

DEVELOPMENT LOG PRODUCT: WAVESTRIP

Course Title: New Product Development

Course Number: ETM 547/647

Instructor: Ron Khormaei, Ph.D.

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Team members:

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DEVELOPMENT LOG 1

Date: Jan 6-8, 2011

Participants: Jared Ames, Matthew Letts, Sevket Can Nuhisi, Yasser Alizadeh, Yulianto Suharto

Activity: Pre-Project -- Opportunity Identification

The team brainstormed for product ideas based on cursory market research, internet search and needs that we encountered in our daily lives. The ideas ranged from innovative products to those that bridged a market gap. At this stage, the team decided not to eliminate any ideas and evaluate all ideas within our competitive strategy.

Tools/Methods:

- 1. Brainstorming
- 2. Selection matrix

Result/output:

Based on the brainstorming process, the team came up with a rank for ideas using a selection matrix. The ranking process was based on several criteria: time frames, energy to deliver the process from concept to real product, enthusiasm of team members on the selected concept/product and the ability to generate prototype. Weight is assigned to those criteria to determine the rank. The complete matrix is shown in Appendix 1.

Key Learning:

- 3. Team members learned that there are so many opportunities can be pursued based on team members interest. One simple method utilized by the team was brainstorming to get to the point of first round elimination. Brainstorm a large possibility of ideas from members with diverse backgrounds and experiences: the larger the number of projects input into the funnel, the better the chances of choosing the right product for development. The team learned that snipping ideas as worthless without evaluation is not ideal.
- **4.** Mostly, the ideas were generated from team members' interest in certain products rather than from the market point of view.
- 5. The team decided to focus on the competitive strategy and aligned the product selection process with key strengths within the teams and also with the time frame available to deliver the product for the purpose of this course.

Recommendations for Improvement:

Brainstorming and the selection matrix developed in this stage was solely based on the perception that our team had an idea champion who faced a genuine problem in his everyday life and this provided the team with strong evidence that there could be more potential customers for

this product. Throughout the process of the NPD course, we learned that in a real product development scenario in organizations, we would have to support our selection matrix (or any other scoring model necessary) through market research for each of the identified products, evaluate them using SWOT analysis, perform competitive benchmarking for each, use greater R&D resources and perform ethnographic studies to support final choice of product. At first, the team was confident about the deliverability of the product in terms of providing a prototype, manufacturability issue, and the time allocated to get a real product at the end of the term. However, several other questions that we had to address were the potential target market size, growth forecast for the market segment, and past sales data for similar products. This step is important to determine whether the product we chose has an economic value or not.

DEVELOPMENT LOG 2

Date: Jan 15, 2011

Participants: Jared Ames, Matthew Letts, Sevket Can Nuhisi, Yasser Alizadeh, Yulianto Suharto.

Activity: Business Statement and Identify customer needs.

Product Development Stage:



Tools/Methods:

- Brainstorming
- Face to face Interview
- Observed users
- House of Quality (HOQ).

Identify Customer Needs

The phase includes several steps that we conducted:

Defining the scope:

In order to be more focus on the future product development, first thing we did was to determine our mission statement as: --- Develop a new wall outlet integrating outstanding safety, retention, and ease of release ---

Our complete business statement can be found on Appendix 2.

Gather raw data:

In this phase we gathered raw data from the customers based on two methods.

1. Face to face interview.

2. Observed Users: We also observed people regarding to their problem in using a conventional power strip/outlet.

The example of customer observation is shown in Appendix 3.

Interpret raw data:

In this phase we translated the raw data obtained from the customers into need statements. This is a critical step in this phase. The team has to be able to interpret customer needs that in most cases are more intrinsic (not spoken out loudly word by word) by the customer; at the same time we are not supposed to lead the customer.

The complete versions of customer need statement are shown in Appendix 4 and Appendix 5.

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 needs grouping process (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 categories such as existing capability, new capability, safety, ease of use and price.

The affinity exercise result is shown in Appendix 6 and Appendix 7.

House of Quality (HOQ):

After defining the customer value statements and organizing them into their major topics, they were entered into a HOQ 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 HOQ 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. The HOQ for our product is shown in Appendix 8.

Result/output:

The processes explained above helped the team in translating the customer value statements into needs based on which it was divided into five categories and the affinity diagram helped in ranking customer needs where unwanted remove of plug is rank 1, provide surge protection and an outlet that can provide sufficient number of appliances are rank 2, and ease to unplug; safe to use; and prevent energy drain are rank 3. Moreover this process gave a clear picture of the disadvantages of the existing outlet/power strip. Therefore the WaveStrip (our product's brand name) was designed to overcome these problems.

Key Learning:

- Overall, the application of the HOQ during these stages of product development helped the team for the later stages of the product development process.
- Building HOQ is of the fundamental and strategic importance in quality function deployment (QFD). The foundation of the HOQ is the belief that products should be designed to reflect customers' desires and tastes.

