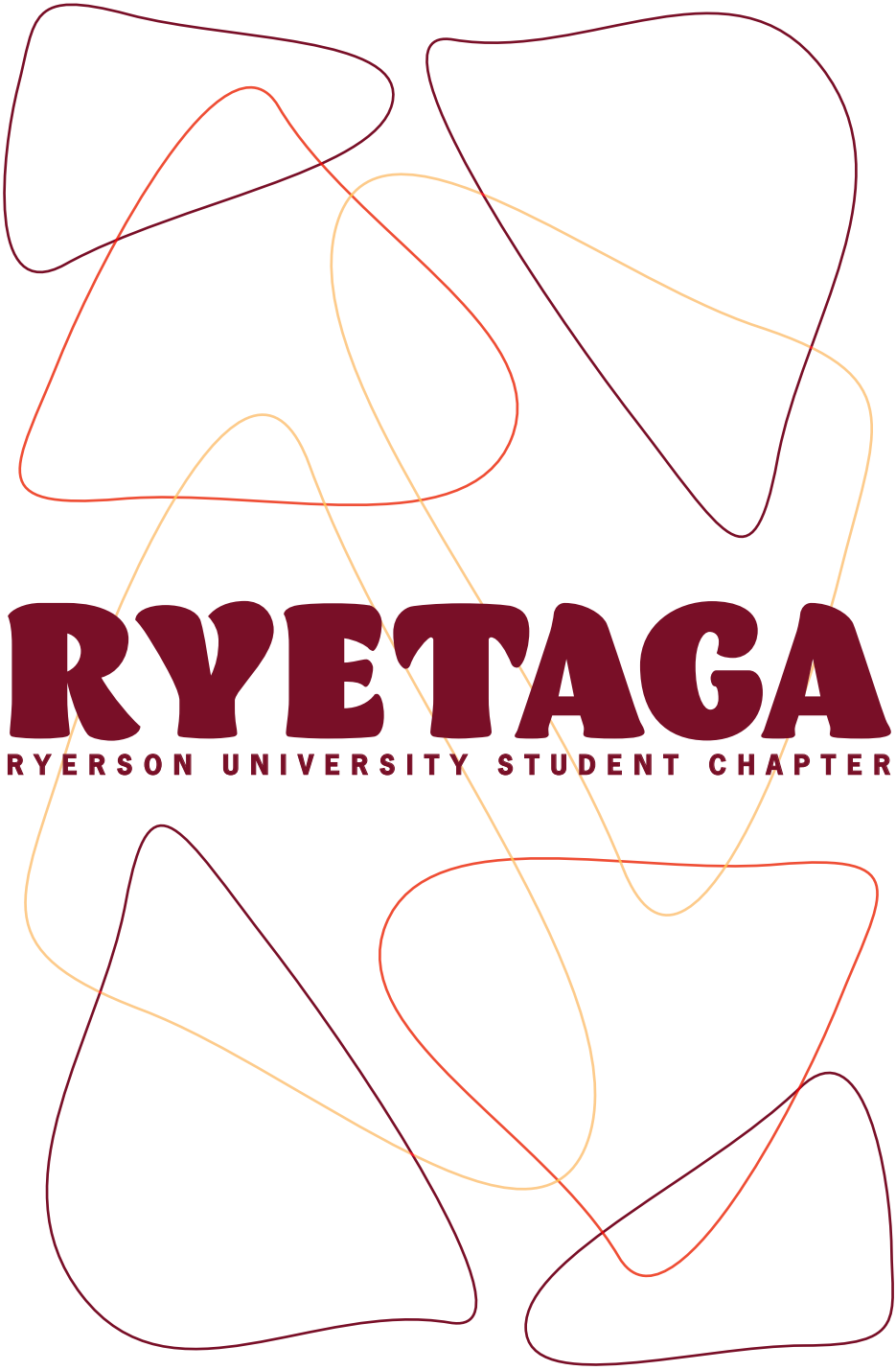
RYETAGA
RYERSON UNIVERSITY STUDENT CHAPTER

RYETAGA

Technical Association of the Graphic Arts
Ryerson University Student Chapter © 2020

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“bringing the old anew”

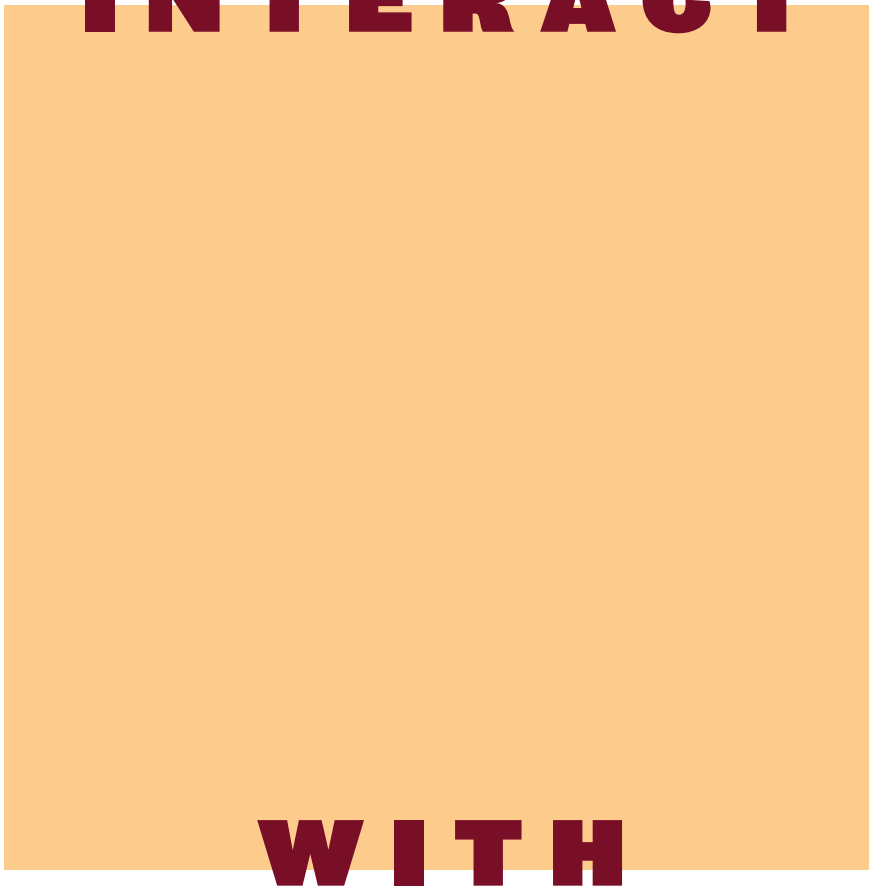
OUR

INSPIRATION

For the 2020 RyeTAGA journal, our creative vision was to simply "bring the old anew". We have pulled from the "Mad Men" era and incorporated an abstract approach to showcase the juxtaposition between modern and vintage graphic styles that create a contemporary and timeless design. Rather than recreating the past, we have interpreted it in the present. It is the essence of the sixties and seventies with the technology we have today.

After completing research, we discovered that in the past, innovation in the printing industry was shown through design and layout. Today, innovativation comes from a combination of the production processes and the new technology used. We will use these contrasting principles to create something that will be unique and dynamic with plenty of depth beyond the surface of the page.

INTERACT



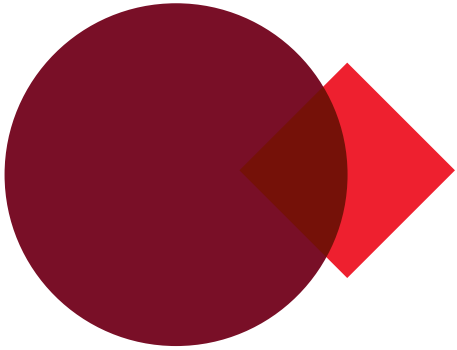
WITH RYETAGA

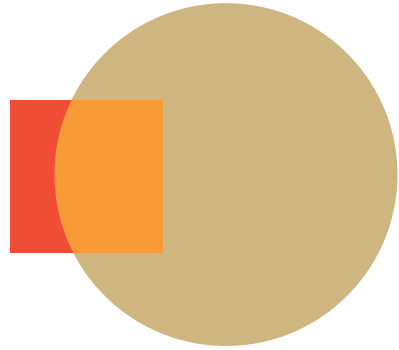
Thanks to the Creative Technology Lab at Ryerson University, our multimedia team was given the opportunity to experience new and emerging technologies.

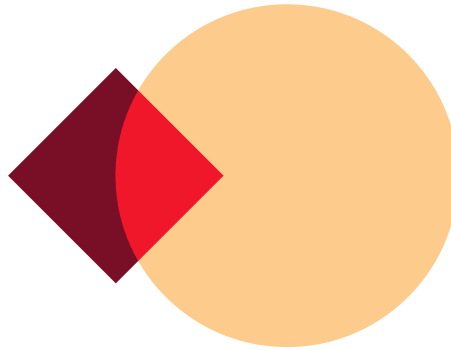
Scan the code below to access the custom webpage built for the 2019/20 RyeTAGA Student Chapter and explore:

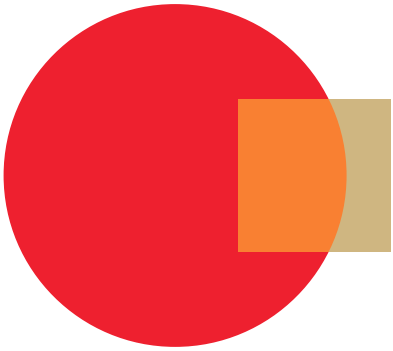
360 Degree Video
3D Object Scans
Report Abstracts
Book Production Montage
Accessible Interactive PDF

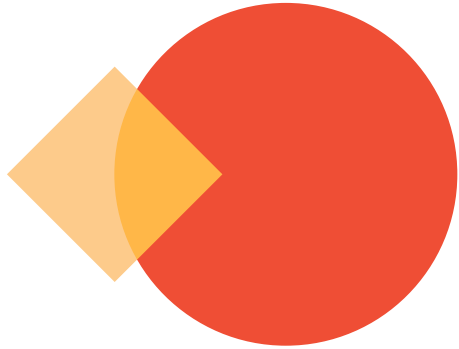
table of contents

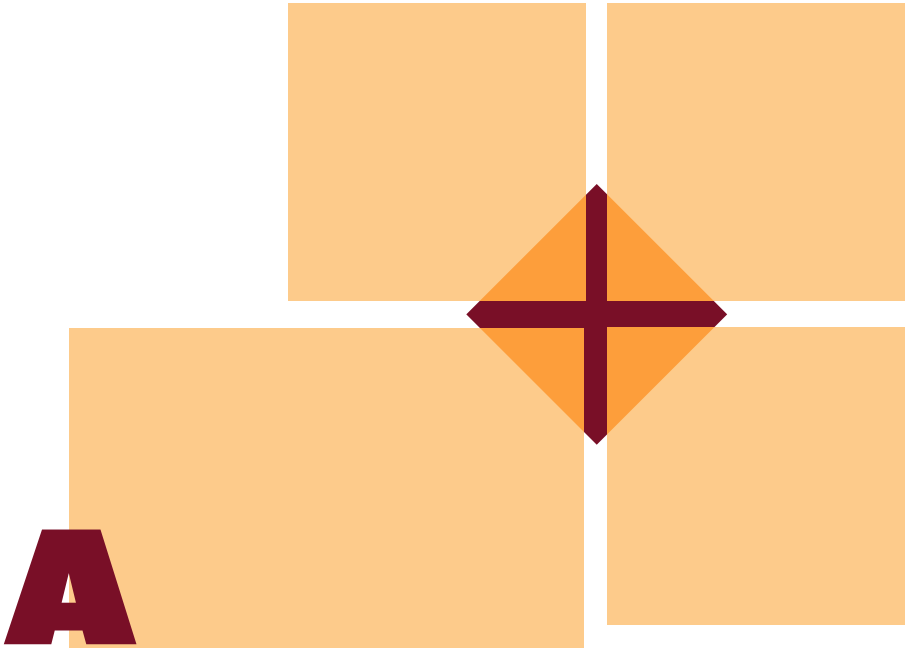












A LETTER FROM...

OUR FACULTY ADVISOR

MARTIN HABEKOST

Dear RyeTAGA student chapter,

I can't believe it is that time of the year again when the RyeTAGA journal is close to being produced and all the pieces of the journal are being put together and one of these pieces is my letter to you.

A lot of time and hard work has been put into the production of this journal. Many ideas were put forward and then discarded. Creative was really great and made it look like it was no big deal at all. Getting good research articles is also not simple, since quite often these articles were written by students in their final year and now, they have graduated, and it can be difficult to get a hold of them to get their okay to put their research articles into the journal. Many, many countless hours went into this journal and without the support from many sides, this journal would not have been possible.

As your faculty advisor, I am proud of what you have accomplished. You can be proud of your journal!

I look forward to the 2020 conference in Oklahoma. Enjoy the conference and may the best journal win (hopefully ours!).

Martin Habekost, Dr. rer. nat.
RyeTAGA faculty advisor

OUR PRESIDENT

JULIA FORRESTER

Dear TAGA,

It is with great pride and pleasure that I present to you Ryerson University's 2020 student journal. This journal is the product of a year's worth of hard work and dedication, made possible only by the incredible group of students who form our RyeTAGA team. I would like to extend my gratitude to the entire RyeTAGA team for their commitment to producing such a high calibre student publication, as well as to our faculty, staff, and sponsors whose generous support helped this journal take form.

I truly believe that this year's journal represents the innovation and forward-thinking nature of not only its talented GCM contributors, but also of the Canadian graphic arts industry at large. I hope you enjoy reading and interacting with our journal as much as we enjoyed producing it.

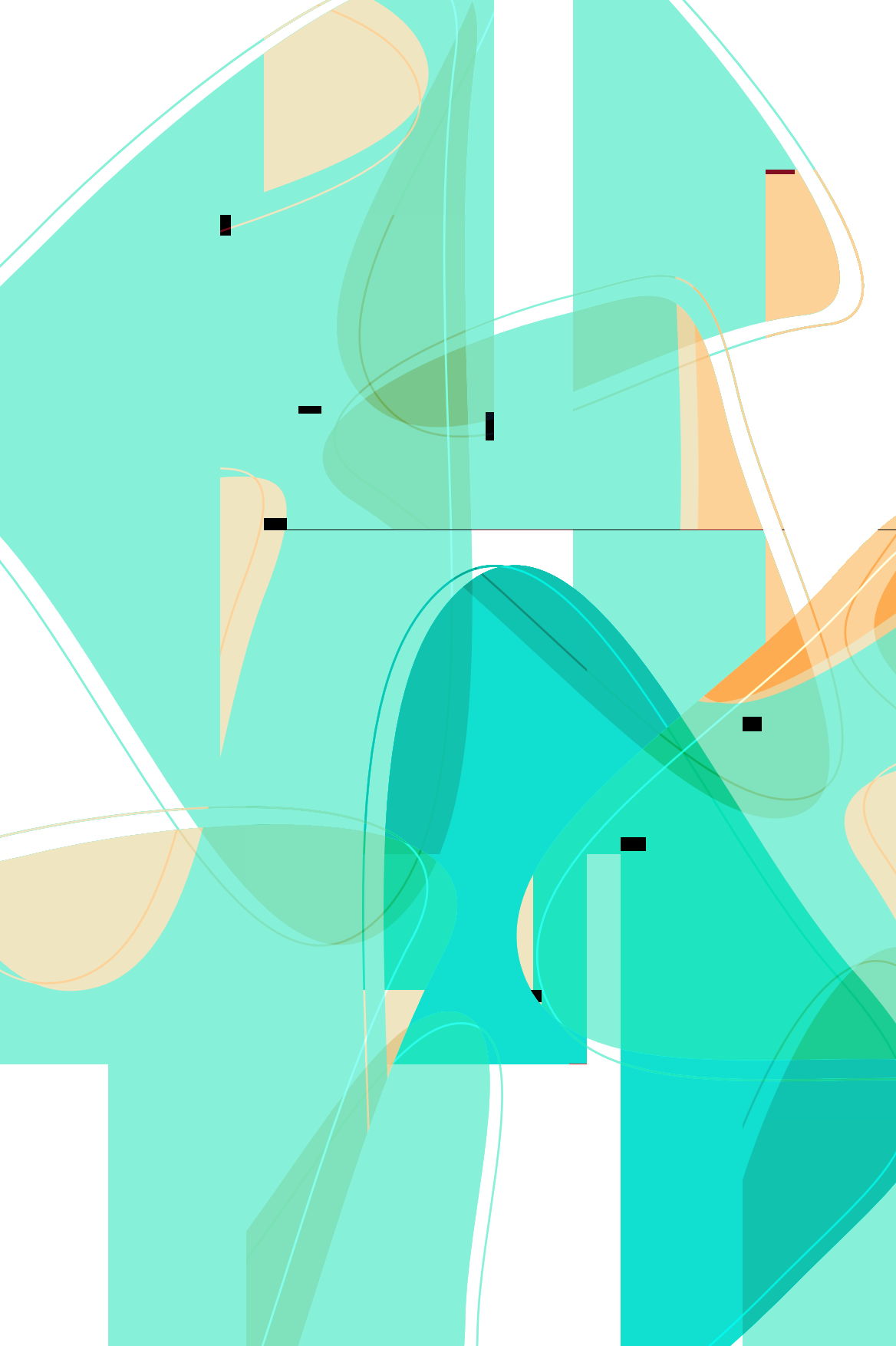
From the start, our team strived to produce the best journal possible this year. We knew that there were high expectations for us to meet, but I am incredibly proud of how our team rose to the occasion. Leading this year's RyeTAGA team has been an unparalleled experience for me and I am grateful for having been given the opportunity to do so. On behalf of the Ryerson University Student Chapter, it is my honour to share this year's journal with you.

Julia Forrester
President, RyeTAGA

SUSTAINABILITY IN PRINT & PACKAGING

Annika Boyer, Samantha Chung, Lauren Henderson, Cara LoBrutto

1



EXECUTIVE SUMMARY

This report provides an analysis and evaluation of Clif Bar's primary and secondary packaging to determine the eco-friendliness of the existing package in order to propose a sustainable alternative. Methods of analysis include market accessibility and legal trends, Comparative Packaging Assessment (COMPASS), and cost and supply-chain considerations. Results of the data analyzed show that the existing primary Clif Bar package is not sustainable with much room for improvement and innovation. Although 100% of the paperboard packaging is recyclable, only 35% of the material used is post-consumer resin (PCR). Redesigning the transportation method by removing air travel reduces the carbon footprint by 80%.

Further investigation revealed an improvement of using 62% less material by replacing the primary packaging made of aluminium and plastic with a biodegradable microfibrillated cellulose (MFC). Sustainable performance of the materials is very poor in both the existing primary and secondary packaging components.

Clif Bar is advertised and marketed to a segment of consumers who care for the environment. The report evaluates the range of sustainability within the product and concludes that it would be ideal to innovate and redesign various components of the package. This would satisfy the existing consumer demand as well as bring in new market segments.

It is recommended that ...

- Right-sizing is adapted into the secondary packaging
- Replacing the components of the primary packaging (metallised oriented polypropylene, or MET + OPP) with a recyclable or biodegradable option (microfibrillated cellulose, or MFC) would be better for the end-of-life
- Replacing the current inks with those that are free of volatile organic compounds (or VOC-free), water-soluble, and biodegradable for printing on the primary and secondary packaging
- A biodegradable or easily removable adhesive be used for both packaging components
- Air travel be removed from the Clif transportation system, therefore relying on rail

PRODUCT

PACKAGING SYSTEM DESCRIPTION

The Clif Bar product-packaging unit in this report consists of two components. The primary package is a 1.2g MET + OPP wrapper that is flexible. The secondary package is a rigid 39.0g box. Clif Bar & Company has a large brand portfolio with Clif Bars being the original brand product with the widest range of flavours. In addition to the original bars and the spin-off flavours that are seasonally rolled-out, Cliff Bar & Company has Luna Bars, Shot Energy Gels, Bloks Energy Chews, Builders and Z Bars for kids within their brand.

On both the primary and secondary packaging the Rainforest Alliance logo is present. This means that Clif Bar as an enterprise has been audited and meets the Rainforest Alliances' standards for environmental, social and economic sustainability (Rainforest Alliance, 2018). On the secondary packaging, there is a Certified 100% Recycled Paperboard symbol. Since Clif Bars are frequently sold individually and by the box there are barcodes on both the primary and secondary packaging but only a QR code on the secondary box. Similarly, there is only a digital variable data printed best before date stamp on the box. The Clif Bar branding, including the Clif Bar Family Foundation logo, are present on both forms of the packaging unit.

Clif Bar talks extensively on their website about their sustainability efforts as well as supporting those who are looking to make the world a more environmentally sustainable place. Although Clif Bar Canada would not answer any questions regarding the kind of ink and print practices they use, their transportation methods and their wrapper materials do follow a pillared sustainability practice called the "five bottom lines." Their five bottom lines are business, brands, people, community and planet. They have published a full public annual report about these values (Clif Bar & Company, 2019). Sustainable initiatives regarding product packaging are reducing the size of the wrapper by 10%, as well as including more rail transportation to reduce their carbon footprint (Appendix).

TARGET CUSTOMER

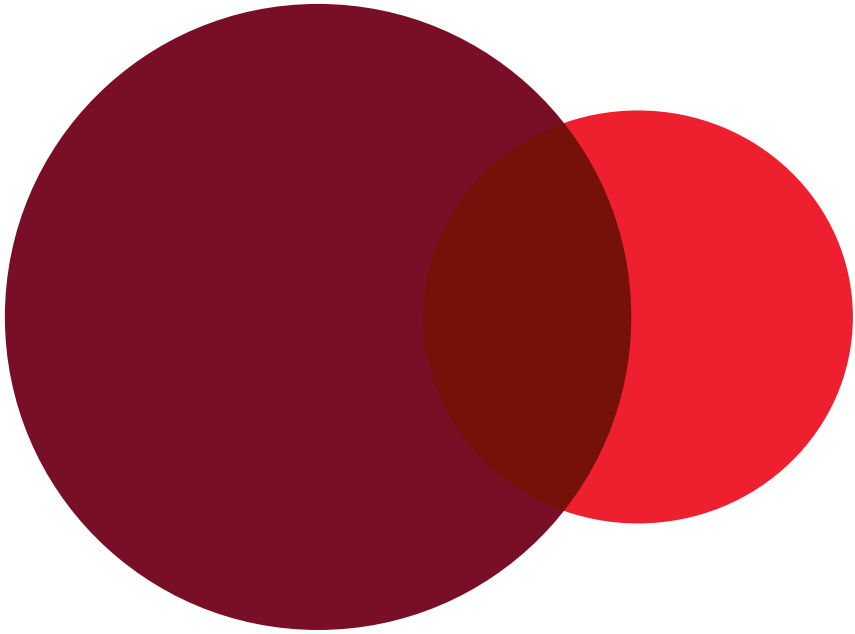
To understand the target customer of Clif bars, the product's demographics need to be understood as well as the branding and design efforts of the packaging itself. Clif bars are sold across Canada, the U.S., the U.K. and other parts of Europe, and focus their branding efforts on being an organic, healthy snack (Clif Bar & Company, 2019). When looking at the package itself, Clif Bar's branding and design is unique. Each bar wrapper has customized branding of various scenes displaying a form of physical activity. From the Clif website, the branding towards health, activity, and being active outdoors is the focal point, as well as an overall high-quality feel of packaging (Appendix A).

Geographically, Clif bars are sold largely to their existing target consumer. Clif Bar has demonstrated social responsibility and created brand loyalty by donating to environmental and organic groups in order to gain awareness from people who buy fair trade and organic products (Creating Impact Blog, 2017). Another large factor in determining their target market is price. The average price for a nutritional bar in the U.S was $2.88 in 2016 (Statistica ,2019). In comparison, the price of an individual Clif Bar ranges from $1.29 to $1.79 (Loblaws Inc, 2019). On average, Clif Bars are not the most expensive snack bar on the market, but are still priced and packaged in a way that depict them as a higher quality product. Finally, as shown from the research above, one can draw the conclusion that the target market for Clif Bars is people that value a higher quality product and those that are athletic and/or outdoorsy, as well as environmentally conscious.

PACKAGING SEGMENT

MARKET RESEARCH

Clif Bar's baseline packaging is a foil-lined wrapper made from layers of MET, OPP, and PET (polyethylene terephthalate) produced by TerraCycle. The market segment for this type of wrapper is food products because it can be moulded into different shapes, stretched, preventative of light exposure, and be an oxygen and moisture barrier (Gaille, 2018). Although the packaging can be used for multiple types of food, it is particularly good for nutritional bars like Clif Bars that are greasy and require a solid barrier. Current segment trends for this packaging is growing as the demand for on-the-go, healthy snacks is increasing. According to Natural Products Insider (2019), snack bars accounted for the largest segment in food bar consummation, and three in four people ate a snack bar within the past month. As the demand for snack/ nutritional bars increase, the packaging for these products will focus more on the target market and branding. The substrates used (MET, OPP and PET) form a flexible and thin wrapper that can easily be torn open and disposed of. The technology used to make the packaging includes the moulding of the layers, printing on the outer side of the package, and using various flexible packaging machines such as shrink wrapping and packaging systems (Pyramid Packaging Inc, n.d.). The competing packaging formats for nutritional snack bars can be seen in the other most common materials used in this type of wrapper, such as LLDPE (linear low density polyethylene), PE (polyethylene), PPE (p-phenylene ether), and BOPP (biaxially-oriented polypropylene) (Swiss Pac USA, 2015). These are various forms of plastic that can be layered with other materials, such as foil, thinly stretched, and then sealed to create the ultimate convenient purchase for consumers.



ACCESSIBILITY, SAFETY & LEGAL CONSIDERATIONS

The Canadian Food and Drugs Act (F&D Act) and Food and Drug Regulations (FDRs) regulates packaging materials in Canada (Regulation of Food Packaging in Canada, 2014). Food packaging needs to protect the food from external factors, contamination and from being tampered (Food Packaging--Roles, Materials, and Environmental Issues - IFT. org, 2007). Foil-lined packaging provides a barrier against factors such as moisture, oxygen and other gases improving the overall shelf life of the Clif Bar (Lamberti & Escher, 2007). In regards to the chemical stability and food safety of aluminum foil packaging, it is dependent on the composition of the food inside. The seal of the foil and the tightness of the packing plays a significant role in keeping food safe (Lamberti & Escher, 2007).

In regards to accessibility, the primary packaging (the Clif Bar) is easy for consumers to tear open with the ends being teethed. This correlates to Clif Bar's target market as consumers usually consume Clif Bar on a grab-and-go active lifestyle. The secondary packaging has a perforated opening on the back (See Figure 1.3) for ease of opening for in-store use, and a tuck and lock tab at the top for the consumer access.

The Canadian Food Inspection Agency department of the Government of Canada enforces mandatory label requirements on food packaging. Firstly, the package must indicate the place of origin, known as the origin claim, indicating if it is a *Product* of Canada or *Made* in Canada. Furthermore, the name and address must be in either French or English - Clif Bars are distributed by Clif Bar and Company in Emeryville, California, USA. A package must also indicate an allergy statement and list the ingredients. Additionally, the package must include a bilingual nutrition facts table; best before date (date marking); a composition claim, highlighting any ingredients that need attention; and net quantity, identifying the amount of food in the package. Finally, the package's primary display panel must indicate the common name and net quantity (Interactive Tool-Food Labelling Requirements, 2014). The Clif Bar package corresponds to the mandatory labelling requirements.

CORE PROBLEM

PACKAGING ASSESSMENT

Eliminating the use of oriented polypropylene metallized film (OPP + MET) will increase Clif Bars' overall sustainability. Due to food regulations, the food contact material (FCM) cannot be printed on which implicates the necessity of a double lined wrapper. However, the double lining can be done with more sustainable materials, ultimately eliminating one layer of the three layers. Even if the bars were designed to have the plastic be easily recyclable for provincial and municipal programs, the production of more plastic is not sustainable.

OBJECTIVES FOR DESIGN CHANGES

The elimination of both aluminum and plastic (OPP + MET) in the wrappers will be prioritized because they have the most impact on the life-cycle in the end-of-life stage. By changing both the number of layers in the wrapper and the composition material, it will make the wrappers easily biodegradable to decrease the end-of-life impact. Replacing the OPP and MET with microfibrillated cellulose (MFC) will make the entire wrapper biodegradable. MFC is an effective alternative to both aluminum and plastic in packaging ("MFC for packaging", n.d.). MFC can reduce the amount of metal used in over a billion food and beverage products and can effectively protect against oxygen and grease in barrier coating films. By using MFC, the CO2 footprint that aluminum carries in a package can be reduced ("MFC for packaging", n.d.).

Additional changes include: right-sizing the secondary packaging and increasing the amount of post-consumer recycled content to 50%. Even though the box is 100% certified recycled paperboard, only 35% of the current box is post-consumer content (See Figure 1.2).

COMPASS ANALYSIS

In order to get the most accurate analysis from COMPASS, OPP + MET was broken down into three separate materials due to COMPASS not offering OPP + MET as a substrate option. Polypropylene oriented film (OPP), aluminum sheet rolling and polyethylene terephthalate (PET) film extrusion, were used in order to account for all the elements. The overall weight of the wrapper (See Figure 1.0) was divided into three equal parts because individually weighing each immensely thin layer was not a viable option. Since microfibrillated cellulose (MFC) is not an option as a material in COMPASS, modified starch mater-bi was chosen as the closest alternative for the redesigned wrapper.

1

Life-cycle for Primary Package

1.1 *MATERIALS*

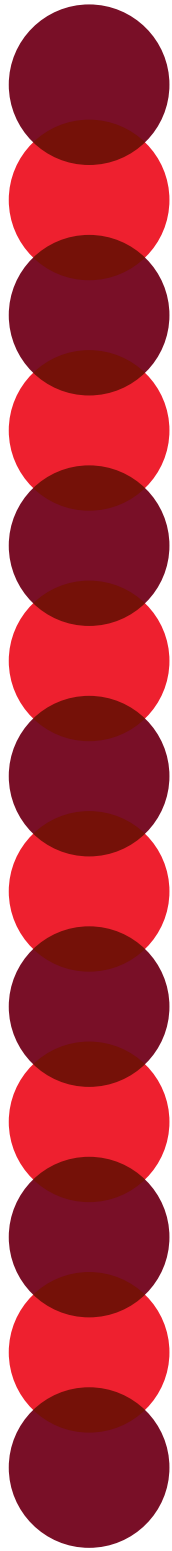
The current wrapper material consumes the most fossil fuels, GHG emissions, water consumption and has the greatest human impact than any other life-cycle portion of the primary package. This is most likely because the wrapper is made of aluminum and plastic. The process of converting "raw bauxite into aluminum is incredibly energy-intensive, requiring copious amounts of electricity, water and resources to produce" (Leigh, 2010). The plastic film portion of the wrapper cannot be stripped from the aluminum wrapper for recycling. The Clif Bar wrapper material uses almost 62% more material than the proposed redesign.

1.2 *MANUFACTURING*

From the COMPASS analysis, manufacturing impacts currently produced by Clif Bar wrappers will be reduced completely with the new biodegradable wrapper. However, given COMPASS does not have MFC in its database, this is not the case. MFC is not being used largely in the market "due to the high-energy consumption associated with its production" (Ålander, 2017).

1.3 *TRANSPORTATION*

Through a call with Clif Bar & Company, it was confirmed that one of Clif's methods of transportation is rail in order to reduce their carbon footprint. Clif Bar uses many forms of transportation across North America and internationally. For the purpose of the analysis we compared rail transportation between the Clif Bar headquarters in Emeryville, California and Toronto, Ontario. In order to compare the oceanic transportation methods, we are using the distance between Emeryville, California and Vancouver, British Columbia. In order to reduce fossil fuel consumption by 98.3% in the new proposed package, air travel was eliminated. In order to accommodate for the removal of air transportation, rail travel was doubled in the redesign. The transportation accumulated 35.73% of the fossil fuel consumption given the air travel but by removing air travel with the new proposed package, the fossil fuel consumption will be reduced by 80% with the proposed redesign.



1.3 *END-OF-LIFE*

The end-of-life impacts occupy the smallest implications to the life cycle of both packages. The redesigned wrappers have reduced the impact on fossil fuel consumption, water usage, and human impact. However, GHG emissions have increased with the new wrappers. It can be assumed that since the redesign is 100% biodegradable it will give off more CO2 when it decomposes compared to a plastic product that does not give off any CO2 in the end-of-life stage since plastic does not decompose. Any and all organic matter that decomposes will give off some CO2 (Brown & Subler, 2007).

2

Life-cycle for Secondary Package

The secondary packaging of Clif Bars is certified 100% recycled paperboard box with a maximum 65% pre-consumer content and a minimum 35% post-consumer fibre content (See Figure 1.2). The box was entered into COMPASS at its total weight (See Figure 1.). The redesign aims to reduce the box size and have 50% post-consumer fibre content. On account that the box material is not changing, only the post-consumer fibre percentage, box size and ink transition from solvent to water based, the overall impacts on fossil fuel consumption, water usage, and human impact will be reduced 30-60%.

SUSTAINABLE DESIGN PROPOSAL

The new design proposal includes changes to the outside and material design of the current Clif Bar packaging. The first design change would be to replace these materials with a double layer of MFC (microfibrillated cellulose) which would ultimately make the wrapper recyclable and biodegradable. Second, ink coverage on the outside wrapper will be altered to achieve their current branding but reduce coverage. Clif Bar branding is vibrant, multi-coloured, and highly saturated which means a large amount of ink is used, making it more difficult to dispose of. The implementation of biodegradable water-soluble inks would replace plastisol (polyvinyl chloride) inks. Although plastisol inks are easier to use and more readily available, water-soluble inks eliminate the amount of PVC (polyvinyl chloride), that takes years to decompose, as well as the VOC (volatile organic compound) and other harmful emissions that pollute the air and leak into soil (Sustaining Our World, 2019).

There are a few trade-offs in the process of changing the packaging material and inks. The first trade-off is that by changing the current packaging materials to MFC it is ten times less effective than low-density polyethylene at keeping out moisture and oxygen. As well, it is proven most effective when added to paper products as a film (MINIPAKR, 2019). Due to the fact that the product is not a liquid or one that needs refrigeration,

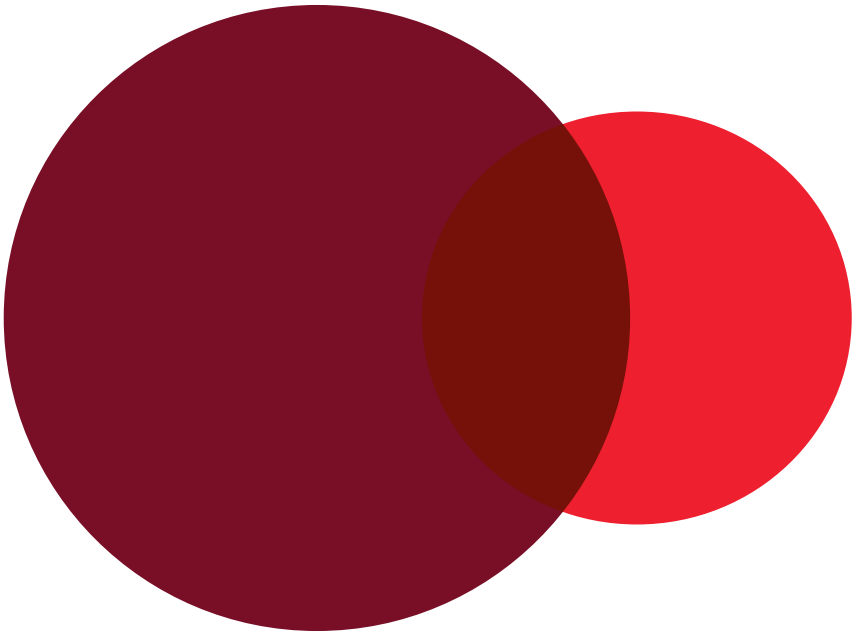
using MFC as the primary wrapper material remains a viable alternative. Another challenge is the possibility of not being able to recreate the vibrant, highly saturated printing that creates Clif Bar's branding with water soluble inks. Although better for the environment, water based inks do not perform as well when printing Pantone colours and achieving gradients and halftones (Melmarc, n.d.). Not achieving the current branding was a trade-off but adjustments made to compensate include: less ink usage, simplifying the design, and using the eco-friendly appeal to our advantage by making it appear more minimal. Taking the original design, it would be adapted into minimal line work and accented with various coloured gradients.

The changes made to the primary package will be evident to the consumer through touch and sight. The feel of MFC compared to plastic and aluminum will be different in the users hands. The natural, organic, almost kraft-like feel of a fibrous material communicates to the customer that it is a potentially recyclable material. Adapting the use of biodegradable water-soluble inks and decreasing the ink coverage of the primary package allows the primary package to reveal more of the raw material beneath what used to be 100% ink coverage on the existing packages. In addition to the texture, the visual branding will need to be modified on the primary and secondary packaging to visually let the customer read that the package will be 100% recyclable or biodegradable [See Figure - 1.2]. The idea for the design overhaul was to keep the same consistent branding imagery that customers are comfortable and accustomed to seeing but changing it to be more environmentally conscious and appealing.

The same decrease of coverage in printing inks can be applied to the secondary package. The material, however, will be upgraded to a potential 50% PCR material. Through the process of updating the substrate on the secondary package, the design will be adapted to look similar to the primary package; including the reduction of ink coverage and coloured branding. By right-sizing the package, the visual graphics of the secondary package will need to be altered to fit the new package structure. In addition to the graphic alterations, there will also be call-outs on the secondary package to indicate the new "50% PCR material" that is also recyclable and indications that the primary package is biodegradable.

The adhesive used on the existing package, primary and secondary, are not biodegradable and very hard to completely remove from the substrate. By modifying the type of adhesive used, this will allow for complete recyclability and biodegradability of the unit. Avery Dennison's CleanFlake water-based adhesive makes recycling easier for the secondary package. Through the recycling process, the adhesive is easily separable from the substrate used on the secondary package, which makes it viable to completely recycle. As for the primary package, the package itself will eventually decompose and so will the water based adhesive.

The existing Clif Bar packages have 100% ink coverage on their primary and secondary packaging. With the increase in cost from switching over from typical flexographic inks to the eco-friendly alternative, an economic fix for this trade-off would be to minimize the ink coverage. By adapting the package design to an outline and using gradients in place of the solid colour, it would allow a decrease from 100% ink coverage to about 20%.

