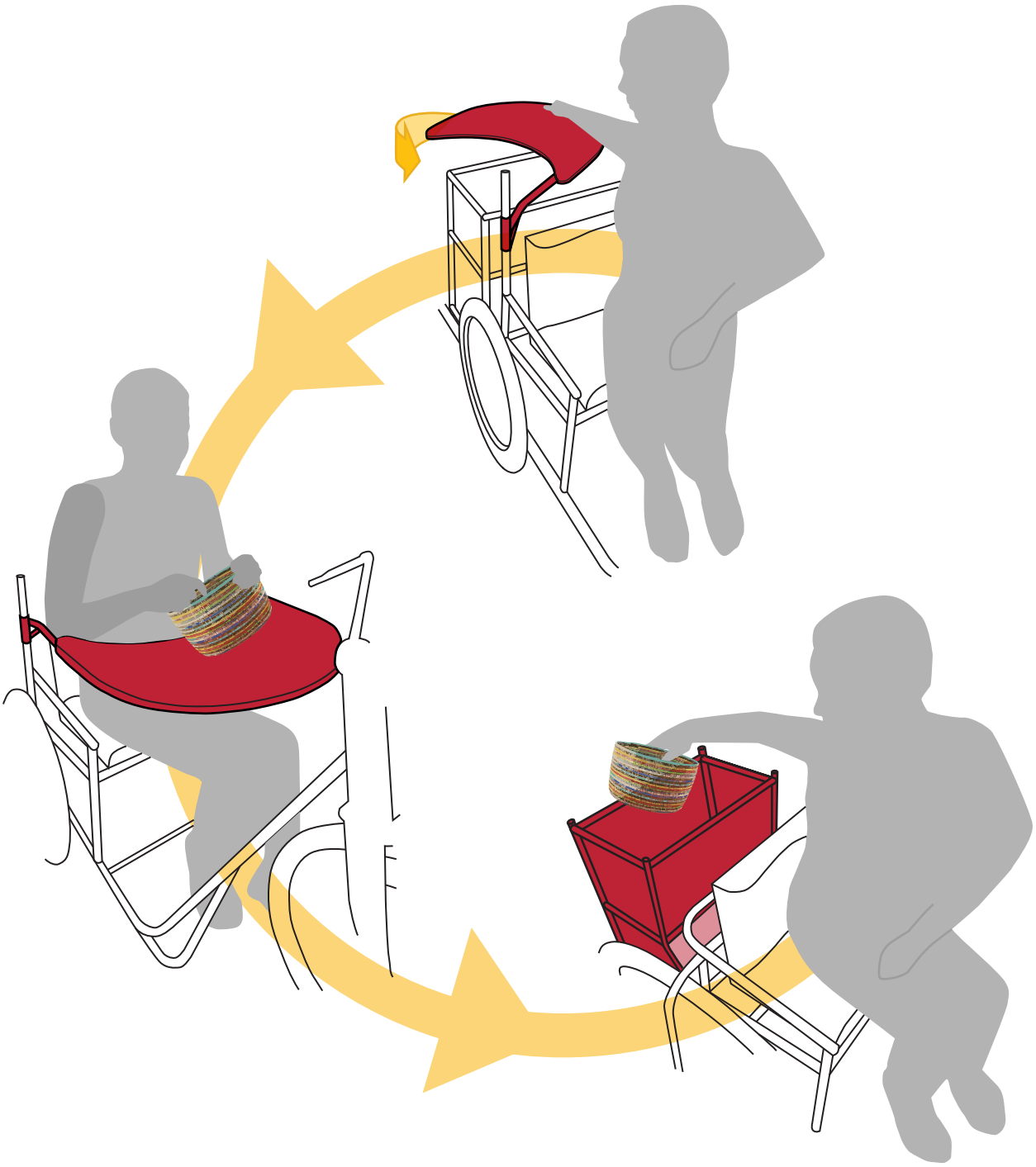




I made scale models to see if the materials and configurations could handle the movement and weight requirements. I also needed to get an idea of the size of these devices to see if they would be comfortable for the user and to get an idea of how they would fit onto the existing tricycle. Building them by hand ensured that the processes were simple enough that they could be made by Kiyo, the local manufacturer.

