



FIFO:

How Mobile Apps are the First In, First Out (FIFO) Solution to
Advancing the United Nations' Sustainable Development Goals (SDGs)

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To My Momma & My Favorite Dad -

*This dedication serves as a small token of appreciation for the countless sacrifices
you have both made sure to ensure my happiness and success.*

*Momma—thank you for reinforcing that in a world where I can be anything, to be kind.
Daddio—thank you for teaching me that everything is an opportunity.
Your unwavering support and belief in me have fueled my dreams and aspirations.
I dedicate all my achievements to you both.*

To Mahe -

*Thank you for always encouraging me to “chase the passion!”
You have fundamentally shaped my Georgetown experience, and I am forever
grateful for you.*

To Nana -

*You're right. It's gonna work.
-Your Christmas Cookie*



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INTRODUCTION:

//Abstract

Mobile apps should and can be used to implement the United Nations Sustainable Development Goals to complement current initiatives of the program through tech's inherent abilities to collect, connect, protect, and affect. Moreover, these technological solutions are most effective when implemented as FIFO (First In, First Out) solutions; meaning the future of sustainability relies beyond singular technological solutions and exists in additional collaborative, creative, and community-based measures.

// Why the SDGs?

In 2016, the United Nations announced the Sustainable Development Goals ("Sustainable Development Goals"). As a middle school student unaware of the complexities of Global politics and international affairs, the UN sharing these goals was just another news feature of CNN 10's program. However, through social media, I followed along as a member of my church (or, Traverse City's Central United Methodist Church) embarking on a year-long journey from my hometown to travel the world. Emily Falconer spent her junior year of high school traveling the world and exploring how different individuals, organizations, and countries were using their platforms to promote the SDGs. She would post on attending United Nations meetings and post frequent blog posts on her travels. Throughout this year, I was tapped into Emily's mission through Instagram and her blog, GoGlobalTravels.

As described in her blog, GoGlobalTravels:

"The United Nations recently published a new set of 17 Global Goals for Sustainable Development. What do these goals mean for young people and the way we live and work for generations to come? Beginning in August 2016, I will commit 12 months to travel and explore the stories behind these 17 goals. By exposing the stories through a daily blog, I will also share my own journey of trying to make sense of these 17 Sustainable Development Goals." (Falconer)

Because I found her adventurous, zealous spirit so admirable, I followed her journey because I believed in her enthusiasm. As Falconer stated in her blog:

"Here is a little bit more about me. Being young presents great opportunities when looking at a problem. A problem is not always bad news; it is an invitation for innovation. I have many years to invest in new ideas that may appear at first to have small impact, but with time, these ideas could serve as a catalyst for significant systemic change. I want to explore both the roadblocks and strengths of situations interrelated to the 17 Global Goals, and hopefully discover ideas that my generation can cultivate in the many years ahead of us. By building off of strengths, we can empower a person to improve one life, then one small community and ultimately, one world. I continue to be excited about the stories I will be able to hear, and using this blog portal as a place to share everything I learn. Hopefully, as I go, others are inspired to take action and go find their goal!"(Falconer)

Throughout the year, I would read about the people she met and see the places she visited. Seeing the on-the-ground grassroot work that Emily was sharing through her blog exposed me to the world beyond the Midwest: the international affairs of the United Nations, the developmental challenges of

nations, and the changemakers in the system who are promoting sustainability. Through Emily, I learned the importance and context of the Sustainable Development Goals.

//The History of the SDGs

Before beginning any conversation on how technology can be used to enhance the United Nations Sustainable Development Goals (or, the SDGs), it is critical to first examine their historical context and where they came from. In understanding the SDGs' history are we better able to criticize their applications to address global development and the challenges faced by the international community.

The United Nations Sustainable Development Goals (or, the SDGs) were born out of the United Nations Conference on Sustainable Development, also known as the Rio+20 summit, held in Rio de Janeiro in 2012 ("Background on the Goals."). The objective of the conference was to produce a set of universal goals that address the urgent environmental, political, and economic challenges facing our world.

The SDGs replaced the Millennium Development Goals (or, the MDGs), which were established in 2000 to tackle poverty and other development priorities (The SDGs in Action). The MDGs focused on measurable objectives such as reducing extreme poverty, improving access to education and healthcare, and combating diseases like HIV/AIDS. Over the course of 15 years, the MDGs drove progress in several important areas, including poverty reduction, access to clean water and sanitation, child mortality reduction, and improved maternal health (SDG Accelerator).

However, the job remained unfinished for millions of people around the world, and there was a need for a more comprehensive and ambitious agenda. Thus, the SDGs were developed to build upon the achievements and lessons learned from the MDGs (SDG Accelerator). The SDGs consist of 17 interconnected goals that address a wide range of issues, including poverty eradication, gender equality, climate action, sustainable cities, and responsible consumption and production.

They are:

1. No Poverty (SDG 1)
2. Zero Hunger (SDG 2)
3. Good Health and Well-being (SDG 3)
4. Quality Education (SDG 4)
5. Gender Equality (SDG 5)
6. Clean Water and Sanitation (SDG 6)
7. Affordable and Clean Energy (SDG 7)
8. Decent Work and Economic Growth (SDG 8)
9. Industry, Innovation, and Infrastructure (SDG 9)
10. Reduced Inequalities (SDG 10)
11. Sustainable Cities and Communities (SDG 11)
12. Responsible Consumption and Production (SDG 12)
13. Climate Action (SDG 13)
14. Life Below Water (SDG 14)
15. Life on Land (SDG 15)
16. Peace, Justice, and Strong Institutions (SDG 16)
17. Partnerships for the Goals (SDG 17)

("Sustainable Development.")

The SDGs are a call to action for all countries, developed and developing, to work together in a global partnership to achieve peace, prosperity, and sustainability for people and the planet. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health, education, reduce inequality, and tackle climate change. The goals are designed to be interconnected, meaning that progress in one area will affect outcomes in others, and they prioritize leaving no one behind.

The process of designing the SDGs was informed by a three-year-long transparent and participatory process that included consultations with stakeholders from around the world. The goals and targets were agreed upon by member states in August 2015, and the 2030 Agenda for Sustainable Development was officially adopted.

The SDGs are unique in that they cover issues that affect us all and reaffirm the international commitment to end poverty everywhere. They provide a blueprint for a more sustainable, inclusive, and prosperous future for all humanity.

Importantly, it should also be noted that the United Nations SDGs are often criticized for not holding enough accountability for global powers. Because the goals are non-binding and underfunded, opponents of the SDGs cite them as being “too vague”, and “not urgent enough”, and believe they have the potential to exacerbate global inequality (Pecquet). However, I am in the camp that any work advancing sustainability is notable and deserves recognition. While to some these goals may be “vague” and “not urgent enough”, the goals do an excellent job of providing room for entrepreneurs, developers, and changemakers to explore, interpret, and expand the meaning of sustainability. Moreover, while mobile apps are inherently founded on systems of global inequality—as not everyone has access to a mobile device, let alone clean drinking water—there are some practical considerations to consider when implementing mobile apps as a means to address the SDGs.

First, the United States holds 4.23% of the world’s population (“United States Population (2024) - Worldometer.”). While, developed nations contribute 79% of the world’s total annual emissions (“Developed Countries Are Responsible for 79 Percent of Historical Carbon Emissions.”). The United States individually contributes to 13.49% of the world’s total annual emissions (“Does It Matter How Much the United States Reduces Its Carbon Dioxide Emissions If China Doesn’t Do the Same?”). The alarming disproportion reveals the true nature of how American consumers strain Earth’s resources at a disproportionate rate among the world’s population. American developers and product designers need to create products that reduce environmental impact. Meanwhile, American consumers need to prioritize using products that reduce environmental impact.

Second, the concept of “leapfrogging” technology to skip periods of potentially harmful environmental degradation can continue to advance developing nations in the fight for climate sustainability. Leapfrogging is a powerful concept that holds great potential in advancing developing nations in their pursuit of climate sustainability (Erol Yayboke, et al.). As described by the Center for Strategic and International Studies (or, the CSIS), “Leapfrogging occurs when a nation bypasses traditional stages of development to either jump directly to the latest technologies (stage-skipping) or explore an alternative path of technological development involving emerging technologies with new benefits and new opportunities (path-creating).” (Erol Yayboke, et al.) In this process, nations have the opportunity to bypass periods of potentially harmful environmental degradation. Therefore, leapfrogging allows developing nations to embrace cleaner and more sustainable solutions without having to go through the same harmful practices. Many tech enthusiasts consider leapfrogging as a beacon of hope, offering a path toward a greener and more sustainable future for all.

As developing nations account for 63% of current carbon emissions, the technological transfer of innovation will inevitably mitigate carbon emissions in the future using the concept of leapfrogging by connecting technology to developing nations (“Developing Countries Are Responsible for 63 Percent of Current Carbon Emissions.”). Implementing sustainable technology in nations like the United States will facilitate the future use of sustainable technologies in all nations.

That is why this thesis works to highlight 5 mobile apps that have successfully taken for-profit models that tangibly address concerns that the SDGs provoke. Specifically, these apps are fully operational in the United States, an economic environment that promotes innovation through both university systems and research triangles (such as Silicon Valley, the UNC/Duke/NC State area, and Kendall Square). In finding economic value in innovating solutions to address and create sustainable solutions for local and global development, the mission to save the planet and its people can become more attractive to key stakeholders.

// “Do all the good you can”

Significantly, when I think of Emily and these SDGs, I think back to the founder of Methodism, John Wesley and his infamous words: “Do all the good you can, by all the means you can, in all the ways you can, in all the places you can, at all the times you can, to all the people you can, as long as ever you can.” (Wesley) While our hometown is nestled into the rural Midwest, I watched as Emily took her junior year as an opportunity to explore international sustainability, sharing it with others and inspiring her followers like me (Schollett). Through the power of technology and social media, I was able to connect to her story.

Yet, as I looked around my own community, I saw that there were systemic issues that prevented my area from achieving true sustainability. For example, during its peak around 55 years ago, Detroit was a thriving city and the headquarters of General Motors, one of the largest automakers in the world. At that time, Detroit boasted a population of nearly 2 million residents, making it the fifth-largest city in the United States. However, in recent years—especially after the Great Recession in 2008—both General Motors and the city of Detroit have faced significant challenges. Detroit has experienced a population decline, with the number of residents plummeting to around 700,000. The decline brought economic struggles, as Detroit has faced one of the highest unemployment rates (over 16 percent) among major American cities (“Detroit’s Downfall | Bentley University.”). Here, Detroit can be a case study of how a community cannot reach sustainability if fundamental issues are preventing Decent Work and Economic Growth (or, SDG 8) and Industry, Innovation, and Infrastructure (or, SDG 9).

When I was in middle school, downstate in the city of Flint, Michigan, the community saw politicians prioritize profits over their people (“Flint Water Crisis: Everything You Need to Know.”). Without access to clean drinking water, the people of Flint were most obviously deprived of Clean Water and Sanitation (or, SDG 6). Meanwhile, while I was in high school, a serious conversation emerged on the controversial pipeline, Enbridge Line 5 in Michigan (“Line 5.”). The pipeline connects Michigan’s Lower and Upper Peninsula with 22 million gallons of crude oil and natural gas across 645 miles of countryside every single day (“Line 5.”). The Line has historically been unreliable: in the last 50 years, the pipeline has had 29 spills, releasing a total of 1.1 million gallons of toxic oil into the environment. Shockingly, “researchers recently determined that most spills were not even discovered by Enbridge’s leak detection systems, which Enbridge uses to justify reckless pipeline routes.” (“Line 5.”) The controversial pipeline company has spent its time through both Michigan State Courts and Federal Courts because of the pipeline’s potential environmental risks and the need for its safe operation. Thus, provoking Michiganders

to question the sustainability of Enbridge's operations and its application to Clean Water and Sanitation (or, SDG 6), Affordable and Clean Energy (or, SDG 7), Industry, Innovation, and Infrastructure (or, SDG 9), Sustainable Cities and Communities (or, SDG 11), Climate Action (or, SDG 13) and Life Below Water (or, SDG 14).

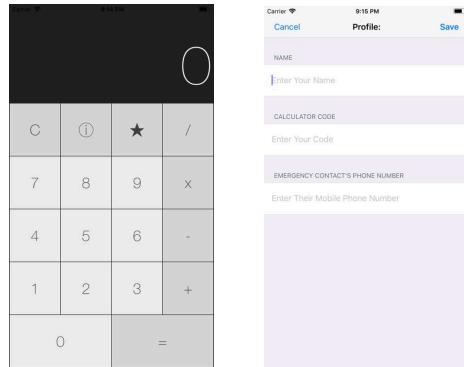
Growing up, my community has faced severe sustainability issues that make one question: how sustainable are developing nations? How can the SDGs contribute to their own sustainable development?

// How to “Do all the good you can” with Technology

In 2017, I was studying at a local hotel. Every Thursday, I would use their facilities—I was especially grateful for the hotel allowing me to use both their Wi-Fi and a conference room—to log into Zoom and meet virtually with my Chinese instructors to review content. My Mom would wait outside in the car while I was in class. One random Thursday as I was working, I saw a man out of the corner of my eye walking up and down the street, staring at me. We would lock eyes, and then he would quickly turn away. When we locked eyes for the final time, he disappeared, and I did not see him again outside. However, the hotel I was working from, there was a bar. Twenty or so minutes after I lost sight of him, he appeared in front of me with a whiskey in his hand. He walked into the conference room I was in even though there was a “Do Not Disturb” sign outside the door. He came up to me, pulled out a chair, and started talking to me. I was wearing noise-canceling headphones, confused, and scared. He sat behind my computer, away from the camera, so my classmates and teacher could not see him. Meanwhile, my mom was outside the building with no idea that this stranger was sitting in front of me, inching closer, and asking me how old I was and which local school I went to. At that moment, I felt so isolated.

After the night, I thought how strange it was to have technology in front of me, yet I couldn't get help: he was watching my every move. While I was comprehending the uncomfortableness I was feeling, there was a national movement unfolding in front of me with #MeToo and the Time's Up campaigns. At this time, I thought back to Wesley: “Do all the good you can, by all the means you can, in all the ways you can, in all the places you can, at all the times you can, to all the people you can, as long as ever you can.” (Wesley) I felt the need to contribute a positive solution.

So, I taught myself how to code. As a freshman, I asked Elijah Cobb, one of the extremely smart and extremely kind seniors at my high school, to tutor me, and he did. Quite quickly, I built my first app: CalcuSaver, an incognito way to send help when you are in an uncomfortable situation. The user would enter their name, a numerical code, and the phone number for their emergency contact. Meanwhile, the user interface of the app was simply a calculator. However, if that calculator's output equaled the user's code, a message would immediately be sent to the user's emergency contact saying that the user was in a situation and requested to be contacted. The app was my 15-year-old solution to using technology to address safety. However, the app also helped contribute to a safer community in Good Health and Well-being (or, SDG 3), Gender Equality (or, SDG 5), Reduced Inequalities (or, SDG 10), and Peace, Justice, and Strong Institutions (or, SDG 16).



Not only was this app the gateway into my technical understanding of computer science and mobile app development, but it encouraged me to understand my role as a steward of my community. In 2018, my computer science teacher Mr. Barren and the STEM coordinator for my district, Mrs. Heidi Maltby-Skodack, encouraged me to submit my app to the Congressional App Challenge, a national award that celebrated students across the country who have built apps for their communities. I won the congressional award and was invited to Washington, DC in Spring 2019 to share my app with my congressional representative for my District, Rep. Jack Bergman, and was invited to be interviewed by CNN.



