ECOCYCLE

AI INTEGRATED WASTE MANAGEMENT SYSTEM

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Cover Sheet for Team Final Project Report
(22LLP008 - Collaborative Project)

Students must complete this cover sheet and attach it to their final project report. Students are asked to record their team membership and substantive contribution(s) to the report below:

Student Name	Student Number	Contribution to Project Report
Manjuri Biswas	F217429	- Secondary research and developed the final concept, key stakeholders, and our key value propositions - Developed the framework and initial digital toolkit - Designed the questionnaire for assessment - User journey chart - PowerPoint production and scripts
Meng Hai	F232981	- Research and case study - System blueprint development - Slide integration
Anran Luo	F139239	- Research and concept development - Methodology: Double Diamond Model - Methods: User Journey Map and Service Blueprint - All Prototype design (hi-fi) - Handbook design (final version)

		- PowerPoint production
Yihui Yu	F215185	- Research and concept development - Timeline set-up - Development of System Flowchart & Service Blueprint - Team Report: Method & Methodology- Timeline, Double Diamond, Five Elements of User Experience, System Flowchart - PowerPoint production - Pitch presentation
Megha Sharma	F235873	- Research and insightful idea generation - Presenting the report - Helping with the questionnaire and review - Conclusion
Haotian YIN	F218767	- Research and concept development - Timeline set-up - User Journey Map and Service Blueprint - All Prototype design (hi-fi) - Team report writing: Introduction & Summary - PowerPoint production

Shoucheng Jin	F139467	- Research and case studies - Value proposition development - Principle assessment questionnaire - Literature review

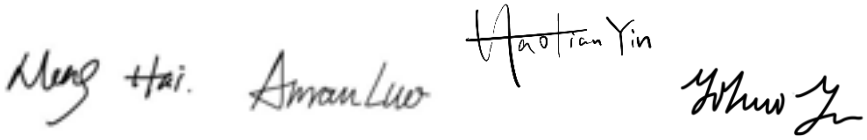
Declaration

By making this submission we confirm that the attached coursework is our own work and that anything taken from or based upon the work of others – or previous work of group members – has its source clearly and explicitly cited; failure to do so may constitute Academic Misconduct.

Submission Date:

Word Count: approx. 5000

Signatures:



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Introduction & Summary

In the United Kingdom, the recycling system is onerous and sorting household waste is difficult, UK households generate 27 million tons of waste in 2020, up 2.1% on 2019 (The Guardian, 2022). Almost 45% of waste generated at home is recycled, which means most of it goes into the improper waste stream (Morgan, 2021). Originating from different areas of London, we encounter similar problems. Most of the time, the receptacles are either overloaded or improperly separated. When trash cans are overflowing, individuals begin to defecate in the vicinity. And from 2015 to 2020, the entire UK household trash recycling rate remained below 50% and kept declining beyond that year (GOV.UK, 2022). The reasons for the growing problem of household waste, in addition to the development of a consumerised society, are more to do with the current waste recycling system itself: for example, the lack of adequate collection and disposal infrastructure and the improper collection, transport and disposal of waste.

Given the recent rapid development of artificial intelligence, it is becoming possible to use the analytical power of artificial intelligence to deal with everyday chores. Utilizing AI (Artificial Intelligence), we intend to resolve the issue of waste management. To create a more effective

system that is sustainable. It is an all-inclusive, accessible, and environmentally friendly solution to the problem. As the brief suggests, "to do good" - ours will fall under the category of value generation by giving it back to nature. By introducing a sustainable way of waste management and circular economy, we will be able to reduce the amount of waste generated by a household and keep carbon emissions under control.

Principal stakeholders will include waste management companies, the council currently responsible for waste management, electricity boards, community members, and charitable organizations. The SDGs that will be covered in our project are - seventh, which focuses on affordable and clean energy; Nineth, which seeks to develop resilient infrastructure, promote sustainable industrialization, and cultivate innovation; and eleventh, which focuses on making cities inclusive, secure, resilient, and sustainable. Lastly, the twelfth principle ensures sustainable consumption and production patterns.

Literature Review – Case Study & Findings

The global energy system is facing and undergoing a transformation due to the global depletion of fossil fuel resources and climate change influenced by carbon emissions, as well as the changes in technology and the demands of social development, such as increased demand and economies of scale due to population expansion. The existing dominant fossil fuel-based centralized networked energy systems are no longer able to meet the needs of societies and populations due to the depletion of fossil fuels, the geopolitical vulnerability of energy facilities and the effects of climate change (Bouffard & Kirschen, 2008). The development of new energy sources and the transformation of new energy systems are increasingly on the agenda of countries.

