An Investigation Into the Makeup of a Successful Mugshare Program: Materials, Tracking, and Organization

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Submitted by:
Albert Ruskey
Shaista Meghji
Evelyn Zhang
Tao Li

Faculty of Applied Science
University of British Columbia

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Abstract

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By Albert Ruskey, Shaista Meghji, Evelyn Zhang, Tao Li

This investigation explores the UBC Mugshare program and strategies required to execute a successful program. Three primary issues were focused upon: the most sustainable material, what made other mugshare programs successful, and how can the mugs be properly accounted for.

A triple bottom line analysis of potential mug materials shows that although plastic is more cost efficient than stainless steel, it has a higher energy footprint, and a number of health concerns attached to it. Accounting for the mug usage requires the ability to track mugs and participants. Digital identification accomplishes this cleanly, the increased data capacity of QR codes or the portability of RFID is unnecessary for this application and a simple barcode can easily accomplish the task. From other mugshare programs it is clear that the two biggest barriers to participation are cost and awareness. The majority of survey respondents indicate that they are unaware these programs exist and how they operate. Additionally, those that were aware tended to shy away from participation if the cost to join is above $5.

Based on these findings, it is recommended that the UBC mugshare program proceed with the stainless steel mugs it is currently using. As the program grows and pen and paper accounting becomes infeasible a barcode tracking system should be implemented until such a time that mugshare can link with the UBC card. Finally, two recommendations for implementation are to keep the signup fee close to $5 and to dedicate resources to building awareness of the program.

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Glossary

Barcode	Digital encoding of data comprising of ordered spaces and bars
BPA	A chemical byproduct of plastic, potentially harmful to humans
Ceramic	Material made of clay, and fired to a high temperature until hardened
Joule	Unit of energy equivalent to work done by a unit force through a unit distance
Mugshare	Sustainability program that promotes the use of reusable mugs for purchase of coffee/tea
Plastic	Material produced from organic polymers
QR Code	2-Dimensional digital encoding of data
RFID	Wireless identification and tracking technology
Stainless steel	Steel alloy containing chromium, and sometimes nickel or molybdenum

List of Abbreviations

BPA -	Bisphenol A
GPS -	Global Positioning System
KJ -	Kilojoule
QR -	Quick Response Code
RFID -	Radio Frequency Identification Device
TBL -	Triple Bottom Line
UBC -	University of British Columbia
UNBC -	University Northern British Columbia

1.0 INTRODUCTION

Every year Canadian university campuses produce in excess of 1.6 Billion disposable paper cups (Macpherson, 2011) from the sale of coffee and tea. Mugshare programs are a designed to reduce this waste by introducing reusable mugs from which students can purchase their beverages. The basic operation of the program involves students paying a small sign-up fee to join the program; this fee helps to offset the material cost of the mugs. Members can then purchase coffee/tea for a small discount at any participating location; they must then return the mug to any participating location before they can receive a new one. The University of British Columbia (UBC) recently implemented their own mugshare program. However, the program in its initial stages still required further investigation into what material to use, how to account for the mugs in use, and how to best to manage participation in the program.

This investigation answers these questions by looking at mugshare programs that have been successful previously, what technology is available to keep an accounting of mugs, and finally by performing a triple bottom line (TBL) analysis of the potential mug materials. Previous mugshare programs are assessed based on participation, costs, and reception. The technology for keeping track of in-use mugs was considered based on viability of implementation. Results from the TBL analysis provide the break-even points for each potential material with relation to both the economic cost and energy consumption. Finally, a survey of UBC students was used as a primary source to determine what the target customer base would like to see in a mugshare program.

The information from the investigation concludes with a series of recommendations to the UBC mugshare program in order to maximize their participation, success, and positive impact on the environment.

2.0 INVESTIGATION

2.1 FACTORS INVOLVED IN SUCCESSFUL MUGSHARE PROGRAMS

In order to find the best way to operate the program, we investigated other successful programs; these included the Pilot To-Go Cup sharing program, Borrow-A-Mug program in the University of Northern British Columbia, and also the mugshare investigations by previous APSC 262 students at UBC. Drawing from the successful aspects of these programs we were able to come up with a number of recommendations.

