

**PORTABLE HAMMOCK STAND DESIGN AND  
BUSINESS MODEL DEVELOPMENT**

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## **ABSTRACT**

Currently hammocks are thought of as stationary relaxation devices that use trees as support structures. The industry mainly focuses on hammock innovation over the way in which the hammock is actually hung. Having been around for thousands of years, reinventing the idea of the hammock is not something that is occurring or has been thought of.

This senior project proposes the idea of a portable or more adaptable hammock stand. It takes the idea of hammocks as stationary devices to them being something that can be taken almost anywhere. Shifting how hammocks are thought of and exposing the potential they possess by introducing an innovative hammock stand. The report discusses the design and use of a light weight easy to use hammock stand. Through market research and product development, a portable hammock stand is presented with a rough business plan as to how to make a sustainable business model around the product.

## **ACKNOWLEDGMENTS**

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## SECTION I INTRODUCTION

This report talks about the design and production of an innovative portable hammock stand. Upon reading this report one will learn the benefits of what a hammock offers as well as the extreme convenience a portable stand will provide. This will open the readers mind to new ways of thinking of hammocks and the possibilities they offer.

### **Problem Statement**

In today's market place there are many options when it comes to purchasing hammock stands, though one option seems to be unmet. People who are looking for a hammock stand that can be deployed with ease and easily conveyed will find themselves at a loss. Such a stand does not exist. Having the ability to easily deploy, store, and convey a hammock stand will touch on the lives of people who find themselves looking to easily relax. This product will be used by people who are capable of lifting anywhere from 20-50 lbs. and enjoy relaxing in hammocks. This project will focus mainly on backpackers/campers looking to use a hammock as their main means of sleeping and not have to haul around a large hammock stand or revert to sleeping on the ground.

At first, the redesign of the hammock stand may seem unnecessary when considering the stationary aspect of hammocks. This is a valid thought though it is not the redesign of the stand that is most important; it is the redesign of how hammocks are thought of. This product will make the hammock something that is accessible everywhere and anywhere there is a flat surface. Currently the majority of our society's understanding of hammocks is having the hammock hang between two trees, which are most likely stationary. The other limiting factor to this is in some State or National parks you are not allowed to hang your hammock from trees, making the hammock option not as desirable. This new product would allow the individual to participate in the joys of hammock relaxation anytime and anywhere without hassle.

The average user will be someone who typically finds themselves looking to relax in an effective and time efficient way. Sleeping in a bed may not be an option and time is always of the essence. For the sake of this project, the average user will be someone who is on a hike or to someone who is on the move and needs a place to rest. It is a proven fact that taking naps can improve one's health. This product will aid in allowing one to take naps significantly by giving them an easy alternative that is not too complex.

While on the move, such as backpacking or camping, it is essential to have light weight gear to make the trip bearable. This product will fit in easily and replace bulky bed fold outs or blow up mattresses. It will allow the individual to stay light on their feet and still have a place to relax. The demographic that will be targeted will mostly be able bodied people 15 years old and up; though it is not limited to such a demographic. People who are searching for a permanent hammock stand in their yard or even their house can use this and store it away if they would like or move it with ease.

## **Needs**

With the target market being those who are on the move and potentially camping/backpacking, this product will have to stand up to the elements. It will have to be able to withstand elongated exposure to high amounts of moisture as well as UV degradation. The hammock stand will have to be light weight but strong enough to hold around four hundred pounds. This will allow a wide variety of options when it comes to how many people can lie in the hammock or what is stored in it. The stands themselves will have options for campers to store items under the legs to make things a bit easier when setting up camp. The needs of this hammock and the ratings of importance are displayed below in Table I.

Table I: Product Needs Assessment

#	Description of Product Needs	Importance
1	Light weight enough to carry with ease.	4
2	Easily conveyed so as to not greatly hinder movement. (Packaging & Product Design)	4
3	Able to withstand various environmental elements for long periods of time.	4
4	Able to withstand large loads and shock of loads.	3
5	Deployable with ease. (Does not include extra nuts or bolts for assembly)	3
6	Provides extra storage for convenience.	2
7	Stability during use. (Swaying back and forth as well as side to side)	4
8	Provide a comfortable hammock experience.	4
9	Ability to be deployed in different terrain.	3

\*Rated on a scale of 1-4. "1" being of lesser importance and "4" being of greater importance.

These needs are meant to be met by the product, but the reasons the customer needs this product are vast. A few reasons are listed out below:

- Make traveling easier.
- Less of a hassle.
- Easy to relax practically anywhere.

Through the utilization of this product, the user will be able to travel with ease in the sense that their bedding will be conveniently conveyed. Compared to large blow up mattresses that require a pump, or tents that subject you to lying on the ground, this portable hammock stand will allow one to easily travel with their bed set-up anywhere they go. Along with that, the customer will also be able to do this with less hassle. The hammock stand will allow for ease of use and storage. Related products have multiple moving parts and can be difficult as well as less accommodating to varying sized hammocks. This product won't only allow for ease of use and transportation, but for the sheer benefit of having the ability to relax anywhere you please. It will allow the customer to deploy the hammock anywhere there is sufficient space. The hammock itself has the ability to be deployed on solid ground due to the fact that the user does not need to drive any stakes into the ground for use. It is light weight enough to take almost anywhere so it is



not limiting in one's ability to discover and explore; this hammock stand allows unlimited ability to relax where ever the user sees fit.

### **Related Products**

Currently there are multiple products on the market that are marketed as portable hammock stands just as the product described in this paper will be marketed. However, with further research one would find that although they are portable, they do not fulfill all the needs that one would desire in a portable hammock stand. These products do not accommodate different sized hammocks and do not allow for easy transportation. When compared to the needs, these products are not compact nor are they light weight. Although they may provide a comfortable hammock experience, they only do so with the use of one hammock size. They force the customer into buying a specific hammock instead of allowing them to choose for themselves. The hammock stand described in this paper allows the user to use any type of hammock they so desire. It does not force the user into buying a certain type of hammock and can accommodate most if not all hammocks. This product will have the option to be sold separately from the actual hammock itself to not force the customer into having to use a certain hammock. Related products and their designs are talked about more so in the literature review.

### **Objectives**

Upon completion of this project the author hopes to have fulfilled certain goals which are listed below:

- Understand what is desired from the customer and successfully implement that into a product.
- Produce a durable, quality, effective product (hammock stand) and business plan.
- Build a product that go above and beyond all expectations and desires.
- Make something that everyone will want and will be able to use with ease.
- Design a reliable and effective packaging system for both shipment and customer use.
- Possibly submit a patent application for the product upon completion.
- Build a working prototype of both package and product.

This product will contribute to its customers by allowing them to easily deploy a hammock and to relax where ever they see fit. The ease of being able to nap/rest in a hammock,

may improve the customer's health by relieving stress and giving them the chance of being better rested. It will lighten the load of campers/backpackers and travelers of the like; even motorcyclist looking for quick rest while on the road. Over all it will make the hammock experience a more relaxed and easy going one.

### **Contribution**

This product will contribute to the lives of its users in multiple ways. The benefits and how the product accomplishes them are shown in Table II.

Table II: Product benefits

Benefit	How it is accomplished
Better napping experience.	With the ability to easily deploy the hammock stand, the user can deploy it wherever for a quick nap. With the aided rocking that occurs during the use of a hammock, sleep can be enhanced and improve one's napping experience.
Lightens the load.	Due to the hammock stands compact design and light weight, it will allow the user to possibly lighten their load depending on the bedding used beforehand.
Very few limitations.	This hammock stand does not limit the user in regard to location due to the fact that it only needs a fairly firm and somewhat even ground for deployment.

These are a few of the main points of how the hammock stand will contribute to the life of its user. This hammock stand has multiple benefits that all focus on making the life of its user easier.

**Project Scope**

The scope of this project will include the testing for demand within the market as well as customer feedback of what is desired for a new design of hammock stand. It will entail the proof of concept and design modifications to researched environmental conditions. Surveys will be distributed to the general public for feedback and critiques. The material to be used will be researched as to choose the most effective and fitting kind. Product and packaging design will happen in tandem as to make it easier on the user when deploying and conveying. Working prototypes of the product and product package will be delivered upon completion after having gone through testing to verify their worth. This along with a business plan will be drawn up to help take the product from concept to reality.

## **SECTION II**

### **LITERATURE REVIEW**

Upon starting this project the first step taken was research regarding the current market of hammocks and hammock stands, product design, and related issues. The main thought first going into this project was to create something for everyone to enjoy. Not only for the customer to enjoy the ease of how the product works, but to have them enjoy the benefits that the stand has to offer as well. These benefits span from improved sleep to a more relaxing life style. The true purpose was to fill an unfilled option within the hammock world. It was to improve the back end of the hammock experience which is the stand itself. Setting up and finding the right place for a hammock can be challenging and having the ability to simply choose any location and to then deploy a hammock with ease is something that still needs to be solved. As people travel and choose to be more on the move, they also need a way of relaxing with ease. This product solves the problem of having to go through some kind of trouble to relax. It allows the user to more easily enjoy being on the move by allowing an easy and effective outlet of stress by means of hammock relaxation.

