Can Stopper:
New Product Development Log

Course Title:	New Product Development
Course Number:	ETM 547
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Term:	Winter
Year:	2009
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Date:	17th March, 2009

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Report No.:

Type: Student Project

Note:

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1. Introduction

We are product development team in a consumer product company based in Portland, Oregon. Our company specializes in developing and producing add-on product to add values and features to every-day consumer product. Our team was assigned to work in the white space to come up with a new product for enhancing the company's sales and exploring new market opportunities.

In the book: Product Design and Development, the authors defined product development as "the set of activities beginning with the perception of a market opportunity and ending in the production, sale and delivery of a product" [1]. In this development log, we will illustrate the process of developing a can stopper for beverage can. We will follow the development process used in Product Design and Development book by Ulrich. The development will go through different phases which are shown in figure 1:

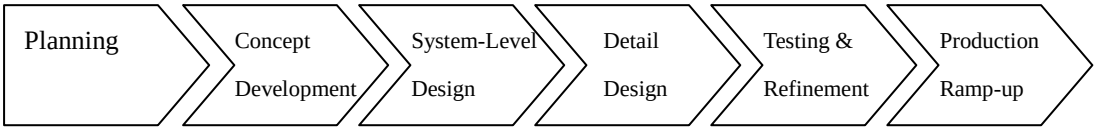


Figure 1: Product Development Process

We want to keep our development process organized and structured, so we will follow almost the same phases as the ones presented in the book. However, since our product fits in the improvement product category, our development phases would change slightly, and consequently it would require less development time.

2. Product Development Process

2.1 Planning

To get our project started, we set up our first kick-off meeting. In our first meeting, each team member needed to came up with at least one product idea (see Appendix A). After this brainstorming section, we had eight great ideas. We went through all the ideas, and then we did a multi voting to narrow down those ideas to one. The can stopper idea was picked for moving to our next development process because we believed that there were some market opportunities for this product and it was a simple product. We tried to keep our idea simple as Dr. Jetter, our team's senior consultant, mentioned in her guide lines for the project "Not based on a new technology, nothing too fashion or design focused, nothing proprietary… Start with something you know… Exploit team member expertise and interests… Keep it simple: few parts, simple prototype."

From our own experiences and observation, we realized that there are a lot of people that drink can beverages outside and cannot finish it in one time. Many of times we saw the beverage spill out over the table or even their clothes. Because of that, our team thinks there is a potential market for our product. In order to help us identify market opportunity, we did some research on the internet to see if there was any can stopper selling in the market and we found couple different types of this

product, so we ordered three different can stoppers in order to have a deeper insight of this kind of product. The type of our product development project is derivative of existing product, so our first task was to analyze competitors, similar products. And then we needed to research current problems and address the customer needs over an existing product.

For our potential customers, we believed that there were millions of people that drink can beverages so we would focus on general can beverage consumers. We would also look at soft drink manufacturers and distributors as our potential customers. At this point, our potential customer seemed too broad. However, as went along the development process we believed that we will find a niche market among potential customers.

For allocation for resources and timing, the project was scheduled to completed and introduced in first quarter of 2010, so we had about 12 months for the entire developing process before the ramp-up phase with realistic budget to test the viability of the product. Our plan was to interview a sample of potential customers from both sex and different ages to explore the viability of the product with an interpretation of the customer needs. Then, we will match the needs to the engineering design. After that, a prototype sample will be made before the production ramp-up. In order to complete the pre-planning process, we came up with the mission statement for our project.

Mission Statement: Can Stopper	
Product Description	• A beverage can cover that can keep the can closed after opening
Key Business Goals	• Product introduced in first quarter of 2010 • Leader in can stopper market by the end of 2010
Primary Market	• Any can beverage consumers
Secondary Market	• Soft drink manufacturers • Soft drink distributors
Assumptions	• Add-on to the can beverages • Fitting to any standard can • Preventing spilling out • Keeping insects and dust out • Protecting against sharp edges • Keeping in fizz
Stakeholders	• Users • Manufacturers • Distributors and resellers • Production • Health department

Table 1: Mission statement

2.2 Concept Development

2.2.1 Identifying Customer Needs

To identify our customers' needs, we conducted interviews with 10 individuals from different ages and both sex. The need for both is to see how favorability and perceptions of our project between male and female, and between teens, youth, middle ages, and elders. Male were account for 70% of all interviewees, and the range in terms of age was from 15 to 45 years old. Surprisingly, we find that most of the interviewees who think can stopper as an essential need are females. It was coincidently that one of the interviewees, who has 3 years old kid, has presented some safety related questions about how the can stopper will help protect his kid, so we started thinking to narrow down the scope of our potential markets to mainly focus on females and parents who have kids.

Asking the right questions would help our team to identify customer needs and come up with the creative idea to develop the product in the future. As a result, our questions that we asked interviewees were opened questions that can handle different answers and allows the interviewee to elaborate and discuss the answer, i.e. questions weren't yes/no questions (see appendix B). When it came to the interpretation of the data, we listened to the records along with our individual notes. We recorded the interviews to have better interpretations for the data gathered when listen to them again and again. Then, we came up with the following four basic buying needs pertaining to the product:

1. Functionality
2. Manufacture
3. Cost
4. Emotional

Below is the table that show customer needs interpreted from customer requirements in each category of basic buying needs. The specific document about the customer statements and interpreted needs is documented (see appendix C).

Main Category	**Interpreted Need**
Functionality • Keeping the taste • Convenience • Preventing Spilling • Keeping from dust • Safety	1.The can stopper can keep the gas. 2.The can stopper is convenient to carry. 3.The can stopper is easy to keep after using. 4.The can stopper is tight enough to prevent spills. 5.The can stopper can keep bugs and dirt out. 6. The can stopper can protect people from sharp edge.

Manufacture	7. The can stopper is comfortable to keep after using. 8. The material of can stopper is safe for human being. 9. The can stopper allows the user to put straw in. 10. The can stopper can fit many sizes of can beverages. 11. The design of can stopper is attractive. 12. The can stopper is identifiable. 13. The can stopper is reusable. 14. The patterns of can stoppers are collectable. 15. The can stopper can be used in different location.
Cost	16. The can stopper is free. 17. The can stopper is available for extra charge. 18. The can stopper is available less than 1 dollar. 19. The can stopper is available more than 1 dollar.
Emotional	20. The can stopper makes the users feel their hands are clean. 21. The can stopper is easy for the customers to use. 22. The can stopper should be very easy to acquire.

Table 2: Customer statements and interpreted needs about cost of product

2.2.2 Product Specifications

After translating the customers' needs, we evaluated relative importance of the customers' needs through one to five points. Each person gave 1 point to the most important need, 2 points to the second important one and so on. Then we averaged every one's point to give the final decision in terms of the relative importance. The following table shows customers' needs for the can stopper and their relative importance.