In building this app, I not only learned the technical significance of coding but also how valuable it is to problem-solving and the civic duty we all have to promote sustainability within our communities. For me, my civic engagement revealed itself in building and scaling apps for social impact. Therefore, I strongly believe that technology can be used as a means to expand the ability of sustainable development (at least, in environments where this technology can be used). Moreover, in building apps, I have experienced how technology connects, collects, protects, and affects.

Through CalcuSaver, the app collects and stores information (or, the user's name, emergency contact, and the calculator code) to ensure that whenever the user opens the app, they can immediately and discretely reach out for help. The app digitally connects individuals to their emergency contact;

motivating an individual to reach out and ensure that the app's user is okay. The app promotes the protection of the users by its inherent safety capabilities. And lastly, the app works to affect change by creating a platform that empowers its users to seek assistance in a physical environment where it is either uncomfortable or difficult to verbally communicate for help. Technology is impactful and can create positive change through its ability to connect, collect, protect, and affect.

// Introduction to Wellfed Market

Coming to Georgetown, I observed first-hand a level of very intense socio-economic disparity. Aside from inside the gates of Georgetown and within the student body, the neighborhood features expensive restaurants, shopping, and attractions. Meanwhile, individuals beg on the streets for food. In fact, in the Capital Area Food Bank's 2022 annual report, one-third of Washingtonians are food insecure ("Hunger Report 2022 - CAFB Hunger Report."). How could a community—and especially a community that is the nation's capital—feature such a disproportionate level of poverty and food insecurity all in the same environment?

With lavish lifestyles, comes the ability to over-indulge and over-consume. The concept revealed itself to be quite apparent to me when I came to the university and saw the amount of food wasted across the student body. However, other like-minded Georgetown students shared the alarming nature of both food insecurity and food waste on campus. Thus, Georgetown student groups emerged, like Georgetown SAFE (Students Advancing Food Equity). Here, the groups collect excess foods from local Georgetown eateries and bring them to campus for all students to enjoy. The efforts of the group have been awarded with campus-wide recognition and awards. Meanwhile, the excess food that is available on campus is also given a second opportunity for consumption. The Georgetown-exclusive "Free Food on Campus" GroupMe is famous for providing students with food leftovers from on-campus events, restaurants, or even food leftovers that students have before leaving on breaks and holidays.

Here, students are congregating on a group chat platform—or, GroupMe that, which was not intended to be a solution for solving food waste on college campuses—and using the technology to connect to other students, collect food items, protect food from contributing to landfills, and affect students to be more sustainable stewards in their consumption. Deeply fascinated, I surveyed this group in Fall 2021.

In Fall 2021, 3,345 students were involved in a Georgetown-exclusive GroupMe called the "Free Food on Campus" group chat. Meanwhile, now in April 2024, this number has increased to 4,169 users. During the time of the survey, the students would share excess food from events, meals, or produce from gardens with other users of the group chat. The group chat was designed to alleviate food insecurity on campus across the approximately 7,9000 students on campus ("Georgetown University."). Interestingly, though, 74% of Georgetown's student population is a part of the top 20% of American earners ("Economic Diversity and Student Outcomes at Georgetown."). With over half of the undergraduate population inside this group chat, the intentions behind Georgetown students to use this group chat go beyond food insecurity motivations. Potentially, this engagement could indicate that the large participation of Georgetown students suggests a different motive that excites Georgetown students: mitigating food waste.

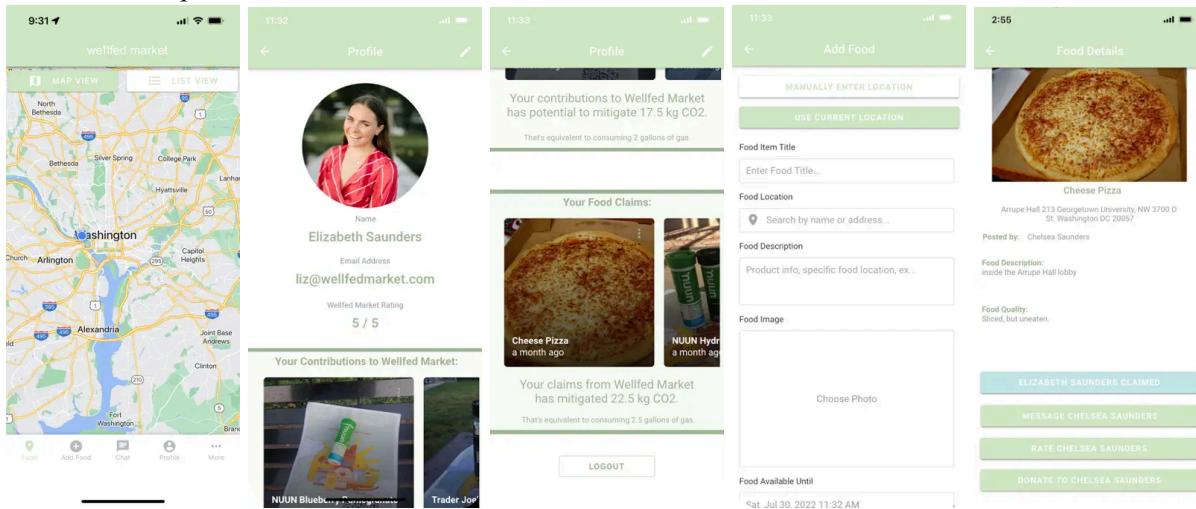
In the US, 40% of food within the food supply chain goes to waste ("Food Waste FAQs."). Consumers are responsible for 42% of this food loss ("What Part of the Supply Chain Is Responsible for Food Waste?"). In 2020, this equated to 1,249 calories per person per day of food waste, a financial loss of over \$1,500 per family of four, and an annual revenue loss of \$161 billion (Buzby, Jean C., et al.). When thrown out, food congregates in landfills. Food makes up the majority of landfill contents, accounting for between 22 and 24 percent of weight ("From Farm to Kitchen: The Environmental Impacts

of U.S. Food Waste.”). Disastrously, as organic materials decompose, they release methane, a greenhouse gas 21 times more powerful than carbon dioxide (“Importance of Methane.”). Additionally, for every pound of food wasted, 2.5 kg of CO₂ is emitted into the Earth’s atmosphere (Susan Brownlow).

Again, I thought back to Wesley’s words: “Do all the good you can, by all the means you can, in all the ways you can, in all the places you can, at all the times you can, to all the people you can, as long as ever you can.” (Wesley)

To learn more about how these students are fighting their carbon footprint through food waste, I surveyed the group chat in the Fall 2021 semester. I learned that 69.5% of reported students have used this group chat to get food from their peers. That 67.7% of reported students confidently believe that the food on this group chat is of quality. That 76% of the food these reported students consumed from the group chat were perishable items. Additionally, 85% of respondents check the group chat at least once a day. The “Free Food on Campus” system is reliable, trusted, and has the ability to be scaled to other campuses and other communities. Additionally, if this system can be scaled outside the Georgetown student body, it would bring a legitimate solution to combat consumer-generated food waste.

In the Spring and Summer of 2022, I developed my app, Wellfed Market. The app is a mobile food-sharing application developed for the IOS Apple App Store. Users post free or discounted edible food items to other users in their local area. Wellfed Market is a food-sharing platform empowering consumers to mitigate the environmental effects of food waste, alleviate hunger, and connect communities through food. Ultimately, I hope to localize the food system of America through technology’s ability to connect, collect, protect, and affect.



I was invited to join the Georgetown University Summer Launch Incubator, where I worked to release a beta version of this app to Georgetown students in the area over the summer. I received funding to continue pursuing this app as well as making connections. That fall, partnered with Georgetown SAFE (or, Students Advancing Food Equity) to further expand access to this app to students in need of high-quality, low-cost food options. Additionally, I was awarded \$3,000 in funding from the Georgetown Office of Sustainability and Green Commons. Through the help of this funding, I was able to expand the presence of my app to more users in the DMV area and even to users back home in Michigan.

Importantly, while there are other apps that are contributing to sustainable food systems—like Too Good To Go, Goodr, Karma, Olio, and many others—it is valuable that there exists multiple options to achieve sustainability. Different apps resonate with different users; therefore, it is vital to have many apps that contribute to growing sustainability efforts. For Wellfed Market, the community is valuable for individuals who reinstate with the existing “Free Food On Campus” GroupMe, or my peers at Georgetown University. Therefore, in this thesis I will not be going into further details on these other food recovery apps, as I will be discussing how my own experiences in developing apps has allowed me to understand the process of technology connecting, collecting, protecting, and affecting.

// Why FIFO?

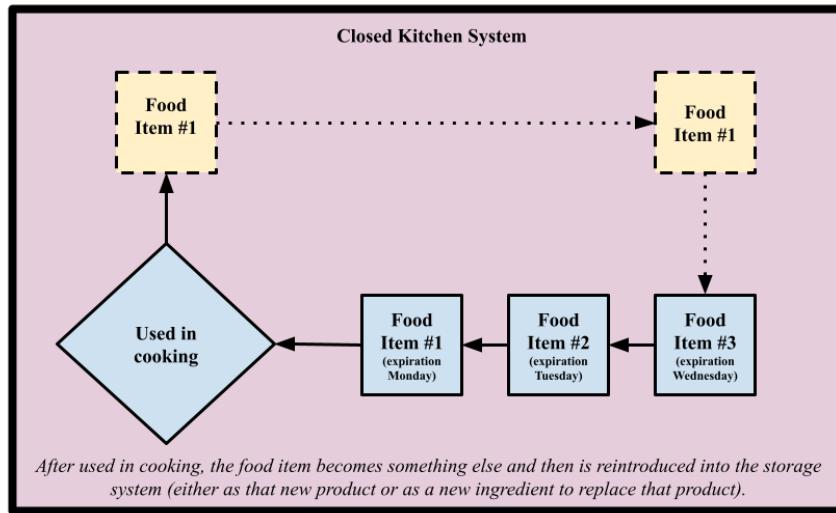
In my Junior spring semester in 2023, I took a Medical Leave of Absence and chased a passion that I have been cultivating since I was younger and through the influences of my Nana and my Mom: I went to culinary school. Throughout the entire semester, I cooked every day and learned recipes straight from the Epicurean and from Escoffier. While I am a vegan, I could not taste the French-style cooking I was creating. So, my instructors would grade me on my presentation, and I was expected to have my classmates taste the food I was making as I was working along. During this time, my understanding of the culinary arts expanded; however, unexpectedly, computer science concepts became more clear. The interdisciplinary in my culinary school lessons did shed light into my computer science curriculum as a student of Georgetown. I still tell people that even in my leave of absence, I was invested in my CS education (“computer science” or “culinary school”—both were in practice).

During pastry and baking week, my culinary class baked raspberry pies. Funny enough, one basic motherboard system that students usually first engage with and practice on, is called a Raspberry Pi. The name “PI” actually stands for Python Interpreter; as the original developers intended “to equip the Pi with a built-in interpreter for Python, just like the C64 had a built-in Basic interpreter.” (Brennan) Meanwhile, “raspberry” comes from the tradition of naming technology in terms of fruits: Tangerine Computer Systems, Apricot Computers, and the old British company Acorn (which is also a family of fruit) (Doug). In developing and naming technology, individuals have worked to root the technology into the natural world.

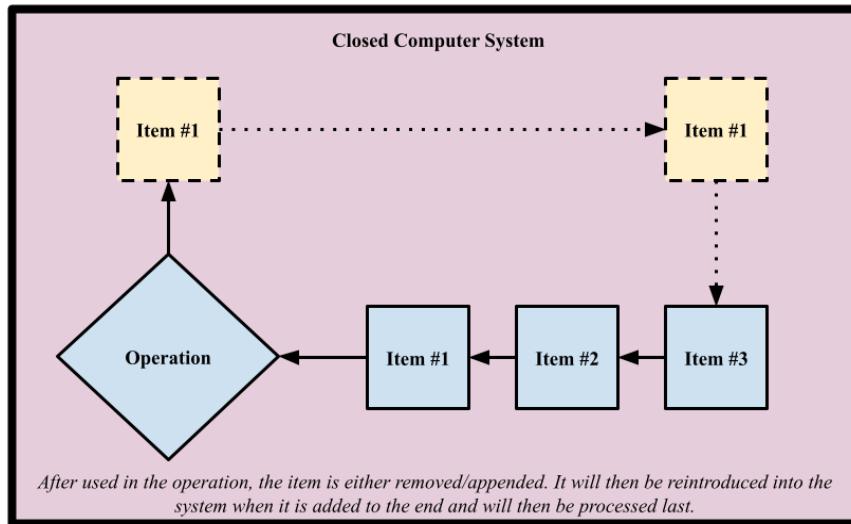
Additionally, in working with Dr. Mahendran Velauthapillai to work through this thesis, his office neighbor, Dr. Richard Squier was giving away books one day after one of Mahe, and I’s meetings. In picking up one of the books, titled: “Perl Cookbook” (by Tom Christiansen and Nathan Torkington), I learned that a “cookbook” in computer science is a book containing solutions to common short tasks. Again, proving how culinary studies and computer science are both disciplines that overlap. I am forever excited and grateful for the interdisciplinary experience that has been my Georgetown education.

Meanwhile, and to the importance of this thesis, the very first lesson I learned in my “Safety and Sanitation” class was the concept of FIFO (or, First In, First Out). When hearing this, I understood the concept quite clearly because it is a fundamental concept in computer science. In tech, “FIFO is an abbreviation for first in, first out. It is a method for handling data structures where the first element is processed first, and the newest element is processed last.” (GeeksForGeeks). While in the kitchen, “First In, First Out (FIFO) is a system for storing and rotating food. In FIFO, the food that has been in storage longest (“first in”) should be the next food used (“first out”). This method helps restaurants and homes keep their food storage organized and to use food before it goes bad.” (“StateFoodSafety Resources.”)

While not commonly visually taught as a circular process, I view the culinary school definition as involving this process:

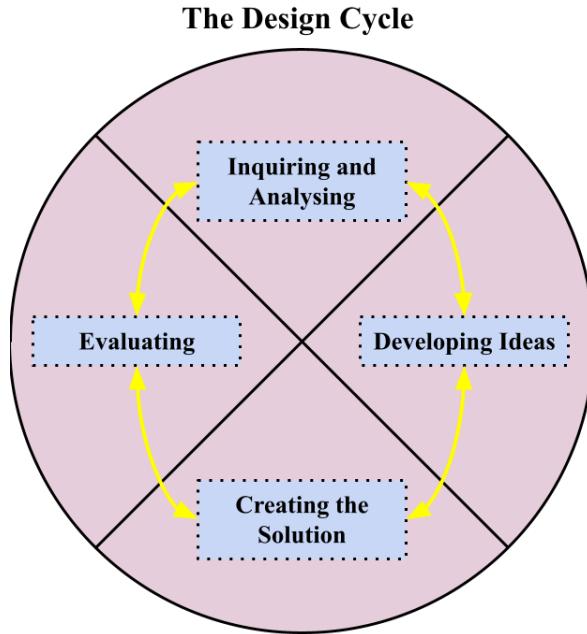


Meanwhile, while it is not commonly visually taught as a circular process, I view the computer science definition as involving this process:



Regardless, both definitions underscore FIFO as the ability that whatever is introduced into a system will be the first thing used, implemented, or solved; which does change the functionality or conditions within the system. When exhausted, the object is removed from the system and the next object enters the system. The circular process in which an object is entered, used, and exhausted is a common theme in the technological world. Thanks to innovation, the technical world exists in this circular system.