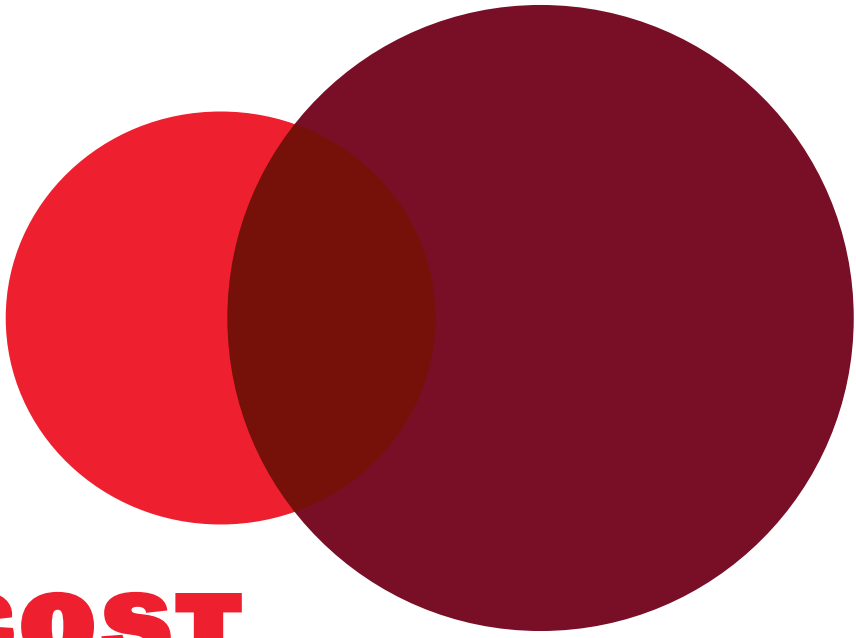


SUPPLY-CHAIN CONSIDERATIONS

Microfibrillated cellulose (MFC) is not being used frequently in North American packaging. Consequently, there are few suppliers. Weidmann, Borregaard, and Cellulose Lab are the current leaders in MFC manufacturing. Since Weidmann is located in Switzerland and Borregaard in Norway it makes the most economical and environmental sense for the redesign material to come from the only Canadian company, Cellulose Lab. If the MFC was to come from overseas for products to be manufactured in North America it would cause too much burden shifting onto the manufacturing stage of the product life cycle. Cellulose Lab also has the added advantage of formulating the MFC to a company's specific needs, which means that Clif Bar can specify the density and strength that the wrapper requires (Cellulose Lab, 2019).

Similar to Loblaws, Clif Bar makes more than a million deliveries a year, thus improving transportation is important for the supply chain of both companies. Loblaws replaced their trucks with efficient models that will minimize their impact on the environment. Furthermore, Loblaws changed how they ship to Atlantic Canada by making shipments arrive in Halifax rather than shipping to ports in Montreal and Vancouver as well as using railway transportation. The secondary package redesign was reduced in size which correlates to Loblaws actions to reduce packaging sizes (The Way We Do Business: 2015 Corporate Social Responsibility Report, 2015).

In an analysis of Walmart's Sustainable Packaging Playbook, having a sustainable source of materials, specifically increasing recyclable and renewable content, is important to the supply chain. The redesigned Clif Bar secondary package increases the use of post-consumer recycled content from 35% to 50% which correlates to Walmart's Playbook. Additionally, increasing sustainable content, like the use of MFC in the redesign, aligns with Walmart's Playbook ("Walmart Sustainable Packaging Playbook", n.d.).



COST ASSESSMENT

The costs to produce the Clif Bar wrappers are likely to increase overall given the choice of using MFC rather than the original OPP + MET wrapper (Are Biodegradable Materials More Expensive?, n.d.; Ålander, 2017). The costs of manufacturing the MFC will increase due to higher energy consumption through production (Ålander, 2017). However, ink costs will be reduced given that water-based ink produces much fewer VOCs, and therefore costs related to pollution emission will be much less compared to solvent-based ink (Solvent Based Ink Vs Water Based Ink: Should I Use Which Ink for Flexographic Printing? - KYMC., 2018). Overall, ink costs will increase given the switch to water-soluble inks, but reducing the ink used on the wrapper overall will attempt to balance the trade-off.

In regards to the secondary package, the smaller box will reduce the costs of the package and the increase of post-consumer content will increase the cost of the package (100% Recycled Paper Policy - FAQs, n.d.).

APPENDIX A

Figure 1.0

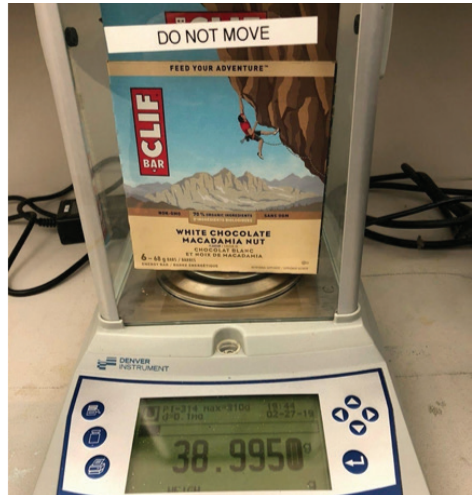


Figure 1.1

Figure 1.2

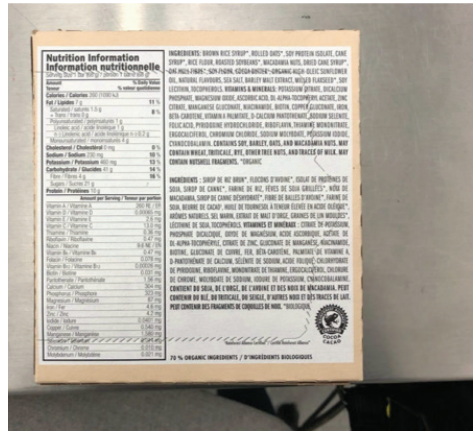


Figure 1.3

APPENDIX B

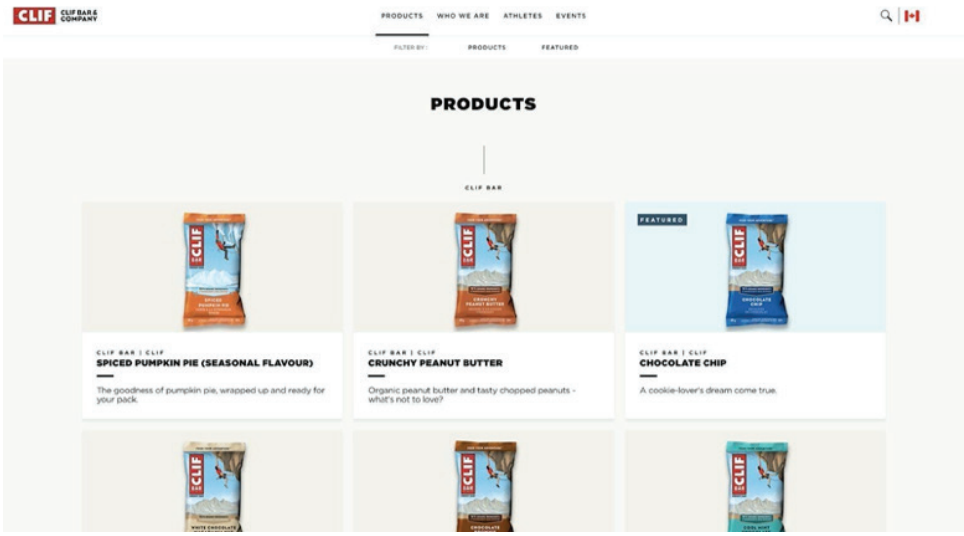


Figure 2.0
("Clif Bar & Company: Feed Your Adventure®.", 2019)

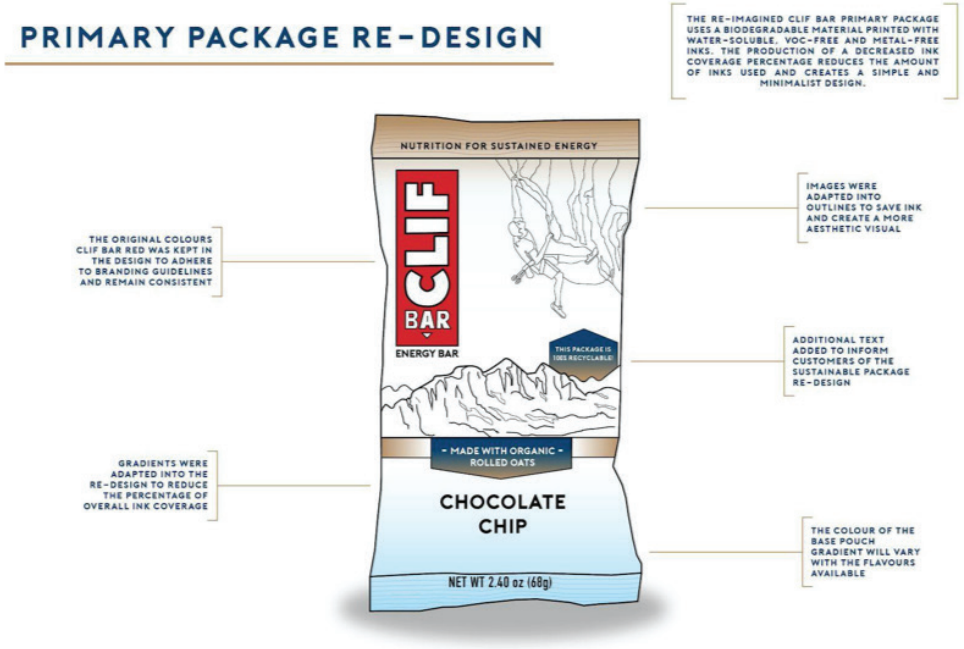


Figure 2.1 - Primary Package Redesign.

APPENDIX C

COMPASS ANALYSIS

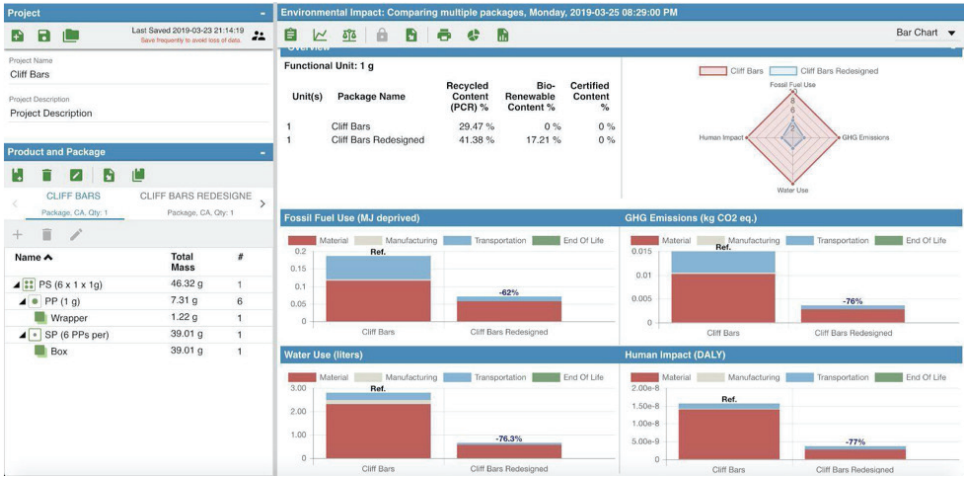


Figure 3.0 - Primary Package

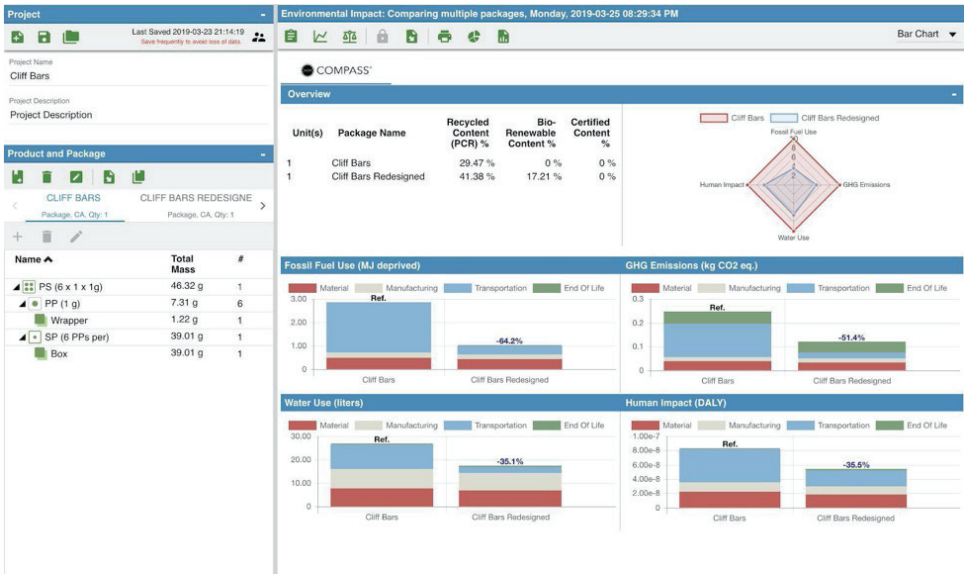


Figure 3.1 - Secondary Package

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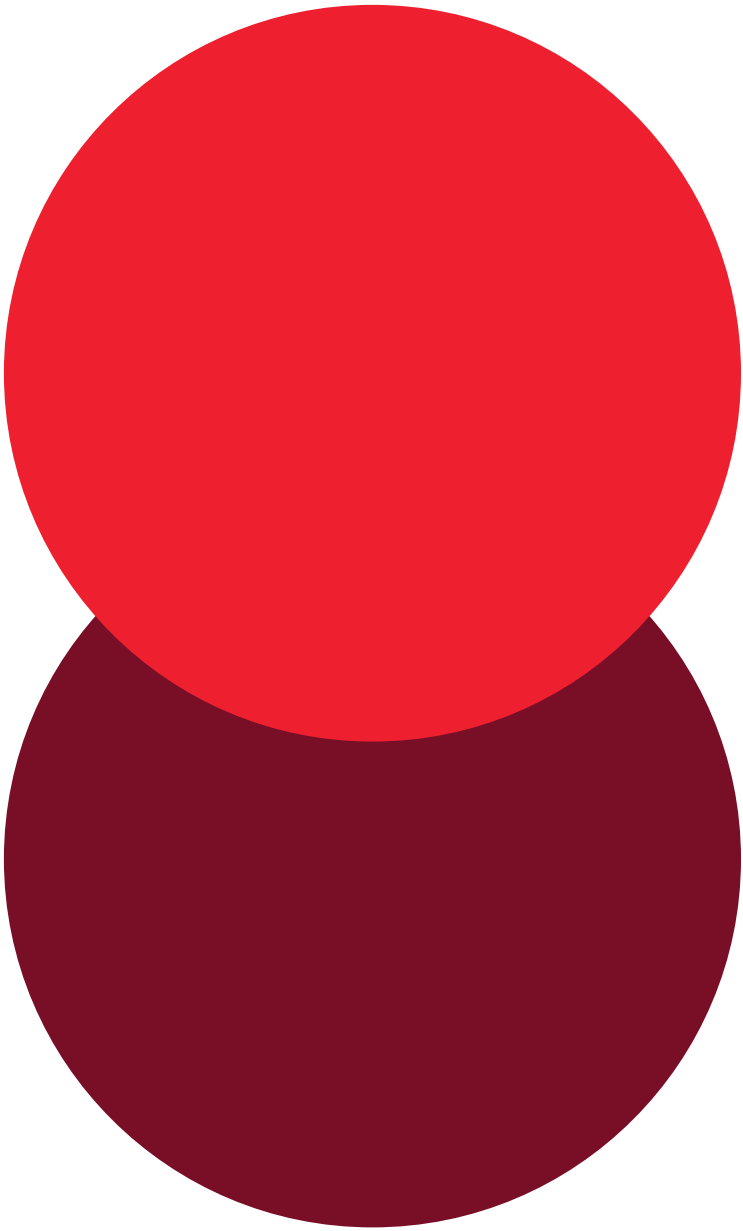


EVALUATING THE TRIPLE BOTTOM LINE FOR SMART PACKAGING

Mila Khatri

2

ABSTRACT

The purpose of this thesis is to evaluate the benefits and challenges of smart packaging in three key areas: the people (consumers and brands), profits, and the planet. This thesis makes reference to the triple bottom line, which is used as a method of evaluating smart packaging. Results of the research and surveys conducted in this thesis conclude that smart packaging does not yet meet the triple bottom line, but it is well on its way to getting there. This is concluded based on the fact that only half of the consumers surveyed are willing to purchase smart packaging and see the benefits to paying more money for the technology. Others state that it is not worth the extra money. Smart packaging has the ability to provide brands with many benefits such as net revenue, brand loyalty, and brand awareness. However, the triple bottom line is not being met yet because there are challenges to implementing smart packaging such as high costs, and the fact that consumers must be willing to purchase smart packaging in order for brands to profit from it. Finally, smart packaging poses some challenges to the end-of-life phase such as the issue of recyclability. Smart packaging is a complex type of package, that results in higher recycling costs. If researched in-depth and appropriate materials are used, then smart packaging will pose less of an impact on recycling and sustainability.

INTRODUCTION

PURPOSE

In the retail landscape, brands are consistently trying to find new innovative ways for their products to stand out on shelves. This is where smart packaging comes into play. Smart packaging is an innovative way for brands to get their target market's attention. Brands use smart packaging as a way to stand out on the shelves, provide consumers with a more interactive and engaging experience, as well as adding value to their products. Brands are realizing that there are a lot of factors that must be discussed when creating a smart package. Brands need to think about whether their consumers are interested in purchasing smart packaging, how much it would cost them, and how to still produce sustainable packaging. Consumers need more than just a f ashy gimmick. Smart packaging needs to do something useful for them. Consumers are also becoming increasingly aware of the environmental issues in the world today and are more focused on sustainable products and brands that help the planet.

The purpose of this thesis is to evaluate the effects smart packaging has on people, profits, and the planet. Some questions this thesis aims to answer are: Are consumers really interested in smart packaging? What do consumers seek in smart packaging and how much are they willing to pay for it? How much does it cost to implement smart packaging? Is smart packaging a sustainable type of packaging for brands to implement for a prolonged period of time? How does complex smart packaging affect the end of life phases? Lastly, how can smart packaging be disposed of or recycled in an environmentally friendly manner? By answering these questions, this thesis will be able to provide an answer to how effective smart packaging will be if it meets the triple bottom line.

WHAT IS SMART PACKAGING?

Definitions

Smart packaging provides an enhanced functionality. There are many other terms that can be used to refer to smart packaging: active packaging, intelligent packaging, and interactive packaging. Active and intelligent are two types of smart packaging.

Smart Packaging Applications

Smart packaging has a variety of uses that benefit brands, retailers, and consumers. Figure 1 from *Capturing value from the smart packaging revolution* provides an excellent summary of the various purposes of smart packaging.

Figure 1:
Smart Packaging Applications

Source: (Armstrong, Fazio, Herrmann, & Duckworth, 2018)

TYPES OF SMART PACKAGING

ACTIVE

Active packaging is based on the idea that certain components are added to the packaging itself that release or absorb substances from the packed food or the environment to extend shelf life and maintain quality. To become familiar with active packaging concepts, this section of the thesis will introduce some common active packaging technologies.

One of the most common types of active packaging is moisture absorbers. Moisture absorbers are an efficient way to control excess water accumulation in a package (Realini & Marcos, 2014). One method of implementing moisture absorbers in packaging is by using a super absorbent polymer in between two layers of microporous or non-woven polymer (Realini & Marcos, 2014). Another method of using moisture absorbers, specifically in meat products, is building a dual-compartment system into the packaging where the second compartment has porous seam in which moisture and drip loss from the meat is diverted (Realini & Marcos, 2014). This ensures an attractive presentation as well as hygienic storage. Lastly, a common type of moisture absorber, often found in products that need climate or humidity control, are little silica sachets placed in products. These sachets have often been found in purses, pharmaceutical bottles, dried food packages and ground coffee jars (Gaikwad & Ajji, 2018). Silica sachets are also commercially available via companies such as Sorb-It, Ageless, MiniPax, and FreshPax (Gaikwad & Ajji, 2018).

Antimicrobial packaging is a type of active packaging which controls the growth of microorganisms. This technology aims to extend

the "lag" phase and reduce the "growth phase" of microorganisms, which helps to extend shelf life, maintain quality and keep food safe (Realini & Marcos, 2014). For microorganisms that are non-volatile or can possibly migrate into the food, the packaging must be in direct contact with the food for maximum effectiveness (Realini & Marcos, 2014). Some examples of innovative ways to implement antimicrobial packaging are using natural extracts and essential oils from grapeseed, garlic, oregano, and thyme. These essential oils have components that delay the growth of microorganisms in meat products (Realini & Marcos, 2014). Other forms of antimicrobials include salts, oxides, and colloids.

An important type of active packaging technology is carbon dioxide emitters/ generators. The purpose of carbon dioxide emitters is to increase the CO2 levels in the package (Realini & Marcos, 2014). The increase in CO2 helps reduce the surface growth of microbes as well. Carbon dioxide emitters are commonly used and associated with modified atmosphere systems (MAP) (Realini & Marcos, 2014).

Oxygen scavenging is a similar technology in active packaging which has an inverse function. Scavengers are used to remove oxygen from the packaging once it is sealed as oxygen is often responsible for the oxidation of food, resulting in a growth of bacteria, reducing the quality and shelf life of food. Oxygen scavengers are also used in combination with MAP systems and vacuum packaging to ensure almost all of the oxygen has been removed from the package. These scavengers come in the form of iron powder oxidation, ascorbic acid oxidation, photosensitive dye oxidation, enzymatic oxidation, unsaturated fatty acids, or immobilized yeast (Realini & Marcos, 2014).

The last major type of active packaging this thesis will be discussing is antioxidant packaging. Antioxidant packaging is an alternative to oxygen scavenging when preventing food oxidation (Realini & Marcos, 2014). Antioxidants can be included into the packaging material itself such as polymers. Other ways to implement antioxidants is via sachets, labels, coatings on packaging surfaces, and multilayer films (Realini & Marcos, 2014).

TYPES OF SMART PACKAGING

INTELLIGENT

The main purpose of intelligent packaging is to monitor the condition of packed food and its surrounding environment. Its primary task is to communicate information about the product such as its status, spoilage, and traceability in order to ensure the food is safe and maintaining quality. Other reasons intelligent packaging is used is to increase brand loyalty, raise brand awareness, increase consumer engagement, and provide added value and convenience for the consumer. Some functions that fall under intelligent packaging are: detecting, sensing, recording, tracing, and communicating. Indicators provide information about a change, such as temperature, oxygen, integrity, and freshness (Realini & Marcos, 2014). Biosensors are used to detect, record and transmit information about biological changes to the food and the package.

The first type of intelligent packaging this thesis will discuss are time temperature indicators (TTIs). The purpose of TTIs is to continuously monitor the temperature and time history of chilled and frozen products throughout the food supply chain (Realini & Marcos, 2014). These indicators work by providing a visual indicator that can inform about a cold chain break and when the food is no longer cold. TTIs on the market today are based on physical, chemical, enzymatic and biological processes (Realini & Marcos, 2014). An indicator developed by 3M, Monitor Mark®, is a fatty acid that has a selected melting point that is mixed in with a blue dye (Realini & Marcos, 2014). When that melting point has been reached, the substance melts, diffusing through the indicator and allowing the blue dye to show. Another type of TTI available is one that uses a photochemical reaction where the indicator

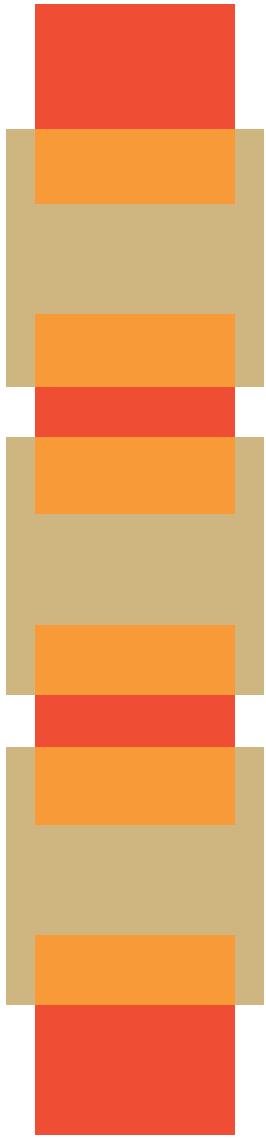
contains a pigment that changes colour over time at temperature-dependent rates (Realini & Marcos, 2014). The indicator is activated when it is exposed to UV light, becoming dark blue and then fading over time. One of the most unique and innovative types of TTIs available is one that is a label for barcodes printed with fading inks. When the product is exposed to critical temperatures, the barcode starts to disappear, hindering consumers and cashiers from scanning that product at checkout (Realini & Marcos, 2014).

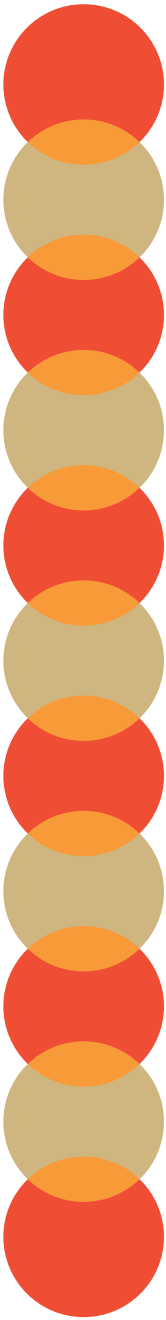
Another technology used for intelligent packaging is integrity indicators. Integrity indicators can be something as simple as a time indicator, which informs consumers how long a package has been open for (Realini & Marcos, 2014). Time indicator labels are activated when a product has been opened for consumption, the breaking of a seal acting as a trigger. Over time the indicator will start to change colour. In meat products, the most common type of integrity indicator are gas indicators, which provide information on the package throughout the supply chain (Realini & Marcos, 2014). A more specific example would be oxygen indicators, which are the most common type of gas indicators used in MAP systems.

Biosensors are used in a variety of ways. A biosensor is a "compact analytical device that detects, records, and transmits information pertaining to biochemical reactions. It consists of two primary components: a bioreceptor that recognizes a target analyte, and a transducer that converts biochemical signals into a quantifiable electrical response" (Realini & Marcos, 2014). Biosensors are usually used as freshness sensors/ indicators. Freshness indicators have not yet become popular in the market

because food processors are unwilling to risk their brand image by implementing a system that could show their products are not fresh.

A major technology used in intelligent packaging is radio-frequency identification tags (RFID). RFID tags "use RF electromagnetic fields to store and communicate real-time information" (Realini & Marcos, 2014). The tag is composed of an integrated circuit that is attached to an antenna transmitting information stored on the chip to a reader (Realini & Marcos, 2014). A key advantage of RFID tags is that they can be remotely accessed and controlled, allowing multiple products to be monitored simultaneously (Realini & Marcos, 2014). Advanced RFID tags can also be used in combination with other forms of intelligent packaging such as TTIs and biosensors. The use of RFID tags allow for a more efficient supply chain, reduced waste production, and increased savings.





THE TRIPLE BOTTOM LINE

The triple bottom line is a concept used to broaden a business's focus from only looking at profits to considering environmental and social factors as well. The three bottom lines are: people, profit, and planet. A more formal definition of the triple bottom line is it "captures the essence of sustainability by measuring the impact of an organization's activities on the world" (Slaper & Hall, n.d.). Companies use the triple bottom line as a method of running a business that generates profits, but also improves people's lives and helps the planet at the same time. Nowadays, an increasing number of consumers are willing to pay more for items produced by brands that are socially and environmentally responsible.

It should be noted that implementing a planet and people bottom line can help a company increase their profits as well (Kenton, 2019). In 2015, millennials were the largest consumer demographic, and 73% of them said that they were willing to pay more for goods that met the people and planet bottom lines, which was an increase from 43% of millennials in 2014 (Kenton, 2019). Implementing a triple bottom line can help build corporate brands and goodwill, which represents 30% of the brand's value in public companies (Kenton, 2019).

Measuring the triple bottom line can be a difficult task. How does a company measure the value of an oil spill – or the prevention of one? Since there is no standardized method of evaluating a company's triple bottom line, each company has the ability to use their own metrics that work for them (Kenton, 2019). One method to measure the triple bottom line is by monetizing the social and environmental impacts (Slaper & Hall, n.d.). An example would be calculating environmental damage by how much waste or greenhouse gas emissions are produced. However, a drawback to this method is that not all social and environmental impacts can be monetized. Another method would be to create an index (Slaper & Hall, n.d.). This eliminates the incompatible units issue as long as a universally accepted method of accounting is used (Slaper & Hall, n.d.). An issue with this type of method includes determining how each bottom line should be weighted. A third method of measuring the triple bottom line would be to simply measure each factor/ category on a standalone basis, removing the need for common units (Slaper & Hall, n.d.).

APPLYING THE TRIPLE BOTTOM LINE TO SMART PACKAGING

Based on the definition of "Triple Bottom Line" provided, the triple bottom line will be applied to smart packaging in a similar fashion. Since smart packaging is not a brand or corporation in itself, certain variables of the triple bottom line may not directly apply. Therefore, the triple bottom line will be applied to smart packaging as an evaluation of its functions and ability to benefit consumers and brands while maintaining a sustainable packaging life cycle.

For the social aspect, this thesis will focus on how useful and beneficial smart packaging is to end users (consumers) and brands (business-to-business consumers) that wish to use

smart packaging for their product. This thesis will determine the end users' willingness to purchase smart packaging, how much more they are willing to pay for it, and what their overall level of interest in this technology is. This information will then be used as part of discussing what the benefits and challenges of implementing smart packaging are for brands.

The profits pillar will be evaluated based on how profitable and beneficial smart packaging can be to the brand. This will include monetary profits, increases in brand loyalty, and increases in brand awareness. First, the costs of implementing smart packaging will be looked at, focusing on the prices of various technologies itself. Next, the benefits that smart packaging provides brands with will be discussed. Finally, both of these costs and benefits will be compared against the results of the people bottom line to see if investing in this technology is worthwhile for brands.

When discussing the planet bottom line there will be a key focus on the recyclability of intelligent packaging because electronic components can complicate the recycling process. One main hardware this thesis will look at are RFID tags and the impact it has on end-of-life phases. It is also suggested that RFID tags can be used to solve other sustainability issues such as food waste and increasing efficiency.

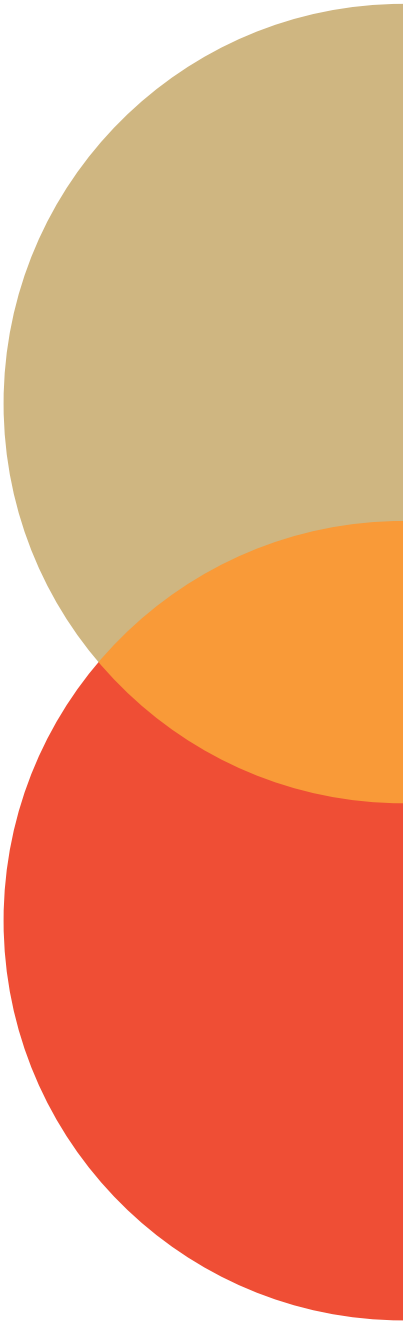
METHODOLOGY

Since smart packaging is a new and emerging technology, not many consumers are aware of what smart packaging is. In order to introduce the concept of smart packaging to readers, the primary method of research for this section was reviewing and researching the functions of smart packaging as well as technologies used in it.

When evaluating the triple bottom line, multiple case studies are used as further evidence of the facts and conclusions made. The goal of conducting case studies is to provide readers with real life examples of brands that are creative with how they use smart packaging technology. In most instances, the case studies allow for a thorough analysis of all three bottom lines including consumer interest, cost of the technology used, and sustainability goals for the packaging.

For the people bottom line, a survey was conducted to receive consumer feedback about smart packaging. The survey was used to determine how willing consumers are to purchase smart packaging, how much more they would pay for it as well as how smart packaging would affect their perception and opinion of a brand, including brand loyalty.

Some limitations imposed on this thesis are time and level of difficulty in determining costs of smart packaging. Due to a time constraint, a longer and more thorough survey with a larger group of respondents was not possible. Within a short period of time, only a handful of consumers were surveyed, acting more as a focus group. Due to the smaller number of consumers surveyed, the numbers cannot be deemed as accurate as those collected from a much larger demographic. The limitations on obtaining accurate costs for smart packaging technologies is that cost is usually determined by the type of product being packaged. Costs are provided in the form of quotes where type of product, volume, size, and type of materials are first taken into consideration. As a student conducting research for the sole purpose of knowledge and information, quotes were difficult to obtain. Therefore, costs listed in this thesis are based on smart packaging technologies that are commercially available. For the purpose of this thesis all costs must be considered as approximations.



RESULTS & DISCUSSION

TRIPLE BOTTOM LINE
People

A smart package needs to be useful and entice a consumer. Consumers need to be willing and interested in purchasing products with smart packaging in order for the technology to truly take off and be successful. They must accept smart packaging and in order to do that, they need to see the benefits of it. To gain insight into how consumers feel about smart packaging, a small survey was conducted. Due to the limitations discussed earlier, this survey is not based on a large group of people, but a rather small group. A total of 25 people were surveyed with the majority of respondents being in the 18-25 (56%) or 26-45 (36%) age range. In terms of gender, the respondents were almost evenly represented.

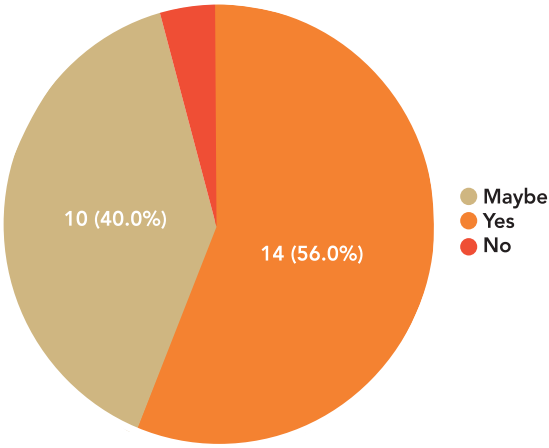
A general question that respondents were first asked was how often they go grocery shopping, to which the results stated that 68% shopped once

a week, 20% shopped less than once a week, and 12% shopped 2-3 times a week. Another question they were asked was if they shopped for groceries online. 24 out of 25 respondents said no they do not while 1 person said that they do buy groceries online. The purpose of these questions was to find patterns on their grocery shopping habits. This information can lead to the creation of smart packaging that targets user experience applications such as access and usage by providing convenience to the consumer. It can also create new purposes and uses for smart packaging.

For brand loyalty, consumers were asked a variety of questions to see what factors and uses of smart packaging would entice them to increase their brand loyalty and purchase a specific brand over others. Based on the results of the survey, respondents would be more loyal to brands that allowed consumers to obtain information such as where their product is coming from, how it was made, and overall transparency and traceability of the product.

Figure 2:
Brand Loyalty

Will your brand loyalty increase if brands use intelligent packaging to present itself as more transparent?



Consumers were then asked how much they were willing to pay for these benefits. Willingness to pay was broken down into three sections: added safety, added convenience, and uniqueness and consumer engagement. Figures 3 to 5 show the results.

Figure 3:
Added Safety

How much more money are you willing to spend on a package offering safety through smart packaging?

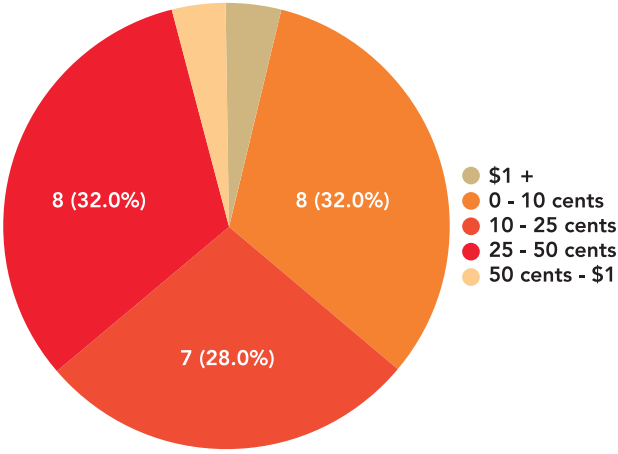


Figure 4:
Added Convenience

How much more money are you willing to spend on a package offering added convenience through smart packaging?

