Sustainability Innovation

Research Into The Pros And Cons Of Existing Paper Straw's Environmental Friendliness, Economics, And Functionality; And Proposals Of Improvement

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Summary

Straws are widely used in everyday life for drinks of a variety of kinds: milk, tea, juice, carbonated water, and the burgeoning new kinds of drinks. According to China’ s National Development and Reform Commission, more than 40 billion pieces of straws are produced each year. From a global perspective, the consumption of straws is similarly, if not more, shocking. Americans consume about 500 million straws per day; while in UK 8.5 billion straws are used per year.

Against the big picture of massive straw usage is the fact that most of the straws used are plastic ones. Plastic straws, made of polypropylene, a commonly used polymer. A polymer is a very long chain of molecules all bonded together. The popularity of plastic straws can be well explained by several factors: first, plastic is an easily available material. Polypropylene can be massively produced by today’ s manufacturers, and has become one of the most widely used materials for a variety of everyday commodities including straws, textile, stationery, etc. Second, the economic cost of plastic straws is cheaper than other types of straws. The economic incentive makes it easier for both businesses and customers to accept plastic straws. Third, plastic straws do have some merits that can explain their prevailing popularity - very light; high elasticity; resistance to water and high temperature; a variety of color choices.

However, despite all the merits, the usage of plastic straws can cause counterproductive effects in several ways. First, the increasing usage of plastic straws have proved detrimental to environmental. Plastics made of polypropylene can take over hundreds of years to dissolve in natural environment. Therefore, accumulated abandoned plastic straws become an ongoing threat to natural environment. Second, plastic straws destroy the habitat of animals, and can cause direct or indirect physical harm to animals. The most direct and shocking evidence is that in recent years there are increasing reports of sea turtles whose nostril got stuck with plastic straw. This severely caused injuries to the health of turtles. However, these are not isolated cases. Third, plastic straws also threaten human health because of polypropylene, which can be accumulated in human body and cause harm to important organs such as liver. It is not only polypropylene itself that might harm human body; there could also be other poisonous ingredients in straws.

The rise of concerns of negative impact on environment and human body has already engendered a wide range of actions from government, business, civil

societies, and individual level. To sum up, there have been these measures so fa. On the government level, many countries have made it law to ban plastic straws. On the business level, coffee shops, restaurants, drinks stores, etc. are providing alternatives to plastic straws such as paper straws. On the individual level, customers are becoming aware of the environmental and health issues caused by plastic straws, and become willing to use alternatives.

Among all these measures, paper straws seem to have become the spotlight of discussions. There are views that paper straws can significantly alleviate the environmental and health impact caused by plastic straws. However, there are opposing views that paper straws have their own defects, for instance, easy to bend; lack of resistance to high temperature, etc. Therefore, our team take the action to study paper straws from three main approaches. From the environmental perspective, we want to find out if people are aware of the negative impacts caused by plastic bags. From the economic perspective, we want to investigate whether paper straws cost more for businesses and customers. From consumers' perspective, we aspire to find out existing defects of paper straws.

Our ultimate goal is to design several solutions to help solve the defects of paper straws; boost environmental awareness among consumers; and make proposals to business, government, and individuals about how to use straws in a responsible way. In conducting the research, we implemented these steps:

First, we organized a six-people team, and assigned tasks according to each member' s strength and skillset.

Second, we read existing research about straws extensively, and did literature review.

Third, we designed a survey and spread it nationwide. Based on 182 pieces of survey response, we used both qualitative and quantitative analysis. By qualitative analysis, we assigned a member to go to stores and visit consumers for their opinions on plastic and paper straws. By quantitative analysis, we used statistics to find out people' s awareness of environment, and defects of plastic straws. From the above steps, we identified the root cause of the wide use of plastic straw is people' s lack of environmental awareness; and the root cause of complaints about paper straw is their failing functionality.

Fourth, we designed a new type of paper straw that could avoid the defects of existing paper straws and improved consumer experience, and interviewed people' s opinion; and also designed a campaign poster to increase people's awareness of the environmental effects of straws.