Moreover, we also deduce that innovation is circular, as the concept is even reflected in the design cycle that is most commonly taught to students learning how to develop technology. Technology is every building on top of itself, relying on previous innovation in order to create the future. By circulating back, technology does inherently have a circular principle in application.



As a CS student (and as both a Computer Science and Culinary School student) engaging with Environmental Biology, I think about the sustainability of this system. Is this sustainable—the turnover of wants and needs of communities and the inevitable strain of resources this puts on environmental health? Between the interdisciplinary nature of my education, partnered with my belief that technology should be used to promote social impact initiatives and advance the health, safety, and inclusion of populations, I look toward the Sustainable Development Goals when I grapple with the philosophical questions that arise with consumption, production, and innovation.

// The FIFO Application to the Sustainable Development Goals

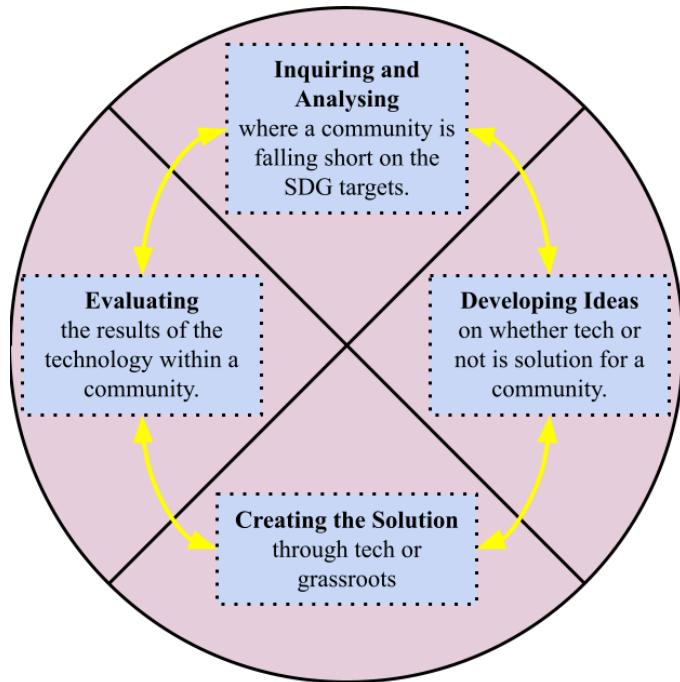
To explain how the FIFO cycle can contribute to the Sustainable Development Goals, I will be exploring five apps and their relationship to the fundamental understanding of how technology has the ability to collect, connect, protect, and affect. Through these deep dives into these mobile apps, we can understand how technology can contribute to sustainability efforts and enhance the productivity of the SDGs. These five apps include: Natural Cycles, Empower, MeetingMaker, Politicking, and (the app I have made) Wellfed Market.

However, it is vital to acknowledge that these mobile apps will not solve the issues the Sustainable Development Goals target. The SDGs are complex and solutions vary from community-to-community based on political, social, and cultural interests, as well as the accessibility of technology for that community, and the inherent social structures of that community. Moreover, in most cases, a complete solution is not possible for the SDGs. Therefore, when reflecting on my CS journey, I am excited to share how FIFO applies to the understanding of sustainable development.

As described earlier, because technology is always evolving and changing, it cannot be a reliable solution toward solving global issues. What is needed to solve the complexity of these challenges is through systemic changes to the systems within these communities. Should technology be introduced within a system, it should advance the missions of the SDGs. And as I will cover in this thesis, technology does offer valid solutions to the SDGs because technology like mobile apps offer the potential to create systemic changes to communities as they develop.

Therefore, technology like mobile apps should be implemented as a “First In, First Out” solution to achieve sustainable development. Long-term, grassroots efforts are fundamental, while technology serves as a catalyst for systemic change. As technology is introduced to a population to address the SDGs, it should be implemented, used, taken out, and replaced with an updated system that makes the existing technology more efficient and relevant to that community. Implementing technology is a great first step towards approaching the SDGs through its ability to collect, connect, protect, and affect. However, without taking the technology out to be updated to the changing needs of a community, the road to sustainability becomes difficult. Visually, we can understand the FIFO application of mobile apps to address the SDGs as being similar to the fundamental structure of the design cycle described earlier.

The Design Cycle (SDG-specific)



//Definitions**Changemakers:**

A policymaker, a developer, or a user of technology.

Echo Chambers:

“A social media echo chamber is when one experiences a biased, tailored media experience that eliminates opposing viewpoints and differing voices. Due to social media algorithms that ensure we only see media that fits our preferences, we have found ourselves in a comfortable, self-confirming feed.” (Cabianca)

Fem Tech:

“It refers to diagnostic tools, products, services, wearables, and software that use technology to address health issues that affect women solely, differently, or disproportionately. This includes everything from pregnancy and menopause to cancer and cardiovascular disease.” (Deloitte)

Food Waste:

Food waste is defined as the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers, and consumers (FAO)

Food Insecurity:

Food insecurity is defined as a household-level economic and social condition of limited or uncertain access to adequate food. It is important to note that food insecurity does not necessarily cause hunger, but hunger can be a possible outcome of food insecurity. (FAO)

The United States Department of Agriculture (USDA) divides food insecurity into two categories:

Low food security: This refers to reports of reduced quality, variety, or desirability of diet, with little or no indication of reduced food intake.

Very-low food security: This category includes reports of multiple indications of disrupted eating patterns and reduced food intake.

Food Deserts:

“Food deserts are regions where people have limited access to healthful and affordable food. This may be due to having a low income or having to travel farther to find healthful food options.”

(Caporuscio)

Food Loss:

Food loss is defined as the decrease in the quantity or quality of food that occurs between the production and retail stages of the food supply chain (FAO)

FIFO (First In, First Out):

Culinary: “First In, First Out (FIFO) is a system for storing and rotating food. In FIFO, the food that has been in storage longest (“first in”) should be the next food used (“first out”). This method helps restaurants and homes keep their food storage organized and to use food before it goes bad.” (“StateFoodSafety Resources.”)

Computer Science: “FIFO is an abbreviation for first in, first out. It is a method for handling data structures where the first element is processed first, and the newest element is processed last.” (GeeksForGeeks)

Gig Economy:

“The gig economy—also called sharing economy or access economy—is an activity where people earn income providing on-demand work, services or goods. Often, it’s through a digital platform like an app or website.” (“Gig Economy Tax Center.”)

Hashtag Activism:

“Hashtag activism is the act of fighting for or supporting a cause that people are advocating through social media like Facebook, Twitter, Google+ and other networking websites. This is the kind of activism that does not require any action from the person other than sharing or “liking” a post or “retweeting” tweets on Twitter. The term gets its name from the liberal use of hashtags (#) that are often used to spread the word about a cause over Twitter.” (Rouse)

Leapfrogging:

“Leapfrogging occurs when a nation bypasses traditional stages of development to either jump directly to the latest technologies (stage-skipping) or explore an alternative path of technological development involving emerging technologies with new benefits and new opportunities (path-creating).” (Erol Yayboke, et al.)

Sustainability:

“Meeting the needs of the present without compromising the ability of future generations to meet their own needs.” (United Nations)

Technology:

A tool to advance society; it is a tool to solve a problem by bringing something from point A to point B. (Adams)

CHAPTER 1: COLLECT

“The internet is not just one thing, it's a collection of things - a network of networks.”
 - Tim Berners-Lee, Computer Scientist (Xoxoday)

Intro to Discussion

In today's digital age, technology has become an integral part of our lives, transforming the way we live, work, and interact. One of the remarkable abilities of technology is its capacity to collect vast amounts of data and process them quickly.

While perhaps controversial, the collection of data can empower us with knowledge and contribute to the advancement of the United Nations' Sustainable Development Goals.

The history of computer development serves as a backdrop to understand the evolution of data collection. From the early days of large, room-filling machines to the compact devices we carry in our pockets today, computers have undergone tremendous advancements. In the past, computers were primarily used for mathematical calculations and data processing. However, with the advent of the digital era, computers have become powerful tools for collecting, storing, and analyzing data.

A peek into the concept of data storage reveals the complexity and magnitude of the collective data we have today. Data is collected from various sources, including social media platforms, sensors, internet-connected devices, online transactions, etc. This vast pool of information is stored in data centers, which are massive facilities housing countless servers and storage systems. These data centers act as the backbone of our digital infrastructure, enabling the storage and processing of enormous amounts of data.

While the collection of data brings significant benefits, it also raises important environmental concerns. Data centers consume substantial amounts of energy, contributing to carbon emissions and straining power grids. Additionally, the cooling systems required to maintain the optimal temperature in data centers consume large amounts of water, further impacting the environment. As we continue to rely on technology for data collection, it becomes crucial to address these environmental challenges and implement sustainable practices to mitigate their impact.

The knowledge derived from data collection is a powerful resource that can drive positive change. By analyzing vast datasets, we gain insights into various aspects of society, such as human behavior, public health, climate patterns, and economic trends. Armed with this knowledge, we can make informed decisions, develop innovative solutions, and work towards achieving the United Nations' Sustainable Development Goals.

The Sustainable Development Goals (or, the SDGs) provide a framework for addressing global challenges and creating a sustainable future. The collection of data plays a vital role in tracking progress toward these goals, identifying areas that require attention, and measuring the impact of interventions. Whether it is combating poverty, ensuring access to clean water, promoting gender equality, or addressing climate change, data collection enables us to monitor and evaluate our efforts, making informed decisions to drive positive change.

In conclusion, technology's ability to collect large amounts of data has revolutionized our world, offering unprecedented opportunities for knowledge and progress. Understanding the history of computer development, the concept of data storage, and the environmental concerns associated with data collection helps us navigate this transformative landscape. By harnessing the power of data and utilizing it to advance the United Nations' Sustainable Development Goals, we can work towards a more sustainable and inclusive future for all.

Case Study

Natural Cycles, the first FDA-approved form of non-hormonal birth control, has transformed the landscape of contraception. With the recent partnership with Oura Ring and Apple Watch to track basal temperatures for ovulation, Natural Cycles offers a unique and effective approach to family planning. What makes the Natural Cycles app so innovative, is that it provides an effective, natural method of birth control that is delivered in the form of an app.



The app was founded in June 2013 by former CERN physicist, Dr. Elina Berglund and her physicist husband Dr. Raoul Scherwitzl (“Natural Cycles In Numbers.”). Since its conception, the app has grown from its headquarters in Stockholm, Sweden to three offices worldwide (“Natural Cycles.”). The growth can be attributed to its historical \$44.5M in funding across 5 funding rounds with support from venture capital (or, VC) specifically groups like Samsung Ventures, EQT Ventures, Bonnier Ventures, Headline, Heartcore Capital Logo Heartcore Capital, and Ion Pacific. The app is still private and for-profit, indicating that social impact startups and companies can find profit in working towards sustainability.

To deliver an effective product, the app uses a smart algorithm that is sensitive to subtle patterns in a woman’s cycle to determine daily fertility. By collecting a user’s basal body temperature and period data, the app can calculate and predict fertility windows. With this knowledge, users and their sexual partners are able to know when a body is either fertile or not (or the app denoting red days as a fertile day or a green day as a non-fertile day), further influencing the sexual activities between two partners. Through its testing, the app is 93% effective with typical use (or, having unprotected sex or using withdrawal on a red day, as well as pregnancies that occur while the method is used as intended). Compared to other non-hormonal birth control options on the market, like in the real-world use of condoms, which are only 85% effective (NHS Choices). However, if the app is perfectly used (or, only including pregnancies due to condoms breaking, or the app giving a wrong green day), the app is 98% effective. Compared to hormonal forms of birth control, like the pill, the typical use of the pill is only 93% effective and in perfect use, over 99% effective.

What makes Natural Cycles an even more enticing form of birth control for its users, is that it is an option for non-hormonal birth control. Shortly, “non-hormonal birth control methods reduce the risk of

pregnancy in ways that don't affect a woman's hormones. They include devices that prevent sperm from reaching eggs and chemicals that kill sperm." ("Hormonal vs. Non-Hormonal Birth Control.") Meanwhile, Natural Cycles is also such an innovative healthcare product because it does not include invasive procedures; the company provides its birth control exclusively as an app. While there are non-hormonal birth control options that are effective, options like the Copper IUD require surgical incision. Because the app does not require doctor's visits, or medication, or even involves the healthcare system, the app works to revolutionize contraceptives into a more inclusive space. Per the app's website, "Natural Cycles' mission is to pioneer women's health with research and passion, by empowering every woman with the knowledge she needs to be in charge of her health," the company provides inclusive access to all women who have a smartphone and basal temperature tracking device (either through wearable teach like a smartwatch or as a thermometer) in their possession ("About Natural Cycles.")

The FDA has recently approved the integration of third-party thermometers, including consumer wearables, into the Natural Cycles app to enhance its fertility algorithm. This significant development allows the app to utilize wearable data, including a user's temperature and heart rate, to improve the accuracy of its fertility predictions. The FDA clearance marks a pivotal moment for Natural Cycles, as it expands the app's capabilities and usability, ultimately benefiting users seeking effective non-hormonal birth control options. Moreover, the FDA is continuing to clear additional innovations for Natural Cycles to further insight into progress toward reproductive health care and sustainable community building. Namely, in the Fall of 2023, Natural Cycles received FDA clearance to integrate with the Apple Watch. This fall, Natural Cycles will pair with Samsung devices to integrate more users onto its platform.

Natural Cycles has been at the forefront of digital contraception, leveraging innovative technology to provide women with reliable and non-invasive (and most importantly, non-hormonal) methods of birth control. The app's algorithm, which utilizes basal body temperature and menstrual data, has been a cornerstone of its effectiveness since its inception. With the recent FDA revision, the app can now seamlessly integrate wearable data, further enhancing its fertility algorithm and empowering users to make informed decisions about their reproductive health.

This development is particularly significant in the context of the fem tech market, which exceeded the expected \$127.1 billion evaluation by 2023, with fertility being a substantial component (Market.Us.) Natural Cycles' approach aligns with the growing demand for innovative and effective contraception methods, catering to the needs of approximately 64% of American women between the ages of 15 to 49 who are currently using contraception, according to the CDC (Daniels, Kimberly and Abma, Joyce C.)

The partnership between Natural Cycles and Oura Ring reflects the company's commitment to leveraging wearable technology to advance reproductive health. By integrating wearables into the app's experience, users can benefit from a more seamless and reliable method of contraception, ultimately contributing to improved reproductive health outcomes.

Natural Cycles' journey, from its initial CE certification in 2017 to gaining FDA clearance and expanding its capabilities through wearable integration, underscores its commitment to innovation and user-centric solutions. While the company has faced challenges, including regulatory scrutiny and controversies, its dedication to providing a reliable and effective birth control option remains unwavering.

The FDA's approval of wearable integration for the Natural Cycles app represents a significant milestone in the fem tech industry. By harnessing the power of wearable technology and innovative algorithms, Natural Cycles continues to redefine the landscape of non-hormonal birth control, offering women a safe, effective, and user-friendly contraceptive option. Moreover, Natural Cycles innovation

goes beyond being a safe and natural alternative to traditional birth control methods, it also contributes to several United Nations' Sustainable Development Goals (or, the SDGs). Specifically, Natural Cycles aligns with SDGs such as Good Health and Well-being (or, SDG 3), Quality Education (or, SDG 4), Gender Equality (or, SDG 5), Industry, Innovation, and Infrastructure (or, SDG 9), Reduced Inequalities (or, SDG 10), Sustainable Cities and Communities (or, SDG 11), Responsible Consumption and Production (or, SDG 12), and Peace, Justice, and Strong Institutions (or, SDG 16).

