ETM-547 New Product Development

Team 3 - Development Log

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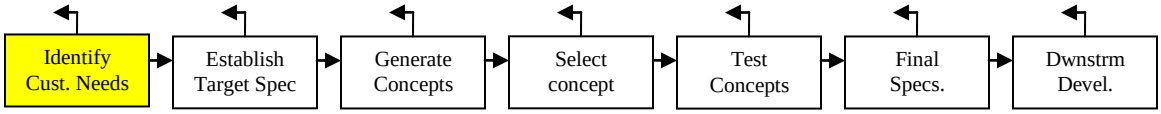
Development Stage:



Date(s): Jan 5-18, 2009	**Participants:** Arun Chenchugopal, Chris McGinnis, Josh Kelly, Rajesh Talla, Saad Al-Askaar, Saranya Sethu Pragasam.

Tools / Methods Used:

- Brainstorming
- Face to face Interview
- Observed users
- Quality Function Deployment (QFD)

Assessment:

Idea Generation:
In this phase every team member was asked to come up with a new product with an innovative idea and at the same time which is not too complex in order to be developed in ten weeks. Each member came up with different ideas which were new to the market and hence we performed a complete analysis in order to determine the right product to be implemented.

- **Product Idea selection:**
  Here we performed a complete analysis of the all the ideas based on the complexity of the product, time constraint, easy prototyping and at the same time keeping in mind the success of the product. This session helped us in streamlining the various ideas after which all the members of the team were asked to vote for the most feasible product. After performing the brainstorming session we decided on developing the cabinet step stool.

Identifying Customer Needs:
The various steps involved in this phase are:

- **Defining the scope:** In this phase we defined the mission statement for our product as
  "A stepstool that is built-in to the lower cabinet that allows the user to reach the contents of the upper cabinet".

- **Gather Raw Data:** In this phase we gathered raw data from the customers based on two methods.

  1. **Face to face interview**: Interviewed people using a step stool in order to overcome the flaws present in the existing ones and also interviewed people without a step stool to find out the reason for not having one and what are their requirements.
  2. **Observed Users**: We also observed people using a step stool which helped us to

understand their concerns among which safety and portability topped the list. As a result this process also helped us in identifying our potential customers.

Interpret Raw Data:
In this phase we translated the raw data obtained from the customers into need statements based on the sample table in the appendix. At the end of this process some of the need statements obtained are

Customer Comment	Category	Need Statements
I like the no slip, groved steps.	Safety / Stability	The step stool's step has a no-slip surface.
Step size should be 18"x18".	Function / Characteristic	The step stool's step area accomodates an adult's sized feet comfortably.

Organized needs into hierarchy:
From the above process all the raw customer data were translated into need statements. This helped in performing the next process which is the affinity exercise. Here all the customer comments were each written in a sticky note. And then based on the comments obtained we categorized them into four divisions such as safety, function, convenience and accessibility.

Quality Function Deployment
After defining the customer value statements and organizing them into their major topics, they were entered into a QFD diagram. At this point we reviewed the results of the affinity exercise and determined as a group what the different weightings should be. The weightings were also references in the following development stages to make sure that concepts matched what customer's valued.

Also, at this stage in the development process, the QFD required the input of the different engineering characteristics. By cross referencing these with the customer values it helped us make sure that manufacturing aspects of our product directly affected the customer's values.

Outcome / Results:

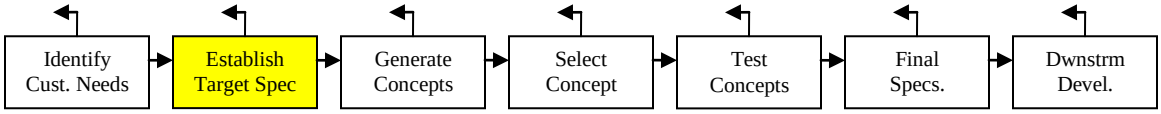
This process helped in translating the customer value statements into needs based on which it was divided into four categories and the affinity diagram helped in categorizing customer needs where safety-31%, function-29%, convenience-23% and accessibility-17% respectively. Moreover this process gave a clear picture of the disadvantages of the existing step stool which were lack of portability, storage and safety. Therefore the cabinet step stool was designed to overcome these problems.

One disadvantage that occurred in this stage of development was that the engineering characteristics were based on an unselected concept, so remained rather broad and high-level. In hindsight, this tool should have been revisited after the concept had been selected and user tested.

Because of this omission we originally missed the customer needs and engineering characteristics of the storage aspect of the step stool. These were eventually discovered through discussion and customer surveys. The impacts of this are described later in this development log.

Overall, the application of the QFD during these stages of product development helped us for the later stages of the product development process. It gave us as complete of a view as possible on what our concepts would have to meet and how these directly related to the customer values. It also helped us transition to the next stage of defining the product's target specifications.

Development Stage:



Date(s): Jan 13-18, 2009	**Participants:** Arun Chenchugopal, Chris McGinnis, Josh Kelly, Rajesh Talla, Saad Al-Askaar, Saranya Sethu Pragasam.

Tools / Methods Used:

- Competitive Benchmarking
- Quality Function Deployment Diagram
- Researched Building Codes

Assessment:

During this phase, the competitive benchmarking provided the best input for developing our target specifications. By reviewing the other step stools we were able to establish a baseline for what out product needed to provide given the stepstool market place. It wouldn't be prudent to enter the market with a product that did not at least meet the specifications of other step stools. Integrating these baselines with the customer value statements developed in the previous section established our product's target specifications.

Development of the Quality Function Deployment (QFD) diagram in the previous step ensured that our target specifications matched the engineering characteristics that were developed to address the customer's needs. Also, after weighting the different customer value statements and identifying which engineering characteristics addressed which customer value we were able to adjust our target specifications to focus and exceed our competitors for those engineering characteristics that customers valued the most.

The target specification section of the QFD also required specific units of measurement for each engineering characteristic. While most units were basic dimensions and sizes, it did require some research to best describe other non-trivial measurements. For example, measuring the amount of friction a material has is done using the coefficient of friction (COF) and research was required to find not only what was acceptable, but the measured levels of different materials.

At this point in the development process we had yet to reach the product concept stage so we did not have a complete picture of the product that we would be developing. Given this, the storage aspects of the product were not addressed until later in the process and required us to go through these steps again once we had selected a product concept.

Researching existing building codes was not as helpful as previously thought in the development of our target specifications. The building codes are based on the minimum that needs to be completed to pass building certification, which did not match what our customers described as the

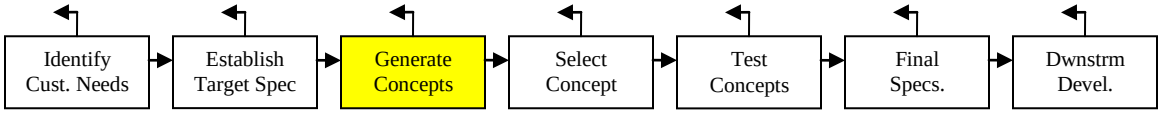
ideal position and placement of the steps. Placements that exceeded the minimums described in the code provided more value to the customer.

