E-KIDTS

DESIGNED BY WILLIAM PERRY

Title: E-KIDTS

Research Question:

How can building an Electric Motorbike inspire the next generation of builders?

Abstract

Encouraging creativity among people is important, especially during their teenage years. Unfortunately, most educational projects lack excitement as well as practical applications. How can building an electric motorbike inspire the next generation of builders? Aimed to spark interest in science, technology, engineering, and math, STEM, I have created a consumer-direct kit where teenagers and adults alike are able to build and ride their own electric bike, capable of speeds up to 28 mph. The frame is made out of recycled High-Density Polyethylene plastic, HDPE, allowing the kit's color to be customized while also remaining sustainable. Through the power of hands-on work, builders will have the exciting and rare opportunity to assemble their own electric bike. The next steps for this product are to continue research and development, identify a supplier and secure an intellectual patent to protect the E-KIDTS business model for further product development.

Product goals significance

The formation of this motorbike occured in three different stages, beginning with ideation, followed by prototyping, then user testing. The final product is a motorbike kit made from recycled plastic, designed to be shipped in the mail and built by the rider. Through building building electric bikes on my own, I aim to streamline the process for other individuals interested in building their own motorbike. Believing an engineering degree is not required to be able to build something, my goal is for this message to resonate with the builder and encourage them to continue hands-on-learning.

Context/Background/History

Today, children spend half the time outside than their parents did.[1] As our world becomes increasingly digitized, many youth find themselves in front of an iPad instead of playing outside. As a result, Generation Z (born after the year 2000) misses out on critical developmental experiences that many educators consider the building blocks of learning.

STEM initiatives attempt to provide meaningful educational experiences. Unfortunately, most educational projects lack excitement as well as practical applications. The Bridge Building Challenge is a staple of many after-school programs: students use popsicle sticks, paper and tape to suspend large textbooks. Once students complete, or lose interest in the project, the lessons learned in the project are often forgotten. Instead, what if there was a project that promoted critical thinking, collaboration and confidence as well as excitement, not just during the building of the project... but for years to come?

E-KIDTS offers the next evolution of the vehicle: one designed and built by the rider. As such, our product asks children to *build* their next toy, rather than *order* or *download* it. The customer journey begins on the E-KIDTS builder app where individuals customize their new rides. First, t enter their height and age to sort them into one of two sizes, small or medium. Next, riders customize a base color and additional accessories and features. Press print and the package arrives in six weeks! Included in the package are all the necessary components, tools, and

1 Association, Press. "Children Spend Only Half as Much Time Playing outside as Their Parents Did." The Guardian. July 27, 2016. Accessed May 6, 2019. https://www.theguardian.com/environment/2016/jul/27/children-spend-only-half-the-time-playing-outside-as-their-parents-did.

directions required for the child and parent to assemble their own electric motorbike or customized ride.

The necessity of developing constructive working child-parent relationships cannot be understated. Parents are often who children look to for guidance and inspiration. By working together through building this motorbike, trust and openness are distilled in a parent-child relationship. E-KIDTS present itself as a practical education for people living in a materialistic world. In fact, the sequence of facing, failing and overcoming a challenge is essential to future success. E-KIDTS provides both a physical and intellectual challenge in a safe, structured environment. Built with simplicity in mind, the kit is designed to be built within an afternoon, allowing the creation to be ridden the same day.

E-KIDTS is manufactured with recycled High-Density Polyethylene, HDPE. HDPE provides an environmentally friendly, durable weather-proof frame. Another benefit of HDPE is the opportunity for color customization, this market need was identified through user research and product testing. E-KIDTS are powered by a 1000-watt hub motor, integrated into the rear wheel, capable of pushing the rider up to 28 mph. Password protected speed controls allow parents of adrenaline-filled children to set max limits. In current form, E-KIDTS are pedal-less. Riders propel themselves with a throttle, giving it the legal classification of an off road motorbike. Legally, these electric motorbikes operate on trails permitting as well as private property. As riders develop and grow larger physically, they may outgrow their current frame and need a larger one. All E-KIDTS components are interchangeable throughout models, reducing waste and saving the builders money.