The research done and material found help to better understand where to take the product and how it fits into the history of the hammock. It allows the reader, as well as the designer, to understand what is desired by the target market and to also understand what the target market may be. The benefit of having done ample research allows the designer and manufacturer to understand exactly where to place the product and how to market it. It allows for a better understanding of how the hammock came to be and offers new ideas for design. In this section the reader will get a glimpse of the large world of hammocks and see where and how this product fits into the current market. It will help to understand the need as well as the reason for the products production.

First this section will go over a brief history of hammocks and how they came to be as well as their adaption over time. The benefits of owning a hammock as well as the benefits to a person's health due to hammocks will be discussed. This includes the reduction of stress, better sleep, and possible memory enhancement due to the rocking effect of hammocks during sleep. It will then discuss modern day applications and review multiple products that are currently on the

market by going over patents and the most popular hammocks being sold today. Referencing current hammock forums and outdoor needs today, this literature review will help the reader understand concepts to hammocks that they may have never thought of. Once the overall understanding and history of hammocks has been covered, from current products to health benefits, the review will talk about the added value of the product being produced in this project as well as how it trumps the competition in the field it is entering.

### **Hammock History**

The origin of hammocks dates back to Central America with the ancient Mayans some one thousand years ago (Staff, 2011). They were hand crafted from tree bark and meant to keep sleepers above the ground to avoid contact with the dirt below (Staff, 2011). It helped to prevent the sleeper from coming into contact with undesirable insects or animals. It is also documented that hot rocks or small fires would be placed underneath the hammock for warmth during the night. It is said that Columbus and his men were among the first Europeans to encounter hammocks in the Bahamas among the indigenous people, depicted in Figure 1. Upon arrival back to Europe the use of the hammock spread rapidly (Staff, 2011). People in Spain would replace their stationary beds in their homes with swinging hammocks due to their space saving ability as well as hygiene benefits (keeping them off the ground). The hammocks of this time were suspended with two cords wrapped around the closest support and as the use of the hammock increased, it found its way into ships as the primary sleeping apparatus. Countries militaries would assign its solders hammocks during World War I, II and even for Vietnam to allow for easy sleep on the go (Staff, 2011).

Figure 1: Depiction of Europeans encountering hammocks for the first time in the Caribbean.



The British prison system, in the late 19<sup>th</sup> century, chose to swap out the cots they had with hammocks (Staff, 2011). This decision saved money and space but did not last long given that the inmates found ways of making weapons out of the brass hooks and rings used to hang the hammocks (Staff, 2011). In the turn of the century, hammocks within the United States began to catch on as leisure items for the rich as well as cheap and easy sleeping arrangements for the poor. As hammocks began to grow in popularity, production did as well. The first known mass production facility within the United States to produce hammocks was in Pawleys Island, South Carolina, in 1889. Only a couple decades later was it discovered that the use of mosquito covered hammocks could help prevent and rid yellow fever which was a huge threat during the construction of the Panama Canal (Staff, 2011). This advent helped to further popularize hammocks and people began to understand their potential. More recently, current studies have found possible explanation as to why hammocks are so relaxing. The swaying of hammocks is thought to synchronize brain waves to allow for better and deeper sleep (Staff, 2011). This concept will be discussed later in this paper.

The reason that a brief history of hammocks is provided is to better understand how hammocks are used and how they were used. It also allows the designer of the new product to have a better understanding of what conditions as well as how the hammock should be designed. Certain ideas and applications of hammocks used in the past allow the designer to adapt and include them into the final rendering of the proposed product. The most common way to hang a hammock is with two main lines strapped to a sturdy foundation. Use of a stand is more common

in modern times and is evolving as new technologies and ideas are introduced. The design of the new proposed product will attempt to incorporate past uses as well as current uses of hammocks by offering certain characteristics and applications. Ideas taken from the brief history research are as follows: the use of the hammock stand by the military, on ships, for sanitary reasons, keeping it cheap but classy for the upper class crowd, etc. All of these ideas will be dissected in depth further along in the paper.

### **Benefits**

Though it may seem to be a little farfetched and unbelievable, sleeping in a hammock could possibly better your memory (Cell Press, 2011). The act of sleeping in a hammock can actually benefit the individual in more ways than one. It is not simply the fact that you are sleeping in a hammock that can be beneficial; it is the way the hammock moves. The rocking of the hammock, or the oscillation, syncs with brain waves to allow for a better/deeper sleep. The act of rocking oneself or being rocked to sleep is something that is typically only found with a mother and her child and is disregarded of as we age (Shorman, 2011). Certain studies show that being rocked back and forth can actually greatly enhance one's sleep, possibly improve memory, aid those who have insomnia, reduce stress as well as even help reduce the risk of heart disease (Shorman, 2011) (Letter, 2007).

The enhancement of one's memory can be contributed to the increase in sleep spindles that occur while one is slowly being rocked while sleeping (Cell Press, 2011). Sleep spindles are short bursts of brain activity that occur during deep sleep. These spikes in brain activity are a part of our brain's repair and reorganization of information cycle that goes on while we sleep (Cell Press, 2011). With the increase in sleep spindles, one's memory may be fine tuned and allow them to feel more refreshed upon awakening. This also may help people who have sustained some amount of brain damage to recover faster (Cell Press, 2011). It would help the brain repair itself faster which would allow one to recover faster overall.

Sleeping in a state of being slowly rocked has also been shown to possibly put one into a deeper sleep faster (Cell Press, 2011). The rocking motion synchronizes with one's brain waves and allows them to achieve a deeper sleep in a shorter amount of time. A study carried out by a

group of Swiss researchers took a group of male volunteers and had them take a 45 minute nap while being oscillated back and forth (Cell Press, 2011). The use of female volunteers was not done due to the effect of the menstrual cycle on sleeping (Shorman, 2011). During their naps, volunteers were strapped up to a brain monitoring device that recorded their brain's activity. An increased length of N2 sleep was recorded in a majority of the volunteers (Cell Press, 2011). N2 sleep is a stage in deep sleep that is not a part of REM (Cell Press, 2011).

Taking the time for a quick nap has been shown to possibly reduce the chance of heart disease as well. A study done in Greece among working men who regularly took siestas (a nap during the day) showed that those who did, were less likely to develop a heart ailment (Letter, 2007). This study is up for speculation due to the varying explanations as to why these men are less likely to develop heart disease, but the fact that most all of them took siestas was a commonality (Letter, 2007). This does not show a cause and effect analysis, but simply a correlation between the two. The fact that these men do not have heart disease could simply mean that they are relaxed and have the time to take naps compared to someone who cannot sleep and needs to nap during the day, which actually enhances one's chance of heart disease (Letter, 2007). Although this may not be fact, taking the time to nap can reduce blood pressure as well as aid in reducing stress which benefits the health of one's heart (Letter, 2007).

An improved sleep experience or even napping experience can greatly reduce stress as well as aid in one's health. In today's fast paced world, it is essential for one to find the time to reset and take care of themselves. It is difficult for people to find places to rest effectively while they are busy running around. This limits the amount of down time each person has to reboot and relax which is essential for a healthy life style. With the assistance of the product being proposed in this paper, one can easily sustain a healthy life style. The ease of deploy ability as well as conveyance will allow one to stop and relax wherever they may please. It will allow one to be able to partake in the swaying motion of the hammock while sleeping and benefit from a deeper sleep. This light weight portable hammock stand will allow one to partake in all the benefits of owning and sleeping in a hammock anywhere they so please.

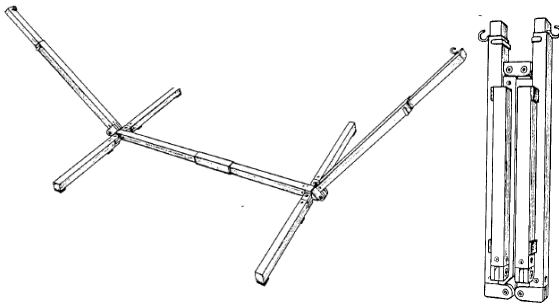


## Existing Products

Currently in the market there are foldable and portable hammock stands and multi use hammocks that are light weight, but they are bulky and uncomfortable to carry around. This section will present two patents found that take on the notion of foldable/portable/collapsible hammock stands and dissect them showing where they falter. The patents found do not show all current options so in order to do so a few market-available hammock stands will be analyzed as well. Although these stands succeed in solving the problem of portable hammock stands, they do not cater to people who are on the move and need a light weight easy to use stand.

