Final Design Report - Store N' Slide

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Executive Summary

Every 17 minutes, falling furniture causes an injury in the United States, according to *Consumer Reports* by the Consumer Report Safety Commission. The same report also states that a child is killed by a falling piece of furniture in the United States every two weeks. Dressers, in particular, often fall on small children when children climb on them because many dressers are not built to withstand this force. There is a simple solution to this problem, anchor the dressers to the wall; in fact, every dresser sold today comes with the hardware to do so. As it turns out, many parents fail to properly anchor their dressers to the wall behind them. Nancy Cowles from Kids in Danger identified this problem and believes that it is in dire need of a solution.

The purpose of our project is to solve the problem of child injuries and deaths with dressers by constructing one that would not tip over when a child climbs on it. In fact, we wanted to create a dresser that would even encourage children to play on it in a safe and secure manner. With this purpose in mind, our final design was reached through talking to many parents of small children to gain their input on what an ideal playspace-dresser combination would look like and by using multiple stages of design and survey. We wanted to maintain the end user in mind throughout the entire process in order to ensure that our group remained true to human-centered design.

Our final design is a dresser that is trapezoidal shaped, the base is larger than the top and the front face of the dresser is angled at 70 degrees from the horizontal. There are rock wall pieces attached to the drawers, a ladder on the right side of the dresser, and a slide on the left side. This design addresses our problem because there is essentially no way for our dresser to tip forwards and onto a child should they be playing on the front of our dresser. We can confidently declare this due to the fact that we have created a slanted dresser so that the base of our dresser is much wider than the top and, therefore, much heavier as well. In addition, our dresser encourages play with fun aspects such as a rock wall, a ladder, and a slide as well as incorporating bright colors into the design. In addition, the ladder and slide are detachable through a modular design. This extends the lifespan of our product because it can still be used as a dresser without the slide and ladder once the child grows older and no longer has need for them.

Introduction

Two years ago, a two year old toddler was left alone for a routine nap in his crib. He was able to climb out of the crib, and, being a curious toddler, he sought to reach the top of his dresser. His parents later entered the room and unfortunately found the small boy crushed under the massive MALM dresser designed by IKEA. The Consumer Product Safety Commision, whom relayed the information regarding the incident also mentioned that the MALM line of dressers had been recalled before the incident ("Following an Additional Child Fatality").

This emotionally gripping case is only one in countless incidents involving dresser tipovers ending in a tragic event. In fact, a child's life is ended in a similar tragedy every two weeks, according to the Consumer Product Safety Commision ("WLS").

Earlier in August, Nancy Cowles, executive director of the non-profit, Kids In Danger, based in Chicago, IL, reached out to us and brought upon us the challenge of designing a dresser that will effectively keep children safe from tip-over accidents. Kids In Danger focuses on protecting children from numerous faulty products such as tipable dressers ("Kids In Danger", n.d.). Our team followed the design thinking process where we first tried to substantiate our perception of the problem.

First off, the solutions implemented by companies thus far are not effectively stopping dressers from harming children. Regarding the incident involving the two-year old boy, ABC news reported IKEA's investigation "indicates that the chest involved in this incident had not been properly attached to the wall" ("Death of 2-year-old boy"). In essence, IKEA's solution is to urge consumers into strapping dressers to the wall. In an interview with the Chicago Tribune, James Dickerson, the chief scientific officer at Consumer Reports, warned that product designers "should not put all the burden on the consumer." Relying on parents to strap furniture is not a good approach to this problem because they are not guaranteed to do it. For example, we reached out to a mom of a two year old girl and asked her if she would fasten a dresser to the wall; her initial response was that she wouldn't because she wouldn't want to penetrate the wall. Attachables did not solve the issue at hand.

The core of the problem is that there are many dressers that cannot resist the force of a child's weight when climbed on. A good way to quantify the safety of a dresser is to test if a

dresser can bear certain weight on it; essentially, testing the design of the dresser. The American Society of Testing and Materials International, comprised of volunteers with a broad range of engineering and societal knowledge, known as the ASTM, outlines a method for which companies can test dresser stability. The procedures include clinging weights to each individual drawer, then opening all the drawers; the dresser passes the test if it doesn't fall, according to ASTM F2057 standards (ASTM Standard 2057). Although these procedures may sound appropriate in screening out poorly designed dressers, there is no governing basis that prohibits faulty dressers from reaching consumers. According to Consumer Reports, it is entirely up to companies to decide whether they want to build a safe and sturdy dresser (Peachman).