Finally, we made several practicable solutions that can be adopted by government, business, and consumers.

Choose the Topic

Identify the Challenges

1. The commercial consideration of selling and using different types of straws
It is human nature that people want to save money and earn as much profit as possible. For sellers, they desire to generate profits and only a small group of them will care about the environmental impact of their business; for consumers, they desire cheaper products and good user experience. On the biggest shopping website in China, Taobao.com, paper and plastic straws are much cheaper than straws made of Polylactic Acid (PLA), which is degradable, and straws made of glass. From a seller’ s perspective, there is an innate tendency to sell the less expensive straws to increase the sales volume and gain more profits. It is barely impossible for sellers to consider whether it is environmentally friendly or not before they gain enough profits for business growth. As we can see, the companies that use PLA or other environmentally friendly materials, Starbucks and Xi Cha for example, are all big companies that do not have to worry about the increasing cost for straws. From consumers’ perspective, the price of the straw product may increase because of using environmentally friendly materials. If the sellers choose to use the materials that cost more, the price of the product also will increase more in order to gain the money they spend on buying straws. However, not everyone can accept paying more just because it is good for the environment. According to the survey we made, 34.07% of 182 participants are not willing to spend more on drinks just because they use a more environmentally friendly material. As a result, one of the biggest challenges of this project is to find a way that not only has a suitable price but also is an environmentally friendly option.

2. The disadvantage of existing materials
Most straws on the market today are made of plastics, paper and PLA. However, these materials have disadvantages of their own. Plastic takes a long period of time to degrade fully. Usually it takes 200 years above to degrade, some types of plastic can even take 500 years above (The lifecycle of plastics, 2021). . And for paper straws, it influences the drinks’ taste a lot. In the survey we gave out, 91.21% of participants suggest that the it is easy for paper straws to get soft while drinking, 57.14% of them think it is hard for paper straws to thrust the cover of the drink and 49.45% of them believe that paper straws cannot be used for drinks that have a high temperature. While for PLA, as one of the materials people focus most on, also have some disadvantages. As a degradable material, one of the features of it is that it cannot bare high temperature. It would soften around an environment around

60°C. It causes difficulties for not only storing but also drinking drinks in a higher temperature. As a result, it is necessary to find out a new way to solve these pre-existing problems or develop a totally new material that can avoid these disadvantages.

3. People’ s unawareness of the environmental crisis

Nowadays, although media have emphasized the importance of protecting the environment, many people still regard this as ‘none of their business’ . The government has made policies about limiting plastic use and forbidden the use of plastic straws. However, according to the survey we made, there are still 32.42% of the participants store plastic straws at home. Also, although some people are willing to take action to protect the environment, they are lack of relevant knowledge. In our survey, we ask people to answer the question ‘how long do you think the plastic’ s degradation need?’ , and only 30.77% of them know the correct answer, which is 200 years above. There are even 8.24% of the participants think it only takes 20 years below for the plastic to degrade. Public education and outreach are needed in this case to help the public understand the facts. While doing the survey, I asked the participants about whether they prefer plastic straws or paper straws now. Many of them think it does not matter, as long as it does not influence their drinking experiences. However, the recent global movement on Environment, Social and Governance (ESG) and news from environmental and animal protection NGOs have brought the environmental issues to the public and more and more people start to think about our impact to this planet.

4. Economic and business consideration for straw manufactures

Making straws of new materials is a big challenge for factories. The cost is one of the problems. According to the interview to Shuang Tong Company, one of the world-famous straw making company, the cost of normal plastic straw is around 0.01 yuan, while the straws made of paper and PLA is around 0.03-0.04 yuan. Despite the higher cost, the storing condition for PLA is also stricter. The PLA products usually have a shelf life of less than 12 months and will degrade if kept too long, so they must sell it as soon as possible. What’ s more, it is not easy to produce paper straws. Since every consumer has their own needs, the machine needs to be adjusted for every time during production. Even if the it is successfully completed, drying is a problem for many small companies. In a nutshell, manufacturing paper straws increases the burden because of doubled costs, shorter shelf life, and complexities of the manufacturing process.