No.		Need	Imp.
1	The Can-Stopper	can keep the gas	1
2	The Can-Stopper	is convenient to carry	2
3	The Can-Stopper	is easy to keep after using	3
4	The Can-Stopper	is tight enough to prevent major spills.	1
5	The Can-Stopper	prevents from dust falling into the can	3
6	The Can-Stopper	protects people from sharp edges	2
7	The Can-Stopper	is comfortable to keep after using	2
8	The Can-Stopper	material is safe for human being	2
9	The Can-Stopper	allows the user to put straw in.	3
10	The Can-Stopper	fits many sizes of can beverages.	3
11	The Can-Stopper	design is attractive.	2
12	The Can-Stopper	is identifiable.	3
13	The Can-Stopper	is reusable.	3

14	The Can-Stopper	patterns are collectable.	4
15	The Can-Stopper	can be used in different location	5
16	The Can-Stopper	is free	2
17	The Can-Stopper	is available for extra charge	3
18	The Can-Stopper	is available less than 1 dollar	3
19	The Can-Stopper	is available more than 1 dollar	1
20	The Can-Stopper	makes the users feel their hands are clean	3
21	The Can-Stopper	is easy for the customers to use.	2
22	The Can-Stopper	should be very easy to acquire.	5

Table 3: Customer needs for the Can-Stopper and their relative importance

Based on the table, we can find customers are more concern about the functionalities of the can stopper in terms of keeping the gas inside the cans and preventing dust from falling into the cans. Also, the most important thing for customers is whether the can stopper is tight enough to prevent any spills or not.

Such descriptions are helpful in developing a clear sense of the issues of interest to customers but we still need to use specific guidance to talk about how to design and engineer the product. First of all, we have prepared the list of metrics for the Can stopper to realize what target standards our product has to meet. The relative importance of each metric and the units for the metric are shown below.

Metric No.	Need Nos.	Metric	Imp.	Units
1	1	time for the can beverages still keeping in fizz	1	days
2	2	can stopper size	2	in
3	2	total mass	2	lbs
4	3	time to clean it after using	3	s
5	4	volume of the liquid leaking out after falling down the can	1	mm^3
6	5	cover whole mouth of the cans	1	in
7	6	cover the edge of the mouth of the can	2	Subj.
8	7	can be cleaned even without water	2	Subj.
9	7.20	won’t be sticky after cleaning	3	Subj.
10	8	safe material for human being	2	Subj.
11	9	space make straws be able to put in when it is attaching	3	In
12	10	can be attached on any kind of beverage cans	3	Subj.
13	11	Providing interesting design on the can stopper	2	Subj.
14	12	identifiable	3	Subj.
15	13	the material is reusable	3	Subj.
16	14	Providing a serious of interesting pattern on can stoppers	4	Subj.

16	15	can be operated with just one hand	5	Subj.
17	16-19	unit manufacturing cost	2	USD
18	21	time to attach it on cans	2	S
19	21	knowing how to use without reading the instruction	2	Subj
20	21	power to attach it on cans	2	Lbs
21	21	time to detach it from cans	2	S
22	21	Hand power to detach it from cans	2	Lbs
23	22	Sold with can beverages	5	USD

Table 4: List of metrics for the can stopper

According to table 4, we can see some needs which can be measured so we put the appropriate units for the needs. For example, the first metric says that "time for the can beverages still keeping in fizz," so we tend to use days as the unit to measure the length of the time that those sample can beverages can still keep in fizz. Besides, metric number 5 describes "volume of the liquid leaking out after falling down the can" so we can measure the volume, in the unit of mm^3, of the liquid leaking out after falling a can-stopper-implemented can down. However, some needs cannot easily be translated into quantifiable metrics. In these cases, we note the metric to be subjective like metric No7, 8, 9, 10…etc.

After that we use a simple needs-metrics matrix which represents the relationship between needs and metrics. For this table, the rows of the matrix correspond to the customer needs, and the columns of the matrix correspond to the metrics. Consequently, we apply this matrix to better understand what features of the product satisfy customers. The following table is a needs-metrics matrix for the Can-Stopper.

	Metric	1	2	3	4	5	6	7	8	9	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
	Need	time for the can beverages still keeping in fizz	can stopper size	total mass	time to clean it after using	volume of the liquid leaking out after falling down th	cover whole mouth of the cans	cover the edge of the mouth of the can	can be cleaned even without water	won't be sticky after cleaning	safe material for human being	space make straws be able to put in when it is attac	can be attached on any kind of beverage cans	Providing interesting design on the can stopper	identifible	the meterial is reusable	Providing a serious of interesting pattern on can stop	can be operated with just one hand	unit manufacturing cost	time to attach it on cans	knowing how to use without reading the instruction	power to attach it on cans	time to detach it from cans	Hand power to detach it from cans	Sold with can beverages
1	The can stopper can keep the gas	●																							
2	The can stopper is convenient to carry		●	●																					
3	The can stopper is easy to keep after using				●																				
4	e can stopper is tight enough to prevent major spills					●																			
5	an stopper can prevent from dust falling into the can						●																		
6	The can stopper can protect people from sharp edges							●																	
7	The can stopper is comfortable to keep after using								●	●															
8	The material of can stopper is safe for human being										●														
9	The can stopper allows the user to put straw in											●													
10	The can stopper can fit many sizes of can beverages												●												
11	The design of can stopper is attractive													●											
12	The can stopper is identifible														●										
13	The can stopper is reuseable															●									
14	The patterns of can stoppers are collectable																●								
15	The can stopper can be used in different location																	●							
16	The can stopper is free																		●						
17	The can stopper is available for extra charge																		●						
18	The can stopper is available less than 1 dollar																		●						
19	The can stopper is available more than 1 dollar																		●						
20	n stopper makes the users feel their hands are clean									●															
21	The can stopper is easy for the customers to use																			●	●	●	●	●	
22	The can stopper should be very easy to acquire																								●

Table 5: The needs-metrics matrix

As we know, an alternative competitive benchmarking chart can be used to compare customers' perceptions of the relative degree to which the product satisfy their needs. Therefore, in order to get competitive values, our team also applies this chart in order to see the advantages and weaknesses of our competitors. Finally, after a wide range search on the existing products, we chose three of them which are Nip Beverage Can Caps, Snap Caps Can Cover and Hulk/Spiderman Sports Caps to be the targets of our competitive benchmarking process. Afterward we tested each product and scored more dots to correspond to greater perceived satisfaction of the need. According to this chart (Appendix D), we found that our potential customers are more concerned about the spill issue. However, only one competitor from Snap Caps Can Cover can really prevent spills very well, but in other aspects, it is also failed to meet the customer needs, such as the "convenience of carrying." Moreover, the product can keep the gas that is another important customer need. Nevertheless, all three competitors do not satisfy all of the customers' needs that we have investigated. In short, if we want our product to be successful, collecting competitive benchmarking information is another necessary part in our new product development process.

2.2.3 Concept Generation

The function diagram shows how to implement the overall function of the product, so our team came up with a series of process to show the overall function of the Can stopper. First, you open beverage can and then you apply hand power to manipulate the beverage can like hold it or steady it, or whatever you manipulate beverage can. Afterward you still apply hand power to put can stopper onto beverage can and tight can stopper. Finally, you will get the sealed beverage can.