- A. Good Health and Well-being (or, SDG 3): Natural Cycles promotes good health and well-being by offering women a hormone-free and non-invasive method of contraception. By tracking basal temperatures with the help of Oura Ring, the app accurately predicts ovulation, empowering women to make informed decisions about their reproductive health. This promotes a sense of control, autonomy, and overall well-being.
- B. Quality Education (or, SDG 4): Natural Cycles contributes to SDG 4 by providing educational resources on fertility, reproductive health, and family planning. The app's user-friendly interface, informative articles, and personalized insights help users understand their menstrual cycles and fertility patterns. By promoting reproductive health education, Natural Cycles empowers individuals to make informed choices about their bodies and reproductive health.
- C. Gender Equality (or, SDG 5): Natural Cycles supports gender equality by providing women with a reliable and effective method of birth control. By empowering women to take control of their reproductive health, the app promotes bodily autonomy and enables women to make choices about when and if to have children. This contributes to achieving gender equality by ensuring that women have control over their own bodies and reproductive decisions.
- D. Industry, Innovation, and Infrastructure (or, SDG 9): Natural Cycles embodies the spirit of SDG 9 by leveraging innovative technology to revolutionize contraception. The partnership with Oura Ring demonstrates the app's commitment to industry, innovation, and infrastructure. By combining fertility tracking with wearable technology, Natural Cycles creates a seamless and reliable method of birth control, showcasing the potential of technology to improve reproductive health.
- E. Reduced Inequalities (or, SDG 10): Natural Cycles contributes to reducing inequalities by providing equal access to reliable and effective birth control. The app is accessible to individuals from diverse socio-economic backgrounds, ensuring that everyone has the opportunity to make informed choices about their reproductive health. By reducing barriers to contraception, Natural Cycles promotes equality in reproductive rights.
- F. Sustainable Cities and Communities (or, SDG 11): Natural Cycles aligns with SDG 11 by promoting sustainable family planning practices. By offering a hormone-free and non-invasive alternative to traditional birth control methods, the app supports responsible population growth and contributes to building sustainable communities. Sustainable family planning practices are essential for creating livable and resilient cities.
- G. Responsible Consumption and Production (or, SDG 12): Natural Cycles promotes responsible consumption and production by providing a sustainable alternative to hormone-based contraception. By opting for a non-hormonal birth control method, users reduce their consumption of hormonal contraceptives, thereby minimizing their environmental impact. This aligns with SDG 12's goal of promoting sustainable consumption patterns.
- H. Peace, Justice, and Strong Institutions (or, SDG 16): Natural Cycles indirectly contribute to SDG 16 by promoting peace, justice, and strong institutions through reproductive rights and autonomy.

By providing women with control over their reproductive health, the app fosters a sense of empowerment and contributes to a more equitable society. Furthermore, access to reliable contraception reduces the risk of unintended pregnancies, leading to healthier relationships and stronger family institutions.

Natural Cycles combined with the integration of Oura Ring or Apple Watches for basal temperature tracking, offers a groundbreaking approach to family planning. By aligning with various SDGs, including Good Health and Well-being, Quality Education, Gender Equality, Industry, Innovation, and Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, and Peace, Justice, and Strong Institutions, Natural Cycles contributes to a more sustainable and inclusive future. As technology continues to advance, the app's potential for revolutionizing contraception and promoting reproductive health becomes even more promising.

Wellfed Market

As discussed earlier in the Introduction on Wellfed Market in this thesis, the DC area faces extreme food insecurity, with approximately 30% of DC residents food insecure ("Hunger Report 2022 - CAFB Hunger Report."). Meanwhile, as stated in the same section, Georgetown University is directly impacted by this food insecurity as discussed in the "Free Food on Campus" GroupMe. As we continue to explore how technology has the potential to collect, it is vital to highlight that food insecurity is not only affecting developing nations. Food insecurity is a global issue that affects developed nations, impacts the capital of the United States, and hits home here at Georgetown. By collecting data on populations and their ability to get food and sustain their families, we can better create technology that can contribute to sustainability efforts and protect vulnerable populations.

Because the home screen of the User Interface (or, UI) of Wellfed Market is a map, you can directly see where available food is within a community; further contributing to collecting information and sharing that food data with the app's users. On the backend of the app, I store every food item entry that has been posted onto the app. In doing this, I can convert these data points into something statistically meaningful. While I have not explored these options, collecting these data points can allow for the deployment of specific technology to specific areas to enhance food security efforts.

Overall, the core functionalities of the app through food sharing and community empowerment, allows Wellfed Market to have the ability to collect valuable data on food insecurity, and food deserts, and physically gather surplus food items. This data collection capacity plays a crucial role in advancing several Sustainable Development Goals (or, SDGs) by empowering knowledge creation, fostering partnerships, and aiding policy development.

- A. Quality Education (or, SDG 4): Wellfed Market's data collection efforts provide insights into food insecurity and food deserts, contributing to the goal of quality education. By understanding the challenges faced by communities in accessing nutritious food, policymakers and educators can develop targeted interventions and educational programs to address these issues. Wellfed Market's data can empower knowledge-building around food security, promoting informed decision-making and sustainable development.
- B. Industry, Innovation, and Infrastructure (or, SDG 9): The data collected by Wellfed Market serves as a valuable resource for industry, innovation, and infrastructure. By understanding the patterns of food waste and surplus, stakeholders can identify opportunities for innovation and develop

efficient infrastructure to mitigate food waste. This data-driven approach supports the advancement of sustainable practices within the food industry, contributing to SDG 9.

- C. Reduced Inequalities (or, SDG 10): Wellfed Market's data collection efforts shed light on inequalities in access to food resources, contributing to the goal of reduced inequalities. By identifying areas with high levels of food insecurity and food deserts, policymakers, NGOs, and community organizations can develop targeted initiatives to address these disparities. Wellfed Market's data enables evidence-based decision-making and supports efforts to create more equitable and inclusive societies.
- D. Sustainable Cities and Communities (or, SDG 11): Data collected by Wellfed Market provides valuable insights into the food landscape of communities, promoting sustainable cities and communities. By understanding the availability and accessibility of food resources, policymakers can design urban planning strategies that prioritize equitable access to nutritious food. Wellfed Market's data contributes to the development of sustainable and inclusive communities, aligning with SDG 11.
- E. Responsible Consumption and Production (or, SDG 12): Wellfed Market's data collection efforts contribute to responsible consumption and production patterns. By understanding the patterns of food waste and surplus, stakeholders can develop strategies to reduce waste and promote responsible consumption. This data supports efforts to optimize resource utilization, minimize environmental impact, and foster sustainable production and consumption practices, aligning with SDG 12.
- F. Peace, Justice, and Strong Institutions (or, SDG 16): Wellfed Market's data collection contributes to promoting peace, justice, and strong institutions. By understanding the factors that contribute to food insecurity and disparities in access to food, policymakers and institutions can address these issues through targeted policies and interventions. Wellfed Market's data empowers evidence-based decision-making, promotes social justice, and strengthens institutions working towards sustainable development, aligning with SDG 16.
- G. Partnerships for the Goals (or, SDG 17): Wellfed Market's data collection efforts foster partnerships among various stakeholders for sustainable development. By providing valuable data on food insecurity and surplus, the platform facilitates collaboration between policymakers, NGOs, community organizations, and businesses. These partnerships allow for the exchange of knowledge, resources, and best practices, promoting collective action and advancing the SDGs, particularly SDG 17.

In conclusion, Wellfed Market's ability to collect data on food insecurity, food deserts, and physical food items contributes to various SDGs. By empowering knowledge creation, aiding policy development, fostering partnerships, and promoting responsible consumption, the platform plays a significant role in advancing sustainable development. Wellfed Market's data collection efforts provide valuable insights for policymakers, NGOs, and community organizations, enabling them to address inequalities, promote sustainable practices, and build resilient communities.

Complications?

While data collection plays a crucial role in driving innovation and improving services, it is not without limitations. Two key and significant limitations of data collection are ethical and environmental concerns. Large-scale data collection has the potential for excessive data harvesting and its connection to

discriminatory algorithms. Meanwhile, environmental concerns arise from data storage centers specifically seen with the warming of water. These limitations highlight the importance of ethical considerations and sustainable practices in the realm of data collection and storage.

One limitation of data collection is the risk of excessive data harvesting, which can lead to ethical concerns and discriminatory algorithms. The Cambridge Analytica scandal serves as a prominent example, where the personal data of millions of Facebook users were harvested without their consent, raising questions about privacy and data protection. Excessive data harvesting can result in the creation of biased algorithms, perpetuating discrimination and reinforcing existing societal inequalities. When algorithms are trained on biased or incomplete data, they can generate discriminatory outcomes, such as biased hiring practices or targeted advertising that reinforces stereotypes. It is crucial to establish ethical guidelines and robust data governance practices to address these concerns and prevent the misuse of collected data.

Another limitation of data collection lies in the environmental complications associated with data storage centers. These centers, often referred to as server farms or data centers, are essential for storing and processing vast amounts of data. However, they require significant amounts of energy for their operations, leading to environmental consequences. The excessive energy consumption required to power these facilities contributes to increased carbon emissions, exacerbating climate change ("The Effects of Data Centers on the Environment"). Furthermore, the data centers require excessive water consumption to keep the servers cool, an aspect of data centers that is not commonly criticized. In Oregon, Google's data center makes up over a quarter of the city's water consumption (Osaka). As data centers consume large quantities of electricity, the resulting heat needs to be dissipated. This is often achieved through water cooling systems, which can lead to the release of warm water into nearby water bodies, potentially affecting aquatic ecosystems and increasing water temperatures. Such environmental implications highlight the need for sustainable practices in data center design, including the use of alternative cooling methods and the adoption of renewable energy sources to minimize the environmental footprint.

The limitations of data collection encompass ethical concerns related to excessive data harvesting and the potential for discriminatory algorithms, as well as the environmental complications arising from data storage centers. Addressing these limitations requires the establishment of robust ethical frameworks for data collection, ensuring transparency, consent, and protection of individual privacy. Additionally, adopting sustainable practices in data storage centers, such as innovative cooling methods and renewable energy sources, can mitigate the environmental impact. By recognizing and addressing these limitations, we can harness the power of data while upholding ethical standards and safeguarding the environment.

FIFO Application to the SDGs

Mobile app solutions are not the solution for achieving complete sustainability across communities given their inherent complex ethical and environmental concerns. However, mobile apps like Natural Cycles and Wellfed Market do elevate and complicate the motivations behind the United Nations Sustainable Development Goals. Therefore, these apps that collect user data to make predictions and provide a deeper understanding and context of communities, should strive to be a FIFO (or, First In, First Out) approach to achieve complete sustainability.

In the context of the Oura and Natural Cycles or Apple Watch partnership, more individuals can learn more about their bodies to make mindful decisions. Having control over bodily autonomy is liberating and therefore critical for building a sustainable community. However, the inherent challenges that come with having access to reproductive resources and education are systemic and must be

challenged by changemakers (who play a crucial role in promoting alternative low-cost technical solutions for non-hormonal birth control and improving reproductive health literacy). By advocating for accessible and affordable non-hormonal contraceptive options and enhancing reproductive health education, changemakers can empower individuals to make informed choices about their reproductive well-being.

While data collection is valuable for advancing the Sustainable Development Goals (SDGs), there is a need for better on-the-ground solutions to complement the insights derived from data. By advocating for the development and promotion of sustainable and accessible contraceptive options, as well as enhancing reproductive health literacy, changemakers can drive positive change and contribute to the advancement of reproductive health and well-being.

The adoption of a FIFO approach in mobile app solutions, coupled with the advocacy for alternative low-cost technical solutions and improved reproductive health literacy, can contribute to the sustainability and effectiveness of reproductive health apps. By prioritizing data integrity, promoting accessible contraceptive options, and enhancing reproductive health education, changemakers can empower individuals to make informed choices about their reproductive well-being, ultimately contributing to the advancement of the SDGs and the promotion of reproductive autonomy and choice.

CHAPTER 2: CONNECT

“Technology is best when it brings people together.”

- Matt Mullenweg, WordPress founder (Angel)

Intro to Discussion

In the early days of computing, computers were not machines but human clerks who performed calculations (Copeland). They laid the groundwork for commerce, government, and research establishments by meticulously calculating thousands of figures. However, as technological innovation progressed, the role of human computers was gradually replaced by machines. The term “computing machine” gained popularity in the 1920s, marking a shift from humans to machines as the primary computers.

But when did computing lose its humanity? According to Matt Mullenweg, the founder of WordPress, “Technology is best when it brings people together.” (Angel) While human computers used to work independently and compare their calculations in person, modern technology has enabled a different kind of connection. In today's world, computers can bridge the physical distance between individuals and facilitate collaboration, even in remote work settings.

The rise of software development and remote work, especially in the post-pandemic era, has highlighted the ability of technology to connect people across the globe. Companies and individuals now have the opportunity to hire developers from different countries and continents to work on their software projects. This interconnectedness brings diverse perspectives, expertise, and creativity to the table, ultimately enhancing the quality and effectiveness of technological solutions.

The power of technology to bring people together extends beyond the realm of work. Online platforms and social media have revolutionized communication and networking, enabling individuals to connect with others who share their interests, passions, and goals. These platforms have created virtual communities where people can exchange ideas, collaborate on projects, and support one another, regardless of geographic boundaries.

However, it is important to acknowledge that technology-mediated connections also come with challenges. The phenomenon of “echo chambers” and the spread of misinformation through unregulated social media platforms are potential pitfalls of online connectivity. Additionally, online interactions' binary nature can limit human communication's nuances and complexities.

To harness the true potential of technology in bringing people together, it is crucial to humanize it. We must recognize that technology is a tool and that its effectiveness lies in the hands of the people who use it. By emphasizing the importance of human connection and interaction, we can leverage technology to foster collaboration, bridge divides, and promote understanding.

In conclusion, technology can transcend mere computation and bring people together. From the early days of human computers to the current era of remote work and online communities, technology has revolutionized the way we connect and collaborate. By embracing technology as a means to enhance human connections, we can harness its potential to address the challenges and achieve the goals outlined in the United Nations' Sustainable Development Goals.

Case Study

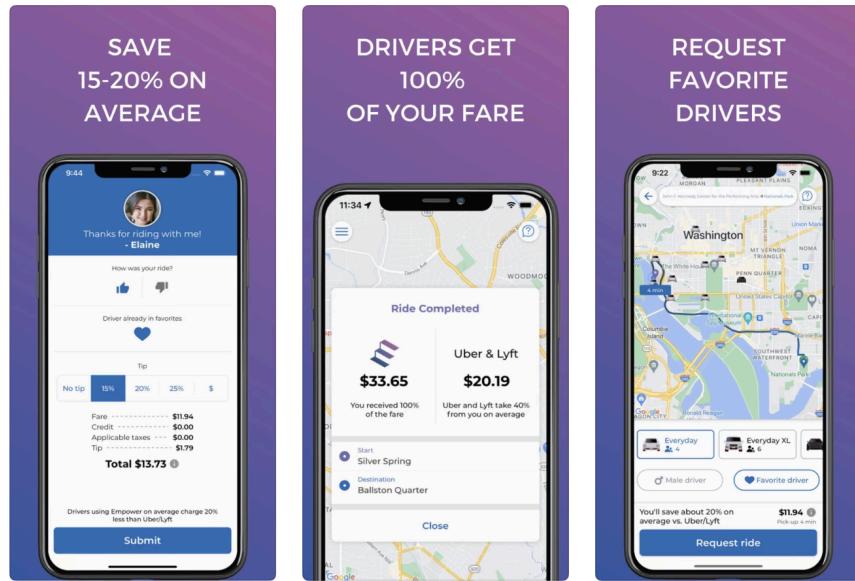
In the era of mobile apps, Empower stands as a software startup that exemplifies the power of connectivity in promoting the United Nations' Sustainable Development Goals (or, the SDGs). By

decentralizing the ride-share industry and empowering both drivers and riders, Empower showcases how mobile apps can create safety, and ownership, and support various SDGs.