The current energy system is at a critical juncture of dramatic technological and institutional change, and while centralized energy systems will play a key role in the coming decades, the current trend in all countries is towards low-carbon, cooperative and decentralized systems ('A World in Transition'. 2016). The ongoing development of new energy sources and the transformation of new energy systems requires, to a certain extent, the participation of individual households and communities to close the loop in a sustainable way (Van Oost et al., 2009).

The transition from centralized to decentralized energy systems is a sustainable and innovative social trend. In decentralized energy systems, individual households and communities are given

a new production and consumption role (Koirala et al., 2018), and in their participation, the personal and community waste generated contributes to technological improvements in the development of recycling of corresponding materials and provides important feedback to technology producers (Schot et al., 2016), such as the recent development of AI intelligent waste sorting systems and data analysis systems. In this way, public acceptance of new energy sources can be increased, and the development and innovation of new energy technologies can be decentralized to the community and individual perspective.

Case Study

Case studies allow researchers to explore individuals or organizations that use complex interventions, relationships, and communities to support the structuring and reconstruction of various phenomena (Yin, 2003) and are an excellent opportunity to gain great insight into cases (Baxter & Jack, 2015). For the theme of AI involvement in waste management, the team analyzed, for example, IKEA's food waste management, the WASTE ROBOTICS sorting robot, the Binary Brains app for optimizing the purchasing and recycling process and Greyparrot's waste management system (Refer to Appendix for details of more cases). The most informative of these are the cases of IKEA and Greyparrot.

IKEA UK&IE aims to reduce food waste by 50% by the end of August 2020, to bring sustainability to life and to inspire more people to change their behavior when it comes to food waste. AI has a lot to offer in helping organizations with product design, customer support and other key business aspects (Jordi Canals & Franz Heukamp, 2020). So, in 2017, IKEA partnered with WINNOW VISION to bring AI into the commercial kitchen of the future (Picture 1). The designers combined cameras, smart scales and the same machine-learning technology found in self-driving cars. In this food waste management system, AI's visualization toolkit provides a direct visual representation of low-level information (Choo & Liu, 2018), allowing for better waste management in the back of the house and management.

(Picture 1: IKEA & WINNOW's partnership programme)

(Source: https://blog.winnowsolutions.com/ikea-winnow-halve-their-global-food-waste)

Another successful example is the AI waste management system created by Greyparrot (Picture 2), which aims to address the global waste crisis. As the leading AI waste analytics platform for the circular economy, it digitizes the waste management industry, using innovative artificial intelligence sorting to provide transparency in waste recycling. As a platform, Greyparrot has access to real-time and historical data at the minute-by-minute level, generates recycling reports and analyses them, estimates quality, customizes alerts, customizes dashboards and more. It is used in a much wider scenario than WINNOW and this platform can be installed in most manufacturing plants to complete sorting. It has been extremely useful in waste regulation.

(Picture 2: Greyparrot waste management recycling analysis platform)

(Sourse: https://www.greyparrot.ai/product)

These success stories have all contributed in varying degrees to the promotion of the circular economy, but at the same time, the addition of AI has led to many problems, such as job loss and thus staff uncertainty, and conflicts between data analysis and user privacy protection when recycling (Wilts et al., 2021). and demonstrate that AI technology can revolutionize the process of solid waste management (Ihsanullah et al., 2022). Furthermore, in most cases, the services provided by the process mostly stop waste recovery and presentation of data. This suggests that the group could extend more processes backwards, e.g., how to recycle and the recycling of the results produced after recycling. In this way creating a better and more circular economy-compliant waste management recycling system.

Some of the energy recycling aspects of the energy system examples above have helped to inform the energy systems constructed in this paper, addressing some of the individual technologies and issues associated with implementation. In the following ECO Energy System, a comprehensive and integrated approach to local community energy recovery systems is

described, assessing the role of the household and community in the existing system architecture and the potential impact of the energy recovery process.

Concept

According to Don Norman, director of The Design Lab at University of California, San Diego, and author (Norman, 2023), “Humanity-centered design represents the ultimate challenge for designers to help people improve their lives. Where “human-centered” puts a face to a user, “humanity-centered” expands this view far beyond to the societal level of world populations who face hordes of highly complex and interrelated issues that are most often tangled up in large, sophisticated, “human-caused” systems.” Through our key concept we have tried to follow a humanity-centered design approach. Our system is to integrate AI waste management system and create a more holistic approach towards sustainable consumption of energy and managing waste. Our principles are being inclusive, accessible, innovative, conscious, collaborative, and supporting ethical practices. It is a concept that comprises optimizing rubbish collection, sorting, and recycling operations with the use of contemporary technology. The objective is to reduce the amount of rubbish that ends up in landfills while also ensuring that recyclable items are correctly sorted and processed.