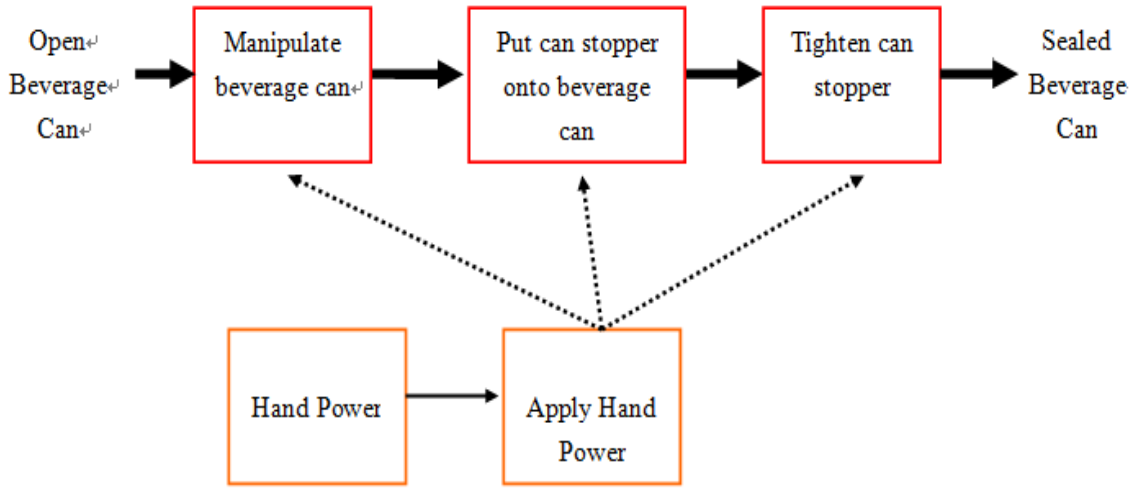


Figure 2: Function Diagram

2.2.4 Concept Selection

Concept selection is an integral part of the product development process. In the concept selection phase, the main goal is to evaluate concepts with respect to customer needs, compare the relative strengths and weaknesses of the concepts, and then select out one or more concepts for further investigation, testing, or development.

The product development team applied a two- stage concept selection methodology which included *concept screening* and *concept scoring*. In concept screening, first of all, the product development team generated the five initial product concepts under consideration. Each concept was rated in comparison to the reference concept (NIP BEVERAGE CAN CAPS) relative to seven selection criteria by using the screening matrix (Table 6). Two concepts (concept D and E) with the same highest score were selected and two concepts (concept A and F) with the same second high score were combined. After some alternatives were eliminated, the team chose to move on to concept scoring and conducts more detailed analysis and finer quantitative evaluation of the remaining concepts (concept D, E, and AF) using the scoring matrix (Table 7) as a guide. This method uses a weighted sum of the ratings to determine concept ranking.

Selection Criteria	A	B	C	D	E	F
	Plug	Straws	Reference	half lid	Two-layer	Thumb-shape
	Alice	Fahad+ Kai	NIP BEVERAGE CAN CAPS	Ying	Kun	Jocelyn
Tightness	+	+	0	+	+	-
Ease of use	-	-	0	0	-	+
Portability	+	-	0	0	+	+
Attractiveness	0	0	0	+	+	+
Ease of manufacture	0	-	0	0	-	-
Flexibility	0	0	0	0	+	+
Human Safety	0	+	0	0	0	-
Sum +'s	2	2	0	2	4	4
Sum 0's	4	2	7	5	1	0
Sum -'s	1	3	0	0	2	3
Net Score	1	-1	0	2	2	1
Rank	3	6	5	1	1	3
Continue?	Combine	No	No	Yes	Yes	Combine

Table 6: The concept screening matrix

(+ for "better than," 0 for"same as," – for "worse than") in order to identify some concepts for further consideration.

		Concept					
		AF		D		E	
		T-shape		Half lid		Two-layer	
		Alice+Jocelyn		Ying		Kun	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Tightness	25%						
Prevents spilling	15%	5	0.75	5	0.75	4	0.60
Prevents dust and bug from getting in	5%	5	0.25	5	0.25	4	0.20
Keeps the taste	5%	4	0.20	4	0.20	3	0.15
Ease of use	15%						
Easy to attach	5%	3	0.15	4	0.20	2	0.10
Easy to remove after using	4%	3	0.12	4	0.16	2	0.08
Easy to drink when in use	6%	4	0.24	4	0.24	3	0.18
Portability	20%						
Easily stored after using	10%	5	0.50	2	0.20	2	0.20
Easily carried when not in use	10%	5	0.50	3	0.30	4	0.40
Attractiveness	10%						
Attractive appearance	10%	5	0.50	3	0.30	4	0.40
Ease of manufacture	5%						
Low-cost materials	2%	3	0.06	4	0.08	3	0.06
Low complexity of parts	3%	2	0.06	3	0.09	2	0.06
Flexibility	10%						
Fits in different sizes of beverage cans	10%	4	0.40	3	0.30	4	0.40
Human Safety	15%						
Prevents sharp edge	7%	4	0.28	4	0.28	3	0.21
Safe materials for human health	8%	4	0.32	4	0.32	3	0.24
	Total Score		4.33		3.67		3.28
	Rank		1		2		3
	Countine?						
			Develop		No		No

Table 7: The concept scoring matrix

2.2.5 Concept Testing

In this process, we have done two concept tests with our potential customers in order to fully understand what the customers want and also agilely react to customers' feedbacks. In two tests, we had via-s-via interviews with our potential customers, which are considered as the most efficient way in terms of securing customers' real voice. The questionnaire of the first concept test is provided in Appendix E. Besides, we also used the sketch as the auxiliary while talking to the interviewees. The result of the first test is provided as follows.

	Definitely not Purchase	Probably not purchase	Might or might not purchase	Probably purchase	Definitely purchase
Male	3	1	2	0	0
Female	1	0	1	4	1
Parents	1	0	1	2	2
Total	5	1	4	6	3

Table 8: Result of the first concept test

We then calculated the probability of purchase following the guideline inside the book, and got the percentages as follows.

- $P_{GENERAL}$(without parents) = 0.4*0.08 + 0.2*0.31 = 0.094
- P_{MALE} = 0.4*0 + 0.2*0 = 0
- P_{FEMALE} = 0.4*0.14 + 0.2*0.57 = 0.17
- $P_{PARENTS}$ = 0.4*0.33 + 0.2*0.33 = 0.198

It turned out that parents have highest likelihood of purchase, and females have relative high likelihood of purchase. Finally, there is no need for males. So obviously, we need to narrow down the scope of our potential customers to focus on female consumers and parents who have kids. After we decided to slightly shift our market focus, the second concept test (See Appendix F) was coming along.

In addition to the small change on the market focus, in the second test, we also improved our concepts based on the suggestions that we got from a previous concept testing, finally we have dramatic increase on the probability of the purchase.

	Definitely not Purchase	Probably not purchase	Might or might not purchase	Probably purchase	Definitely purchase
Female	1	1	2	3	3
Parents	2	0	2	2	4
Total	3	1	4	5	7

Table 9: Result of the second concept test

P_{FEMALE} = 0.4*0.3 + 0.2*0.3 = 0.18

$P_{PARENTS}$ = 0.4*0.4 + 0.2*0.3 = 0.22

P_{Total} = 0.4*0.35 + 0.2*.25 = 0.19

According to the result, after we narrow down the scope of our potential customers, and improved some concepts of our products, the P raised from 0.094 to 0.19. In order to further predict the potential volume of sales, we also did the research about the possible number of female soft drink consumers. It turned out there will be around 120 million female soft drink consumers in U.S. by 2010 possibly [2]. We believe this number has covered the two segments we are targeting at, because females are also half of the parents. Further, after the assumption of the awareness of the customers, which we set up at 0.1, we are allowed to calculate the potential sales based on the equation below.