Literature Review

As children get older, their interests tend to change, but bicycling remains a constant source of excitement throughout childhood and even adulthood. As the World Health Organization (WHO) considers adolescents to be from ages 10-19, this is an important time where and children find their interests develop their personalities. For those interested in STEM-based fields, there are few products in the market that teach individuals and while providing them with continuous excitement.

The Product:

E-KIDTS is an electric motorbike kit, giving adolescent children and adults like the experience of building and riding their own creation. Through a process similar to building an IKEA table, KIDT will arrive at the builder's house a flat pack box with an instruction manual. Built with simplicity in mind, the kit is designed to be built within an afternoon, allowing the creation to be ridden the same day. The bike has a minimal impact on the environment as it is made out of high-grade plywood and aluminum reinforcements. While plywood was been used in the prototypes, there is the ability for the frame to be cut out of recycled HDPE, which would weather-proof the frame while remaining eco-friendly. The bike is powered by 1000-watt hub motor, integrated into the rear wheel, capable of pushing the rider up to 28 mph. Several reasons lead me to a hub motor including its durability and simplicity. With the age demographic ranging from 16 years and older, I did not want to over complicate the build process using a gear system with pedals. Instead, riders will propel themselves with a twist throttle on the handlebars, similar to a classic dirt bike. Due to the fact E-KIDTS is electric and does not have pedals, and is powered

via a throttle, it is considered an dirt bike. Once again, given the current state of this product, and general laws regarding electric bikes and e-scooters, E-KIDTS is also restricted to only be ridden on private property. Despite this factor limiting areas of operation, future models are intended to meet bike trail and road standards. Despite its position as cultural normality among children, data has shown "bicycling has declined as an activity for kids. Between 2007 and 2016, the percentage of youth ages 6-17 riding bicycles decreased by nearly 7%. (from 30.9% to 24.2%)"[2] This product will encourage children to pursue STEM-based interests while staying active outside. Through improving upon something children already find interesting, bicycling, I have found an untapped market for children who are interested in building electric devices they can ride on.

The Assembly:

Before the 21st century, shop class was a standard in high schools across America, however, with the rise of technology, its importance has been overlooked. Shop classes are unique to the school system, as it provides students with creative thinking skills that cannot be derived from looking at a screen. Matthew Crawford, author of *Shop Class as Soulcraft*, dives into this the difference thinking and doing. He explains how the lack of skilled manual labor has created a "more passive and more dependent" society. In Crawford's final remarks, he gives advice directly to a young person, encouraging them to approach college in the spirit of a craftsman, "In the summers, learn a manual trade. You're likely to be less damaged, and quite possibly better paid, as an independent tradesman than as a cubicle-dwelling tender of

[2] Care.com, Inc. "Why Is Learning to Ride a Bike Important for Kids?" Care.com. February 10, 2017. Accessed February 05, 2019. https://www.care.com/c/stories/9490/why-is-learning-to-ride-a-bike-important-for/.

information systems." [3] Richard Sennett expands on this topic as he depicts the dependency we have on manual labor in his book, *The Craftsman.* Sennett views it is a human impulse to do well for its own sake, but in a world where a fraction of the population is capable of working with their hands, skilled manual laborers are becoming more valuable [4]. Exploring the connection between material consciousness and ethical values, Sennett's words are closely related to many topics this project tackles. I believe building something yourself forms a special connection between you and the creation of a connection, but why can't consumers have this experience too? Building something and then being able to use it can be one of the most gratifying feelings someone can have. Through the creation of this kit, users will build their own pocket bike and have the liberty to ride it. This kit also serves as a learning opportunity, about bike fabrication but also the builder. There is a stigma in society today that says only engineers can build things, I think this is discouraging and incorrect. Through building this electric motorbike, I hope to stimulate creativity and confidence, motivating these builders to follow their ideas and make them possible.

As the skill of hands-on work begins to fade out of school curriculum, it is important to see where else you can get hands-on building skills. While IKEA furniture is most likely the last thing you have assembled from a kit with instructions, it is also likely you felt good about what you made. You didn't design it, didn't even pick up a pencil! But because you invested your time and effort into assembling that coffee table or bed frame, you treasure it more. This is called the IKEA effect, the satisfaction a customer gets after assembling something themselves.[5] This project is not the first of its kind, there are several transit-oriented products on the market that

---

[3] Crawford, Matthew B. *Shop Class as Soulcraft: an Inquiry into the Value of Work*. Penguin Books, 2009. Pg 54

[4] Sennett, Richard. *The Craftsman*. Penguin Books, 2008.