INTENDED USE CYCLE

A STEP BY STEP GUIDE



ETHICS

ENSURING PARTICIPANTS' SAFETY

I submitted my ethics application in November, and after one revision it was accepted by the Carleton University Ethics board. I wanted to make sure my test plans were ethical and would not cause any physical or emotional stress for my test participants. In order to accomplish this, I had to consider the context in which I would be conducting the testing. People with disabilities are considered a high risk population, and I would be in a different culture with different beliefs and values, so I had to make sure my questions were appropriate while still obtaining the information that I needed to move forward with my project.

Additionally, I needed to create an oral consent script that would be easy to translate and understand for the participants. Because not everyone in Uganda can read and write, it was more appropriate to ask them orally rather than have them sign a consent form. It was also very important that they knew they could pause or withdraw at any time if they felt stressed, and that any and all input from them would be extremely valuable to me as a designer.

Lastly, I needed to communicate to the ethics board my intentions to encrypt and securely store the data recorded after the testing phase was over. These answers may be personal and it is important for the data to remain protected.

Meeting at Makerere University

Handicrafts are quite varied

DEFINITIVE DESIGN DEVELOPMENT

RECOUNTING MY TRIP

To conduct accurate user testing, I traveled to the district of Kasese in Uganda. There I could test with women with disabilities in the context it would eventually be made and used. I had packed one of my pre-made devices with me, and I sent Kiyo drawings of the other device so I could be ready to test as soon as arrived. I traveled there with the intentions of testing by asking participants a few background questions, asking them to complete a few simple tasks with the devices, and then having a follow up dialogue to see what they did and did not like about the system I designed.

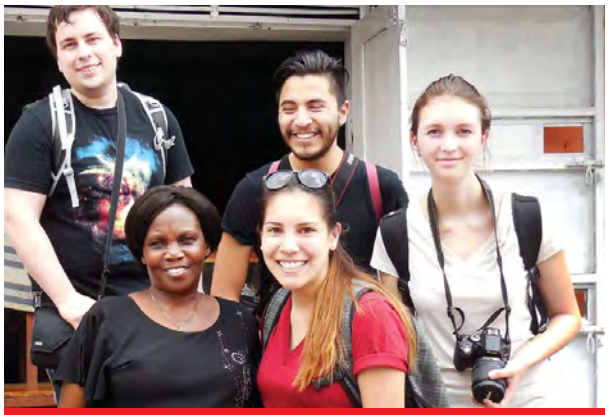
One of the first places we visited upon arriving in Uganda was Makerere University where there is an engineering program that the Carleton School of Industrial Design has been trying to partner with. Each of us did a short presentation on our designs, followed by questions and comments from staff, students and faculty. One of the professors let me know that making handicrafts includes a wide variety of products. A flat workspace might not be versatile enough to afford creating many types of handicrafts. This was also the first mention of children I had heard. One of the professors immediately asked me if the women were away from the home creating or selling handicrafts, how their babies came along. This is something that I did not uncover in my research so I had not considered it. I kept it in the back of my mind while I continued forward.

A few days later I arrived at Kiyo's workshop and saw the device he manufactured for me for the first time. He either did not properly read my drawings, or took it upon himself to improve upon them, but the storage device was not exactly how I had drawn it. However it was still sufficient to do interviews with women.

The manufactured storage unit was not what I expected but worked well none the less

Maria tries out the hand pedalled tricycle with the storage unit on the back

Jonoless, baby Sarah, Sylvia & myself



Mary, myself, and fellow classmates

All involved gathered for a meeting to hear about our designs

Baby Fiona is tied onto her mother's back, as is typically done in Uganda

Once I started asking Once I started asking women with disabilities about the work space attachment and storage device, they had positive feedback. However, for a second time I was asked how the child could go with the mother. It was at this point that I started seriously considering this suggestion.

I continued testing and sketching with the thought of children still in my mind. A couple days later I was able to meet both Mary from KADIWOD and Sylvia. I pitched them my design and both were delighted that I was focusing on women with disabilities as often women are overlooked. But again, Mary asked me how the mother leaves the household without the child, as typically babies are carried with their mothers everywhere. After some thought and deliberation I thought it best to change my focus from earning an income to allowing the mother to bring the child on the existing hand pedalled tricycle.

Once I switched my focus, I changed the type of testing I conducted. I needed more information on mothers and children so I conducted interviews with mothers and women with disabilities. Again, Mary and Sylvia gave me a lot of help and insight, and I also interviewed Alice, a little person, and Jonoless, a woman with two children of her own. I learned that 50% of the population in Uganda is made up of children, and that these children stay with their mothers until they are two years old. Typically, they are tied to the mother's front or back with a piece of cloth. However, women who use the hand pedalled tricycle had no where to put the child as their back was against the backrest and their arms and the pedals of the tricycle came too close to their front for it to be safe to carry a child there.

