PROJECT DESCRIPTION

Tell us about your project! What inspired it, and how does it capture the maker spirit? Does it solve a real-world problem or bring a new idea to life?

Diaper changing is a defining activity of parenthood, occurring several times a day, for years on end. Several factors complicate the diaper changing process, but one that requires immediate attention is the need for a clean, level, and stable platform on which to lay the baby, especially when traveling. Many public restrooms have changing tables mounted on the walls, but many do not. Even if they do, they are often in poor condition or mounted in the handicap stall, which is not always available. Even if every public restroom had a clean and accessible changing table, many parents experience the inevitability of needing to change a dirty diaper while being miles from the nearest restroom. In this case, some options include laying the baby on the seat of the car, on the floor in the trunk, on the hood of the car, on top of the trunk, or on the ground. None of these options is ideal because the seats aren't flat or large enough, while on top of the car and on the ground are dangerous options that frighten the child, leading to an even more complicated diaper change. To ease this pain point for parents, a portable changing table must be designed.

Most changing tables have the same basic design: a sturdy, level platform, big enough to hold a baby. To make it portable, it must be lightweight and compact to fit in the average diaper bag or be stored in the car when not in use. It can be made compact by designing a thin platform that can fold or telescope out to full size. The table must also be light enough to be comfortably carried in the diaper bag. Changing tables often have other features like soft padding, raised edges or straps to hold the baby, or a built-in wipe or diaper dispenser.

This project involves prototyping and other R&D activities to develop a portable changing table that can provide a level and safe place to change a baby's diaper in any location. The prototyping must also be accompanied by feedback from parents to know which direction to move, which features are necessary, and which are luxuries. This collaborative effort will ensure that the developed product will meet the needs of parents and solve a problem they face daily.

PROJECT EXECUTION PLAN

Describe your project roadmap. Outline where you will begin, the steps you'll take along the way, and the technologies or tools you plan to use (e.g., 3D printing, laser cutting, etc.).

The project is organized into 6 phases.

Phase 1 includes gathering opinions of the parents of diaper-wearing children through surveys and interviews. This information is essential to understand what the most valued aspects of changing tables are and to answer questions like the optimal size and weight dimensions of the table when collapsed. If funding is provided, a small monetary incentive will be awarded to participants of this phase. This phase also includes making preliminary sketches and developing an abstract model for the product.

In Phase 2, the sketches and CAD will be used to develop physical prototypes. This phase includes experimenting with different construction materials (metal, PETG, polycarbonate) to investigate their benefits and drawbacks. Simple sketches will be hand-drawn on paper, and SolidWorks will be used to render a 3D model. 3D printing will be used to manufacture plastic parts. Components from other materials are expected to be simple enough to require only hand-cutting and hand-tooling. This prototyping phase will undergo iterations until a reasonable version can be used and tested. Several replicates of the quasi-final design will be manufactured.

The prototypes will undergo safety testing in Phase 3. The safety testing will address concerns such as the weight limit and ease of cleaning. Safety testing will involve test dummies to not endanger any children. Ease of cleaning will be partly evaluated by testing various household cleaners on replicate prototypes and observing the wear over an extended period. The results of these tests may require returning to Phase 2 to reiterate and solve problems that weren't previously identified.

In Phase 4, the prototypes will be supplied to parents for field testing and review. The parents will be asked to use the prototype whenever possible when changing a diaper and record drawbacks and pain points, as well as features they appreciate. The parents will be provided a list of intended features of the current prototype, and asked to score each one based on how often that feature was used or how much easier it made the task. Participants will also be asked to provide an overall satisfaction rating. As with Phase 2, participants will be awarded a small incentive for their active cooperation. At the end of this phase, the comments will be collected and reviewed. In Phase 5, revisions will be made to the prototype based on the parents' feedback. General communication with participants will be over email, and feedback will be collected via a custom survey form like Google Forms. Assuming no further iterations are needed, a patent application will be submitted in Phase 6.

Describe the most difficult part of your project—whether it's a specific component or step. How do you plan to tackle it?

Safety testing will be the most difficult part. Since this product is intended to be used on small children, it is essential that there is no inherent danger posed to the child. The child's safety can be assured by identifying all the possible risk factors and performing testing to define the limits within which the product is safe to use. While live, real-world testing is necessary to obtain feedback to help shape the product's design, the product must be deemed safe before use with real children. This may be attempted by simulating real-world scenarios with test dummies, but simulations often fail to accurately replicate the real world. The difficulty lies in identifying the risk factors and planning and performing sufficient realistic safety tests to address each risk.

I plan to address the product's safety by drawing on my own experience as a parent, as well as the experience of other parents, to identify what testing needs to be done. For example, when I have used a fold-down changing table that's hanging on a public restroom wall, the thought crossed my mind about the changing table breaking under the weight of my child. The weight limit can be routinely tested using various weights before a child is placed on the table. Other safety concerns may be whether any pinch-points could pinch the child, and how easy it is to clean the surface.