[5] Ariely, Dan, and Dan Ariely. "Why We're so Attached to Our Own Creations - Even When They're Ugly." Ideas.ted.com. December 16, 2016. Accessed February 21, 2019. https://ideas.ted.com/why-were-so-attached-to-our-own-creations-even-when-theyre-ugly/.

are centered around user assembly. Such as Dutch designer, Basten Leijh, who created Sandwich bikes in 2006 and is currently the closest related product to the BYOB, as it is a wooden bike that comes disassembled in a flat-pack box. While these products share a similar concept and material, they vary in different shape, functionality, and environmental impact. Starting at a price just over €799 [6] ($1,000) this product looks to be a statement more than a functional piece, but given the emphasis, the Netherlands have on bicycles, this product a niche market of unique designer bikes. Following the trend of user assembly bikes, the Fictiv/ FOSMC has made its mark in the transportation industry as the first open source motorcycle. The first of its kind, Fictiv is "a manufacturing platform and the most efficient way to fabricate parts. Our mission is to democratize hardware development by providing universal access to the best tools for prototyping and manufacturing." [7] While this requires a certain level of building experience, this company has taken down numerous barriers preventing people from building their own motorcycle. By sending the files to a local machine shop, users can build their own street-legal motorcycle "with nothing but a wrench and some hand tools." [8] While both of these products differ in size, they are still considered weekend projects. Advertising on Fictiv's website, "In just a weekend, you can build a custom-designed, street-legal motorcycle".[9] When building the electric pocket bike, the assembly is designed to only take a couple hours (2-4) allowing the builder to enjoy their creation in the same day.

---

[6] Lavars, Nick. "Wood-Framed Sandwichbike Ready to Hit the Streets." *New Atlas - New Technology & Science News*, New Atlas, 29 Nov. 2013, www.newatlas.com/wooden-sandwich-bike/29963/.
[7] Fictiv/FOSMC, 2017, https://www.fictiv.com/blog/fosmc
[8] Fictiv/FOSMC, 2017
[9] Fictiv/FOSMC, 2017

The Experience:

Riding bikes has always appealed to children for the thrill, freedom, and responsibility it provides. On top of assembling the motorbike, the children will gain skills while riding their creation. Designed for someone interested in entering the motorbike realm, E-KIDTS provide increased dexterity, through frame geometry and twist throttle. Emulating the frame of a motorcycle, riders will learn how to operate motor-powered vehicles along with proper riding technique. Like any other bike, E-KIDTS provide riders with an enhanced sense of freedom, allowing them to explore further distances in less time. Everything an adventurous individual could want, all on something they built. Communities can also arise from this product, having gathering places where kids can race the bikes they build, similar to the Boy Scouts Pinewood Derby race. As mentioned earlier, this product has the opportunity to serve as a learning tool in schools, providing half or full day entertainment for students interested. Kits can either be sold to the kids who built at the end of the day, or the kits can be taken apart and reused in for another school assembly. Schools not only have the children interested in building things, but the infrastructure to allow children to ride. Finally, E-KIDTS provides riders with a sense of responsibility through the act of building something on their own, known as the IKEA effect, evoking sentimental value within a product.

The Benefits:

Along with building a tangible product, the completion of the electric scooter promotes a sense of accomplishment and pride within the builder. Most products on the market are complete products, requiring zero assembly, but that is where this product differs. Through