- All of the team members have an engineering or science background with very limited experience on eliciting customer needs. We were more accustomed to working on a given set of product specifications and lacked the front end customer centric approach. The customer needs statement and affinity exercise helped us get a first-hand experience with this process.
- Throughout the NPD course, the team learned that HOQ is performed by a multidisciplinary team representing marketing, design engineering, manufacturing engineering, and any other functions considered critical by the company. In general, it provides a framework in which all participants can communicate their thoughts about a product. More specifically, HOQ is often used to identify the relationships between requirements based on different viewpoints.

Recommendations for Improvement:

In hindsight, this approach of HOQ should have been revisited after the concept had been selected and user tested. The team also realized that benchmarking, which is one of the important issue in HOQ concept were not sufficiently addressed to calculate the market share of our product. At the later stage, the team found out that other companies have been working on the same product, some are still on the development phase, and others are commercially ready. The fact made it more difficult since it was only meant that we should differentiate our product from those competitors.

DEVELOPMENT LOG 3

Date: Jan 22&29, 2011

Participants: Jared Ames, Matthew Letts, Sevket Can Nuhisi, Yasser Alizadeh, Yulianto Suharto

Activity: Establish Target Specifications

Product Development Stage:



Tools/Methods:

Steps for setting target specifications:

- 1. List of metrics through the House of Quality (HOQ).
- 2. Competitive benchmarking.
- 3. Set target values

Result/output:

A list of metrics was developed that directly addressed the clarified customer needs. This was documented in a house of quality. This included a roof where we identified relationships between the measures. A negative relationship was noted between retention force and force for unplugging, and also between shock risk and the number of outlets. No positive relationships were identified. See the complete list of metrics in the HOQ shown in Appendix 8.

We benchmarked against 120V outlets and power strips available in hardware stores. Standard wall outlets and power strips were found with some variations. Additional features available in outlets were GFCI protection and tamper protection and the choice of 15A or 20A. Power strips were commonly available with surge protection and 8 outlets.

We wanted to better than the competition in all of the identified needs, but we did not have the resources to make real measurements of the benchmark except in the number of outlets. The metrics and target specifications are in the table below and are compared to the final specifications in Appendix 9.

Metric	Target Specification		
Maximum force of Retention (N)	Higher than standard power strip		
Minimum force for unplugging (N)	Lower than standard power strip		
Number of outlets (#)	8 +		
	Equal to standard power strip (w/ surge		
Energy overload protection (J)	protection)		
Shock risk (jury)	Equal to standard power strip		
Power draw potential when not in use (watts)	0 (w/ automatic power shutoff)		

Key Learning:

- The HOQ was useful in identifying relationships between measures. The negative relationships would prove useful later in brainstorming potential solutions.
- It was difficult to choose targets when we still had no concepts, but it was helpful to understand that these are merely targets and there would be opportunity for revision.

Recommendations for Improvement:

We only benchmarked initially against the standard power strips commonly available in hardware stores. We later decided we should market online. Since we made that decision we should have also benchmarked against all the popular power strips available online. That would have given us the opportunity to develop a product significantly different and better than the available competition. Also, it would have been useful to not try to improve every customer need as this proved beyond the capability of our team. If we had chosen 1 or 2 exciters to

improve at this stage we could have focused our brainstorming to develop an outstanding niche product.

DEVELOPMENT LOG 4

Date: Feb 5,12 &19 2011

Participants: Jared Ames, Matthew Letts, Sevket Can Nuhisi, Yasser Alizadeh, Yulianto Suharto

Activity: Generate and Select Concepts.

Product Development Stage:



Tools/Methods:

- 1. Competitive benchmarking.
- 2. Concept Selection

Result/output:

To have a better understanding, the team decided to search the market and gather information about our competitors the market [Appendix 10]. We found similar products that could be considered as our competitors. Some of those products were not in the market yet; they were in the development phase or were just concepts.

In the process of selecting the concept for our project, every team member wrote his concept ideas, and then we combined all those ideas in a spreadsheet [Appendix 11]. After writing down all the concept ideas, we did a concept screening and tried to group the concept ideas that were similar to each other. The reason to group and combine some ideas was to reduce the number of ideas and be able to decide easily.

The next step was to evaluate all the combined ideas. After scoring all the concept ideas, we had a final ranking, and depending on the final ranking, the highest ranked concept idea was ready to be tested.

Key Learning:

- We learned about our strength of competitors in the market, had an idea about the pricing strategy.

- Trying to consider all different concept ideas and trying to decide on one final concept idea made the team think and work together and it was a positive step for the upcoming weeks.

Recommendations for Improvement:

As a team, while deciding on the final concept, we wanted our product to have a lot of features. We didn't think about the cost of manufacturing those features and we wanted to have all the best features from different products in the market. If we had the foresight, we could eliminate some of the features in this phase, so that we wouldn't have to make changes on our product in the upcoming weeks.

DEVELOPMENT LOG 5

Date: Feb 19-26 2011

Participants:

Activity: Concept(s) testing

Product Development Stage:



Tools/Methods:

- Concept Testing Using Survey Paper based survey
- Photograph/Rendering image to communicate the concept.
- Forecasting Sales / Demand : Q = N x A x P calculation

Result/output:

To gather customer feedback a paper survey was created. We used a written description and 3D CAD illustration to show customers what the product was going to be. The purpose of the survey is to determine the expected value of the product, confirm that the concept we chose is closest to the customer needs and rate the importance of features. The complete figure of the survey is shown in Appendix 12.