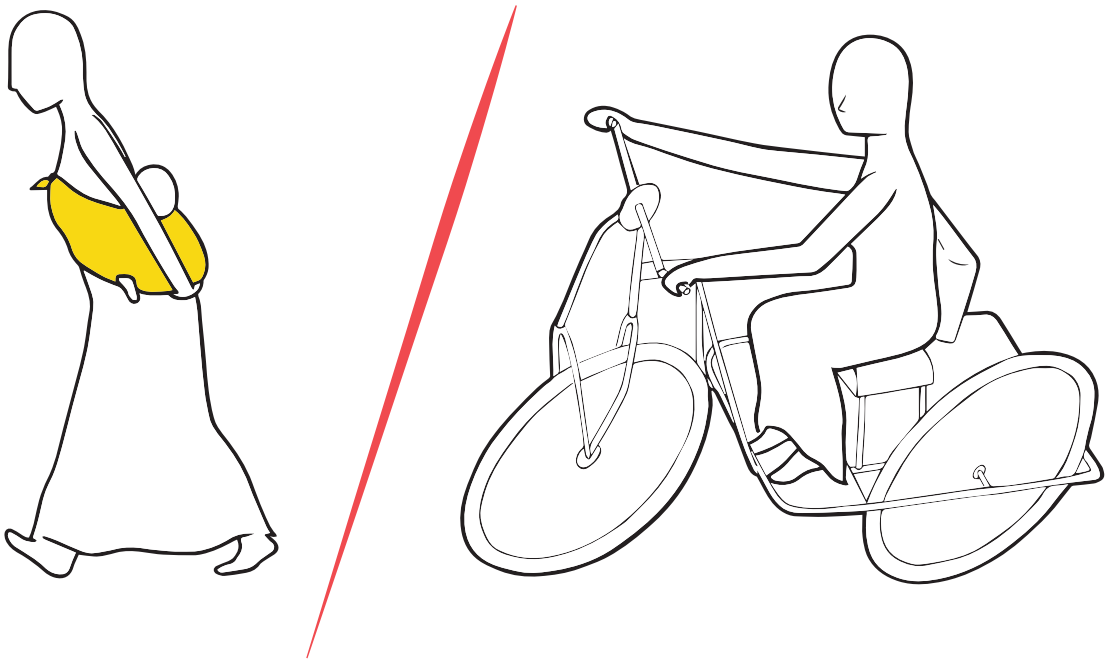
I continued to ideate and study local materials that could be acquired at local markets. I left Uganda with a completely new focus from when I arrived. The biggest overarching lesson I learned is that co-design is crucial to any design process. As much as you assume about a target user, there will always be something you didn't consider that can only be learned from working together with the end user. This is the only way a design can be successful.

50% of Uganda's population is children

Mothers carry their babies everywhere

REDEFINING THE OPPORTUNITY

TAKING A CLOSER LOOK AT THE REAL PROBLEM



...But where do the babies go?

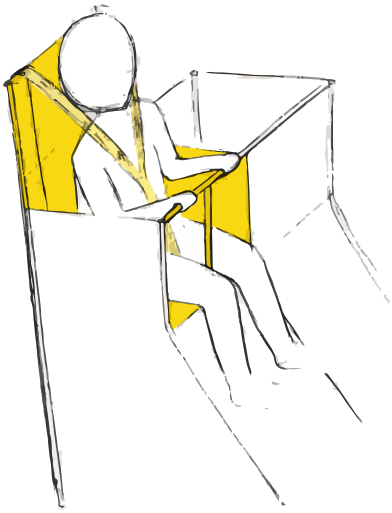
As mentioned, it was discovered that creating and selling handicrafts was not as big of an issue for mothers as carrying around their child was. Because of this, I changed my design focus to better suit the needs of the end users. I decided instead to design a child carrier for the existing hand pedalled tricycle so mothers would have a way to transport both themselves and their babies.