After reading countless reports published by SaferProducts, where consumers report faulty functionality of merchandise, we found that standard rectangular dressers are very tipable. In one report by the database *Safer Products* a consumer noted that "when you open all of the drawers [of his]... BamBam dresser which is extremely heavy…[the dresser] topples over"("Incident Description"). Heavy is not enough when it comes to designing sturdy dressers. Once a heavy dresser is tipped the impact of its weight can become extremely lethal. Consumer Reports also points out that wardrobes under thirty inches are especially left without any regulations as there are no safety standards in place for them, possibly because their smaller size makes lethal dresser tipping seem unrealistic (Peachman).

The bottom line is that children are curious human beings. Furniture firms are not embracing their spontaneity in the design of their dressers. The MALM dresser that we purchased from IKEA is a standard rectangular looking wardrobe with four drawers. Our team modified it into a more playful design that invites climbing and sliding. Our dresser, affectionately branded as the Store N Slide, embraces the curious and playful nature of children.

Users and Requirements

Requirements

The main requirement of our design is to ensure the dresser will not tip over so that when children are present they are safe from a tip-over accident regardless of what they do on the

dresser. Since we are taking the approach of building the dresser into a play-structure, it is also important that it is fun for kids to play on.

Main Users of the Design

Child - The specific age range for play use would be two to eight years old, but it can be used for people of all ages to store clothing.

Parents - The parents of the child will be the secondary users of our design. They will be responsible for assembly/disassembly of the dresser as well as placing it in the room. The structure will be modular, as the slide and ladder will be detachable, hence the parents will need a tool to unscrew the slide and ladder as they wish.

Design Concept and Rationale

After discussing what requirements we had for our design and what our users needed, we decided our design would be a combined dresser and playset for kids, which we lovingly named the Store N' Slide. The main piece of our design is the 4- drawer dresser, which is slanted back slightly, so it can double as a rock wall for kids to climb on. On the right side of the dresser piece, there is a ladder, so kids can climb up to the top of the dresser. On the left side of the dresser piece, there is a slide for kids to go down. Both the ladder and slide are detachable, which ensures the dresser doesn't take up nearly as much space when the kids grow older and stop using the playset feature of the dresser.

The dresser is 39" tall and 31" wide. At the base of the dresser, the depth is 32.75", and at the top of the dresser, the depth is 18.875". The front of the dresser doesn't begin to slant until it is 3" off the ground and then makes a 70° angle once it begins to slant. The dresser has four drawers, and on the face of these drawers are ten rock inserts for the rock climbing wall. On the right side of the dresser is a ladder that is sitting on top of a 10" tall box, which doubles as a step. On the left side of the dresser is a slide that is 40" tall, and it has a support system under it that will support its weight. Both the slide and the ladder have bolts that can attach and detach from the side of the dresser using one tool to make the design modular. This modularity concept was put in place because of the obsoleteness that can arise when the users no longer sees the product suitable for the children's age.

While it may seem hard to discern how the product in its final iteration came to be, the design was obtained through a rigorous series of user surveys, consultations with the client, and consultations with manufacturing experts. We first started out with 4 different opportunity spaces: circular designs, designs that intentionally break apart when they fall, designs that extend the dresser base, and designs that encourage children to play on them. To make the decision, we conducted 16 interviews, both on the phone and in person, and 8 parents favored the opportunity space surrounding dressers that encouraged climbing and play. From these results, we brainstormed a list of possible features that could be included in designs of this opportunity space. Through discussions with expert designer Walter Herbst, we decided that features to be included were as follows: a slide, a rock wall/dresser combo, and a ladder.

At this point, we knew what the elements of the design were, but we were still unsure as of how to orient them. To proceed, we went back to the users we had initially queried and ask them to decide between three different configurations of the elements we had. We produced CAD models of possible design concepts and asked users to give us their feedback. Based on this feedback, we narrowed it down to two main designs.

Our next step was to build real size mockups of our final two designs, which we then presented to the client as well as discussing the manufacturing with experts and putting out one last user survey. Based on the client feedback, user feedback, and what we knew about the time and cost to manufacture, we decided upon the design outlined above.