The results of the survey included 22 responses. We found that the expected price for this kind of product was \$15 and the overall reaction to the description and image of the product was 3.6/5.0.

Table 1 shows that our initial assumption about the #1 feature was incorrect and that the number of supported devices was the priority.

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Table 1. WaveStrip Need Comparisons

	Initial	Survey
It prevents unwanted removal of the plug	1	
Can support a sufficient number of devices	2	1
Provides surge protection	2	2
It is easy to access	4	4
Plugs are easy to remove	4	4
It is safe to use	4	2
It can prevent unwanted energy drain	4	

The feature preferences scoring in Table 2 showed us which features to prioritize if the development team had to drop something in order to meet the price target.

Table 2. WaveStrip Feature Preferences

Feature	Average
Expandable sections	4.3
Wave design with continuous slots	4.0
LED power use indicator	3.8
Secure plug with push button	3.7
Wire organization hooks	3.6
Wall mounting	3.2

To forecast the number of sales we assumed we were a part of Leviton, a national company, with access to all the big box stores such as Office Depot, Office Max, and Best Buy. The numbers below reflect these assumptions.

Other assumptions we made is that there are an estimated 50 million power strips in the US and they are replaced every 10 years. Our products would be available is general consumer stores and the probability of purchase came from the survey results.

	How Interested in buying?
% Number of 4's	41%
% Number of 5's	32%
C _{definitely}	20%
Cprobably	40%
Number of Annual purchase	es 5,000,000
Awareness x Availability	10%
Probability of Purchase	23%

Sales (Q)

113,636

This resulted in 113,636 units sold in the first year.

Key Learning:

There were a couple of important learnings in this section mostly around the survey and the sales estimate. When we were selecting concepts our development team filled out a survey to represent the customer needs. This led to a misalignment of the priority of customer needs when we did the actual customer survey. In the future the development team needs to get real customer feedback early on the development as well as during the later stages when prototypes are available.

Another issue was that the survey was only delivered to a small number of customers and only in the office environment. To get the largest benefit from the survey it would have been better to get a larger sample and include some home samples. We also missed gathering feedback from the office building developers. This would have been a smaller market but could have provided different input than the consumer markets.

Regarding the sales estimate we misunderstood the project requirements which led to a greatly over estimated number. The scope of this project was intended to be what our team could accomplish ourselves, not assuming we are part of a larger company. This dramatically decreases the number of customers we would be able to reach. Our new focus is the office workers in the Top 100 companies in Oregon. These numbers give us about 200 units in the first year. It will be discussed in the next section how the volume had to increase in future years to make the product economically feasible

Recommendations for Improvement:

To get the best feedback performing a survey with real customers earlier on in the development would have given the development team better guidance on the features to focus on.

Regarding the sales data using a marketing research firm to get real data would help the team set realistic goals for the first few years of the product life. By just estimating the numbers the team has a large risk of over or under estimating the potential market size and having inventory problems after product launch.

DEVELOPMENT LOG 6

Date: Feb 26 to Mar 5, 2011

Participants: Jared Ames, Matthew Letts, Sevket Can Nuhisi, Yasser Alizadeh, Yulianto Suharto

Activity: Final Specs Adjustment and Downstream Development.

Product Development Stage:

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Tools/Methods:

- Bill Of Material
- Economic feasibility NPV calculation
- Design for Manufacturing (DFM)

Result/output:

Based on our bill of material (BOM) (appendix 20) and the cost estimation for different parts, group developed a net present analysis (NPV). The cost estimation for the raw materials or basic components came from manufactures or components in the market. The first NPV wasn't interesting at all and lead us to decrease the cost. Using the design for manufacturing (DFM) concept we changed eliminate some features and just focused on the core feature. (Appendix 14, rows 1 & 2). Also we decreased the number of segments in the initial design from about 20 to normal 7 segments to decrease the cost of manufacturing and assembling. All detailed changes based on DFM process were:

- Reducing the number of sections from 20 to 7
- Eliminating connecting plugs and incorporated snaps into the plastic housing for easy assembly
- Eliminating all internal cables
- Eliminating push button release and cord management

Based on these changes we modified the initial schematic diagram to a new one (appendix 18). Also based on the final features we focused on two configuration of the product for offices and cubicles. Commonalities and differences determined then. (Appendix 19) Also we modified our long term production plan as follow:

Year 1

- Provide samples to Top 100 businesses in Oregon: 48,180 employees
 - Estimate 1/3 are office workers: 16,060
- Estimate awareness in the office 50%
- Q=N*A*P=(16,060/10)*50%*21%=**168/year**

Year 2-5

- Expand online presence and infomercials
- Estimate awareness: 0.1%
- Probability of Purchase: reduce to 10% estimated national interest
- Year 2: Q=N*A*P=(5,000,000)*0.1%*10%= 500/year
- Purchase Marketing Data for future market size