Q = N * A * P → 120 M * 0.1 * 0.19 = 2.28 M (set up as the target annual sales)

3. Design Phase

3.1 Product Architecture

In this part, we tried to draw the product architecture by following the processes in the book. By doing this exercise, we became more aware of the functionality and the specific elements of the entire product. Basically, this can stopper will include the upper and lower parts, and the most critical idea of this product is the sliding mechanism which can drastically improve the tightness of the can stopper. But after the discussion among the team, we all agreed that this exercise can be much more useful when it is applied on developing a product which is more complicated.

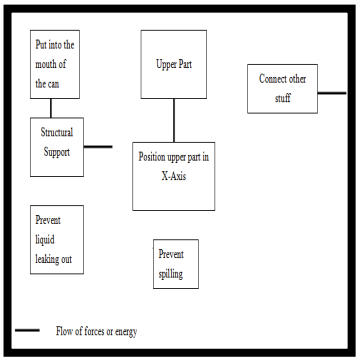


Figure 5: Schematic of the can stopper

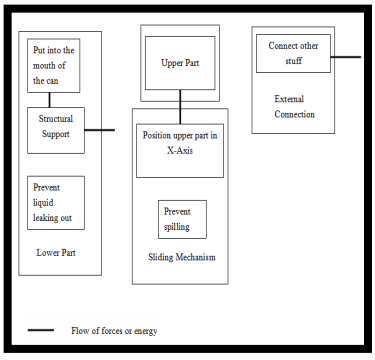


Figure 3: Clustering the elements into chunks

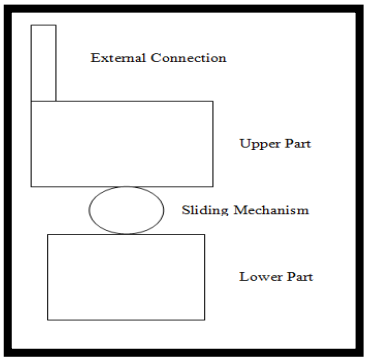


Figure 4: Geometric layout

3.2 Industrial Design

In this stage, we have assessed the importance of industrial design for our product in terms of each of the different customers' needs (Appendix G). Finally, we find that ID can really benefit the users in terms of the ease to clean by eliminating some uncleanable spots on the product. Plus, it allows customers to attach and detach the

product easily. Mostly, a wonderful design can't be perfectly produced without the support form engineering.

3.3 Engineering Trade-Offs

As we mentioned above, a perfect product can't miss the work of either the design aspect or the engineering aspect. However, almost in every project, there are some points from the design aspect are very hard to achieve, or even unachievable for the engineering side. So we have to be very cautious on making these trade-offs, because some customers' needs may be sacrificed after the trade-off has been made. There is no exception in our project, and we also make some trade-offs in order to make the manufacturing applicable.

1. This solution is not able to fit in the cans of different size

Based on our investigation (Appendix H), there are not too many different sizes of the cans in the market currently. Except for Red Bull, other major soft drinks and beers are in the same size and shape of the can. So we decided to focus on the prevalent size of the can, rather than other unique sizes.

2. The tradeoff on the material of the buckle

According to our customer needs about convenience, one of main concern that we know from interviewee is sometimes they feel inconvenient about bringing the can stopper with them. As a result, our team came up with the idea of an additional buckle that can be attached on the can stopper after using. First, we came up with the initial list of 11 ideal buckles. Finally, we decided to develop our product with the "Plastic Snap Bag". The reason we selected the plastic snap bag because we would like to cut down the cost, also make our can stopper a lightweight product. The buckle is made of strong plastic that can be attached on the can stopper [3]. It can create more convenience for customer in bringing the can stopper with them by attaching the buckle to belt loop, bag, or purse. Moreover, without key ring, the key clip measures only 3-1/2" which is not too big or too heavy to carry to anywhere [3]. To more clearly understand about the additional buckle, the picture of the buckle is shown in the Appendix I.

3. The trade of the material of the can stopper

In order to meet the customer's need concerning about the material of our can stopper, we did some research to find what would be the best fit for producing our can stoppers. We finally agreed to use Low Density Polyethylene (LDPE) because of its excellent properties matched with our requirement as well as its competitive price. LDPE was first prepared around fifty years ago by the high pressure polymerization of ethylene. Its comparatively low density arises from the presence of a small amount of branching in the chain (on about 2% of the carbon atoms). LDPE is a very useful and widely used plastic in packaging world [4]. Moreover, it has a very competitive price $0.6-0.9/lb [5]. This is some major LDPE properties that are beneficial to our product [4].

- Excellent resistance to dilute and concentrate Acid and Alcohols
- Safe for food contact packaging
- LDPE is defined by a density range of 0.910 - 0.940 g/cm^3
- Soft and flexible

3.4 Final Specification

After considering all of the customers' needs and engineering trade-offs, we have successfully generated the final specifications. We list them as follow:

- Plug-in Can Stopper
- Small and lightweight < 100g
- Lower part of the can stopper can be stuffed into the mouth of the can
- Upper part of the can stopper can easily be slid forward to cover the uncovered hole
- Upper part can easily be slid backward when users want to remove it from the can
- Upper part can tightly attach on the can
- Using LDPE as the material
- An additional plastic buckle is attached on the can stopper
- Disney's characters, such as Mickey Mouse, would be designed on the product

The pictures of our product are documented in the Appendix J.

4. Testing and Refinement

We have built a handmade prototype in order to strength the communication with our customers, and also set up a milestone for the team's efforts. Unfortunately, we were been too successful on making that, but there is still a basis of our overall concepts.

5. Production Ramp-up

5.1 Unit cost

We have contacted the Jakori Company which is an expert in the Can Stopper business. They gave us information about their products, and that include size, martial, shipping cost and the overall cost of a can stopper. Basically, we made the assumptions following the information from Jakori Company in terms of the cost of our can stopper. The estimates are summarized in the following table:

Part	Cost (¢)
Shipping cost	$0.036
Buckle	$0.30
Material, assembly, and labor Cost	$0.2240
Total	$0.56

Table 10: Cost table

In order to have a low production cost, our plan is to produce the product in China. The work of assembly, material and packaging will be done in China as well. The shipping price from China to United States is around $1500 per 20 feet container. Based on the given information, the unit shipping cost will be around $0.036. Besides, the supplier of the buckles is willing to give us a discount rate, twenty five percent, on our orders if we have large orders.

5.2 Investment

In the first 12 months, we need $50,000 dollars to develop our product and in the mean time we will do testing as well. The testing will cost us $50,000 and that includes the prototyping. For the tooling and ramp-up production we need only $100,000 since most of the work will be done by the Chinese company that we are going to be partner with, and that process needs 6 months. The marketing based on the production needs $50,000 for one year while the marketing movement will cost $72,500 at the beginning and that including different types of advertisements and that is our estimation marketing wise.