One of the primary challenges we encountered was with advertising and visibility. In the survey we conducted of UBC class of 2018/2019 students, some students said that this was the first time they had heard of this kind of program. The program at UNBC had a similar problem. As a novel solution to encourage participation and increase visibility, they allowed participants to make their own designs and decorations on the mugs. The co-creator said the future goal of the program is to find a way to increase their mugs visibility and usability, as well as increase the capacity.

Another challenging problem is how to manage the participation in the program. Pilot To-Go Cup had an effective system for managing their customers. Users buy the $5 cup with a free coffee, which they later return to the cafe or other drop-off locations, while keeping the lid in order to verify their participation. Cups are thoroughly washed and returned to circulation, with patrons currently getting a discount on Good to Go cup drinks. However, the shortcoming of their program is that they cannot track and account for their cups. For this reason they have chosen the relatively cheaper plastic cup, which is not the most preferable and sustainable material to use.

Based on the survey carried out at Dalhousie University on the mug share program, we learn that the largest factor discouraging participation in the program is students' concern for cleanliness of the mug (Guo, Irich, Poirier-McKiggan, Stafford,

2015). In order to avoid the possibility of a similar situation at UBC, it would be preferable that the mugshare program be transparent, that is, information should be made available to students regarding the type of cup being used, steps taken to ensure cleanliness of the mug, and also why they should be a part of the program. The information could be publicized through means of a website, where students and staff who are interested can easily get access.

2.2 TRACKING AND ACCOUNTING OF IN USE MUGS

A primary concern when implementing a mugshare program is the accounting for each mug. There is no quicker way to eliminate all economic and environmental benefit of a mugshare program than by having people walk off with mugs without returning them, thus leaving you with disposable stainless steel mugs. At a minimum it is necessary to keep a record of what members of the program are currently in possession of a mug. At the inception of the program, it is being simply tracked via pen and paper and manually uploaded to a database in order to keep track between mugshare campus locations. However, as the program expands it will become necessary to automate this process. Three options were considered as options for this type of automation.

First, integration with the UBC card was considered. The UBC card is already integrated with a number of food services around campus and from a technological standpoint would require little to have mugshare functionality added. However, the program would have to prove that it is something the student population desires through widespread adoption before integration with the UBC card would be cleared. As a result, the client has initially dismissed use of the UBC card.

Barcodes, QR codes, and RFID technology are a potential low overhead solution for keeping an accounting of mugs. Each of these technologies provides type of digital identification, acting as a way to identify cups and provide a simple method of scanning for participants to check a mug in and out. A comparison of the 3 different technologies is provided in the table below.

Table I: Comparison of Digital Identification Technology

Barcode	**QR Code**	**RFID**
-Cost: $0.91 each for barcode stickers (Uline, n.d) -Requires barcode scanner -Maximum 20 characters storage (qrcode, n.d) -Established technology with free database software (softonic, n.d)	-Cost: $0.91 each for barcode stickers (Uline, n.d) -Can be scanned via Phone -Maximum 7089 characters storage (qrcode, n.d)	-Cost: $0.50 per unit (eachbuyer, n.d) -Wireless Range 8-20cm(rfidjournal, n.d)

Finally a more involved approach that was looked at is GPS tracking. GPS chips are increasingly cost effective with companies offering chips along with tracking software for as little as $15 per chip (TheTrackR, n.d). Additionally, GPS would allow mugshare to know where each mug is at all times, which potentially solves the issue of "lost mugs". However, this raises privacy concerns, as GPS would effectively be tracking mugshare participant's locations at all times. Additionally, the $15 price tag would more than double the mug cost.

In addition to accounting for the mugs whereabouts a concern of the program is the safe return of the mugs from each participant. UBC students can be denied their diploma until their financial accounts are settled with UBC (UBC graduation, n.d), if the program is linked to the UBC card this could potentially be used to promote return or payment for mugs at the end of a school term. However, without a link to the official UBC account this is not a viable method.

Presently the lowest overhead option would appear to be a simple barcode system. Using a simple plastic membership card, cost $0.15(morningprint, n.d), and basic database software it would be simple to scan a user's card and then scan a new mug out to them.

3.0 TRIPLE BOTTOM LINE ANALYSIS

The triple bottom line (TBL) analysis is a comparison of the costs associated with the implementation of different materials. These costs cover the economic, environmental, and social factors. The materials we have looked at are: stainless steel, reusable plastic, and ceramic.