The app is head-quartered in Mclean, Virginia and across its 10 rounds of funding, the company has maintained its for-profit, privately-owned status while successfully raising \$10.1M (“Empower.”). The app’s founder, Joshua Sear, was inspired to create Empower after encountering Uber and Lyft drivers who worked long hours, yet struggling to make ends meet for their families (TRUiC). Initially, when Uber and Lyft entered the ride-sharing gig economy, their vision was to establish a balanced system that provided affordable rides for passengers while ensuring drivers could earn a sustainable income in the long run. However, as these companies prioritized rapid growth, shareholder satisfaction, and disrupting the taxi industry, the outcome fell short of this goal. Recognizing this problem, Joshua saw an opportunity to redefine ride-sharing and align it with its original intent. This realization marked the inception of Empower, his startup company.

Drawing from his frequent use of Uber and Lyft, Joshua began engaging in conversations with drivers during his rides. Through these interactions, he discovered that drivers often felt unheard and undervalued. In traditional ride-share apps like Uber and Lyft, the driver operates as an employee. Because both Uber and Lyft take fees on top of the driving cost, these drivers are subjected to the company's discretion. However, with Empower, the driver pays a monthly subscription to the app instead of the fees tied to the rides. To Sear, it became apparent to him that by reimagining the Lyft and Uber business model and placing the driver at the center as the customer, it was possible to create a software services company that could enhance the experiences of everyone on the road. Empower views its drivers as a customer paying a subscription fee rather than an employee they oversee. Therefore, Empower was built with the aim of transforming the ride-sharing industry and implementing significant improvements specifically for drivers.

In the traditional model, passengers were the primary customers, while drivers merely provided the service for fees and rates set by the ride-sharing provider company. However, with Empower, the driver becomes the customer. This shift empowers drivers by granting them the ability to set their own rates, ensuring they receive fair compensation and enabling them to compete on equal footing with companies like Uber and Lyft. Specifically, what makes Empower such an interesting ride-sharing model, where the drivers keep 100% of the cost of the ride; for competitors like Uber or Lyft, the drivers receive a fraction of the cost of the ride. Meanwhile, to create a profit, Empower operates on a subscription model where drivers pay a fee every month to be eligible drivers on the platform. Therefore, Empower seeks to afford drivers better treatment, fair compensation, and a sense of value every single day, advancing its mission to empower drivers to reach their full potential.



The improvements Empower introduces for drivers have a direct impact on the experience of riders and passengers. With drivers having the autonomy to set their rates and receive the entirety of the fare, passengers can rest assured that their drivers are adequately compensated for their efforts. Additionally, as independent operators, drivers have a strong incentive to prioritize top-notch customer service, as they rely on building a loyal base of riders who choose to repeatedly book their services. Overall, the pioneering improvements introduced by Empower create a win-win situation for everyone involved. Drivers receive the pay and appreciation they deserve, while passengers enjoy unparalleled customer service and high-quality transportation.

Notably, though, the app initially struggled to enter the DMV market. The app is currently not properly licensed to operate in the DC area (Tuss). In the true Silicon Valley mindset of “Move Fast and Break Things,” the Empower app has not gone through the proper paperwork to be licensed to operate in DC. Therefore, in December 2023, the District of Columbia, issued a warning to ride-share users about the unregistered company as it was technically operating illegally in the city. While popular ride-share companies like Uber, Lyft, and Alto are registered with the city, Empower has not registered and has received a cease-and-desist letter from D.C. authorities. Despite this, individuals can still download the Empower app and request rides. The CEO of Empower, Joshua Sear, claims that the company aims to empower drivers by allowing them to set their own rates and receive 100% of the fare. However, D.C. officials have cautioned passengers against using Empower and advised them to instead choose authorized and registered ride-share services. The Department of For-Hire Vehicles (DFHV) has warned that drivers operating under Empower may face enforcement actions, including vehicle impoundment.

While the app does not currently comply with DC regulatory requirements, the app does still exist as a means to successfully connect drivers with riders, all while advancing several SDGs. Empower declined to comment on its involvement with the SDGs for this thesis, yet its innovative ride-sharing approach reflects its inherent commitment to social impact. Particularly, Empower contributes to SDGs such as No Poverty (or, SDG 1), Gender Equality (or, SDG 5), Affordable and Clean Energy (or, SDG 7), Decent Work and Economic Growth (or, SDG 8), Industry, Innovation, and Infrastructure (or, SDG 9), Reduced Inequalities (or, SDG 10), Sustainable Cities and Communities (or, SDG 11), and Responsible Consumption and Production (or, SDG 12).

- A. No Poverty (or, SDG 1): Empower plays a significant role in addressing SDG 1 by creating economic opportunities for drivers. By providing them with 100% of the fare, Empower allows drivers to earn more while charging less to riders. This fair distribution of income helps alleviate poverty and enables drivers to improve their financial well-being, ultimately contributing to reducing poverty.
- B. Gender Equality (or, SDG 5): Empower promotes gender equality through its inclusive approach. By empowering both male and female drivers to take control of their transportation decisions, the app ensures equal opportunities for all genders. This creates a safe and supportive environment, fostering gender equality within the ride-share industry.
- C. Affordable and Clean Energy (or, SDG 7): By decentralizing the ride-share industry, Empower reduces the reliance on traditional fossil fuel-based transportation. The app encourages the use of shared rides, leading to a decrease in fuel consumption and carbon emissions. This shift towards sustainable transportation aligns with SDG 7, promoting affordable and clean energy for a more sustainable future.
- D. Decent Work and Economic Growth (or, SDG 8): Empower's approach contributes to SDG 8 by providing drivers with decent work opportunities and economic growth. With the flexibility to set their own pricing and receive 100% of the fare, drivers can earn a fair income. This empowers them to improve their livelihoods and contribute to economic growth in their communities.
- E. Industry, Innovation, and Infrastructure (or, SDG 9): Empower's innovative approach to ride-sharing reflects the essence of SDG 9. By utilizing mobile apps, the company disrupts traditional industry norms, fostering innovation and promoting the development of efficient transportation infrastructure. This paves the way for future advancements in the industry, enhancing connectivity and accessibility.
- F. Reduced Inequalities (or, SDG 10): Empower actively contributes to reducing inequalities by democratizing the ride-share industry. The app empowers drivers by providing them with fair compensation and ownership over their work. By ensuring equal opportunities and promoting inclusivity, Empower helps bridge the gap between different socio-economic groups, fostering a more equitable society.
- G. Sustainable Cities and Communities (or, SDG 11): Through its decentralized model, Empower contributes to SDG 11 by promoting sustainable cities and communities. By encouraging shared rides and reducing the number of single-passenger vehicles, the app reduces traffic congestion and carbon emissions. This results in cleaner and more livable cities, supporting the development of sustainable communities.
- H. Responsible Consumption and Production (or, SDG 12): Empower promotes responsible consumption and production by encouraging shared rides and reducing the overall carbon footprint of transportation. By optimizing vehicle occupancy and reducing empty seats, the app fosters efficient resource utilization. This aligns with SDG 12, promoting sustainable consumption patterns and responsible production practices.

Empower's innovative approach to ride-sharing showcases the potential of mobile apps in promoting sustainable development and supporting the United Nations' SDGs. By connecting people, creating safety and ownership, and contributing to various goals such as No Poverty, Gender Equality, Affordable and Clean Energy, Decent Work and Economic Growth, Industry, Innovation, and Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, and Responsible Consumption

and Production, Empower demonstrates how mobile apps can drive positive social impact. As mobile apps continue to evolve, the potential for apps like Empower to create a more sustainable and inclusive future is limitless.

Wellfed Market

Wellfed Market's connection functionality serves as a powerful tool in solving the logistical challenges associated with wasting food by effectively connecting people to available food resources. This feature not only helps address the issue of food waste but also fosters a sense of community and collective responsibility towards sustainable practices. Importantly, the app platform's ability to address No Hunger (or, SDG 2) of the United Nations Sustainable Development Goals underlines the app's connection functionality.

By leveraging technology and providing a platform for individuals to share and access surplus food items, Wellfed Market creates a direct connection between those with excess food and those in need. This connection functionality enables a seamless and efficient redistribution process, ensuring that edible food does not go to waste. Through the platform, individuals with surplus food can easily connect with others who can benefit from it, effectively reducing the amount of food that would otherwise end up in landfills.

The connection functionality also allows users to search and find available food listings within their local communities. This feature not only helps address the logistical challenges of wasting food but also promotes a sense of shared responsibility. Users can actively engage with their communities, fostering connections and building relationships centered around the shared goal of reducing food waste.

Moreover, the connection functionality of Wellfed Market goes beyond the mere transactional aspect of food sharing. It encourages users to engage in meaningful interactions, such as providing feedback, sharing reviews, and building a sense of community around sustainable food consumption. This connection and local engagement foster a culture of mindful consumption and responsible food sharing, creating a positive impact on both individuals and the environment.

By connecting people to available food resources, Wellfed Market tackles the logistical challenges of food waste head-on. It streamlines the process of redistributing surplus food, ensuring that edible food reaches those who need it the most. This efficient and effective connection functionality is instrumental in addressing the issue of food waste at a local level, contributing to global efforts towards sustainable development and responsible consumption.

In conclusion, Wellfed Market's connection functionality not only solves the logistical challenges of wasting food but also fosters a sense of community and collective responsibility. By connecting people to available food resources, the platform enables a seamless redistribution process, reducing food waste and promoting sustainable practices. Through its user-friendly interface and emphasis on community engagement, Wellfed Market creates meaningful connections and builds a culture of mindful consumption, making a positive impact on both individuals and the environment.

Complications?

Mobile apps have revolutionized the way people connect and access information, fostering a digital environment where individuals can engage with diverse perspectives and access a wealth of knowledge. However, these connections also give rise to complications, such as the formation of "echo chambers" and the spread of misinformation when unregulated through social media. Additionally, the act

of connecting people to information in a binary world can be problematic, as discussed in “Race and/as Technology; or, How to Do Things to Race” by Wendy Hui Kyong Chun.

The concept of “echo chambers” refers to the phenomenon where individuals are exposed primarily to information and opinions that align with their existing beliefs and perspectives. This can lead to the reinforcement of preconceived notions and the exclusion of diverse viewpoints. Studies have identified the presence of echo chambers on social media platforms, where algorithmic selection and self-selection contribute to the formation of like-minded communities. While some research suggests that most social media users receive information from a diversity of viewpoints, the existence of bounded, enclosed media spaces cannot be discounted. When deliberately false information is introduced into these echo chambers, it can be absorbed and viewed as credible, reinforcing users' false beliefs and hindering the penetration of factual information.

The spread of misinformation on social media is a significant concern, with the role of echo chambers being a key factor in its vitality. Misinformation can be absorbed and disseminated within these closed, non-interacting communities, perpetuating false narratives and hindering the spread of accurate information. The presence of echo chambers and the extent of homophily play a crucial role in the spread of misinformation, highlighting the need for measures to control and mitigate its impact. In the context of connecting people to information in a binary world, the challenges and implications discussed in “Race and/as Technology; or, How to Do Things to Race” shed light on the complexities of navigating information dissemination in a digital landscape. The binary nature of technology and information dissemination can contribute to the perpetuation of stereotypes, biases, and inequalities, emphasizing the need for critical examination and intervention to address these issues.

In conclusion, while mobile apps have facilitated connections and access to information, it has also given rise to challenges such as echo chambers and the spread of misinformation. Addressing these complications requires a multifaceted approach, including regulating information dissemination on social media platforms, the promotion of diverse viewpoints, and a critical examination of the impact of technology on societal dynamics. By acknowledging these challenges and actively working to mitigate their effects, it is possible to foster a digital environment that promotes inclusivity, diversity, and the dissemination of accurate and valuable information.

FIFO Application to the SDGs

In the pursuit of achieving the Sustainable Development Goals (or, the SDGs), it is essential to humanize technology, recognizing its role as a tool that relies on the actions and intentions of individuals. Steve Jobs, co-founder of Apple, once said, “It's not a faith in technology. It's faith in people.” (Goodell, Jeff) This quote encapsulates the need to prioritize human values and empathy in the development and utilization of technology. While mobile apps can connect people and advance the SDGs, it is crucial to address limitations and challenges, such as the potential for arrogance, ignorance, and problematic connections that can hinder sustainability efforts. By acknowledging these concerns and striving for a First In, First Out (FIFO) approach in sustainable community building, we can mitigate harmful narratives and promote a human-centered approach to technology.

The achievement of the SDGs relies on the collective efforts of individuals who are empathetic towards others. Technology can facilitate connections and amplify the impact of these efforts. However, if individuals use technology to perpetuate arrogance, ignorance, or problematic connections, it becomes challenging to attain sustainability. Empathy forms the foundation for understanding diverse perspectives, collaborating effectively, and addressing social and environmental challenges. By fostering empathy in

both the design and use of technology, we can harness its potential to bridge divides and empower individuals to contribute meaningfully to the SDGs.

Mobile apps have the power to connect people, facilitate knowledge sharing, and mobilize collective action towards the SDGs. However, it is essential to recognize its limitations and address concerns that arise from harmful narratives and misinformation. To achieve sustainability, mobile apps are not the answer to sustainability. However, mobile apps offer a FIFO approach to sustainable community building. By encouraging changemakers to promote on-the-ground solutions to facilitate connections and build communities up, mobile apps can be used to complement such productivity. Apps like Empower and Wellfed Market that aim to use connections to advance the SDGs are limited in their influence if they exist in a hostile environment. It is critical to encourage more creative problem-solving when addressing sustainable community building. Therefore, mobile apps are a great initial FIFO solution in advancing the SDGs through technology's inherent ability to connect users.

Moreover, technology has the potential to exacerbate harmful narratives and amplify misinformation if left unregulated. It is crucial to implement measures that stop the spread of misinformation and address concerns such as echo chambers and the reinforcement of biases. This requires a collective effort involving app developers, policymakers, and users themselves. These changemakers, who promote critical thinking, media literacy, and responsible use of technology, can help mitigate the negative impacts of unreliable information and ensure that technology effectively contributes to the SDGs.

To achieve sustainability with the SDGs, it is imperative to humanize technology and prioritize empathy in its design and use. The quote by Steve Jobs emphasizes the importance of faith in people rather than blind faith in technology itself. Mobile apps, when utilized responsibly and with a human-centered approach, can connect people and advance the SDGs. However, it is crucial to address limitations, promote empathy, and actively mitigate harmful narratives and misinformation. By adopting a FIFO approach in sustainable community building and fostering critical thinking, we can ensure that technology serves as a powerful tool in achieving the SDGs while respecting the values and needs of individuals and communities.

CHAPTER 3: PROTECT

“Technology is not just a tool. It can give learners a voice that they may not have had before.”
 - George Couros, Author (LaFave)

Intro to Discussion

In Malcolm Harris' book, Palo Alto, the author narrates the history of computers and the rise of Silicon Valley (Harris). In his narration, Harris dives into the history of protecting computers both through cybersecurity and physical measures. The history of cybersecurity traces back to the early days of computing, when the concept of protecting computer systems from unauthorized access and malicious attacks first emerged. One notable incident involving cybersecurity and the Vietnam War occurred at the Massachusetts Institute of Technology (MIT) and the University of California, Berkeley during the 1970s.