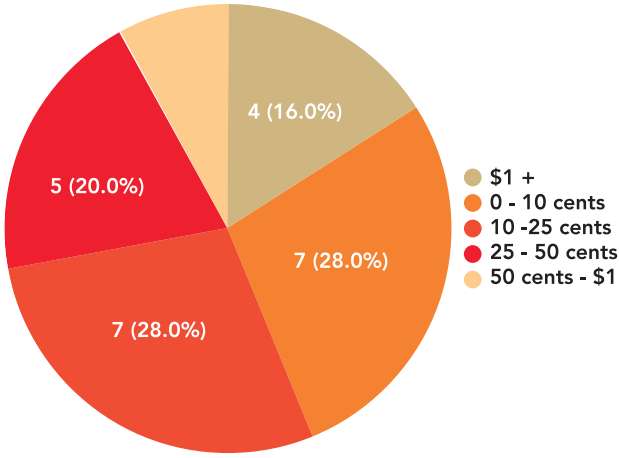
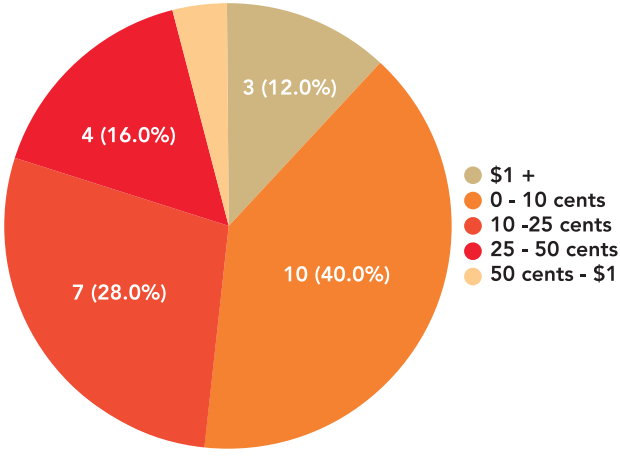


Figure 5:
Uniqueness & Consumer Engagement

How much more money are you willing to spend on a packaging for uniqueness and consumer engagement?



Comparing Figures 3, 4 and 5, one key section that stands out is the varying percentage of how many respondents are willing to pay over $1.00 for smart packaging for the different purposes. In Figure 3, only 4% are willing to pay over $1.00 on smart packaging for safety purposes, while in Figure 4, 16% are willing to pay $1.00 for convenience, and 12% are willing to pay $1.00 or more for the uniqueness and engagement smart packaging provides in Figure 5. This might show that consumers may already think that products are safe enough, and they trust the brands that produce the products they buy. Consumers would rather pay more for smart packaging that provides them with more convenience or engages with them in some way. For safety and consumer convenience, the more expensive sections of the pie graphs have higher percentages of people willing to pay for that feature.

Another factor that respondents were asked about was the sustainability of smart packaging and how that would impact their decision. First, respondents were asked how much they pay attention to sustainable packaging while grocery shopping in general. The responses were that 4% always buy products that have sustainable packaging, 56% try to buy products with sustainable packaging, while 40% have never thought about sustainable packaging while grocery shopping before. Respondents were then asked if they would purchase smart packaging regardless or whether or not it was sustainable and the results were 8% for yes, 68% for maybe, and 24% for no they would not buy unsustainable smart packaging.

CASE STUDY
FRESH - CHECK INDICATOR

TimeTemp Corporation is a leading international manufacturer of time-temperature indicators for food products (Fortin & Goodwin, n.d.). Fresh-Check is one of their products which is a TTI the size of a postage stamp that can be applied to the outside of a package (Fortin & Goodwin, n.d.). In a previous study discussed in this article, consumers in Finland were surveyed about whether or not they were willing to pay more for packaging that included TTIs. 59% said that they were willing to while 41% said no because they believed the food was already safe enough, labels guaranteed food safety and quality, and they could not afford higher prices (Fortin & Goodwin, n.d.). In another study in the Belgian food system, findings revealed that consumers care most about the expiration date, meat type, weight and price on a label and only 10% of the people surveyed were willing to pay more for a label that had more information on it (Fortin & Goodwin, n.d.). However, the labelling with the most traceability and origin information was most preferred (Fortin & Goodwin, n.d.).

In interviews with grocery store managers and food technologists talking about Fresh- Check, some issues that were discovered were that people did not have much knowledge or awareness about these indicators and had a general distrust towards them (Fortin & Goodwin, n.d.). Some retailers also wondered if these indicators would force them to throw out produce that is still sale-able. Retailers questioned about consumer abuse and mishandeling after purchase as well.

Table 1:
Fresh Check® Survey

	YES	NO	MAYBE
Brand Recognition for Fresh Meat Products	37%	63%	
Been or Known Someone who has gotten sick from Fresh Meat Products	26.30%	73.20%	
See a Benefit for Fresh Check® Indicators	74.40%	4.40%	21.20%
More Likely to Buy Product with Fresh Check® Indicator	58.00%	16.80%	25.20%
See Fresh Check® Indicator as Significant Food Safety Advantage	71.70%	7.60%	20.50%
Preference for Buying Product with Fresh Check® Indicator	57.30%	8.50%	34.30%
Prefer Shopping at Stores that offer Fresh Check® Indicators	34.50%	24.10%	41.40%

Source: (Fortin & Goodwin, n.d.)

Table 2:
Fresh Check® Survey

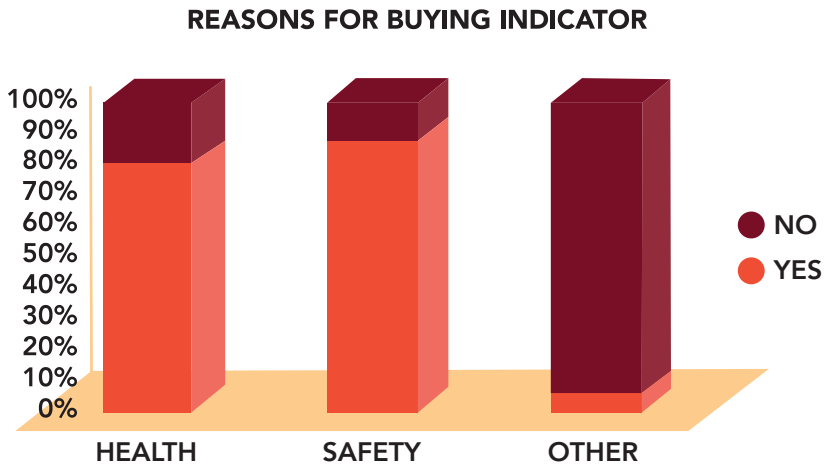
	0 Cents	10 Cents	20 Cents	30 Cents	40 Cents	50 Cents	> 50 Cents
Willingness to Pay	16	104	35	34	11	35	7

Source: (Fortin & Goodwin, n.d.)

Peter Ragaert, a technological advisor for Pack4Food at the University of Ghent in Belgium also mentioned that time-temperature indicators may not be 100% accurate (Fortin & Goodwin, n.d.). Modified atmosphere packaging for example, creates a different environment inside the package than the outside, so a time-temperature indicator on the outside of the package may not accurately predict the actual state of the product (Fortin & Goodwin, n.d.).

For the Fresh-Check product, a survey outside seven major grocery stores was conducted that included about 250 people surveyed (Fortin & Goodwin, n.d.). In this survey, almost 75% saw a benefit to using Fresh-Check as a food safety advantage, while 21% said maybe to seeing a benefit to using Fresh-Check (Fortin & Goodwin, n.d.). 57% said they would rather buy a product with a Fresh-Check indicator on it and the people that said yes to purchasing a package with a Fresh-Check indicator said that the main reason was for safety and health (Fortin & Goodwin, n.d.).

Figure 6:
Fresh Check® Survey



Source: (Fortin & Goodwin, n.d.)

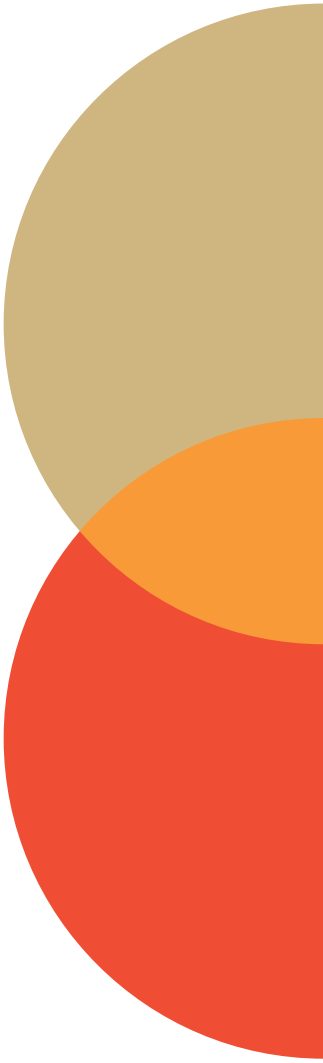
CONCLUSION

Based on the survey data and Fresh-Check case study, there is a real market and opportunity for growth for the smart packaging industry. The applications that consumers would find most beneficial are product integrity (authenticity, traceability, safety) and user experience (convenience and information). Consumers are willing to pay anywhere from 10 cents to over $1.00 depending on how useful smart packaging is for them. Further research should include a bigger survey conducted as well as educating consumers on what smart packaging can do for them. Other methods of research can include tests where consumers are given the opportunity to evaluate some smart packaging examples themselves, try it out, and based on their experience decide how valuable smart packaging can be in their daily lives. As far as sustainability goes, consumers are becoming more aware of the environmental issues prevalent in our world today. The packaging industry's goal as a whole should be to strive for sustainability and that includes smart packaging. However, that being said, there will always be consumers that will buy a smart package, sustainable or not, if it presents them with sufficient value.

TRIPLE BOTTOM LINE
Profits

For brands, the cost of smart packaging is one of the main barriers to adopting and implementing this new technology. Active packaging is a more developed and thoroughly researched technology, and is much older. Due to this, there are not as many high costs for active packaging. Active packaging technologies have also become commercially available such as moisture absorbent sachets. The more costly type of packaging is intelligent packaging, since it is a newer form of smart packaging and includes hardware components. The hardware itself is also a newer technology such as RFID and NFC chips. Implementing RFID and other tags have not yet become a commercial success due to the costs. To embed this technology in packaging, it also requires advanced equipment that has the manufacturing capabilities to support smart packaging.

To evaluate the profits and benefits of smart packaging for brands, the results from the people bottom line will be used to weigh the benefits against the costs for brands interested in implementing smart packaging. Profit may not always be in terms of net revenue. Brands can benefit from smart packaging in other ways such as increased brand awareness and brand loyalty.



ACTIVE PACKAGING COSTS

Moisture Absorbers are a common type of active packaging that have become commercially available. For food applications, the most common forms of moisture absorbers are sachets, pads, humidity regulating trays, and polymeric films. Generally, the commercially available moisture absorbers are little sachets and moisture absorbent pads. These can be bought by consumers for a variety of purposes. The humidity regulating trays and polymeric films are harder to find for consumers since they are used for food and need to be implemented during manufacturing. Listed in Table 3 are the costs of some commercially available moisture absorbing technologies. It is evident that the cost of moisture absorbers can vary greatly. Generally speaking, the smaller the size of the moisture absorber sachet, the cheaper it is.

Table 3:
Cost of Moisture Absorbers

SOURCE	PRODUCT	PRODUCT SIZE	# OF UNITS / BUNDLE	BUNDLE PRICE	PRICE / UNIT
Amazon.ca	Sorb-It Silica Packets	0.625" x 0.281"	Pack of 6,000	$695.99	$0.12
Amazon.ca	Sorb-It Silica Packets	0.875" x 1.5"	Pack of 5,000	$1,236.06	$0.25
Amazon.ca	Sorb-It Silica Packets	0.875" x 2.125"	Pack of 3,000	$567.99	$0.19
Amazon.ca	Sorb-It Silica Packets	1.5" x 3.25"	Pack of 600	$784.99	$1.30
Amazon.ca	Dri-Lock SafePro Moisture Absorbent Pads	4" x 7"	Pack of 500	$75.17	$0.15
Amazon.ca	Dri-Lock Saveazon Moisture Absorbent Pads	4" x 7"	Pack of 2,000	$264.22	$0.13

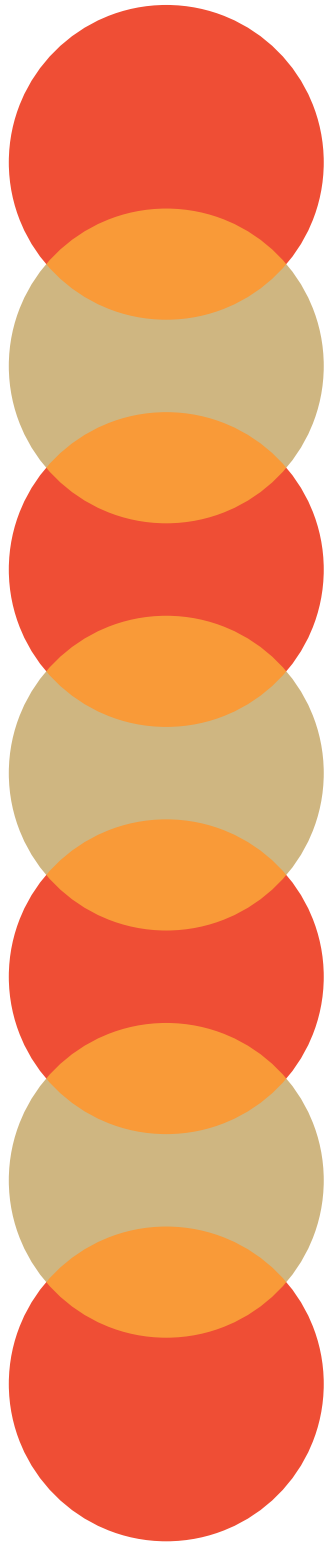
This table takes a look at some commercially available moisture absorbers. Source: (Amazon.ca, n.d.a)

Table 4:
Cost of Oxygen Absorbers

SOURCE	PRODUCT STRENGTH (IN CUBIC CENTIMETER)	# OF UNITS / BUNDLE	BUNDLE PRICE	PRICE / PACKET
ULINE Canada	30	Pack of 6,000	$244.00	$0.04
Amazon.ca	50	Pack of 100	$33.40	$0.33
ULINE Canada	50	Pack of 5,000	$239.00	$0.05
Amazon.ca	100	Pack of 100	$15.74	$0.16
ULINE Canada	100	Pack of 2,500	$166.00	$0.07
Walmart	300	Pack of 100	$29.98	$0.30
Amazon.ca	500	Pack of 100	$34.47	$0.34

This table takes a look at some commercially available oxygen absorbers.

Oxygen scavengers or absorbers are commercially available in the form of sachets, similar to the moisture absorbers. Table 4 provides a list of various oxygen absorbers that are available to consumers today. The cost of oxygen absorbers depends on the strength of the absorber. The strength of these absorbers are measured in cubic centimetre, which indicates how much oxygen it can absorb. A weak oxygen absorber can have a 30cc strength versus a stronger absorber with a 100cc strength.



INTELLIGENT PACKAGING COSTS

As noted before, intelligent packaging is more costly than active because this type of packaging requires a hardware component or a device to act as a reader. The main types of hardware used in intelligent packaging are RFID tags, NFC chips, and TTIs.

RFID tags can cost as little as 10 cents or up to $50 depending on the type of tag used, type of application, and volume of the order (RFID FAQs, n.d.). For smart labels that are applied to pallets and cases, RFID tags usually cost around 15 cents or more (RFID FAQs, n.d.). RFID tags are considered "active" when there is a battery included in the tag. These active tags are the most expensive type of RFID tags because they are completely automated and require no human intervention (Advanced Mobile Group, 2016). On their own, active tags can cost $15 - $20, but when combined with a sensor, the costs can increase to $50 per tag (Advanced Mobile Group, 2016; RFID FAQs, n.d.). Although active tags are battery powered, readers are available for these tags and are the least expensive, costing $1,250 to $1,500 each (Advanced Mobile Group, 2016).

Less expensive RFID tags are ones that are smaller and do not include a battery. These are called "passive" tags. Passive tags require a reader to provide it with the power necessary to respond and transmit data (RFID FAQs, n.d.). Basic passive tags used for paper, non-metal, and liquid materials cost about 10 cents each (Advanced Mobile Group, 2016). Metal passive tags are larger and can be used on metal materials which are a little more expensive at US$1.00 per tag (Advanced Mobile Group, 2016). Readers for passive tags are the most expensive, ranging in price from $3,000 to $20,000 a piece (Advanced Mobile Group, 2016).

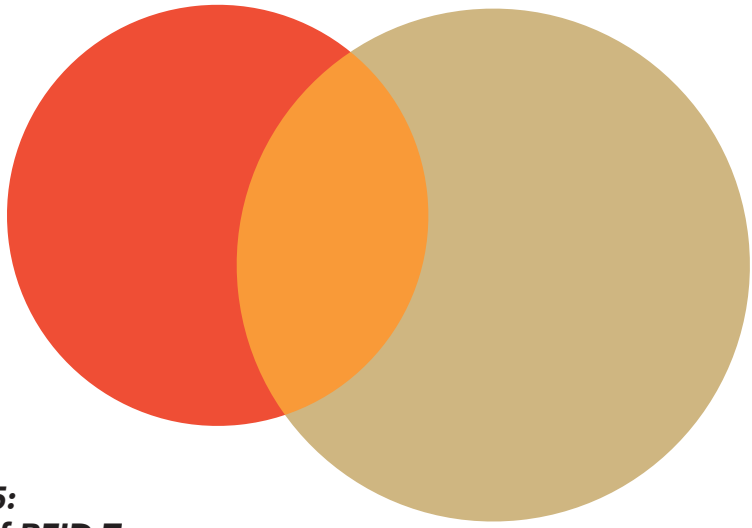


Table 5:
Cost of RFID Tags

SOURCE	PRODUCT	PRODUCT SIZE	MIN. ORDER QUANTITY	PRICE / TAG
Alibaba.com	UHF RFID Inlay	Customizable	1	$0.05 - $0.06
Alibaba.com	RFID Anti-theft Passive Tag	Customizable	1,000	$0.10 - $0.30
Alibaba.com	Plastic Anti-Metal RFID Tag	Customizable	1,000	$0.15 - $0.25
OnlineLabels.com	High Performance Thermal RFID Labels	4" x 1"	2,500	$0.14
OnlineLabels.com	General Purpose RFID Inlay Thermal Labels	4" x 2"	2,500	$0.14

This table takes a look at some commercially available RFID tags.

Table 6:
Cost of NFC Chips

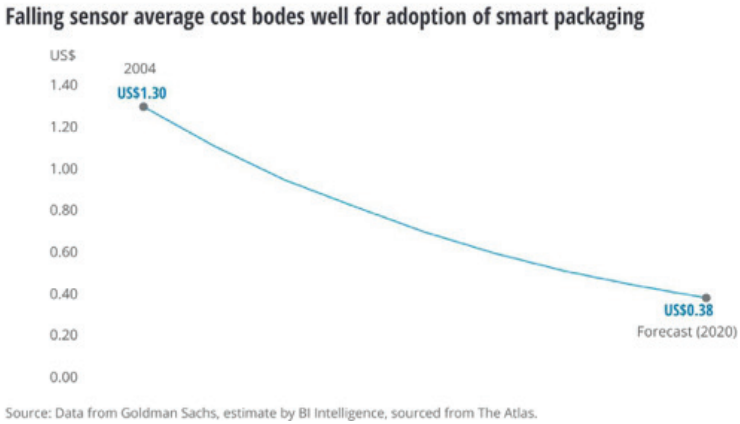
SOURCE	PRODUCT	PRODUCT SIZE	# OF STICKERS / ROLL	PRICE OF ROLL	PRICE / STICKER
Amazon.ca	NFC Stickers	1"	20	$47.75	$2.39
Amazon.ca	NFC Inlay White, Wet	22mm	1,000	$325.22	$0.33
Go to Tags Store	NFC Stickers	38mm	1,000	$384.70	$0.38
Amazon.ca	NFC Inlays Clear, Wet	38mm	1,000	$482.77	$0.48
Go to Tags Store	NFC Stickers	25mm x 25mm	3,000	$929.23	$0.30
Alibaba.com	Paper NFC Inlay Clear, Wet	50mm	500 min. / order	N/A	$0.10 - $0.45
Alibaba.com	Contactless NFC Stickers	custom	10000 min. / order	N/A	$0.12 - $0.15

This table takes a look at some commercially available NFC chips.

A newer form of RFID tags are near field communication (NFC) chips, which are a short range version of RFID tags (RFID FAQs, n.d.). NFC chips also use a reader device such as a smartphone to read data from the chip. The benefit of NFC chips is that they can be formatted to fit and reflect the use case. Tables 5 and 6 depict a list of various types of RFID and NFC tags and their associated costs. Based on the tables, some NFC chips seem to be more expensive than passive RFID tags as well. When comparing the cost of these tags to active packaging technologies from Table 3 and 4, the cost per unit is in the same range.

It should be noted that since intelligent packaging using RFID tags and other electronics is a newer industry, these technologies have not taken off yet. Because smart packaging is in its early stages of the product life cycle, start up costs are still high with early adopters (retailers and brands) trying to pioneer the use of intelligent packaging. However, it is predicted that once intelligent packaging takes off and becomes a mainstream technology, the costs of sensors, RFID tags and NFC chips will decrease. Figure 7, from *Capturing value from the smart packaging revolution*, predicts the falling costs of sensors for intelligent packaging.

Figure 7:
Prediction of Falling Sensor Costs



Source: (Armstrong et al, 2018)

Another form of intelligent packaging with higher costs are time-temperature indicators (TTIs). Table 7 lists the costs of various TTIs and based on the results TTIs are much more expensive when bought in smaller quantities. In general TTIs are more expensive because they are made of complex technology – TTIs must be able to sense the temperature changes and indicate that to retailers and consumers.

Table 7:
Cost of Time - Temperature Indicators

PRODUCT	PRODUCT DESCRIPTION	MINIMUM ORDER QUANTITY	PER UNIT COST @ MINIMUM QUANTITY	HIGHER VOLUMER PER UNIT PRICE
Cold Chain TTI Labels	Non-reversible Temp. Indicators	20	$6.32	$5.06 @ 1,000+
Cold Chain TTI Labels	Falling & Rising Indicators	25	$3.95	$3.16 @ 10,000 +
Cold Chain TTI Labels	Trigger Temp. 5˚, 48 hour run out	100	$3.99	$2.95 @ 5,000 +
Cold Chain TTI Labels	Falling & Rising Indicators	100	$9.00	N/A
Cold Chain TTI Labels	Rising Temp. Monitor, permanent	100	$1.45	$0.93 @ 10,000 +

This table takes a look at some commercially available TTIs.

BENEFITS OF SMART PACKAGING FOR BRANDS

Smart packaging, especially intelligent packaging, can provide a lot of benefits to brands and retailers. RFID tags, for example are a great tool to use throughout the supply chain because it allows for better supply chain management (Pierce, 2014). The supply chain can be made more efficient when the data RFID tags collect is analyzed and weaker points or problem spots in the supply chain can be identified and fixed. In addition, intelligent packaging can enable better stock and inventory management as well. If all products or pallets are equipped with RFID tags or NFC chips, inventory can be accurately calculated through those tags, rather than manually calculating inventory levels.

Smart packaging also provides security of the product and condition monitoring (Pierce, 2014). This would include factors such as any spoilage and shrinkage of product that may occur throughout the supply chain and distribution. It would reduce shrinkage because a brand's products would be connected to a surveillance system via the packaging (Pierce, 2014). This way products can be tracked every step of the way and always be accounted for. Another benefit similar to condition monitoring is extending shelf life. Extending the shelf life of products can provide huge savings to brands if products do not spoil very fast and consumers are still able to consume it. Extending the shelf life would also prevent food from going to waste. Food retailers estimate that about 31% of all food products are discarded due to spoilage, resulting in a loss of US$146 billion (Armstrong, Fazio, Herrmann, & Duckworth, 2018).

A global packaging survey conducted in 2012 on new consumer technology solutions states that some of the key drivers behind the increase in demand

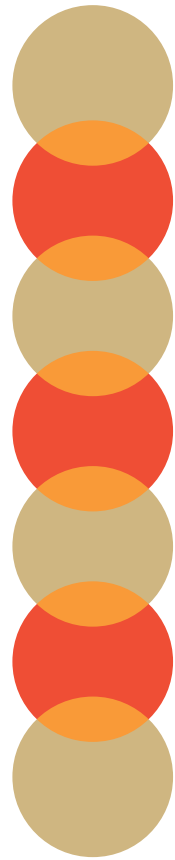
for smart packaging are consumer convenience, lower costs, safety, and traceability ("Global Packaging Survey", 2012). Safety is an important benefit in the food and pharmaceutical industries because it pertains to both consumers and the brand (LaManna, n.d.). This means ensuring that consumers are not prone to any hazards from food or drugs because incidents like that are dangerous, expensive, and can "kill" a brand (LaManna, n.d.). The food and pharmaceutical industries are also becoming tighter on regulations or introducing new ones, requiring brands to find new and innovative ways to ensure their products stay in compliance (LaManna, n.d.).

A key reason smart packaging is beneficial is access to information. Using smart packaging can help brands learn more about their consumers and target them in a more specific way using loyalty offers or special promotions (Pierce, 2014). As mentioned earlier, data collected on consumer behaviour can allow the brand to identify niche markets that they may not have known about or could not target before. With this additional information brands can target niche markets based on how their product is used and consumed.

Along with collecting information, intelligent packaging is used to reach shoppers at the point of sale (Wood, 2016). At the point of sale, intelligent packaging can assist with creating enhanced in-store visibility (Wood, 2016). Specifically, technologies such as printed electronics can be applied to create OLED lighting, allowing the brand to stand out (Wood, 2016). Intelligent packaging also engages consumers while they shop. Consumers can use the smart packaging to access content via their smartphone, download apps, look at additional information, and share an experience online (Wood, 2016). By using intelligent packaging, it also allows the brand to receive feedback from the packaging, to assess and analyze how well their product is capturing consumers' attention.

CASE STUDY: AMAZON DASH REPLENISHMENT SERVICE

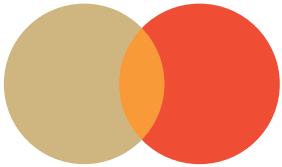
A consumer convenience focused smart packaging technology is being offered by Amazon called the Dash Replenishment Service (DRS), which is beneficial to consumers, and to retailers using this service, as well as Amazon for hosting this service. This originally started out as the Dash Button, which was a piece of hardware (a button device), that allowed consumers to re-order one specific product; the button was linked to a product and consumers would use the button when they wanted a refill on that item. The purpose of the Dash Button was to make purchasing typical low-cost household items easy and convenient. This was a very successful service provided by Amazon. Along with this benefit to consumers, using the Dash Button had benefits for the brand. Dash initiated purchases had increased to 4 purchases per minute by 2017 (Pierce, 2018). Ziploc has more than 50% of their Amazon sales via the Dash Button and Cottonelle's share of the wallet in the bath tissue category doubled from 43% to 86% among Dash users in 2016 (Pierce, 2018). Since then, Amazon has decided to take this technology one step further by using DRS which allows brands to embed the technology directly into their packaging so when it senses that supplies are low, it can automatically reorder that item, even without the push of a button (Pierce, 2018). The smart packaging would include either RFID, NFC or Bluetooth Low Energy (BLE) technology.



From a cost perspective, they are focusing on embedding their service in device-plus consumables, claiming that is the most useful way of using this service right now (Pierce, 2018). In

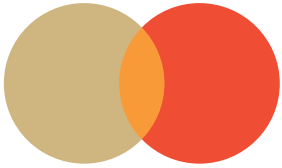
an interview with Packaging Digest, Williams and Jabil Packaging Solutions, the company that creates the technology for DRS, stated that depending on the way NFC chips are implemented in the package, it can increase the cost of the package by 15 cents. An increase of 15 cents in cost makes sense for high-end beauty products and spirits, but not for low cost consumables that are sold for $2.00 (Pierce, 2018). For those low cost consumables, the DRS technology would be applied in the form of a label using conductive inks for the sensory solution and to augment the label (Pierce, 2018). Then it would only be a matter of going from a low-end label to a high-end label with minimal to negligent costs for durables and consumables. Printed electronics are depended on to bring down the cost of connecting packaging to the DRS system (Pierce, 2018). This is because printed electronics can be printed roll-to-roll, allowing them to print faster and cheaper than the current method of printing flexible electronics (Pierce, 2018).

For this DRS service, consumers can use the Amazon app to set their own auto- replenishing level to trigger a reorder, as well as have the option of changing the order in the app if need be (Pierce, 2018). Consumers receive convenience through the smart packaging and control of it through the Amazon app. Other benefits for consumers include keeping an inventory of items in your household and freeing consumers of the mental labour it takes to determine what they need. In a business environment this service can also help ease the process of calculating inventory and increase efficiency in the supply chain (Pierce, 2018). It is also beneficial to brands that embed this technology in their packaging because it provides valuable consumer insight about how their consumers are using their product. It can provide basic yet valuable information such as the frequency of usage and how often it needs to be ordered (Pierce, 2018). This in turn will help brands market their product to specific kinds of households based on use.



CONCLUSION

Based on the data and analysis from the people bottom line and the costs and benefits showcased in the profits bottom line, it can be concluded that investing in smart packaging is worthwhile for brands and retailers. From the data interpreted in the people bottom line, the majority of consumers are willing to pay at least 10 cents for smart packaging. Looking at the costs of actually implementing intelligent packaging hardware the costs of items such as RFID tags and NFC chips are similar, starting at 10 cents or even less. The amount of money consumers are willing to spend will also depend on the type of smart packaging offered. Generally, smart packaging that provides a type of convenience and safety will result in consumers willing to pay more for the packaging. From the survey conducted in the people bottom line, consumers understand that brands that go above and beyond to ensure customer satisfaction and increase safety of products, are brands that put the consumers first. When consumers see that smart packaging applications are beneficial to them, it will increase their brand loyalty. If the right application of smart packaging is identified, brands and retailers will earn their much deserved profits through revenue, brand awareness, and loyalty.



TRIPLE BOTTOM LINE
Planet

It should come as no surprise that consumers, brands, and companies globally are paying more attention to the ever growing environmental issues prevalent today. Consumers are demanding that retailers and brands be more aware of the impacts they have on the environment and come up with innovative solutions to battle issues like global warming. When shopping, consumers are also becoming more conscious of the products they buy, ensuring that the brand whose products they would like to purchase, invest in sustainable practices.

Alas, a global movement is finally happening, with countries and governing bodies banning harmful materials and products such as plastic shopping bags and plastic straws. Brands are coming up with innovative solutions such as biodegradable plastics and packaging as well as implementing zero waste solutions in grocery stores. A major issue that needs tackling is the end-of-life stage in the product life cycle. End-of-life includes activities such as reuse, recycle, recovery, or landfill.

Currently 95% of plastic packaging material value is lost after a short first use cycle, roughly $80 - $120 billion (Ellen MacArthur Foundation, 2016). Plastic packaging material is mostly linear with 78 million tonnes being produced annually (Ellen MacArthur Foundation, 2016). Of the 78 million tonnes, 98% is virgin stock – pure, non-recycled material – with 14% being diverted for incineration/energy recovery – which is the lowest form of value that should be obtained from packaging materials (Ellen MacArthur Foundation, 2016). 40% ends up in landfills, while 32% is leaked into the

environment – land and ocean environments (Ellen MacArthur Foundation, 2016). 14% is collected for recycling and from that 4% becomes lost in the process due to those packages being non-recyclable. 8% of the 14% is diverted for cascading recycling and only 2% is used in closed loop recycling (Ellen MacArthur Foundation, 2016). That is a shockingly low number compared to the majority of the waste that is being leaked out into the environment or ending up in the landfill.

It is clear that smart packaging may pose a problem to the end-of-life stage. Smart packaging can become a complicated package to recycle due to the increasing number of materials used in the packaging. Additives that are used in active packaging could alter the composition of material and decrease the value of a pure material such as corrugate or plastic. Many electrical components are used in intelligent packaging such as RFID tags, NFC chips, and sensors that could contain metal components, adhesives, plastics and other tiny components. This would be considered a multi-material package, which are primarily more complex to recycle and reprocess. In this section, the recyclability of RFID tags primarily will be researched because it is an electronic component that is becoming more popular in smart packaging. Other aspects that will be looked at is how smart packaging can be used to reduce other environmental impacts.

RECYCLING RFID TAGS

RFID tags can be tricky to recycle because it is an electronic component with many materials inside it. RFID tags when embedded into a package, causes that packaging system to be more complex to recycle. One of the main reasons that packaging is not recycled is that packages are made up of multi-materials that are difficult to separate in end-of-life stages. It is evident that the use of RFID tags or any other electronic hardware in smart packaging will prove to be an obstacle when creating smart packaging.

RFID tags are composed of many metals and plastics that are not easy to recycle and reprocess together. The metal and semi-metal components of the RFID tag have higher carbon footprints as well as higher material value (Schindler et al., 2012). According to the book *SMART TRASH: Study on RFID tags and the recycling industry*, recovery of the metals from RFID tags is the most feasible way to reprocess the tags because of the high metal value (Schindler et al., 2012).

One method of recovering metals from RFID tags is "copper metallurgy", in which copper, gold, and silver can be recovered through copper refining. Gold and silver can also be recovered because this process has the collector capacity to capture other metals as well (Schindler et al., 2012). The downside to this process is that aluminum is lost as a secondary metal (Schindler et al., 2012). In another method of recovering metals called "aluminum metallurgy", copper, silver, and gold are lost because they dissolve in the melt and become alloying elements (Schindler et al., 2012). Recovering copper, silver, and gold then becomes a more difficult task later on in the process. To send RFID tags down the metallurgical route, the tags need to be extracted from diverse waste streams, which is not a feasible process (Schindler et al., 2012).

First, it is important to evaluate which waste streams RFID tags will end up in based on where RFID tags are used. Generally, RFID tags fall under the electronic devices category because they contain batteries or other power supplies. The impact of the RFID tag in a waste stream will depend on whether the waste stream is complex or a single material waste stream (Schindler et al., 2012). Another factor to consider would be the recycling process. For example, material recycling usually means that a high purity of the material is needed in recycled objects, but this can become a difficult process if there are too many different materials in that waste stream or the

objects are composed of multi-materials (Schindler et al., 2012).

RFID tags attached to packaging that is a single material will now make that package complex to recycle, resulting in increased costs of recycling and reprocessing.

RFID tags that are attached to an already complex package will have less of an impact on the recycling process because that waste stream would already be equipped for handling complex items (Schindler et al., 2012). In the reprocessing of complex objects, the first step required usually is dismantling or deconstruction of the package to separate the various materials in the package (Schindler et al., 2012). This generally goes for all multi-material packages that are recyclable and can be applied to packaging that has RFID or other electronics embedded in it as well. Another option to recycle intelligent packaging would be to remove the RFID tags manually first, to allow it to be reprocessed for metals, or let it remain attached to a dismantled part of a package and go through subsequent recycling (Schindler et al., 2012).

RFID tags that are used in a closed loop application are reused and do not generally enter the waste stream. Closed loop applications can include RFID tags being reapplied or staying with a container that is being emptied and refilled. These types of applications would normally be seen in a supply chain or distribution systems.

SUSTAINABILITY BENEFITS OF SMART PACKAGING

Although smart packaging may be a complex package to dispose of or recycle in a sustainable manner, it has been argued that smart packaging technologies can actually have a positive impact on other sustainability aspects. For example, as mentioned in the "Benefits of Smart Packaging for Brands" section, about 31% of all food products are discarded due to spoilage, resulting in a loss of US$146 billion (Armstrong, Fazio, Herrmann, & Duckworth, 2018). When discussing smart packaging, it requires looking at the sustainability problem from another point of view. Minimizing packaging can result in a counter-productive solution, where too little packaging may cause the product to be damaged. In the fight against food waste, active packaging plays the role of extending shelf life, not by adding preservatives into the food, but by adding it to the packaging.

Another suggestion to using smart packaging technology is implementing RFID tags in recycling bins to allow authorities to keep tabs on bins (Murphy, 2017). Using RFID tags would also save sanitation workers from spending lots of time determining which bins should go where and what should be in each bin (Murphy, 2017). Since municipal governments earn money from recyclables, implementing RFID tracking chips in bins could help

them enforce recycling rules and save money on trash disposal (Murphy, 2017). That being said, if RFID tags were to be implemented, existing recycling bins would have to be replaced, the tags would have to be purchased, and scanning devices in garbage trucks would need to be installed (Murphy, 2017). RFID tags can also be used to determine the contents of a recycling bin to provide information such as if consumers are recycling and if the waste has been sorted appropriately (Murphy, 2017). Based on this information, necessary action can be taken against consumers who do not recycle or for community outreach purposes to educate communities to participate in recycling (Murphy, 2017).

The benefits of using RFID tags in recycling bins to improve sustainability must be weighed against the possible drawbacks. Some drawbacks include the cost of RFID tags themselves as well as privacy concerns for consumers (Murphy, 2017). Consumers have been known to state that tracking what they recycle by "rummaging through their trash" is equivalent to "peering into their private lives" (Murphy, 2017). Nonetheless, RFID tags can help the end- of-life stages for products by ensuring that they are disposed of correctly and improve overall recycling systems.

SMART PACKAGING CHALLENGES

Although there are many benefits to smart packaging and market size is expected to increase, there are some challenges that brands face when wanting to adopt this new technology. First of all, a factor that brands find challenging is the high cost of raw materials. Companies wonder how they would make money, especially packagers since they provide critical substrates but are not seen as value-added participants to smart packaging (Armstrong et al., 2018). Another challenge brands face is the complexity in recognizing the right technology for their purpose ("Global Packaging Survey", 2012). If smart packaging is implemented incorrectly, without thorough research and use of materials, another problem it can face is recyclability (LaManna, n.d).

It is also speculated that since smart packaging, especially intelligent packaging is still in its early stages of the business life cycle, there is not enough solid evidence suggesting that smart packaging will be a commercial success that will be accepted globally (LaManna, n.d). At the moment, only early adopters and risk takers are investing in smart packaging. As another result of being a new technology, legislation can be a problem because smart packaging has not been standardized. To implement it without creating issues such as privacy concerns, heavy legislation needs to be put in place. Since smart packaging could collect information, it would need to be ensured that the data is sanitized, blinded, and/or aggregated in order for brands to be able to use it without breaking privacy laws (Armstrong et al., 2018). The other issue is who owns the information that is collected since there are multiple stakeholders involved in the process of

creating smart packaging (Armstrong et al., 2018).

As with any new technology and innovation, scalability is a concern for brands (Wood, 2016). Technology must be robust, scalable, and reliable for a high volume of products (Wood, 2016). If smart packaging does become a commercial success, support would need to be put in place for consumers to access for technical support purposes (Wood, 2016). Consumers must also be educated on the various smart packaging technologies so they can recognize and use them correctly. To make it as easy as possible for consumers to use, the interface for smart packaging must be seamless to drive consumer interest and engagement further (Wood, 2016). Other technological obstacles include standardization of the technology itself (Armstrong et al., 2018). Standards for the Internet of Things (IoT) have not yet been established, and because the industry lacks one single standard to which all participants can build solutions to, it is delaying the growth of the industry (Armstrong et al., 2018).