5. Carbon emission during production

From some perspective, straws made of environmentally friendly materials may not

be as environmentally friendly as we thought. According to EPA, Paper straws emit five times more greenhouse gases (9.35g) than plastic straws (1.7g). Steel straws even produce 48.5g of greenhouse gases during production. What' s more, most recyclers do not accept paper with food residues, so most paper straws would go directly to incinerators instead of recycling sites, which make them burn to produce more greenhouse gases. Also, decomposing the paper straw in the natural environment also has strict condition, such as not coated with fluorescent agent or plastic, not too thick and so on. Only paper straws made of "pure paper" can be decomposed by natural microorganisms within a few weeks (Molinaro). As a result, in order to achieve real 'environmentally friendly', we should focus on not only the material itself, but also the carbon emission behind it.

6. Consumers have got used to the plastic straws

It has been a long time we use plastic straws. Since 1960s, the industrial system for plastic straws was formed, we have been using plastic straws until recent years. Consumers have got used to the plastic straws because it is easy to use and almost no impact to the drink. And suddenly other types of straws break into our lives without giving us time to get used to it. As a result, it is normal for consumers to get dissatisfied of paper straw, an immature product used for transition. As a result, we need to invent a type of material that can replace plastic and let the consumers get used to it.

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Identify a Root Cause

The root cause of people using plastic straws, and the less use of paper straw is functionality - plastic straws are functionally better than paper straws. When you think from a customer’ s perspective, this is self-evident: plastic straw is agile, looks colorful, and resistant to high temperature, and stable in different drinks. By comparison, paper straws can easily bend, not resistant to high temperature, and look less appealing than plastic straws.

To find out people's habbit of and attitude toward using different straws, and awareness of environment, we conducted online surveys, which generated 182 effective responses. According to our survey, There are only 10.99% of the survey respondents are totally satisfied with existing paper straws. And most people point out that paper straws are dysfunctional in these ways：

Often fail to pierce into the plastic lid of bottled drinks (57.14% of total respondents);
Unable to transport hard ingredients such as tapioca to consumer’ s mouth (28.02%);
Have some smell (30.77%);
Easy to soften (91.21%);
Make the drink less tasteful (29.67%);
Not suitable for high temperature drinks (49.45%);
The paper material used for paper straws are harmful to health (19.23%)

Please refer to the attached survey results for more details.

All these complaints highlight the urgency of improving the functionality of paper straws. And people do not need to worry if consumers are willing to use paper straws, our survey shows that 65.39% of people are willing to use paper straws even if this means higher costs of drinks. As such, our team’ s goal is to design a better type of functional paper straw to serve as alternatives to plastic straws and existing paper straws.

survey results

Generate Solutions

Solution 1: make a type of straw which is not easy to deform and can endure high temperature
We plan to improve straws. First and foremost, we plan to purchase different types of straws which are available in the current market, including materials like plastic, paper, glass and silica. Then we place 4-5 bottles of water on the table and put different straws inside them as controlled experiments, and record their performance according to criteria, involving if the straw is softening or not, will the beverage’ s flavor changed, etc. Then we use the data collected from the experiment and make analysis of why specific types of material is durable than others. Hence we combine all advantages to synthesize new material with better performances.

The experiment procedure is as follows:

1. We bought four kinds of straw(plastic straw, paper straw, stainless straw, and silicone straw)
2. We bought many drinks from different brands to compare the level of the soften process.
3. We also use the TDS (total dissolved solids) index to measure the water quality for water before put into the straw.
4. Use two same straws and put one into the water and one in the drinks to determine the soft-resistance of straw in drinks.
5. Use two different straws and put both of them into the water to determine which straw has better ability of soft-resistance in same liquid and which of the straw has less affection to the water quality.
6. Collect the data after thirty minutes.

Note: Below is our explanation of TDS:
TDS stands for Total Dissolved Solids, we have used TDS meters for testing TDS of the solutions after 30 minutes. A TDS meter is a small hand-held device used to indicate the Total Dissolved Solids in a solution, usually water. Since dissolved ionized solids, such as salts and minerals, increase the conductivity of a solution, a TDS meter measures the conductivity of the solution and estimates the TDS from that reading. If the data after using 30 minutes straws increases compared to TDS figure before putting the straws in, then it indicates that there are dissolved solids from the straws which may affect human health system.