The first hammock stand is US Patent number Des. 295,242; shown in Figure 2 below (Frick, 1988). This hammock stand fulfills the need of portability as well as fold-ability. Where it falls short is in its ability to be deployed over any type of terrain as well being easily conveyed. The material used may not be able to withstand all types of environmental conditions and is not easily concealed for easy conveyance. This patent was also published in 1988 and does not show up in any major searches showing that although the design fulfilled certain needs, it did not fulfill all of them.

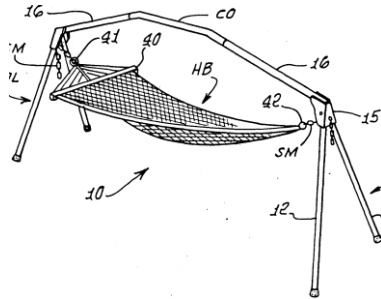
Figure 2: US Patent # 295,242 Drawing



The second hammock is US Patent number 5,035,012; shown in Figure 3 below (Westrich, 1991). This hammock stand also fulfills the need of portability and well as fold-ability; to an extent. The pieces come apart and are individual which increases the risk of losing a piece and also increases complexity of assembly and deployment. The hammock stand also limits the ability of the user by having something over head which can obstruct the users view as

well as act as an inconvenience. Also, like the previous hammock stand, this patent was published in 1991 and does not come up in any major searches as a for purchase product.

Figure 3: US Patent #5,035,012



Other available and more modern hammock stands use a lattice-like foldable setup to achieve the portability and compatibility desired; shown in Figure 4. These stands also do not allow the user to deploy them on multiple types of terrain and take up too much room for the traveling person. Also, a majority of portable hammock stands require the user to drive stakes into the ground as a support which can limit the hammocks location if the ground is impenetrable; as shown in Figure 5. There are also do-it yourself types of hammock stands that people can make on their own. These hammock stands are effective but the material used is not reliable for exposure to environmental conditions, they require manual labor, and they too require driving stakes into the ground for support.

Figure 4: Bliss Portable Hammock stand



Figure 5: Example of Current Portable Hammock stand



One, “do-it yourself” type hammock stand is known as a bridge stand. This is shown in Figure 6. This type of stand is used when one wants a hammock in an area where there is no place to hang the hammock from. It can be easily built at home by one’s self with the use of many house hold power tools and a run to the Home Depot for 2”x2” wood beams. This is an effective way of solving the problem; though it is at the expense of sacrificing some main benefits of using two points to hang a hammock. This hammock stand does not allow for the user to use different types of hammocks or to be able to sway from side to side. This is a rather large loss given the previously stated benefits of the rocking motion of hammocks. Along with that, the stand is heavy, bulky and incredibly difficult to move around.

Figure 6: Home-made hammock stand



These, “do-it yourself” type of hammock stands are usually made from PVC piping or of lumber purchased at a local supplier. The benefits of these materials are that they are cheap and easy to come by. This may be true, but these materials aren’t as reliable as a metal alloy. The product described in this paper will be made of an aluminum alloy, coated steel alloy, or

magnesium material. These materials are corrosion resistant as well as incredibly reliable and durable. They can withstand harsh environments as well as a good amount of punishment.

### **Comparison**

When looking at the current hammocks on the market, one would think that this problem has already been addressed though in actuality it has not. Designers have attempted to solve this problem for some time now but have yet to completely satisfy the need. The shortcomings of these previously stated products are large enough to merit the redesign of a portable hammock stand. These products lack in the ability to accommodate different styles of hammocks, be used for more than just hanging hammocks, are not compact enough for easy conveyance, and do not allow for easy deployment wherever the user pleases. Listed below in Table III is a comparison of the listed products to the needs in Table I; using a similar numbering system.

Table III: Current Product Comparison

Description of Product Needs	Patent #: Des. 295,242	Patent #: 5,035,012	“Do-it Yourself” Type Stands
Light weight enough to carry with ease.	4	3	4-5 (depending on type)
Easily conveyed so as to not greatly hinder movement. (Packaging & Product Design)	3	2	2-5 (depending on type)
Able to withstand various environmental elements for long periods of time.	2 – Made from wood	4 – Made from metal	3-5 (depending on material used)
Able to withstand large loads and shock of loads.	3	3	2
Deployable with ease. (Does not include extra nuts or bolts for assembly)	4	3	2
Provides extra storage for convenience.	2	2	1
Stability during use. (Swaying back and forth as well as side to side)	4	4	2
Provide a comfortable hammock experience.	5	5	4
Ability to be deployed in different terrain.	3	3	2

\*Ranked on a scale of 1-5. ‘1’, meaning that the product does not satisfy the criteria at all and ‘5’ meaning that is completely satisfies it.

## **SECTION III**

### **SOLUTION/METHOD**

This section will cover the progression of design and material selection of the product discussed in this report. It will dissect the proposal of three different solutions to the problem; from material and design to testing and market analysis. This section will cover what was done to obtain the proper information as well as how the designs were conceived. It will first present the three different designs being considered as well as the different types of material that may be used. It will then go into detail as to how those will be conceived and how they will be chosen. This section will go over the data collected from the market research as well as the research that is done while prototyping is occurring.

#### **Product Development Process**

The product itself went through many phases before the design was solidified. Identifying a market need, product ideation, conceptual design, prototyping, and product launch are all covered in the following. The presented designs do not differ all that much from one another but, instead, build off of one another. The initial design will depict more of a conceptual idea and the final two are further researched and finely tuned. These designs are labeled as Design #1, #2, and #3.

Upon conceiving the idea, certain designs were considered and imagined. These ideas were then modified with further research of what already existed within the market place. First, research regarding current products and solutions to hammock hanging were investigated. These include current ways of hanging hammocks from the use of trees to stationary handmade stands. Second, the hammock itself was researched; from its origins to its present day uses. Hammocks of all types were discovered and looked into. Hammocks with or without spread bars as well as hammocks made to endure the environmental conditions to ones that were made to be hung inside. With all of this information gathered and understood, the design began to take a more applicable form.

Prior to any further development of the product design and ideation, the market in which it would enter was considered. The initial research of the origins of the hammock showed areas where it was and had already been used. With further observation and research, certain areas stood out more so as a possible market segment to target. The lack of hammocks on beaches in California and the want for them to be there was something that became apparent. This product is more of a push product by showing the customer that it is something they did not know they wanted. As communication between customers increased, it was noted how most, if not everyone, would react positively to the idea and would say how much they would like to own one. This along with the realization that the product could be used in the Army as a comfortable substitute to the cots they are now using was a concept brought up to a local ROTC representative. It was communicated that the current cots are uncomfortable and bulky; a new design would be beneficial. Not to mention the current issued army cots haven't been redesigned in over 40 years. With these in mind, the product ideation and conceptual design began.

Multiple hours of brainstorming preceded the previous findings to determine a decent starting off point for the design. The initial design that came to mind was far too bulky and after certain research, was debunked completely. Design #1 is the culmination of research and understanding of certain materials. As research continued to uncover certain modifications, Designs #2 and #3 were developed. This research includes conversations with people in the metal fabrication industry and their understanding of the material being used. That along with further research into what is currently used for hammock stands on the market. It was discovered that most of the current products on the market are made with coated steel. Though this is structurally stable, steel is easily susceptible to corrosion when introduced to the elements for long periods of time. Along with that, steel is much heavier than other metals on the market. This research and questioning made the use of Aluminum seem most fitting for its light weight and corrosion resistant properties. As this information was being gathered, the idea of how the hammock stand would work became more and more clear. The first conceptual design used curved and tapered tubing. After having discovered the lack of availability and difficulty of use this would impair, it was drastically changed.

A certain amount of market feedback was brought into consideration before the designs were drawn out as well. Such feedback as to how hammocks are currently used as well as what would be desired from such a product was acquired. The amount of information acquired was minimal compared to what should have been obtained before prototyping began. Though this is true, a minimum viable product was the target of this paper which is exactly what is being obtained. Investigation into current online forums was also researched to see how people are currently solving this problem. This included everything from YouTube videos to the subscription of various hammock forum type websites. Looking into what was being discussed as well as what was already being utilized was the main purpose of this research.