We reduced the market awareness by going from the Oregon market to the nationwide market as well as our purchase probability. Now performing the second round NPV analysis (appendix 22)

shows a positive NPV around \$25000 by assuming a 2.5% discounted rate. Then cash flow, discounted cash flow and payback time was calculated. (Appendices 23, 24 and 25)

Key Learning:

- 1- We would lose our advantage of being a local manufacturer after the 2nd year and we have to only rely on web as the distribution channel. Traditional distribution channels we looked at like home depot and Office depot ask for big proportion of the operational margin which makes decrease the NPV dramatically and makes it less attractive.
- 2- Calculating the NPV, exchange rate of money should be considered as the discounted rate in the market. It's not based on company's favorite rate of return or MARR.
- 3- Decision to make or break a product is influenced a lot with the company's position in the market and even other products in the production portfolio. While from a start-up company perspective our outcome could not be very attractive, due to 5 years investment and NPV around \$25000, it could be considered a really good breakthrough product for a well-established company with established infrastructure and machinery and also distribution channel.

Recommendations for Improvement:

- 1- At this final stage we applied the NPV analysis which would be more effective to be done in each gates and stages. By doing that we probably could focus earlier to the key features and remove the costly features with low added value.
- 2- Our very first mission statement (see log 2) dramatically changed through the whole procedure. It shows that we probably were too specific about it at the first stage, which we couldn't be committed to it until the end.
- 3- We needed to do more market survey in the building builders and construction involved customers for the wall mounted configuration product.

APPENDICES

Appendix 1.Opportunity Identification—Selection Matrix

	C	veryone vot						
Ideas	Time	Energy	Enthusiam	Prototype	Total			
1. Defogger	3	3	2	3	31	33	28	31
1. Dog flippers	3	3	3	3	33	33	24	20
2. Tug of war	3	3	2	3	31	33	27	20
3. Waterproof tablet/ereader case	3	3	3	3	33	33	30	33
4. HVDC transmission lines	1	1	1	1	11	22	13	11
5. Self body move analyzer	1	1	1	1	11	16	22	11
6. Hair cut previewer	2	1	1	1	15	20	33	33
7. Remote thermostat	2	1	2	2	19	26	20	11
8. High speed chain cables	1	1	1	1	11	22	20	11
9. Push button ice traction	2	2	2	3	24	26	22	11
10. Baby hand rail	3	3	2	3	31	31	25	15
13. Silicon sleeve case for laptops	3	3	3	3	33	31	0	0

Weights							
Time	Time Energy Enthusiam Prototype						
	4	3	2	2			

Votes (everyone vote for top 3 choices)							
Matthew	Jared	Yasser	Yulianto	Sevket	Total		
2	3	1	1	1	5		
3	1				2		
					0		
1	2	1	1	1	5		
					0		
					0		
		1	1		2		
					0		
					0		
					0		
					0		
				1	1		

Appendix 1.Opportunity Identification—Selection Matrix

Idea	Source of opportunity
1. Defogger	Personal experience
1. Dog flippers	Personal experience
2. Tug of war	Personal experience
3. Waterproof tablet/ereader case	Consumer observation
4. HVDC transmission lines	Technology application
5. Self body move analyzer	Technology application
6. Hair cut previewer	Technology application
7. Remote thermostat	Personal experience
8. High speed chain cables	Consumer interviews – ski resort customers
9. Push button ice traction	Consumer interviews – ski resort customers
10. Baby hand rail	Consumer interview – personal friend
13. Silicon sleeve case for laptops	Technology application
14. Push release wall outlet	Personal experience

Appendix 2.Business Statement

Company: Wall outlet division of electrical fixture company (i.e. Leviton) Mission Statement: Develop a new wall outlet integrating outstanding safety, retention, and ease of release. Product Description: Wall connection for transferring power to electrical devices Key Business Goals: Tested prototype by March 8, 20% margin, 2.5% market share in 2 years Potential Markets: Single Family homes, offices, industrial buildings, education facilities Assumptions and constraints: Meets government regulations, white or off-white colors available, new protected IP, low cost supplier manufacturing, Stakeholders: Users, developers, retailers, sales force, manufacturing, certification department

Appendix 3.Office Observation

"Accidentally unplug it every once in a while with my feet"

"Want more outlets, have to use power supply to have enough"

"A little difficult to get it out"

"It bends the prongs sometimes"

"A little difficult to get it out"

"I want the plugs to remain plugged in but not draw power"