TDS rate:
0~9 is pure water; 10~60 is mineral water; 60~100 is purified water; 100~300 is tap water; > 300 is polluted water.

The summary of the test results was shown in the table attached. Photos of experiments are also attached.

From the test result above, a few findings were observed. First, the paper and silica sample straw have a smell. Customers tend to prefer a straw product without a smell. Second, straw sample weight changes before and after use was observed for paper and plastic material, for plastic material, the weight increase was probably the strawberry shake residual inside the straw. For paper straws, the weight gain is because the paper material absorbs the drink. Third, Total dissolved solids (TDS) reading increases were observed for paper straw. The paper straw got soft after 30 mins use, and there are particles from the paper straw released into the drink, causing the TDS to be increased.

Solution 2：Promote the subsidization of paper straw manufacturers and the establishment of quality standards for paper straw. The reason for this solution is that there’ s almost no mandatory standard of the quality of paper straws. In order to solve this issue, firstly we plan to make an inquiry about the issue of paper straw by interviewing straw factories in the city in order to know their lines of production and their perspective of paper straws. And then we plan to write email to the government to promote the establishment of policies based on our data.

Solution 3：Use social media (Tik Tok, Bilibili,Kwai - young audiences); (Wechat moments videos , newspaper ---- all audiences) to seek social expectations and requirements for paper straws. We plan to make several questionnaires for people to answer, both online and offline. Such questionnaires include the expectations of paper straws and current utilization of straws and reviews. When the result is available, we plan to analyze them carefully and make elaborated plans for the next step, such as focusing on particular functions of straws.

Solution 4: Establish a bonus point mechanism to reward businesses such as for every 10,000 paper straws consumed by businesses, the government will reward 100 yuan. We plan to get to know the cost of paper straws with high quality by searching for information on the Internet and make comparisons. Then we calculate the amount of the money that will endow the mechanism with great efficacy, thus the mechanism will be accurate. Then we plan to write to the government in order to promote the establishment of policies based on our mechanism.

Solution 5: “Bring your own reusable water bottle and straw” or drinking cup with

easy to drink opening without using a straw
Similar to the ban on plastic shopping bag, customers are encouraged to bring their own shopping bag to the market, otherwise, they need to pay an extra cost for the shopping bag. We can encourage the customer to bring their own water bottle and reusable straw. The shop can provide incentive for the customer who bring their own bottle and straw. Alternatively, without using a straw, the store can provide customer the cup with easy to drink opening on the cup lid.

Experiments of different straws and photos

Identify the Criteria

Customer experience:
Paper straw has many disadvantages. Sometimes it softens too fast when drinking hot drinks. Sometimes drinking a drink with large particles, the straw will get stuck or break. People are also worried about drinking straw fragments when drinking. Therefore, we intend to measure whether the improvement of paper straw through the solution can meet the good experience of customers.

Sustainability:
Sustainability is that to figure out whether the results of improvement measures can be used for future development. For example, is it good for the environment? In the production process of traditional paper straw, a large amount of pulp will be used. These pulps need a lot of trees, and a lot of wastewaters will be produced in the process of production. In addition, for businesses and customers, are they willing to consume improved paper straws in the future? Therefore, we intend to look to the future of improved paper straw.

Economic benefits:
The cost of paper straws is usually high. In order to make up for the high price of paper straw, merchants usually raise the price level of goods. As a result, it also leads to customers' reluctance to consume paper straws. Therefore, we intend to consider whether the economic impact of this improvement is beneficial to socio-economic development.

Health care:
Part of the pulp used in the traditional paper straw is recycled waste. In addition, the content of potassium permanganate in some paper straws exceeds the standard, which will affect metabolism. People are worried about the health of the materials used to produce paper straws. At the same time, the fragments generated during the use of the paper straw may be swallowed into the stomach. Therefore, we should measure whether this improvement brings security risks.