During this period, computer systems played a crucial role in military operations and research, making them attractive targets for adversaries seeking to disrupt or gather intelligence. The Advanced Research Projects Agency Network (ARPANET), a predecessor to the modern internet, was utilized extensively by various institutions, including MIT and UC Berkeley, for research and communication purposes (Anderson).

In the late 1960s and early 1970s, as opposition to the Vietnam War grew, activists sought to disrupt the military-industrial complex and its use of computer systems. MIT and UC Berkeley, being prominent research institutions with ties to military projects, became targets of cyber-attacks. These attacks were primarily carried out by anti-war protesters and hacker collectives seeking to disrupt the institutions' operations and convey their opposition to the war.

The attacks ranged from unauthorized access to system disruptions and data manipulations. Activists leveraged vulnerabilities in the computer systems to gain unauthorized access and manipulate data, effectively disrupting ongoing research and communication. These attacks not only highlighted the vulnerabilities of computer systems at the time but also underscored the need for robust cybersecurity measures to protect sensitive information and maintain the integrity of computer networks.

In response to these attacks, institutions like MIT and UC Berkeley began to prioritize cybersecurity and develop measures to protect their computer systems. These early incidents served as catalysts for the development of cybersecurity as a field of study and led to advancements in securing computer networks and data.

Today, the history of cybersecurity during the Vietnam War era serves as a reminder of the ever-evolving threat landscape and the importance of continuously improving security measures. It highlights the need for ongoing research, collaboration, and innovation to safeguard computer systems from malicious attacks and protect critical information in an increasingly interconnected world.

Yet, from the era of working vigorously to ensure that humans protect their technology, humanity has approached the point where technology can be used to protect themselves.

Case Study

In the world of addiction recovery, one name stands out: Alcoholics Anonymous, or AA for short. For decades, AA has provided a lifeline for countless individuals battling alcoholism (“Alcoholics Anonymous: The 12 Steps of AA & Success Rates.”). AA meetings are traditionally held in church basements, community centers, coffee shops, or other low-rental fee venues. These meetings have become a sanctuary for those seeking solace and support. The atmosphere provides space for empathy,

understanding, and non-judgment. Within these walls, anonymity is a sacred principle, fostering an environment where individuals can freely share their experiences, victories, and setbacks.

Stories of rock bottom moments, lost friendships, and shattered lives intertwine, creating a tapestry of shared pain and hope. The foundation of AA lies in its 12-step program, a spiritual approach that encourages self-reflection, acceptance, and surrender. Participants are guided through a process of personal inventory, making amends, and seeking spiritual growth. The concept of a higher power, whether religious or secular, is central to AA's philosophy, providing strength and guidance to those in recovery.

While it is a global organization, AA is largely associated with the United States and how the US treats addiction and recovery. In fact, some AA participants are required by the courts to attend meetings; for example, some individuals are mandated with "30 for 30" or "90 for 90" (where an individual attends 30 or 90 meetings in 30 or 90 days). Failure to comply with these requirements could result in court time. While the courts use AA as a means to support recovery, it should be noted that AA is a separate non-profit organization that was not created in partnership with the courts.

Therefore, in a treatment court system that encourages individuals in recovery to use the AA meetings to keep accountability towards recovery, it is imperative that technology can protect participants in AA. As the AA system relies on anonymity to create a safe and secure environment for all participants, there are some problematic aspects of the current system that are not protecting participants in AA.

When a participant goes through the treatment court system and is mandated to attend AA, the court gives the individual a piece of paper to track their meetings. At every meeting, the participant will sign the paper with their name, the location of the meeting, and have the chair of the meeting sign the paper. The paper system is not effective in protecting the members of these AA meetings.

First, the individual who is mandated to attend the AA meetings through the courts, inevitably broadcasts themselves to the group as someone who is in trouble with the law when they have to go up to the chair of the meeting and ask for a signature. Here, the individual is no longer anonymous and is viewed as a criminal, facilitating a stigma over that individual. Thus, defeating the purpose of ensuring anonymity across the group.

Second, the chair of that AA meeting who signs the slip verifying the participant's attendance inevitably shares their first and last name with the treatment courts. Here, the chair is no longer anonymous. Thus, defeating the purpose of ensuring anonymity across the group.

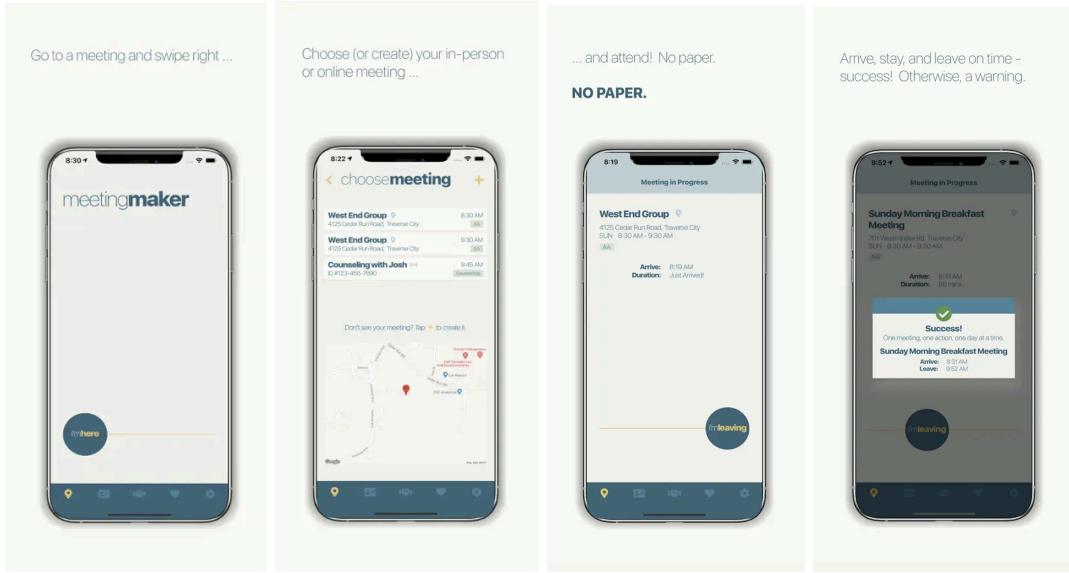
Third, should the individual leave the AA meeting early or have someone else falsify an attendance verification signature, the validity of the AA system is jeopardized. Without properly accounting that a user was where they said they were when, it is difficult for a court mandator, judge, or caseworker to ensure that the individual who is supposed to attend AA is actually attending. Thus, delegitimizing the relationship between AA and the treatment court system.

Lastly, should a participant in AA lose their paper slip, there is no recovery. If an individual cannot present to a treatment court that they have been attending the mandated meetings, the inevitable consequence is jail time, placing strain on community resources and funding.

Therefore, in an era where technology plays an integral role in transforming various aspects of society, the MeetingMaker mobile app emerges as a powerful tool that not only protects user privacy but also aids individuals in advancing through the legal system, optimizing their interaction with corrections officers and case managers, and facilitating their journey towards recovery.

The MeetingMaker app is designed to simplify the process of verifying meeting attendance. Its main goal is to serve individuals who are required to provide proof of attendance for 12-step programs, community service, and other recovery-related meetings. However, it can also be used in non-recovery

circumstances. The app streamlines how individuals can track their recovery by first attending a meeting. A user can discreetly check in on the app when they arrive at a meeting. During the entirety of the meeting, the app will continuously update to track the location of the participant by creating a geo-fence around the user's location. When the meeting is over, users can check out on the app. Or, the app will ultimately stop recording the meeting when the user steps out of that generated geo-fence. The meeting will be tracked through a non-editable weekly record attendance sheet, creating a safe, secure, and accurate record of the user's attendance for all required meetings. Users can add contacts to automatically send meeting attendance reports to anyone they choose. These reports are sent to the user and their contacts every Monday morning to verify the user's activity of the previous week.



The app aims to eliminate the need for paper-based verification, which can be prone to error, loss, and lack of privacy. By leveraging geolocation technology, MeetingMaker ensures reliable and secure attendance verification. The app also offers features such as virtual meeting verification and the ability to manage progress. Developed by Jodie Schanhals, a woman tech developer in recovery, she prioritizes creating an app by people in recovery, for people in recovery, to empower individuals to manage their meeting attendance goals. Additionally, the app is available for download on both the App Store and Google Play Store.

The MeetingMaker app exemplifies how mobile apps align with the United Nations Sustainable Development Goals, specifically focusing on SDG 3: Good Health and Well-being, SDG 5: Gender Equality, SDG 8: Decent Work and Economic Growth, and SDG 9: Industry, Innovation, and Infrastructure.

- A. SDG 3: Good Health and Well-being: The MeetingMaker app contributes to SDG 3 by promoting good health and well-being among individuals going through treatment courts. By providing a user-friendly interface that allows seamless access to necessary resources, the app empowers users to take control of their recovery journey. It offers features such as medication reminders, appointment scheduling, and access to educational materials related to addiction, mental health, and overall well-being. By ensuring individuals receive the support they need, the app aims to improve their overall health outcomes.
- B. SDG 5: Gender Equality: Promoting gender equality is a fundamental aspect of the MeetingMaker app's mission. This is achieved by providing equal opportunities and resources to

all individuals, regardless of gender. The app's user interface and functionalities are designed to be gender-neutral and inclusive. Additionally, the app ensures that treatment court processes are fair and unbiased, eliminating any gender-based discrimination that may exist within the legal system. By empowering individuals of all genders, the app supports SDG 5 and fosters a more equitable society.

- C. SDG 8: Decent Work and Economic Growth: The MeetingMaker app contributes to SDG 8 by facilitating individuals' reintegration into society and promoting their economic empowerment. By streamlining communication between users and their corrections officers or case managers, the app enhances the efficiency of the legal system. This, in turn, allows individuals to spend more time working towards their rehabilitation, improving their chances of successfully transitioning into the workforce. The app also provides access to educational resources that can enhance individuals' skills and knowledge, enabling them to seek decent work opportunities.
- D. SDG 9: Industry, Innovation, and Infrastructure: The MeetingMaker app aligns with SDG 9 by leveraging innovative technology to improve the infrastructure of the legal system. By digitizing and centralizing important information, the app reduces administrative burdens and enhances communication efficiency. This innovative approach not only benefits individuals going through treatment courts but also creates opportunities for collaboration and information-sharing among legal professionals. The app's contribution to the legal infrastructure promotes the use of technology in advancing the justice system and fostering a more efficient and effective environment.

The MeetingMaker mobile app catalyzes positive change within the legal system, aligning with multiple United Nations Sustainable Development Goals. By prioritizing user privacy, facilitating efficient communication, and promoting individual empowerment, the app contributes to SDG 3: Good Health and Well-being, SDG 5: Gender Equality, SDG 8: Decent Work and Economic Growth, and SDG 9: Industry, Innovation, and Infrastructure. Through its innovative features and commitment to enhancing the legal system's efficiency, MeetingMaker paves the way for a more equitable, inclusive, and rehabilitative justice system.

In Summer 2023, I came onto MeetingMaker and joined Jodie Schanhals as an Intern Developer for her company. In my role, I assisted in UI, UX, database, and client-facing website development for the startup's smart solution to addiction and recovery. Moreover, I was invited to Houston, Texas to present on the app as a part of the RISE23 conference, the only national conference for treatment court professionals. In May 2024, I will be attending the RISE24 conference, where I will again share the app with treatment court professionals in Anaheim, California.



I believe the MeetingMaker app to be highly effective and increases participation and engagement for individuals in treatment recovery, all while decreasing the stigma for these participants. However, in order to achieve a more sustainable cycle of treatment recovery in the United States, there needs to be a systematic change in how recovery is handled. This will be better explained when considering the limitations of technology below at the end of this chapter.

Wellfed Market

The Wellfed Market app stands as a compelling case study of how an application can protect both the people and the environment surrounding it. With its motto of “No food wasted!”, Wellfed Market serves as a food-sharing platform that empowers consumers to address the environmental impact of food waste, combat hunger, and foster community connections through the power of food. The ultimate goal of Wellfed Market is to localize the food system in America.

By creating an account on Wellfed Market, users gain access to a vibrant community where they can view, post, and share food listings. The platform operates on the principle that all food available on the app is free, with users having the option to donate to the person who originally posted the item they claimed. This innovative system not only reduces food waste but also allows individuals to recover some of their financial losses associated with unused food.

Wellfed Market tackles the pressing issue of food waste by providing a platform for users to share excess or unused food with others who may benefit from it. Through this process, the app helps to prevent perfectly good food from ending up in landfills, where it contributes to greenhouse gas emissions and environmental degradation. By redistributing surplus food within local communities, Wellfed Market mitigates the environmental effects of food waste and promotes a more sustainable approach to consumption.

Additionally, the app supports the protection of its users and safety through public review infrastructure: Wellfed Market prioritizes user safety by implementing a public review infrastructure within the app. This feature allows users to provide feedback and rate their experiences with other users, ensuring transparency and accountability within the community. By fostering a culture of trust and accountability, the app creates a safer environment for users to engage in food-sharing activities.

Through its public review infrastructure and focus on reducing methane emissions, Wellfed Market demonstrates its commitment to protecting user safety and the environment. By fostering a sense

of community, accountability, and sustainability, the app serves as a powerful tool in promoting a more responsible and conscious approach to food consumption and waste reduction.

In addition to its environmental impact, Wellfed Market addresses issues of hunger and food insecurity by providing individuals in need with access to free and nutritious food. By connecting surplus food with those who would otherwise struggle to access it, the app contributes to alleviating hunger and fostering food security within communities.

Moreover, Wellfed Market catalyzes community engagement and connection. Through the shared act of giving and receiving food, users build relationships and strengthen community bonds. By facilitating direct interactions between individuals within a local area, the app promotes a sense of togetherness and collective action towards a more sustainable and equitable food system.

In conclusion, the Wellfed Market app exemplifies the potential of technology to protect people, the planet, and the environment. By enabling the sharing of surplus food, reducing waste and hunger, and fostering community connections, Wellfed Market serves as a powerful tool in mitigating the environmental effects of food waste, addressing hunger, and building a more localized and sustainable food system for America.

Complications?

While technology protections on mobile apps have undoubtedly improved over the years, they are not without their complications. Two significant challenges are the vulnerabilities and failures that can occur and the increased dependence on these protections: vulnerability and failure and the worry of increased dependence.

First, mobile apps are not immune to vulnerabilities and failures. Despite developers' best efforts to implement robust security measures, there is always a risk of loopholes or flaws that can be exploited by malicious actors. Hackers and cybercriminals are constantly finding new ways to breach security systems and gain unauthorized access to sensitive user information. This vulnerability can result in data breaches, identity theft, and other detrimental consequences. It highlights the need for continuous monitoring, updates, and improvements in app security to stay ahead of emerging threats.

Second, as mobile apps become more integrated into our daily lives, individuals and businesses have become increasingly dependent on their functionalities. From banking and shopping to communication and entertainment, mobile apps have become an essential part of our routines. This reliance on technology protections can create a sense of complacency and trust, leading users to overlook potential risks or vulnerabilities. In some cases, individuals may unknowingly provide sensitive information or grant excessive permissions to apps, putting their privacy and security at risk. The consequences of a security breach or app failure can be significant, as it disrupts our ability to carry out crucial tasks and compromises the safety of our data.