Appendix 4. Needs Statement from office Employees

	Experience			
Customer Type	Туре	Customer Statement	Need Statements	Frequency
Male, 28, Network Engineer	Office	In our office we use Wifi system for internet connection, which is less secured with limited range, Why we cannot share the internet connection through outlets in the office. There are the technologies out there it needs to be embedded in the office use outlets. It would be more efficient and less expensive	Outlet can allows networking	1
Male, 26, Engineering office, plugs under desk	Office	"want more outlets, have to use power supply to have enough	Outlet can provide to sufficient number of appliances	1
Male, 26, Engineering office, plugs under desk	Office	can't reach the plugs, make me frustrated"	Outlet is easy to access	4
Male, 26, Engineering office, plugs under desk	Office	"hard to see, that's a minor issue"	Outlet is easy to access	4
Male, 26, Engineering office, plugs under desk	Office	easy to install"	Outlet is easy to plug in	2
Male, 26, Engineering office, plugs under desk	Office	"a little difficult to get it out	Outlet is easy to unplug	2
Male,?	Office	More than once I've kicked the power strip plug out and powered down my computer in the middle of doing something	Outlet prevents unwanted removal of plug	5
	Office	Current setup can cause power cords to unplug from the rack	Outlet prevents unwanted removal of plug	5
Male, 26, Engineering office, plugs under desk	Office	"accidentally upplug it every once in a while with my feet"	Outlet prevents unwanted removal of plug	5
Male, 40, Yahoo	onice	I use different convertors to convert the 120 AC to different low voltage DC. For me it will be usefull to have an outlet with a convertor embodied in side with capability to provide a range of	outer prevents unwanted removal of plug	5
Employee	Office	DC as well	Outlet prodives different DC output	1
Male, 40, Yahoo Employee	Office	"Why all the outlets are not able to protect the devices from voltage/Amp shocks? We need to use UPS for our important computers at the office	Outlet provides the surge protection	1
	2		Be protection	-

Appendix 5. Needs Statement from Home Based Customers

Customer	Experience		
Туре	Туре	Customer Statement	Need Statements
Male, 31	Home	"Why there is a difference in Phase and null prongs? It takes time to set the prongs for right direction	Outlet accepts plug in any direction
Male, Age 28	Home	sometimes the prongs have been badly bent	Outlet doesn't cause damage to plug
Femal, 31	Home	It bends the prongs sometimes	Outlet doesn't cause damage to plug
	Home	I hate when I go too far with the vacuum and pull out the plug. I need to walk all the way back to the wall outlet	Outlet gives me a freedom to move in a vast range
Femal, 29	Home	not having to reach down	Outlet is easy to access
Male, 38, Parent of a child	Home	" I usually use plastic protections to make plugs safe for my daughter, but sometimes I forget to do that. Why an protection is not embodied in the outlet	Outlet is safe to use
Male, 38, Parent of a child	Home	Also why they are installed at low levels, in which I'm always worried for my child?	Outlet is safe to use
Famal 27			Outlet prevents unwanted energy
Femal, 27	Home	Thate when I go too far with the vacuum and pull out the plug. I need to walk all the way	orain Outlet prevents unwanted removal
Male, Age 28	Home	back to the wall outlet	of plug Outlet prevents unwanted removal
Femal, 30	Home	If I pull the vacuum too far the plug comes out	of plug
Male, 31	Home	Why all the outlets do not provide a universal slot for charging the cell phones as well. In that case I can directly use the outlets for charging my cell phones anywhere without carrying my charger."	Outlet provides universal connector for mobile devices

Appendix 6. Affinity Exercise



New Capabilities

Appendix 7. Affinity Exercise (Prioritized Needs)

	м	J	YU	s	Y	Average	Ranking
Outlet prevents unwanted removal of plug	5	5	5	5	3	4.6	1
Outlet is easy to access	2	5	3	2	3	3	
Outlet is easy to plug in	2	2	3	4	4	3	
Outlet is easy to unplug	4	3	4	5	3	3.8	3
Outlet can allows networking	1	1	4	3	4	2.6	
Outlet can provide to sufficient number of appliances	4	4	5	4	5	4.4	2
Outlet prodives different DC output	3	2	1	1	1	1.6	
Outlet provides the surge protection	5	4	5	3	5	4.4	2
Outlet doesn't cause damage to plug	3	3	3	3	3	3	
Outlet is safe to use	4	2	4	5	4	3.8	3
Outlet doesn't cause damage to wall while pulling out	2	2	4	4	2	2.8	
Outlet prevents unwanted energy drain	4	3	4	4	4	3.8	3

Appendix 8. House of Quality

Maximum force of Retention (N)					*	Negative
Minimum force for unplugging (N)	*					relationship
Number of outlets (#)				_		
Energy overload protection (J)					_	
Shock risk (jury)			*			
Power draw potential when not in use (watts)						
	Maximum force of Retention (N)	Minimum force for unplugging (N)	Number of outlets (#)	Energy overload protection (J)	Shock risk (jury)	Power draw potential when not in use (watts)
Outlet prevents unwanted removal of plug	х					
Outlet is easy to unplug		х				
Outlet can provide to sufficient number of appliances			х			
Outlet provides the surge protection				х		
Outlet is safe to use					х	
Outlet prevents unwanted energy drain						х

Metric	Target Specification	Final Specification
	Higher than standard	80+ N
Maximum force of Retention (N)	power strip	(achieved with wire clips)
	Lower than standard power	Equal to standard power
Minimum force for unplugging (N)	strip	strip
	8 +	24 standard plugs,
Number of outlets (#)		expandable
	Equal to standard power	Equal to standard power
Energy overload protection (J)	strip (w/ surge protection)	strip (w/ surge protection)
	Equal to standard power	Equal to standard power
Shock risk (jury)	strip	strip
	0	Equal to standard power
Power draw potential when not in	(w/ automatic power	strip
use (watts)	shutoff)	