The current markets of hammocks were also researched to better understand how each market utilizes the hammock. Campers use a hammock between two trees typically and are more inclined to purchase a light weight hammock as to not hinder their ability to travel with ease. Families or people who live in more residential areas purchase mostly bulky hammock stands that are stationary and rarely move. Not much was found on the use of current portable hammock stands, but it is assumed that most people use their portable hammock stand when traveling on family camping trips where mobility is not an issue. Also, research into military use was considered. The use of a comfortable, portable and light weight hammock stand is something that may prove beneficial to the army. An easy to move bed that would grant soldiers a more comfortable and effective sleep is something that would greatly benefit the army. Currently soldiers sleep on the ground or if they are at a base camp they sleep in uncomfortable cots. Each of these markets have something in common, they need a light weight easy to use hammock stand. With this in mind, the product designs held those needs characteristics as most important and were designed around them.

Once the first design was finished, the search for parts to build it proved difficult given that everything was custom designed. This drastically changed design #1 when building design #2. The search for the correct pieces to complete the stand proved more difficult than what was initially thought. Finding off the shelf pieces to construct a hammock stand design that had never been built before took some time. After multiple re-design ideas and research, a fairly similar design concept was created with new dimensions and with the use of actual products. Though



Design #2 contained current products that would work, it still needed to be adjusted. The completion of Design #3 marked the final design that seemed to fulfill all the needs of the previously stated criteria. The progression of these designs and conceptual demonstrations will be discussed further in Progress of Product Designs.

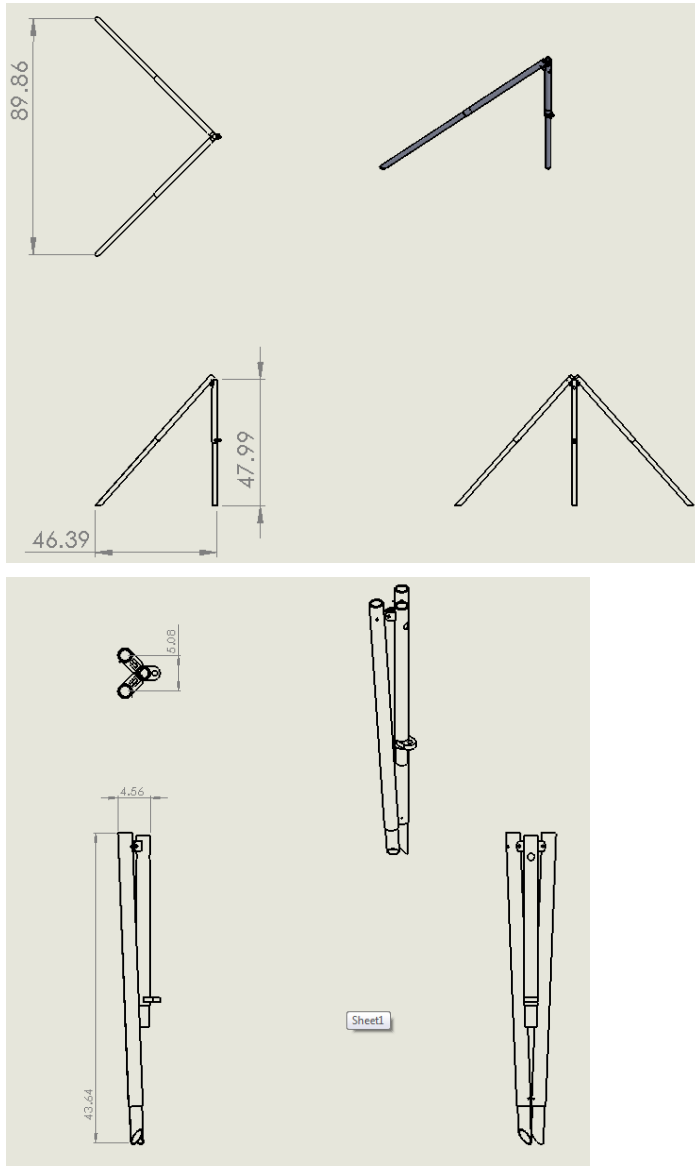
Upon completion of the final 3<sup>rd</sup> design, prototyping began. Most of the parts of the stand had been designed with current, off the shelf, products which made procuring the parts fairly simple. With help from people in the metal fabrication industry, quality aluminum piping was ordered for cheaper than usual pricing. The final step, once a working prototype is designed, is to introduce this product to the public. It has been considered to introduce the product to a specific market at first in order to obtain traction. This product can have multiple uses and has the potential to be introduced to dozens of markets. Limiting the market to one in the beginning will aid in building traction and focusing on one customer segment will increase their satisfaction. Partnering with a current hammock producer is one route that is being looked into. This would allow for an easy entry into an existing market without having to build the hammock from the ground up. Partnering with a substantial and quality hammock company would immediately give the stand a good name. Marketing would target mostly families with large disposable income due to the fact that initial start up costs will drive up the price of the hammock stand. Once a substantial amount of products had been sold, the stand will be lowered in price and introduced to new markets such as college students, backpackers, and the Army. The latter markets are more difficult to enter given the price range and expectation of quality each demand. Backpackers would research the product extensively prior to purchase and look for something that is durable. Having partnered with a well known quality hammock company, the stand would have a good reputation behind it to fuel the purchase. This along with guerilla marketing in the form of a cross country marketing campaign would increase the public awareness of the product. Although the product is in no way at the point where it can be introduced to the public, this is a plan that will most likely be used when it comes to that particular time. Currently, public demonstrations will be held showing off the design and answering any questions people may have about the stand.

## Progression of Product Designs

This section will go over the progression from design one to design three. It will go into how each design was thought up and the evolution of each one.

### Design #1

Figure 7: Design #1



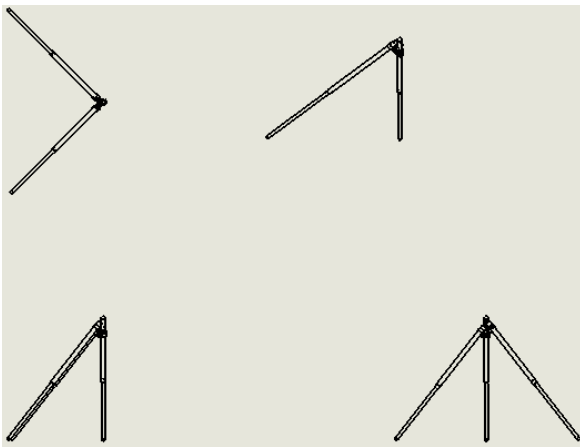
This being the initial design means that there was definite room for improvement. This design allows for the user to easily collapse and deploy the stand. In coming up with this design, the

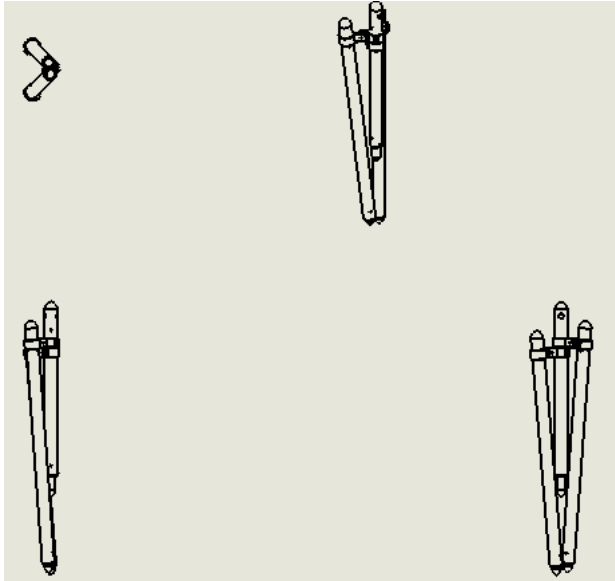
angles and size of tubing were chosen with the strength of the stand in mind. It was thought that each stand should be able to support a substantial amount of weight. The ability to distribute the weight evenly is hoped to be achieved by the use of adding torque to the stand. This is done with the addition of a connecting loop on the back leg of the stand. The rope used to hang the hammock itself will be attached to this hook which will pull the stand up as well as down at the same time. This creates an amount of torque and diverts most of the force into the front two legs of the stand. The benefit of this is that it will evenly distribute the weight into the ground through the front two legs.

With the analysis of the given statistical data, the ease of transportation was highly taken into consideration. This particular design is a bit too long and wide for the liking of the general public. It was decided that the size of the hammock, when folded, should be no longer than a backpack is long. With this comparison, the first design needs to be rethought. Also, when it comes to the actual hanging of the hammock, the stand should be able to suspend the hammock at a 30 degree angle. This is thought of as the “optimum” angle to hammock enthusiast. The second design will take into consideration the “optimum” angle as well as the compact size of the hammock. Not only is the size of the hammock important when it is collapsed, but when it is outspread as well. The current wing span of the first design is around seven feet. This needs to be addressed due to the fact that that is a rather large space to take up. The next design will attempt to consider all of these newly brought up considerations.