To address these complications, developers and app providers must prioritize ongoing security assessments, regular updates, and prompt responses to identified vulnerabilities. User education and awareness campaigns can also play a vital role in helping individuals understand the potential risks associated with mobile apps and how to navigate them safely. Additionally, regulatory frameworks and industry standards can provide guidelines and best practices for app developers to ensure the implementation of robust security measures.

While technology protections on mobile apps have come a long way, it is essential to acknowledge the potential complications they bring. By remaining vigilant, and proactive, and

continuously improving security measures, we can strive to mitigate vulnerabilities, minimize failures, and maintain a healthy balance between technological advancements and user protection.

FIFO Application to the SDGs

Currently, in the United States, the drug and alcohol recovery system is archaic (“The Patriarchy of Alcoholics Anonymous.”). The system is largely attractive as a spiritual approach that teaches its participants to suppress their ego and accept that they have a substance abuse problem. This type of vulnerability and acceptance largely attracts white, christian, men. As this demographic historically has been in positions of privilege, the AA cycle is a pivotal moment in which they are no longer in control. Acknowledging that they are not in control does provoke a very emotional process that allows millions of AA participants a valuable road towards recovery.

However, while AA has transformed the lives of many, it is not without its critics (“The Patriarchy of Alcoholics Anonymous.”). Some argue that its patriarchal structure may not be suitable for everyone, particularly women. In fact, women make up the fastest-growing demographic becoming dependent on alcohol. As the spiritual approach was created by men, occasionally the message is less applicable to women. Instead, many argue that women and minorities—who have historically lacked the ability to be in positions of privilege—do not relate to AA’s messaging because it reinforces problematic societal biases. Therefore, some argue that AA does reinforce a patriarchal structure and suggests that women should not be required to blame themselves or conform to traditional gender roles in their recovery. Additionally, as the spiritual approach was created through a christian lens, occasionally the message is less applicable to non-Christians. As AA expects its participants to believe and work with Christian principles, it is difficult to be a non-Christian in the program. Meanwhile, these beliefs that AA is exclusive to white, christian, men are reinforced when hearing that AA attendance is lower among African American, Hispanic and young populations (Norton).

Regardless of criticism, it is important to note that AA has been proven effective in helping individuals achieve sobriety, and its approach may vary depending on individual experiences and preferences. Defenders of AA highlight its supportive and inclusive nature. They point to the countless success stories of individuals who credit the program with saving their lives. They argue that the fellowship, camaraderie, and mentorship found within the walls of AA provide a crucial support system that is often lacking in other avenues of recovery.

While AA has been proven effective in many cases, it is crucial to recognize that different individuals may require different approaches. It is through open dialogue, understanding, and a willingness to explore alternative methods that we can better support those seeking recovery from addiction. In the end, the nature of AA is a complex tapestry of hope, resilience, and community. Its principles continue to resonate with countless individuals, offering a path to sobriety and a renewed sense of purpose. Whether one embraces the traditional methods of AA or seeks alternative routes, what truly matters is finding a path to healing and reclaiming a life free from the clutches of addiction.

Therefore, in a treatment court system that encourages individuals in recovery to use the AA meetings to keep accountability towards recovery, it is valuable to advocate for other support groups that help guide individuals through recovery. In expanding the resources available for recovery can systemic changes be made. Moreover, partnering with technology, like MeetingMaker, can path the way for sustainable development.

MeetingMaker, as a tool, does not directly solve the problem of fixing recovery but rather enables a solution for corrections officers and case managers to allocate more time and attention to their caseload. It recognizes that the real work of recovery happens through the guidance and support provided by these professionals. By streamlining administrative tasks and automating certain processes, MeetingMaker enables a solution for corrections officers and case managers to spend more time working with their caseload, as that's where recovery happens. Tech enables change, but change happens through people. It is vital to understand that the MeetingMaker is commonly associated with tracking AA; however, AA is not the sole avenue for recovery (yet, many treatment court participants are mandated to track AA meetings).

Importantly, the essence of MeetingMaker lies in enabling corrections officers and case managers to allocate more time to work directly with their caseload, recognizing that genuine recovery occurs through human interaction and support.

Similarly, Wellfed Market doesn't single-handedly eradicate food waste, but rather, it empowers individuals to be mindful of consumption and actively participate in reducing waste. By leveraging technology to facilitate the sharing of surplus food within communities, Wellfed Market encourages people to reconsider their consumption habits and engage in sustainable practices. The app catalyzes change, emphasizing that real transformation occurs through people's actions and choices. It's a reminder that while technology can enable change, the true impact is driven by individuals making thoughtful decisions and fostering a collective commitment to reducing food waste.

In both cases, the role of technology is to facilitate and enable positive change, but the essence of transformation and progress lies in the hands and hearts of people. Whether it's supporting recovery or advocating for mindful consumption, the human element remains at the core of driving meaningful change in our communities and society.

CHAPTER 4: AFFECT

“The most important thing about technology is that it changes people.”
 - Jaron Lanier, Computer Scientist (Hamilton)

Intro to Discussion

Human beings are inherently very physiological creatures, and what we see has a profound impact on our actions and behaviors. Technology's pervasive presence in humanity's lives can shape our perceptions and ultimately influence our actions. Social media platforms, in particular, have become an integral part of modern society, creating micro-trends that impact our choices and behaviors. These micro-trends, driven by viral content, influencers, and algorithmic recommendations, shape our preferences and influence our decision-making, from the products we buy to the places we visit.

Disruptive technologies such as Uber, Lyft, Airbnb, VR BO, and Amazon have reimagined entire industries, transforming the way we vacation, mobilize, and purchase products. These platforms have revolutionized transportation, hospitality, and e-commerce, providing convenience, flexibility, and accessibility to consumers. The rise of the sharing economy has blurred the lines between traditional business models, empowering individuals to monetize their assets and creating new avenues for economic participation.

Moreover, technology has played a significant role in mobilizing populations and driving social change. Hashtag activism, a form of online activism that utilizes social media platforms to raise awareness and advocate for specific causes, has emerged as a powerful tool for social and political movements. Through hashtags, people can come together, share their stories, and organize protests and demonstrations to demand justice, equality, and systemic change. The collective power of social media has demonstrated its ability to amplify voices, challenge structures of power, and create a tangible impact in society.

However, it is essential to recognize that technology's influence is not without its challenges. The echo chambers created by algorithms and personalized content can lead to the reinforcement of existing beliefs and the spread of misinformation. The addictive nature of social media and its potential impact on mental health are also important considerations. As we navigate the digital landscape, it becomes crucial to evaluate the information we consume critically and actively shape our relationship with technology to ensure its positive influence on our lives.

Ultimately, though, technology's ability to affect individuals and society has the potential to significantly enhance the achievement of the United Nations' Sustainable Development Goals (SDGs). By leveraging its influence, technology can drive positive change and contribute to the advancement of sustainability on multiple fronts.

For example, technology's power to affect behavior and shape perceptions can be harnessed to promote sustainable practices and lifestyles. Through innovative applications, platforms, and devices, individuals can be encouraged to adopt environmentally conscious behaviors, such as reducing energy consumption, practicing responsible consumption, and promoting waste reduction. For example, smart home technology can monitor and optimize energy usage, while e-commerce platforms can enable consumers to make informed, sustainable choices by providing information on product origins, materials, and ecological footprints.

Additionally, technology's ability to connect people and facilitate collaboration can enhance efforts towards achieving the SDGs. Collaborative platforms and digital tools enable individuals,

organizations, and governments to share knowledge, resources, and best practices, fostering cross-sectoral partnerships and collective action. This interconnectedness creates opportunities for innovative solutions and accelerates progress in areas such as poverty alleviation, education, healthcare, and environmental conservation.

Furthermore, technology plays a crucial role in data collection, analysis, and monitoring, which are essential for sustainable development. The collection and analysis of large-scale data sets can provide valuable insights into social, economic, and environmental trends, enabling evidence-based decision-making and targeted interventions. By leveraging technology's data-driven capabilities, policymakers and stakeholders can monitor progress, identify gaps, and evaluate the impact of initiatives related to the SDGs, facilitating informed and effective strategies for sustainable development.

Moreover, technology's influence can extend to raising awareness and mobilizing populations to support sustainability causes. Social media platforms and digital campaigns have proven to be powerful tools in engaging and mobilizing individuals, amplifying messages, and fostering a sense of collective responsibility. Hashtag activism and digital advocacy campaigns have the potential to drive social change, inspire action, and mobilize communities around sustainability issues, ultimately contributing to the achievement of the SDGs.

In conclusion, technology's ability to affect individuals and society presents a tremendous opportunity to enhance the Sustainable Development Goals. By leveraging its influence to promote sustainable behaviors, foster collaboration, enable data-driven decision-making and mobilize populations, technology can play a transformative role in advancing sustainability. Embracing technology's capacity to affect and harness its potential for positive change can create a pathway toward a more sustainable and inclusive future for all.

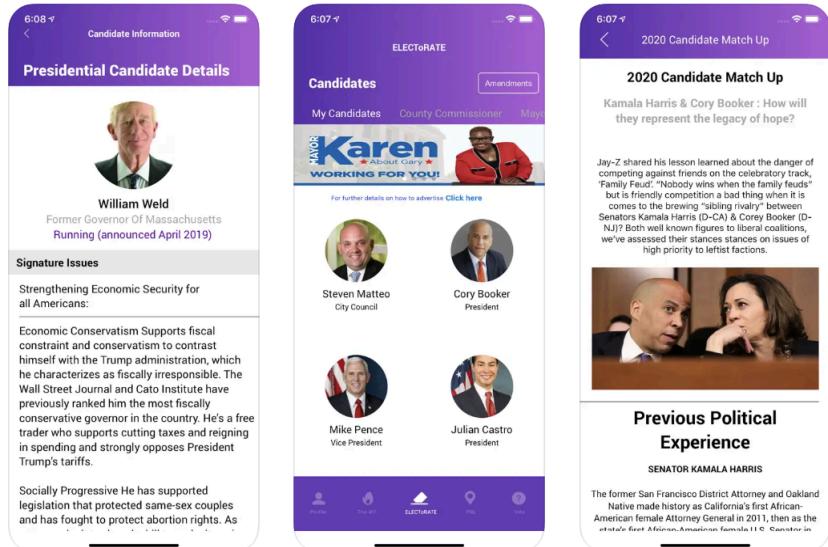
Case Study

In 2016, Politicking app co-founder, Wen-Kuni Céant, was on a walk with friends in Washington, D.C. discussing how the electoral college worked (Saunders). Céant was baffled when her friends were adamant that it was impossible for a presidential candidate to win an election without winning the popular vote. Yet, in American politics, Céant knew that with the electoral college, it was possible. She explained this to the friends she was walking with. At that moment, Céant thought about how to better educate her community on how politics function in the United States.

Later that year, Céant accepted a Fulbright scholarship to work in Senegal. As she worked, she continued to think about politics, international affairs, and how to communicate that knowledge with others. When she returned to Washington D.C. from her time abroad, she and her co-founder, Jordan Wilson, began to survey friends, family, and community members about political issues and their understanding of American politics. The results lead them to launch their app, Politicking, onto the App Store and Google Play Store on July 3, 2019 (just in time for the 2020 elections). Since that time, the app has worked to connect individuals to political issues and their political leaders through the app's interface and in-person events.

In order to promote younger Americans to get engaged with American politics, the app has six key features that enhance voter literacy for the app's users, or "Politickers". First, Politickers are able to create a virtual voter ID that will advise them as to what districts and precinct they are registered to based on their address. Second, Politickers are able to keep track of need to know issues based on a personalized news feed that caters to the user's interests. Third, the app provides general information about the voting process. Fourth, depending on where the user is voting, Politicking will allow users to view amendments

and referendums that will appear on Politicker's ballots and have them broken down in layman's terms. Fifth, Politickers are able to view all candidates that will be on their geo-targeted ballot. Sixth, from these ballots, Politickers are able to compare and contrast each candidate based on their campaign platform.



In today's fast-paced world, mobile applications have become a powerful tool for social change. The Politicking app, a sociopolitical mobile application dedicated to galvanizing the millennial vote, holds immense potential to address the United Nations' Sustainable Development Goals (or, the SDGs). By providing information about micro and macro politics, this app empowers users to cast an educated ballot, fostering a more informed and engaged electorate. Particularly, the Politicking app can contribute to various SDGs, including Quality Education (or, SDG 4), Industry, Innovation, and Infrastructure (or, SDG 9), Reduced Inequalities (or, SDG 10), Sustainable Cities and Communities (or, SDG 11), and Peace, Justice, and Strong Institutions (or, SDG 16). For information on how Politicking relates to the SDGs, Wen-Kuni Céant agreed to be interviewed for her perspective.

- Quality Education (or, SDG 4): The Politicking app plays a crucial role in promoting quality education by providing users with comprehensive information about political processes, policies, and candidates. Through easy-to-understand content and informative resources, the app demystifies the voting and political process. By enhancing voter literacy, the app empowers users to make informed choices, fostering a more knowledgeable and engaged citizenry.
- Industry, Innovation, and Infrastructure (or, SDG 9): The Politicking app exemplifies the potential of mobile apps to drive industry, innovation, and infrastructure. By leveraging cutting-edge technological advancements, the app seamlessly streamlines information related to elections, political events, and policy updates. Its user-friendly interface, real-time notifications, and interactive features attract a broad audience, enhancing civic participation and promoting innovation in the realm of political engagement.
- Reduced Inequalities (or, SDG 10): With its focus on galvanizing the millennial vote, the Politicking app contributes to reducing inequalities by bridging the gap between different socio-economic groups. By providing accessible and inclusive information, the app empowers individuals from all walks of life to engage in the political process. It helps eliminate barriers such as limited access to information or political bias, ensuring that everyone has an equal opportunity to participate in democracy.

- D. Sustainable Cities and Communities (or, SDG 11): The Politicking app fosters sustainable cities and communities by promoting civic engagement and local governance. By providing users with information about local elections, community initiatives, and political events, the app encourages citizens to actively participate in shaping their communities. Through its interactive features, the app facilitates future dialogue between citizens and policymakers, fostering a sense of ownership and collective responsibility toward building sustainable and inclusive cities.
- E. Peace, Justice, and Strong Institutions (or, SDG 16): The Politicking app contributes to SDG 16 by promoting peace, justice, and strong institutions through its emphasis on transparency and accountability. By providing unbiased information about candidates, policies, and political events, the app helps users make informed decisions, fostering a fair and just electoral process. Additionally, the app encourages users to actively engage with their elected representatives, holding them accountable for their actions and ensuring the integrity of democratic institutions.

The Politicking app represents the future of mobile apps in enhancing voter literacy and promoting civic engagement. By addressing the United Nations' Sustainable Development Goals, including Quality Education, Industry, Innovation, and Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, and Peace, Justice, and Strong Institutions, the app empowers users to become active participants in democracy. As mobile apps continue to evolve, the potential of apps like Politicking to affect positive change and create a more informed and engaged electorate is boundless.

Wellfed Market

Wellfed Market, a food-sharing platform, is not simply a solution to the problem of individuals wasting food; instead, it catalyzes for individuals to become more mindful of their consumption habits. While technology enables change, it is ultimately through people that true transformation occurs.

Wellfed Market empowers consumers to address the environmental impact of food waste, combat hunger, and foster connections within communities through food sharing. By creating an account on the platform, users gain access to a community where they can see, post, and share available food items. The core principle of Wellfed Market is that all food shared on the platform is free. However, users who claim food items have the opportunity to donate back to the original poster, thereby facilitating a process to recover some of the financial losses associated with food waste.