Appendix 9. Product Specifications

Appendix 10 Competitors in the Market





Appendix 10 - Competitors in the Market Cont'd









Appendix 11 Concept Selection

		Outlet prevents unwanted removal of plug	Outlet is easy to unplug	Outlet can provide to sufficient number of appliances	Outlet provides the surge protection	Outlet is safe to use	Outlet prevents unwanted energy drain	Outlet is easy to access	Tech. Maturity	Manufactu rability	Patent capability	Score	Rank
		16%	13%	15%	16%	13%	13%	13%	33%	33%	33%		
An outlet-plug combination that uses inductance to transmit power to the device. There is only plastic showing so it eliminates the safety concern. The plug would be held in magnetically. It could rotate to make removal easier.	Magnetically attached inductance outlet	3	4	3	3	5	1	5	4	3.5	5	7.5	3
Combined idea: An outlet accepting a standard plug that removes by pulling up on the cord. If the cord is hanging against the floor it can't be removed./A magnet plug working with grasping to a embeded metal plate in the wall, working with inductance	Magnetic inductance outlet with upward removal	4	3	3	3	4	1	4	4	3	4	6.8	6
Combined idea: An outlet accepting a standard plug that removes by pulling up on the cord. If the cord is hanging against the floor it can't be removed./An outlet omprises of a long flexible band with two paralel phase and null plates, capable to be install on any hight or shape on the wall. You can easily plug lot of plug anywhere in it, suitable for your office ergonomics	Flex band outlet with upward removal	5	4	5	3	4	3	4	4	5	5	8.6	1
A magnet plug working with grasping to a embeded metal plate in the wall, working with inductance	Large magnetically attached inductance plate	2	5	5	3	5	1	4	4	3	5	7.5	4
An outlet emprises of a long flexible band with two paralel phase and null plates, capable to be install on any hight or shape on the wall. You can easily plug lot of plug anywhere in it, suitable for your office ergonomics	Flex band outlet	3	4	5	3	4	3	4	4	5	5	8.3	2
an outlet where each socket can pull away from the wall like a retractable extension cord. so if someone pulls on the vacuum cord to hard the socket releases and provided a little extra length.	Retractable outlet	3	3	3	3	3	3	3	5	5	3	7.3	5

Appendix 12. Questionnaire for Concept Testing

WaveStrip Concept Feedback Survey

Do you work in a: (Mark choice with X)

Cubicle	
Office	
Home	

How many devices do you have plugged in at your workspace? (Circle your response)

0 - 2 3 - 4 5 or more

Do you frequently insert and remove the power of one or more devices in your workspace? (Circle your response)

Yes

No

WaveStrip

Wire organization

What types of power outlets have you purchased in the past? (Check all that apply)

Standard wall outlet
Power Strip
Multi-outlet adapter
I haven't purchased any outlets but am familiar with them
I know nothing about wall outlets

Please read the following description of a new product concept: the WaveStrip.

Concept Description:

A revolutionary new power strip enhanced for use in the office.

It includes everything you would expect in a common surge protector:

- Provides power to multiple devices.
- Includes surge protection and a power switch. •
- Plugs into a standard 120V outlet.



In addition the common features this power strip enhances functionality, usability, and appearance to make your experience better:

- Mounts to a standard wall or a cubicle divider to be easily accessible and keep the floor free of wires. It can be mounted above a desk or below.
- Blue LED lights appear when devices are drawing power in standby mode. This alerts the user to turn off the switch and save power.
- A push button release captures the plugs so they will not accidentally come unplugged.
- Wire organization hooks are included to keep the wires out of the way against the wall.
- Expandable and customizable design with optional curved and straight links that can be arranged as desired.
- The receptacle is a continuous strip instead of individual plugs that is more aesthetic and requires less room for the same number of plugs.

Overall, what is your reaction to the described product? (Mark choice with X)

Poor
Fair
Good
Very Good
Excellent

What is your reaction to the specific innovative features? (Mark choice with X)

	Poor	Fair	Good	Very Good	Excellent
Wall mounting					
Wave design with continuous slots					
Expandable sections					
Wire organization hooks					
Secure plug with push button					
LED power use indicator					

What is it you like about the product? Please enter as many items as you wish

What do you like least about the product?

What would be your main reason for buying the product?

Overall, how interested are you in buying this product if it were available? Please select one.

Not at all interested
Not Very Interested
Neither Interested nor Uninterested
Somewhat Interested
Very Interested

Which of the following best describes your need for this product?

I really need this product because nothing else can solve this problem
This is a minor improvement over what I currently use.
It looks okay but is about the same as what I'm doing now.
My current product would serve me better.
You've got to be kidding. Why would I need this product?

Based on the description, what price would you expect to pay for the product?

Assuming the new product is priced comparably to other major brands, would you say it is a.....

Very poor value
Somewhat poor value
Average value
Fairly good value
Very good value

In what ways does the described product appear to be superior to other wall outlets?

Overall, what would be your most important factors in choosing a power outlet? Please check three.