The lifetime of our product is 5 years owing to the changes of the market and the need to update the product components. The sales volume will be 2,800,000 units per year and it will increase 10% each year after launched. The following table summaries the investment needed to the project:

Process	Cost (000's)/Time (months)
Development	50,000/12
Testing	50,000/12
Tooling and Ramp-up	100,000/6
Ongoing Marketing Costs	72,500(+50/12)/24
Sales volume	(2,000,000/12) and increase every years 10%
Unit production cost	$0.056/unit
Unit revenue	$1.5/unit
Discount rate	2.5%/ 3

Table 11: Investment summary

We decided to make the unit price to the wholesalers to be $1.5 and that will cover our expense. The project total cost over 5 years will be $7,442,760 and the revenue will be $19,494,000.00. Our initial investment is about $200,000 before the first sales and the return on the investment which measures the project profitability is as follows:

$$\text{Return - on - Investment (ROI)} = \frac{\text{Cumlutive Earnings}}{\text{Initial Investment}} = \frac{\$19{,}494{,}000}{\$200{,}000} = 9.75 \times 100 = 975\%$$

The project net present value (NPV) will be $17,355,100. The following chart shows the difference between the base value and the NPV during the 20 quarters (5 years):

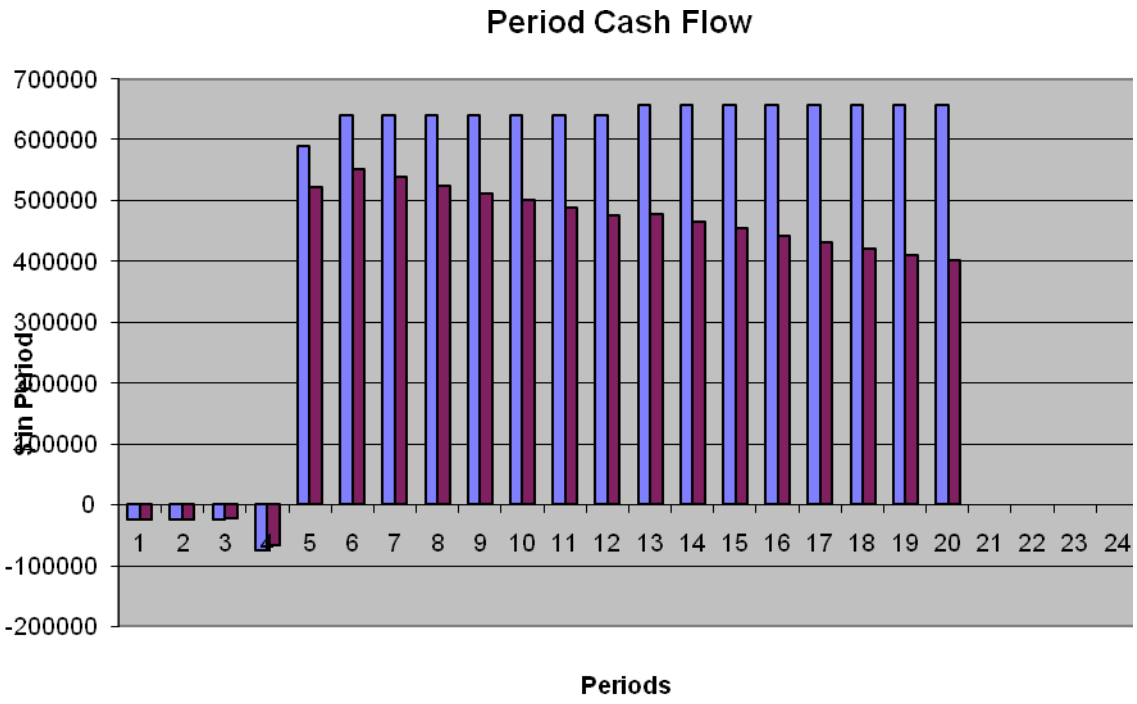


Figure 6: Period cash flow with present value for each quarter

The cash curve shows that the breakeven point in the first quarter of the second year.

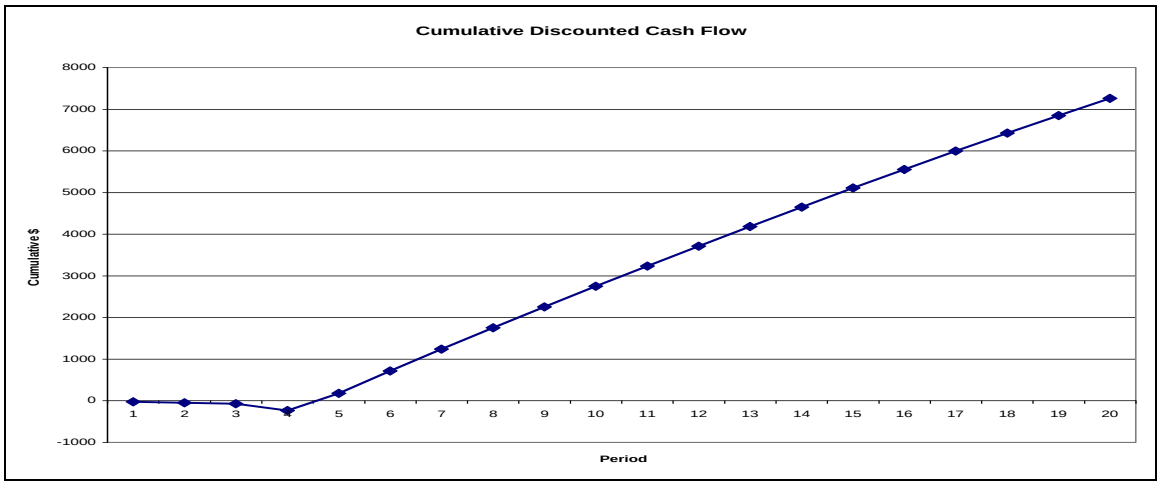


Figure 7: Our project cash curve over five years

6. Conclusion

We think our product is really viable and can be a "million idea" if the manufacturing and engineering works are done flawlessly. After we have gone through all of the exercises, we realize that the lack of professionalism, time, and resources is the biggest burden for us to come up with a product that can meet even more customers' needs. Our suggestion to the management is to give us more time to

see the viability of changing the design and focusing on quality and its effects to the product cost.

7. Future Research

One observation we have had after the investigations of the existing products is that there are only few can stoppers sold in the big physical stores, such as Safeway, Fred Meyer and so forth. So our team would like to know if there is an opportunity to sell the can stoppers in those big physical stores. Additionally, we also would like to know how to alter the shape of the upper part to increase the attractiveness without affecting the functionalities of the can stopper.

8. References

[1] Ulrich K., Eppinger S., Product Design and Development, 3rd Edition, McGraw Hill, 2003.

[2] Best Practice In Marketing To Female Consumers, Available: www.just-drinks.com/store/product.aspx?id=53600

[3] MrLock.com, (March 2009). "Key Chain, Plastic Snap bag", [Online]. Available: http://www.mrlock.com/eshop/locks/48106.html, Retrieved on March 2009.