Once we had the design concept chosen, we cleaned up our CAD model of the design and then met with the manufacturing experts once more to go into more specific detail about how we were going to build our design. In this meeting, we decided to buy and modify a dresser from IKEA, use compressed laminate for the back facade, and buy a plastic ladder/slide set, which we could split up and put the ladder on one side and the slide on the other. With all of the results of our surveys and design decisions we've made, we are confident that we have a great product that kids will love to play on and that gives parents peace of mind about their child's safety.

Design Limitations

Although we are very happy with how our final prototype turned out, there are many design elements we believe should be added to future iterations of design to ensure the highest quality of safety and fun for the children climbing on it. Those changes include further testing of our product with children, adding railings to the top of the dresser, adding drawer stops to the drawers, and using a full size ladder. Below is a detailed list of these improvements.

Further Testing

Children: In the process of building our prototype, our team did not have the means to have actual children play on our product to see how much they enjoyed playing on it. Ideally, we would like to have children climb on it and give us their feedback on how much fun they had in order to make sure our product is as appealing as possible to those who will be playing on it.

Improvements to the Design

Railings: Although our team would have loved to add railings to our prototype to add to the safety of our product, we unfortunately did not have the materials or means to do so. When railings get added in future iterations of our design, we believe they should be wood bars that are about 3 feet tall that wrap around the entire dresser, excluding holes for the children to access the slide, rock wall, and ladder. Adding railings to the top of our dresser would make the product much safer to use for kids since it would prevent risk of injury from falling off the dresser.

Drawer Stops: One of our biggest safety concerns is ensuring that a child won't be able to kick a drawer open while climbing the rock wall since such an incident could cause the child to slip and injure himself. We were unable to complete adding drawer stops as we ran out of time and materials, but we wouldn't have even considered including putting a rock wall on the face of the dresser if we weren't confident it could be done safely. Adding drawer stops would ensure that the drawers of the dresser couldn't get kicked open while a child is using the rock climbing wall on the front of the dresser.

Ladder: Our team wanted to have a simple ladder that could attach the side of our dresser, but due to an error when ordering materials, we got a product that was too short for our dresser. We didn't have the funds to replace our ladder with one that was the proper size, so we had just had to work with the ladder that came. Ideally, we would eliminate the box underneath the ladder, and just have a normal ladder going up the side.

The ideal version of our design would be an incredible product when finished. Not only would it ease more parent's minds with the additional safety features, such as the railings and drawer stops, but it would also directly check in with children to make sure that they are having fun. Although our current design is fantastic, the future improvements would help ensure two of our main focuses for our design: safety and fun.

Conclusion

We were sickened by the idea of children being crushed by dressers while simply exploring their curiosity, so we created The Store N' Slide to reconcile the idea of safety and fun. Most dressers, including the MALM line sold by IKEA, do not embrace the vivid nature of a child in their design, but rather focus on the aesthetics of the dresser. Our design recognizes the curiosity and spontaneity of children, which are factors that make a child likely to climb on any dresser. To ensure we accomplished this along with making the dresser safe, we made sure to meet the following criteria.

- The face of the dresser is at a 70 degree angle relative to the ground so that the center of gravity is closer to the ground - making the dresser essentially untippable.
- The dresser's shape also leaves a lot of room for storage since the bottom drawers are especially long.
- Due to the modularity of the design, the ladder and slide are removable, parents are able to get rid of the slide and ladder once they deem it unfit for the child's age. Removing and linking the components is easy because it just involves just one tool.

In summary, the design is fun for the child to play on, considering it has a rock wall and a slide, while keeping the children safe from falling dressers. Our design invites play and ensures a child's curiosity will not be the barrier or problem to his safety.

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Appendix A: Background Research

The following document is a compilation of all the research done by students in the DTC Class in order to address the client's statement of a need for a better solution to prevent furniture tip over accidents, especially concerning dressers under 30 inches tall. Based on what information the class believed they would need, the class split up into 4 groups; each group conducted background research in the area that was assigned to them. These four areas were as follows: regulations, design of children's dressers, current solutions, and the causes of tip-over accidents. This report has been split into 4 sections to correspond with each of these categories.