## Design #2

Figure 8: Design #2





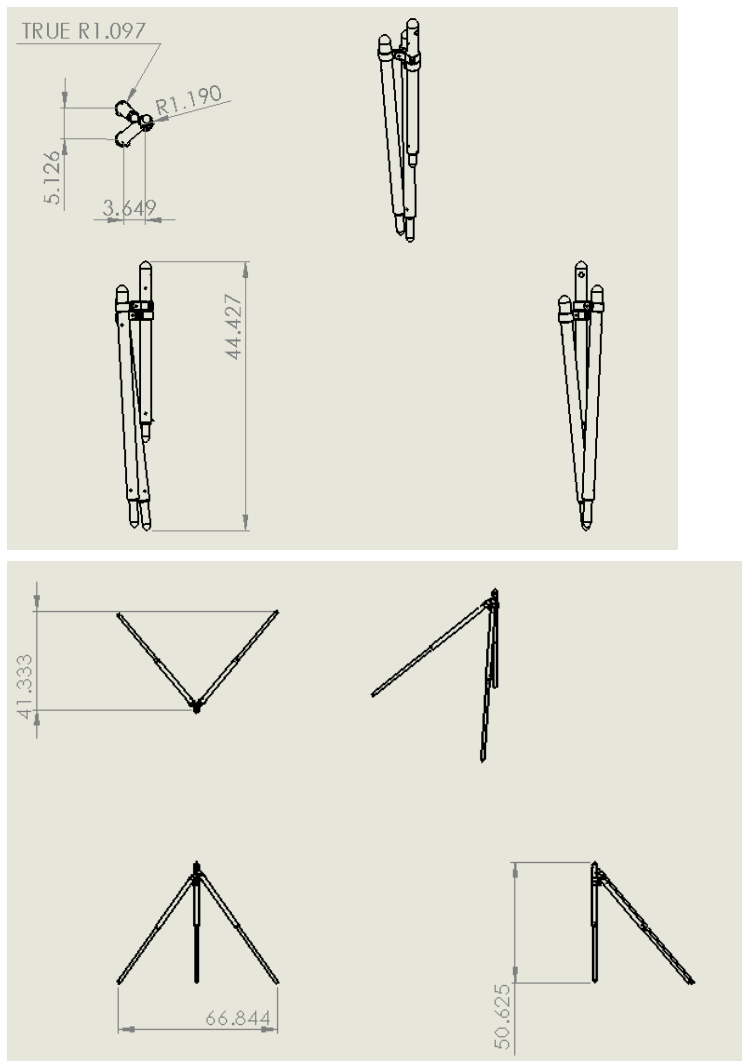
This design does not address the wingspan nearly as much as is desired but does address the material used and the available products on market in constructing the stand itself. It addresses certain support and connection problems that were discovered after the first design was created. This design addressed all necessary materials that will be used in the actual production of the product. It addressed additional support for the legs once they are elongated and how that will be facilitated. It will be done with the addition of a welded on 'D' shape to the main shaft of the stand. This will have a measured out amount of Paracord (cord used in parachutes) attached to it that will connect to each leg and provide additional support. The cord will be threaded through Clevis pins that will be used as the locking device for the telescoping feature of the legs. The Clevis pins have a small hole at the end of them that is large enough to fit the cord through and create a support triangle that connects all the legs. This along with the lowering of the extended leg positions allows them to rest against the main shaft adding further support. Along with that, rounded end caps were added to the top and bottom of each pipe. These are made of aluminum which may prove as an unnecessary weight increase, but for now they provide debris from filling the pipe and allow the stand to sit on an uneven surface with ease.

The suspension of the hammock will be done with the use of a hand woven continuous loop Amsteel whoopie sling with an attached aluminum climbing ring. This will be fed through the top hole of the main shaft and tied to the hook down the shaft of the hammock stand. This

allows the user to hang any type of hammock with an s-hook as well as to detach the whoopie sling when ever desired and to use it as they see fit. This allows for adaptability and diversity of use.

### Design #3

Figure 9: Design #3



This design is very similar to the previous in that it uses all the same materials and general concepts. The only differences are with the position and location of the extending pipes and where they hit the main pipe. The wing span of the extended pipe was also shorted which allows for a more effective distribution of weight. This is the final design that is to be prototyped and tested. Although there are certain areas of improvement, this design is a minimum viable product

meaning that it gets the job done and can be improved down the line. After further testing of the idea, as to how to improve it will be considered and made.

## **Materials**

The material to be used for the hammock stand needs to be able to with stand the following criteria:

- Resistant to corrosion.
- Light weight.
- Strong.
- Durable.
- Can withstand extreme outdoor temperatures. (under 200° F)
- Easily worked on for production.
- Relatively inexpensive.

Based on previous experience from the Industrial Materials (IT329) class offered at Cal Poly, two categories of materials are potentially appropriate for this product: metals and composites. Though composites are a great option given their strength to weight ratio and durability, they were not considered for prototyping. This is because of composite materials low availability as well as high cost. These would have included carbon fiber-like tubing and similar materials.

When considering certain metals for use, two types of metals were considered: aluminum alloys and magnesium alloys. Magnesium is one of the lightest building materials on the market and has a relatively high strength to weight ratio. Magnesium is the optimum material to be used for this project. With further research, magnesium proves impractical though. This is because of its high price tag as well as difficulty to obtain. Magnesium may be the best option when it comes to material characteristics, but is far too expensive and uncommon to use in mass production. When considering aluminum alloys, they too offer great material characteristics. Aluminum alloys are easy to come by given their common use in industry. The type of aluminum chosen for prototyping was T6 6061 Aluminum pipe. The 'T6' referring to the tempered properties of the aluminum. T6 means that it is on the harder side of most aluminum piping which makes it good for structural use. Piping was chosen aside from tubing given the rather large price difference. This material is far more expensive than steel but less expensive

compared to magnesium and has the appropriate characteristics needed; which is why it was chosen.

As for the bushings that will be made for the telescoping of the piping, the plastic known as Delrin was chosen. This plastic is known for the following characteristics:

- Incredibly tough as well as stiff
- Has reduced wear and friction compared to other plastics
- Great UV resistance
- Impact resistant

All of these characteristics are exactly what was needed in a plastic that would constantly be exposed to the outside elements. Nylon was also considered for this application but ultimately disregarded. Nylon has desirable characteristics and can be relatively cheap. The varying types of nylon allow for different applications and wide applications. In the end, the type of nylon that would be used was more expensive than Delrin and was no longer considered.

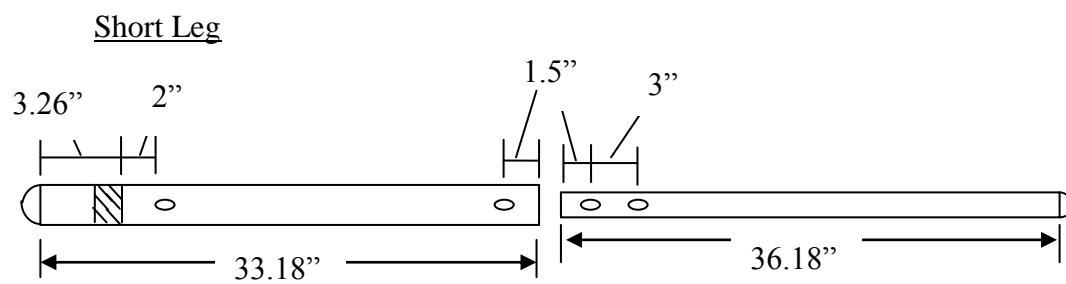
The support cord that would span between each leg of the stand was first considered to be made of some type of metal wire. Initially thought, metal wire was the “go-to”, given its durability. Though this was an initial thought, it was discovered that most metal cords are made of steel which can easily corrode. Along with that, metal wire can add a bit of weight to the overall weight of the hammock itself; which is no way desirable. Paracord was the substitute to metal cord and was chosen as the ultimate material. This cord is what is used for parachutes and is very resistant to outside elements. It has an incredible strength to weight ratio and weighs much less than metal cord. Along with that, it is much easier to handle than metal cord. Paracord has more than enough strength properties to fulfill the necessary requirements for the stand.