Outcome / Results:

Overall, using competing step stools to establish a baseline and comparing those baselines off of our first customer interviews helped greatly in defining what we needed to provide to be competitive. The structured approach of developing a QFD diagram, made sure that we were addressing all of the customer needs with a measurable target specification. Also, by applying these weightings, it showed opportunities were we could exceed current products in the market place and provide more value to the customer.

These target specs were then revisited throughout our development process and helped in the final product architecture and guiding the product decisions that were made during the DFM process later on.

Development Stage:



Date: Feb/March 2009	**Participants:** Arun Chenchugopal, Chris McGinnis, Josh Kelly, Rajesh Talla, Saad Al-Askaar, Saranya Sethu Pragasam.

Tools / Methods Used:

- Functional Diagram
- Competitive Benchmarking
- Patent Search
- Product Concept Presentations

Assessment:

Of the tools and the methods that we used above, for the purposes of generating our concepts, the Functional Diagram proved to be the least helpful. Our team spent most of the time figuring out what the correct application of the diagram was, rather than what the diagram could do to help us with the project. In this regard, the customer value statements that were gathered in the previous step ended up better describing what the product needed overall and the functions were clearly understood by the team. The book described the purposes of such a diagram was to decompose a difficult problem into smaller problems, but the team didn't feel like the problem was complex enough to warrant the use of the tool.

Competitive benchmarking, combined with the customer value statements ended up being the biggest help to us during this step. Since our product was derived from existing step stool designs, we could leverage them to define what our product needed, and the use of customer value statements helped us to determine the improvements that could be made. During this stage, each member was tasked with collecting different specifications from step stools in the market and entering the values into a database. These values were then added to the QFD so that we could develop and measure our target specifications.

The patent search was a useful exercise to get us familiar with the tools, but overall the results ended up being unwieldy and difficult to parse. With the amount of patents that were recorded, and since we were not considering submitting an actual patent application it was decided that our efforts were better placed elsewhere.

At this stage everyone understood the problem and where we could apply value, but everyone had their own idea on what the product could be, and how it would behave. During a team meeting, everyone drew their idea on a chalk board and presented it to the others in the group. There were a few ideas that were similar, and some that were completely different. Once completed each concept was weighed for its pros and cons, including the design challenges that still needed to be

solved. After the presentations we combined a few ideas into a single concept and narrowed down the choices to three. By the next team meeting, people's concepts were communicated again: one was done with CAD diagrams, another with Photoshop renderings and finally, the third was presented with a cardboard prototype.

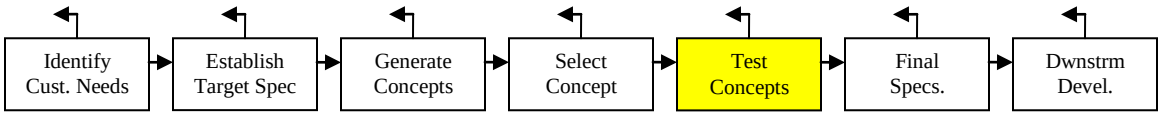
Outcome / Results:

Of the five steps described in class and the book for concept generation, our development process exercised four of the five: clarify the problem, search externally, search internally and reflect on the solutions and the process. The missed step of explore systematically would have probably been very helpful for the team. While everyone agreed on the final concept, this decision was mostly reached through gut feeling and verified using the customer value statements. Using a combination table may have helped us generate even more concepts. (During our second iteration when we explored the concepts of the storage tray, we used a combination table which really helped us define the different possibilities.)

Another aspect that affected our concept generate phase was the application of external constraints. Given that we had a relatively fixed area for installation of our product we found these constraints also needed to be weighed for each of the concepts and helped us decide on the final one. Of the concepts that the team had come up with, only one fit these constraints and still addressed the customer values.

Finally, customer testing a collection of different concepts would have also helped us decide on which concept to go forward with. We reached this conclusion internally and probably would have benefited from outside input into the product. It would have proved interesting to see the outcome of multiple surveys, each addressing one of the three main concepts that we had developed.

Development Stage: Concept Testing – I



Date:	**Participants:** Arun Chenchugopal, Chris McGinnis, Josh Kelly, Rajesh Talla, Saad Al-Askaar, Saranya Sethu Pragasam,

Tools / Methods Used:

1. Concept testing process I:
   - Survey I – Paper based survey
2. Photograph/Rendering image to communicate the concept.
3. Forecasting Sales / Demand
   - Q = N x A x P calculation

Assessment:

Though concept testing process is used in every new product development process, but in our product it is very crucial. There were 3 major methods or so called tools were used they are, Concept test survey (survey I – Paper based survey), Photograph/Rendering image to communicate the concept, and Forecasting Sales / Demand (Q = N x A x P calculation).

Concept Testing for our product is used for several purposes:

- Confirm concept selection decision – The primary purpose of the concept testing in our product is to confirm the decision taken about the selected concept.
- Soliciting improvement ideas – The next important purpose of this concept testing is to gather the customers input and to make improvements based on that.
- Forecasting demand – Finally, this concept testing is also helpful in approximately measuring the number of units that could be sold per year.

Concept testing process I:
In our cabinet step stool product, there were several steps that were involved in this process, they are:

- ✓ Defining the purpose of the test
- ✓ Choosing a survey format
- ✓ Communicating the concept
- ✓ Measuring customer response
- ✓ Interpreting the results
- ✓ Reflect on the results and the process

Survey I – Paper based survey:

- This was our first step in concept testing.

- The survey is divided into two sections (part 1 and part 2).
- The survey included 10 questions, photograph/rendering of the step stool product, and a product description.
  See Appendix 1 for the sample survey I format.

Survey I – Results:

- Results of survey I was not positive and there were several reasons that were later realized. They are,
  - *Survey format too broad:*
    The paper based survey format did not cover all of the essential questions. The concept communication sharing was very general.
  - *Market definition too vague:*
    There was no clear market definition was involved in the survey. The target market was not measured and survey was not exactly targeted toward that specific market.
  - *Rendering image not clear:*
    The primary method what we have used to communicate the concept is photograph/rendering image of the cabinet step stool product. And, in our first survey, the image was not clear enough to do the purpose. Some of the cons are, very small image, contrast too high, no clarity.
  - *Description not enough:*
    The description of the product was not up to the point, the survey takers had a hard time understanding the concept.
- Based on the above difficulties, not even a single respondent said they will definitely/probably purchase the step stool.
  See Appendix 2 for the sample survey I results.

Survey I – Measuring responses:

- There were many valuable user comments that helped us to navigate through and rethink the concept again. One of the very important comments that has to be mentioned is about shoe dirt falling on to the utensils that are placed inside the cabinet.
- There were some useful comments that suggested where to place our storage slot in the cabinet.
- As the rendering image was not clear, concerns were even raised upon attachment method and portability of the step stool. Thus customers responses could not be measured correctly.