From a management and organizational perspective, one challenge the smart packaging industry faces is that very few brands/companies have all the necessary equipment in-house to create a smart package. Securing and managing all the different pieces required that you do not own for a smart package proves to be a challenge in itself (Armstrong et al., 2018). It would require efficient planning and logistics to be put in place to bring all the pieces together. Despite these challenges and obstacles, the smart packaging industry looks promising, with enough consumers and brands interested in this innovation for the industry to really take off. The credit for making smart packaging a success will go to the early adopters, risk takers, and innovators who believe in the benefits of this technology and work to find new ways to drive costs down and new purposes for it.

CONCLUSION

In conclusion, based on all the evidence provided in this thesis, the assumption can be made that smart packaging at the moment does not meet the triple bottom line, but is very well on its way to getting there. It was originally hypothesized that perhaps smart packaging did meet the triple bottom line – that there are many important benefits for consumers and they recognize that; even though costs were higher than what would be considered ideal, smart packaging provides many wonderful opportunities for brands to connect with those consumers. Even when looking at sustainability, smart packaging can result in complex packaging, but with the right use of materials and avoiding others such as silicon, RFID tags and smart packaging can be recyclable. Smart packaging can be used to assist in other sustainability issues as well such as reducing food waste. Based on predicted future trends of smart packaging, this technology will meet the triple bottom line in the future. Consumers can only be exposed to the benefits of smart packaging if they are able to use it themselves, and that can only happen when brands and retailers are willing to invest in the technology. Brands will invest in smart packaging technology when costs and other barriers are overcome by the industry. Cost, standardization, and legislation are barriers that will be resolved in the near future as the technology continues to evolve, driving costs down and creating a single standard.

When the people bottom line was evaluated, there is an overall mixed signal from consumers. Many consumers say that smart packaging would be beneficial for them and can help make small tasks convenient for them, but there are many others who also say that smart packaging is not an essential technology and therefore are only willing to pay the minimal amount for it.

Of course, not all consumers will be interested in the idea of smart packaging. Smart packaging may only target a niche market of consumers who are looking for more ways that technology can make their lives easier. Because this is also a relatively new technology, it has not yet become a commercial success and many consumers are still unaware of what smart packaging is. If more consumers were exposed to smart packaging and educated on the various ways this technology can be used, they may be more open to the idea of using it.

In the profits bottom line, it is no surprise that the costs of intelligent packaging are currently higher than what brands wish they were. This is due to the fact that it is a new technology, in the early stages of the business life cycle. Costs are always higher during the introduction of new products and technology, which is expected. However, as the technology continues to evolve and become mainstream, costs of hardware such as RFID tags and NFC chips will decrease. Other emerging technology that will help reduce costs include printed electronics as well.

For the planet bottom line, smart packaging can be recycled if it is created appropriately.
In order to create sustainable smart packaging, it is important to first research which materials are ideal for recycling and in what combination. If materials are chosen carefully, then smart packaging can be recycled. In other sustainability aspects, smart packaging can help reduce food and product waste by extending shelf life and providing accurate information on the status and state of the food.

Smart packaging is a very new technology, especially intelligent packaging, and the industry does not have all the resources and capabilities yet to meet the triple bottom line. It is too soon with not enough research and testing being done yet to come to a firm conclusion on the success of smart packaging. Smart packaging is on the cusp of meeting the triple bottom line and as soon as a few wrinkles are ironed out, this technology will change the food and packaging industry for the better.

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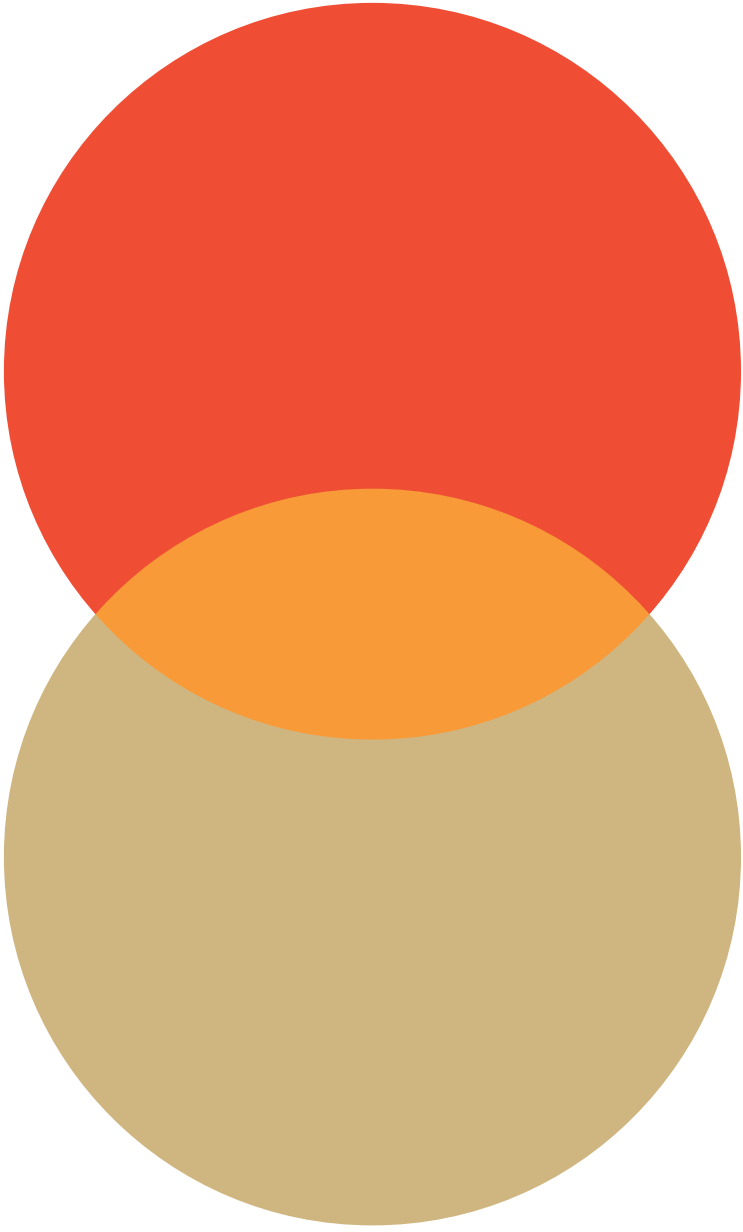


THE SUSTAINABILITY OF EXPANDED GAMUT

Igor Grusecki

3

PREFACE

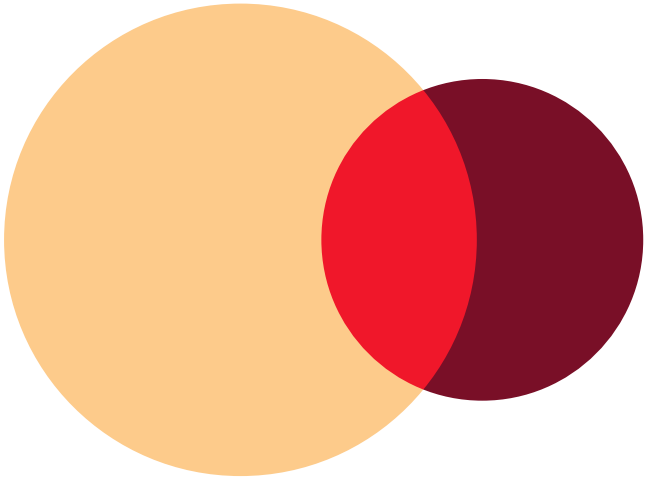
ABSTRACT

This thesis will examine the sustainability of expanded gamut printing. Expanded gamut is the practice of printing using seven colours to produce a high range of colours using a standardized ink set. This eliminates the need for a spot colour on press. However, is it sustainable to use more inks on press? Sustainability, as a term, has been expanded to include the social and economic impacts of an idea or innovation. Instead, sustainability is an examination of the economical, environmental, and social aspects. All of the aspects are equally important; if one fails, the rest fails, thus making the idea unsustainable. Something cannot be sustainable if it fails to be economically and socially conscious as well as environmentally sustainable. It was found that the use of expanded gamut printing is indeed sustainable in the print industry. Of course, there are shortfalls, but the benefits outweigh the costs. It is economically viable, more environmentally sustainable than traditional print, but the social aspect is a net neutral.

THE SUSTAINABILITY OF EXPANDED GAMUT

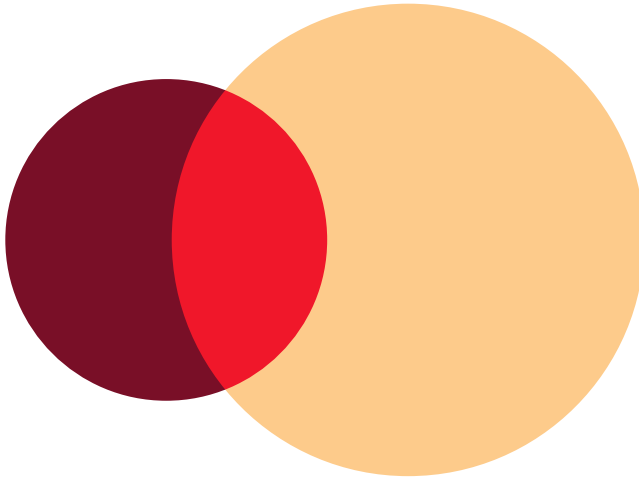
Expanded gamut is the theory of using a plethora of printing inks to achieve more colours on the visible colour gamut. Traditionally, the graphics industry relies on four colour printing (Cyan, Magenta, Yellow and Black). Printers will use Pantone (or spot colour) inks to achieve a colour outside of the colour gamut of CMYK. The CMYK colour gamut currently cannot produce a large array of colours. In terms of the Pantone colour guide, it can only match 60% of the book (Sweeney, 2010), forcing printers to choose between sacrificing colour reproduction or economic costs. However, expanded gamut bridges the gap between colour reproduction and economic savings. Theoretically, expanded gamut "stretches" the gamut by selectively choosing colours

that a regular CMYK gamut fails to reproduce. Through experimentation and modelling programs, most key actors agree that the expanded gamut colours should be CMYK plus Orange, Green, and Violet/ Blue (Baldwin, 2016), which are the colours between the CMYK peaks on a gamut graph. In addition, the ability to gang jobs together by using the same seven inks should mean that there will be cost-savings when compared to jobs using Pantone inks (Baldwin, 2016). However, an analysis of the impact that expanded gamut will have, has yet to been written and there are some underlying questions that must be answered, the most pressing being sustainability. If research and money is being spent to develop expanded gamut, then we need to ensure that it is sustainable. For humanity and society to move forward in a positive direction, the topic of sustainability must be examined in every aspect of life. This thesis will examine the sustainability of expanded gamut printing using the 3 pillars of sustainability as a comparative tool. The three pillars are: environment, economic, and social. The term "sustainable" has been expanded to meet these three terms. If it cannot be economically feasible, then the product will not launch and therefore not be sustainable. The same goes for the social and environmental impacts. This thesis will examine the sustainability of expanded gamut printing based on those three pillars and prove that it is the most sustainable option when compared to four colours + spot colour printing.



BACKGROUND

Expanded gamut printing has been a buzz word in the industry for nearly 20 years and it has yet to become popularized. Although many key industry players are advocating for and funding expanded gamut research, industry standards have not been established. Why is that? A lot of research has been conducted to show the superiority of the expanded gamut, but not enough has been conducted to show the sustainability of the technology. The technology can be potentially superior but if it does not prove to be economically, socially, or environmentally feasible for the industry, then it will not be adopted. In the end, a company must worry about its own survival, which includes the sustainability of its technologies and products. This paper aims to compile reports, articles, and data to prove that this innovation will prove to be sustainable for the graphics industry.



SCOPE

This paper will be an analysis based on the current information available. The breadth of this paper will rely on the availability of the reports and articles currently published by industry members. Additional information and personal insight will be provided via experience gained through personal experimentation with expanded gamut printing, thanks to a research project conducted with Dr. Martin Habekost. In addition to this, critical thinking will be used to help draw conclusions. The goal is to combine hard data (objectivity) with critical thinking (subjectivity) to deliver a report that will be well-informed and accurate.

For the purpose of this paper, the sustainability factor will be mostly compared against conventional types of printing: i.e. lithographic, and lexographic. However, it should be noted that many digital printers use expanded gamut printing today. It will be assumed that the findings derived from the research will be applicable to the rest of the industry.

THEORY

EXPANDED GAMUT

Expanded gamut, extended gamut, EG, and XG are a few of the terms used to describe the method of printing using multiple inks. It is required to have at least seven colours for EG. Currently, the most common ink set to use for EG is CMYK plus Orange, Green, and Violet (or Orange, Green, and Blue). The reason for its advent was the need for high-quality colours and a wide gamut. Figure 1 is an example of a press sheet with both 7C and 4C coloured logos. As observed, the colour difference is apparent. Today, many brand owners rely on their logos for differentiation on the market. They even go as far as trademarking certain colours; such as Tiffany Blue (Conradt, 2017). The CMYK gamut cannot reproduce many of the colours in the Pantone library, and as such, printers rely on the Pantone library to create brand-specific colours. Figure 2 is a ColorThink screenshot that shows that a typical CMYK gamut (like GRACoL) cannot reproduce the Pantone library. However, the use of Pantone inks is not feasible for every job. The use of Pantone inks will increase the costs that the printer will incur. Therefore, instead of using Pantone inks, researchers theorized the use of additional inks to create brand colours. In theory, the idea of using an expanded gamut produces a high range gamut that is also economically

feasible (Baldwin, 2016). Print shops can now rely on the same seven inks for every job, thus eliminating the need to buy one-off inks. In addition, print shops can gang jobs and reduce wash-ups.

Expanded gamut is not a new concept. The first instance of adding more process colours actually began in the 1960s (Seymour, Expanded Gamut - When an Idea's Time has Come, 2018). Hallmark had the issue of reproducing pastel colours for their card. As a solution, they added fluorescent pink, yellow and magenta to help extend the gamut and reach those needed colours. The first patent for EG was filed in the late 1960s Shoichi Shimada for the reproduction of images using CMYK and additional inks (like orange, violet and green). This patent included a simple workflow to create separations. However, it was not until the mid-nineties, where the technology really began to accelerate. Several patents were filed for producing "high-brilliance" colour images, using more than four colours for printing (Seymour, The Heyday of Expanded Gamut Printing Patents, 2018).

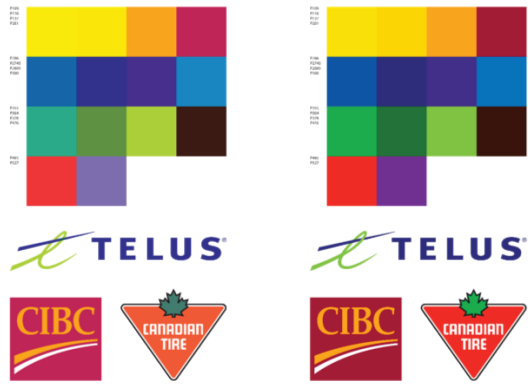


Figure 1

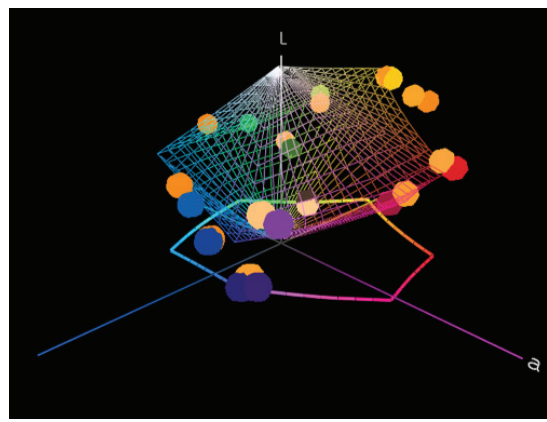


Figure 2

Print researchers realized the potential of "stretching the gamut" by adding colours that would effectively fill in the gaps of a gamut. Early researchers focused on developing Hexachrome, namely Pantone. This was a workflow that relied on using cyan, magenta, yellow, black, orange, and green inks; originally, this was extended gamut printing. Since few printers had more than six printing units, this solution bridged the gap between feasibility and colour reproduction. In 1994, Linotype-Hell released *Hifi Color 3000*. This introduced the seven colour expanded gamut printing. It was argued that seven colours would produce a cleaner, larger, and more accurate colour gamut. One of the first seven-colour patents was Opaltone. This solution was an expanded gamut that used CMYK plus Red, Green and Blue inks rather than CMYK plus OGV. In this, they argued that the RGB inks extend the gamut further than OGV inks since orange can be made from yellow and red. There was a later iteration of this patent that described a solution without the use of black. Instead, one would print with 100% RGB to produce black. This way, the gamut could be extended by relying on six printing units instead of seven. These are just a few examples of companies that published their own patents for expanded gamut solutions. Despite all the effort, the field of expanded gamut has made little headway. The biggest obstacle may be due to the lack of standards to regulate and implement this technology. As a result, expanded gamut has yet to take root in the market. The field of expanded gamut is the future of high-quality print but without a collaborative effort towards standardization, its potential remains limited.

Expanded gamut is a different process than traditional print workflows and requires special considerations. Printing with expanded gamut is more difficult and requires a modified workflow. Unless the press room is willing to adapt to new changes, expanded gamut will remain difficult to achieve. Before the advent of digital workflows and computer-to-plate systems, making separations for expanded gamut printing was incredibly difficult. This is not an issue anymore since most systems

today are deployed with digital workflows and CtP systems. Today, the separations of EG are easy to make but have different requirements. The use of additional inks causes the appearance of moiré patterns to become prevalent. Traditionally, printing is done with AM screening. This method relies on creating tones by using equally spaced dots that change in size, however, undesirable patterns appear if the dots are aligned on the same axis. Since there is a limitation on the number of screen angles possible, the moiré patterns would appear as some inks would share angles. Theoretically, you can use AM screening and find some screen angles that could work. For example, the premedia department could place opposing colours on the same angle. The theory in expanded gamut is that you should only use three inks at a time (with the addition of black if necessary) to produce a colour. Figure 3 is a representation of a colour gamut (based on hue angles). It can be seen that using cyan and orange to produce a colour would not make sense; they are polar opposites. Instead, it would make more sense to use the closest two or three colours. The only way to safely combat this is to use stochastic screening, otherwise known as FM screening. The difference is that FM screening relies on dots that are equally sized, spaced randomly to create tints. That way, you can avoid having to use screen angles altogether, and thus, avoid moiré patterns. It has been recommended to use FM screening with expanded gamut printing (Politis, Tsigonias, Tsigonias, & Gamprellis, 2015). In addition,

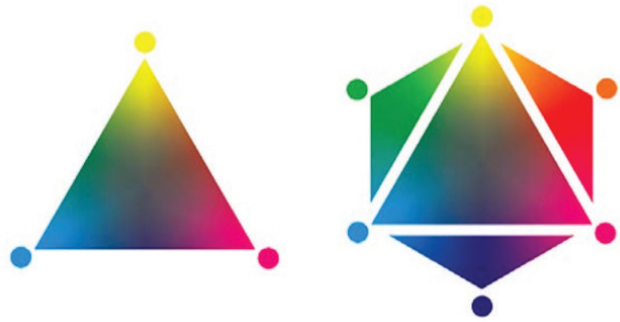


Figure 3

expanded gamut requires software that can handle the modified workflow, from the beginning to the end of the life cycle. Many companies offer their own expanded gamut workflow solution that supports the design, premedia, and production stages. The use of a packaged workflow allows a synergistic approach so that jobs can be processed much easier. For example, when designing using expanded gamut, you require a converter plug-in, such as Esko's Equinox, because design software (such as Adobe Illustrator) cannot handle expanded gamut (Esko-Graphics, 2019). Of course, this is one of many companies that offer their own solution; each company has their own philosophy when it comes to handling expanded gamut. It is best to research each solution, contact the companies, and view a demonstration to see which solution fits your workflow best.

The biggest market for expanded gamut is the packaging and brand managing sector. For companies whose value relies heavily on brand awareness and excellent marketing, a good design is necessary. Good design starts at colour

choice (Chapman, 2010). Strong brand awareness and recognition requires a colour that exemplifies what the company and its products stand for. Usually, companies will elect to use a Pantone spot colour to solidify their branding. Though, it does not make economical sense for every printed piece to be made with Pantone colours nor does it make economical sense for a print house to keep all of their client's required colours. Thus, expanded gamut holds the advantage in this situation. It allows print houses to eliminate the need for multiple one-off inks and increase their efficiency. Smaller companies that wish to grow their brand recognition can now have a wide array of colours to choose from without having to pay a premium for spot colours. Figure 4 is a Delta E calculator (courtesy of Scott Millward) that shows the difference between measured and sample values for Pantone colours. It goes to show that expanded gamut closely matches the Pantone samples and can indeed be an efficient substitute for it.

Figure 4

Patch#	Standard			Sample			Total Colour Variance		
	L	a	b	L	a	b	ΔE (CIE 1976)	ΔE (CIE 1994)	ΔE (CIE 2000)
ΔE: Pantone Solid to 4c	-						#VALUE!	#VALUE!	#VALUE!
P109	86	5.9882812	98.550781	82.6731	3.94556	84.65502	14.43	4.24	3.58
P116	85	8.2382812	89.46875	79.82542	8.15688	83.74392	7.72	5.30	3.69
P137	76	31.140625	81.640625	67.12796	28.95638	70.0777	14.74	9.23	7.29
P201	36	52.921875	23.199219	31.45544	44.27302	19.36292	10.50	5.25	4.62
P286	22	17.929688	-67.91016	31.3258	7.33194	-46.41532	25.72	11.24	7.89
P2745	12	35.980469	-54.53906	21.87686	18.33662	-36.41652	27.15	12.07	9.60
P2685	13	40.988281	-53.39844	24.7759	23.61976	-38.0105	26.02	13.31	10.39
P300	35	-9.691406	-62.01172	41.00658	-3.77156	-45.59166	18.46	7.74	8.47
P355	52	-67.03906	33.949219	51.37074	-57.28578	29.48356	10.75	2.53	2.60
P364	45	-26.76953	35.789063	36.31098	-25.76188	25.17726	13.75	9.88	9.00
P376	70	-37.19141	73.371094	64.48944	-34.32844	54.8245	19.56	7.28	6.72
P476	25	11	12.980469	20.06262	9.18614	8.68992	6.79	5.67	4.62
P485	49	69.101563	54.640625	48.62534	66.48566	49.434	5.84	1.57	1.74
P527	37	48.628906	-48.12891	31.83002	37.11006	-33.73138	19.15	6.95	6.74
	-						#VALUE!	#VALUE!	#VALUE!
ΔE: Pantone EG to 7c	-						#VALUE!	#VALUE!	#VALUE!
P109	85	4.5507812	90.3125	85.30594	2.47798	88.37434	2.85	0.98	1.19
P116	84	7.3164062	88.589844	84.68818	3.93586	89.88928	3.69	1.65	1.98
P137	77	27.449219	79.65625	73.54552	32.99526	87.44434	10.17	4.11	3.44
P201	36	55.328125	18.324219	41.3305	61.0088	21.63886	8.47	5.66	4.96
P286	28	14.34375	-58.07422	27.8147	12.94408	-56.00934	2.50	0.81	0.43
P2745	15	35.765625	-58.55078	14.57436	33.021	-52.21496	6.92	1.80	2.08
P2685	16	41.621094	-54.55859	16.29964	34.98004	-52.6363	6.92	2.51	2.77
P300	37	-7.238281	-52.05078	43.33512	-18.06468	-50.50376	12.64	8.79	8.05
P355	54	-67.41016	35.09375	58.55312	-66.27442	0.87454	34.54	16.15	15.33
P364	44	-27.75391	35.742188	46.69292	-36.36678	39.39216	9.73	4.59	4.24
P376	73	-34.44922	69.996094	69.06776	-26.58024	61.0323	12.56	4.93	4.35
P476	26	9.0585938	11.371094	23.83992	10.11164	10.486	2.56	2.44	2.12
P485	49	69.355469	51.984375	52.42576	64.20962	48.12898	7.29	3.67	3.68
P527	39	39.96875	-40.74219	40.05498	29.72014	-41.05636	10.31	4.79	5.28
	-						#VALUE!	#VALUE!	#VALUE!
ΔE: Pantone EG to Solid	-						#VALUE!	#VALUE!	#VALUE!
P109	85	4.5507812	90.3125	86	5.9882812	98.550781	8.42	1.96	1.79
P116	84	7.3164062	88.589844	85	8.2382812	89.46875	1.62	1.08	0.83
P137	77	27.449219	79.65625	76	31.140625	81.640625	4.31	1.72	1.86
P201	36	55.328125	18.324219	36	52.921875	23.199219	5.44	2.89	2.98
P286	28	14.34375	-58.07422	22	17.929688	-67.91016	12.07	6.65	4.87
P2745	15	35.765625	-58.55078	12	35.980469	-54.53906	5.01	3.31	2.76
P2685	16	41.621094	-54.55859	13	40.988281	-53.39844	3.28	3.02	2.00
P300	37	-7.238281	-52.05078	35	-9.691406	-62.01172	10.45	3.67	3.63
P355	54	-67.41016	35.09375	52	-67.03906	33.949219	2.33	2.05	1.99
P364	44	-27.75391	35.742188	45	-26.76953	35.789063	1.40	1.13	1.06
P376	73	-34.44922	69.996094	70	-37.19141	73.371094	5.28	3.17	2.50
P476	26	9.0585938	11.371094	25	11	12.980469	2.71	1.84	1.91
P485	49	69.355469	51.984375	49	69.101563	54.640625	2.67	1.02	1.19
P527	39	39.96875	-40.74219	37	48.628906	-48.12891	11.56	3.79	3.43

SUSTAINABILITY

Sustainability is a term used to illustrate the impact on the environment. Typically, this term is used to evaluate the impact of a product or technology, including the design, manufacture, distribution, and disposal. It is crucial for the health of the planet that society's impacts are evaluated, as the planet's health is tenable.

There are multiple ways to determine sustainability. One of the best ways to evaluate the sustainability of a product is to perform a Life Cycle Assessment (LCA). This is the examination of the inputs and outputs of materials and energy of a product or service throughout its lifecycle (ISO 14040:2006, 2006). This is an extensive procedure that requires a lot of details for a proper assessment. This process helps managers, creators, and designers to evaluate the sustainability of their product, service, or technology. Then, they can take the appropriate action to achieve better sustainability. This tool is to be used as a guideline to help evaluate but it cannot solve the problem. This tool is highly objective and thus requires further thinking to make decisions.

Another way to evaluate sustainability is to determine how inherently sustainable a product can be. Similar to the LCA tool, this requires the decision-makers to evaluate the inputs and outputs. However, this does not rely on objective data but rather on subjective thinking. Of course, the best way to determine sustainability is to combine both tools. Using objectivity to support subjective thought will produce better and more sustainable products, services, and technologies. These tools can aid in decision making but it requires a strong understanding of the environment and economy to make decisions that will have long-term effects. However, one can achieve only a certain level of sustainability in the cradle-to-grave economy. The best way to achieve sustainability is to remove the cradle-to-grave economy and introduce the cradle-to-cradle economy (Kopnina, 2018). Rather than needing an exorbitant amount of virgin material from unsustainable resources, this system relies on reducing, reusing, and recycling our materials to reduce the strain on the environment.

Sustainability is a complex concept and becomes increasingly complex when trying to implement it into a product, service, or technology. In order for a product, service, or technology to be sustainable, it must be viable for the environment, economy, and society (Kopnina, 2018). All three types of impacts will affect each other, and it is imperative to balance them as best as possible. Of course, the goal is to prioritize the environmental pillars without sacrificing too much from the other two pillars.

The first concept, economy, is the understanding that the idea is marketable (Duić, Urbaniec, & Huisingh, 2015). It does not need to make millions, but it needs to have a net positive effect. Otherwise, the system will reject the idea, which renders it unsustainable. In terms of achieving economic feasibility, there are multiple ways to go about this. The most obvious way would be to create a product or service that responds to market needs. The other way to ensure economic feasibility is to change the system and force it to adopt your idea. To do this, one can either present the idea as an innovation and create a new market; phase out the previous installation so that the market is forced to adopt the new idea; or use a combination of the two. How one strategizes their ethos and achieve those tasks is up to the economic environment and the philosophy which you hold.

The environment pillar regards all information ascertaining to the impact of the idea on the natural environment. It has been simplified to the impacts on the biosphere, atmosphere, and the hydrosphere (ISO 14040:2006,2006). In other words, the impact on the oceans, the air, and our surrounding environment. The environmental impact can be evaluated based on subjective and objective methods of measurement. Using either on their own is not sufficient enough for a proper analysis. Using raw data to examine the impact is necessary as it illustrates how and when the environment is impacted. However, the tool on its own is not enough for decision making. You must use subjective thinking or critical thinking to help guide your decisions. Of course, there are fallacies within this field. One decision may seem logical but prove to be just as destructive. This is known as burden shifting (Manzardoa, Lossa, Nierob, Vianelloc, & Scipionia, 2018). Essentially, this is the result of a decision that shifts the environmental impact from one point in the life cycle to another. This is easy to avoid as long as one is truly committed to sustainability. This means finding evidence to support claims and avoiding any hidden trade-offs. It is crucial to remember that the end-goal of this pillar is to improve the impact even if there are a few trade-offs with the other pillars.

The last pillar, social, regards the impact on all of the actors that are and potentially can be affected by the decisions (Karbassi, 2019). This can be as simple as examining the change in workflow or as complex as evaluating the job satisfaction of employees. If the idea ultimately harms the actors involved, then they will be driven away. As a result, the idea becomes unsustainable. To determine who to evaluate, you have to examine who comes into contact during the lifecycle no matter how insignificant or how few touchpoints they may have. This means the designers, the production employees, and the end users. However, that list is not exhaustive as there are many different people to consider. The way to evaluating the social impact depends on the idea and perspective. There are many ways to do so such as conducting interviews and viewing performance reports. It is important to explore every avenue to gather as much information as possible. Then, one can filter the data by relevance. The data can be either subjective or objective. What is crucial is that you exhaust every opportunity and gather all data before you make any decisions. That way, the decision making is well-informed and will have a better impact on sustainability.

METHOD

This report will rely on the information currently available, so it will be a literature review. The primary goal is to prove that expanded gamut is indeed a sustainable form of printing. A secondary goal is to collect enough information from various sources to collect into one central document that can be referred back to.

Meticulous care has been afforded for ensuring that the resources collected for this paper are relevant and valid. As a result, the methodology of collecting data has relied on database searches and company websites. A majority of the information will be collected from the Ryerson University Library and Archives. This database allows the user to search for a variety of information of different content types, from scholarly articles to newspapers articles. The database is committed to supporting graduates for their research projects and in doing so, review every resource for validity and relevance. Another portion of the information will be collected from company reports directly sourced from their websites. The idea is to collect both types of resources to help broaden the breadth of the paper. In other words, the paper will be a combination of theoretical and practical information. The method of searching involves using certain keywords that help narrow down the millions of articles available.

Most of the resources will have come from other papers investigating other topics within the same field. The aim is to use those findings and data to draw a conclusion for this paper. However, this limits the paper. Gathering information from multiple different sources can muddy the quality of the paper. What may apply in one circumstance will not apply in another. That means this paper is not meant to be an absolute. It should spark more discussions and an interest in pursuing this topic further.

ANALYSIS & DISCUSSION

ECONOMICAL

The method of analysis relies on industry expertise and the costs associated with print. The objective is to prove that the benefits outweigh the costs and is therefore economically sustainable.

THE MARKET OF EXPANDED GAMUT

The first stage is to examine the market potential of expanded gamut. It is important to determine whether companies will adopt this technology. If companies do not see the benefits, then they will not use expanded gamut, which compromises its sustainability. The benefits of expanded gamut grant the opportunity to create a unique market. It can bridge the gap between cost and quality. Traditional CMYK printing is relatively inexpensive but the colour will not be brilliant nor as accurate as the designer intended it to be. Printing with a spot colour allows the opportunity to create brilliant colours that are consistent to design, except, it is expensive to print with. Often, brand owners and designers must choose between the two; cost or quality. But with a set of standard inks that have an extensive gamut, it eliminates the need to decide between the two. Of course, there will be uses for traditional CMYK printing and spot colours. John Sweeney, a key industry market, argues that the proliferation of expanded gamut will create a new market in which meets an increasing demand (Sweeney, 2010). He shows that the growing demand for colour in newspapers, packaging and office documents will transform the industry. As mentioned before,

the regular CMYK colour gamut can only reach about 60% of the Pantone colours and so he believes that there is an opportunity for a market that differentiates itself from traditional CMYK printing and spot colour printing, rather than replacing it. The need for high-quality prints that are an accurate reproduction of brand colours and photos is ever-increasing. However, using spot colours cannot fulfill that need. First, spot colours can only be used as tints and not for process images, limiting the uses available for spot colours. Second, he goes on to argue that the demand for spot colour printing is diminishing as companies realize that the cost-benefit relationship of using spot colours is not beneficial. For example, Unilever has called for the reduction of the use of spot colours in their designs to reduce costs, so that a company will not have to pay a premium for spot colours with limited uses and a limited return. He says that expanded gamut printing can meet both demands of high-quality prints and lower cost. Of course, there is no data to support this but the points that he illustrates show that it can indeed be marketable. As the margin for print narrows, companies are looking for ways to differentiate themselves and reduce cost at the same time. In another article, Matthew Furr claims that one of the most important factors for brand recognition is through colour (Furr, 2014). His article argues that even a slight deviation in packaging design and colour reduces brand recognition and causes confusion amongst consumers (Furr, 2014). This demonstrates the importance of colour variation. Expanded gamut printing produces colours that are cleaner and can closely match the desired Pantone colour.

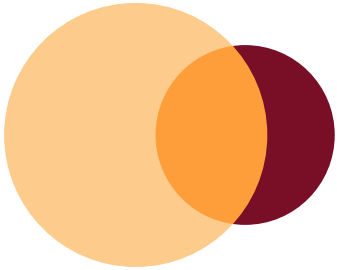
Case in point, there is a market for expanded gamut. The introduction of expanded gamut will change the future of print.

SAVE ON COSTS

The top four concerns in the press rooms are all cost-related: downtime, media waste, ink ordering and storing, and decreasing profit margins. All of these concerns are related to how printing is traditionally conducted. However, expanded gamut gives the opportunity to address all of those issues (Esko). A well-detailed document outlines the face-value benefits of using expanded gamut in a print shop (Baldwin, 2016). The benefits will be outlined and explained below.

The use of expanded gamut calls for a fixed set of seven inks that, theoretically, will never be changed. This means that they can be used for all types of jobs. If the customer does not require seven colours, then the printer can simply turn off the units on the press. Jobs requiring Pantone inks means that the inks on press must be switched out for every job thereby causing significant downtime for the press operators and increased costs for the print house. Any opportunity to reduce downtime results in a quicker turnaround for jobs. This is possible with expanded gamut as it used a fixed set of inks.

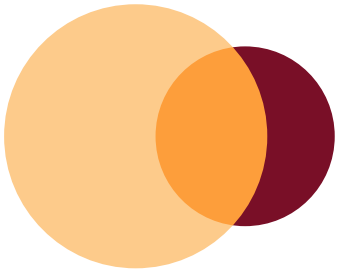
Ganging jobs is another way of reducing costs. It allows the print shop to save on materials like ink and paper. With jobs that have unique Pantone colours, this is not possible. Expanded gamut allows the possibility to print those Pantone



colours without having to separate the press runs. Thus, saving money by ganging jobs together.

Another way of saving on costs is the reduction of speciality inks. Pantone colours are typically printed for brand owners with a special composition. Print houses will have to order, and store those inks until they are used. However, it may never be fully used. Instead, expanded gamut allows the print house to remove the need to order, and store speciality inks by using a fixed set of inks. In fact, the top method in reducing costs in packaging printing is through the reduction of custom spot colours (Seymour, The Heyday of Expanded Gamut Printing Patents, 2018). Expanded gamut enables the reduction of custom spot colours.

All these benefits allow the print house to save on costs and increase their margin. Of course, there are no statistics to support this claim because every situation will be different. It depends on how the workflow is designed in the print house. If the print house relies on many brand owners with numerous Pantone colours, then the savings will be more considerable. Either way, the cost savings are apparent because of the inherent benefits of using expanded gamut.



COSTS OF EXPANDED GAMUT

Whether it be monetary or not, there will be costs associated with printing in expanded gamut. There will be a cost for creating a workflow for expanded gamut and there will be a cost for printing in seven inks.

The first thing to examine is the workflow. Expanded gamut requires a specialized workflow that can handle a seven-colour process workflow. There is a considerable amount of details to consider when designing for expanded gamut; from design to premedia, to production. Of course, there are companies that design workflows that include expanded gamut modules. This means that if the existing workflow has a module for expanded gamut, then it can be as simple as purchasing and modifying the existing workflow. The cost of doing so is unknown as it depends on the needs of the print house and can range greatly. It simply depends on how holistic and modular the workflow is. The more holistic and modular, the more inexpensive it will be (Esko). The other aspect to consider is the equipment. The press room must be able to support seven colour printing. If the press room

only has four colour printing machines, then expanded gamut is not a viable choice. It would be remiss to invest in an expanded gamut workflow if it does not fit the current workflow. If the press room can already support seven colour printing, then it would not be too costly.

The biggest issue to consider is whether the existing workflow can support expanded gamut. In terms of actual costs, the largest factor lies within updating the workflow to fit. It requires a sizable investment (Ellis, 2017). In terms of actual printing costs, theoretically, it should not be any different than printing with traditional CMYK. Printing with expanded gamut only requires 3 inks to be laid down at any point. So, the ink use is then spread out across the 7 colours. Thus, the cost of printing with expanded gamut versus CMYK should not be different. That being said, there is no public data to support this. Most companies that manufacture an extended gamut workflow do not have any claims ascertaining to cost-savings or costs. They illustrate theory and facts that support the fact that expanded gamut is a good system.

CONCLUSION

The economical return will prove to be a worthy investment for print houses. It has the potential to meet an unseen market that has been previously unsatisfied. In addition, the cost of using expanded gamut only lies within having to adopt expanded gamut into the workflow. There are multiple authors, including Ryerson's own Abhay Sharma, reporting that the use of expanded gamut helps to increase the colour gamut as well as reduce costs (Sharma, 2016). Many of the industry experts agree that innovation is the future of the industry, specifically, for packaging and brand recognition purposes. An article by Graphic Arts Magazine actually examines the lowering cost of using expanded gamut. As the development of digital workflows and enabling technologies grows, the cost and complexity of expanded gamut shrinks (Smyth, 2017). So, the actual costs of implementing expanded gamut rely on the technology surrounding it. The economic benefits clearly outweigh the costs, therefore it is economically sustainable.