Regulations

Within the category of regulations, we have split our research areas into subsections pertaining to ASTM standards (mentioned by the client), consumer reports standards, fire safety, and other standards

The government standards for safety in regards to dressers is set in ASTM F2057. First of all, this guide specifies it is intended to cover furniture over 30 inches in height and is intended to be applicable for children up to the age of five. The standards are essentially a set of tests for the furniture to go through without the use of any tip over restraints, such as the use of supplemental straps. The first of these tests is to open all cabinet doors 90 degrees and all drawers to their stopping point, or two-thirds of the way if a stopping point isn't present. If this test is successful, the next step is to open each drawer or cabinet while every other one is closed and gradually apply weights to the edge of the opened drawer/cabinet, but it doesn't specify a specific weight it must hold ("ASTM Standard 2057") .

In addition to the ASTM standard, the industry operates under a "voluntary testing standard." According to Consumer Reports, this standard suggests that any dresser more than 30 inches tall should not tip with up to 50 pounds of weight hanging from the end of any drawer. Since dressers under 30 inches do not fall under the voluntary testing standard, ⅜ of dressers of this height tipped when 50 pounds was hung from the top drawer front. Based on the tests in figure 1 below, the Consumer Reports report noted a few more things when it came to the design impacting performance ("ASTM Standard 2057").

- Dressers that were oriented more horizontally than vertically showed more success in passing the tests
- Heavier dressers were generally more successful in passing all three tests, however, the weight of the dresser did not guarantee success

i. Figure 1

All drawers are open	The top drawer is completely open with 50 lbs hung from the front	The top drawer is completely open and weight is gradually increased from 50 to 60 lbs.

In regards to fire safety, we investigated a few different standards that are in place in the US to ensure fire safety of furniture, but specifically furniture made of wood, a more common material used to make dressers. According to NFPA 703 (released by the National Fire Protection Association), there are standards in place to test fire-retardant-treated wood. The wood will be tested in accordance with ASTM E84 which states that the wood shall only be considered fire-retardant-treated wood if the wood has a listed flame spread index of 25 or less, show no evidence of significant progressive combustion when the test is continued for an additional 20 minute period, and the flame front shall not exceed more than 10.5 feet beyond the centerline of the burners at any time during the test. (“ASTM E84”)

In addition to the standards established by ASTM F2057, there are codes that require transparency on the manufacturers end. Furniture must be labeled with the following: dimensions and weight, items included in the box, description of filling material, and contact info of manufacturing companies, which leaves the consumer aware of all the intentions of the manufacturer (“National Institute of Standards”).

We also conducted research about the current state of the dresser market. While we were browsing through IKEA’s catalog website, we found that the dressers are usually rectangle in shape and overall very alike. The dressers can be single or double columned, and will usually

feature table tops, or flat top surfaces where many people put objects. There is also slight variation of base design, as most dressers either have flat or 4 legged bases.

Material-wise most dressers are made of particle board, while some expensive ones are actual wood. In most cases the particle board is laminated and painted with a wood finish. The material used will generally determine the pricing, which can range anywhere from $90 to $1000. The height of the dressers is usually over 30 inches, and the weight can be up to 90 pounds, based on the material ("Home Furnishings").

Our research also showed that there are other ways to store clothes without the need for heavy structure that can pose a threat in tip-over accidents. There are many commercially available clothing storage systems that are made of cloth or acrylic, and they can often be meant to hang from the wall. This option, however, could be unsuitable for some parents who wish to store items on top of their dressers in order to be more space efficient. Another alternative is open wire rack or cubby designs, where clothes are stored in trays. This option can often be much lighter than traditional dressers due to lighter materials and not having full drawers. This option could also be more cost efficient ("Home Furnishings").

Safety Devices that Currently Exist

Another current solution to furniture tip overs is brackets. One part of the bracket latches onto a leg or base of the furniture, while the other part of the usually "L" shaped bracket is attached to walls. It is usually attached to the wall by screwing into studs, which as mentioned above is non-ideal for many consumers due to permanent wall damage, difficulty of installing, and needing to place furniture in a room based on where studs are. While this method is inexpensive, it is seldom used (Gromicko).

Lock mechanisms are devices that make it harder for draws to be opened, using child-proof locking that attaches from the side of the drawer to ensure that no child could open a drawer, or that not more than one drawer is open at the same time. This solution is cheap and somewhat effective, but the obvious downside is the inconvenience it causes to parents who need to open the drawer. Furthermore, accidents can occur with a single drawer open, so it is by no means a perfect solution ("2017 OECD").