### **Prototyping and Final design**

In starting the prototyping process, material was ordered through a local metal fabricator in order to reduce cost. The material was received in 20 foot long pieces which were then cut down into six, 40 inch long pieces to allow for more easy transportation. 1.5” O.D. 6061 Schedule 40 Aluminum Pipe as well as 1” O.D. 6061 Schedule 40 Aluminum Pipe was used for prototype. The pieces were then cut down to their appropriate sizes using a band saw. Once cut, the 7/16”

holes for the telescoping bolt inserts were drilled as well as the  $\frac{3}{4}$ " hole for the pipe channel. These were done using an end mill as well as a drill press. Figure 10 shows the lengths of the pipe as well as where each hole was drilled. The bushings were the next item to be fabricated. This was done with the use of a lathe which turned down the Delrin tubing to fit the pipes. A band saw was also used in the production of the bushings in order to cut them to size. Figure 11 shows the dimensions of the bushings. After this was complete, the hook, rope support, and pipe channel were all welded on to the main support pipe. The hook was welded about 2 inches above the telescoping bolt insert on the lower end of the main leg. The rope support loop was welded on directly opposite of the hook at the same height. After having welded on the pipe support channel, the excess material had to be sanded off in order to match the outer diameter of the pipe. Once this was complete, the Delrin bushings were set in place with JB Weld and set to dry overnight. Once dry, the smaller pipe was inserted into the larger one and tested to see how the bushings worked. The rounded end caps were then manually pressed on to the pipes to create an almost finished product. The speed rail fittings were then placed over the pipes and placed in their appropriate positions. On the main leg, the two speed rail fittings had to position a certain degree apart from one another; this is shown in Figure 12. Once attached, the fittings were then joined together via store bought  $\frac{7}{16}$ " bolts; Figure 13 shows the type of speed rail fittings used. Between the bolts and speed rail fittings are metal and nylon washers to ensure ease of movement. A lock washer, keeping them in place, is also utilized in this section. Once the stand was complete, the 2 ft. long continuous loop with a climbing ring attached was fed through the pipe support channel and wrapped around the hook on the lower part of the main leg. The climbing hook is where the hammock attaches to the stand. Figure 14 shows one side of the prototyped design and a close up of a continuous loop with a climbing ring.

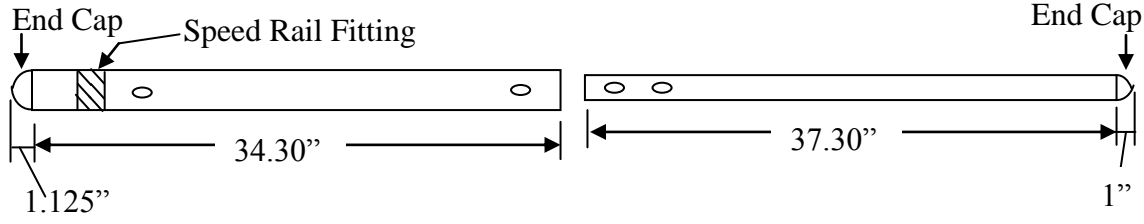
Figure 10: Short, Long, and Main Leg Dimensions



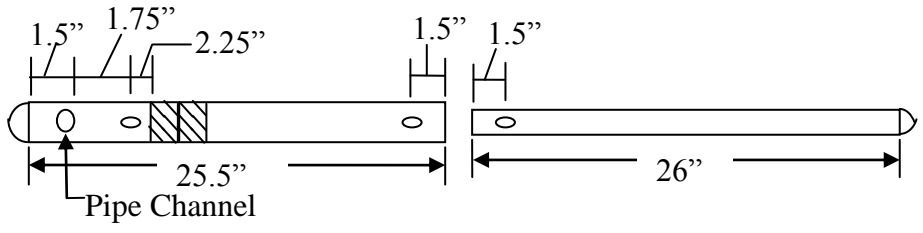


Long Leg

\*Holes have same dimensions and layout as Short Leg.



Main Leg



\*All End Cap dimensions same for each leg.

Figure 11: Bushings

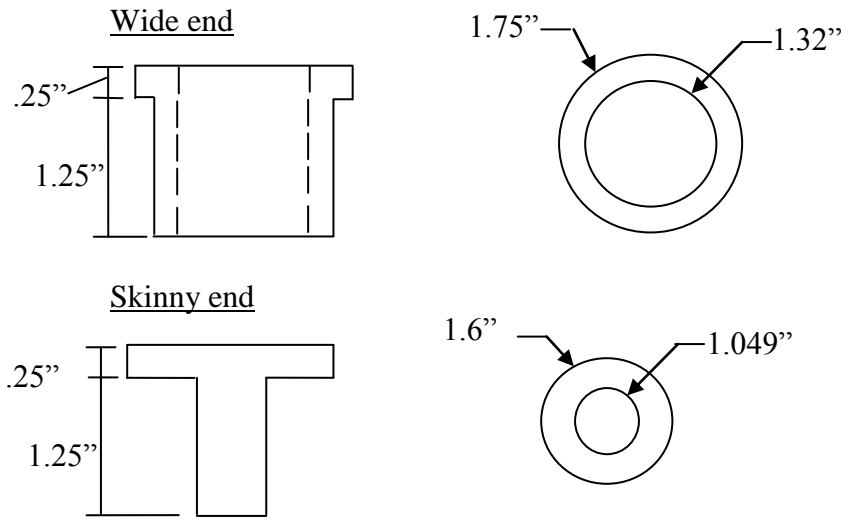


Figure 12: Degree Separation

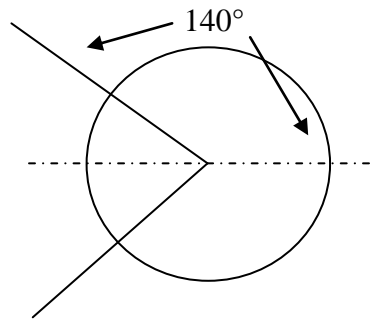


Figure 13: Speed Rail Fitting

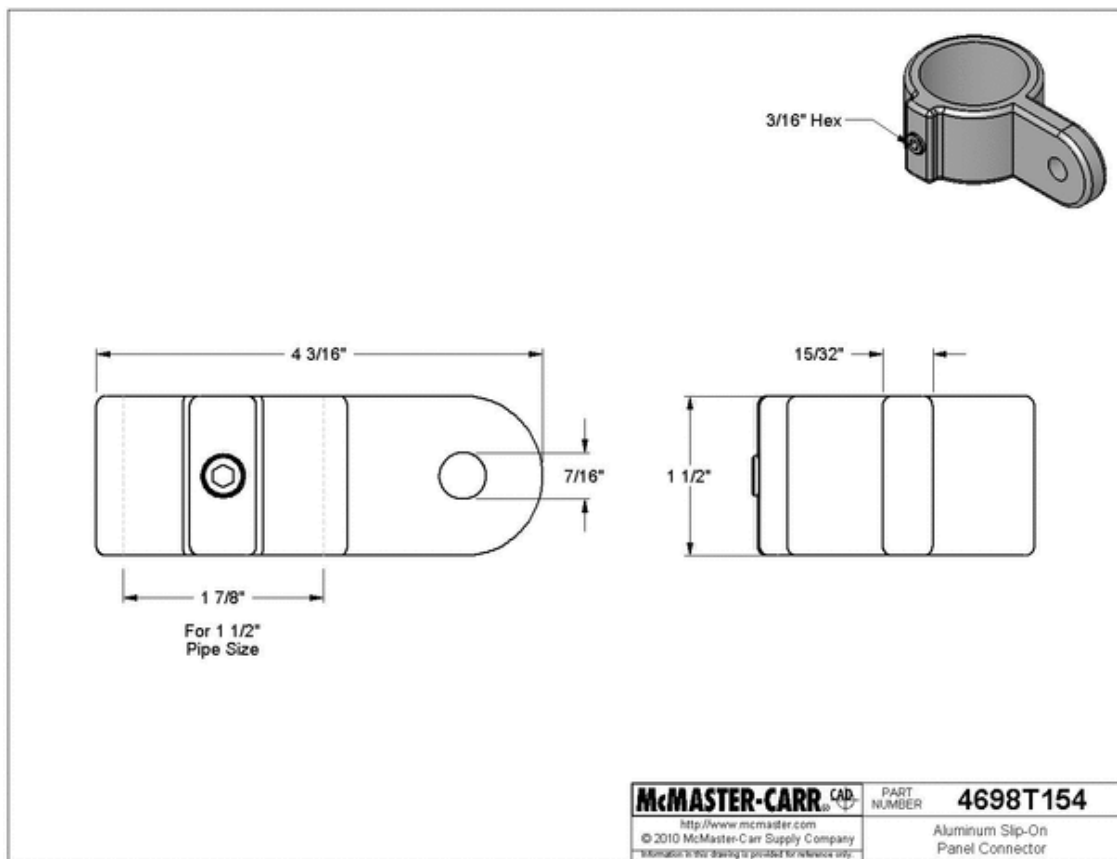


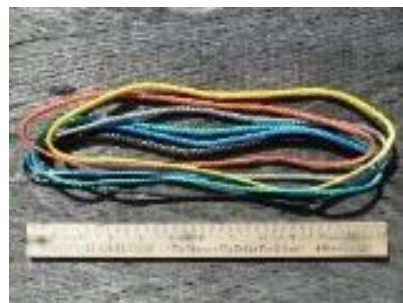
Figure 14: Final Prototyped Design as well as Continuous Loop and Climbing ring



Climbing ring:



Continuous Loop:



## Testing

Upon completing the prototype, a series of tests were carried out. These tests are stated below:

- Testing to see if the stand can perform basic functions.
  - o Once the two sides of the stand were complete, the stand was tested to see if a person could be supported in a hammock by the stand itself. The prototype ended up failing this test; unfortunately. The stand fell in on itself when force was exerted on the hammock.
  - o A few design changes would fix this problem but are not included in the scope of this project. They will be mentioned and explained but not tested.
- The hammock was then tested for ease of deploy-ability.
  - o This was done by giving the stand to someone who had never seen the hammock stand before and asking them to deploy it. Once carried out, the person was asked how they felt about deploying the stand and if there were times when they felt it was too difficult.
- As for ease of mobility, the hammock stand will be transported in a canvas bag and tested on ease of conveyance.
  - o The custom canvas bag that will be used for the hammock was ordered but the lead time was too long. The bag will not be in possession in time to record any conveyance data to improve upon. When it does arrive, the hammock stand will be carried around and the necessary data will be recorded though may not be within the scope of this project.