Feasibility:
Feasibility is the difficulty of completing this change. Does this change require a lot of money and government coercive measures? For the public, people need a change with less energy and cost. Therefore, we should evaluate whether this improvement makes it easy for people to implement and regulate.

Effectiveness:
Can this improvement effectively improve the paper straw? Does the benefit outweigh the disadvantage? Is it good for the environment? Will people choose paper straw? Therefore, we need to evaluate whether the impact of improving policies can effectively solve current problems, such as environmental problems.

Evaluate the Solutions

evaluate solutions

Make an Action Plan

Based on the solution and evaluation criteria we designed earlier, combined with the root causes analyzed above, we developed an Action plan. According to the stakeholders involved in the paper straws, this action plan is divided into three parts, which are paper straw manufacturers, the customers who buy the paper straws in bulk (that is, various milk tea shops and restaurants), and the users of the paper straws.

1.1 Factories that only produce paper straws
For factories that only produce paper straws, government can provide certain support. For example, the government can award such factories a "most environmentally friendly factory" award or give these factories some financial or policy supports. These supports will encourage other straw manufacturers to increase the proportion of paper straws produced and to reduce the production of other materials straws. Furthermore it also help government to emphasize the importance of environmental protection.

As for us, we can interview the product designers of these factories to learn about the points in the design and production of paper straws. At the same time, we can provide them with people’ s opinions on the production of paper straws that we collected in the questionnaire. In addition, we can consult them about our new paper straws designed by ourselves, and improve our paper straws with their help. After the improvement, we can cooperate with the factory to produce the paper straws we designed and try to sell them. During the pilot sale, we will collect opinions on the improvement of paper straws and improve our paper straws based on the it. We hope that the factory can accept the new paper straws designed by us after the improvement and put it into production.

1.2 Factories that produce straws made of different materials including paper straws
For these factories, the government can carry out propaganda. The propaganda can compare paper straws with straws made of other materials to highlight the advantages of paper straws in terms of environmental friendliness, so as to encourage these factories to reduce the production ratio of other materials, especially plastic straws. The government's goal for these factories is to change these factories from producing straws made of various materials in different proportions to a production principle that mainly produces paper straws.

At the same time, we can collect people's opinions on straws made of different

materials and provide statistical data to factories that produce straws made of different materials and encourage them to adjust the production ratio of straws made of different materials based on the statistical results.

1.3 Factories that mainly produce plastic straws
For these factories, we should promote the advantages of paper straw production, expressing the hope that they can produce paper straws and reduce the production of plastic straws. We can also recommend our own paper straws to them.

In addition, we can organize an online seminar, inviting the Environmental Protection Association, factories that mainly produce plastic straws and factories that mainly produce paper straws. In the seminar, the Environmental Protection Association can interpret plastic straws and plastic straws based on professional knowledge. Factory that mainly produce paper straws can list the reasons why they decided to mainly produce paper straws instead of other straws. We can also introduce the paper straws we designed in the seminar and ask them for suggestions for improvement. Through this seminar, we hope to encourage factories that mainly produce plastic straws to try to turn their main products into paper straws and collect suggestions for improving the paper straws we designed.

1.4 Establish production standards for paper straws and conduct quality inspections on the paper straws production
In order to carry out quality inspections fairly and smoothly, the government should first conduct relevant investigations, and then experts can formulate production standards for the production of paper straws. The production standards should be combined with the feedback from the public and the food safety standards established by the Food Safety Supervision Bureau. The formulation of production standards is a key step in the production and popularization of paper straws. After the production standards are established, the government can give manufacturers one to three months to adjust their production process, and let each manufacturer conduct self-assessment and technical improvement. After three months, the government can conduct a census to check the production of paper straws. The government can also hold a quality evaluation competition for paper straw production, awarding medals and a certain amount of bonuses to the factories that perform well, or commission factories with environmentally friendly production and high quality as partners of an event. At the same time, corresponding warnings are issued for factories that fail to meet the production process or quality standards. After the warning, the factory will be given three months to make corrections. Then, if the factory's production process or quality still can’ t meet the standards at the second investigation, the factory's operating and producting franchise will be withdrawn. Through strict government control, the production of paper straws will reach a new milestone.