Survey I – Communicating the purpose:

- Photograph and rendering – The concept communication method used for our concept is photograph/rendering method. The first survey had a non productive rendering image that the image was very small, image contrast too high, no clarity on the image concept. See Appendix 3 for survey I rendering image.

Sales Forecast ($Q = N \times A \times P$):

- When defining the market for which the sales forecast was to be calculated, we did not follow the market defined during the first few weeks in the Mission Statement. This led to our calculations being off because the chosen beginning value was the overall households

in the United States (110,000,000) and we were attempting to gain 25% awareness.

Annual Sales	=	Num. Annual Purch.	Awareness	Probability
1,677,500	=	110,000,000	0.25	0.061

Outcome / Results

The first survey proved to not be as useful as we had thought it would be and realized that we had made some mistakes in drafting it. First we did not start with a qualifying question. Second, the concept communication was unclear and lead to some unusual answers. Finally, questions were characterized as yes/no instead of using a range. As described, the results of this first survey showed that no one was definitely going to buy the product.

Computing the sales forecast estimates based on the survey results and the incorrect market size led to a number that could not be considered accurate. After going over the results and receiving comments from classmates and the instructor, we realized that in order to get a better idea on our sales a second survey needed to be performed.

Development Stage: Concept Testing - Process Iteration I:

Tools / Methods Used:

1. Concept combination table method
2. Concept testing process:
   - Survey II – Internet based online survey
3. Photograph/Rendering image to communicate the concept.
4. Forecasting Sales / Demand
5. Q = N x A x P calculation

Assessment:

Based on the results of survey one, there was a great need of rethinking the concept of storage slot. This included attachment type of the slot, material, geometry, and even location in the cabinet. So, a team meeting was conducted to brainstorm the change of concept.

Concept Combination table method:

- This method was very helpful in grouping different possible solutions together to discuss the pros and cons of the concept. Here, various a concept combination tables is drawn (see appendix 4) and several combinations are formed for better and feasible fit.

Concept testing process I:
In our cabinet step stool product, there were several steps that were involved in this process, they are:

- ✓ Defining the purpose of the test
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- ✓ Communicating the concept
- ✓ Measuring customer response
- ✓ Interpreting the results
- ✓ Reflect on the results and the process

Survey II – Internet based survey:

- Much improved version of survey I
- Free 3rd party online survey tool (http://esurveypro.com) was used to survey people
- Survey was very fast and easy
- Nearly instant 50 responses instantly
- The survey included 16 simple direct questions, detailed product rendering image, and

detailed and sufficient product description.
See Appendix 5 for online survey questions

Survey II – Results:

- Results of survey II was very positive.
- All the mistakes in the previous survey process has been resolved, such as, changing the rendering image, communication the concept exactly the way user wanted, etc, see Appendix 6 for new rendering image for survey II.

Sales Forecast II

Going back to our market segmentation we reviewed what was previously defined in our market statement and looked up new numbers for the Q=NAP sales forecast estimation. We also split our calculations up into two segments: households with a member under 5'8" and a segment of the population that were home owners and over the age of 65. The sales forecast for these market segments were as follows:

Households with a person between the ages of 35-64 under 5'8"

Annual Sales	**=**	**Num. Annual Purch.**	**Awareness**	**Probability**
923,726	=	43,986,960	0.25	0.084

Households with a person over the age of 65

Annual Sales	**=**	**Num. Annual Purch.**	**Awareness**	**Probability**
324,304	=	15,443,026	0.25	0.084

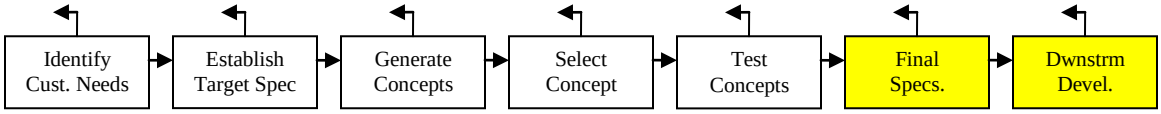
Outcome / Results

For the second survey, using the internet to collect data provided us with more responses than our previous attempt with just the paper surveys. During the second survey the rendering of the product concept was better defined and gave a clearer view of the product that we were going to sell. This led to better results that we could use to determine our sales forecasts. Conducting the second survey also helped us to refine the questions and the types of data that we would get back.

Using the results from the second survey, our sales forecast numbers showed a difference of 429,470 units lower than our previous calculations. This number still seems high, but it's based on a high awareness level for the product, which has been factored into our later calculations.

Using the combination tool for selecting how to design the storage tray also proved to be very successful during this stage of development. It helped us keep the customer values clear and introduced more options than were previously generated from brainstorming in a group.

Development Stage:



Date: March 2009	**Participants:** Arun Chenchugopal, Chris McGinnis, Josh Kelly, Rajesh Talla, Saad Al-Askaar, Saranya Sethu Pragasam.

Tools / Methods Used:

- Design For Manufacture Process
- NPV Calculation

Assessment:

Each tool used in this process was both useful and necessary. It would not be advisable to proceed with a project before first determining its profitability using an NPV calculation. Additionally, we discovered opportunities to lower the product cost and bring additional value to the customer via the DFM process.

The DFM process is meant to minimize product cost and maximize customer value. The process we followed is right out of the book and class lecture. First we estimated the product costs, we then tried to remove costs from materials and labor by finding less expensive components, combining components or removing process steps that do not add customer value. We then checked our design decisions against the design intent and verified the customer value was maximized.

The DFM process turned out to be make-or-break for our design. The initial concept as designed was both too costly and too heavy. The first step was to make a material substitution for the steel frame; Aluminum is both less expensive and lighter. This first step would have been enough, but continuing with the process proved to be productive.

As a group we brainstormed step materials. We developed a pro/con table for wood, aluminum and plastic molded steps. As it turned out, from a customer point of view we determined that either aluminum (with a plastic slip resistant top) or a molded step would be acceptable. We reran the cost estimate with a molded step, with a lower component cost and with a small bit of labor removed and ended up with another small reduction in cost.

As a final step, we reviewed our second survey and determined that our customer preferred a chrome finish versus the painted finish we'd be estimating. We re-costed the design one last time in chrome and found that it was pennies less expensive still, due to the slight difference in raw material and omission of the painting process step. The final design was a chrome aluminum frame with a plastic molded step.

The NPV calculation showed us the viability of the project and allowed us to test the sensitivity of success against the assumptions we made. All along in the NPD process we were collecting data that would eventually be used in this process. The sales projections from the test concept phase are the most critical assumption, as is the target pricing from the surveys we completed.

The results from the DFM were fed into the NPV calculation. The unit cost was directly entered. The design feature decisions drove a multitude of development costs that were summed and along with a project schedule determined the payment schedule for the project.

Our marketing plan involves direct consumer marketing via television commercials and retail sales through stores like Target and Bed, Bath and Beyond. The NPV calculation required an estimate of the marketing costs. We estimated the TV commercial production costs as well as the airtime required to make 60 million people aware of our product (again from the sales estimate calculation). We also added the costs of the sales people required to market the product through the retail channel.