ENVIROMENTAL

With the increase of environmental consciousness, there has been an increase of criticism in the printing sector, especially with the use of a natural resource. In fact, print is one of the most sustainable industries (Anonymous, 2009). Wood is a renewable resource that can be sourced from farms rather than old forests. Also, a significant amount of input resources can be sourced from recycled fibres which reduces the load on virgin materials. Both concepts allow the industry to be a part of the circular economy (Jones, Rundle, & Crownover, 2018). In regard to the other aspects of the printing industry such as ink, plates, and waste, the industry is quite advanced. Unfortunately, the LCA tool requires specific product features and applications so it is difficult to assess with this approach (Elia, 2013). However, a considerable amount of the industry has environmental standards and specifications. This forces the industry to meet a level of environmental accordance that ensures that it is sustainable. Although, many companies choose to invest in environmental issues as it is a part of their civic duty (Masurel, 2006). In this case, the impacts on sustainability fall upon the ink and the waste in production (Lankinen, 2017). These are the only impacts on sustainability that have any significant weight. Of course, one can examine the use of energy in the process of printing. However, one can assume that the difference in energy is negligible (Lankinen, 2017). Even so, the source of the energy can come from a renewable source. Therefore, it will not be considered in this paper. The main point to prove is that the use of expanded gamut will reduce the amount of ink needed and reduce the overall waste in the pressroom.

REDUCTION OF WASTE THROUGH STANDARDIZATION

For expanded gamut, the environmental impact is quite hard to approach. There are no claims in regard to decreasing the impact. However, there are some implicit claims that can be derived. Expanded gamut standardizes the inks used in the press room. This eliminates the need for Pantone inks altogether. The environmental issue with using Pantone inks is the material waste and the production of an ink that is never used to capacity (Sweeney, 2010). Often, the ink is ordered, and then stored or disposed of. This is a waste of materials and therefore not a part of circular economy thinking. Instead, expanded gamut eliminates the need for Pantone inks altogether. In addition, there is material waste involved with having to print with Pantone inks. For every job, the printer must be set up to be used as a proofer as well (Baldwin, 2016). In order to produce a colour accurate proof, the press must be used to print a proof, thus materials must be consumed before the production begins. Through a standardized expanded gamut process, it eliminates the need to use the press as an expensive proofer (Baldwin, 2016). Once the press is characterized, then material waste will be severely reduced.

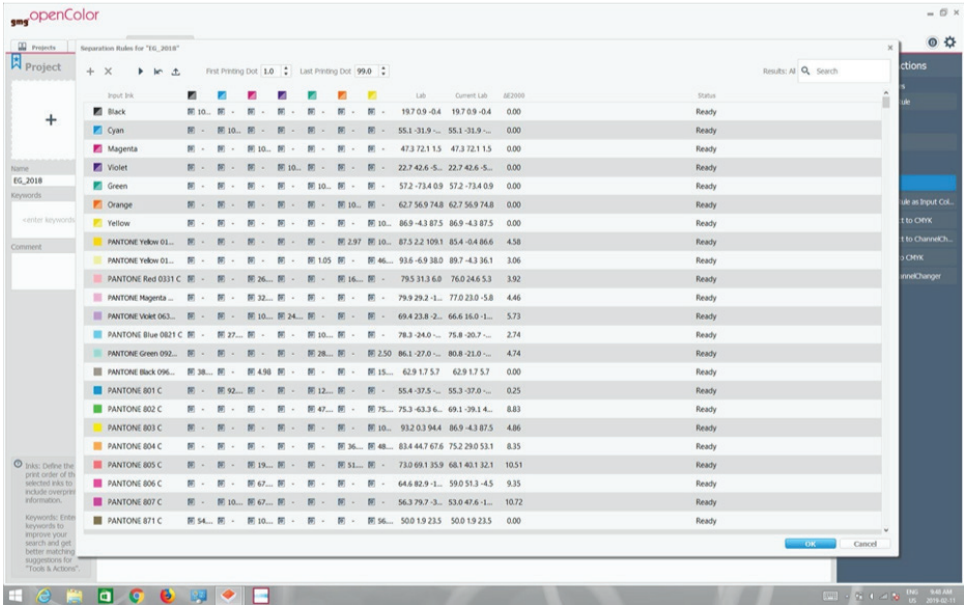
EXAMINATION OF REQUIRED MATERIALS

In expanded gamut, the only material that changes is the ink and its use. Similar to traditional print, it is a form of process printing, where the ink is laid down to produce halftone images. However, with a different amount of inks, that means there will be a different percentage of ink laydown. This means that one form will use fewer materials, and therefore be more environmentally stable.

In terms of ink use, there should be a reduced use of ink. Recall that printing with expanded gamut only requires the use of three inks at most. Printing with CMYK will print with four inks at most. This means that, implicitly, there is a reduced use of ink through expanded gamut. For example, to produce an orange with the CMYK ink set requires 100% yellow and 50% magenta. That means there is a 150% ink laydown. However, with a CMYK + OGV ink set, you only need 100% orange, or a 100% ink laydown. This is just one example in which it shows that expanded gamut requires less ink. In addition, it was found that in practice, printing with 7C actually used less ink overall. The overall ink laydown percentage was nearly 50 to 100% less. The additional colours meant that

less ink was required to create certain colours. Although there are more inks on press, the actual product requires less ink overall. Figure 5 is taken from GMG's OpenColor software. In the research project, it was used as a profile calculator to determine the separation values for the printing of the test form. OpenColor uses advanced calculations to determine the best separation values for colour accuracy. It was found that many of the colours (including the entire Pantone library) required less ink than CMYK printing. For example, to produce Pantone 201 using CMYK required: C: 7%, M: 100%, Y: 68%, and K: 32% for a grand total of 207% ink coverage. To produce Pantone 201 using expanded gamut required: M: 100%, O: 56%, and V: 26% for a grand total of 182%, which is 25% less ink. Having more process colours will allow the press to produce cleaner colours and therefore use less ink. So, through adding printing units, this reduces the amount of material used for production.

Figure 4



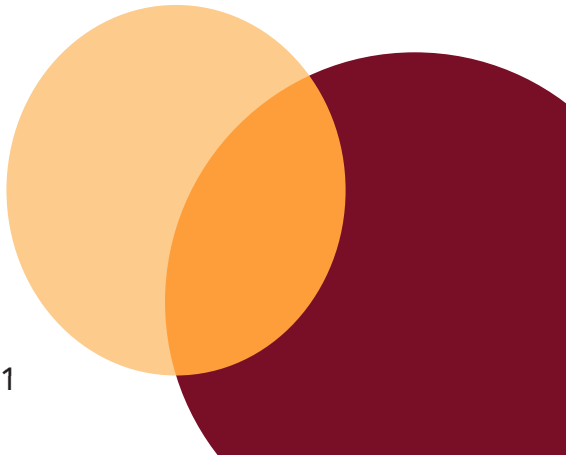
Another thing to consider is how the ink is manufactured. Ink is comprised of two elements; the vehicle, and the pigment. Both can severely affect the sustainability factor. A vegetable-based oil ink that is sourced from a sustainable source is a relatively good sustainable choice. Traditional CMYK printing now relies on the sustainable manufacture of inks (PPI Pulp & Paper News Service, 2014). Through reliable, and sustainable sources, manufacturers have now standardized the production of sustainable inks. These inks are typically used for commercial CMYK printing. Since expanded gamut is an extensible form of CMYK process printing, one can assume that the inks used for expanded gamut can be manufactured the same way. This is not a positive, but it is not a negative either; it is a net neutral.

CONCLUSION

Expanded gamut is more environmentally sustainable than printing with a spot colour. Overall, it reduces the amount of ink and wasted materials. Since it produces cleaner colours, it requires less ink to be laid down. In addition, it helps to standardize the process which then reduces the amount of waste in production. Indisputably, printing using an extended gamut ink set helps to reduce material use, and is, therefore, more environmentally sustainable than traditional CMYK printing with a spot colour.

SOCIAL

The social aspect is evaluated by examining the way the idea affects the people involved. It is important to see how people will adapt to meet the new criteria. Any form of resistance to change can jeopardize the investment. Normally, this is examined by the quality of life, and the change thereof. If the net quality of change is negative, people will become disgruntled and oppose the changes rather than support them. In this circumstance, this will be evaluated by examining how the workflow will be changed. Printing for expanded gamut requires a modified workflow that is specifically designed for it. If the change is too drastic, then the workers will oppose it and not adopt the changes to its full potential. This portion will illustrate exactly how different it will be to traditional printing.



DESIGN & PREMEDIA

The first step is to characterize the press so that a profile can be created in which the designer can create a design in line with the press's capabilities. Designing the product becomes simpler as the designer is now less limited by the colour gamut on press. Most of the change occurs in the premedia; processing requires extra effort, but once standardized, it becomes a part of the workflow. The first step is building or purchasing a workflow that can handle the expanded gamut workflow and includes layout tools, colour management tools, processing templates, and much more. A non-monetary cost associated with a new workflow is having to train employees to use the new system (or a new module), which can prove to be difficult. Not everyone can be a quick learner which can affect productivity and company turnaround. Some workers may be disgruntled due to the new changes. However, some may actually welcome the new changes. This is tough to determine without assessing the behaviour and reaction in the press room. It is important to consider workers' perspectives and have empathy. They are the backbone of the press room and it is imperative to support them throughout the process. However, once the changes are implemented, then they are permanent. Once the workers are trained and become used to the changes, then things will return to normal business. This was seen during the research project with Martin Habekost. The original workflow had no support for expanded gamut. This meant that most of the workflow had to be made via trial and error. There were many inefficiencies which slowed down the entire process. However, once it was figured out and documented, the process became efficient once again.

PRODUCTION

Handling the production of an expanded gamut workflow is not a hard task. In fact, a properly implemented expanded gamut workflow will blend in with the current workflow. This approach does not require the press room workers to change their current workflow but rather requires a simple adaptation. However, it requires a significant amount of time for makeready. When compared to a traditional CMYK workflow, the makeready process becomes longer and requires more work as there are more colours to work with. If the press room is used to printing with more than four colours, then it would not be much of a change. Again, it is not more complicated but rather more work that requires more time. If the company regularly has jobs for spot colour printing, then the impact will be minimalized.

CONCLUSION

Overall, the impact on the social factor is a relative net neutral. The use of expanded gamut does not bring any inherent abilities to improve the workflow. It does have the ability to bring standardization to the press room. Its larger range of colour means that the company can rely less on spot colour printing. This simplifies the overall process and makes the workflow easier. However, the same can be said for traditional CMYK printing. Both use a fixed set of inks that, in theory, do not require special modifications per job. Therefore, the usage does not promote any social benefits. One thing to consider is the temporary disruption in the workflow during the implementation of expanded gamut. During implementation, workers have to adapt to the new changes. This is performed through training and conducting practice using the new system. It is important to support the workers during this phase as the success of the use of expanded gamut relies on the happiness of the workers. Disgruntled workers will result in lowered efficiency or worse, exodus. However, this stage is temporary. Once implementation is complete, the temporary duress is eliminated and returns to a net neutral.

CONCLUSION

RESULTS

Expanded gamut is the future of print. The benefits outweigh the negatives by a large margin. Its potential to tap into an entirely new market is an exciting prospect for printers wishing to differentiate themselves and increase their profit margin. The sustainability of expanded gamut is an important topic to examine because it determines the long-term prospect.

It was determined that expanded gamut is a sustainable concept. It was found that the benefits outweighed the costs in both the environmental and economical aspects. It is clearly marketable and is economically viable for the print industry. It can meet an unsatisfied need in the industry. It can bridge the gap between cost and quality. So, the initial fixed costs will be justified by potential economic return. Environmentally, it was found that it is more sustainable than CMYK print with a spot colour. Once standardized, it requires less waste during makeready, and it requires less ink. Overall, it uses fewer materials and reduces waste. Therefore, it is more sustainable. In terms of a circular economy, it satisfies the requirement of reducing the use of materials. To be fully sustainable, the inks must be sourced from a renewable source. Regardless, the innovation reduces the need for material, thus reducing the strain on virgin or recycled stocks. In terms of the social aspect, it was found that it was a net neutral. Expanded gamut does not have any benefits with respect to increasing the quality of life. A standardized ink set will reduce the strain and stress, however, a press operator will have been used to that. Therefore, a net neutral. Although, it should be noted that during the implementation, a net negative will take place. Until the workers have been trained and accept the new workflow, there will be a level of dissatisfaction. Of course, the company should support the workers so that they return to being happy and limit the negative impact.

LIMITATIONS & RECOMMENDATION

This paper severely lacks objective data to help support the subjective critical thinking. The critical thinking carries validity; however, objective data helps to support those claims. The lack of industry data makes it hard to evaluate. A lot of the information is derived from articles that support the use of expanded gamut. However, most of the articles do not provide data or charts that support these claims. For the future, an analysis like this should have more objective data. To obtain this data, an experiment should be set up to compare multiple processes and determine their sustainability. That way, it is possible to obtain data as well as compare it against a baseline. In addition, it is imperative to gain support from industry leaders. This helps to apply industrial knowledge that can be applied to the theory.

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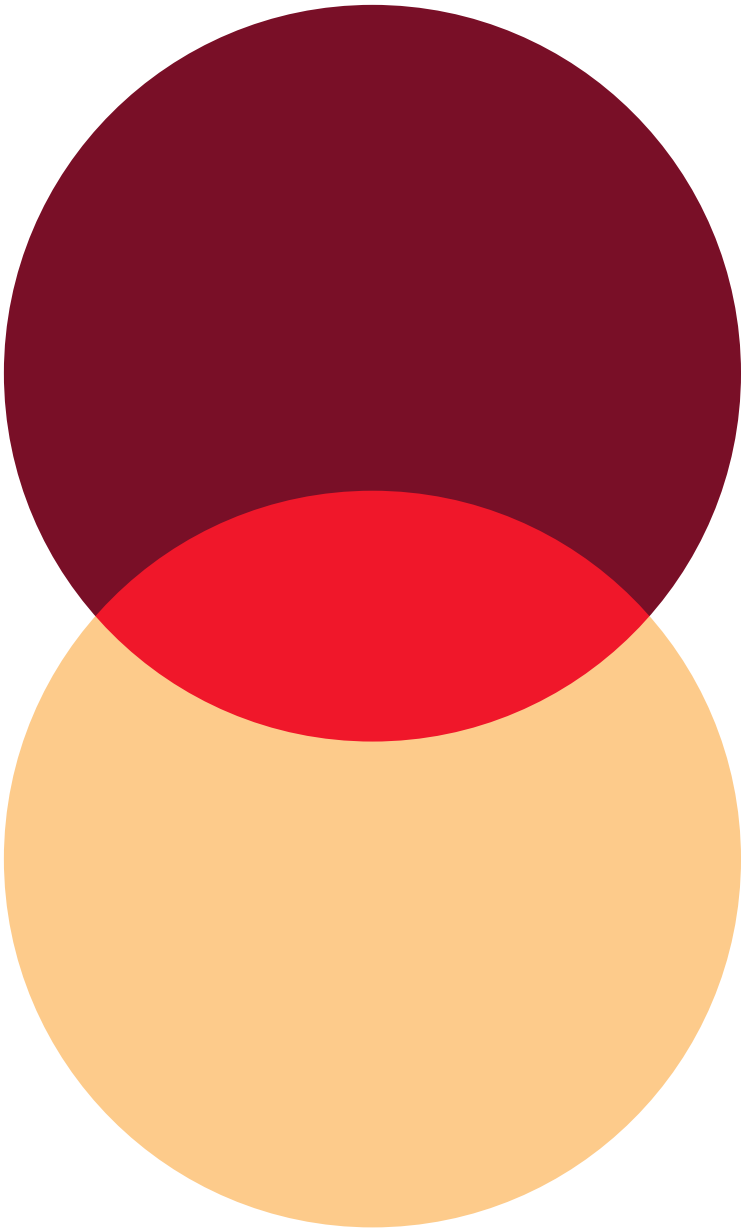
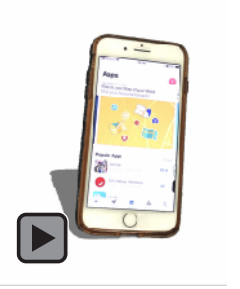




PRINCIPLES OF DESIGN IN IPHONE APP EVOLUTION FROM 2008-2019

Melissa Wroe

4

ABSTRACT

The purpose of this thesis is to research the principles of good and bad design by completing a subsequent review of the evolution of iPhone applications through the years 2008 until 2019. This thesis explores the principles of design while providing a subsequent review of the evolution of iPhone applications from the years they were invented until the present. The results of the surveys and research conducted show which design features and appearances are present in the most successful iPhone application versions. Through the use of surveys and the evaluation of the principles of good and bad design for each annual top rated application, it is clear that iPhone users tend to prefer the most recent version of iPhone applications due to their good design features and appearances.

chapter 1

INTRODUCTION

The objective of this program of research includes the evolution of iPhone applications through a subsequent review of the principles of good and bad design through the years 2008 until 2019. The goal of this paper is to answer the following question: what applications throughout the last decade have faced good and bad design principles during their evolution, and why? The focus of this study is to examine specific popular applications that have had major changes through their evolution, and how they are presently being designed to be compatible and adaptable for users.

The purpose and specific aim of this study is to be able to provide a subsequent review based on the principles of good and bad design on several popular and frequently used applications. The purpose of this study is to explore the reason(s) why application developers chose to change the application's design features throughout the years. The objective of this study is to determine what design features are the most successful and prominent in iPhone applications.

chapter 2

HISTORICAL BACKGROUND & PRODUCT INFORMATION

Steve Jobs, American inventor, designer and entrepreneur who co-founded Apple, believed that cell phones were going to transition into significant devices for portable information access, hence, cell phones need to have excellent software synchronization (Apple Stock, 2017). Steve Jobs focused on the iPod's synchronization abilities to make it compatible with the iTunes software that Steve Jobs had developed in January 2001. On September 7, 2005, Apple partnered with Motorola to release the ROKR E1, which is the first mobile phone to synchronize with iTunes. Shortly after, Jobs was unsatisfied partnering with a non-Apple designer since this would prevent Apple from fulfilling its full potential. One year later, September 2006, Apple decided to discontinue their partnership with Motorola (Andreescu, 2005). On January 9, 2007, at the Macworld conference, the very first iPhone was unveiled as Steve Jobs revealed that Apple had been working on this iPhone for over 3 years due to its cutting-edge technology (History Cooperative, 2019). This device was introduced

first as an iPod with a large touch screen. It was described to be a mobile phone and a device connected to the internet simultaneously. This was Apple's first step in "reinventing the phone" (History Cooperative, 2019). Six weeks before the release of the iPhone 2G, Steve Jobs replaced the plastic screen with glass as the prototype was more susceptible to scratches. The following chart lists the subsequential iPhone developments following the iPhone 2G.

iPHONE VERSIONS AND SPECIFICATIONS

iPHONE VERSION	GIGABYTES	COLOUR	CAMERA SPEC
iPhone 2G	4, 8, 16 GB	Aluminium (Grey)	Back: 1.9 MP
iPhone 3G	8, 16 GB	B & W	Back: 1.9 MP
iPhone 3GS	8, 16, 32 GB	B & W	Back: 2.1 MP
iPhone 4	8, 16, 32 GB	B & W	Back: 5.0 MP, Front: 0.3
iPhone 4S	4, 8, 16, 32 GB	B & W	Back: 8.0 MP, Front: 0.3
iPhone 5	16, 32, 64 GB	B & W	Back: 8.0 MP, Front 1.2
iPhone 5c	16, 32, 64 GB	G, P, W, Y, B	Back: 8.0 MP, Front 1.2
iPhone 5s	16, 32, 64 GB	Gold, Silver, Gray	Back: 8.0 MP, Front 1.2
iPhone 6	16, 64, 128 GB	Gold, Silver, Gray	Back: 8.0 MP, Front: 1.2
iPhone 6 Plus	16, 64, 128 GB	Gold, Silver, Gray	Back: 12.2 MP, Front: 5
iPhone 6s	16, 64, 128 GB	Gold, RoseG, Silver	Back: 12.2 MP, Front 5
iPhone 5c	16, 32, 64 GB	G, P, W, Y, B	Back: 8.0 MP, Front 1.2
iPhone SE	16, 32, 64, 128 GB	Gold, RoseG, Silver	Back: 12.2 MP, Front 1.2
iPhone 7	32, 128, 256 GB	Gld, RseG, Slvr, Red, Bk	Back: 12.2 MP, Front: 7
iPhone 7 Plus	32, 128, 256 GB	Gld, RseG, Slvr, Red, Bk	Backx2: 12.2 MP, Front:7
iPhone 8	64, 256 GB	Gold, Silver, Gray, Red	Back: 12.2 MP, Front: 7
iPhone 8 Plus	64, 256 GB	Gold, Silver, Gray, Red	Backx2:12.2 MP, Front 7
iPhone X	64, 256 GB	Silver, Space Gray	Backx2:12.2 MP, Front 7
iPhone XR	64,128, 256 GB	Red, Y, W, Coral, Bk, Bl	Backx2:12.2 MP, Front 7
iPhone XS	64, 256, 512 GB	Gold, Gray, Silver	Backx2:12.2 MP, Front 7
iPhone XS Max	64, 256, 512 GB	Gold, Gray, Silver	Backx2:12.2 MP, Front 7

Note:

Each MP refers to megapixels in regard to each camera specification. B & W refers to Black and White, G refers to Green, P refers to Pink, W refers to White, Y refers to Yellow, Bl refers to Blue, RoseG refers to Rose Gold, Gld refers to Gold, RseGld refers to Rose Gold, Slver refers to Silver, Bk refers to Black, Gray refers to Space Gray.

chapter 3

IPHONE APPLICATION BACKGROUND : 2008

IPHONE APP STORE

The following chapter will explore the background and the design features of the first version applications that were invented when the App Store was first introduced in 2008.

The iPhone App Store was released to iPhone users on July 10, 2008. One day later, Apple released the iPhone 3G that came with pre-installed applications from the App Store. The App Store first launched with over 500 applications; over 125 of the applications were free, while the other applications cost $9.99 or less. Apple trademarked the term "App Store" in 2008 due to many competitor companies using the term "app store" for their mobile devices. On the 2008 App Store, users could browse by category listings such as: Business, Education, Entertainment, Finance, Games, Healthcare & Fitness, Lifestyle, Music, Navigation, News, Photography, Productivity, Reference, Social Networking, Sports, Travel, Utilities, and Weather. Most of these applications take full advantage of the iPhone's large display with the multi-touch user interface and fast hardware-accelerated 3D graphics technology (Apple Inc, 2017). In February 2013, Apple informed developers that

they could begin using Appstore.com for links to their own applications. Applestore.com URLs were generated automatically and linked to individual apps or to a developer landing page (Foresman, 2013). Apple created this service so that it was easier to promote apps with the capability to remember the Web address. The App Store added a "Kids" section which was a new feature that categorized apps by age range and was released with iOS 7 in September 2013 (Perez, 2013). In 2014, Apple updated the App Store so that all applications that were free to download were labelled as "Get" instead of the original "Free". This update was due to many "free" applications' inclusions of paid in-app purchases where users purchase virtual goods with micropayments; this involves a small sum of money that is transferred online (Apple Inc, 2017). On January 2017, the upcoming releases of iOS 10.3 allowed developers to respond to customer reviews in the App Store, which made a significant change from the original limitations that prevented developers from communicating with application users. In March 2017, the App Store rejected application submissions containing pricing details with the words "free" in the name.

APP STORE DEVELOPMENT

Apple's CEO Steve Jobs did not plan for third-party developers to build native apps for iOS, instead Jobs directed them to make web applications for the Safari web browser (9To5Mac, 2016). However, after backlash from the developers, Apple reconsidered with Jobs as they announced in October 2007 that Apple would have a software development kit available for app developers by February 2008 (9To5Mac, 2016). The software development kit that Apple released was a free download for users of Mac computers. This software also contains an iPhone simulator to mimic the look and feel of the device on the computer while developing the app. To test the applications made with this program, developers were required to subscribe to Apple's Developer Program. The Software Developer Program was combined with XCode, which is an

integrated development environment for the macOS containing a suite of software development tools for developed Apple software (Apple Inc, 2012). The software developer kit, combined with XCode, used officially supported programming language including Swift and Objective-C. Swift is a general-purpose, multi-paradigm, compiled programming language developed by Apple for iOS, macOS, watchOS, tvOS, Linux and z/Os. Swift was created to work with Apple's frameworks and the large body of existing Objective-C code written for Apple products. Objective-C is a general purpose, object-oriented programming language that adds Smalltalk-style messaging to the C programming language and is the main programming language supported by Apple for the macOS and iOS operating system (Apple Inc, 2019).

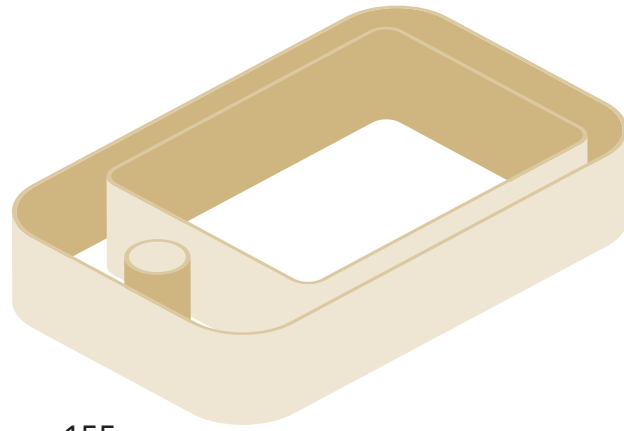
APPLICATION CATEGORIES

On July 10, 2008, Apple's former CEO Steve Jobs stated that the App Store contained 500 third-party applications for the iPhone and the iPod Touch, of which 25% were free. Within the first weekend of July 10th, ten million applications were downloaded, and by September, the number of available applications had increased to 3,000 with over 100 million downloads (Apple Inc, 2019). By January 2017, there were over 2,200,000 iPhone applications available in the App store, with over 130,000,000,000 downloaded to date (Golson, 2016). The App Store offers multiple categories to users to browse through. The top categories in the App Store in 2019 include Books, Business, Education, Entertainment, Finance, Food & Drink, Health & Fitness, Kids, Lifestyle, Magazine & Newspaper, Medical, Music, Navigation, News, Photo & Video, Productivity, Reference, Shopping, Social Networking, Sports, Travel, Utilities, and Weather. Within these primary categories are sub-categories, which narrow down the options into more specific options within the list.

chapter 4

TECHNOLOGY DEVELOPMENT OF IPHONE APPLICATIONS

Mobile app development is the process of developing applications for mobile devices, such as iPhones. Applications can be pre-installed on the iPhone during the manufacturing stage or downloaded from the App Store after the user purchases the iPhone. Application software developers must consider different screen sizes as each of the iPhone generations vary in screen width and length (iPhone SE, iPhone 6, iPhone Plus, iPhone X). App developers must also consider hardware specifications and configurations. The mobile user interface is also essential in the creation of apps, as it considers constraints, contexts, screen input and mobility as outlines for design. The user interface is the industrial design field



of human-computer interaction and is a space where interaction between humans and machines occurs. The goal of this is to allow effective operation and control of the machine from the user's end, while the machine sends feedback and aids the human's decision-making process (Satzinger, 1998). The main goal of the mobile user interface is to be understandable and user-friendly. Mobile user interfaces are the front-ends of the application system and rely on mobile back-ends to support the entire program. The mobile back-ends include data routing, security, authentication, authorization, working off-line, and service orchestration. This functionality is supported by a mix of middleware components including mobile app server, mobile backend as a service (MBaaS), and service-oriented architecture (SOA) infrastructure (TimesPartner, 2015).

chapter 5

POPULAR APPLICATIONS 2008 - 2018

This chapter summarizes the top iPhone applications, as listed on the App Store's Top 10 Free Downloads, from 2008 to 2018 to determine what the consumers chose as their favourite applications. A survey was then conducted to see what consumers today view as the most popular application in regard to its design.

2008

TOP 10	APP NAME	DESCRIPTION
1	Pandora Radio	A radio and music application.
2	Facebook	A social media application first launched in 2008 for the iPhone.
3	Tap Tap Revenge	A music game for users to play popular songs by tapping the beat of the songs.
4	Shazam	A freemium application where users can identify songs through the lyrics and sounds
5	Labyrinth Lite Edition	A game where users control a steel ball by tilting a wooden figure. The lite version has 20 levels.
6	Remote	An application that allows the iPhone to become a remote device for an Apple TV.
7	Google Earth	An application where users can view real satellite images worldwide of specific places.
8	Lightsabre Unleashed	The iPhone screen turns into a Lightsabre.
9	AIM	An instant messaging application where iPhone users can message other users with AIM.
10	Urbanspoon	An application dedicated to helping users find food and dining experiences as they can explore over 1 million restaurants (Zomato Media, 2008).

2009

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Facebook	The 3.0 update was anticipated by many iPhone users, as it enabled a new interface and additional features that have been requested by users. The user interface improvements of this application resulted in many successful features and downloads. The user interface design features a new home screen that is more user-friendly and intuitive with more options and better accessibility in comparison to the version 2.5 of Facebook.
2	Fandango	An application that was made to aid users in purchasing movie tickets and viewing showtimes from your iPhone. This application allowed for search queries for movies and theatre listings, watching trailers, viewing rating, and purchasing tickets with little to no human interaction needed (Walton, 2009).
3	Beejive 3.0	This was one of the first applications to take advantage of push notifications. It is a multi-client instant messaging application in a class of its own, using push features, iPhone and iPod users can easily have instant messaging conversations.
4	LogMeIn	This application brings your desktop to your iPhone; it links the user's computer and iPhone, allowing access to the computer screen from afar. The user-interface is easy, and feature-filled which delivers the best VNC connection to your devices (Kumparak, 2008).
5	Mobile Navigator	An app that tries to replace the default maps application due to its insignificant features. Mobile Navigator offers turn-by-turn directions from your device similar to any GPS. This application provides a landscape GPS with many useful features and user-interface that is very compatible and user-friendly.
6	Dropbox	A syncing application that allows users to access all of their files from their iPhone when signed in with their Dropbox account.
7	Textfree Unlimited	A free texting service via push notifications and is similar to the default SMS application but is a free alternative.
8	Google Mobile App	The application included a revolutionized search tool on the iPhone with its voice search and in-app browsing (Perez, 2017).
9	TweetDeck	A social media dashboard for managing Twitter Accounts with a sleek interface and great features.
10	Craigsphone	An application that offers the entire craigslist experience in one easy package, with features such as buy, sell, search, and bookmark posts.

2010

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Facebook	This application (version 3.0) remained very popular for iPhone users.
2	Angry Bird Lite	A demo version of the Angry Birds game, and only includes are the 12 chosen levels and was later deleted and replaced with Angry Birds Free.
3	Words with Friends	A word game where users can play word games with users from your contact list or randomly selected.
4	Skype	With this application, users can now receive Skype calls for free. The graphic have been updated to support the iPhone 4's Retina Display.
5	Tap Tap Revenge 3	A music-based game that was owned by Disney, but later in 2014, the game was removed from Disney's ownership as they no longer support the game.
6	Weather Channel	An application that provided iPhone users with updated statuses of the current weather.
7	Paper Toss	A game where users attempt to toss a wad of paper into a waste basket factoring in many different alternatives such as snow or rain.
8	Bing	A search engine owned and operated by Microsoft, which provides a variety of search services such as web, video, image and map.
9	Rock Band	A music video game release and was published by MTV Games, and developed after the PlayStation video game and created into an iPhone game after its popularity.
10	Talking Tom Cat	An application where children can talk to Tom the Cat and he will repeat what is said, also users can play with Tom the Cat, and feed him.

2011

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Tweetbot	A third-party Twitter application, it is a customizable application for users to access their twitter accounts.
2	HBO Go	An application in which HBO TV subscribers can login to the application using their credentials and instantly have access to the majority of HBO television on demand.
3	W.E.L.D.E.R	A word game for that is similar to Boggle, Scrabble and Hangman, by building words across a grid.
4	Super 8	An application that turns your iPhone into a Super 8mm Camera with grain, and picture effects, also allows users to store and play back movies and upload directly to social media sites.
5	Grand Theft Auto 3	A PlayStation 2 video game that was developed for iPhones.
6	Songza	An application that allows users to browse through playlists of music, create their own mixtapes and discover new artists or songs.
7	Infinity Blade	An action role-playing video game with great powerful graphics capabilities.
8	Instacast	An application which allows users to download podcasts from the iTunes app, and allows users to browse through audio or video podcasts and can also sync with Dropbox or iCloud.
9	Mixel	A photography application that users can create collages out of their own photos or photos from the web. Mixel also allows for users to discover other people's collages and to subscribe to their profiles to instant updates when they post new artwork.
10	Airport Utility	A free app released by Apple that allows users to manage Airport Extreme or Express from their iPhone.

2012

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Google Maps	An application that featured a street view, turn-by-turn voice-guided directions and routing planning with traffic features.
2	Chrome	A web browser from Google created for use on IOS systems, as it was marked as one of the best third-party browsers on the platform (Perez, 2017).
3	YouTube	After Apple removed all the pre-installed Google applications from iOS in 2012, YouTube was the first application to make its way back to iPhones (Perez, 2017).
4	iTunes U	An application which provides free books, course outlines and support material for the majority of subjects taught in colleges around the world.
5	Smartr Contacts	An application which integrates social networks that users have with their address book so that they can view their history of interactions with all their contacts from social networking sites.
6	CloudMagic	An application that allows users to search through and for anything with their multiple social media accounts such as Gmail, Facebook, Google Docs, Dropbox.
7	Google Drive	An application which allows users to create and manage their documents in their Google Drive account.
8	Speaktoit Assistant	A customizable virtual assistant that answers all users' questions about weather, sports, or general knowledge.
9	Steam	An application which allows users to manage their steam accounts, purchased games, and to interact with gamer friends as well as discovering deals.
10	Podcasts	After iOS 6, Apple separated podcasts from the Music application by giving Podcasts its own application.

2013

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Candy Crush Saga	A video game for iOS devices to switch and match colourful candies to unwrap in-game surprises (King, 2012).
2	YouTube	This new updated YouTube application features new methods for exploring brand new content, such as music, news and videos with great retina-displays.
3	Temple Run 2	An endless running video game where users can manipulate their way through temples to find hidden gems. Temple Run 2 is the sequel to Temple Run.
4	Vine	A social media application where users can create six seconds of video and publish it via Vine's application for users to share and follow content.
5	Google Maps	This application has been updated since the last version, allowing for transit and food features, as well as street view.
6	Snapchat	A social media application which opens the camera feature and allows users to send videos and camera to their friends that only last as long as 10 seconds.
7	Instagram	A social media application that allows users to share and capture photos from their camera roll onto a social media site for users around the world to have access to.
8	Facebook	The updated 5.0 version includes new features such as "Chat Heads", moveable profile photos, a new redesign that introduced features of the tab bar for navigation (Steeber, 2018).
9	Pandora Radio	An application for Music and Podcasts that iPhone users can access via the App Store.
10	Despicable Me: Minion Rush	A game developed after the Despicable Me movie, where users can run in a 3D game environment after the Minion characters.

2014

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Facebook Messenger	A messaging app and platform for iOS devices with a separate interface for Messenger for Facebook users.
2	Snapchat	As snapchat has become more popular during their evolution, their user base has grown significant by 400 million in 2014 due to their significant updates and greater functions such as video and text calling, a live feature so users can follow live events, push notifications for Snapchat stories, and now receiving advertisements.
3	YouTube	Version 2.13 has been released in 2014 for YouTube, which has important bug fixes that caused problems with the user interface, and the keyboard orientation problem has been resolved (iPhoneTricks, 2014).
4	Facebook	Facebook celebrated their 10th anniversary, during which over one billion users connected to Facebook via their iPhones. In 2014, Facebook also introduced a new gender setting, where users can add a custom input field so that they can choose from a wide range of gender identities (Constine, 2014).
5	Instagram	The application is developed and releases three stand-alone applications with specialized functionality, such as Bolt, where users can message other users by clicking on the profile, Hyperlapse, where users can create fast time-lapse videos, and Boomerang, which is a video application that combines photos into a short video that can be played in a loop (Chaykowski, 2015).
6	Clash of Clans	A freemium iPhone application where users can develop a strategy, build defences and attack their enemies with characters.
7	Candy Crush Saga	This application is the same version as the one in 2013, with little to no changes made.
8	Game of War: Fire Age	A freemium iPhone game where users can play with multiple players online via this strategic game.
9	Pandora Music	This application has no changes from 2013 as it still remains popular.
10	Big Fish Casino	A casino-based game where users can play to win chips around the world.

2015

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Trivia Crack	An application that allows users to compete against multiple players across the world based on trivial questions.
2	Facebook Messenger	Facebook's messaging application for Facebook users remained on the Top Ten list with little to no changes from the previous version.
3	Dubsmash	A video recording application where users can choose different audios and sounds and record their own videos based off of those sounds to publish online.
4	Instagram	The updated version allows a zoom feature on user's photos when they pinch-to-zoom on the screen.
5	Snapchat	The updated version introduced different 'Discover' and 'Lenses' known as filters for Snapchat users.
6	YouTube	They introduced a feature called "YouTube Kids", which is designed for children with a simpler user interface , and curated selections of channels with age-appropriate content and parental control (Perez, 2015).
7	Facebook	They updated a new feature on their application for a news portal with "instant articles" to provide news on Facebook through the iPhone application without having to leave the app.
8	Uber	A transportation network company that allows users to find transportation methods nearby.
9	Crossy Road	A game based on an arcade video game that was released in 2014 and quickly became popular after.
10	Google Maps	There were no updated features that have been added since 2012. The majority of the popular iPhone applications for 2015 were social media based.

2016

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Snapchat	The application featured a new 2.0 update where Snapstreaks were introduced, which were trends on how many days users snapchatted each other.
2	Pokémon Go	The first augmented reality application that iPhone users have made popular, where users can chase Pokémon characters and view them as a 3D object on their iPhone screen.
3	Facebook Messenger	No updates were made from 2015.
4	Facebook	No updates were made from 2015.
5	YouTube	The application update now supports HDR video 4096x3072 pixels (YouTube, 2010).
6	Google Maps	No updates were made from 2015.
7	Pandora Music	No updates were made from 2015.
8	Netflix	Netflix was operated in more than 190 countries, and developed an iOS application for users to access their accounts to view movies and television shows through their iOS device.
9	Spotify	A freemium application for users to stream and listen to music via their iOS device.
10	Uber	No updates were made from 2015.