hands-on work, a more intimate connection between the builder and scooter if formed. Gaining insight on not only what the components do, but how they work together. In addition to building the stock scooter, the users will be able to customize their ride, furthering their emotional investment. In a PBS article, writer Cheryl Lock highlights the internal benefits between children and the arts. Studies show how the arts can instill pride, teach real-world skills, increase test scores, increased opportunities for self-expression, and even create a sense of being through a community.[10] While the arts may not fit in everyone's daily life, their impact does. An educational consultant and arts/literacy curriculum writer and teaching trainer, Dory Kanter said, "The arts are a great leveler, as we are all in the same boat, learning to create and succeed in new and unexpected ways". She continued by saying, "Children not only become appreciators of each other's work but also develop skills of self-reflection in the effort to bring their personal vision to fruition." [11] Distilling this behavior and thought process in children is not something that cannot be forced, rather, encouraged. In the article, *The Art of Happiness and Self-Esteem,* writers Holly Oberacker and Tracey Bromley Goodwin, discuss the various techniques parents can do to enable a child with ADHD, allowing them to see their strengths in a world that too often criticizes. In response to the children's shortened attention span, it is shown immediate goals obtained through hands-on work invoke a greater reward in their behavior complex, encouraging the act of building. After the bike is built and ridden, it still holds significance, serving as a visual reminder of builder's hard work, enforcing accomplishment and pride.[12] While there is potential for adolescent children to buy this product strictly for the riding experience, the assembly process is an unavoidable part that encourages riders to think deeper about how their toys work.

---

[10] Lock, Cheryl. "Turn to the Arts to Boost Self-Esteem." PBS. May 25, 2012. Accessed January 30, 2019. http://www.pbs.org/parents/education/music-arts/turn-to-the-arts-to-boost-self-esteem/.

11 Lock Cheryl, PBS

[12] Oberacker, Holly, and Tracey Bromley Goodwin. "The Art of Happiness and Self-Esteem." ADDitude Magazine. January 29, 2019. Accessed January 30, 2019. https://www.additudemag.com/creativity-and-adhd/.

In esteem to children's development of emotions surrounding the build process, this kit also has the ability to foster new and existing relationships. While it is encouraged for an adult to supervise and look over their work before riding, or to get their own kit, the bike is designed simple enough to be built by a child, allowing them to maximize the physiological reward of completing it. Being said, this kit serves as the perfect bonding tool between parents and children. Through teamwork, the builders are able to share the experience of riding their creation all within a couple hours of unboxing the kit. This rapid build and use concept can take place in a variety of settings whether it be a children's play date or a school-sponsored event allowing children get to build their own bike and use it all within the same day.

Methodology

The formation of this motorbike occured in three different stages, beginning with ideation, followed by prototyping, then user testing. With the final product being a kit the user assembles themselves, I will primarily be working on the design and manufacturing process behind these kits. Believing an engineering degree is not required to be able to build something, my goal is for this message to resonate with the builder and encourage them to continue hands-on-learning.

This project all started with the intent to re-use decommissioned Lime BIke frames, however, as this project became closer to a product, the direction changed quite a bit. Rather than retrofitting electric bike components onto discarded bike frames, I wanted users to have a more significant part in the building process, requiring me to shift the focus. The bike frame is now made from recycled plastic, providing benefits touching sustainability, durability, customization, and product distribution.

The ideation phase of this project took the most effort, as I began to design a brand new product. Inspired by the timeless design of the cafe racer motorcycle along with the simplicity of assembly found in a balsa wood airplane, the first bikes began to take shape. From the paper, the designs were then taken into illustrator, an Adobe Creative software allowing me to turn my

sketches into scaled drawings. After creating numerous digital models, I decided to create a miniature model at ¼ scale. These models were created by importing the illustrator file into Rhino, which then allow the file to be sent to a laser cutter and cut out of ¼ plywood. Using these wood cut outs, I was able to simulate the build experience each of these models brought to the user. With various characteristics of each model furthering the frame design, I finalized the first full scale prototype and cut it out of ¾ plywood using a CNC machine.

Before the first prototype could be cut out, the computer file was sent to Rhino, a 3D computer software, where I used RhinoMILL, a processing system that tells the CNC machine what cuts to make. Once all the commands were completed, the file was exported into G code, an old-school coding language that the CNC machine uses. Taking approximately 55 minutes to cut out the first frame, an additional 35 minutes were used for machine set up, break down, and clean up. Once the frame was complete, I took all the components to a table router, where the sharp edges were rounded out, giving the builder a better tactile experience. In total, the frame of the first prototype took approximately 2 hours and 15 minutes to make. Following this achievement, I ran into the biggest challenge of the project, which was securing the bike fork. For the first prototype, I chose to use a compression method to hold the bike's head tube, to where I fashioned an apparatus out of scrap 2"x 4". Staying true to the tests I put it through, I put the front fork apparatus on the burner, to be solved at a later date. I soon gathered all the bolts, washers, and nuts required to build the bike, allowing the first prototype to be assembled. Powered by a 20" 250 watt hub motor sourced from Amazon and a 36v 14ah lithium ion battery and controller sourced from Propella Electric Bikes, the final component needed, a bike fork and front wheel, were bought off Craigslist. The bike took about 55 minutes to assemble and had a top cruising speed of 15 mph. Within a week of building the bike I had already made some major design changes to the frame in terms of dimensions and ergonomic comfort, however, I still wanted to hear what people had to say about the bike. My friend's 12 year old brother and his parents were the first people to build their own bike, with the help of a instructions manual. From this preliminary round of user testing, I was able to reinforce my ergonomic changes to the bike, along with find out more information on what the target audience would like. These recommendations included color customization, wider tires, and a higher top speed. The feedback showed to be very useful, as the second iteration of the bike had significant improvements.