Outcome / Results:

The outcome of the DFM process is the final design. The final design was greatly modified from the original concept. In its original form, the design was made with steel and powder coated. Initially we conceived a formed aluminum step with a plastic no-slip top adhered to it. The final design ended up being an aluminum frame, chrome instead of painted. The aluminum step with plastic liner was replaced with one molded step, reducing the component count by one.

The DFM process reduced the overall unit cost of our product from $16.39 to $11.99. This is a $4.40 decrease, or a 27% reduction. This was a critical to achieving the target price and margin. Using the initial $16.39 production cost, we ended up with a negative NPV.

The NPV calculations left us with two main take aways. First our project shows a positive NPV value of nearly a million dollars with the assumptions we used, and second the research we put into coming up with the marketing expense required showed us we have a very high up front advertising cost. None of our group members guessed we'd require over a half million dollars for the TV advertising alone. In addition, it's interesting to note just how much the marketing costs overshadow the development costs. We are outspending marketing to development by five to one.

Appendix – QFD

Customer Attributes	Engineering Characteristics	Relative Importance	Width of the step	Height of the step	Depth of the step	Number of steps	Flatness of step	Step material	Height of the top step	Distance between steps	Slip resistance on a dry step	Slip resistance on a wet step	Weight capacity	Number of supporting feet	Weight of the step stool	Total product weight	Height when stowed	Depth when stowed	Width of stool when deployed	Height of stool when deployed	Depth of stool when deployed	Offset between different steps	Tools needed for installation
User feels safe using it	The step stool's step area accomodates an average adult's feet comfortably.	8	X		X		X																
	The distance between the steps allows adults to climb up or down easily.	8								X												X	
	The step stool's steps have a no-slip surface.	9.25					X				X	X											
	The step stool stays firm on wet/slippery floors	8.25												X									
	The step stool supports heavier adults	8.5		X				X					X										
	The step stool is stable when in use.	9.75												X		X			X	X	X		
	The step stool's steps accommodate both of the user's feet.	6.75	X		X																		
Installation is easy	The step stool is easy to install in the cabinet.	9													X								X
Convenient to use	The step stool has a compact design for storage.	10														X	X	X					
	The step stool is light weight so it can be moved easily.	7														X							
	The step stool is portable.	7								X						X							
	The step stool is easy to climb up and down.	6.75				X																	
	The step stool can stored in a fixed location	8.75																					
	The step stool places the user at an appropriate height to access the top shelf	6.5							X														
	The step stool is comfortable on the user's bare feet.	7						X															
	The step stool is adjustable for different cabinet/shelf height	7.5																					
	Measurement Units		in.	in.	in.	num.	deg.	type	in.	in.	c.o.f.	c.o.f.	lbs.	num.	lbs.	lbs.	in.	in.	in.	in.	in.	in.	num.
Objective Measures	Our step stool		16	0.5	16	2	0	plas	19	8	1.2	0.9	300	4	3	4	1	16	12	16	11	8	0
	(a) Cosco Signature Series 5' Aluminum Step Ladder		31	1	3	3	0	alum	41	14			225	4	10	10	3		32.8	59	20.1	6	0
	(b) Little Giant Ladder Systems Safety Step		20	1	5	3	0	steel	39	10			300	4	20	20			21.8	50.2	34.3	5	0
	(c) Polder LDR-6102 2-Step Designer Step Stool with		8.5	1	4	2	0		24	12			225	4	15	15	3.75	33	9	33	18	3	0
	(d) Rockford Series Two-Step Stool		13	0.75	9	2	0	wood					225	4	18.5	18.5			14				0
	(e) Gorilla Ladders 2 Step Easy-Storage Household			0.5		2	0	alum	19				200	4	10.2	10.2	2.4		18.3	32	32	5	0

Appendix - Concept Test Survey

CONCEPT TEST SURVEY – I

PART I:-

Do you own a step stool? ————————

Where do you keep it? ————————

Can you reach top shelf with assistance? ————————

How do you reach top shelf? ————————

How often do you use your step stool? ————————

PART II:-

After having seen the picture of the Step Stool, how likely:

Would you buy this step stool for yourself? ————————

Would you buy this step stool for somebody else? ————————

How much you pay? ————————$

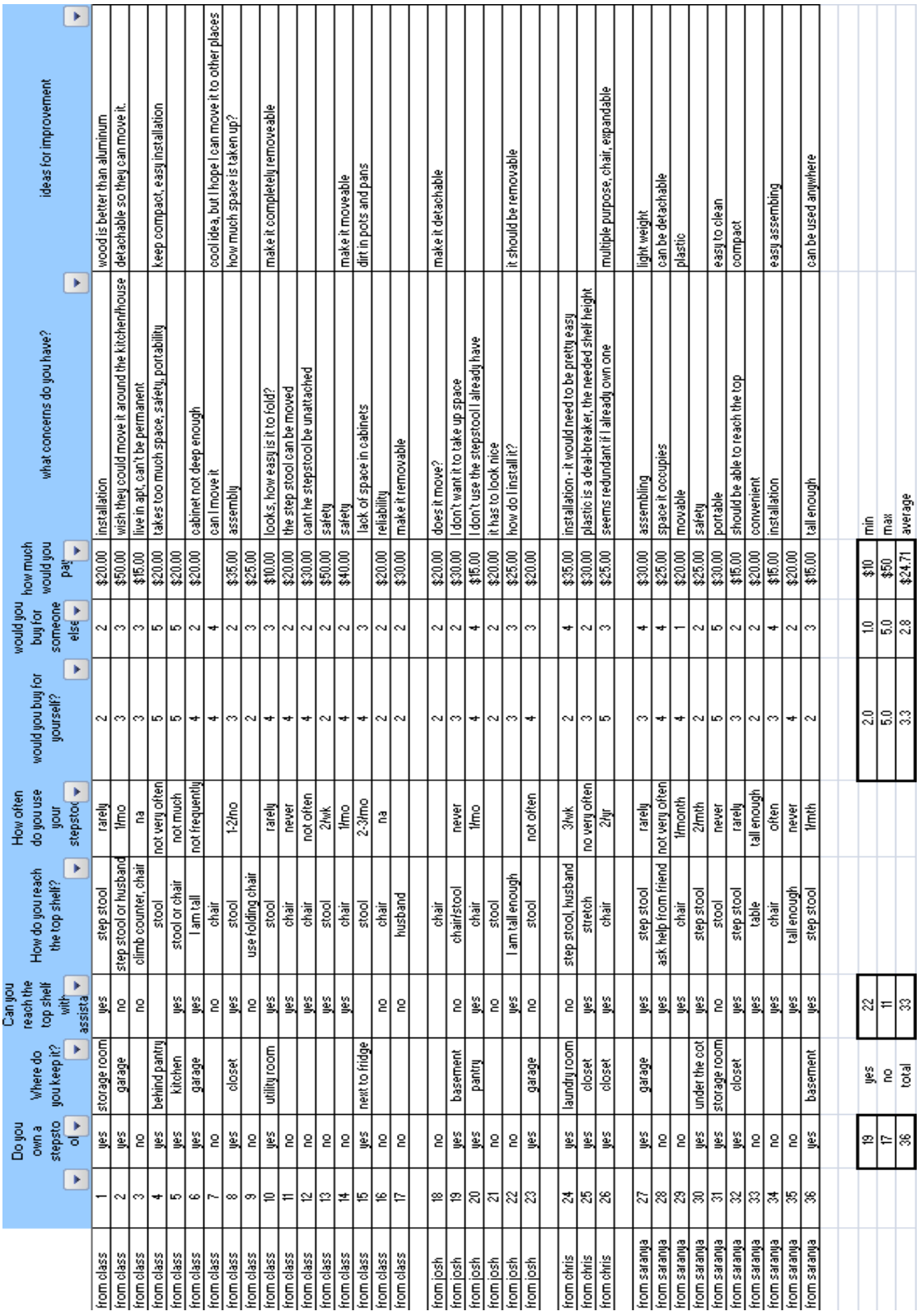
What concerns do you have? ————————

Ideas for improvements ————————————————————

————————————————————

————————————————————

Appendix - Sample survey I results



		Do you own a stepstool	Where do you keep it?	Can you reach the top shelf with assista	How do you reach the top shelf?	How often do you use your stepstool	would you buy for yourself?	would you buy for someone else	how much would you pay	what concerns do you have?	ideas for improvement
from class	1	yes	storage room	yes	step stool	rarely	2	2	$20.00	installation	wood is better than aluminum
from class	2	yes	garage	no	step stool or husband	1/mo	3	3	$50.00	wish they could move it around the kitchen/house	detachable so they can move it.
from class	3	no		no	climb counter, chair	na	3	3	$15.00	live in apt, can't be permanent	
from class	4	yes	behind pantry		stool	not very often	5	5	$20.00	takes too much space, safety, portability	keep compact, easy installation
from class	5	yes	kitchen	yes	stool or chair	not much	5	5	$20.00		
from class	6	yes	garage	yes	I am tall	not frequently	4	2	$20.00	cabinet not deep enough	
from class	7	no		no	chair		4	4		can I move it	cool idea, but I hope I can move it to other places
from class	8	yes	closet	yes	stool	1-2/no	3	2	$35.00	assembly	how much space is taken up?
from class	9	no		no	use folding chair		2	3	$25.00		
from class	10	yes	utility room	yes	stool	rarely	4	3	$10.00	looks, how easy is it to fold?	make it completely removeable
from class	11	no		yes	chair	never	4	2	$20.00	the step stool can be moved	
from class	12	no		yes	chair	not often	4	2	$30.00	cant he stepstool be unattached	
from class	13	no		yes	stool	2/wk.	2	2	$50.00	safety	
from class	14	no		yes	chair	1/mo	4	2	$40.00	safety	make it moveable
from class	15	yes	next to fridge		stool	2-3/mo	4	3		lack of space in cabinets	dirt in pots and pans
from class	16	no		no	chair	na	2	2	$20.00	reliability	
from class	17	no		no	husband		2	2	$30.00	make it removable	
from josh	18	no			chair		2	2	$20.00	does it move?	make it detachable
from josh	19	yes	basement	no	chair/stool	never	3	2	$30.00	I don't want it to take up space	
from josh	20	yes	pantry	yes	chair	1/mo	4	4	$15.00	I don't use the stepstool I already have	
from josh	21	no		no	stool		2	2	$20.00	it has to look nice	
from josh	22	no		yes	I am tall enough		3	3	$25.00	how do I install it?	it should be removable
from josh	23	yes	garage	no	stool	not often	4	3	$20.00		
from chris	24	yes	laundry room	no	step stool, husband	3/wk	2	4	$35.00	installation - it would need to be pretty easy	
from chris	25	yes	closet	yes	stretch	no very often	3	2	$30.00	plastic is a deal-breaker, the needed shelf height	
from chris	26	yes	closet	yes	chair	2/yr	5	3	$25.00	seems redundant if I already own one	multiple purpose, chair, expandable
from saranya	27	yes	garage	yes	step stool	rarely	3	4	$30.00	assembling	light weight
from saranya	28	no		yes	ask help from friend	not very often	4	4	$25.00	space it occupies	can be detachable
from saranya	29	no		yes	chair	1/month	4	1	$20.00	movable	plastic
from saranya	30	yes	under the cot	yes	step stool	2/mth	2	2	$25.00	safety	
from saranya	31	yes	storage room	no	stool	never	5	5	$30.00	portable	easy to clean
from saranya	32	yes	closet	yes	step stool	rarely	3	2	$15.00	should be able to reach the top	compact
from saranya	33	no		yes	table	tall enough	2	2	$20.00	convenient	
from saranya	34	no		yes	chair	often	3	4	$15.00	installation	easy assembling
from saranya	35	no		yes	tall enough	never	4	2	$20.00		
from saranya	36	yes	basement	yes	step stool	1/mth	2	3	$15.00	tall enough	can be used anywhere

19	yes	22
17	no	11
36	total	33

2.0	1.0	$10
5.0	5.0	$50
3.3	2.8	$24.71

min
max
average

Appendix – Survey I rendering image

Appendix 4 Concept combination table

Matching Criteria	Attachment Type	Material	Geometry	Location in the Cabinet
Easy Install	Screw	Plastic	Tray	Above
Dirt	Magnet	Aluminum	Only Rails	Below
Removable Tray	Glue	Steel	Rails w/ Tray	Side
Feasibility	Suction Cup	Wood	Hooks	Cookie Sheet Cabinet
Compact Profile	Adhesive Tape	Iron	Tabular	
Light Weight	Nails		Footing and Snap/Clip	
Minimized Cost	Hooks			
	Gravity			

Matching Criteria	Attachment Type	Material	Geometry	Location in the Cabinet
Easy Install	Screw	Plastic	Tray	Above
Dirt	Magnet	Aluminum	Only Rails	Below
Removable Tray	Glue	Steel	Rails w/ Tray	Side
Feasibility	Suction Cup	Wood	Hooks	Cookie Sheet Cabinet
Compact Profile	Adhesive Tape	Iron	Tabular	
Light Weight	Nails		Footing and Snap/Clip	
Minimized Cost	Hooks			
	Gravity			

Matching Criteria	Attachment Type	Material	Geometry	Location in the Cabinet
Easy Install	Screw	Plastic	Tray	Above
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Feasibility	Suction Cup	Wood	Hooks	Cookie Sheet Cabinet
Compact Profile	Adhesive Tape	Iron	Tabular	
Light Weight	Nails		Footing and Snap/Clip	
Minimized Cost	Hooks			
	Gravity			