2017

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	Bitmoji	An application that allows users to create personalized avatars to use in social media applications such as Snapchat, or Messaging.
2	Instagram	The application featured a new update that allows users to upload up to ten photos or videos in one post with a swipeable feature and allows users to upload photos that were not in square format (Constine, 2017).
3	YouTube	No updates were made from 2016.
4	Facebook Messenger	No significant changes were made from 2016.
5	Facebook	The application was updated to unify the design of the news feed and features that looked more like the Messenger conversations to have a similar design.
6	Google Maps	No updates were made from 2016.
7	Netflix	No updates were made from 2016.
8	Spotify	No updates were made from 2016.
9	Uber	No updates were made from 2016.
10	Super Mario Run	An application that was developed by Nintendo for iOS devices that was similar to the video game version of Super Mario Run.

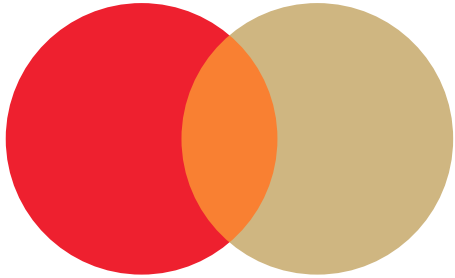
2018

TOP 10	APP NAME	DESCRIPTION OR UPDATE
1	YouTube	The application was updated with a new feature called Reels, which is a similar “Story” feature to ones used by Snapchat and Instagram, where users can engage with followers by posting videos up to 30 seconds long (Perez, 2017).
2	Instagram	They introduced a new feature to applications from portray mode called “focus mode“, which blurs the background of a photo while keeping the main subject in focus (Estrada, 2018).
3	Snapchat	They added a feature of deleting a sent message before it is read, also where users can send GIFS and TuneMojis (Deahl, 2018).
4	Facebook Messenger	No new features were added to the application.
5	Facebook	The application changed the user interface on News Feed to prioritize friends and family content to de-emphasize content from media companies (Isaac, 2018).
6	Bitmoji	No updates were made from 2017.
7	Netflix	The application offered the feature of downloading content from the application to the iPhone.
8	Google Maps	No updates were made from 2017.
9	Gmail	The application offers notifications, multiple account support, and search options throughout the users Gmail account via the application.
10	Spotify	No updates were made from 2017.

chapter 6

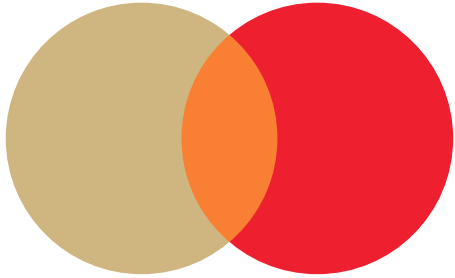
PRINCIPLES OF GOOD & BAD DESIGN

The principles of good design that are used to evaluate and review the specific evolved applications include: innovation, product usefulness, aesthetics, product understandability, honesty, durability, and minimalism. In order for an iPhone application to meet the principles of good design, they must be innovative; they need to differ from the rest of the applications, in terms of its physical design and its functionality. Usability is another component of a good design and is evaluated through the product's functionality and aesthetics (Dieter, 2013). A good iPhone application must be aesthetically pleasing as most users tend to download an application due to its attractiveness that is attributed to great design features. In order to develop a successful iPhone application, the design of the application must make the product understandable.



If an iPhone application's design appears to be confusing, or unreadable, then most users will tend to ignore and dismiss this application due to its confusion. The design will aid the success rate if the design appears to provide the same value as it appears. If the iPhone application design is an honest design that demonstrates its innovative features, then it is an example of a principle of good design.

Designing an iPhone application is a slow process and must be well thought out in order to successfully meet the needs of the target market. For example, when designing an iPhone application for children in the age range of 4-7 years, one must consider the use of large shapes, bold and large typefaces, bright primary colours and a simplified user-interface. Lastly, when designing an iPhone application, based on research and survey results, it is determined that good design is typically minimalist and only contains the essentials, rather than being crowded and overly distracting, making difficult to navigate.



POPULAR APP DESIGN

A survey was conducted to further research what iPhone consumers view as the most popular iPhone application versions in terms of design.

FACEBOOK

After conducting the survey based on different versions of Facebook since 2008, most iPhone users prefer the major Facebook changes made in the year 2019. The results for this survey indicates that most users prefer the latest update of Facebook, released in 2019. Facebook's latest version demonstrates good principles of design and creates a more user-friendly interface through the use of: a minimalistic design, lighter shades of blue and more rounded shapes rather than squared edges. It is also easier to control the News Feed as there are more filters so that users can view their friends and family's content without sifting through advertisements and media. The icons of 2019's version of Facebook demonstrate a minimalist design as they are simplified outlined shapes as demonstrated in Figure 2. The 2017 version of Facebook demonstrates principles of bad design and contains outdated icons. The font in the earlier versions of Facebook's iPhone application appeared to have a bolder and larger font due to the crowded user-interface that contained less white space.

Figure 1:
Survey for Facebook's popular application versions. Adapted by Wroe, Melissa, 2019.

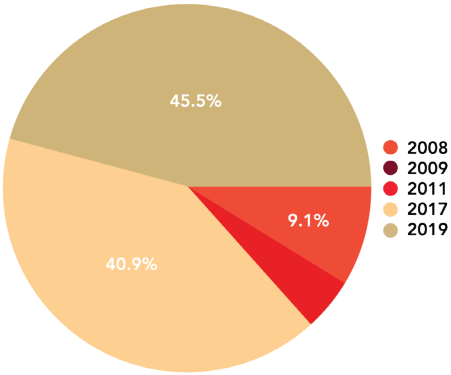


Figure 2:
2019's Version of Facebook. Adapted by Wroe, Melissa, 2019.

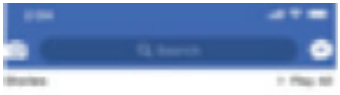


Figure 3:
2017's Version of Facebook. Adapted from 'The Incredible Evolution of App Design', by Kovach, S, 2017, Business Insider.

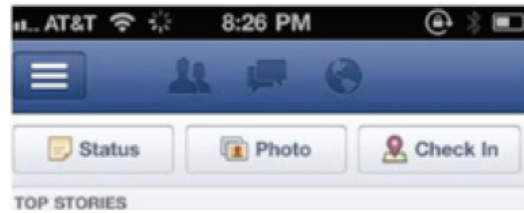
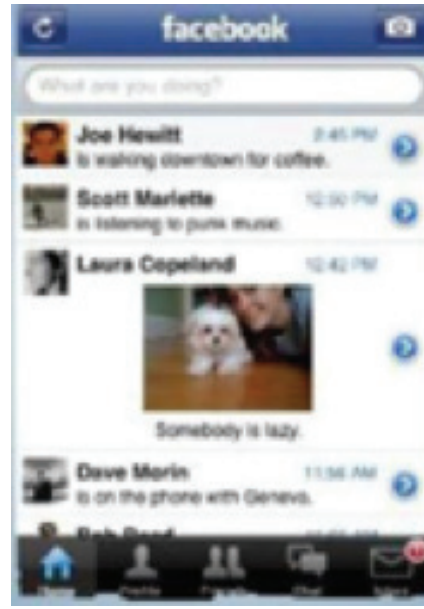
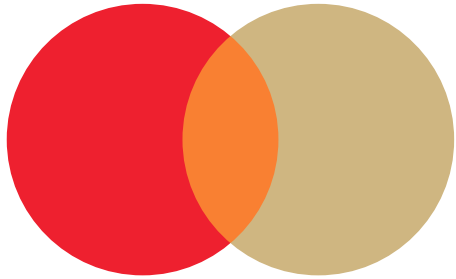


Figure 4:
2010's Version of Facebook. Adapted from 'The Incredible Evolution of App Design', by Kovach, S, 2017, Business Insider.

Figure 5:
2008's Version of Facebook. Adapted from 'The Incredible Evolution of App Design', by Kovach, S, 2017, Business Insider.





INSTAGRAM

The survey results show that 81.8% of users prefer the 2019 version of Instagram in retrospect to the previous versions. In the 2019 version, the application's designers modified the colours from dark blue, black, and dark grey to white, black, and red. The colour changes resulted in more white space which is a feature of good design techniques. It allows for the users to stay focused on the purpose of the application, without becoming distracted by the insignificant background noise that deters the users from the purpose of the application. Instagram's 2019 version demonstrates a more minimalistic and simplified version rather than their original design in 2015. Another principle of good design that was followed was the modification of their application to focus on white space, leaving users to create their own profile page with their own creativity. This modification allowed more room for the users' own self-expression.

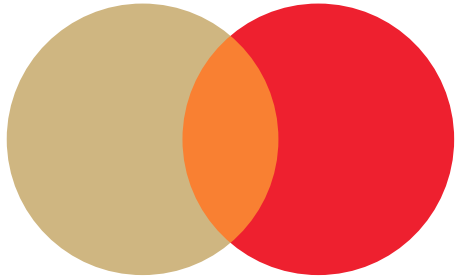


Figure 6:
Survey for Instagram's popular application versions. Adapted by Wroe, Melissa, 2019.

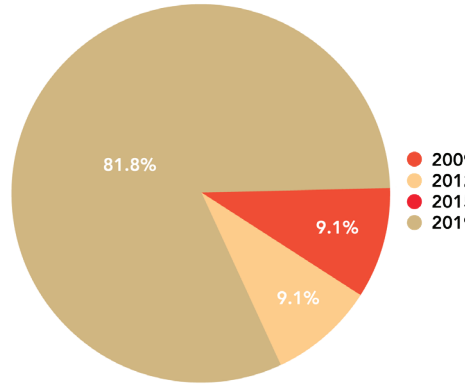


Figure 7:
2019's Version of Instagram. Adapted by Wroe, Melissa, 2019.

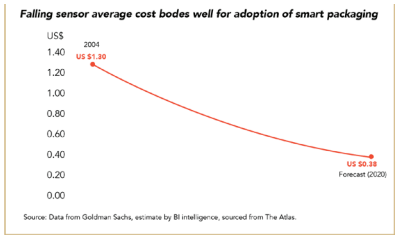


Figure 8:
2015's Version of Instagram. Adapted from 'Eavesdropping on the 7th grade Instagram', by Borne, E, Pinterest.

SNAPCHAT

As demonstrated in Figure 9, the results show that 72.7% of Snapchat users surveyed prefer the newer 2019 version of Snapchat compared to the older versions. Snapchat's 2019 version utilized good principle of design techniques by modifying the application to be more understandable and adding more detail-oriented and practical user-interface features, to fulfill the needs of the users. These features that have been added in 2019's update include a Snap Map feature where users can share their locations and can be viewed on the Snap Map by contacts when using the application. Another feature that improved Snapchat's design was changing the original colours of purple, yellow, pink and green to white, light blue, light purple and light red. These subtle changes gave the application a longer-lasting and innovative design concept. Using white as the primary colour, it gives designers more room to utilize various colour combinations. The primary function is to view and send photos to the users' contact list, hence, the usage of white allows for these functions to not be obscured by the less essential features. This results in a more valuable user experience.

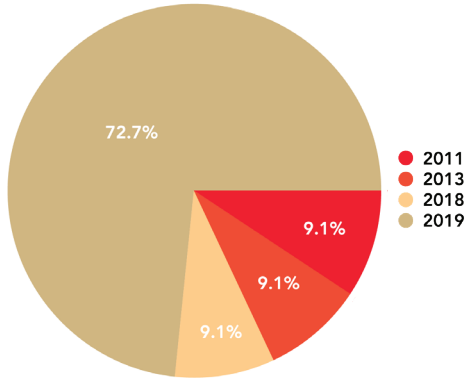


Figure 9:
Survey for Snapchat's popular application versions. Adapted by Wroe, Melissa, 2019.

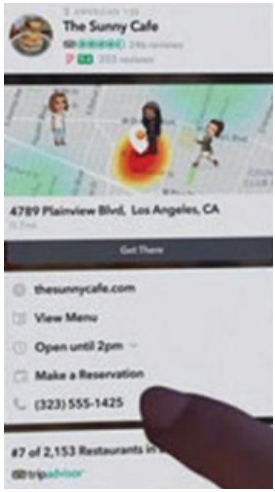


Figure 10:
2019's Version of Snapchat. Adapted from 'Snapchat shares hit all-time low as search acquisition', by Constine, J, 2018, Tech Crunch.

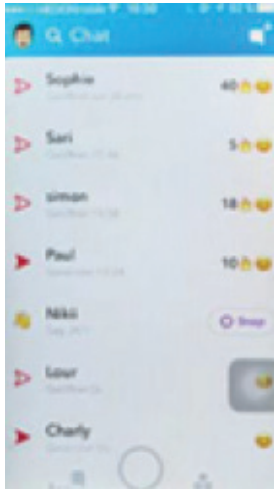


Figure 11:
2018's Version of Snapchat. Adapted from 'Snapchat update brings new look, and users are NOT happy', by Brown, A, 2018, Express.

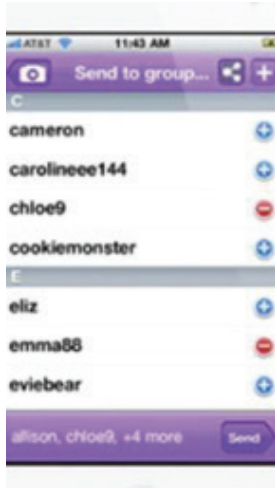


Figure 12:
2011's Version of Snapchat. 'Adapted from Snapchat's History: Evolution Of Snapchat And Timeline', by Team B, 2018, BuyCustomGeoFilters.

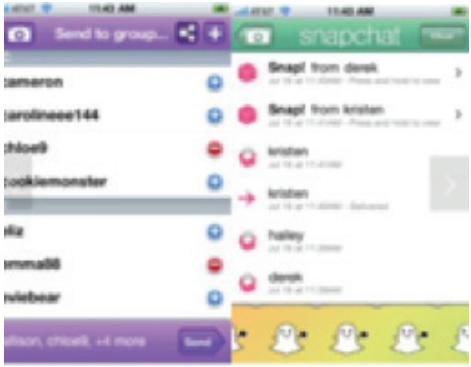
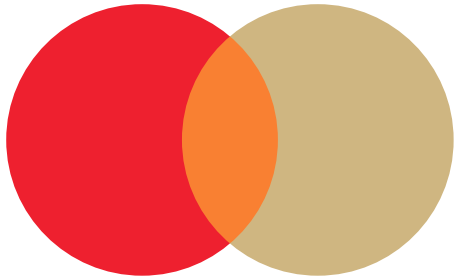


Figure 13:
2008's Version of Snapchat. 'Adapted from Snapchat's History: Evolution Of Snapchat And Timeline', by Team B, 2018, BuyCustomGeoFilters.



APPLE MAPS

The results of the survey reveal that more iPhone users prefer the newest 2019 version of Apple Maps in contrast to the older versions, such as 2012, 2017, and 2018 versions, due to greater features in the user-interface. One of such features is Flyover, which allows users to view the map in a 3D birds-eye-view of several locations. This allows users to study the landscape and architecture in greater detail (Priday, 2019). In addition, new cities and towns had been added. The design has drastically improved from the previous 2012 version through the addition of more innovative features, including the ability to note points of interest and directions in popular cities. City Tours provided tour sites in notable areas of cities and fixed all their inaccuracies and errors on the map. Figure 14 demonstrates the aesthetic progression of the user-interface of Apple Maps from 2012 to 2019.

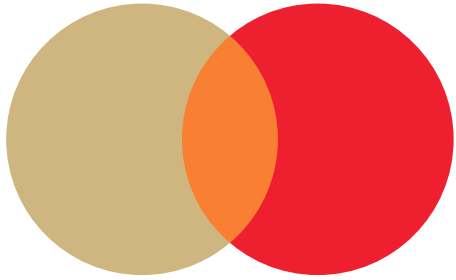


Figure 14:
Survey for Apple Maps' popular application versions. Adapted by Wroe, Melissa, 2019.

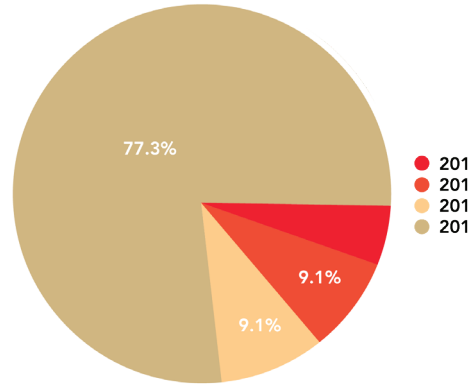


Figure 15:
2019's Version of Maps. Adapted from 'The best of 2018: The Apple edition', by Staff, P, 2018, PC Mag.

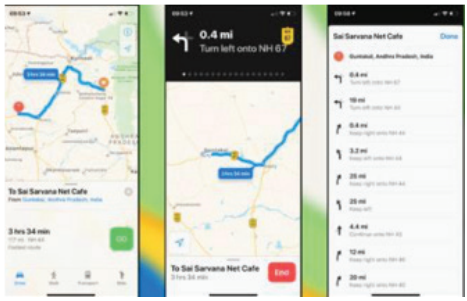


Figure 16:
2018's Version of Maps. Adapted from 'Apple is fixing Maps using its own data', by Fingas, j, 2018, Engadget.

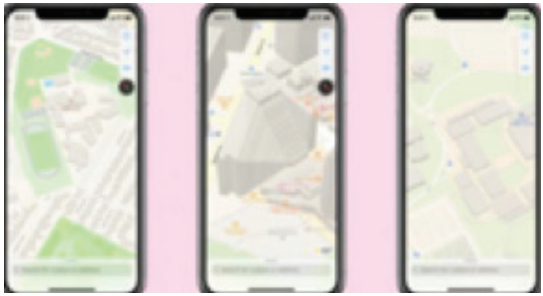


Figure 17:
2017's Version of Maps. Adapted from 'Apple Maps Hints at Transit Directions Expanding', by Rossignol, J, 2017, Mac Rumours

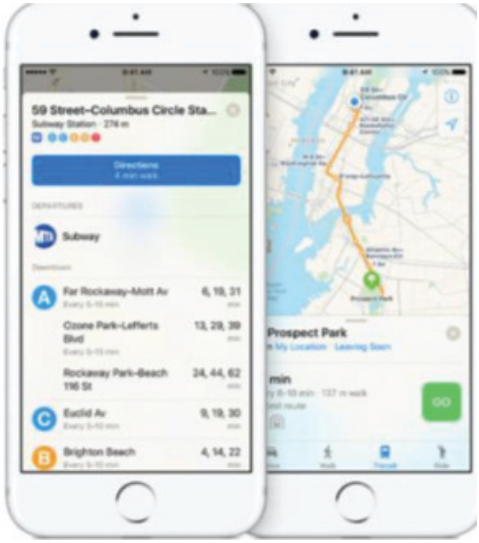


Figure 18:
2012's Version of Facebook. Adapted from 'The Incredible Evolution Of App Design', by Kovach, S, 2013, Business Insider.

chapter 7
CONCLUSIONS

Through research and a subsequent review of the principles of good and bad design, some very insightful information can be gained in regard to the evolution of iPhone applications. The applications created corresponds to the iPhones of the time by mimicking and demonstrating the capabilities of each generation of iPhones. As the App Store's Top Ten iPhone applications from 2008 until 2018 were analyzed, one can draw conclusions as to why certain applications remained in the App Store's top ten listings for several years. This is due to their good design features. After analyzing the results of the surveys conducted, an in-depth investigation was provided in regard to why the majority of iPhone users preferred the newest application version in terms of their design. To support these findings, assessments of these applications were done by analyzing the usage and incorporation of the principles of design. The results show that the newer 2018 and 2019 versions of iPhone applications utilized multiple principles of good design techniques, such as the use of white space, while many of the older versions demonstrated poor design features.

In conclusion, the most successful and popular applications all reflected the proper usage of good design principles. Although, with great success from these findings, there are limitations that while conducting this thesis study. One of such limitations is the sample size of the surveys. The majority of people surveyed online were contacted through social media sites such as Facebook, Twitter, email, and Instagram, which as a result limited the scope as most individuals were in a similar age range. This limitation made the study difficult as it was strenuous to find significant differences in the data due to there being many identical answers and preferences, which could be the result of the sample originating from the same demographic group.

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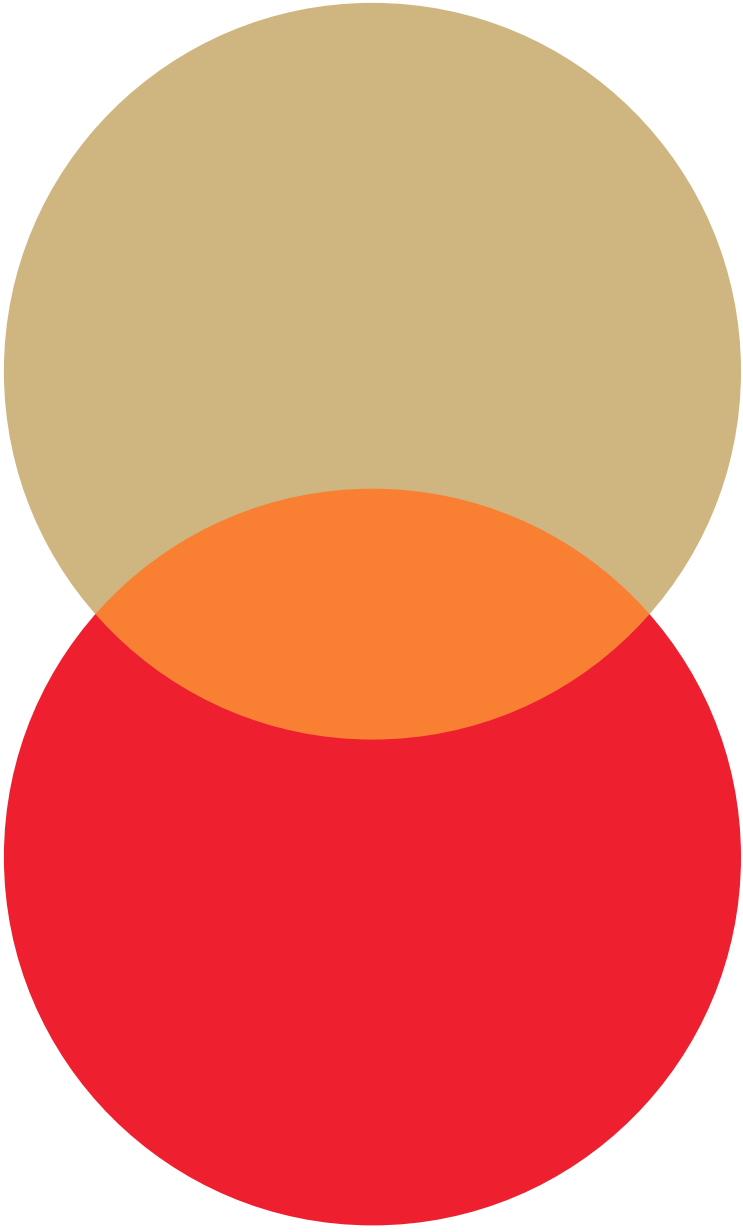


HOW CONSUMER AGE AFFECTS LOGO PREFERENCE

Lital Chernyi

5

ABSTRACT

This thesis is exploring the evolution of six fast food company logos — McDonald's, Burger King, KFC, Subway, Domino's, and Pizza Hut — while comparing this to current logo trends and consumer preferences based on their age. Three age groups are measured: generation Z (18-24), generation Y (25-39), and generation X (40-53). In this study, 74 people are participating in a survey that is asking for their age and is questioning their opinion and preferences on the fast food companies' logos, as well as on a non-existent company logo that was created for the purpose of this survey. The results of the survey are measured using the IBM SPSS statistical analysis tool and examine if the different variables had a significant statistical effect on other variables. The analysis of the survey shows that there is a significant difference between the age groups in their logo preference, specifically between generation Z and generation X. The results of this study proves that the younger age group tends to prefer simpler logos and logos that have sans-serif fonts, whereas the older age groups prefer more complex logo design and a larger variety of fonts.

STATEMENT OF ORIGINAL AUTHORSHIP

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

chapter 1

INTRODUCTION

Since the 1960s, many popular fast food companies have been evolving their logos regularly in order to comply with the emerging logo trends, as well as to fulfil and adhere to the changing and progressing customer perception. This study will research the logo evolution of six well-known fast food companies: McDonald's, Burger King, Subway, Domino's Pizza, Pizza Hut, and KFC. Even though some of these companies were established as early as the 1940s, to limit the scope of this thesis and to ensure consistency, this paper will only consider the companies' logo evolution starting from the 1960s and will be focusing solely on Ontario residents' perception.

BACKGROUND

As the famous graphic designer, Paul Rand, said: “design is the silent ambassador of your brand” (n.a.). Fast food company logos are very persistent in our everyday lives. They can be seen in printed advertisements, online advertisements, billboards, social media, packaging, and more. It is almost impossible to avoid seeing these logos daily and, because of that, it is a very important branding tool for fast food companies. Their logo design and brand recognition have a direct correlation to customer perception of the brand. Thus, fast food companies have changed their logos multiple times throughout the years to try and improve their brand’s perception.

Logo design can consist of multiple components, including text, images, and illustrations. On top of that, logos can also be analysed by the colours used, the fonts used, the size of the fonts, the size of the logo itself, the use of illustration, and the use of special effects. The different components and features of a logo design can be used to compare its simplicity and uniqueness with other logos, as well as with previous versions of the same logo. A lot of companies design and redesign

their logos based on emerging design trends, as well as on the constantly evolving customer perception.

Customer perception is unsteady and indefinite; it is constantly adjusting and developing. According to the business dictionary, customer perception is defined as "a customer's impression, awareness and/or consciousness about a company or its offerings" (n.a). Overall, it refers to the customers' preferences and opinions that cause them to behave a certain way, shop in a certain store and buy a certain product. Brands tend to study consumer perception in order to learn about their behavioural and purchasing patterns, to adjust their brand to better fit the consumer's needs and wants, and to eventually improve the brand's identity and increase their market. One of the dominant parts of brand identity includes a logo. Thus, many companies are changing and modifying their logos regularly to better fit the current consumer perception.

Overall, this study will focus on the connection between the evolution of fast food logos since the 1960s and the evolution of Ontario residents' perception and preferences during the same time. This will be done through qualitative research on opinions regarding different logo designs from consumers in different age cohorts, and by historical and quantitative research that will evaluate trends and patterns in the logo design sector.

CONTEXT

The framework of this study is the printing and packaging industry since it is focused on the design aspect of logos and on how those logos are used in packaging. The goal of this study is to better understand logo design and consumer perception, while focusing on the fast food industry in Toronto. This study also concerns the fields of marketing, social studies, and the fast food industry.

PURPOSES

The main purpose of this study is to gain a better understanding of the evolution of fast food logos since the 1960s and try to establish a relationship between those changes and the preferences of customers from different age cohorts. In addition, this study will also explore the connection between the patterns and trends different fast food companies used in their logo design, comparing and contrasting those different evolutions with the purpose of discovering a general trend in the fast food industry.

SIGNIFICANCE AND SCOPE

The scope of this study will be limited to the logo evolution of six fast food companies starting in the 1960s, and it will concentrate solely on Ontario residents. Thus, this study will be narrow enough to focus on its purpose while being broad enough to gather a sufficient amount of information and have solid grounds to establish results. The significance of this study is to understand the specific trends in the fast food industry logo designs since the 1960s, to find if there is a connection between the customer's age group to their design preferences, and to figure out what the reason is for this connection. These findings may be important to further explore how fast food companies can customize their logos to different age cohorts, and potentially help with predicting future trends that will emerge in logo designs for this particular industry.

RESEARCH QUESTIONS

The study will attempt to answer several important research questions in regards to logo design, consumer perception, the connection between the consumer's age and their design preferences, and the changing trends and patterns in the fast food industry.

The research questions are:

- What are the current trends in logo design and how have they changed since the 1960s?
- How have the logos of the six chosen fast food companies changed since the 1960s and do they correspond to the trends in the previous question?
- By what components can one analyse a logo design? Using those components, what are the differences and similarities between the logo evolution of the different companies?
- What is the overall consumer opinion about the different logo design aspects and what is the general preference?
- What are the specific preferences of the different age groups in regard to logo design and what is the reason behind the different opinions in the different age groups?
- How can this information be used to improve consumer perception of fast food companies through logo design and how can fast food companies use this information to tailor their advertisement towards their target market, based on the audiences' age?

HYPOTHESES

The first hypothesis refers to the significant statistical difference between the age groups in terms of logo preference based on simplicity.

H0 There is no significant statistical effect of the age group on their preference of logo design based on simplicity.

H1 There is a significant statistical effect of the age group on their preference of logo design based on simplicity; the younger age group will prefer simpler designs, while the older age groups will prefer less simplistic logos.

My second hypothesis refers to the significant difference in the typeface preference between the different age groups.

H0 There is no significant statistical effect of the age group on their preference of typeface.

H1 There is a significant statistical effect of the age group on their preference of typeface; the younger generation would prefer the sans-serif font, while the older generations will prefer other font types.

The third hypothesis refers to the significant difference between the age groups in their preference of logo depth.

H0 There is no significant statistical effect of the age group on their preference of logo depth.

H1 There is a significant statistical effect of the age group on their preference of logo depth; the younger generation will prefer flat logos, while older generations will prefer different variations of logo depths.

Finally, this thesis will compare all those dependent variables to the participant's gender. The fourth hypothesis refers to the significant difference between the genders and their preference.

H0 There is no significant statistical effect of the gender on the participant's logo preference, preference of design simplicity, and preference of typeface.

H1 There is no significant statistical effect of the gender on the participant's logo preference, preference of design simplicity, and preference of typeface.

chapter 2

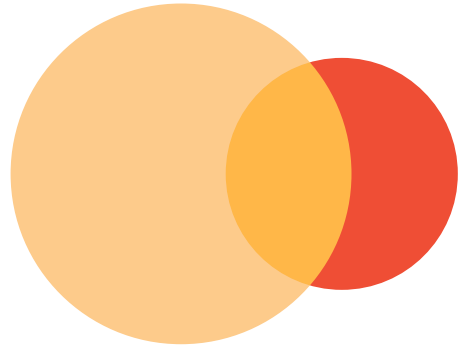
LITERARY REVIEW

HISTORICAL BACKGROUND

This study will focus on the logo evolution of six fast food company chains in Toronto: Burger King, Subway, Pizza Hut, Domino's Pizza, KFC, and McDonald's. This section will explore the historical background of each of those companies, as well as their popularity. The logo evolution of each of these companies will be described in this section and will include several elements of logo design, such as colour and number of colours, font type, number of fonts, number of components, the use of three-dimensional effects, and the use of shadows and strokes. Although some of these companies were founded and had several logos before the 1960s, this study will only focus on the company logos that were created during the 1960s and onwards. Likewise, this study will only focus on logos that were used in Toronto during those years. Thus, it will not cover the entire logo history of these companies, but rather the relevant parts of it. Overall, this section will help to reach a general understanding of the logo evolution in order to later investigate the reasoning behind it.

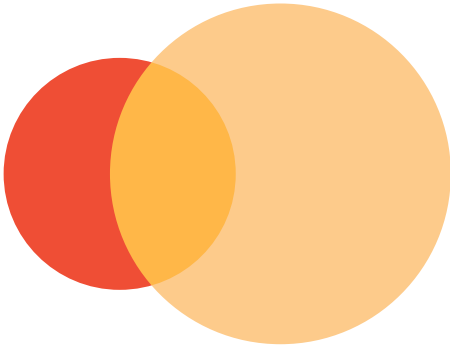
BURGER KING

The Burger King chain was founded in 1953 with the name "Insta-Burger King" that was later changed to Burger King in 1954. Burger King had several major logo designs since they were established in 1953 (Figure A1). However, the first logo design that will be discussed in this study is from 1957 (Figure A1.1). This logo was a multi-colour logo that included an illustration, used several different sans-serif fonts, and a yellow gradient background. Overall, this logo consisted of a number of components and included a lot of detail. In 1969 (Figure A1.2), their logo was changed to a three-component logo that only included two colours, red and orange, and one large uppercase sans-serif font. This logo was also relatively flat, with no special effects, and comparably simpler than the original logo. Later, in 1994 (Figure A1.3), the logo went through a slight modification, where the colours were changed to a brighter shade, the shape of the buns changed slightly, and the font was changed to a smaller and simpler font. Overall, the logo did not change drastically, still achieving a flat simple effect. Finally, in 1999 (Figure A1.4), the logo was changed to the one that is known today. The font was slanted, the colour blue was added, and a three-dimensional effect was made to enhance the logo. Likewise, the shape of the logo was adjusted to give it a more circular look. The logo designers decided to shift from the flat looking logo by adding colour and depth.



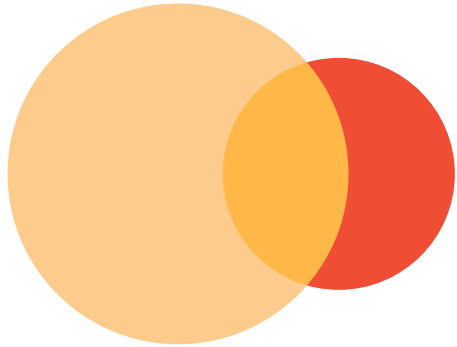
SUBWAY

Subway was originally established in 1965 under the name "Pete's Super Submarines" and was renamed in 1968. The subway logo has been through several changes since it was renamed in 1968 (Figure A2). The original Subway logo was a plain orange sans serif font (Figure A2.1), that was changed in 1968 (Figure A2.2) to a three-colour logo, using white, yellow, and green, as well as a thicker font. This added more detail to the logo and strived to differentiate itself from the original logo that was created for "Pete's Super Submarines". In 1982 (Figure A2.3) the logo was changed again, and while the colours remained, the designer adjusted the font to be oblique, and instead of a green background, the designer placed a green stroke. The 2015 logo (Figure A2.4) replaced the previous logo by using only one colour - green, but nothing else was changed. Lastly, the newest logo, designed in 2016 (Figure A2.5), is made out of two colours, yellow and green, and has changed the font to one similar to the 1968 logo, making it simpler than both the 1968 and 1982 logos, but still more detailed than the 2015 plain green logo.



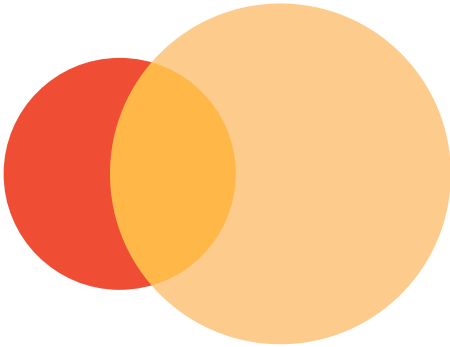
PIZZA HUT

Pizza Hut was founded in 1958. Their first logo (Figure A3.1) featured the mascot Pete holding the words "PIZZA" and "HUT", using uppercase letters in a sans-serif font. This logo is flat, features four colours, and has a black background. In 1974 (Figure A3.2), the logo was significantly changed: the background and the illustration were removed. Instead, the designer placed the words "Pizza Hut" in a serif font, using a combination of uppercase and lowercase letters, and placed a red roof above the words. The change represents more simplicity and a higher emphasis on the company's name. In 1999 (Figure A3.3), the font was changed to a script font, the yellow and green colours were added, and a black stroke was added around the red roof. Those changes seem to come with the purpose of adding depth to the logo. Eleven years later, in 2010 (Figure A3.4), the stroke around the red roof was removed and a three-dimensional effect was added. In 2014 (Figure A3.5), the designers moved towards simplicity again and removed the green and yellow colours, leaving the logo with only two colours, similar to the 1974 version. In the same year, the final change was made to the logo (Figure A3.6). It now became white with a red circular background. The designers have also removed the three-dimensional effect and have left the logo flat.



DOMINO'S PIZZA

The Domino's Pizza chain was first established in 1960. Their big success led to the opening of the first Domino's pizza store in Canada in 1983. Their first logo was designed in 1960 (Figure A4.1) and it features a red domino with three white dots and a blue rectangle underneath with the writing "Domino's Pizza" in a white sans-serif font. Later on, in 1987 (Figure A4.2), the logo was rotated 90 degrees counterclockwise, a thin inside stroke was added to the domino and the writing was changed to uppercase letters. Then, in 1996 (Figure A4.3), the logo was rotated on its side to resemble a diamond shape, the thin strokes were removed, rounded corners were added, the font was bolded, and the writing changed back to a combination of uppercase and lowercase letters. Finally, in 2013 (Figure A4.4), the blue and red colours were adjusted and changed to colours that resemble a closer shade to cyan and magenta, the background behind the word "Domino's" was removed, the domino now included a blue background, and the word "Pizza" was eliminated. The artistic choices seem to try and achieve simplicity without sacrificing the identity of the brand.



KFC

Kentucky Fried Chicken, KFC, was founded in 1930, but for the purpose of this study, the only KFC logos that will be investigated are the ones designed from 1978 onward (Figure A5). In 1978 (Figure A5.1), KFC came out with a plain black logo featuring the KFC mascot, Colonel Sanders, and the words "Kentucky Fried Chicken" in a serif font and a combination of lowercase and uppercase letters. In 1991 (Figure A5.2), the logo was changed significantly; the Colonel's head remained, while a background of red stripes was added., The words "Kentucky Fried Chicken" were replaced with "KFC" in an all uppercase, red serif font. Also, a very light shadow was added behind this logo to add depth. In 1997 (Figure A5.3), the logo was changed again to a four-coloured square logo that features the Colonel in a larger size and the letters "KFC" in a smaller size with a three-dimensional effect, all on top of a red background. Next, in 2006 (Figure A5.4), the logo was changed to a circular version, still portraying a large image of the Colonel, with the letters "KFC" in white. The final logo was created in 2010 (Figure A5.5), where the shape was changed from a circle to a trapezium, with the letters "KFC" underneath the image in black. KFC seems to be one of the only companies that is adjusting its logo to a more complex version by adding colours, shapes, and depth.