This unique approach to food sharing highlights an important distinction - Wellfed Market does not solely solve the problem of food waste by redistributing excess food items. Instead, it acts as a medium to raise awareness about the issue and encourage individuals to be more conscious of their consumption patterns. By participating in Wellfed Market, users become active participants in reducing food waste and promoting sustainable practices. They gain firsthand experience in the value of food and the importance of minimizing waste.

Technology, in this case, serves as an enabler, providing a platform for individuals to connect, share resources, and contribute to a more sustainable food system. However, it is the users of Wellfed Market who drive the change. Through their active involvement and mindful consumption choices, they embody the transformation that is needed to address the larger issue of food waste.

It is crucial to recognize that technological solutions alone cannot solve complex societal problems. Wellfed Market acknowledges this by emphasizing that change happens through people. By encouraging individuals to be mindful of their consumption habits and fostering a sense of responsibility,

Wellfed Market aims to create a community-driven movement towards a more localized and sustainable food system.

Therefore, serving as an enabler, Wellfed Market's innovative approach to food sharing and community empowerment aligns with several United Nations Sustainable Development Goals (or, the SDGs), contributing to the global agenda for sustainable development.

- A. Zero Hunger (or, SDG 2): Wellfed Market's food-sharing platform directly contributes to the goal of achieving zero hunger by enabling the redistribution of surplus food to those in need. By mitigating food waste and alleviating hunger, the platform supports efforts to ensure food security and promote sustainable agriculture.
- B. Good Health and Well-being (or, SDG 3): Access to nutritious food is essential for promoting good health and well-being. Wellfed Market's community-driven approach not only addresses food accessibility but also fosters a sense of communal support, contributing to improved well-being and social cohesion.
- C. Industry, Innovation, and Infrastructure (or, SDG 9): Wellfed Market represents an innovative approach to addressing food waste and promoting sustainable consumption. By leveraging technology and community engagement, the platform contributes to the advancement of sustainable infrastructure and innovation within the food industry.
- D. Reduced Inequalities (or, SDG 10): The inclusive nature of Wellfed Market's food-sharing platform promotes equality and reduces disparities in access to food resources. It provides a space for individuals to share and receive food items, fostering a sense of community and solidarity while addressing inequalities related to food access.
- E. Sustainable Cities and Communities (or, SDG 11): Wellfed Market's localized approach to food sharing aligns to create sustainable and inclusive urban communities. By connecting individuals within localities and promoting responsible consumption, the platform contributes to building resilient and sustainable communities.
- F. Responsible Consumption and Production (or, SDG 12): Wellfed Market actively promotes responsible consumption by facilitating the sharing of surplus food items and encouraging users to be mindful of their consumption habits. This aligns to promote sustainable consumption and production patterns.
- G. Climate Action (or, SDG 13): Addressing food waste is integral to climate action, as it reduces greenhouse gas emissions and environmental impact. Wellfed Market's efforts to mitigate food waste contribute to the broader goal of combating climate change and its impacts.
- H. Life on Land (or, SDG 15): By reducing food waste and promoting responsible consumption, Wellfed Market supports efforts to sustainably manage land resources and biodiversity, aligning to protect terrestrial ecosystems.

In conclusion, Wellfed Market's food-sharing platform not only addresses immediate food-related challenges but also aligns with multiple SDGs, contributing to broader efforts for sustainable development, community resilience, and social equity. Through its innovative approach and community-driven ethos, Wellfed Market exemplifies the potential of grassroots initiatives to make meaningful contributions to the global sustainability agenda. Additionally, Wellfed Market goes beyond solving the problem of food waste by instilling in individuals the importance of mindful consumption. While technology plays a pivotal role in enabling the platform, it is the active participation and conscious choices of users that bring about meaningful change. By integrating technology with human agency,

Wellfed Market empowers individuals to make a positive impact on the environment, combat hunger, and build stronger communities through food sharing.

Complications?

The impact of technology on human behavior is a complex and evolving field of study, with ongoing research exploring the effects of digital technology on mental health, social interactions, and cognitive abilities (Hoehe, Margaret R, and Thibaut, Florence). Our interactions with technology shape our thoughts, emotions, and actions in ways that we may not always realize. The constant exposure to social media, online content, and virtual environments molds our perceptions, preferences, and decision-making processes. Whether it is through targeted advertisements, curated news feeds, or addictive gaming experiences, technology has a profound impact on our behaviors. It affects our communication patterns, relationships, and even our mental well-being. As technology continues to advance and integrate further into our daily lives, it becomes increasingly important to critically examine its influence and make conscious choices about how we engage with it. By understanding the power of technology to shape behavior, we can harness it for positive outcomes while mitigating its potentially negative effects.

FIFO Application to the SDGs

Technology serves as a powerful catalyst for change, enabling innovative solutions to address pressing societal issues (Faster Capital). However, it is crucial to recognize that change ultimately happens through people. While technology provides the tools and resources, it is the individuals and communities who drive positive social impact.

For example, while apps like Politicking can help enhance voter literacy, it is up to the user on whether or not they show up to the voting polls and cast their votes. Here, technology can only go so far in promoting social impact and elevating the UN's SDGs for it is up to the user to use the tools in their possession to drive sustainability.

Alternatively, apps like Wellfed Market have the ability to provoke a user's perception of resources. For example, if the app challenges a user from considering excess food as potential to serve as an additional meal and not something that is waste, hundreds of tonnes of food will be diverted from landfills and contribute to rising methane emissions and therefore negatively impacting the UN's SDGs.

Therefore, apps have the potential to influence and affect their users to show up for causes they might have not otherwise shown up for and participated in before. Moreover, mobile apps like Politicking or Wellfed Market allow users to engage directly with the UN's SDGs in a capability they might not have done before, thus encouraging sustainability through innovation.

While technology plays a vital role in supporting the achievement of the SDGs by facilitating access to education, healthcare, and clean energy. It empowers individuals to connect, collaborate, and mobilize for change. Nevertheless, it is the collective efforts of people from all walks of life, including policymakers, activists, businesses, and citizens, that drive progress towards a more sustainable and equitable future. Technology is a powerful enabler, but it is the passion, determination, and actions of individuals that truly make a positive impact on society and contribute to the realization of the SDGs.

CONCLUSION

Concluding Remarks on Sustainability, Technology, and Innovation

Just as what is traditionally taught in both culinary schools and computer science classrooms around the world, life is complex, but integrated and interconnected. In both the computer science and culinary school definitions of FIFO, whatever object is introduced into a system will be the first thing used, implemented, or solved; which does change the functionality or conditions within the system. When exhausted, the object is removed from the system and the next object enters the system. The circular process in which an object is entered, used, and exhausted is a common theme in the technological world. Thanks to innovation, the technical world exists in this circular system. Tech founders even acknowledge this circular system and contribute it to their larger success. For example, the CEO and Co-founder of Sun Microsystems, Sam McNealy, once said: “Technology has the shelf life of a banana.” (Grossman) Here, the CS definition of FIFO is validated by a tech executive: just as quickly as food can become obsolete, as can technology.

McNealy goes on to state: “By the time you buy it, implement it, and train people on it, it’s obsolete. The right thing to do is to share IP. Rather than litigate and protect our IP, we’ve decided[ed] to innovate and share it.” (Grossman) Here, the founder shares a growing perspective shared by so many developers; or, that innovative companies and organizations are more concerned with moving quickly and putting out their technology to the public than they are with the legality of their product or even the patent and IP protection they could use to establish exclusivity on the market. A figurehead for this movement, Elon Musk, once famously said “Patents are for the weak.” (AsiaIP) Meanwhile, Mark Zuckerberg built Facebook with the mission to “Move fast and break things.” (Harvard Business Review) These perspectives shared by top tech entrepreneurs like Musk and Zuckerberg fundamentally shaped the culture of Silicon Valley and what it means to be an innovator in the tech space. Yet, these comments bring into question the validity of achieving sustainability in an environment that strains resources in the pursuit of innovation. How sustainable is it to “move fast and break things”? The answer: it is not sustainable. Yet, the fundamental circulator nature of technology can bring innovation closer to implementing sustainable practices. As discussed, technology offers an advantageous solution for achieving sustainability through its inherent ability to connect, collect, protect, and affect. Meanwhile, mobile apps offer an advantageous solution for achieving sustainability through their ability to be in a user’s pocket and collecting, connecting, protecting, and affecting change. Moreover, technology can build upon itself to grow larger and more powerful and have a growing significance on enhancing sustainability efforts.

However, obtaining sustainability is not circular. Instead, “circularity and sustainability aren’t interchangeable terms, but they are related.” (Inachainge) While ultimately, sustainability is the end goal, circularity is a means to achieve sustainability. Because circularity prioritizes “reducing waste as much as possible while keeping a product’s value intact for a longer period of time,” circularity decreases the number of goods needed for consumption and therefore decreases strain on environmental resources. Therefore, to achieve sustainability, it is vital to implement responsible circular practices to support longevity. As technology largely operates on a circular plane, it can be used to achieve such sustainability.

Again, as stressed in this thesis, tech is influential (remember: connect, collect, protect, and affect). Yet, as Albert Einstein once said: “The human spirit must prevail over technology.” (Bhaskar). To ensure that sustainable initiatives are being implemented and practiced—particularly in addressing the UN’s SDGs—it is imperative to be aware of technology development to ensure the ethical implications on environmental, social, and economic well-being.

Therefore, dear reader, regardless of your role in the technological process, you are a changemaker and have the responsibility to ensure that the technology that is being implemented is done so in sustainability.

Concluding Remarks to My Reader

“Do all the good you can,
by all the means you can,
in all the ways you can,
in all the places you can,
at all the times you can,
to all the people you can,
as long as ever you can.”

(Wesley)

// Policymaker

If you are a policymaker engaging with technology and sustainable development, it is your responsibility to promote technology at all levels to promote and grow opportunities for social impact innovation. Female computer science legend, Margaret Hamilton, once said: “As a society, we need to invest more in STEM education to prepare the next generation for the challenges ahead.” (Bookey) As one of the first computer programmers, and a largely influential researcher in sending the first humans to the moon through the NASA Apollo mission, Hamilton is right in advocating for educating users on technology. With knowledge comes power; having the ability to understand the importance and implications of technology can allow the public to make behavioral changes. For example, as seen with the app Natural Cycles; having the ability to understand one’s body can lead to action.

Meanwhile, policymakers are instrumental in the application and approval of technology to exist and operate. Hamilton once said, “Technology is a tool, but its impact depends on how we use it for the betterment of society.” (Bookey) While regulations and enforcement are valuable to ensure public safety, occasionally such regulations disincentivize progress and innovation. For example, in DC discouraging the use of the Empower app, fewer users will be on the app, therefore reducing the amount of users on the app (and inevitably reducing the contributions that the app makes towards the UN’s SDGs).

// Developer

If you are a developer, it is your responsibility to build technology that contributes to a more sustainable planet. As a female ocean conservationist legend, Dr. Sylvia Earl, once said: “Everyone has power. But it doesn’t help if you don’t use it.” (BrainyQuote) With knowledge comes responsibility; having the ability to build technology and share it with others is a privilege. Therefore, it is paramount to build technology that is ethical and sustainable to the communities the technology engages with. As Margaret Hamilton also once said: “Every code we write has the potential to change the world, for better or worse.” (Bookey) Therefore, if a developer can engage with the United Nations’ SDGs in their work, the goals will only become more legitimate in the eyes of the public, encouraging more users to engage with sustainability issues.

Moreover, as the female tech founder of Tinder and Bumble, Whitney Wolfe Herd, once said: “The best way to predict the future is to create it.” (Feliciano) If, collectively, both the public and private sectors work to enhance the UN’s SDGs in their work, it is more likely that the SDGs will succeed in their 17 unique visions to address global sustainable developmental concerns. Even if this thesis largely discusses how developed nations can implement technology to enhance sustainability concerns in their own communities, the conversations here open the potential for discussion on how technology can be

implemented by developing nations to achieve global sustainable development through technology, on-the-ground initiatives, and programming.

// Users

If you are a technology user, it is your responsibility to engage with ethical and sustainable technology. As female environmental conservationist, Dr. Jane Goodall, once said: “What you do makes a difference, and you have to decide what kind of difference you want to make.” (Goodall, Jane) Technology companies—especially for-profit and private companies, like the companies that built the technology discussed in this thesis—respond to consumer behavior. If enough of its users want to see a particular feature or initiative from that technology, that company will see that action through. Meanwhile, if that company declines to innovate and does not implement what its users ask for, that company will see a loss in its customer base as its customers will look elsewhere to meet their needs. The public holds a tremendous amount of responsibility, as many decisions are made with these users in mind. Therefore, users have the ability to contribute to technology that promotes social impact initiatives and especially promotes the United Nations SDGs.

// To my readers

If you are a reader who believes that they do not fit into the traditional role of a changemaker as laid out—or, being a policymaker, a developer, or a user of technology—this conversation will redirect to Margaret Hamilton's quote, “Dream big, because you never know where your passion and hard work might lead you.” (Bookey) Ambition and perseverance carry a tremendous amount of weight in this life. Regardless of if one finds value in the Sustainable Development Goals as outlined by the United Nations or fits into the traditional role of a changemaker, I hope that you chase the passion to what lights your soul on fire. For me, it's building technology that promotes sustainability and has a social impact. I hope to continue building apps like CalcuSaver and Wellfed Market that enhance the collective effort that groups around the world have been taking to address the SDGs.

Future Work

// Where I Hope my Research Contributes To in the Future:

I hope this thesis achieves two significant goals. First, I hope this thesis encourages individuals (policymakers, developers, users, and my readers) to consider the implications of the technology that they use and create. As outlined above, there are many key players in how technology is researched and developed; from user to developer, all are instrumental in integrating technology into society. Therefore, I hope this thesis leads to more discussions in academic, professional, and social spaces on how significant these policymakers, developers, users, and my readers are integrating technology solutions to achieve sustainability.

Second, while it is natural to see the pending (and real) threats of climate changes as sources of extreme anxiety. Or, the occasionally scientific-fiction/fantasy type of threats when discussing the future of machine learning, AI, and robotic technology as sources of extreme anxiety as sources of extreme anxiety. I hope this thesis alleviates some fears. Technology is a tool to advance society; it is a tool to solve a problem by bringing something from point A to point B. I wish for this research to lead to more discussions on the optimism technology has the potential to bring into solving sustainability issues.

// Where I Will Be Contributing in the Future:

This fall, I will be enrolling at the University of Colorado, Boulder's College of Engineering & Applied Science, where I will be pursuing a Masters in Creative Technology and Design (on a Social Impact track). The program is housed under CU Boulder's ATLAS Institute, “an interdisciplinary institute for radical creativity and invention. We transform ingenious ideas into reality through research,

experimentation and critical thinking.” (“The ATLAS Institute.”) I am so excited to continue my interdisciplinary education, where I will continue to build off my Georgetown education.

Through my studies and being immersed in the innovative Greater Denver area, I will continue to build technology that contributes to a more sustainable future for all. Using the United Nations’ SDGs as my North Star, I will prioritize research and development that creates invaluable impact to both developed and developing nations.

As I look towards my future, I hope for a life where I continue to contribute to sustainability efforts by both engaging with existing sustainable solutions and offering my own sustainable practices. Fundamentally, I want to sustain the resources I enjoy for the next generations, from skiing to rowing to accessibility to sustainable food systems. I do hope my actions do inspire others as I have been profoundly impacted and continuously inspired by so many others who have come before me.

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