3.1 ECONOMIC

Initially, it seems as though purchasing paper cups is the cheapest option as they have the smallest cost compared to the other materials. However, in the long run reusable cups are cheaper as it saves on transportation costs and waste management.

Currently, the UBC mug share program is implementing stainless steel travel mugs as their main material. From various literature reviews and through the use of surveys we find that stainless steel is the most popular choice among respondents (Survey, 2016). Stainless steel mugs are the most expensive mugs costing about 15.50 Canadian dollars per 16 oz mug (Aliexpress, n.d). However, they do make up for the high cost by being strong and durable; they last about 3000 uses (Correa, 2015).

Plastic mugs are a possible alternative to stainless steel mugs though they are the least popular choice among respondents from our survey. A 12 oz cup with a silicone sleeve costs about 7.90 Canadian dollars (Aliexpress, n.d). Although plastic travel mugs are cheaper than stainless steel, they do not last as long. Their lifetime spans between 500-1000 uses (Refiller, 2013).

Ceramic mugs being the second most popular choice among respondents, and with the same lifespan as plastic would be the best alternative to stainless steel mugs currently being used. This is because they cost the least in terms of monetary value, with a 12oz mug and a silicone lid costing about 5.35 Canadian dollars (Aliexpress, n.d).

However, based on respondent preference and taking into account the lifetime of each material, it seems as though stainless steel is the best material from an economic point of view as it makes up for its costs with durability.

Table II: Economic Factors of each material summarized

Material	**Price for each cup**	**Lifespan**	**Break even point**
Disposable cups + lid (12 oz)	$ 0.15	1 use	-
Reusable plastic cups with silicone sleeves (12 oz)	$ 7.90	500-1000 uses	52 times
Ceramic mugs with silicone cover (12 oz)	$ 5.35	500-1000 uses	36 times
Stainless steel travel mug with handle (16 oz)	$ 15.50	~3000 uses	103 times

3.2 ENVIRONMENTAL

Based on a study from 2009, the energy required to wash a cup in a common household dishwasher is 88.5 KJ/cup (Ziada, 2009). Using this value together with the equation to measure the break-even point, we calculated the break-even value for each material relative to a paper cup.

$$\text{Break even point} = \frac{\text{Energy required in manufacturing the reusable cup}}{\text{(Energy required manufacturing a paper cup} - \text{Energy of washing the cup)}}$$

Table III: Break-even point calculated using Hocking's method and values, together with the values from Ziada's study in 2009 (Hocking, 1994; LOCOG guidelines, 2012; Ziada, 2009)

Material	**Energy required in manufacturing**	**CO_2 emission/ kg of production**	**Break even point**
PE coated paper cup with sleeve	902 KJ/cup	1.55	-
Reusable plastic	6,230 KJ/cup	3.09	8 uses
Ceramic	14,088 KJ/cup	0.69	17 uses
Stainless steel	~19,500 KJ/cup	6.44 kg	24 uses

Based on the break-even value, reusable plastic is the most favourable in terms of energy consumption as it requires the least amount of energy in manufacturing and breaks even with paper cups after 8 uses. Therefore, after the 8th use, reusable plastic is better than paper cups. On the other hand, stainless steel is the least favourable as it requires the largest amount of energy in manufacturing and breaks even with paper after 24 uses.

However, based on carbon dioxide emissions, ceramic is the most favourable as it produces the least, about 0.69 kg per kg of production (LOCOG guidelines, 2012). Ceramic has the smallest carbon footprint, while stainless steel has the largest, producing about 6.44 kg per kg of production (LOCOG guidelines, 2012).

Based on the environmental factors, stainless steel although a better material than paper cups may not be the best option, as it requires a large amount of energy in manufacturing, has the largest break-even point, and a big carbon footprint. Ceramic and reusable plastic are both acceptable alternatives to stainless steel.