Matching Criteria	Attachment Type	Material	Geometry	Location in the Cabinet
Easy Install	Screw	Plastic	Tray	Above
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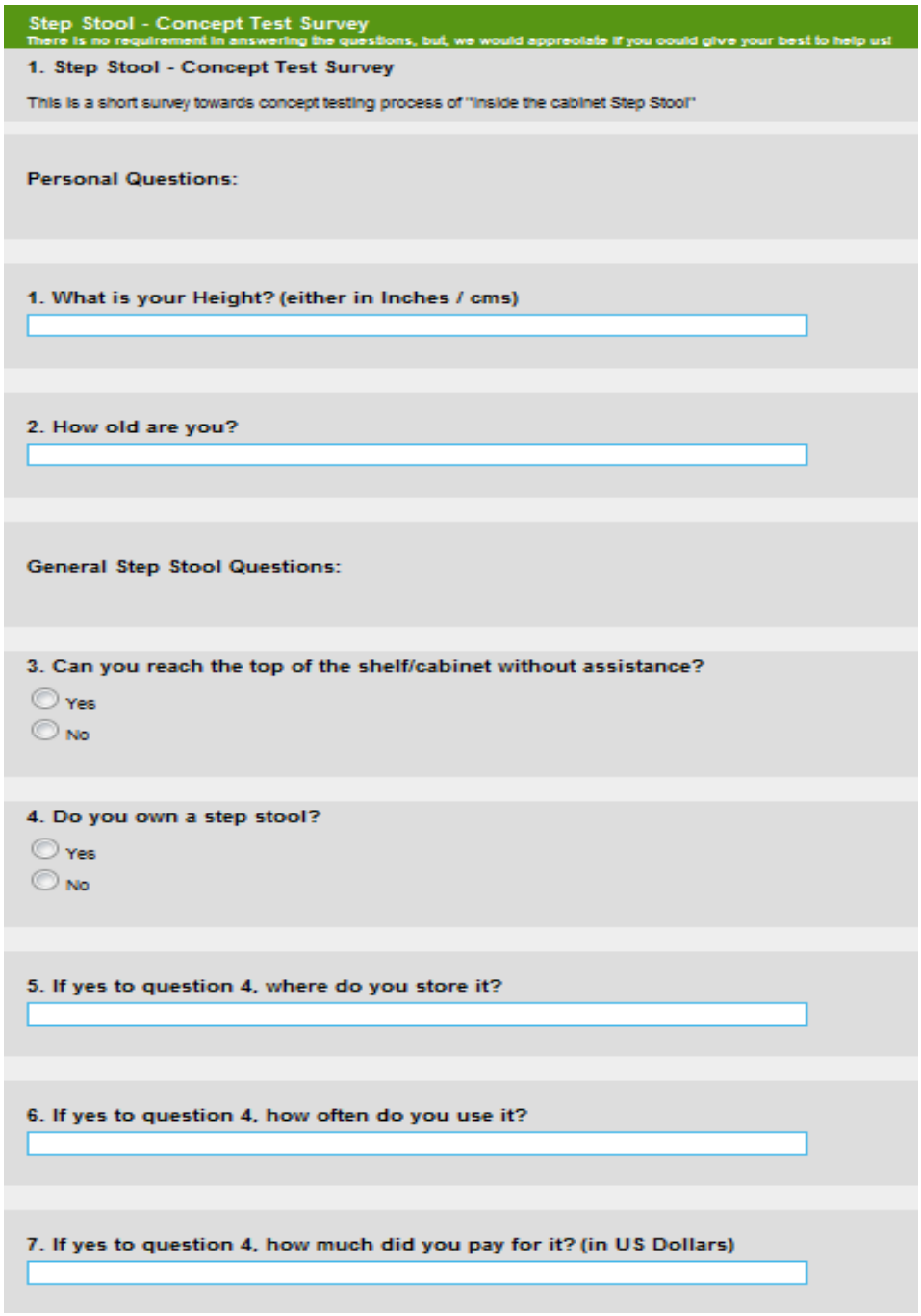
Removable Tray	Glue	Steel	Rails w/ Tray	Side
Feasibility	Suction Cup	Wood	Hooks	Cookie Sheet Cabinet
Compact Profile	Adhesive Tape	Iron	Tabular	
Light Weight	Nails		Footing and Snap/Clip	
Minimized Cost	Hooks			
	Gravity			

Appendix – Online survey questions



Step Stool - Concept Test Survey

There is no requirement in answering the questions, but, we would appreciate if you could give your best to help us!

1. Step Stool - Concept Test Survey

This is a short survey towards concept testing process of "inside the cabinet Step Stool"

Personal Questions:

1. What is your Height? (either in Inches / cms)

2. How old are you?

General Step Stool Questions:

3. Can you reach the top of the shelf/cabinet without assistance?

- Yes
- No

4. Do you own a step stool?

- Yes
- No

5. If yes to question 4, where do you store it?

6. If yes to question 4, how often do you use it?

7. If yes to question 4, how much did you pay for it? (in US Dollars)

8. Other than step stool, how do you reach the top shelf/cabinet?

9. Do you have any idea to purchase a step stool in near future?

- Yes
- No

10. If yes to question 9, how much would you pay for it? (in US Dollars)

Carefully see the renderings below and read the description:

Under the Cabinet Step Stool

2 steps, no slippery step stool
Easy installation, and ergonomic design that suits all types of kitchen
Very compact – folded thickness of just 1 inch
comes with an 'under the shelf storage slot'
Light weight – easily movable anywhere, any time
Completely portable – the step stool not attached to the storage slot

After having seen the renderings and reading the description,

11. Would you purchase this cabinet step stool for your house?

- Definitely Not Purchase
- Probably Not Purchase
- Might or Might Not Purchase

12. Would you recommend / purchase this Cabinet step stool to your friends or others? (As gift / token of love / etc..,)

- ○ Definitely No
- ○ Probably No
- ○ I don't know
- ○ Probably Yes
- ○ Definitely Yes

13. How much can you pay for this step stool? (In US Dollars)

14. Would you prefer step stool to be...

- ○ Chrome Finished
- ○ Painted Finished
- ○ I Don't Care

15. Any concerns do you have about this step stool?

16. Any ideas for improvements?

Thank you so much for your time!