[4] Dynalab. (March 2009). "Plastic Properties of Low Density Polyethylene (LDPE)," [Online]. Available: http://www.dynalabcorp.com/technical_info_ld_polyethylene.asp, Retrieved on March 2009.

[5] Polymer Track. (March 2009). "Raw Material Plastic Price in USA," [Online]. Available: http://www.polymertrack.com/prices/usa_02423a8e.htm, Retrieved on March 2009.

Appendixes

A) Team brainstorm ideas.

No	Name	Description	Category	Vote 1	Vote 2
1	Toilet paper provider	After user finish using toilet,	New product	3	
2	Driver Sleep Aid	If the driver close the eyes more than two seconds, the device will try to wake up the driver by making noise, or Eclectic shock.	New product	2	
3	Robot dog watcher	The user record diet information, the robot dog will read the input to notice user who eats too much.	New product	1	
5	five umbrellas holder with special umbrella	An umbrella will have more than one holder to hold multi-umbrella in the same time.	Existing product enhancement	2	
6	Yolk and egg white separater	Can separate more than one yolk and egg white.	Existing product enhancement	0	
7	Soft drink can stopper	Before user finish the can of soft drink, the can stopper will close the can without leaking. http://fantes.com/stoppers.html	Existing product enhancement	4	3
8	Plate with glass holder	A special plate with several holders to keep the glass or soup cup.	Existing product enhancement, ,	3	2

B) The survey question

General

1. Do you drink can beverages? (if yes) Normally, how often do you have that? (Beer, soft drink, juice….)
2. Did you have any experience of having the drink left in the can because you are unable to finish that in one time?
3. What did you usually do with this situation?
4. Did you have any experience of spilling the beverage while you were having it in cans?
5. What do you concern about the beverage cans keeping opened?

Product ideas

1. What do you like about this can stopper?
2. What is missing on this can stopper? (Keeping the gas, preventing spilling, blocking the dust,…)
3. What can be improved on this can stopper?

Cost

1. How much are you willing to pay for a can stopper?
2. If an ideal can-stopper is provided, will that affect your decision of purchasing the can beverages or not?
3. Will you pay more for a beverage with an add-on can stopper?

Concluding

1. Other follow-on questions, or anything the interviewees want to say

C) Customer statements and interpreted needs about functionality of product

Functionality		
Sub Category	**Customer Statement**	**Interpreted Need**
Keeping the taste	• I try to find a place to put it for a while, but eventually I will finish it up unless the taste is very bad. • The carbonated properties of the beverage would vanish if we keep the can opened for a long time. • I concerned about the change on the taste.	1. The can stopper can keep the gas.
Convenience	• Sometimes I would throw a drink away because it is very uncomfortable to carry the opening can everywhere. • I will either try to finish my drink or dump it. • I would just throw my drink away no matter how much the drink left. • I have nothing to do except keeping it opened. • A can stopper looks good, but seems too big to carry with. • I think a can stopper is not so convenient, because nobody will carry it all the time. It probably will be used just at home. But it is also not so needed at home. • I will concern about the inconvenience for carrying.	2. The can stopper is convenient to carry. 3. The can stopper is easy to keep after using.
Preventing spilling	• I would throw my drink away because I concerned about spilling. • The thing I concerned the most is I have to carry my drink all the time to prevent the beverage spilling out. • At work, I once hit my can	4. The can stopper is tight enough to prevent major spills.

	involuntarily and it caused massive mess around my computers and office items. • When I was on the bus, there was a sudden stop, and I spilled out the liquid on someone's coat.	
Keeping from dust	• Dust will fall down into the can. • I think what concerns me the most is something falls into my drink after I keep my can opened.	5. The can stopper can keep bugs and dirt out.
Safety	• I'm afraid that the sharp edge of can might cut my kids when they drink directly from can.	6. The can stopper can protect people from sharp edge.

Manufacture	
Customer Statement	**Interpreted Need**
• I am kind of worrying about how to keep it clean after using.	7. The can stopper is comfortable to keep after using.
• I concerned about the smell of the plastic. • The material should be not plastic to prevent eroding.	8. The material of can stopper is safe for human being.
• I can't put straw to my drink when using this can stopper.	9. The can stopper allows the user to put straw in.
• A can stopper could be size-adjustable.	10. The can stopper can fit many sizes of can beverages.
• The design is too boring. • A can stopper may be more attractive if it has a sleek appearance. • I think it should have more some fashionable design.	11. The design of can stopper is attractive.
• A can stopper could be marked, so that people won't pick the wrong can.	12. The can stopper is identifiable.
• The material has to be recyclable. • If a can stopper is reusable, I will buy it.	13. The can stopper is reusable.
• If there is some interesting pattern on the	14. The patterns of can stoppers are

product, such as a series of Disney characters, I might purchase it. • If a can stopper provides some fun pattern, I will buy it and keep for my collection.	collectable.
• A can stopper looks like something that would be easily left at somewhere. • After using it, a stopper maybe sticky. I think some container has to be provided for users to carry the used stopper. • I think a can stopper might be made like key chain or flash drive so that I can attach it on my stuff.	15. The can stopper can be used in different location.

Cost	
Customer Statement	**Interpreted Need**
• A can stopper should be provided for free as a souvenir. • If the price is same as non-can-stopper-provided beverage, I will buy it.	16. The can stopper is free.
• I will pay just 1 USD. • I will pay less than $1, but if a can stopper is good enough, I may pay maximum just $2.	17. The can stopper is available for extra charge.
• I would pay 50 cents for a can stopper. • I would pay 10 cents to 1 dollar. • I will pay just 99 cents for a can stopper. • I will pay only less than 1 dollar. • I would not pay more than $1 for a can stopper because there is a potential that I lose it each time I drink soda.	18. The can stopper is available less than 1 dollar.
• I will pay less than $2 for a can stopper. • Two dollars is the most I would like to pay for a whole set of a can stopper.	19. The can stopper is available more than 1 dollar.

Emotional	
Customer Statement	**Interpreted Need**
• Sometimes, the liquid leaked out making my hand really sticky.	20. The can stopper makes the users feel their hands are clean.
• I think a can stopper works somehow, but I've never used it and never seen anybody use it either. • I have to test a can stopper before purchasing that. • A can stopper should not be too complicated, so people at any age can use it.	21. The can stopper is easy for the customers to use.
• If a can stopper is not too costly, I will buy it.	22. The can stopper should be very easy to acquire.