## Tools Used

- Digital prototyping using Solidworks.
- Physical prototyping using manufacturing tools and machines:
  - \*All available and utilized in the Industrial Technology Metals Lab.
  - o End mill
  - o Lathe
  - o Drill Press
  - o Belt Sander
  - o Band saw
  - o Hand held power drill
  - o Hand held deburring tool
  - o Measuring tape
  - o Manual Press
  - o TIG Welder

## **SECTION IV**

### **RESULTS/DISCUSSION**

This project entails the research and development of a portable hammock stand that is different than any other stand on the current market. The initial findings uncovered the need for a light weight portable hammock stand that was easily deployable. This new product idea was then investigated further by researching portable hammock stands that are currently on the market. The information showed that the current products were subpar in the sense that they were bulky, heavy, not user friendly, and limited the user to one size hammock. As well as not meeting all consumer needs, the current stands have poor advertising/marketing given that many people are unaware of their existence. This is also apparent in observation; it seems rare to see a portable hammock stand in use outside of the internet. Upon that realization, it was apparent that this is something that also needed to be addressed with an effective business and marketing plan which will piggyback on a strong product. Various product designs were considered to solve this problem and market feedback was used to determine the features on the stand itself. The following section will give an overview of the process taken to achieve a better understanding of the hammock market and how those needs were met. It will cover the needs listed earlier in the report and how they were addressed with the introduction of the new product and business plan. The advantages of each method will be discussed as well as backed up with credible data.

#### **Advantages/Disadvantages**

After the initial research on the current competitors, the needs were made clear. The products offered now do not meet certain needs that are desired by customers. The product listed in this project identifies certain needs that consumers have as well as offers more than what is expected. Looking back at the proposed product designs, each one has its own advantages as well as disadvantages. Overall, each product design should have successfully fulfilled the following requirements.

- Light weight
- Easily deployed and used
- Allows for use with any size hammock
- Can be deployed in almost any terrain

- Needs to be compact during conveyance

These are the main needs that needed to be met by each design. These were acquired through certain market research which consisted of talking with people who use hammocks on a regular basis or are avid campers. With the gathered information, certain attributes were considered most important and chosen as the main features that need to be accommodated for with the proposed product.

### Design #1

This design fulfilled the need of being easily deployable as well as having the adaptability to be deployed anywhere and accommodating any size hammock. Although it may have met these criteria, it was insufficient in the sense that it did not take into consideration certain manufacturing costs as well as size restraints. This design was far too big and was not representative of actual material that was to be used on the prototype. Everything would have had to have been custom made which would have made production cost far too large if a profit were want to be made on the stand. Also, when the stand itself was compact it was far too long to be considered easily conveyed. This would have hindered the use of the stand in the sense that it would have been very difficult to move around. These disadvantages were too detrimental to the mass production as well as marketing of this product; because of this, the next designs were created.

### Design #2

The second design was far more considerate of the manufacturing cost, which were not addressed in the first design. This was accomplished by researching current off the shelf products that can be used to produce the stand. Although it still was not cheap, it allowed for appropriate design change as well aided the possibility for an outside manufacturing company to produce the stand with ease. With the newly found material and parts to be used on the stand, the second design took an entirely new shape. The new design made for a more compact and easily portable stand. This design also took into consideration the packaging that would be used to convey this product. It also took into account the material used for the structural support of the stand which is aluminum piping. This design accomplished the small size characteristic, ease of deploy-ability, weight, allowed for the use of any size hammock, and was fairly compact when folded up.

Although this design seems to have all of the requirements met, it was missing a few that needed to be adjusted. The foot print of the stand itself was too large and looked as if it would not be able to support the load that was required of it. Along with that, the stand needed to be redesigned to better accommodate certain features such as added support. These disadvantages fueled the development of design #3.

### Design #3

Being the final design, this design touches on all the needed characteristics that were earlier stated. This design allows for ease of use, can be light weight, can be conveyed with ease, has the ability to accommodate any size hammock, and is able to be deployed on almost any terrain. The stand itself weighs roughly around 40 lbs. which is currently the industry standard but is rather heavy. Using a similar design with thinner gauge material would reduce the overall weight of the stand. This product design allows for ease of storage by compacting down to 3.5' and only taking up a 12"x7" area. This design may have a few disadvantages but it is known that these disadvantages can be changed by changing the material used. The design itself compacts to a relatively small size and allow the user to easily deploy it wherever they may be. The following table shows the needs that were presented in the beginning of this report and how this final design meets them. This design may not completely meet all the needs presented, but does act as a great starting point for improvement.

Table IV: Product Need Comparison

#	Description of Product Needs	How effectively the need was met
1	Light weight enough to carry with ease.	1
2	Easily conveyed so as to not greatly hinder movement. (Packaging & Product Design)	1
3	Able to withstand various environmental elements for long periods of time.	5
4	Able to withstand large loads and shock of loads.	5
5	Deployable with ease. (Does not include extra nuts or bolts for assembly)	3
6	Provides extra storage for convenience.	2
7	Stability during use. (Swaying back and forth as well as side to side)	1
8	Provide a comfortable hammock experience.	1
9	Ability to be deployed in different terrain.	2

\*Scale from 1-5; 1 being the least and 5 being the most.

## Discussion

As unfortunate as it is that the third design did not work, this does not mean that it is not possible to redesign it and make it work. The design itself did not work because it did not cancel out the horizontal force that was being exerted on the stand from the hammock. When a force is applied to the hammock, a vertical and horizontal force is created. The stand was unable to effectively distribute the force and eventually toppled over. Along with that, the stand had the tendency to slide inward during use. This may be due to the rounded end on the poles which can easily be modified so that the ends are flat and have rubber end caps. This would resist the stands want to migrate inward by digging into the ground as well as sticking to the ground with the rubber.

The current design does not suffice in holding a hammock because the attachment point for the hammock is at the top of the stand. This allows for the force to pull up and over the stand which makes it topple over. A proposed design that would possibly fix this problem would be to change where the hammock is attached to the stand. By lowering where the hammock attaches to the back leg and having it drape over a metal bar traversing the two elongated legs; the force would be distributed differently over the stands supports. This, along with the moving the back



support leg further out so that it is angled away from where the hammock would be would greatly reduce the stands tendency to topple over.

Also, the current stand is far too heavy. A competitor hammock stand that also utilizes the telescoping of aluminum tubing has a stand that weighs around 10 pounds. After observing this stand it was realized that much thinner gauged aluminum could be used and still support the load necessary. The hammock stand is not a complete failure in the sense that it definitely has room and potential for improvement which is easily modified.

## SECTION V

### CONCLUSION/OBSERVATION

Upon starting this project, many ideas have been considered and have been thrown out. The inspiration for this product was inspired by the fact that one does not see hammocks on the beach. Having realized this, it was decided to research why this was. It was found that there were current hammock stands that were dubbed portable and easy to take anywhere but it still didn't answer the question; why weren't there any hammocks on the beach? After researching the current hammocks, it was found that they were lacking in portability and ease of use. This fueled the design of a new portable hammock stand that is referred to more as an adaptable hammock stand.

Initially starting out by researching what was already offered to the general public and seeing how people went about possibly solving this problem themselves, it was found that most products on the market worked but solely for one type of hammock. This limited the user to the hammock that was supplied to them. If the user currently had a hammock that they particularly enjoyed, they would not be able to use it with the current portable hammock stands on the market. It was also found that people would make their own hammock stands out of every day materials. After viewing various YouTube videos it was found that most people would make their own hammock stands out of wood, PVC and metal piping. Most of these stands were rather bulky and difficult to move around. Along with that, the stands would either require the user having to hammer anchors down into the ground or they would be far too heavy to carry all at once. This limited the mobility of the stand as well as where the stand could be deployed. After going over multiple current products, the history of hammocks and how they came to be was then looked into. It allowed for further development of ways in which they were used and also where to possibly position the hammock stand; once a viable product is created.