Quit Finished

Appendix – New rendering image for survey - II

Appendix – Survey II Results

Page 1. Step Stool - Concept Test Survey

1. What is your Height? (either in Inches / cms)

Details

Number of Respondents	44
Number or respondents who skipped this question	2

2. How old are you?

Details

Number of Respondents	44
Number or respondents who skipped this question	2

3. Can you reach the top of the shelf/cabinet without assistance?	% of Respondents	Number of Respondents
Yes	60.00%	27
No	40.00%	18
Number of respondents		*45*
Number or respondents who skipped this question		*1*

4. Do you own a step stool?	% of Respondents	Number of Respondents
Yes	33.33%	15
No	66.67%	30
Number of respondents		*45*
Number or respondents who skipped this question		*1*

5. If yes to question 4, where do you store it?

Details

Number of Respondents	15
Number or respondents who skipped this question	31

6. If yes to question 4, how often do you use it?

Details

Number of Respondents	15
Number or respondents who skipped this question	31

7. If yes to question 4, how much did you pay for it? (in US Dollars)

Details

Number of Respondents	15
Number or respondents who skipped this question	31

8. Other than step stool, how do you reach the top shelf/cabinet?

Details

Number of Respondents	39

9. Do you have any idea to purchase a step stool in near future?	% of Respondents	Number of Respondents
Yes	20.00%	9
No	80.00%	36
Number of respondents		*45*
Number or respondents who skipped this question		*1*

10. If yes to question 9, how much would you pay for it? (in US Dollars)

Details

Number of Respondents	14
Number or respondents who skipped this question	32

11. Would you purchase this cabinet step stool for your house?	% of Respondents	Number of Respondents
Definitely Not Purchase	11.11%	5
Probably Not Purchase	22.22%	10
Might or Might Not Purchase	37.78%	17
Probably Purchase	26.67%	12
Definitely Purchase	2.22%	1
Number of respondents		*45*
Number or respondents who skipped this question		*1*

12. Would you recommend / purchase this Cabinet step stool to your friends or others? (As gift / token of love / etc.,)	% of Respondents	Number of Respondents
Definitely No	8.89%	4
Probably No	22.22%	10
I don't know	20.00%	9
Probably Yes	44.44%	20
Definitely Yes	4.44%	2
Number of respondents		*45*
Number or respondents who skipped this question		*1*

13. How much can you pay for this step stool? (In US Dollars)

Details

Number of Respondents	40
Number or respondents who skipped this question	6

14. Would you prefer step stool to be...	% of Respondents	Number of Respondents
Chrome Finished	33.33%	15
Painted Finished	17.78%	8
I Don't Care	48.89%	22
Number of respondents		*45*

Appendix - DFM Cost Estimates

Option 1 - Steel Frame - Aluminum Step

Material Costs

PN	Desc	Qty	UoM	Unit Cost	Total Cost	Unit Weight	Total Weight
1	3/4" Square Steel Tubing	8.4	ft	$0.70	$5.88	0.61	5.124
2	Aluminum formedsStep	2	ea	$1.20	$2.40	0.2	0.4
3	Rubber step liner	2	ea	$0.40	$0.80	0.02	0.04
4	Long linkages	2	ea	$0.50	$1.00	0.02	0.04
5	Short linkages	2	ea	$0.30	$0.60	0.02	0.04
6	Step Spacers	4	ea	$0.10	$0.40	0.001	0.004
7	Fasteners	12	ea	$0.02	$0.24	0.001	0.012
8	Rubber Feet (front legs)	2	ea	$0.02	$0.04	0.001	0.002
8	Rubber Feet (back legs)	2	ea	$0.20	$0.40	0.002	0.004
9	Rubber caps (frame)	2	ea	$0.02	$0.04	0.001	0.002
10	Storage Tray plastic	1	ea	$1.00	$1.00	0.05	0.05
11	Mouting Rails	4	ft	$0.10	$0.40	0.005	0.02
12	Double sided foam adhesive	4	ft	$0.02	$0.08	0.001	0.004
				Total Material Cost	$13.28	Total Weight	5.7 lb

Labor Costs

Step	Desc	Time	UoM	Rate	Total Cost
1	Welding Frame	0.2	hr	$4	$0.80
2	Powder Coat Frame	0.1	hr	$3	$0.30
3	Overall Assembly	0.5	hr	$2	$1.00
			Total Labor Cost		$2.10

Total Cost - Margin

Product Cost	$15.38
Packaging	$0.50
Shipping	$0.51
Total Cost	$16.39

Retail Model

Price to retailer @	30%	$21.97
Price to end customer @	40%	$36.62

Direct Marketing

Price to end customer @	50%	$30.76
Margin to End customer @	$24.99	38%

Option 2 - Aluminum Frame (painted) - Aluminum Step

Material Costs

PN	Desc	Qty	UoM	Unit Cost	Total Cost	Unit Weight	Total Weight
1	Aluminum ø 3/4" tubing, no finish	8.4	ft	$0.40	$3.36	0.15	1.26
2	Aluminum formed Step	2	ea	$1.20	$2.40	0.2	0.4
3	Rubber step liner	2	ea	$0.40	$0.80	0.02	0.04
4	Long linkages	2	ea	$0.50	$1.00	0.02	0.04
5	Short linkages	2	ea	$0.30	$0.60	0.02	0.04
6	Step Spacers	4	ea	$0.10	$0.40	0.001	0.004
7	Fasteners	12	ea	$0.02	$0.24	0.001	0.012
8	Rubber Feet (front legs)	2	ea	$0.02	$0.04	0.001	0.002
8	Rubber Feet (back legs)	2	ea	$0.20	$0.40	0.002	0.004
9	Rubber caps (frame)	2	ea	$0.02	$0.04	0.001	0.002
10	Storage Tray plastic	1	ea	$1.00	$1.00	0.05	0.05
11	Mouting Rails	4	ft	$0.10	$0.40	0.005	0.02
12	Double sided foam adhesive	4	ft	$0.02	$0.08	0.001	0.004
				Total Material Cost	$10.76	Total Weight	1.9 lb

Labor Costs

Step	Desc	Time	UoM	Rate	Total Cost
1	Bending Frame	0.05	hr	$4	$0.20
2	Painitng	0.2	hr	$3	$0.60
3	Overall Assembly	0.5	hr	$2	$1.00
			Total Labor Cost		$1.80

Total Cost - Margin

Product Cost	$12.56
Packaging	$0.50
Shipping	$0.51
Total Cost	$13.57

Retail Model

Price to retailer @	30%	$17.94
Price to end customer @	40%	$29.90

Direct Marketing

Price to end customer @	50%	$25.12
Margin to End customer @	$24.99	50%

Option 3 - Aluminum Frame (painted) - Plastic Step

Material Costs

PN	Desc	Qty	UoM	Unit Cost	Total Cost	Unit Weight	Total Weight
1	Aluminum ø 3/4" tubing, no finish	8.4	ft	$0.40	$3.36	0.15	1.26
2	Plastic molded step	2	ea	$0.95	$1.90	0.3	0.6
4	Long linkages	2	ea	$0.50	$1.00	0.02	0.04
5	Short linkages	2	ea	$0.30	$0.60	0.02	0.04
6	Step Spacers	4	ea	$0.10	$0.40	0.001	0.004
7	Fasteners	12	ea	$0.02	$0.24	0.001	0.012
8	Rubber Feet (front legs)	2	ea	$0.02	$0.04	0.001	0.002
8	Rubber Feet (back legs)	2	ea	$0.20	$0.40	0.002	0.004
9	Rubber caps (frame)	2	ea	$0.02	$0.04	0.001	0.002
10	Storage Tray plastic	1	ea	$1.00	$1.00	0.05	0.05
11	Mouting Rails	4	ft	$0.10	$0.40	0.005	0.02
12	Double sided foam adhesive	4	ft	$0.02	$0.08	0.001	0.004
			Total Material Cost		$9.46	Total Weight	2.0 lb