2.1 Shops that only provide plastic straws

The government can promote the sense of "no straws without inquiry" to these stores, that is, the staff will not provide customers with straws if they don’ t ask for it. At the same time, we can call on these stores to carry out the "less straws" activity, that is, whenever a customer consumes a commodity that requires straws, if they choose not to use a straw, they will receive credits which can be redeemed for prizes. We can advertise the advantages of paper straws to these stores, express the hope that they can use paper straws instead of plastic straws, and at the same time, recommend the new straws we designed to them.

2.2 Stores provided paper straws and plastic straws

For stores provide both paper straws and plastic straws, we can hold an event for them: when people buy products that require straws, if customers choose to use paper straws instead of plastic straws, they will get corresponding credits, and when the credits reach a certain amount, they can redeem prizes. We can post publicity about this event in the store.

3.1 Students

We can promote the notion of " less straws" in classes. Simultaneously, we can encourage communities and recruit volunteers to make relevant publicity and post it on WeChat. The publicity can highlight the environmental impact of straws made of different materials, and highlight the advantages of paper straws through comparison.

3.2 Citizenry

We can promote the notion of "less straws" on WeChat and hold offline seminars to discuss their opinions about straws with people of different ages and backgrounds. Furthermore lectures and videos introducing the experience of disposable straws from production to the final degradation are also effective publicities.

3.3 Information collection

We can set up a website to collect feedback from consumers of paper straws, then promote this website in public and various stores that provide straws. People can write their suggestions for improvement of paper straws on the website. The collected improvement suggestions can be provided to the paper straw manufacturer after screening.

Prototype and Test

Prototype Design

New straw design principle The New straw we have designed is a mix of PLA+PBS, softwood and hardwood pulps and edible starch. By considering the environmental friendly bases and the functions, Only use one material for the whole straw cannot meet the expectation of consumers for the straw. As a result, our group devised a substitution for the straw currently in use on the market. Edible starch is used in the top of the straw, by considering some customers like to bite straws, the top has been designed into edible. Using the principle of starch gelatinization, heating, cooling and drying after burn-in, starch can be made into smooth straw. With a film of edible gelatin outside the starch part, the shape of the straw can lasts longer. In addition, a gummy candy can be added to provide a better flavor, this is the second option. PLA+PBS is used in the elastic part in the middle, which can provide angular form of the straw and is easier for customers to drink. The softwood and hardwood pulps are used at the bottom of the straw, which is the paper straw. Applying heat-resistant adhesive rather than the normal adhesive can make the straw suitable for the hot drink.

Propaganda Poster Design principle
The Poster depicts the advantages of the new straw and shows the approach and the purpose of our design of the product.

Advocating Poster Design principle
This poster is for café or other merchants for drinking selling. The poster depicts the negative effects of excessive usage of The advocating poster has the function to encouraging customers not to use straws unless the drinks they ordered need straws.

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new paper straw design
Comparing Advantages and Cost of straws
poster

Feedbacks learnt from users

We demonstrated our solutions to a variety of people, and find out interesting phenomena.
For business, they appreciate our action plan that calls for government bonus of selling drinks with paper straws. According to some drinks store owners, “I’m actually aware of environmental issues. I do care about environment, but my business has to survive.” Therefore, they are willing to cooperate with the ban of plastic straws and the introduction of paper straws, but government needs to give some economic incentives to businesses, especially small businesses which have a narrow profit margin.

For consumers, we collected mixed feedback. Team member Lilian interviewed 5 people in Suzhou for people's feedback; and designer Kelly asked for feedback in Shanghai. In general, they are most interested in our design of the new kind of paper straw. Most people haven’t thought that part of the paper straw could be edible. They are willing to use paper straws if they are functional, and avoid the defects of existing straws as much as possible. However, feedback is mixed between different age groups. People over 50s are generally aloof to our new kind of paper straw; while people aged between 15-40 are highly appreciative of the new design. It suggests that among the younger population, environmental awareness is comparative higher than that among the elder population. Our action plan that calls people to store paper, glass, and metal straws at home is also welcome. Many consumers comment that “we haven’t thought of this idea before.” However, there are concerns that since straws are tiny and sharp objects, therefore, it may pose threats to small children.