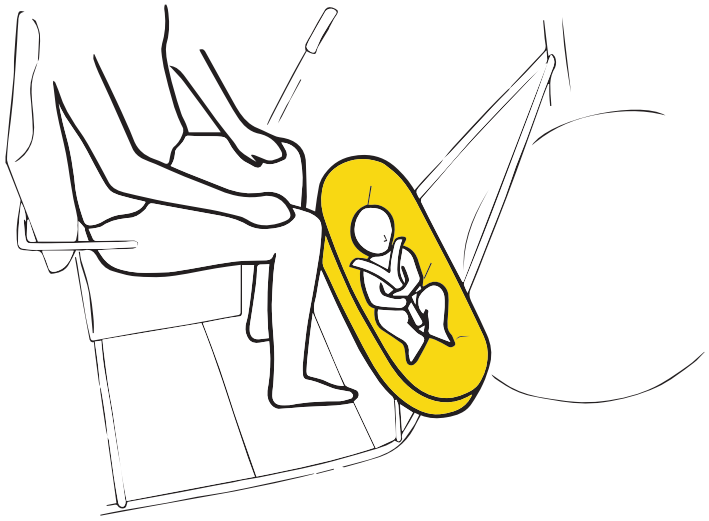
Through research I discovered that by eight or nine months a child is able to sit up by themselves. I split my designs into two categories: bassinets for infants who could not yet sit up, and child seat for children over the age of nine months who could sit up by themselves. The bassinet was designed to be in front of the mother so she could easily tend to her young child, but the child seat was placed in the back for more room. I later focused solely on the child seat for older children due to time constraints of the project.

I modeled my next design somewhat after a bicycle child seat in terms of ergonomics and safety features. Both are for children and both are used similarly.

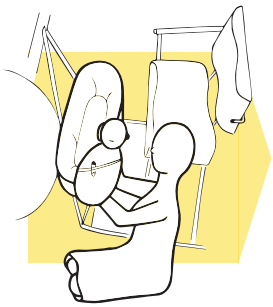
REDEFINING THE USE CYCLE

TAKING A CLOSER LOOK AT THE REAL PROBLEM

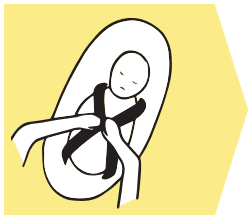




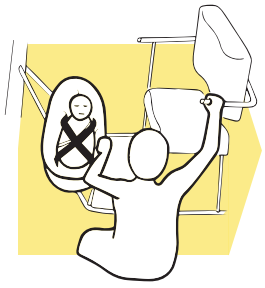
Place baby in cot

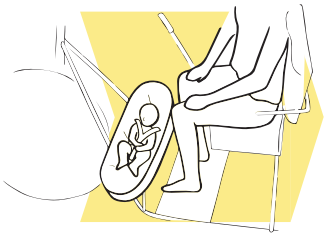


Fasten harness

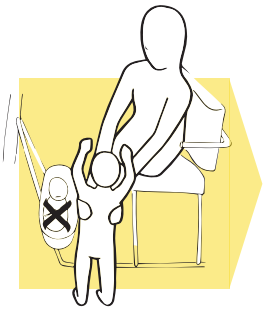


Climb into tricycle

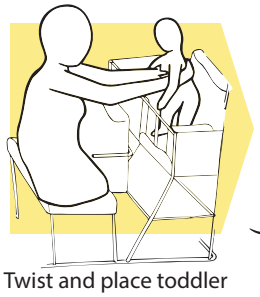




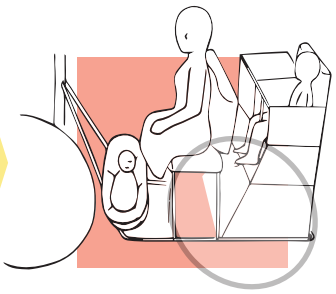
Room for legs



Lift toddler from tricycle



Twist and place toddler



FINAL DESIGN DEVELOPMENT

BRINGING ALL OF MY FINDINGS TOGETHER

IN CONTEXT

PROBLEM STATEMENT

The existing tricycle is great for getting from place to place, but does not afford earning an income.

The carrying device has ample room to carry goods to the market to be sold. Earning an income gives the user more financial independence.

More important to Ugandan women, it does not allow the user to carry a child, typically done until the child is 2.

The device allows the user to bring their child with them in their daily chores and activities so they don't have to sacrifice being a mother while using the tricycle.

USE CYCLE

The final design includes ample room to store and transport goods to sell them, but also includes a child seat for children eight months or older. This design is safe, ergonomically comfortable, easy to manufacture and repair locally, affordable, rugged and empowering.

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