D) Competitive benchmarking chart

	Need	Imp.	NIP BEVERAGE CAN CAPS	SNAP CAPS CAN COVER	HULK/SPIDERMAN SPORTS CAPS
keeping the taste	1. The can stopper can keep the gas	**1**	●	●●●	●●
Convenience	2. The can stopper is convenient to carry	**2**	●●	●	●●
	3. The can stopper is easy to keep after using	**3**	●	●	●●
Preventing spilling	4. The can stopper is tight enough to prevent major spills.	**1**	●	●●●●●	●
Keeping from dust	5. The can stopper can prevent from dust falling into the can	**3**	●●●●●	●●●●●	●●●●●
Safety	6. The can stopper can protect people from sharp edges	**2**	●●●●●	●●●●●	●●●●●
	7. The can stopper is comfortable to keep after using	**2**	●	●	●
	8. The material of can stopper is safe for human being.	**2**	●●●●●	●●	●●
	9. The can stopper allows the user to put straw in.	**3**	●	●●	●
	10. The can stopper can fit many sizes of can beverages.	**3**	●●●	●●●	●●●
	11. The design of can stopper is attractive.	**2**	●●	●●	●●●
	12. The can stopper is identifiable.	**3**	●●	●●	●●
	13. The can stopper is reusable.	**3**	●●●	●●●	●●●
	14. The patterns of can stoppers are collectable,.	**4**	●	●	●●●
	15. The can stopper can be used in different location	**5**	●●●●●	●●●●●	●●●●●
	16. The can stopper is free	**2**	●	●	●
	17. The can stopper is available for extra charge	**3**	●●●●●	●●●●●	●●●●●
	18. The can stopper is available less than 1 dollar	**3**	●●	●●	●
	19. The can stopper is available more than 1 dollar	**1**	●●●●	●●●●	●●●
	20. The can stopper makes the users feel their hands are clean	**3**	●	●●●	●
	21. The can stopper is easy for the customers to use.	**2**	●●●	●	●
	22. The can stopper should be very easy to acquire.	**5**	●●	●●	●●

E) The questionnaire for the first concept test

CONCEPT TEST SURVEY – The can stopper

I am collecting information for a new product and am hoping that you would be willing to share your opinions with me.

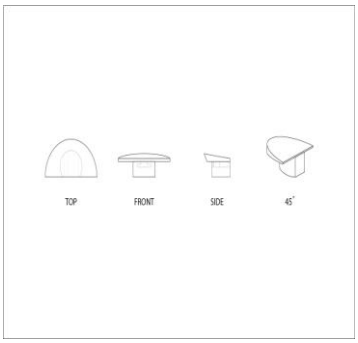
Gender _____

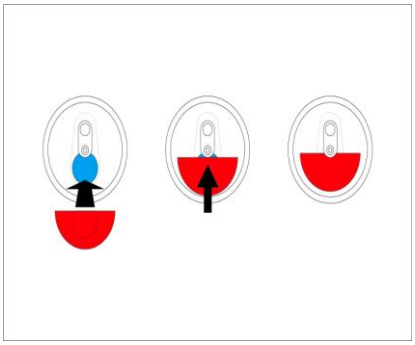
Do you drink can beverage? _____ <If the response is no, thank the respondent and end the survey.>

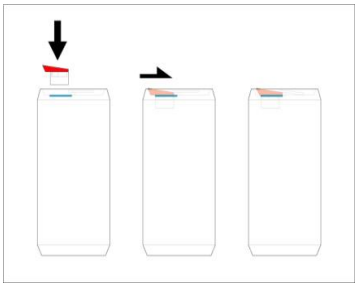
Did you have any experience of having the drink left in the can because you are unable to finish that in one time? _____

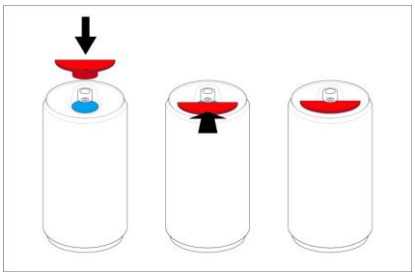
What did you do? _____

Following is a description of a new can stopper:









The product is the plug-in Can Stopper… It is a re-closable top designed to easily add onto most aluminum beverage cans. It effectively converts the ordinary, messy can into an **easily portable, re-closable, and non-spilling one.** One critical feature of this can stopper is that lower part of the can stopper can stuff into the mouth of the can, and upper part of the can stopper can easily be slid forward to cover the hole where isn't filled by the lower part in order to make the mouth of the can be totally covered. Besides, the users just need to simply slide the upper part backward when they want to remove the can stopper from the can.

There are some benefits the Can Stopper can provide, such as preventing dust and bugs from getting into your can, and keep the gas from getting out so the Can Stopper will keep your drinks fresh for days! Besides, The Can stopper is perfect for everyday use or excellent for parties, camping, driving, boating or anytime you want to open a can!

If the product were priced according to your expectations, how likely would you be to purchase the can stopper?

❑	❑	❑	❑	❑
I would d**efinitely not purchase** the can stopper	I would **probably not purchase** the can stopper	I **might or might not purchase** the can stopper	I would **probably purchase** the can stopper	I would **definitely purchase** the can stopper

What would you expect the price of the can stopper to be?_____

What concerns do you have about the product concept?

Can you make any suggestions for improving the product concept?

(For parents only)

CONCEPT TEST SURVEY – The can stopper

I am collecting information for a new product and am hoping that you would be willing to share your opinions with me.

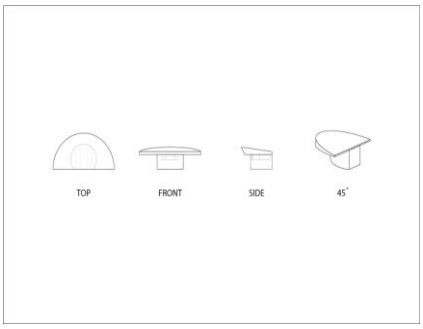
Gender _____ Do you have kid? If yes, how old is he/she? _____

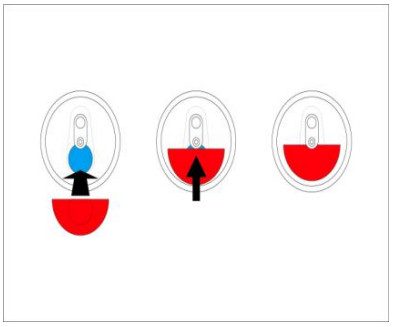
Do you drink can beverage? _____ <If the response is no, thank the respondent and end the survey.>

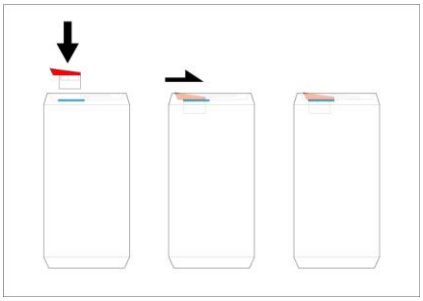
Did you have any experience that your kids spill the unfinished can beverage because? _____

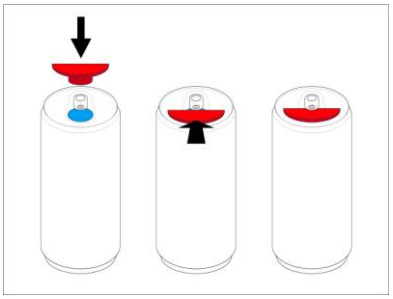
Do you think that is a hideous trouble you need to clean up? _____

Following is a description of a new can stopper:









The product is the plug-in Can Stopper… It is a re-closable top designed to easily add onto most aluminum beverage cans. It effectively converts the ordinary, messy can into an **easily portable, re-closable, and non-spilling one.** One critical feature of this can stopper is that lower part of the can stopper can stuff into the mouth of the can, and upper part of the can stopper can easily be slided forward to cover the hole where isn't filled by the lower part in order to make the mouth of the can be totally covered. Besides, the users just need to simply slide the upper part backward when they want to remove the can stopper from the can.