Please describe the resources needed for your project, including but not limited to budget, equipment, technical support, or any other tools and materials required.

The project is estimated to cost $5,500, split between three sections: materials, tools, and personnel.

Material ($2000): 3D printing filaments such as PLA and PETG, polycarbonate sheets, aluminum, and hardware. Although the size of the finished product is expected to be relatively small (50 x 25 x 0.5 cm^3), this budget includes material needed for initial R&D as well as replicates needed for testing.

Tools ($2500): A 3D printer such as the Bambu Lab P2S for rapid prototyping, a heat gun, and a multi-material cutter.

Personnel ($1000): Money to spend on gift cards or other incentives to encourage participation in focus group and field testing.

Assuming all the resources you mentioned above are provided, please estimate how long it will take you to complete the project.

The entire project is expected to take roughly 1 year. Phases 1-5 will require 1-3 months each and represent the bulk of the funding needed. Phase 6 is where the invention will be patented, which may take a few more years to complete.

Phase 1: Survey and Initial Design (1.5 months)

Phase 2: Prototyping (3 months)

Phase 3: Safety Testing (1 month)

Phase 4: Field Testing (2 months)

Phase 5: Revision (3 months)

Phase 6: Patent (1-3 years)

The proposed timeline assumes minimal supply chain delays, active participation in the focus groups, and is structured to allow steady progress alongside other ongoing commitments.

MAKER INTRODUCTION

We'd love to get to know you better. Tell us a little about yourself and why you believe you should be selected for the Let's Make It Fund.

Shortly after starting my chemical engineering degree, I began feeling dissatisfied. I learned that my previous view of engineering, where engineers spent their days in a lab designing and building cool new technologies, was grossly ignorant. Much of the work I was being trained to do in school was not so I could move on and create something revolutionary, but so I could sit at a desk and stare at a computer screen. I almost gave up on my degree, but then I took a class that was exactly what I had hoped for in an engineering degree: spending time in a lab designing and building things. This class had minimal paperwork, and the entire semester was one project after another, only taking a break between projects for each class member to present their project. During this class, I worked on several projects that piqued my interest: building a spectrophotometer and a photobioreactor out of recycled materials, synthesizing diesel fuel out of hemp seed oil, and developing a continuous process to manufacture alginate beads used for drug delivery. Each of these projects was meant to solve a real-world problem, or at least give us a taste of what solving that problem would entail. For example, the spectrophotometer was meant to show that lab equipment that may cost tens of thousands of dollars can often be made for less than $100. Most importantly, I learned from that class what I wanted to do with my career. I don’t want to join any regular engineering firm and watch temperature and pressure levels at an oil refinery (a typical job for chemical engineers), but I want to play a larger part in the development of a product that solves a real problem.

During my degree, I also learned that I like to be a part of each phase of the project, from conception to production. I attended a design thinking class that taught me about product design theory and specific techniques I could use in every step of a project. This class helped me understand that while physical prototyping is a necessary step, it’s important to give equal attention to preceding steps and do preliminary research to allow the initial design to be guided by the needs of the target community. These classes motivated me to finish my degree because they showed me that I was learning certain skills in my program that could be used to have a successful R&D career.

I got a taste of a career in R&D when I worked for a biotech startup designing rapid diagnostic equipment. The management of the startup was sympathetic to my desire to participate in as much of the product development as possible, and trained me in several areas in the company, including assay development, software engineering, and electrical engineering. Throughout my time there, I was able to draw on my chemical engineering education to solve problems related to heat transport and thermodynamics. By the time I left to start my graduate studies, I had developed a software data-processing tool that later inspired the company's full production database, developed a model for the heat transfer through their system to improve thermal control by several degrees Celsius, and designed and constructed a full-scale polymerase chain reaction machine that decreased diagnostic testing time by roughly 30%.

I'm currently pursuing my PhD in chemical engineering, continuing my R&D experience. My thesis involves interfacial instabilities in microgravity, and I've been granted permission to conduct experiments remotely on the International Space Station (ISS). As part of this project, I am leading a team in designing and constructing the experimental apparatus that will be flown to the ISS later this year. This project illustrates not only my continued interest in making things, but also in my ability to collaborate and make things given specific constraints.

Along with the technical experience I've acquired, I am also intimately familiar with the difficulties of parenting and the need for products that address them. As a parent, I have personally experienced the problems I've described and am therefore motivated to solve them. These problems are not unique to me, but are faced by countless parents and caregivers around the world. My technical experience in R&D, my familiarity with the problem, and the far-reaching impact of this idea make this an ideal project to fund.