Drawer stops are devices that prohibit drawers from opening all the way. They stop pressure from being applied to a draw that is fully extended, at the end of the lever arm of the drawer where force can contribute the most to a tip over. Although this solution can be effective, it makes the dresser much harder to use, either limiting storage space or making it awkward to put clothes in the back. Lastly, if the dresser does not come with this feature built in, it is a timely, difficult installation for parents ("2017 OECD").

Furniture Harming Children

Lastly, we wanted to know more about how furniture was hurting kids. Based on our research, we found that there were 2 deaths per week related to tip over accidents. Of these accidents, there were three main causes of death: crushing 57%, struck 15%, and positional asphyxia 20% and other 9%. Our research also showed that of the objects that caused fatalities, 29% was furniture, 20% was televisions, 45% was both TVs and Furniture and 6% was something else. Of the furniture involved in fatal accidents, our research showed that 38% were tables, 29% were dressers, 18% were shelving units or bookcases, and 14% was other types of furniture ("Product Safety").

Appendix B: User Testing Guide

When trying to decide how to solve our problem of children being injured by unstable dressers, we came up with four opportunity spaces: circular designs, designs that intentionally break apart when they fall, designs that extend the dresser base, and designs that encourage children to play on them. We surveyed 16 people in regards to which design they liked best, and 8 of those people were enthusiastic about the opportunity space regarding designs that encourage children to play on them. The other 8 votes were split between the other three opportunity spaces with responses that weren't as enthusiastic. Once we had the information that the opportunity space that encouraged children to play on dressers was the one that people favored the most, we came up with three possible design concepts and sent them out to 16 more people. Through this survey, we discovered that 15 people were split between our two design concepts that took up the least amount of space, the main difference between them being that one had a slanted dresser with a rock wall on it, and one did not. We were still unsure which of these two designs to build after the survey, so we made mockups of both and brought them to our client, Nancy Cowles from Kids in Danger. She was very intent on making sure our design had a good center of gravity to ensure it wouldn't tip, so we decided the best way to do this was to choose the design with a rock wall since it had the slanted dresser.

Appendix C: Bill of Materials

Item	Description	Qty	Source	Part Number	Unit Price ($)	Total Price ($)
Fiber Board	½” x 24” x 48”	2	Home Depot	1508108	10.95	21.90
Slide with Ladder	23” x 18” x 39”	1	Amazon	B008MH5H4M	34.93	34.93
Climbing Wall Handle	10 Rock Climbing Handles 3/4in. To 1.25in. thick, 20 fasteners, drill bit	1	Amazon	B07HJ7RFK5	15.95	15.95
Edge Trimmer	Hand Tool that uses veneer cutters to cut in two directions	1	Home Depot	33437	9.73	9.73
Edge Tape	3/4in x 25ft White and iron on	1	Home Depot	274431	5.25	5.25
Threaded Inserts	100 pack of 1/4in-20 tpi threaded inserts, .51 in. length	1	Home Depot	901420-13	7.00	7.00
Dresser	4-Drawer White MALM Dresser	1	IKEA	203.604.64	149.00	149.00
					Total Cost:	243.76

Appendix D: Instructions to Build

Instructions

1. Prep
    a. Parts needed
        i. See BOM
    b. Tools/General Shop Materials needed
        i. Drill Bits
            1. 19/32”
            2. 5/16”
            3. #2
            4. #15
        ii. Wood Glue
        iii. Flathead screwdriver
        iv. Phillips Head screwdriver
        v. Bandsaw
        vi. Engineering Square
        vii. Writing Utensil
        viii. Hand Drill
        ix. C Clamps
        x. Hacksaw
    c. Joins Needed
        i. Peg Join-Joins two surfaces together
            1. Drill a hole using a **#2 bit** in both of the surfaces you want to join
            2. Dip pegs in wood glue and place pegs in necessary holes,using a mallet if necessary
            3. Put drops of glue in the holes meant to receive the pegs
            4. Push surfaces together, making sure pegs are all in holes
        ii. Screw Capture Join - Joins surface A of one piece to edge B of another
            1. A

a. Drill hole using **#15 bit**
b. Install screw into hole

2. B
    a. Put a hole using a **5/16" bit** in desired location of attachment on the edge
    b. On inside face that is normal to the edge, make a ⅜" deep hole using the **19/32" bit** 1+⅜" in from the edge