Improvement for next iteration

Feedback 1: a small bubble tea store told us that they need to put economic costs into first consideration. Therefore, in our implementation of the solutions we proposed, we need to urge the government to subsidize small stores who sell non-plastic straws. In addition, we need to figure out a way to lower the cost of our new kind of paper straw.

Feedback 2: At a big chain coffee chain store, the staff are interested in our new design of paper straws, but they raised another concern: since our paper straw has edible parts, therefore, these straws have shorter life cycle than traditional paper straws. This is something we fail to take into full consideration. Therefore, in our future action, we will figure out a way to make sure the new paper straw can have a longer shelter life. Also, the staff suggested that their company needs to give more education on social responsibilities so that a culture of environmental protection could be shown throughout their products and services.

Feedback 3: Our team member Lilian went to a drinks store, and interviewed 5 people in total. They appreciate our new design, and indicated that they are evening willing to become volunteers of our project. Therefore, in our future action plan, we believe it is significant to involve environmentally-minded volunteers to help promote our solution plans.

Feedback 4: We also interviewed Mr. Wang, who studied materials science in National Tsing Hua University, who put forward thoughtful ideas:

1. The straw is divided into three parts: upper, middle and lower. How are the three components bonded together? Is there an automatic machine that can automatically glue and assemble these 3 parts on the market?
2. The straw is covered with edible gummy. The gelatin is easy to absorb moisture.
3. Adding gummy to the straw for flavor has low security rate. How can you avoid the risk of a child swallowing a fudge and choking to death? There are related cases abroad.

In our future action, we will take all those questions into consideration for improvement of our newly designed paper straws.

Team Credits

常清闲 Lilian： participated in survey design and circling the survey; wrote the identify the challenges part; interviewed 5 consumers at a drinks store
王子航Peter: participated in survey design and circling the survey; wrote the generate solutions part
肖荣Tobi: participated in survey design and circling the survey; conducted experiments on paper straws; and will make a campaign video of our project; wrote the identify the criteria part
侯柯瑞Nemo：participated in survey design and circling the survey; conducted experiments on plastic straws; wrote the evaluation of the solutions part
邱子萱：participated in survey design and circling the survey; conducted experiments on paper straws; conducted experiments on sillica straws; wrote the action plan part
余卿仪Kelly：participated in survey design and circling the survey; conducted experiments on glass straws; designed the new kind of paper straw and collected consumer feedbacks and wrote the improvement plan part.

Lilian interviewed consumers

Onsite Conference File

Judge Comments

" Plastics and how we manage them are an ever-growing problem that needs meaningful solutions to happen quickly, in order for us to be able to protect the environment (including landfills and marine ecosystems) from being harmed. I congratulate the team for taking on this complex issue and for developing your understanding of the topic in a structured manner. I particularly appreciate the effort to build in qualitative and quantitative analysis methods during your data collection, and the depth of work that went into thinking through possible design ideas and in obtaining iterative feedback to help improve the work. Also, great job with the background research, including in identifying carbon emissions in production. As you further your understanding of the issue, it would be helpful to think about use when discussing carbon emissions. (How many times on average would a steel straw be used before being discarded vs single-use items such as plastic straws). Great job also on the hands on testing of various products and their physical characteristics.

A quick note on solution 4 in particular – there are usually many disincentives to rewarding companies to give out more paper straws. Consider how you can reward them to replace plastic with paper, and also reduce straws being give out altogether. There are interesting models that would allow you to accomplish that.

I would like to point out that the assessment that larger companies like Starbuck etc do not worry about the price of straws is not fully accurate – I' d argue that they value it, but assign a larger value to sustainability and brand reputation.

Congrats to the team in exploring a complex problem from start to finish – even if the solution you identified was found to have additional limitations, the scientific process you pursued is commendable and I wish your team the best in continuing this line of enquiry.

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