3.3 SOCIAL

Social considerations of mug share program and four potential coffee mugs include the impacts of program on society, customer benefits and drawbacks, and potential health issues. The overall purpose of the mug share program and our report is to reduce the waste due to disposal of these paper coffee cups and the plastic lids, promoting and supporting sustainability on campus. From this aspect, mug share

program creates plenty of job opportunities for university students, which benefits student community. Before starting this program, organizers need to communicate actively with clients, sponsors, manufacturer and responsible university department about the whole picture of mug share in order to ensure a success beginning. To get more help with running this program and involve more participants, advertisement around campus is necessary. As the mug share program keeps running, more people will be hiring to make the program operate normally. The division of work includes keeping in touch with clients, recording customers' information, collecting returned coffee mugs, cleaning returned mugs, and recording suggestions and feedbacks from users. Both the job requirements and advertisements promote sustainable behaviour within students' community.

According to our survey about the preference of coffee mug materials, stainless steel mugs are the most popular choice. High popularity of stainless steel mugs is due to their ease of cleaning, functionality and robustness. These characteristics of stainless steel mugs help safeguard people's health and make their life easier. Stainless mugs are capable of being used for a very long time because they are highly resistant to breaking. Since they are dishwasher safe, this feature is attractive to customers more as well as being potentially energy saving. It is proven that dishwashers are a more energy efficient and sanitary method of washing than any hand washing. According to University of Bonn, Germany, a typical dishwasher uses half the energy, less soap and only one-sixth of the water compare to hand washing. Using a dishwasher for mugs also reduce the possibility of remaining bacteria and virus on the mugs. "Stainless steel largely prevents the formation for any nutritive medium upon which bacteria can grow." (Euro Inox, July 2006). Stainless steel mugs usually are double walled with an insulated lid to keep drinks at perfect temperature in winter and to prevent potential leakage. However, the metals in stainless steel, like iron, nickel and chromium, can affect human health so stainless steel mugs cannot store highly acidic liquid.

For plastic and ceramic coffee mugs, they usually have various attractive designs and appearance appealing to many customers. Customer benefits include the light-weighted, insulation and ergonomic features. Plastic mugs are of great convenience because they are extraordinarily cheap and release customers' burden of

carrying a mug all day and washing it everyday. However, compared with stainless steel, plastic coffee mugs have drawback that cannot be ignored, which is the potential toxicity of plastic containers. Bisphenol A (BPA) is used extensively in the production of consumer products such as polycarbonate plastics, food cans, and plastic packaging. There is great concern regarding the possible harmful effects from exposures that result from BPA leaching into foods and beverages from packaging or storage containers. Research showed that 93% of the US population was under BPA exposure (Belcher, Cooper, Kendig, 2011). Animal studies demonstrated negative effects on the reproductive function in high enough doses. One of the results discovered was that higher temperatures increase the BPA migration from containers made of polycarbonate (Belcher, Cooper, Kendig, 2011). Therefore, BPA liberation into the coffee would be greater than experimental data because coffee is hotter than room temperature. Hence, plastic coffee mugs might not be a desirable material for the mug share program.

4.0 CONCLUSION

As the mug share program is in its initial stages, this report analyzes successful mug share programs of other universities, investigates technology for tracking and accounting mugs, and examines three different potential mug materials using a triple bottom line analysis. Previous mugshare program mainly reveals two challenging problems, low participation due to the lack of advertisement and no guarantee of returning mugs.

To prevent people from walking off with mugs and never returning them, some technology could be integrated in the future. Linking registration of the mug program to the UBC card is a relatively promising option since UBC card has already successfully integrated with several student services around campus. However, since mugshare requires more widespread adoption before it can be linked to the UBC card the use of a barcode scanning system is recommended. Barcodes are low cost, and a well-established technology that would require little overhead to implement.

By triple bottom line analysis, stainless steel coffee mugs are made of 100% recyclable natural materials and are the most durable. However, the CO2 emissions and energy consumption of stainless steel production are the highest among other materials. Ceramic as mug material has relatively high-energy consumption regarding the life cycle of ceramic mugs, so they result in more environmental and economic damages. Plastic mugs are not recommended due to the BPA migration from plastic making process. The toxicity of BPA is dangerous for human health especially at high temperature (for hot beverages). At this time stainless steel has the greatest combination of desirable traits although it is not a perfect solution.

As an emerging program at UBC, the Mugshare program needs the help of funding, volunteers, as well as participants to promote this program. Additionally, if we want to expand this project into society, we should also improve the tracking and managing system to assure the cups are being returned. Further investigation and innovation are needed on new material because we cannot say stainless steel is perfect, especially with the high raw cost in production.

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