MCDONALD'S

McDonald's, founded in 1940, is one of the oldest and most successful fast food restaurants. The first logo design that this study will explore is the 1960 version (Figure A6.1), when the golden arches were first introduced. In this logo, the golden arches have a strikethrough line and the whole symbol has a red stroke. Underneath, the word "McDonald's" is written in a red bold sans-serif font. In 1968 (Figure A6.2), the logo was refined, removing the strikethrough line and the stroke around the "M". The yellow colour of the "M" was changed to a slightly more orange shade, and the word "McDonalds" was changed to black and moved into the golden arches. In 1975 (Figure A6.3), the orange was changed back to yellow, the black text was replaced with white text, and a red rounded square background was added behind the logo. Next, in 1992 (Figure A6.4), the white text was moved below the golden arches and the red background was applied only to the text. Likewise, a stroke was added around the red background and the whole logo got a new three-dimensional effect. It seems that the designers were striving to add more depth to the logo. In 2000 (Figure A6.5), the logo was changed again to resemble a smiley face. All text was removed, and blue was added to represent a shadow. In 2003 (Figure A6.6), the logo was simplified to a simple yellow "M" with a black shadow and the text "i'm lovin' it" added underneath. The text is lowercase letters only, in a black sans serif font. Finally, in 2006 (Figure A6.7), the logo was changed to its most simple form, with only a yellow "M" and nothing else.

LOGO TRENDS

Design trends and patterns have been constantly changing since the 1960s, which can be seen in a large number of fast food companies changing their logos to try and comply with the changing logo design trends, while still keeping their consumer and brand identity in mind. The logo changes since the 1960s until now mainly include simplification, brighter colours and colour contrast, and the movement towards sans-serif fonts.

First of all, in recent years, logo simplification seems to be the leading trend according to Alastair Holmes, an associate creative director at *This Place*, who says: "… there seems to be a trend towards simplifying things, so either taking the existing brand or logo and minimizing it, or completely redesigning the logo to be cleaner" (2018). David Airey, also claims in his book *Logo Design Love: A Guide to Creating Brand Identities* (2010), that simple logos are the most effective ones, as they can be used in many different forms of media, including print and digital. Likewise, simplicity makes the logo easily recognizable, and it will most likely stay in the consumer's mind for longer (Airey, 2010). Logo simplification can be done using several methods, which can be seen in the fast food logo evolution of this study.

First, it could be done through reduction of components, as can be seen in the Burger King, McDonald's, Pizza Hut, and Domino's logos. It can also be done by limiting the number of fonts and the number of colours; both limitations can be seen in the Burger King logo change from the 1957 logo to the 1999 logo. The colour limitation can also be seen in the 2015 Subway logo and the 2006 McDonald's logo, both using only one colour. Finally, logo simplification can be done by flattening it, as can be seen in the Pizza Hut logo, where the strokes and the three-dimensional effects were removed in their 2014 logo redesign, as well as in McDonald's 2006 logo, in which all the shadows and three-dimensional effects were removed.

Secondly, many of the more modern versions of fast food companies' logos are exploring the use of vibrant colours and creating more contrast for the purpose of making a strong statement (GraphicMama, 2018). According to Dementienko, bright colours enhance emotions and influence the digestive system, potentially increasing the consumer's appetite (2008). This can be seen in most of the fast food companies researched in this study. McDonald's was one of the first fast food companies to join this trend by replacing the dull orange in the 1968 design with red and yellow in 1975, which were later replaced with brighter red and yellow in 1992. Burger King also joined this trend and replaced their colours for a brighter red and yellow in their 1999 logo design, while

also adding a bright blue and increasing the contrast between all the colours. Likewise, in Domino's latest logo redesign, they changed their traditional blue and red with more vibrant colours. Pizza Hut is another company who decided to redesign its logo completely in 2015 and went with a vibrant red hue and a simple white, which increased the contrast in the logo.

The movement towards sans-serif fonts could be seen as part of the minimalist logo design motion, as in most cases, sans-serif logos appear to have less decorative elements, especially in comparison to serifs and swashes. According to Maggie Coll's article, Logo *Design: Serif Vs. Sans-Serif* (2018), the reason a lot of companies have been transforming their logo to sans-serif in the recent years, is because sans-serif fonts are typically more readable on a screen (Coll, 2018).

However, studies on the topic were inconclusive. A study by Sheree Josephson, *Keeping Your Readers' Eyes on the Screen: An Eye-Tracking Study Comparing Sans Serif and Serif Typefaces* (2011), found out that the sans-serif font Verdana performed the best out of the several sans-serif and serif fonts used in the study, which was proved using an eye-movement tracking technology (Josephson, 2011). However, a different study by Ariea Arditi and Jianna Cho, *Serifs and Font Legibility* (2005), has shown that 5% cap height serif size

has performed slightly better than 0% and 10% cap height serif, making a small serif more readable than a larger serif or sans-serif font (Arditi & Cho, 2005). Finally, the study *Do Serifs Provide an Advantage in The Recognition of Written Words?*, written by Carmen Moret-Tatay and Manuel Perea (2011), concluded that "results showed a small, but significant advantage in response times for words written in a sans serif font. Thus, sans serif fonts should be the preferred choice for text in computer screens" (Moret-Tatay & Perea, 2011). Since results are uncertain in regards to the readability of sans-serif fonts versus serif fonts, this study will try and focus on what those fonts represent, rather than their legibility. In her article, Coll mentions that sans-serif fonts are associated with being "modern, clean, young, and friendly", while serif fonts are associated with being "traditional, conservative, elegant, formal, or established" (Coll, 2018). Based on those associations it is clear that fast food companies are leaning towards sans-serif fonts, since they are portraying more of an everyday lifestyle, rather than a prestige lifestyle. Similarly, fast food companies generally want to portray a modern and friendly look, while appealing to a younger audience.

CONSUMER PERCPETION

Consumer's perception is referred to as a person's idea and view of a certain product, service or brand. Consumer perception is a very important aspect of a company's branding and marketing, since it dictates what the consumer will think of the brand, and will affect their purchasing decisions. Branding is very important because, as David Airey states, people would usually purchase certain products on the basis of their perceived value rather than the product's actual value (2010). Thus, companies are using their idea of what the consumer wants in order to create a better consumer perception of their brand, increase their market, and generate more profit.

Although the product's flavour and texture have a major effect on the consumer's perception, Nazlin Imram states in his study, *The Role of Visual Cues in Consumer*

Perception and Acceptance of a Food Product (1999), that the "first taste is almost always with the eye". Everyone encounters an enormous amount of advertisements every day, whether we notice it or not (Nagornaya, 2012). As Dharma Singh Khalsa states in his book, *Brain longevity: The breakthrough medical program that improves your mind and memory* (1999), the average American will see about 16,000 advertisements of any form on a daily basis. Those advertisements come in many different forms, including print magazines and newspapers, billboards, social media advertisements, television commercials, and many more. This way, brands are utilizing advertisements to alter consumer perception by creating a stronger brand identity through the use of slogans, different colours and fonts, logos and celebrity or influencer associations.

As logos appear in almost every promotion and advertisement piece, they are very important as they can be used to catch the audience's eye, create a good consumer perception, and reinforce the brand identity. Thus, when a customer sees the logo, they immediately associate it with the brand, and they instantly have an image in

mind that represents their own perception of the brand. For example, Airey says that "when you close your eyes and picture McDonald's, what do you see? Golden arches, perhaps? For those products and services that have a strong brand identity, it's the identity that people often think of first, rather than the product itself" (2010). As Airey phrases it, the most important idea behind a logo design is to make it recognizable for the consumer and to engrave it in the consumer's mind along with positive feelings towards the brand.

However, the issue with consumer perception is that it is not static; it can be very different between people who belong to different age groups, genders, ethnic backgrounds, psychographics, and many other reasons. Therefore, many companies have changed and adjusted their logos throughout the years, in order to satisfy the constantly changing consumer perception and to attract the targeted audience. Such adjustments can be seen in the fast food companies' logos that were examined for the purpose of this study. All those companies had significant changes in their logo design since the 1960s, with the main goal of better complying to the changing consumer perception.

COLOUR PSYCHOLOGY

Colour has an essential role when it comes to marketing a brand, it serves the purpose of perusing the consumer, catching their attention, and differentiating the product or the brand from other brands (Dementienko, 2008). However, in order for the colour, or colours, used in a marketing piece to convey the right message to the audience, the marketer must understand the complex theory behind colour psychology. As Dementienko writes in his journal, *Colour – Psychology in Marketing and Advertisement* (2008), "colour perception is controlled by the human brain and not the eye". Thus, there is an undeniable connection between certain colours and the general feeling or association it creates in the consumer's brain.

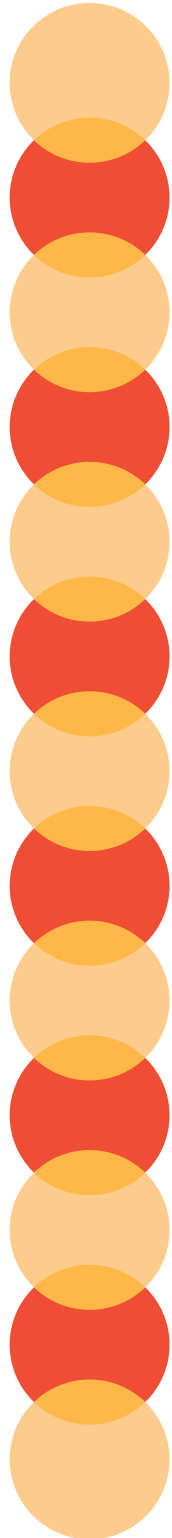
Colour psychology and colour preference can also differ in different target market segments and different cultures, as society has a large impact on the way people perceive colours. Generally, colours are associated with two main types of emotion: warm colours, such as red, orange, and yellow, which are seen as active and exciting; and cool colours, such as blue, purple, and green, which are seen as passive (Dementienko, 2008).

Aside from the emotional influence, Dementienko also claims that colour can influence a physical reaction. To support that, research shows that an individual's response would be approximately 12% faster under red lighting in comparison to regular lighting (Dementienko, 2008).

When it comes to fast food, Dementienko gives several analyses that support the idea of colour psychology in food advertisements and provides a specific explanation as to why some fast food companies are using certain colours in their logos. Firstly, bright colours, including red and yellow, are proven to influence the nervous system and by doing so affect the digestive system and enhance the feeling of hunger (Dementienko, 2008). In a book written by Jill Morton in 1997, *A Guide to Color Symbolism*, the author also supports this and adds that red is also known to symbolize impulse and excitement, and yellow is known to symbolize optimism and hope. Thus, the colour red can be seen in many fast food companies, including McDonald's, KFC, Pizza Hut, Burger King, and Domino's. However, in comparison to other companies, McDonald's and Burger King use the colour combination of red and yellow,

to enhance appetite even more. In comparison, Subway is not using the colour red in their logo design, but they are relying on the colour yellow in most of their logo variations. Secondly, green could be used to place the idea of freshness or health in the consumer's mind; therefore, some companies are using green in their logo to try and appeal to the more health-conscious population (Dementienko, 2008). This theory is supported by Morton, who claims in his book that green symbolizes nature, growth, health, and freshness (1997). For instance, the Subway logo, that has consistently used green since 1968, even created a one-colour logo using only the colour green in 2015. Finally, the colour blue is also used in several fast food companies, including Domino's and Burger King, and it is creating an image of trust, cleanliness, and security, which are associated with those brands (Morton, 1997).

In this literary review, logo evolutions are compared to logo trends, while logo trends are also compared to consumer perception and colour psychology, creating two relationships.



chapter 3

RESEARCH DESIGN

This chapter outlines the design and methodology of the research, which is an online survey. An online survey is optimal in giving this paper more insights as it generates reliable results based on consumer perception, which will then be compared to the evolution of logos amongst the six selected fast-food companies. The main purpose of this survey is to compare the consumer preferences within different age groups. The results will later be used to understand the relationship between logo design evolution and the different age cohorts.

SURVEY DESIGN

The methodology that was used for the purpose of this research was an online survey, that was created in SurveyHero (ENUVO GMBH, 2019) that includes several types of questions: drop-down lists, multiple choice questions, grid questions, slider questions, and text questions. The nature of this survey is to understand the participant's opinion on several logo designs and logo design aspects, including questions regarding a non-existent company by the name of "TimeOut", as well as the six fast food companies that are researched in this paper. The reason an online survey was used is that this is the best way to get a quick response while also achieving trustworthy opinions. The online survey was open for about a month from February 12, 2019, to March 17, 2019. Overall, the survey was quite successful, with 59.2% participation rate and 96.1% completion rate.

This research is designed in a qualitative way; it is used to better understand several opinions and reasons that affect the logo design evolution. This survey combines several independent and dependent variables in order to find the connection between them. The survey starts with questions about the participant, including their age, gender, how often they visit the six researched fast food chains, and how important

their health is to them on a scale of 1-10 (Figure B1). The first question asks the participant's age and has five different options: 17 and under, 18-24, 25-39, 40-53, and 54+. The reason behind it is that, for the purpose of this survey, it was decided to examine only three generational cohorts: generation X, generation Y, and generation Z.

The next questions in the survey are specific questions about how the participant's opinion regarding different aspects of logo design, as well as their preferred logo design for each one of the companies that are researched in this paper. The first question (Figure B2) shows four similar logos that only differ in their font design: serif, sans-serif, decorative, and script. The second question (Figure B3) shows three images of identical packages with the same logo in various sizes. The next question (Figure B4) shows four images of the same logo that differs in its depth. One image represents a flat logo, one represents the same logo with a shadow behind it, one had a three-dimensional effect applied to it, and one has a shadow and a three-dimensional effect. The next three questions (Figure B5) are regarding several McDonald's logos and are asking the participant what logo they are most familiar with, which logo looks more appealing to them, and why. The next three questions (Figure B6) are the same as the previous ones but for the Burger King logos. Afterwards, the same questions are asked for Domino's Pizza (Figure B7), KFC (Figure B8), Subway (Figure B9), and Pizza Hut (Figure B10). All the questions in this section are mandatory, except the questions that ask why the participant chose the particular logo. The text questions ask the participant why they find a particular logo appealing and was not set as mandatory as it might push the participant away, however, this question was included as a voluntary question because it might help understand what aspect of the logo was the most appealing for some of the participants that chose to answer this question (Table B1).

PARTICIPANTS

This research is focusing on:

- Generation Z (ages 18-24)
- Generation Y (ages 25-39)
- Generation X (ages 40-53)

The intended sample size was initially at least 30 participants in each age group. Likewise, to get better results, the initial plan was to have about the same amount of female and male participants.

However, with a total of 75 participants, there were only 10 people who represent Generation Y (13.33%) and 11 people who represent Generation X (14.7%). In comparison to 51 participants who represent Generation Z (68%) (Figure C1). Out of the 75 participants, 78.67% have identified as female, 20% have identified as male, and 1.33% have identified as other (Figure C2).

ANALYSIS

For the analysis of the survey results, this study will get an overall average of the answers, as well as the answers based only on the age group. Then, this study will analyse those results statistically using IBM SPSS version 25 (IBM, 2019). Firstly, this research will compare the choice of familiarity versus preference, to find out if the participants' familiarity with the logo affects their preference. This will be measured using the Binomial test and observing if the p-value is less than 0.05, in which case it could be decided with a 95% confidence level that there is a relationship between the participant's preference and their familiarity with the logo. Next, this paper will compare the general logo preference between the

different age groups, using the Kruskal-Wallis test, which is used to evaluate a difference between three or more populations using separate samples. The null hypothesis will be rejected or confirmed using, again, a p-value with a confidence level of 95%. Then, using the Mann- Whitney test, which evaluates the difference between the two populations, this research will compare the consumer preference with their participants' gender, evaluating it with a p-value < 0.05.

After analysing the general results, this paper will dive deeper into the statistics and focus further on the specific research questions and hypotheses of this thesis. Thus, after the first two analyses, this thesis will look into the effect of age on consumer preference in terms of the simplicity of the logo using a one-way ANOVA test. In these findings, if the p-value is less than 0.05, then a post hoc analysis (Tukey's HSD) will be conducted to understand which age groups have a significant difference between them. Finally, the Kruskal-Wallis H test will be used to find out if there is a relationship between the age group and their preference of font size, type and depth. The "TimeOut" logo that was created for the purpose of this thesis will be evaluated on the basis of p-value < 0.05. Then, the same test and evaluation method will be used to determine the effects of gender on preference of font size, type, and depth. Finally, using the Kruskal Wallis H test again, this paper will measure the effect of the age group on their font size preference, based on the six fast food companies, evaluating the results using a p-value < 0.05. The same analysis and evaluation will be done to measure the effect of gender on the font size, again, using the six fast food companies.

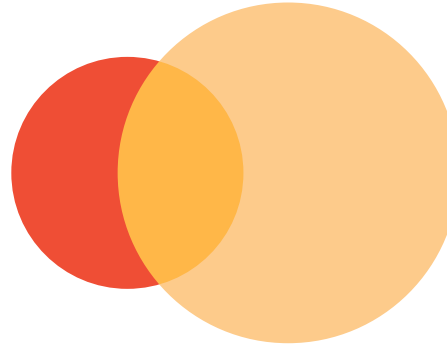
LIMITATIONS

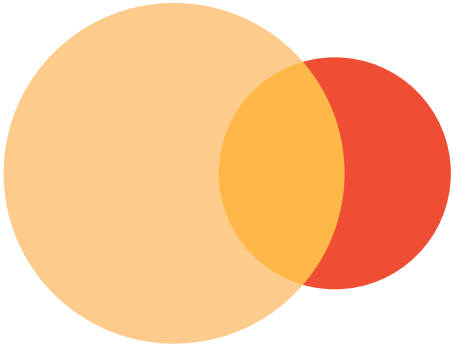
There are several limitations to this method of research design. An online survey can have several issues including less reliability, due to the fact that it is an anonymous survey and some participants might want to finish quickly without paying attention to the questions, and the lack of knowledge regarding who is being surveyed, thus some of the participants might be disqualified, including participants not from Toronto, and participants that are not in between the ages of 18-53. Another set of limitations comes from the specific survey design and the way that the questions are presented. The fact that the questions are set as a multiple choice, rather than as a ranking system, can limit our understanding of consumer preference. Finally, there could be an issue of bias, where the participants will choose the logo they are most familiar with as the logo they prefer the most. However, this issue will be analysed and will be either rejected or accepted, based on statistical analysis. In addition, to avoid any ethical and legal issues, the survey begins with a survey consent portion (Figure B11).

chapter 4

RESULTS & DISCUSSION

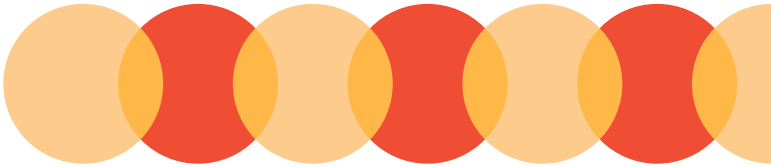
This chapter will detail all the results of the study, based on several testing methods: the Kruskal-Wallis H test, the Mann-Whitney test, the one-way ANOVA test, the Tukey's HSD post hoc analysis, and the Binomial test. All of these tests will be used to understand if the null hypothesis (H0) can be rejected based on the p-value results, with a confidence level of at least 95%, so the p-value < 0.05.





GENERAL RESULTS

After considering the survey and its results, it was decided that the number of times the participant visited each one of the researched fast food companies, as well as the participant's value of health, are irrelevant to the purpose of this study. Thus, the results for those questions would not be included in this portion. Refer to Appendix C for the results of the survey questions concerning the dependent variable, the most preferred result on average, as well as the most preferred result on average based on the age group.



STATISTICAL ANALYSIS

This section will focus on the statistical analysis and the effect of different independent variables on the different dependent variables, using the statistical analysis software IBM SPSS. The effect of the variables will be measured using a p-value with a confidence level of 95%. Thus, to reject the null hypothesis, the p-values have to be less than 0.05.

Firstly, using the Binomial test, this study has analysed if there is a statistical difference between the participant's familiarity with the logo and their choice of preferred logo. The results (Table D1) show that for McDonald's, Domino's Pizza, and KFC, the null hypothesis cannot be rejected, as the p-value was more than 0.005. Thus, the participants' familiarity with the logo did not have a significant effect on their preference. However, the p-value for Burger King, Subway, and Pizza Hut was more than 0.05, therefore, the null hypothesis can be rejected. Meaning, for those three companies, the familiarity of the participant with the logo has significantly affected their preference.

Secondly, using the Kruskal-Wallis test, this paper has evaluated the effect of the age group on the participants' preferences. This test measured only the participants' answers in regards to the six fast food companies that are researched in this thesis. However, the results have differed based on the company. Based on the results (Table D2), the null hypothesis for McDonald's (p-value = 0.010) and Domino's (p-value = 0.020) can be rejected. Thus, there is a statistically significant difference among the three age groups in regards to their McDonald's and Domino's logo preference. However, there is no statistical difference among the three age groups in relation to their preference of the other four fast food companies' logos.

Next, this research evaluated the effect of gender on the participants' preference, using the Mann-Whitney test, again, only measuring the results for the six fast food companies that are being researched. The results (Table D3) show that the null hypothesis for all six brands cannot be

rejected since the p-value was over 0.05 for all brands. Therefore, there is no significant effect of gender on the participant's logo preference.

Afterwards, this paper researched the effect of the age group on the logo simplicity, using all the companies' logos together, excluding the "TimeOut" logos. This analysis was done using the one-way ANOVA test that was conducted with a post hoc analysis (Tukey's HSD). It is important to understand how the logo simplicity was decided in the first place. The logo simplicity for each one of the companies was decided based on three logo elements: number of colours, the simplicity of fonts, and depth. Based on these variables, the simplicity of the logos used in the survey was ranked from 1-4, with 1 being the simplest and 4 being the least simple (Table C16). The results of the ANOVA test found that there was a significant statistical difference between the age groups and their logo preference, as the p-value was 0.025. Then, based on Tukey's HSD test, it can be concluded that age groups of 18-24 and 40-53 show a significant difference in terms of simplicity preference (Table D4). Generally, the younger generation chose the simpler logo, while the older generation chose the more complex logo. For example, in the McDonald's logo, most of the 18-24 aged participants chose the simplest McDonald's logo (Figure A6.7), while the 40-53 age group preferred the most complex McDonald's logo (Figure A6.4).

This study investigated the effect of the age group on the preference of font size, font type, and font depth, using the "TimeOut" logos. This was done using the Kruskal Wallis test again. Based on the results (Table D5), the null hypothesis for the font size and the font

depth cannot be rejected, since the p-values < 0.05. However, the null hypothesis for the font style can be rejected (p-value = 0.016). Thus, there is a statistically significant difference between the age groups and their preference of the font style, with the youngest generation having a velar preference towards the sans-serif font.

Finally, this thesis investigated the effect of gender on the participant's preference of font size, font type, and font depth (examining the results to the "TimeOut" logo), using the Mann-Whitney test. As the p-value was over 0.05 for all three variables, the null hypothesis cannot be rejected (Table D6). Therefore, the gender variable has no effect on the participants' preference of font size, font type, and font depth.

Overall, the results conclude several important things. First, in three of the brands, there is no significant effect of the familiarity of the logo on the participant's preference, while in three other brands the familiarity significantly affected the preference. Secondly, this research found that there is a significant statistical difference between the preferences of the age groups in the McDonald's and Domino's logos. Furthermore, this paper found that there is a significant difference between the age groups in regards to their preferred logo in terms of simplicity, specifically between the 18-24 and 40-53 age groups. In addition, this study found that there is a statistically significant difference between the age groups and their preference of the font style. Finally, this study did not find any correlation between the gender of the participant to their general preference, preference based on simplicity, or preference based on font type, font size, and font depth. There

was no significant difference in consumer perception between different genders.

Those results can show that gender has no effect on consumer preference when it comes to fast food companies' logos. However, this paper did find a different consumer perception on logo design based on age groups. Specifically, this study found that the main statistical significance was in the difference between generation Z's preference and generation X's preference. The younger age group (18-24) tends to prefer simpler logos and sans-serif fonts, which complies with the current trend of simplicity and the movement towards sans-serif fonts, while the older generations prefer more complex logo designs and a larger variety of font types. From these results, it can be concluded that current design trends have an influence on the evolution of fast-food company logos as well as consumer perception. The design trend towards simplicity and the use of sans-serif fonts corresponds to the preferences of the younger generation, generation Z, rather than the other generations. Likewise, this can teach us about the fast food company's target market. If they are constantly changing their logo to make it simpler (for example, McDonald's), this probably means that they are tailoring their company towards the younger generation, but if they are only adjusting their logo, such as adding components and complexity, and trying to keep it traditional (KFC, for example), it can be assumed that they are tailoring their brand towards older generations. When it comes to fast food companies, based on the analysis, it can be assumed that gender does not come into consideration when designing and redesigning their logos.

chapter 5
CONCLUSIONS

The results of this study have established a relationship between the evolution of logos in those six fast food companies since the 1960s and the consumer preference of the different age groups studied in this paper. Firstly, the statistical analysis has proven that the age variable does have an effect on the consumer's perceptions, with significant differences seen between consumer's preference on the McDonald's and Domino's logos based on age. Likewise, there is a significant statistical effect of the age group on their preference of a logo based on simplicity, with generation Z preferring the simpler logo designs. Finally, based on the non-existent "TimeOut" brand that was created for the purpose of this study, it can also be seen that there was a significant effect of age on the consumer's preference of the font type of the logo, with the younger generation's tendency to prefer the sans-serif font. Moreover, it can be seen through the results that there is a relationship between the current logo design trends and the younger generation. The 18-24 age group has a stronger tendency to prefer simpler logos and sans-serif fonts, as proven in the statistical analysis. Furthermore, this study shows that most of the companies are trying to comply with the current trends, that are hugely affected but the younger generation's consumer perception, implying that fast food companies are tailoring their logo design

towards younger people. This includes Burger King's logo with vibrant colours and a more sans-serif text, Subway's logo simplification by removing the background and the stroke, Pizza Hut's logo simplification by removing colours and replacing them with contrasting vibrant colours, Domino's simplification of their logo by removing components and replacing the colours with brighter colours, and McDonald's with their extreme logo simplification by removing all components except the golden arches.

Based on this information, the reader can further understand consumer preference in logo design, the effect that consumers' age has on their preferences and their compliance with the current logo trends, specifically in the fast food industry in Toronto. This information can help fast food chains in Toronto to better understand consumer perception and ensure that their logo adjustment fits with the consumer preference, based on the age range of their target market. Likewise, this information also shows that the younger generation in Toronto seems to comply more with current design trends and has a higher preference towards them, while the older generation prefers more traditional designs and does not follow the current design trends as much.

Although the statistical analysis is reliable due to the 95% confidence level, there are some limitations to this paper that should be considered. First of all, as the sample number of the survey did not match the expectations, the number of participants aged 25-39 and 40-53 was fairly small and it might not be reliable as it is a small sample group. Furthermore, there are many components in addition to age that were not taken into consideration for the purpose of this paper, and those components might have affected the participants' preference of logo design. Lastly, although the statistical analysis did not reject the

null hypothesis of the effect of logo familiarity on the participant's logo preference for McDonald's, Domino's, and KFC, for the other three companies (Burger King, Subway, and Pizza Hut) the null hypothesis was rejected. Thus, for Burger King, Subway, and Pizza Hut, it was not found that the participants' familiarity with the logo has significantly affected their preference. This can show certain bias in the participants' opinions, that some of them did choose the logo they prefer not based on the design but rather based on their familiarity with it. There could be other reasons for that as well, but the connection between familiarity and preference that was found in three of the companies cannot be ignored.

Lastly, based on the results of this study, there are several other areas that should be explored and researched further to gain a better understanding of the connection between consumer preference and logo evolution of different brands. In terms of future research, there are several points that should be studied further. Colour psychology, as well as the current trend of using vibrant colours, was explored in the literary review of this thesis, however, it was not developed further since the survey questions did not focus on colours. In addition, this research was unsuccessful with proving that the age of the consumer affects their preference of logo depth, however, this should be explored further to try and find a connection using a larger participant group, or fully reject this hypothesis. Finally, the same research that was done in this paper could, and should, be done in other industries and other geographical areas. This could be done by conducting the same research on the fast food industry in other geographical areas, researching a different industry in Toronto, or by conducting research on a different industry in a different area.

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APPENDIX A
LOGOS

FIGURES

A1
BURGER KING LOGO EVOLUTION

1957
A1.1

1969
A1.2

1994
A1.3

1999
A1.4

A2
SUBWAY LOGO EVOLUTION

1965
A2.1

1968
A2.2

1982
A2.3

2015
A2.4

2016
A2.5

A3
PIZZA HUT LOGO EVOLUTION

1955
A3.1

1974
A3.2

1999
A3.3

2010
A3.4

2014
A3.5

2014
A3.4

A4
DOMINO'S LOGO EVOLUTION

1960
A4.1

1987
A4.2

1996
A4.3

2013
A4.4

A5
KFC LOGO EVOLUTION

1978
A5.1

1991
A5.2

1997
A5.3

2006
A5.4

2010
A5.5

A6
MCDONALD'S LOGO EVOLUTION

1968
A6.1

1969
A6.2

1975
A6.3

1992
A6.4

2000
A6.5

2003
A6.6

2006
A6.7

APPENDIX B
SURVEY QUESTIONS

TABLE

B1
SURVEY QUESTIONS

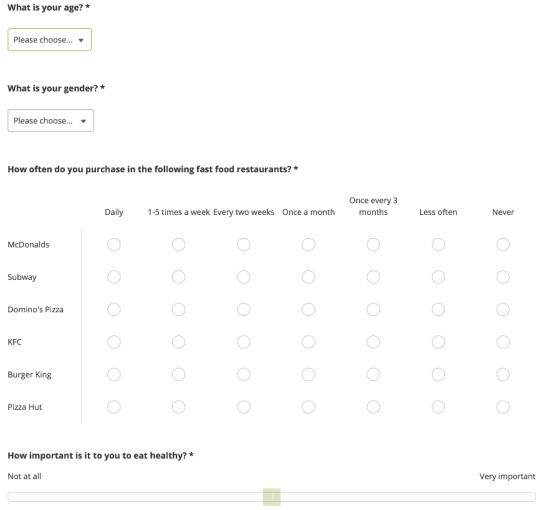
QUESTION #	THE QUESTIONS
1	What is your age?
2	What is your gender?
3	How often do you visit the following fast food restaurants?
4	How important is it to you to eat healthy?
5	A new fast food company called "TimeOut" is being launched, which one of the following fonts do you find most appealing?
6	What font size do you find most appealing?
7	Which one of the following logos do you find most appealing?
8	Which of the following McDonald's logos are you most familiar with?
9	Which of the following McDonald's logos do you like the most?

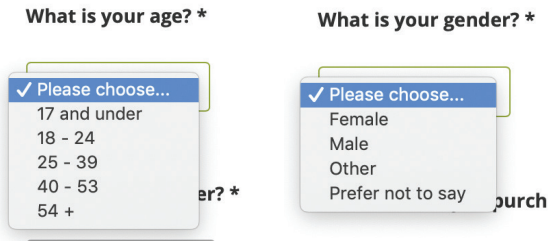
QUESTION #	THE QUESTIONS
10	Why did you pick this McDonald's logo (not mandatory)?
11	Which of the following Burger King logos are you most familiar with?
12	Which of the following Burger King logos do you like the most?
13	Why did you pick this Burger King logo (not mandatory)?
14	Which of the following Domino's logos are you most familiar with?
15	Which of the following Domino's logos do you like the most?
16	Why did you pick this Domino's logo (not mandatory)?
17	Which of the following KFC logos are you most familiar with?

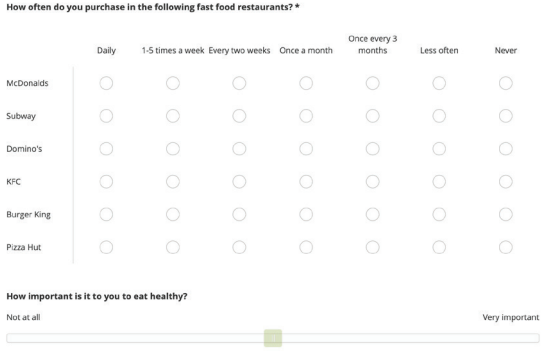
QUESTION #	THE QUESTIONS
18	Which of the following KFC logos do you like the most?
19	Why did you pick this KFC logo (not mandatory)?
20	Which of the following Subway logos are you most familiar with?
21	Which of the following Subway logos do you like the most?
22	Why did you pick this Subway logo (not mandatory)?
23	Which of the following Pizza Hut logos are you most familiar with?
24	Which of the following Pizza Hut logos do you like the most?
25	Why did you pick this Pizza Hut logo (not mandatory)?

FIGURES

B1
QUESTIONS ABOUT THE PARTICIPANT







B2
QUESTIONS ABOUT THE "TIMEOUT" FONT TYPES

A new fast food company called "TimeOut" is being launched, which one of the following fonts do you find most appealing? *

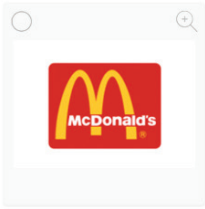
B3
QUESTIONS ABOUT THE "TIMEOUT" FONT SIZE

B4
QUESTIONS ABOUT THE "TIMEOUT" LOGO DEPTH

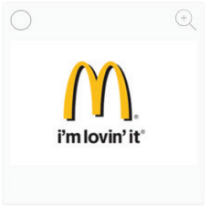
Which one of the following logos do you find most appealing? *

B5
QUESTIONS ABOUT MCDONALD'S

Which one of the following McDonalds logos are you most familiar with? *

Which one of the following McDonalds logos do you like the most? *

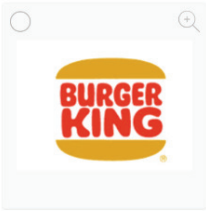


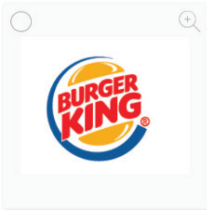
Why did you pick this McDonalds logo (you are not required to answer)?

B6
QUESTIONS ABOUT
BURGER KING

Which one of the following Burger King logos are you most familiar with? *

Which one of the following Burger King logos do you like the most? *

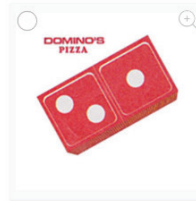




Why did you pick this Burger King logo (you are not required to answer)?

B7
QUESTIONS ABOUT DOMINO'S

Which one of the following Domino's Pizza logos are you most familiar with? *

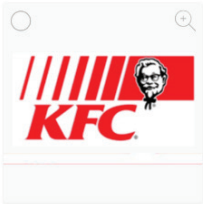


Which one of the following Domino's Pizza logos do you like the most? *

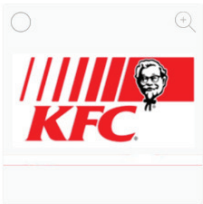
Why did you pick this Domino's Pizza logo (you are not required to answer)?

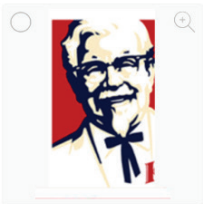
B8
QUESTIONS ABOUT KFC

Which one of the following KFC logos are you most familiar with? *




Which one of the following KFC logos do you like the most? *






Why did you pick this KFC logo (you are not required to answer)?

B9
QUESTIONS ABOUT SUBWAY

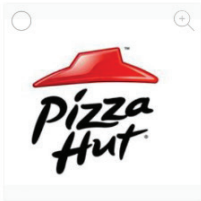
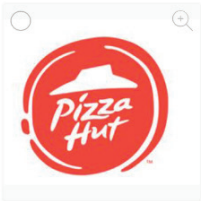
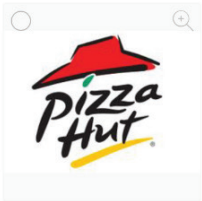
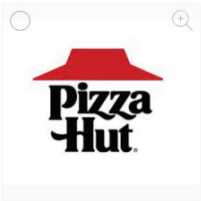
Which one of the following Subway logos are you most familiar with? *

Which one of the following Subway logos do you like the most? *

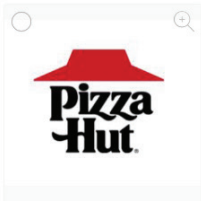
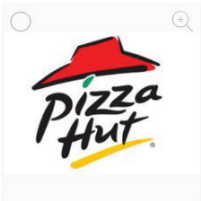
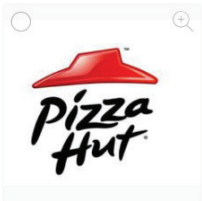
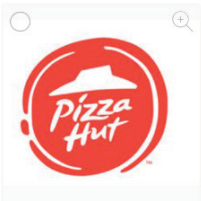
Why did you pick this Subway logo (you are not required to answer)?

B10
QUESTIONS ABOUT
PIZZA HUT

Which one of the following Pizza Hut logos are you most familiar with?? *

Which one of the following Pizza Hut logos do you like the most? *

Why did you pick this Pizza Hut logo (you are not required to answer)?

B11
SURVEY CONSENT

OBJECTIVE

The purpose of this research is to evaluate people's opinions on the current logo in the fast food industry, as well as the general preference for logo design, while taking into consideration their background and behavioural patterns.

PROCEDURE

Filling out the questionnaire will take approximately 5-10 minutes. The questionnaire comprises of two sections:

1. Background information
2. Opinions on logos in the fast food industry

Please answer ALL questions by selecting the most appropriate response. Your approximate response is far more useful than no response.

PARTICIPATION

Participation in this research is voluntary and you have the right to withdraw at any time or to refuse to participate without any penalty. If you desire to withdraw, please exit the tab at any point.

CONFIDENTIALITY

All data obtained from participants will be kept strictly confidential and will only be reported for the purpose of the research study. All questionnaires will be concealed, and no one other than the primary investigators and their assistant researchers will have access to them.

RISKS/DISCOMFORT

Risks are minimal for involvement in this study. Although we do not expect any harm to come upon any participants due to electronic malfunction of the computer, it is possible though extremely rare and uncommon.