Labor Costs

Step	Desc	Time	UoM	Rate	Total Cost
1	Bending Frame	0.05	hr	$4	$0.20
2	Painitng	0.2	hr	$3	$0.60
3	Overall Assembly	0.45	hr	$2	$0.90
			Total Labor Cost		$1.70

Total Cost - Margin

Product Cost	$11.16
Packaging	$0.50
Shipping	$0.51
Total Cost	$12.17

Retail Model

Price to retailer @	30%	$15.94
Price to end customer @	40%	$26.57

Direct Marketing

Price to end customer @	50%	$22.32
Margin to End customer @	$24.99	55%

Option 4 - Aluminum Frame (chrome) - Plastic Step

Material Costs

PN	Desc	Qty	UoM	Unit Cost	Total Cost	Unit Weight	Total Weight
1	Aluminum ø 3/4" tubing, Chrome	8.4	ft	$0.45	$3.78	0.15	1.26
2	Plastic molded step	2	ea	$0.95	$1.90	0.3	0.6
4	Long linkages	2	ea	$0.50	$1.00	0.02	0.04
5	Short linkages	2	ea	$0.30	$0.60	0.02	0.04
6	Step Spacers	4	ea	$0.10	$0.40	0.001	0.004
7	Fasteners	12	ea	$0.02	$0.24	0.001	0.012
8	Rubber Feet (front legs)	2	ea	$0.02	$0.04	0.001	0.002
8	Rubber Feet (back legs)	2	ea	$0.20	$0.40	0.002	0.004
9	Rubber caps (frame)	2	ea	$0.02	$0.04	0.001	0.002
10	Storage Tray plastic	1	ea	$1.00	$1.00	0.05	0.05
11	Mouting Rails	4	ft	$0.10	$0.40	0.005	0.02
12	Double sided foam adhesive	4	ft	$0.02	$0.08	0.001	0.004
			Total Material Cost		$9.88	Total Weight	2.0 lb

Labor Costs

Step	Desc	Time	UoM	Rate	Total Cost
1	Bending Frame	0.05	hr	$4	$0.20
2	Overall Assembly	0.45	hr	$2	$0.90
			Total Labor Cost		$1.10

Total Cost - Margin

Product Cost	$10.98		
Packaging	$0.50		
Shipping	$0.51		
Total Cost	$11.99	16.39	$4.40
			0.268456

Retail Model

Price to retailer @	30%	$15.69
Price to end customer @	40%	$26.14

Direct Marketing

Price to end customer @	50%	$21.96
Margin to End customer @	$24.99	56%

Appendix - NPV Calculations and Sensitivity Analysis

NPV Calculation before DFM Process (negative NPV)

	first	last	burn rate
Development	1	1	-30
Testing	2	2	-20
Tooling and Ramp-Up Costs	2	3	-25
Market Introduction	3	6	-130
Ongoing Marketing Costs	7	16	-50
Unit Sales	3	16	25
Unit Price	3	16	$18.79
Unit Production Cost	3	16	-$16.39
Discount Rate (per time period)		2.50%	

PROJECT NPV $ **-270**

NPV Calculation after DFM Process (positive NPV)

	first	last	burn rate
Development	1	1	-30
Testing	2	2	-20
Tooling and Ramp-Up Costs	2	3	-25
Market Introduction	3	6	-130
Ongoing Marketing Costs	7	16	-50
Unit Sales	3	16	25
Unit Price	3	16	$18.79
Unit Production Cost	3	16	-$11.99
Discount Rate (per time period)		2.50%	

PROJECT NPV $ **954**

NPV Calculation with double development costs (positive NPV)

	first	last	burn rate
Development	1	1	-60
Testing	2	2	-40
Tooling and Ramp-Up Costs	2	3	-50
Market Introduction	3	6	-130
Ongoing Marketing Costs	7	16	-50
Unit Sales	3	16	25
Unit Price	3	16	$18.79
Unit Production Cost	3	16	-$11.99
Discount Rate (per time period)		2.50%	

PROJECT NPV $ **858**

NPV Calculation with double marketing costs (positive NPV)

	first	last	burn rate
Development	1	1	-30
Testing	2	2	-20
Tooling and Ramp-Up Costs	2	3	-25
Market Introduction	3	6	-260
Ongoing Marketing Costs	7	16	-100
Unit Sales	3	16	25
Unit Price	3	16	$18.79
Unit Production Cost	3	16	-$11.99
Discount Rate (per time period)		2.50%	

PROJECT NPV $ **111**

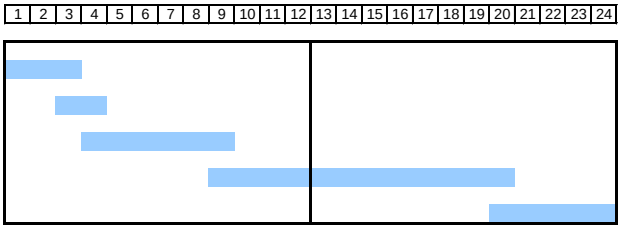
NPV Calculation with double marketing and development costs (NPV near zero)

	first	last	burn rate
Development	1	1	-60
Testing	2	2	-40
Tooling and Ramp-Up Costs	2	3	-50
Market Introduction	3	6	-260
Ongoing Marketing Costs	7	16	-100
Unit Sales	3	16	25
Unit Price	3	16	$18.79
Unit Production Cost	3	16	-$11.99
Discount Rate (per time period)		2.50%	

PROJECT NPV $ **15**

Appendix - Development Schedule

Development Costs /Schedule		
Design	$30,000	3 months
Prototyping Testing	$20,000	2 months
Tooling and Ramp up	$50,000	6 months
Marketing for Launch	$520,000	first year
Ongoing Marketing	$200,000	per year



Appendix - Tooling costs

Mold Tool for Step	*$15,000*
Mold Tools for Rubber Feet	*$5,000*
Mold Tool for Plastic Tray	*$15,000*
Bending Dies for Frame	*$2,000*
Fixtures for painting	*$1,000*
Linkage Machining fixtures	*$1,000*
Misc. Assembly Fixtures	*$1,000*
Extrusion Die for tray rail	*$5,000*
Total	*$50,000*

Appendix - Marketing Costs

Television Commercial Production Costs	*$100,000*
Airtime ($5-15 per 1000 viewers)	*$200,000*
Sales Team	*$100,000*
Marketing Materials	*$20,000*
Year one Total	*$520,000*
Airtime ($5-15 per 1000 viewers)	*$200,000*
Sales Team	*$100,000*
Ongoing Marketing Costs	*$300,000*

Appendix - Final Design

- Aluminum Painted Frame
  - Ø.750” Al 6160 tubing
- Molded Plastic Steps
  - Rigid Polypropylene
- Molded Plastic Tray
  - ABS
- Plastic Extruded Rails
  - Double sided foam tape