1. Build
    a. Dresser
        i. Modify
            1. Dresser
                a. Side pieces(Everything is done to both side pieces)
                    i. Unscrew drawer slides using **Phillips Head ScrewDriver**
                    ii. Mark line through holes that were used to install drawer slides using **Engineering Square**
                    iii. Make slanted cut at 70 degrees starting 3 inches up from bottom front corner using **Bandsaw**
                    iv. Reinstall drawer slides using **Phillips Head ScrewDriver**
                        1. Keeping the slide on the line that you previously marked
                        2. You will need to add holes to the pre existing ones, as many of those were cut off in the angled cut. How many you add is your discretion, but you need at least 2 per rail

3. To add a hole, hold drawer slide where you want it and drill a ⅜” deep hole using a **#5 bit** through a hole in the slide.
4. Once your hole is drilled you can put the screws back in to the new holes you have drilled

v. Drill holes for facade
   1. Measure 4 distances on inside face 1+½”, 10+⅜”, 19+⅞”,29+⅜” away from the top edge of the plant
   2. From each of these marks mark ½” and 1+⅛” up
   3. Drill ⅜” deep holes 5/16” away from the edge using a **#15 bit** in bottom hole of each set(As in **Join #2A)**
   4. Drill ⅜” deep holes 5/16” away from the edge using **#2 bit** in top hole of each set(As in **Join #1)**

vi. Cover exposed edge
   1. Use iron on edging wherever you feel necesary to clean up edges. Follow instructions on edging material packaging

vii. Prepare top edge with Join 2B

viii. Note distance between existing 2B hole and the one you made. **Call this distance A**

b. Top piece
   i. Measure distance from front edge of the side to the center of the first hole. **Call this distance B**

ii. Drill two ⅜” deep holes ¼” away from the edge using a **#15 bit** , the first hole marked **distance B** away from the front edge, and the next hole marked marked **distance A** away from the first hole.

2. Drawers
    a. Side pieces(all instructions happen with both sides)
        i. Attach drawer slides to drawers
        ii. Mark angled cut at same angle you cut dresser
        iii. Drill two holes perpendicular to the edge, according to Join #1 in the front edge of each side piece, the first one 2+⅜” down from the top edge of the slant and the second one 3+13/16 away from the first hole
    b. Bottom pieces
        i. Using a **Bandsaw**, cut ⅜” off of the shorter dimension(AKA your blade should enter in on a shorter side and exit on the opposite shorter side

ii. Assemble
1. Dresser
    a. Follow Ikea instructions except that you should not put on the top or back pieces
    b. Also when installing bars the go in the gaps between the drawers(One of the first steps) you will use the holes you made, as the original holes were cut off by
2. Drawers
    a. Follow ikea instructions for assembly, expect for attaching front piece to sides

b. To attach front piece to sides, follow Join #1 procedure using the holes you drilled in 2.A.i.2.a.iv. And 4 larger holes on inside of front piece

3. Misc
    a. Back Supports
        i. Cut C-channel of any size to pieces longer than 36 inches, ideally around 48 inches.
        ii. Drill ¼” holes centered relative to the cross section of the C channel an arbitrary distance from either end of the cut piece
        iii. Follow the procedure for installing a threaded insert in the back edge of one side of the dresser.
        iv. Bolt the C channel into the one threaded insert you have installed.
        v. Use the hole on the other side of the C -channel to mark a location for a second threaded insert.
        vi. Remove the C channel
        vii. Install the insert
        viii. Install the C channel
    b. Back Brackets
        i. Attach any type of angled bracket to the upper inside back corners of the dresser using ½” screws

a. Slide
    i. Back Supports
        1. Base Plate
            a. Cut out a 8” by 8” square of ½” plastic

   b. Drill 4 pairs of holes all the way through into the larger face as follows: holes ¾” in from the edge, ¾” out from the midpoint of each side
   c. Counterbore holes on one side using any drill bit bigger than ½”
   d. Use the base plate as a template to drill out the 8 ¼” holes in the slide in the same pattern as the base
2. Brackets
   a. Create or purchase 8 brackets that are 1.5” by 1.5” by 2”and on each face have two ¼” inch through holes that are spaced 1.5” apart are are ¾” from the inside of the bracket
   b. Two of these brackets must be bent to around 70 and 110 degrees
3. Planks
   a. Starting
      i. Cut 4 planks of wood or MDF approximately 2.5 inches wide and 40 inches tall
      ii. Cut these to 35+¼”, 36+⅜”(2x) and 37+½”
   b. Front and back bars
      i. Using the shortest and longest bar, cut a 20 angle into the “sides” of the planks starting at the top corner
   c. Side bars
      i. Cut an approximately 20 degree angle into the short sides of the two middle-sized bars using the bandsaw
   d. Bottom holes
      i. See below
   e. Top Holes