There are some benefits the Can Stopper can provide, such as preventing dust and bugs from getting into your can, and keep the gas from getting out so the Can Stopper will keep your drinks fresh for days! Besides, The Can stopper is perfect for everyday use or excellent for parties, camping, driving, boating or anytime you want to open a can!

If the product were priced according to your expectations, how likely would you be to purchase the can stopper for your kids?

❑	❑	❑	❑	❑
I would d**efinitely not purchase** the can stopper	I would **probably not purchase** the can stopper	I **might or might not purchase** the can stopper	I would **probably purchase** the can stopper	I would **definitely purchase** the can stopper

What would you expect the price of the can stopper to be?_____

What concerns do you have about the product concept?

Can you make any suggestions for improving the product concept?

F) The questionnaire for the second concept test

CONCEPT TEST SURVEY – The can stopper

I am collecting information for a new product and am hoping that you would be willing to share your opinions with me.

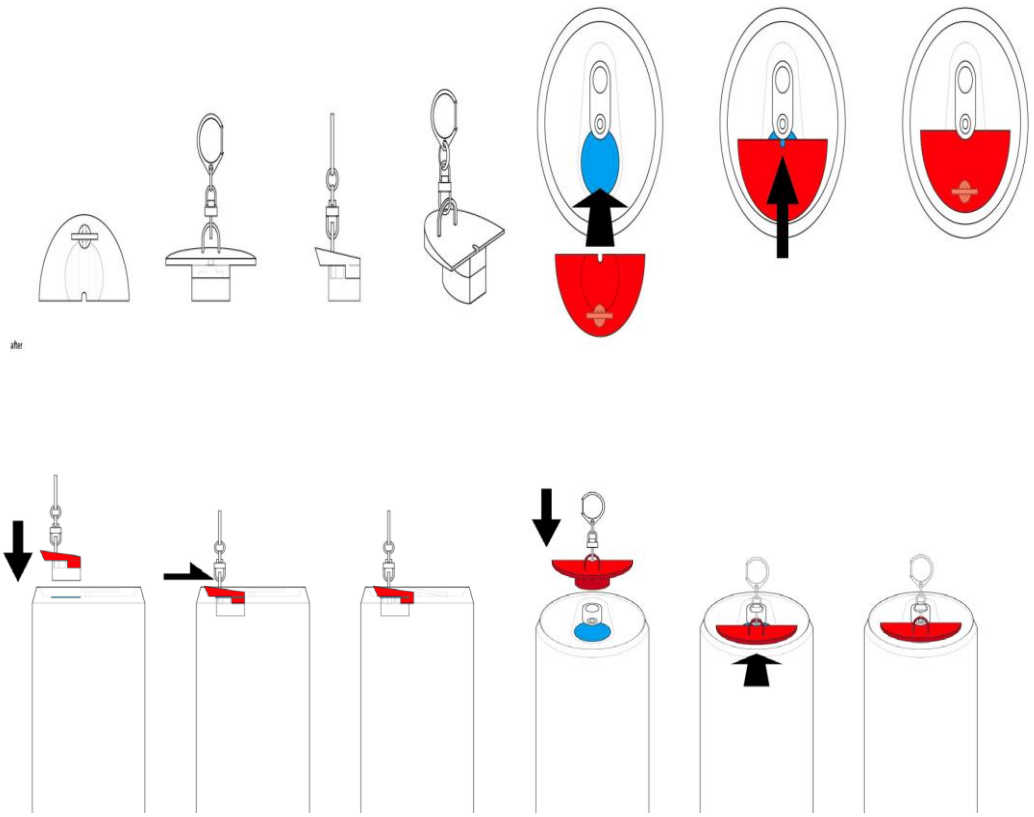
Gender _____ Do you have kid? If yes, how old is he/she? _____

Do you drink can beverage? _____ <If the response is no, thank the respondent and end the survey.>

Did you have any experience of having the drink left in the can because you are unable to finish that in one time? _____

What did you do? _____

Following is a description of a new can stopper:



The product is the plug-in Can Stopper… It is a re-closable top designed to easily add onto most aluminum beverage cans. It effectively converts the ordinary, messy can into an **easily portable, re-closable, and non-spilling one.** One critical feature of this can stopper is that lower part of the can stopper can stuff into the mouth of the can, and upper part of the can stopper can easily be slid forward to cover the hole where isn't filled by the lower part in order to make the mouth of the can be totally covered. Besides, the users just need to simply slide the upper part backward when they want to remove the can stopper from the can.

There are some benefits the Can Stopper can provide, such as preventing dust and bugs from getting into your can, and keep the gas from getting out so the Can

Stopper will keep your drinks fresh for days! Besides, The Can stopper is perfect for everyday use or excellent for parties, camping, driving, boating or anytime you want to open a can!

If the product were priced according to your expectations, how likely would you be to purchase the can stopper?

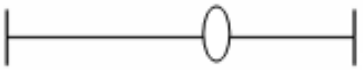
❑	❑	❑	❑	❑
I would d**efinitely not purchase** the can stopper	I would **probably not purchase** the can stopper	I **might or might not purchase** the can stopper	I would **probably purchase** the can stopper	I would **definitely purchase** the can stopper

What would you expect the price of the can stopper to be?_____
What concerns do you have about the product concept?

Can you make any suggestions for improving the product concept?

Can you tell us your favorite cartoon character?

G) Assessing the importance of industrial design for Can Stopper

Needs	Level of Importance	Explanation of rating
	Low Medium High	
1. Ease of use		1. Normally, customers would like to attach and remove a can stopper without using too much strength, so the product's size and shape have to be well designed.
2. Ease to clean		2. To minimize uncleanable spots on the can stopper would be easy for the customers to clean the product after using.
3. Good portability		3. The can stopper was intended to be a small volume product for the customers to easily carry with.
4. Tightness		4. The size of can stopper is able to cover whole mouth of the can and also to be tightly attached in order to prevent any kind of spilling.
5. Safety		5. Basically, there were few safety issues for ID to consider on the can stopper itself. But customers do concern about the material of the product.
6. Attractive appearance		6. For the can stopper, the attractive appearance is provided by some famous cartoon patterns but not that much from the ID.

H) **The size of every kind of beverage cans**

Top 3 Soft Drink Brands	Name	Market Share	Diameter
1	Coke Classic	42.9%	2.3 cm
2	Pepsi-Cola	31.2%	2.3 cm
3	Dr. Pepper and 7Up	14.9%	2.3 cm

http://seekingalpha.com/article/29100-coke-pepsi-losing-market-share

Top 3 Energy Drink Brands	Name	Market Share	Diameter
1	Red Bull	42.6%	1.7 cm
2	Monster	14.4%	2.3 cm
3	Rockstar	11.4%	2.3 cm

http://www.energyfiend.com/2007/04/the-15-top-energy-drink-brands

Top 3 Light Beer Brands	Name	Market Share	Diameter
1	Bud Light	36.8%	2.3 cm
2	Coors Light	19.1%	2.3 cm
3	Miller Lite	18.5%	2.3 cm

http://answers.google.com/answers/threadview/id/33571.html

I) The picture of target buckle

J) Final product