It prevents unwanted removal of the plug
It is easy to access
Plugs are easy to remove
Can support a sufficient number of devices
Provides surge protection
It is safe to use
It can prevent unwanted energy drain

Appendix 13- WaveStrip Need Comparisons

	Initial	Survey
It prevents unwanted removal of the plug	1	
Can support a sufficient number of devices	2	1
Provides surge protection	2	2
It is easy to access	4	4
Plugs are easy to remove	4	4
It is safe to use	4	2
It can prevent unwanted energy drain	4	

Appendix 14- WaveStrip Feature Preferences

Feature	Average
Expandable sections	4.3
Wave design with continuous slots	4.0
LED power use indicator	3.8
Secure plug with push button	3.7
Wire organization hooks	3.6
Wall mounting	3.2



Appendix 15- Product Schematic Cluster

Appendix 16- Differentiation Plan

Differentiation Attribute	Office	Cubicle	Home (Entry)
Mounting	Hard wall mounting kit included	Soft wall mounting kit included	Hard wall mounting kit included
Surge Protection	Included	Included	Not Included
Push Button Lock	Included	Included	Not Included
Type of sections	Straight	Straight	Curved & Straight

Needs	Importance	Assessment	Explanation
Ergonomics			
Ease of Use	Low	Medium	Limited user interaction based on survey results
Novelty of user interactions	Medium	High	Modular sections and push button provide novel interactions
Safety	High	Low	Users rated this highly and we want to reduce any risks of physical harm
Aesthetics			
Product Differentiation	High	High	Wave design is our differentiating feature vs. other power strips
Pride of Ownership	Medium	Medium	Cubicles workers want ways to personalize their spaces.
Team Motivation	Medium	Medium	Concept selected based on our motivation

Appendix 17- Importance of Industrial Design

Appendix 18 – Modified Function Diagram



Attribute	Wall Mount	Power Strip
Mounting	Hard wall mounting kit included	Soft Wall Mounting Clips
AC Cord	N/A	Included
Surge Protection	Included	Included
Price	Lower	Higher

Appendix 19 – Commonalities and Differences table

Appendix 20- BOM and Manufacturing cost estimation for Power Strip configuration

					Processing			
	-	Standard or	Purchased	Processing	(Machine +	Assembly	Assembly	Total Unit
Component	Freq	Custom	Materials	time (sec)	Labor)	time (sec)	cost (Labor)	variable Cost
Front End Section	2				25.00	per nour:	30.00	
AC plug apd cord	1	Chandlard	2.74					2.74
AC plug and cord	2	Standard	3.74			10	0.00	3.74
Plastic Top cover	2	Custom	0.20			10	0.08	0.28
Plastic Bottom Base	4	Custom	0.17			10	0.08	0.25
Powerswitch		Standard	0.97			10	0.08	1.05
Course Dente allow Mandala	1	Chan dan do	4.00				0.05	4.05
Surge Protection Module	4	Standard?	1.00			30	0.25	1.25
			0.20					0.20
wire clips	2		0.05					0.05
Subtotal			6.65	0.	0.00	60.	0.50	7.32
Comercial Constitution	-							
Curved Sections	5	0	0.00			40	0.00	0.00
Plastic Top cover	5	Custom	0.20			10	0.08	0.28
Plastic Bottom Base	э	Custom	0.17			10	0.08	0.25
Power use indication	5							
module		Standard	0.50			10	0.08	0.58
Contact Plate	10	Custom	0.08					0.08
Receptacle Contact								
Bands	10	Custom	0.10	2.	0.01	5	0.04	0.16
Subtotal			6.15		0.01	15.	0.13	7.96
Total Direct Costs			12.80		0.01	75.	0.63	15.27
Overhead Charges								20%
Total Cost								18.33