Once I had received an adequate amount of feedback on the bike, I went back into Rhino, where I made alterations to the frame accommodating a larger seat, larger tires, and the relocation of the battery to name a few improvements. With the date of Senior project night approaching, I decided it was the right time to invest in the final material, a 4'x 8' sheet of recycled High-Density Polyethylene, HDPE, plastic. Deciding to purchase glossy black HDPE due to it's price, neutral color, and relatively close proximity, I quickly brought it to the CNC machine and did the same process as before. Due to the increased number of components, the cut time took approximately 1:20 for the CNC with an additional 35 minutes of setup, break down down, and clean up. In addition to 20 minutes of routing the edges of the frame, the second prototype frame took about 2:20 to complete. The next steps to achieve a functioning second prototype included getting a new set hardware, battery, hub motor, fork, and head tube support This was achieved by bringing my bike into the local True Value and hand picking what worked and what didn't, allowing me to create an itemized list. The second and third tasks were completed by Seattle's very own local business, Amazon, where I purchased a 48v 10.4 aH lithium Ion battery and a 1000W 48v fat tire hub motor. The front fork and front tire match the fat tire in the back, using 4" x 20" wheels to absorb the impact of the road, due to the fact the motorbike doesn't have suspension, these components were taken from a donor bike. Finally, the long awaited problem of how to mount the front fork had come upon me. Dedicated to move away from the clamp method of securing the head tube, I made my own support out of aluminum pipe and square bar. Outsourcing the welding task to a friend who runs a shop, the head tube apparatus was complete after all the bearings were inlaid and secured. With the bike nearly complete, all the component came in right on time, allowing me to test drive the first bike, and needless to say, it was a blast. Propelling the rider up to 28 mph, this motorbike is a blast to drive and appealing to look at. Despite not having pedals, the torque on the bike is able to push the rider up most hills at a decent speed, getting close to 8 miles range per charge in hilly terrain and even more if riding on flat ground. With both front and rear disc brakes, this vehicle not only able to jump off the line and also stop on a dime. The current frame is designed to shipped through the mail in box, behind said, the holes throughout the frame line up with one another, minimizing wasted space and high shipping fees.

Assessment

As I come to wrap up this project, I believe I have reached the goal I had set out for over approximately 12 months ago. First, I went through the design process, coming up with variations of what this project could be, ultimately refining the design allowing me to make the first prototype. Through user testing and public feedback, I refined the design and the build process, creating a more interactive and exciting build experience. While there are several things I improved upon though my second model, such as speed and battery power, I believe this product would be more practical if the individual could build one of two options, a class III electric bike, or a street legal motorcycle. While these two modes of transportation have their differences, they also are very similar can could be the base for a build you own ebike and motorcycle company. Nonetheless, the instruction manual gives users a good idea of this business model, allowing them to experience what it's like to build their own electric motorbike.

Introduction:

My name is William Perry, I received my degree in Community, Environment, and Planning from the University of Washington in Seattle, Wa. Along with receiving a minor in Digital Arts and Experimental Media, I joined an Electric Bike start up my first year of college, to where I have 3 years of industry experience as an industrial designer. Serving as the head of advertising of the only student-run major at the University of Washington, I took on the responsibility of representing the ideals and morals of 80+ students. Holding equity, equality, and diversity close our heart, I produce positive content that is seen by thousands of potential students across the greater Seattle Area.