i. See below

4. Assembly
    a. Attaching Brackets to base
        i. Use ¼-20 bolts and an allen wrench to attach the brackets to the base
    b. Attaching Planks to Base
        i. For each plank, line it up where you want it to be anchored, then mark through the holes in the bracket to get a placement mark for the holes to be made in the plank.
        ii. Take the plank away from the base, drill the 5/32” holes in the plank where you marked
        iii. Now you are ready to use 2” long ¼”-20 bolts to attach the planks to the brackets
    c. Attaching Brackets to slide
        i. Use ¼-20 bolts and an allen wrench to attach the brackets to the slide
    d. Attaching Planks to slide
        i. You may have to use aa dremel or hacksaw to cut away plastic parts of the slide that slightly interfere with where you want to place the supports
        ii. Bring the base into the position you would like it to occupy, and use the brackets on the slide as a way to mark locations for the holes located on the top of the planks
        iii. Use a hand drill to drill 5/32” holes in the locations you marked
        iv. Use ¼-20 bolts to secure the planks to the slide

ii. Front Supports

1. Side Supports
    a. Cut Two 8 inch 2 by 4s
2. Top Supports
    a. Cut a 2 by 4 to 10 inches, then use a slanted table saw to cut a 20 degree angle off the longer side(i.e. The length of the slanted edge should be longer than the other 3 edges
3. Assembly
    a. Drill pilot holes through the slanted face of the top support into the top faces of the side supports, then use the hand drill to screw these together
    b. Line this arch-shaped assembly where you would like it underneath the slide, and repeat the process of drilling a pilot hole and screwing through the slide into the top face of the top support.

iii. Modularity

1. Inserts
    a. Drill holes for threaded inserts on the side edge of the dresser's top piece, vertically centered, with 1 hole ½" from the back edge and the other one 10+½" from the back edge
2. Attach connector to dresser
    a. Cut a somewhat arbitrary rectangular piece of ½" plastic aiming for dimensions around 4" by 12"
    b. Drill two holes for inserts in this piece on the "face" , with both being ½" down from the "top" edge and 1 hole ½" from the back edge and the other one 10+½" from the back edge
    c. Put glue into the hole, then put the inserts in the hole you just made using an allen wrench, then put a 1" ¼-20 bolt

through the inserts in your plastic “connector” piece and the dresser

3. Attach slide to connector
    a. Line the slide up where you would like to have it in relation to the dresser. With a bit of elbow grease you will be able to squeeze the top handle arches of the slide in between the bolts in the connector piece, making placement easier
    b. Simply drill 2 1+½” long wood screws with washers on them at arbitrary locations through the slide and into the connector piece

iv. Paint

1. Where there are screw heads sticking out of the slide, file down the heads of the screws
2. Scratch the area around the screw heads with sandpaper of any grit. Don't go overboard
3. Tape out an area around each set of screw heads that you want to paint
4. Using “Code Red” Montana spray paint, paint in the sections you just taped around being careful not to spray any more area than you have to. Use standard spray technique and apply 2 to 3 coats

v. Foam

1. Obtain a large sheet of 1 inch thick foam
2. Use duct tape to wrap the foam around the entirety of the back support
3. Use duct tape to wrap the foam around each individual front support

b. Ladder

i. Platform

1. Using foam core construct a box with dimensions 10” by 14” by 24”
2. Measure the length of the diagonal of the top face of the box and cut two pieces of foam core to this length and the height of the box
3. Split on of those pieces in two
4. Use hot glue to secure the one long piece across the diagonal, and the two smaller pieces from the two unused corners to the midpoint

ii. Ladder

1. Hacksaw everything above the top step of the ladder off.
2. Hot glue the ladder in the correct position to the top of the completed foamcore box

iii. Modularity

1. Construct or purchase 3 1 by 1 by 1 angle brackets, one of which must be bent to approx 105 degrees
2. Using ½’ long 6x1 wood screws, screw two brackets into the front facing side of the box, and the angled one into the bottom of the top step of the ladder
3. Line the box and ladder up where you want it
4. Use the holes in the sides of the brackets not being used to mark locations for inserts
5. Drill , glue , and install threaded inserts