Once acquiring this information, certain product ideas began to be thought up as well as how they would work. The initial idea of the stand included curved pieces of metal and odd shapes. It was quickly understood that this product design was incredibly unlikely to work which then fueled a rather large pivot in the design. After this realization, researching products that are available off the shelf to help make the prototype and to better define what the design would look

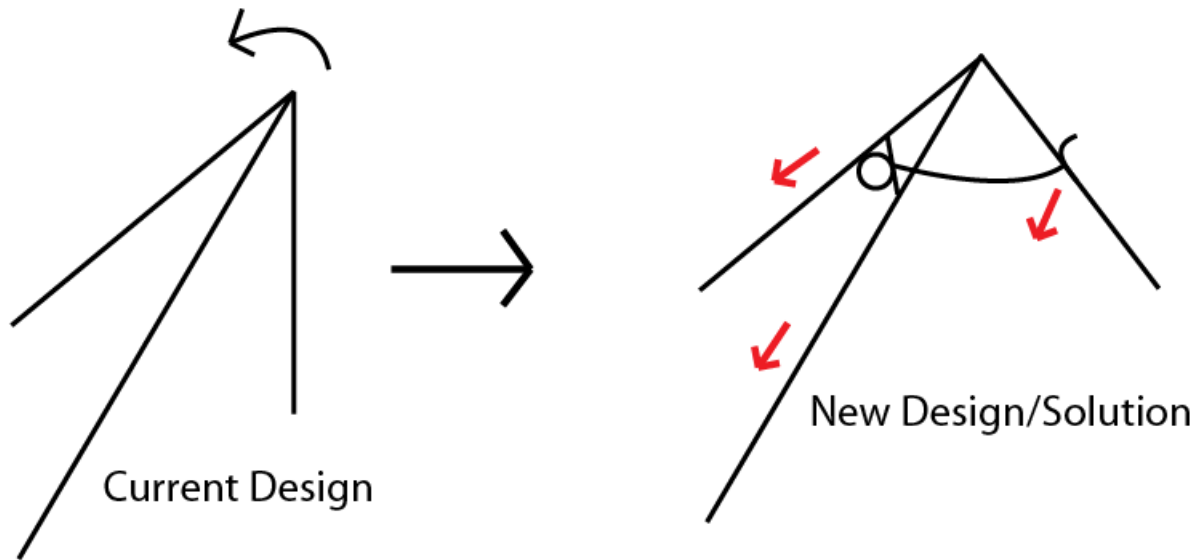
like began. This process went on for some time as the design continued to change and new products that would help in creating the final product were found.

While the product design was being created, the packaging design of the product was also considered. The initial thoughts were of a contraption that would allow the user to hang the hammock off their shoulders and be able to separate the two in order to allow them to wear a backpack simultaneously. The contraption included multiple straps that were sewn together in a fashion that would allow the user to easily release and attach the stand from their back. This was not entirely lost but was set aside when the idea to make the hammock itself turn into a backpack that would hold the stand was offered. After trying to find the optimal way, it was decided to discard the idea and move onto a more traditional approach. Using the hammock as a backpack was discarded due to the fact that the hammock could be easily damaged or dirtied during conveyance. Also, this approach would have called for much more work in designing a custom hammock and the focus of this project is a portable hammock stand; not a hammock. The hammock backpack can definitely be revisited down the line though. In the end, a custom duffel bag was designed to transport the hammock stand. This solution was more practical for the time being and will definitely be revisited and improved as time goes on. When it comes to shipment of the hammock stand, a common RSC will be used. This product is resistant to scuffing and damage which makes this a valid choice.

### **Proposed Solution**

Although the final design ultimately failed to meet the proposed needs as well as support a hammock, there is a possible solution. Currently, the third design did not work due to too much top force on the stand. This made the stand topple over itself. By lowering where the hammock attaches to the stand and using different anchor points, the stand can be successful. Figure 15 below shows the current design and how the forces are acting on along with the new design and how the forces will act on it as well. This design will most likely work but has yet to be tested and will not be further discussed in this report.

Figure 15: Proposed Solution



### Business Plan

As for the development of the business itself, multiple steps have been taken to establish a company platform and to better understand how the company should position itself. A rough business plan was developed during the development of the product discussed in this paper. The overarching theme within the business model would be to help make the world a better place. To accomplish this, recycled resources would be utilized as much possible to be used in the product. The total product life cycle would be considered starting with having the stand be designed to last forever. Though, when people no longer want it or if it is broken, the business will have set up a type of recycling system that will reuse the thrown away parts. Whether the parts are refurbished or melted down and reused, a way will be found to keep it out of a landfill. This along with how we go about distributing our goods and how they are produced will all be approached with an environmentally friendly perspective. This will overall reduce our carbon footprint of the product and help sustain the business.

The idea of enacting the business model of “buy a hammock stand, give a hammock stand” is also being considered. This would be similar to the TOM’s Shoes approach of buy a pair give a pair. Every time someone purchases a hammock stand, a hammock stand will be given away to someone in a less privileged country that does not have the means to sleep above

the ground. Sleeping on the ground is a large contributor to a majority of the diseases obtained by people in third world countries. This would help people sleep more soundly as well prevent them from obtaining certain diseases. The main categories of people that would be considered customers would be outdoors oriented people; family oriented people, military use, as well as younger generations such as college aged people. Each group would have a different sales strategy but in order to keep things simple for launch, family oriented people would be the main target starting off. This would allow for a more finely tuned marketing strategy and allow the product to gain credibility. It would then be branded more towards the other customer segments. This would be accomplished through partnerships with current hammock companies such as Yellow Leaf, REI, or Hennessey Hammocks to name a few.

Before all this is possible, a production plan needs to be laid out. This would include a final design that has been tried and tested. Once the design is established as complete, the material suppliers and distribution pathways would be determined. This is all hinged on the development of a product design. The current prices that hammock stands are going for is around \$150-200 and this product would fit more so on the high end in the beginning but most likely be reduced due to production and development. The only thing holding back this plan is a tried and true design which will be solved in due time; though for the sake of this report it failed, it will one day work.

## SECTION VI REFERENCES

- Staff, H. C. (2011, June 20). *Hammocks' rocking history*. Retrieved from  
In text citation: (Staff, 2011)
- Shute, N. (2011, June 20). Why hammocks make sleep easier, deeper. *NPR Health News*, Retrieved from <http://www.npr.org/blogs/health/2011/06/21/137300311/why-hammocks-make-sleep-easier-deeper>  
In text citation: (Shute, 2011)
- Cell Press (2011, June 21). Need a nap? Find yourself a hammock. *ScienceDaily*. Retrieved October 23, 2012, from <http://www.sciencedaily.com/releases/2011/06/110620122030.htm>  
In text citation: (Cell Press, 2011)
- Letter, H. H. (2007). As the hammock swings. *Harvard Heart Letter*, 17(9), 6. Retrieved from *Academic Search Elite*  
In text citation: (Letter, 2007)
- Shorman, J. (2011, June 21). Study: Rocking hammock promotes faster, deeper sleep. *USA Today*. Retrieved from <http://usatoday30.usatoday.com/news/health/story/health/story/2011/06/Study-Rocking-hammock-promotes-faster-deeper-sleep-/48694602/1>  
In text citation: (Shorman, 2011)
- Misra, R. (2000). Login |create free account college students. *American Journal of Health Studies*, 16(1), Retrieved from <http://www.biomedsearch.com/article/College-students-academic-stress-its/65640245.html>  
In text citation: (Misra, 2000)

- Frick, Larry; Thompson, Harrison (1988) U.S. Patent No. Des. 295,242. Washington, DC: U.S. Patent and Trademark Office. Retrieved from <http://www.google.com/patents?hl=en&lr=&vid=USPATD295242&id=lnM8AAAAEBAJ&oi=fnd&dq=patent+Des.+295,242&printsec=abstract#v=onepage&q=patent%20Des.%20295%2C242&f=false>
  
- Westrich, James (1991) U.S. Patent No. 5,035,012. Washington, DC: U.S. Patent and Trademark Office. Retrieved from <http://www.google.com/patents/US5035012?pg=PA1&dq=patent+5,035,012&hl=en&sa=X&ei=jnepUKS7DeL7iwLg24HoCw&ved=0CDcQ6AEwAA#v=onepage&q=patent%205%2C035%2C012&f=false>

APENDIX

A: Gantt chart