Along with my ability to delegate tasks, lead by example, and work with others, I have extensive experience facilitated numerous participatory design classes surrounding urban issues. Whether I am creating a new space or refining an existing one, believe it is important to work with the people you are designing for through user research, to create a wholesome product that enhances an existing system. I have brought these techniques out of the classroom where I conduct user testing for Propella Electric Bikes. Throughout my time working for a startup, I have gained behind the scene experience of prototyping, user testing, working with manufacturers, and launching a product in the market all in a timely manner.

As my interests revolve around sustainable business design and practices, I have created a number of products that highlight who I am. Learning through hands-on work, I have built multiple electric bikes as well as an off-road electric dirt-bike. Flexible between mediums, I have several works in with virtual reality, ambisonic/ 3D audio, and projection mapping. Incorporating smart design practices into all my projects, I am efficient and effective with my time and materials. My experience designing with communities, various mediums, and launching products has blessed me a multifaceted lens to which I use to create *really cool experiences.*

Bibliography

"Bike Sharing." *Pedestrian & Bicycle Information Center*, www.pedbikeinfo.org/programs/promote_bikeshare.cfm.

Goins, David. "Hundreds of Rental Bikes End up at Dallas Recycling Facility after Ofo Leaves." *KING5*, 8 Aug. 2018, www.king5.com/article/news/local/hundreds-of-rental-bikes-end-up-at-dallas-recycling-facility-after-ofo-leaves/281-581618970.

Crowe, Michael. "What Will Happen to Ofo Bikes in Seattle? Some Meet Their End at Recycling Center." *KING5*, 9 Aug. 2018, www.king5.com/article/news/local/what-will-happen-to-ofo-bikes-in-seattle-some-meet-their-end-at-recycling-center/281-581852854.

Lavars, Nick. "Wood-Framed Sandwichbike Ready to Hit the Streets." *New Atlas - New Technology & Science News*, New Atlas, 29 Nov. 2013, www.newatlas.com/wooden-sandwich-bike/29963/.

Repossessed Plastics inc. Material Safety Data Sheet http://gipo-rpi.com/wp-content/uploads/2015/03/recycled-hdpe-msds.pdf

Crawford, Matthew B. *Shop Class as Soulcraft: an Inquiry into the Value of Work*. Penguin Books, 2009.

Sennett, Richard. *The Craftsman*. Penguin Books, 2008.

"Frequent Questions Regarding EPA's Facts and Figures about Materials, Waste and Recycling." *EPA*, Environmental Protection Agency, 20 Sept. 2018, www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/frequent-questions-regarding-epas-facts-and#Percentages_of_Recycled_Materials.

Roston, Eric. *Bloomberg.com*, Bloomberg, 11 June 2018, www.bloomberg.com/quicktake/recycling-crisis.

"What Are HDPE Plastic Bottles and Their Common Uses?" *Plastic & Glass Bottles*, www.thebottleguide.com/plastic-bottles/hdpe.html.

Fictiv/FOSMC, 2017,
https://www.fictiv.com/blog/fosmc

“Helping Minority Communities Connect to Bicycling and Walking.” *Pedestrian & Bicycle Information Center*, PBIC, www.pedbikeinfo.org/data/library/details.cfm?id=4349.

Taylor, Alan. “China Is Still Sorting Through Its Colorful Bike-Share Graveyards.” *The Atlantic*, Atlantic Media Company, 1 Aug. 2018, www.theatlantic.com/photo/2018/08/china-abandoned-bike-share-graveyards/566576/.

Institute of Lifecycle Energy Analysis, University of Victoria, Canada, and Martin Hocking, Dr. Report. Chemistry, University of Victoria. 2002. Accessed November 20, 2018. https://sustainability.tufts.edu/wp-content/uploads/Comparativelifecyclecosts.pdf.

Independent media institute. "The Complex and Frustrating Reality of Recycling Plastic." EcoWatch. October 29, 2018. Accessed November 25, 2018. https://www.ecowatch.com/recycling-plastic-reality-2615116844.html.

White, Malcolm. "Woodshop vs. Computers - National Institute for Student-Centered Education." National Institute for StudentCentered Education. December 03, 2013. Accessed November 22, 2018. http://nisce.org/blog/features/wood-shop-vs-computers/.