Appendix 21- BOM and Manufacturing cost estimation for wall mount configuration

Freq	Standard or Custom	Purchased Materials	1	Processing time (sec)	Processin (Machine + Labor)	g - As tin 25.00pe	sembly ne(sec) rhour:	Assembly cost (Labor) 30.	Total Uni) Variable .00	it Cost
	2									
	1Standard		0.00							0.00
	2Custom		0.20				1	0 0.	.08	0.28
	2Custom		0.17				1	0 0.	.08	0.25
	1Standard		0.00				1	0 0.	.08	0.08
	1 Standard?		1 00				3	0 0	25	125
	1		0.20				-			0.20
	2		0.05							0.05
			1.94		0.	0.00	60	D. 0	.50	2.61
	5									
	5Custom		0.20				1	0 0.	.08	0.28
	5Custom		0.17				1	0 0.	.08	0.25
	5									
	Standard		0.50				1	0 0.	.08	0.58
	10Custom		0.08							0.08
	10Custom		0.10		2.	0.01		5 0.	.04	0.16
			6.15			0.01	15	5. 0	.13	7.96
			8.09			0.01	75	5. 0.	.63	10.56 20% 12 67
	Freq	FreqStandard or Custom2 1Standard 2Custom 1Standard 1Standard? 11 Standard? 15 5Custom 5Custom5 5Custom 10Custom10Custom	Standard or Custom Purchased Materials 2 1Standard 2Custom 2Custom 1Standard 1 1Standard? 1 1 1 5 5Custom 5 5Custom 5 5Custom 5 5Custom 5 5Standard 10 10 10 10	Standard or Custom Purchased Materials H 2 1Standard 0.00 2Custom 0.20 2Custom 0.17 1Standard 0.00 1Standard 0.00 1Standard 0.00 1Standard 0.00 1Standard 0.00 1Standard 0.00 2Custom 0.17 Standard? 1.00 1Standard? 0.20 2 0.05 5Custom 0.20 5Custom 0.20 5Custom 0.20 5Custom 0.20 5Custom 0.20 5Custom 0.20 10Custom 0.08 10Custom 0.10 6.15 8.09	Standardor Custom Purchased Materials Processing time (sec) 2 0.00 0.00 2Custom 0.20 0.20 2Custom 0.17 0.17 1Standard 0.00 0.17 1Standard 0.00 0.17 1Standard 0.00 0.17 1Standard? 1.00 0.20 2 0.05 0.20 2 0.05 0.20 2 0.05 0.20 2 0.05 0.20 5 5 0.50 5 0.50 0.17 5 5 0.50 10 0.05 0.20 10 0.08 0.50 10 0.10 6.15 8.09 8.09 8.09	Standard or CustomPurchased MaterialsProcessing time (sec)Processing (Machine + Labor)2 1Standard0.00 2Custom0.17 1Standard0.001 2Custom0.17 1Standard1.00 0.001 1 0.20 21 2 21.00 0.051 0.20 21 5 5Custom0.20 0.171 1.945 5Custom0.20 0.171 1.945 5Custom0.20 0.171 2.5 5Custom0.10 0.182.10Custom0.10 0.082.10Custom0.10 0.802.	Standard or Custom Purchased Materials Processing time (sec) Processing (Machine + Labor) As As 2 10 200 2 0.00 200	Standard or Custom Purchased Materials Processing time (sec) Processing (Machine + Labor) Processing time (sec) 2 1 Standard 0.00 25.00per hour: 2 0.20 1 2Custom 0.20 1 2Custom 0.17 1 1Standard 0.00 1 2Custom 0.17 1 1Standard 0.00 1 1Standard? 1.00 3 1 0.20 2 2 0.05 1 5 5Custom 0.20 1 5 5Custom 0.17 1 5 5Custom 0.20 1 5 5Custom 0.17 1 5 5tandard 0.50 1 10Custom 0.10 2 0.01 10Custom 0.10 2 0.01 8.09 0.01 7	Standard or Custom Purchased Materials Processing time (sec) Assembly Labor) Assembly time (sec) Assembly Custom Custom Custom <thcustom< th=""> Custom <thcustom< th=""> Custom Custom<td>Freq Standard or Custom Purchased Materials Processing time (sec) Assembly Labor Assembly time (sec) Assembly cost (Labor) Total University 2 15tandard 0.00 25.00perhour: 30.00 20 10 0.08 2Custom 0.20 10 0.08 10 0.08 1Standard 0.00 10 0.08 10 0.08 1Standard 0.00 0.00 60. 0.50 10 0.08 1Standard? 1.00 0.20 10 0.08 0.25 10 0.08 10 0.08 1Standard? 1.00 0.05 10 0.08 0.50 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.04 10 10 10 10 10 10 10 10 10 10 10 10 10</td></thcustom<></thcustom<>	Freq Standard or Custom Purchased Materials Processing time (sec) Assembly Labor Assembly time (sec) Assembly cost (Labor) Total University 2 15tandard 0.00 25.00perhour: 30.00 20 10 0.08 2Custom 0.20 10 0.08 10 0.08 1Standard 0.00 10 0.08 10 0.08 1Standard 0.00 0.00 60. 0.50 10 0.08 1Standard? 1.00 0.20 10 0.08 0.25 10 0.08 10 0.08 1Standard? 1.00 0.05 10 0.08 0.50 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.08 10 0.04 10 10 10 10 10 10 10 10 10 10 10 10 10

Appendix 22- Net Present Value Analysis

Period	1	2	3	4	5
Development	-40	0	0	0	0
Testing	-25	0	0	0	0
Tooling and Ramp-Up Costs	-10000	0	0	0	0
Market Introduction	-1800	0	0	0	0
Ongoing Marketing Costs	-625	-625	-625	-625	-625
Production Cost	-3600	-9000	-18000	-36000	-90000
Shipment Cost	0	-1000	-2000	-4000	-10000
Product Revenues (wholesale	5000	12500	25000	50000	125000
Unit Sales	200	500	1000	2000	5000
Unit Price	25	25	25	25	25
Unit Production Cost	-18	-18	-18	-18	-18
Period Cash Flow	-11090	1875	4375	9375	24375
PV Time Period 0	-10820	1785	4063	8493	21544
Cumul. Disc. Cash Flow	-10820	-9035	-4972	3521	25065

PROJECT NPV \$ 25,065

Appendix 23- Period Cash Flow



Period Cash Flow

Appendix 24- Cumulative Cash Flow





Appendix 25- Cumulative Discounted Cash Flow