CONTACT INFORMATION

If you have any questions about the research of if you have any problem in loading or accessing the study, please contact us by
email: Lital.ch@gmail.com

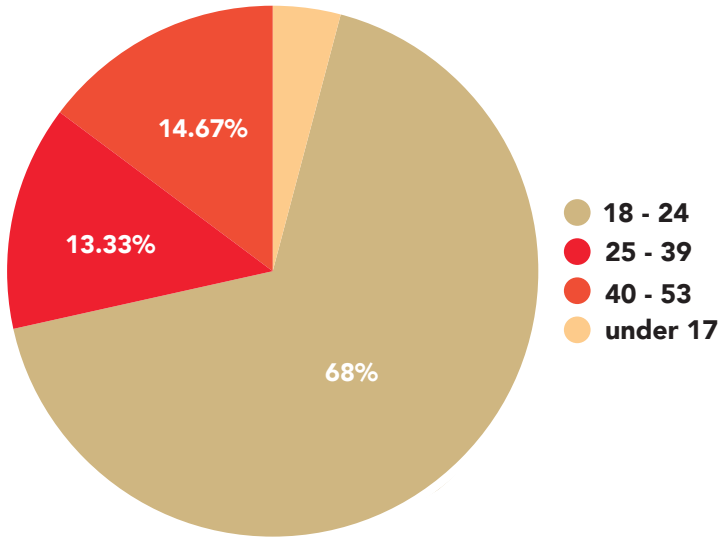
Please click 'Next' if you agree to the terms.

APPENDIX C

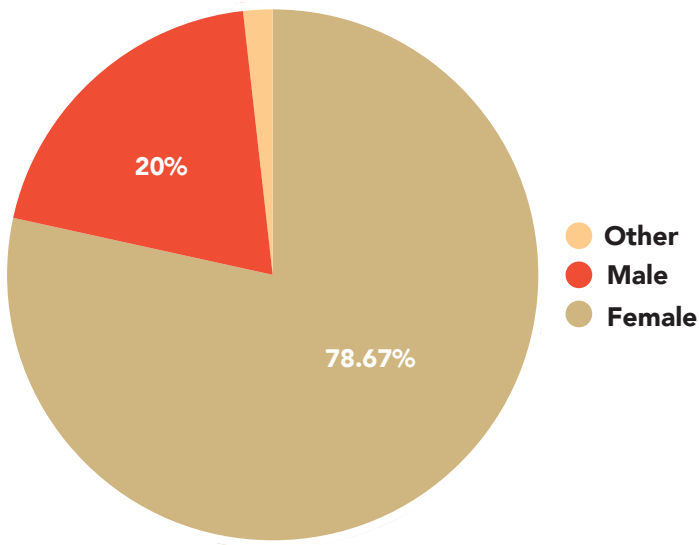
SURVEY RESULTS

FIGURES

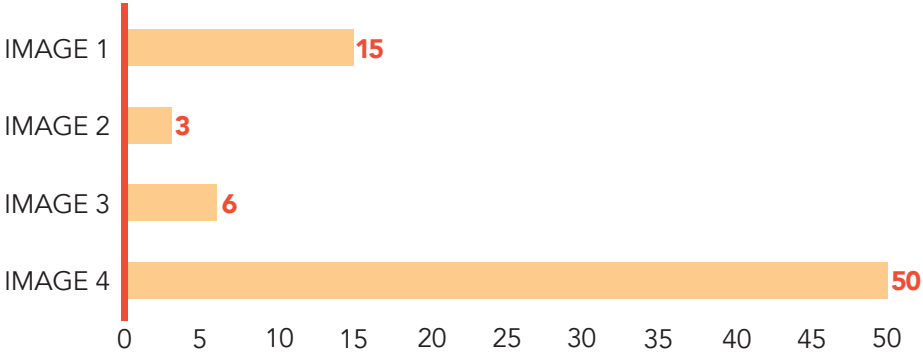
C1
SURVEY PARTICIPANTS' Age Breakdown



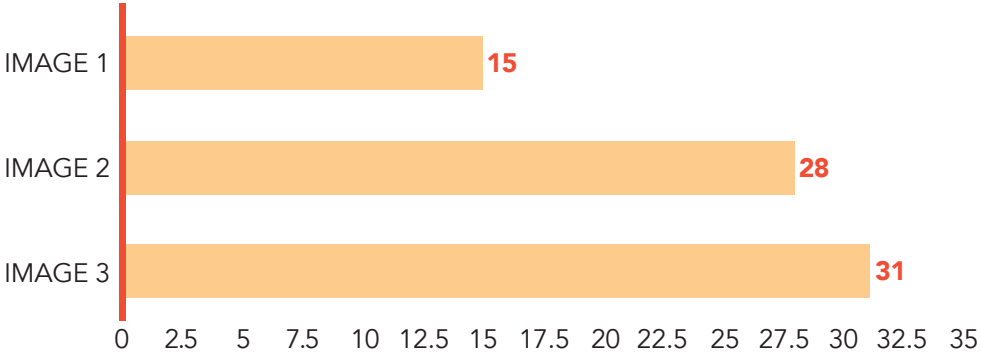
C2
SURVEY PARTICIPANTS' Gender Breakdown



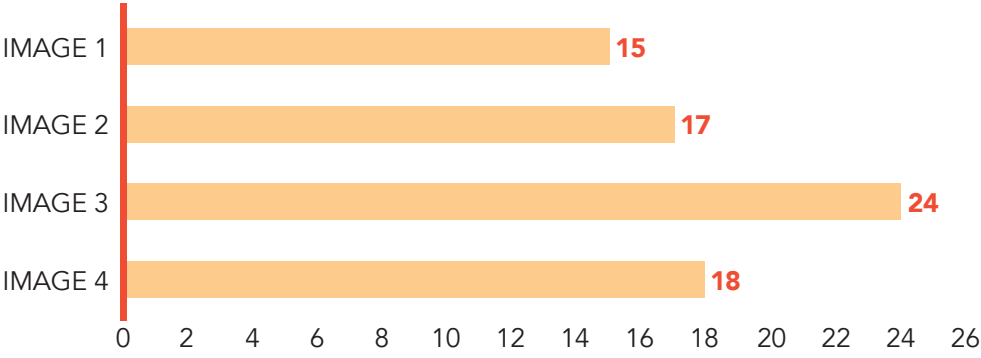
C3
SURVEY PARTICIPANTS' PREFERENCE OF QUESTION 5



C4
SURVEY PARTICIPANTS' PREFERENCE OF QUESTION 6

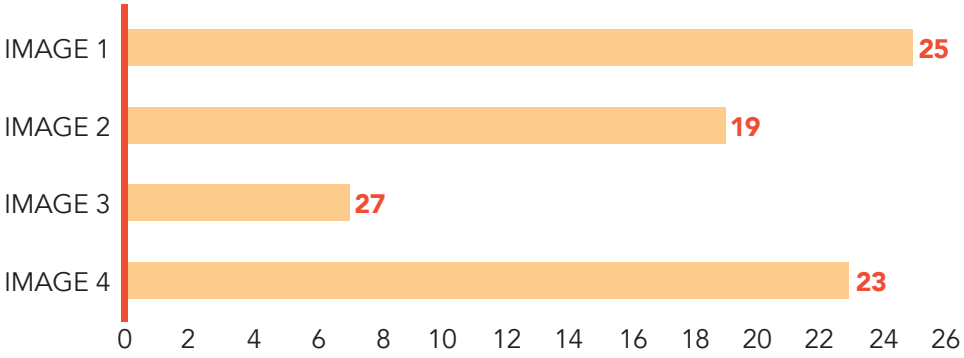


C5
SURVEY PARTICIPANTS' PREFERENCE OF QUESTION 7

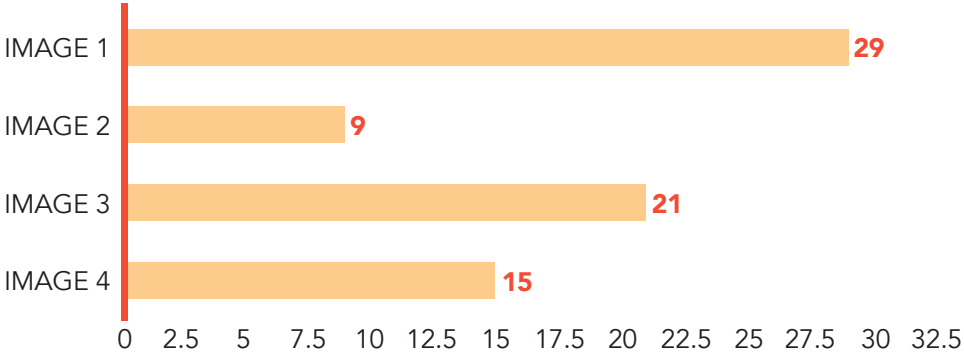


C6
SURVEY PARTICIPANTS' PREFERENCE OF QUESTIONS 8-9

Which one of the following McDonald's logos are you most familiar with?
Number of Responses: 74

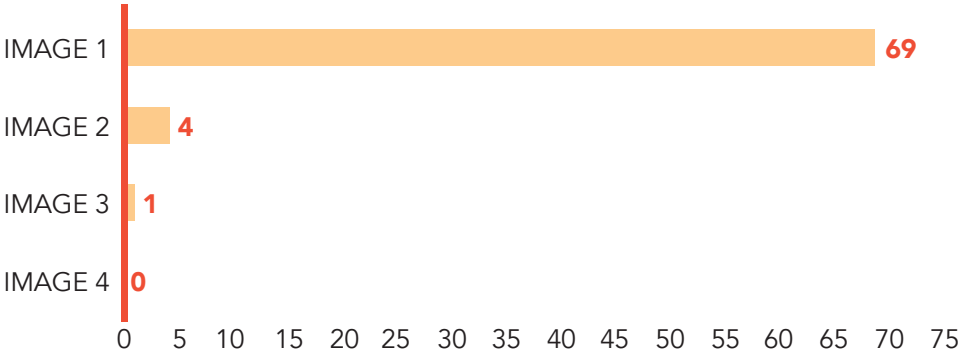


Which one of the following McDonald's logos do you like the most?
Number of Responses: 74

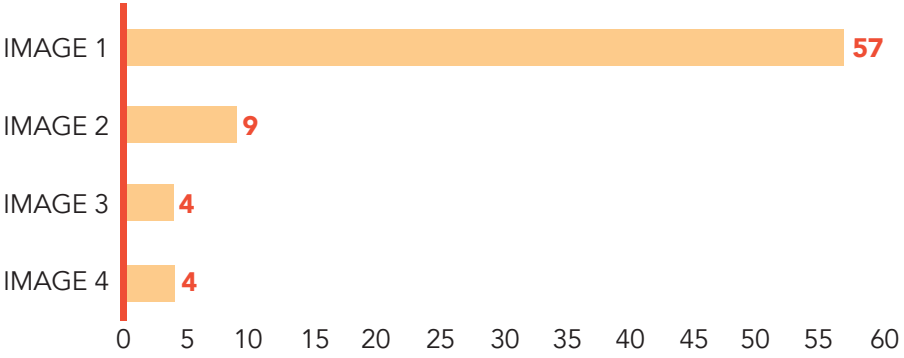


C7
SURVEY PARTICIPANTS' PREFERENCE OF QUESTIONS 11-12

Which one of the following Burger King logos are you most familiar with?
Number of Responses: 74

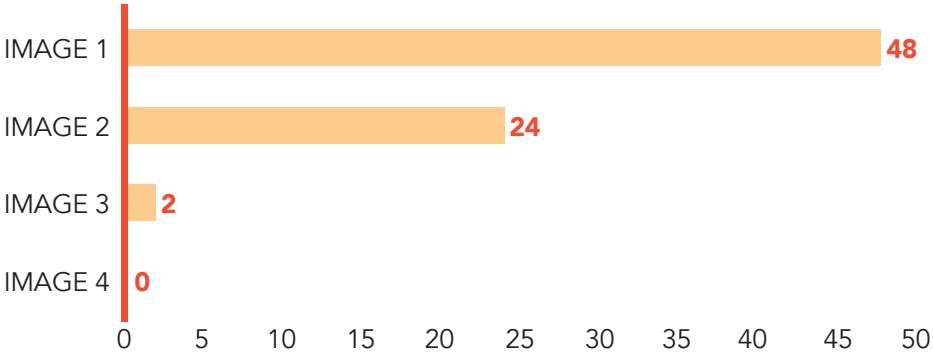


Which one of the following Burger King logos do you like the most?
Number of Responses: 74

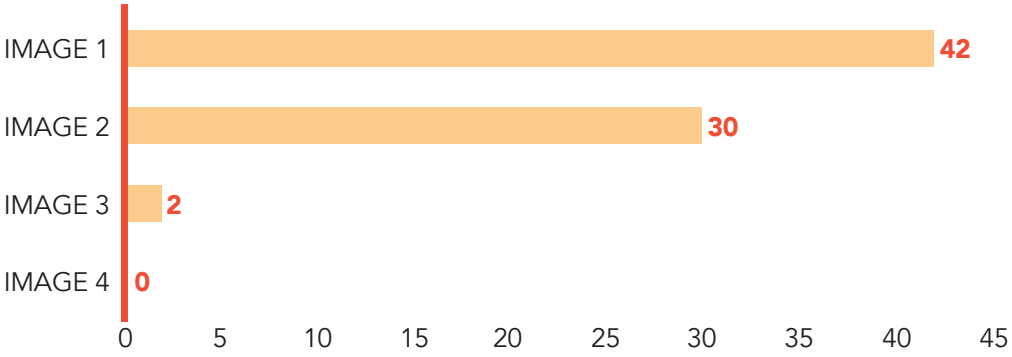


C8
SURVEY PARTICIPANTS' PREFERENCE OF QUESTIONS 14-15

Which one of the following Domino's Pizza logos are you most familiar with?
Number of Responses: 74

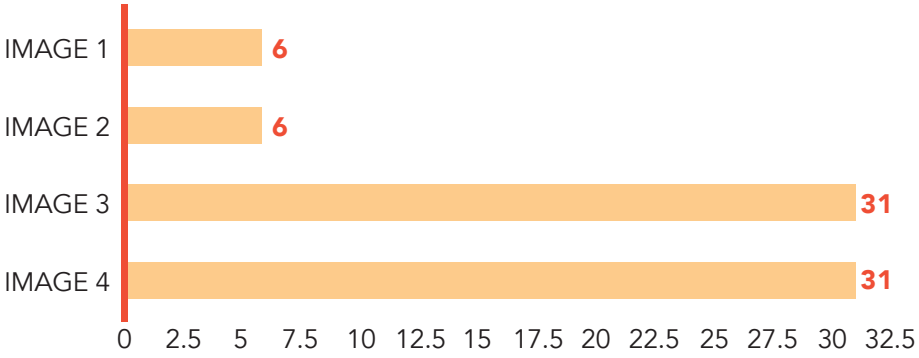


Which one of the following Domino's Pizza logos do you like the most?
Number of Responses: 74

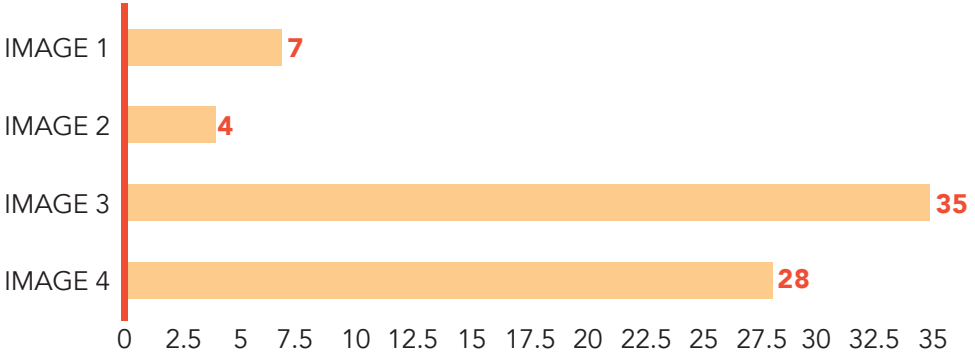


C9
SURVEY PARTICIPANTS' PREFERENCE OF QUESTIONS 17-18

Which one of the following KFC logos are you most familiar with?
Number of Responses: 74

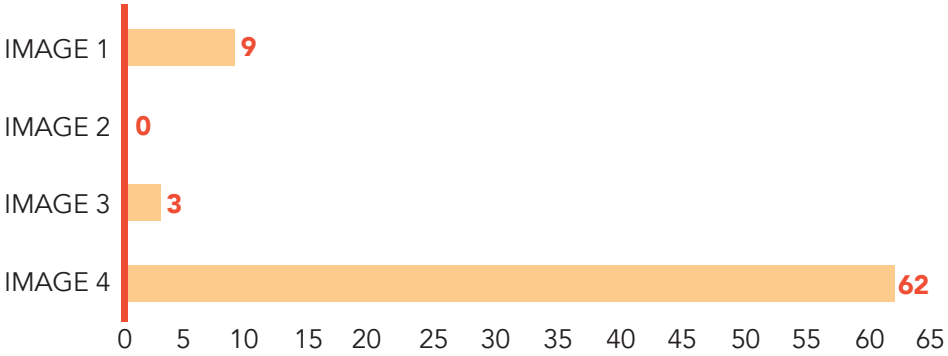


Which one of the following KFC logos do you like the most?
Number of Responses: 74

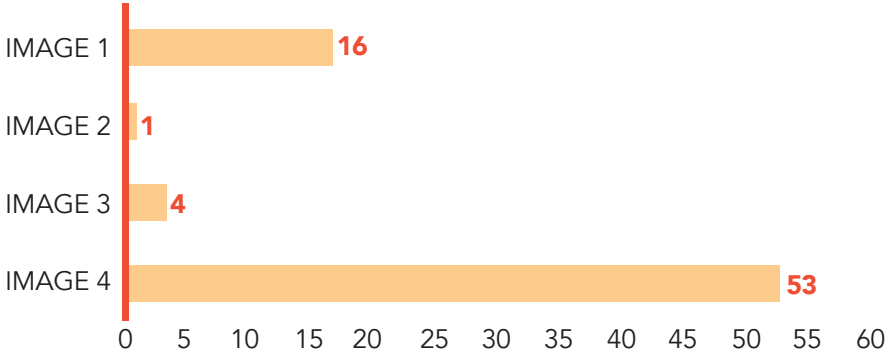


C10
SURVEY PARTICIPANTS' PREFERENCE OF QUESTIONS 20-21

Which one of the following Subway logos are you most familiar with?
Number of Responses: 74

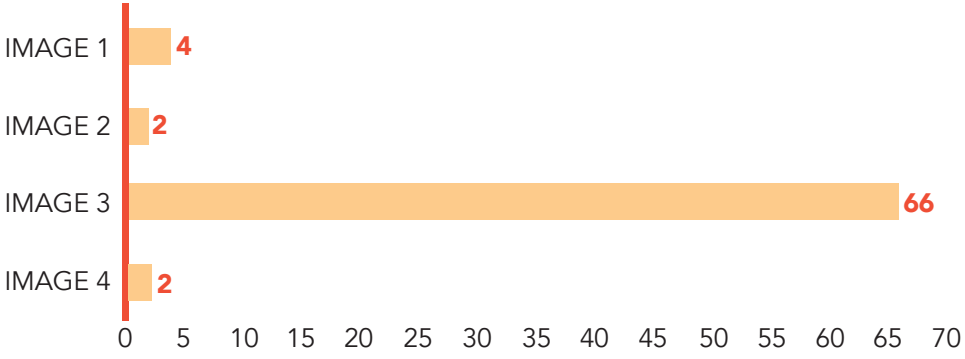


Which one of the following Subway logos do you like the most?
Number of Responses: 74

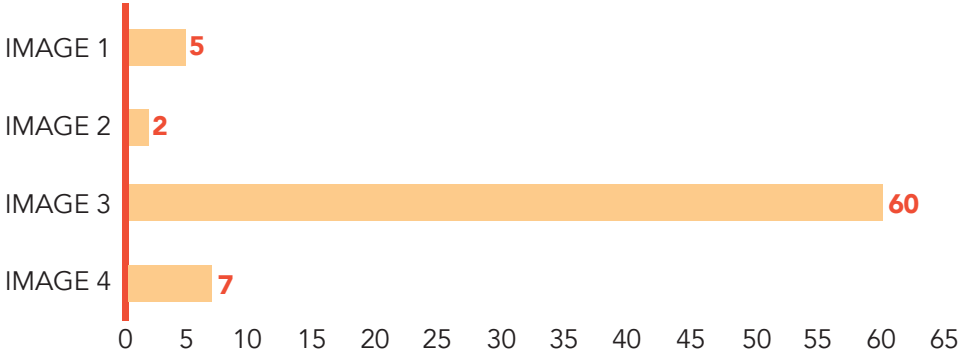


C11
SURVEY PARTICIPANTS' PREFERENCE OF QUESTIONS 23-24

Which one of the following Pizza Hut logos are you most familiar with?
Number of Responses: 74



Which one of the following Pizza Hut logos do you like the most?
Number of Responses: 74



TABLES

RESULTS REGARDING PARTICIPANTS' PREFERENCE OF...

C1 FONT BASED ON AGE

AGE GROUP	% OF PARTICIPANTS PREFER SANS-SERIF FONT	% OF PARTICIPANTS PREFER SERIF FONT	% OF PARTICIPANTS PREFER DECORATIVE FONT	% OF PARTICIPANTS PREFER HAND-WRITTEN FONT
18 - 24	74%	4%	22%	0%
25 - 39	60%	20%	20%	0%
40 - 53	30%	20%	20%	30%

C2 LOGO SIZE BASED ON AGE

AGE GROUP	% OF PARTICIPANTS PREFER SMALL LOGO	% OF PARTICIPANTS PREFER MEDIUM LOGO	% OF PARTICIPANTS PREFER LARGE LOGO
18 - 24	16%	50%	34%
25 - 39	20%	20%	60%
40 - 53	36.4%	27.3%	36.4%

C3 LOGO DEPTH BASED ON AGE

AGE GROUP	% OF PARTICIPANTS PREFER FLAT LOGO	% OF PARTICIPANTS PREFER SHADOW	% OF PARTICIPANTS PREFER 3D	% OF PARTICIPANTS PREFER SHADOW & 3D
18 - 24	38%	20%	22%	20%
25 - 39	10%	20%	30%	40%
40 - 53	27.3%	27.3%	36.4%	9.1%

MCDONALD'S

C4 FAMILIARITY WITH THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	40%	26%	4%	30%
25 - 39	30%	10%	20%	40%
40 - 53	0%	36.4%	27.3%	36.4%

C5 PREFERENCE OF THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	48%	12%	24%	16%
25 - 39	30%	10%	30%	30%
40 - 53	91%	9.1%	54.5%	27.3%

BURGER KING

C6 FAMILIARITY WITH THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	98%	0%	2%	0%
25 - 39	100%	0%	0%	0%
40 - 53	72.7%	27.3%	0%	0%

C7 PREFERENCE OF THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	82%	16%	2%	0%
25 - 39	50%	10%	10%	30%
40 - 53	72.7%	0%	18.2%	9.1%

DOMINO'S

C8 FAMILIARITY WITH THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	72%	28%	0%	0%
25 - 39	40%	60%	0%	0%
40 - 53	54.5%	27.3%	18.2%	0%

C9 PREFERENCE OF THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	66%	32%	2%	0%
25 - 39	40%	50%	10%	0%
40 - 53	18.2%	81.8%	0%	0%

KFC

C10 FAMILIARITY WITH THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	8%	4%	52%	36%
25 - 39	0%	30%	30%	40%
40 - 53	18.2%	9.1%	0%	72.7%

C11 PREFERENCE OF THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	4%	4%	52%	40%
25 - 39	30%	20%	30%	20%
40 - 53	27.3%	0%	0%	72.7%

SUBWAY

C12 FAMILIARITY WITH THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	6%	0%	6%	88%
25 - 39	30%	0%	0%	70%
40 - 53	27.3%	0%	0%	72.7%

C13 PREFERENCE OF THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	14%	2%	2%	82%
25 - 39	30%	0%	30%	40%
40 - 53	27.3%	0%	0%	72.7%

PIZZA HUT

C14 FAMILIARITY WITH THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	4%	4%	90%	2%
25 - 39	0%	0%	100%	0%
40 - 53	18.2%	0%	72.7%	9.1%

C15 PREFERENCE OF THE LOGO BASED ON AGE

AGE GROUP				
18 - 24	8%	4%	80%	8%
25 - 39	10%	0%	70%	20%
40 - 53	0%	0%	90.9%	9.1%

C16 LOGO SIMPLICITY RANKING

COMPANY	1	2	3	4
MCDONALD'S				
BURGER KING				
DOMINO'S				
SUBWAY				
KFC				
PIZZA HUT				

***1 being the simplest, 4 being the least simple

APPENDIX D

STATISTICAL ANALYSIS

TABLES

D1 THE EFFECT OF PARTICIPANTS' FAMILIARITY ON THEIR PREFERENCE

BINOMIAL TEST						
		CATEGORY	N	OBSERVED PROP.	TEST PROP.	EXACT SIG. (2-tailed)
M_FP	Group 1	0	41	0.59	0.50	0.188
	Group 2	1	29	0.41		
	Total		70	1.00		
B_FP	Group 1	1	49	0.70	0.50	0.001
	Group 2	0	21	0.30		
	Total		70	1.00		
D_FP	Group 1	1	40	0.57	0.50	0.282
	Group 2	0	30	0.43		
	Total		70	1.00		
K_FP	Group 1	0	36	0.51	0.50	0.905
	Group 2	1	34	0.49		
	Total		70	1.00		
S_FP	Group 1	1	46	0.66	0.50	0.012
	Group 2	0	24	0.34		
	Total		70	1.00		
P_FP	Group 1	1	51	0.73	0.50	0.000
	Group 2	0	19	0.27		
	Total		70	1.00		

D2 THE EFFECT OF PARTICIPANTS' AGE ON THEIR GENERAL LOGO PREFERENCE

TEST STATISTICS[a,b]						
	M_PREFERENCE	B_PREFERENCE	D_PREFERENCE	K_PREFERENCE	S_PREFERENCE	P_PREFERENCE
Kruskal-Wallis H	9.629	2.637	7.804	5.600	1.793	1.193
dF	2	2	2	2	2	2
Asymp. Sig.	0.010	0.268	0.020	0.061	0.408	0.551

a. *Kruskal Wallis Test*
b. *Grouping Variable: Age*

D3 THE EFFECT OF PARTICIPANTS' GENDER ON THEIR GENERAL LOGO PREFERENCE

TEST STATISTICS[a]						
	M_PREFERENCE	B_PREFERENCE	D_PREFERENCE	K_PREFERENCE	S_PREFERENCE	P_PREFERENCE
Mann-Whitney U	299.000	292.500	290.000	297.000	311.500	306.000
Wilcoxon W	377.000	370.500	368.000	1950.000	1964.500	384.000
Z	-0.716	-1.038	-0.945	-0.775	-0.641	-0.836
Asymp. Sig. (2-tailed)	0.474	0.299	0.345	0.439	0.521	0.403

a. *Grouping Variable: Gender*

D4 THE EFFECT OF PARTICIPANTS' AGE ON THEIR GENERAL LOGO PREFERENCE BASED ON SIMPLICITY

Overall_Simplicity

	Sum of Squares	dF	Mean Square	F	Sig.
Between Groups	1.417	2	0.709	3.884	0.025
Within Groups	12.226	67	0.182		
Total	13.643	69			

POST HOC TESTS

Dependent Variable: Overall_Simplicity
Turkey HSD

MULTIPLE COMPARISONS						
					95% Confidence Interval	
(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
1	2	0.05667	0.14797	0.922	-0.2980	0.4113
	3	-.39333*	0.14797	0.026	-0.7480	-0.0387
2	1	-0.05667	0.14797	0.922	-0.4113	0.2980
	3	-0.45000	0.19103	0.055	-0.9079	0.0079
3	1	.39333*	0.14797	0.026	0.0387	0.7480
	2	-0.45000	0.19103	0.055	-0.0079	0.9079

*. The mean difference is significant at the 0.05 level.

D5 THE EFFECT OF PARTICIPANTS' AGE ON THEIR GENERAL LOGO PREFERENCE BASED ON FONT SIZE, TYPE, AND DEPTH

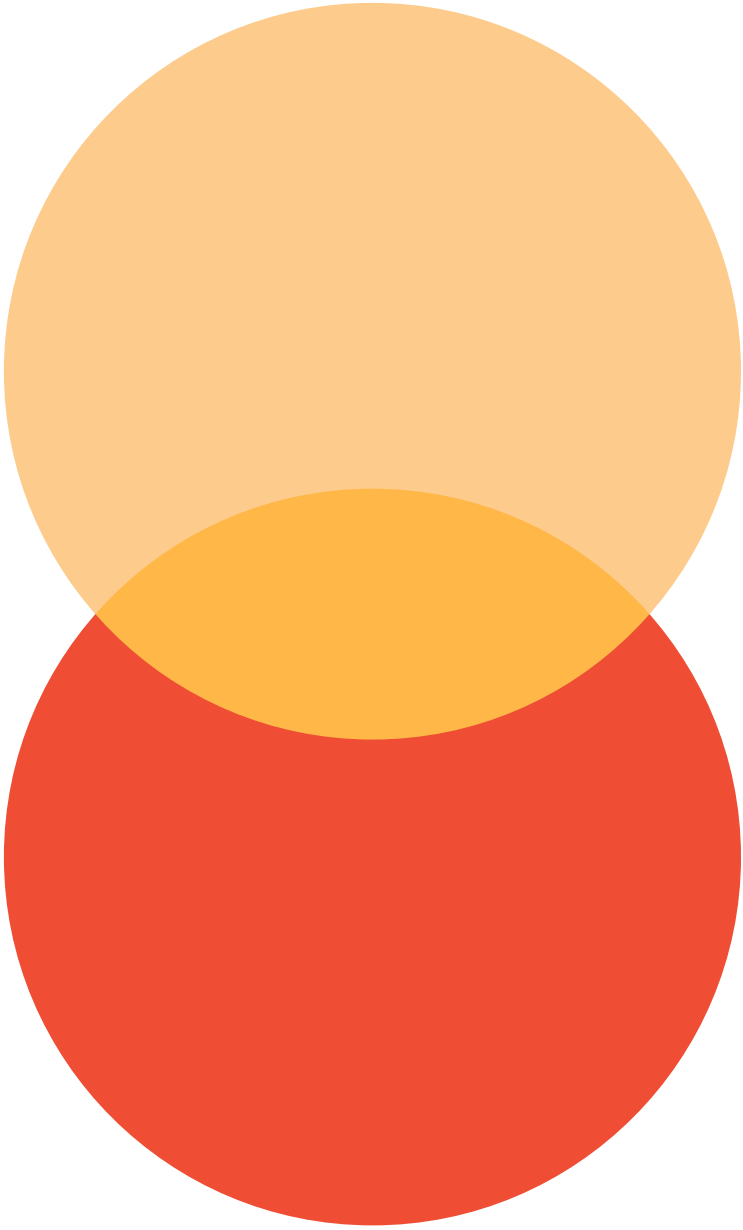
TEST STATISTICS[a,b]			
Kruskal-Wallis H	8.326	1.456	3.718
df	2	2	2
Asymp. Sig.	0.016	0.483	0.156

a. *Kruskal-Wallis Test*
b. *Grouping Variable: Age*

D6 THE EFFECT OF PARTICIPANTS' GENDER ON THEIR GENERAL LOGO PREFERENCE BASED ON FONT SIZE, TYPE, AND DEPTH

TEST STATISTICS[a]			
	TO_Font	TO_Fontsize	TO_Depth
Mann-Whitney U	328.000	341.000	341.000
Wilcoxon W	406.000	1994.000	419.000
Z	-0.266	-0.017	-0.016
Asymp. Sig. (2-tailed)	0.790	0.986	0.987

a. *Grouping Variable: Gender*



MEET

OUR TEAM

PRESIDENT

JULIA FORRESTER

It has been an absolute privilege and pleasure to have led the outstanding group of students who comprise the Ryerson University Student Chapter as this year's President. Throughout the entire process of this journal's production, I have been consistently amazed by the passion and dedication shown by the entire RyeTAGA team. There is no doubt in my mind that they will all continue on to become invaluable members of the graphics arts industry and I am extremely humbled to have been able to work alongside them this year. My time with RyeTAGA has been an integral part of my undergraduate degree and I am and will forever be grateful for having been given the opportunity to be a part of such a formidable team of students. As a graduating student, I look forward to seeing the continued excellence of the Ryerson University Student Chapter in the years to come.

VICE PRESIDENT

LOREN AMARAL

It has been my privilege to lead the 2019/2020 RyeTAGA Student Chapter as Vice President. This is my second year assisting in the production of the RyeTAGA journal and I am so thankful for the opportunity to strengthen my financial, communication and project management skills. I have been lucky enough to work alongside a hard-working and passionate team, all with the committed goal to produce a highly innovative, creative and thought-provoking journal. This year we are paying homage to our roots by presenting our adaptation of what the graphic arts industry used to be and how it has evolved throughout history. TAGA doesn't just provide a platform for students to experience the graphic arts industry first-hand, but it also encourages young professionals to continuously raise the bar and to strive for greatness. Thank you to all of our generous sponsors, faculty, executives, associates and alumni for making RyeTAGA possible!

EDITORIAL DIRECTOR

SAMANTHA NUNZIATO

After being a part of last year's RyeTAGA team as an Editorial Associate, I have had the opportunity of leading this year's Editorial team as the Editorial Director. Being able to work with such a strong, talented team has helped me learn more about the graphic communications industry and the creative process, as well as about myself. Taking on this role has allowed me to develop my skill set and to be able to network with so many inspiring individuals. This has proven to be one of the most challenging yet rewarding learning experiences of my GCM career thus far. It has pushed me outside of my comfort zone, providing me with a new perspective on the industry. I feel that I will be able to walk away from this experience having more confidence in myself and my work. I am very grateful for having worked with all of the executives and associates on this year's team; they are truly inspiring through their hard-work, creativity and determination.

CREATIVE DIRECTOR

LAURYN MARKS

This has been my first year as part of the Ryerson University Chapter, and my first time partaking in a role as Creative Director. I have truly learned so much throughout the process of the creation of the journal, between conceptualizing the creative theme as well as collaborating with the other executive directors. It has been so rewarding to see all of the work we have done come together over the last few months. It has helped me visualize my future in the industry. With the help of our sponsors, we have had the opportunity to produce and create an exceptional journal that my team and I are ultimately so proud of, and, without them, it would not be possible to hold a printed copy of our hard work in our hands. I am looking forward to sharing it with the other chapters at the TAGA 2020 Conference.

PRODUCTION DIRECTOR

IAIN AILLES

I've always had an affinity for storytelling through materials, especially what they can say about a publication before the pages are revealed. As Production Director for RyeTAGA, it has been an informative journey to materialize the technical papers. Following the phrase guiding our creative vision for the journal, "bring the old anew", we chose to use a letterpress print to create the journal cover, a process that dates to the roots of our industry. By holding new research within a cover that's been made with century's old technology, we're acknowledging the value of innovation. Practicing photography and generally admiring beautiful design has informed my passion to create these kinds of meaningful subtleties and I hope to continue doing so in the future. RyeTAGA has an enthusiastic team this year that I am proud to be a part of and it has truly been the best experience to exit with as I graduate.

MULTIMEDIA DIRECTOR

VICTORIA SALLESE

Being a part of the RyeTAGA team for a second year as Multimedia Director has not only been a great learning experience but has been a lot of fun. Collaboration was especially important to us since each director's component could affect another. We wanted to make sure that from concept to delivery, our process was efficiently executed. I am thankful to have had such an enthusiastic team of associates to assist me with the Multimedia component from the ideation phase to the implementation. Thanks to Ryerson University's new Creative Technology Lab, we were able to get our hands on emerging technologies. The team and I were very excited to take on this opportunity and develop it from scratch. I am grateful to have gotten to work with such a dedicated group of people and I hope everyone is able to see that our journal reflects our passion for the industry. I cannot wait for it to be showcased at the 2020 TAGA Annual Technical Conference.

MARKETING & EVENTS

AFRAH IDREES

I have had the wonderful opportunity to lead campaigning and event planning as the Marketing and Events Director of RyeTAGA this year. Aligning with the theme of bringing the old anew, I lead the rebranding of the chapter, beginning with a logo redesign at the start of the 2019-2020 journey. This year, our focus was on understanding the most effective methods of communication in order to meaningfully connect with people in the graphic arts community. This not only included outreach through social media channels, but also through hosting events, further engaging the Ryerson community and those interested in the technical side of the industry. The level of success that we have achieved could not have been possible without the hard work of my Marketing and Events associates, as well as my fellow executive team members. I look forward to experiencing the pay-offs of our perseverance at the TAGA 2020 Conference!

CORPORATE RELATIONS

CAROLYN GALGANOV

This year is my first time being a part of the RyeTAGA team. I am the Corporate Relations for the team and I love how much it gets me in contact with the industry. I am able to meet so many people this way and really network within the industry. Being on TAGA has really broadened my scope for the technical side of our industry and has shown me how many components there are in creating a book. Since my focus had been primarily on packaging, throughout my educational career I have participated solely in packaging related extracurriculars. It was nice to get in touch with the technical side of how to create a book from scratch. I am really enjoying the team and the work we have executed so far! I'm really excited to see what the Conference will bring us after a year of hard work!

ASSOCIATES

Thank you to our associates who provided our executives with their dedication, initiative, and hardwork!

CREATIVE

Grace Fawzy
Isabel Cronin
Danny Wu
Haiying Zing

MULTIMEDIA

Taylor Ball
Madelyn McCarthy
Jamie Milar-Bentia
Jessica Huynh

PRODUCTION

Amanda Arone
Julius Rodrigo
Nicolas Meneses Sandoval
Stephanie Le

EDITORIAL

Fannie Shi
Renée Donaldson
Evin Wong
Victoria Porteous

MARKETING & EVENTS

Essha Khan
Amber Pong
Nancy Ly
Alex La

COLOPHON

Typefaces, Equipment, Software, & Stocks

SOFTWARE

Adobe InDesign
CC, Illustrator, and
Photoshop

TYPEFACES

Avenir
Bureau Grot
Barricada Pro

EQUIPMENT

Vandercook Letterpress SP-15
Komori Impremia IS29
Esko Kongsberg Cutting Table v20

STOCKS

Neenah Folding
Board Concrete Raw
Neenah Royal Sundance
Smooth Cover Natural
Mohawk Superfine
Eggshell Text

MEET OUR SPONSORS

On behalf of the 2019-2020 RyeTAGA team, we would like to express our deepest gratitude to our sponsors. Without your continued support and generous donations, this journal would not have been possible. We are beyond grateful for all that you do to help students and future industry professionals take part in this extraordinary event and produce successful student publications year after year.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