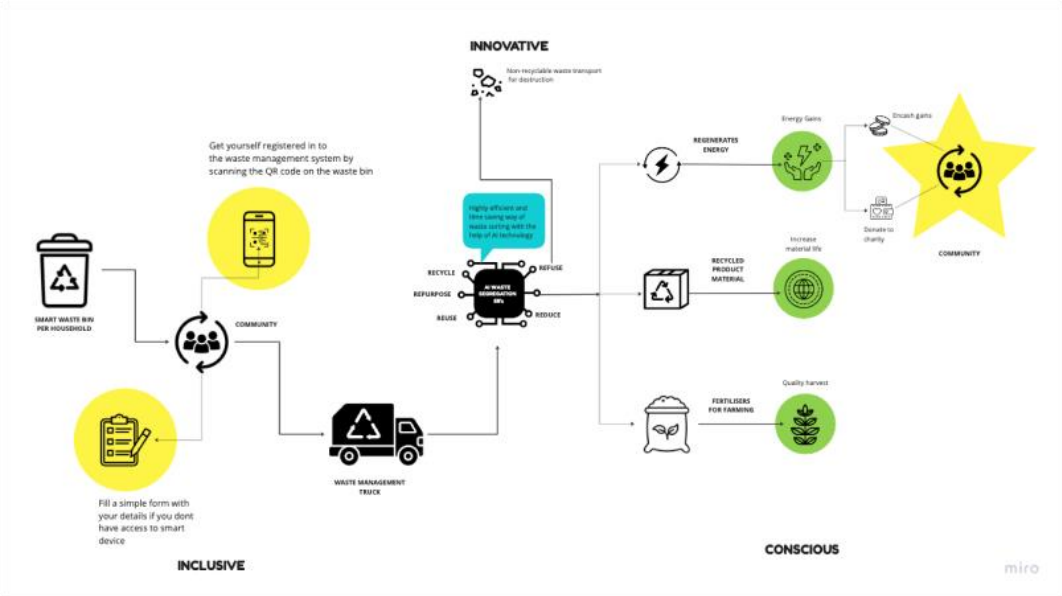
The system will use sensors and cameras to monitor garbage pickup containers and equipment, allowing for real-time data collection on the types and amounts of waste generated in various locations. This data may be examined using AI algorithms to improve collection routes and schedules, reducing the amount of fuel and time required for garbage pickup. The AI system (*Artificial Intelligence for Recycling: AMP Robotics*, n.d.) can also distinguish recyclable materials and classify them for efficient processing using machine learning algorithms. This will help to reduce contamination in recycling streams and ensure that materials are properly processed and may be reused in the manufacturing process. Furthermore, the system can track a material's life cycle from manufacturing through disposal, allowing corporations and individuals to make more ecologically conscious decisions. The collected data may also be used to discover trends and patterns, allowing for the development of customized educational initiatives to encourage garbage reduction and recycling.

AI waste management systems can help develop the circular economy (Rodrigues & Pahwa, 2023), which is a business model that attempts to keep resources in use for as long as feasible while minimizing waste. The circular economy highlights the utilization of renewable resources, material recycling, and waste reduction through innovation and innovative corporate models. AI can help the shift to a circular economy by optimizing garbage collection, sorting, and processing,

minimizing waste transported to landfills (Ibm, n.d.) and incinerators. AI may also be used to monitor trash movements and locate material reuse and recycling alternatives. By integrating the power of AI with the values of the circular economy, we can construct a sustainable waste management system that promotes resource efficiency, economic growth, and environmental protection (*Circular Economy Introduction*, n.d.).

The key partners in the system (Ecocycle) will be council boards, communities, charities, electricity board along with waste management companies. We are focused on covering 4 SDGs (7,9,11 & 12) (*THE 17 GOALS | Sustainable Development*, n.d.) that are related to community, innovation, infrastructure, and conscious consumption of energy. In London, every household has more than two dustbins and an assortment of waste is cumbersome, which also requires a lot of physical energy and manual labor. The process of waste segregation manually is risky and not highly efficient. Through our system (Ecocycle) we are aiming to reduce the number of bins per household and replace them with a smart recycling bin. Sensors in these bins monitor the kind and amount of trash being tossed, allowing garbage collectors to enhance collection routes and timetables. Smart bins will also autonomously filter trash, decreasing the need for manual labor and increasing recycling efficiency. We are not reducing job opportunities but trying to replace the existing job profiles and creating newer ones.

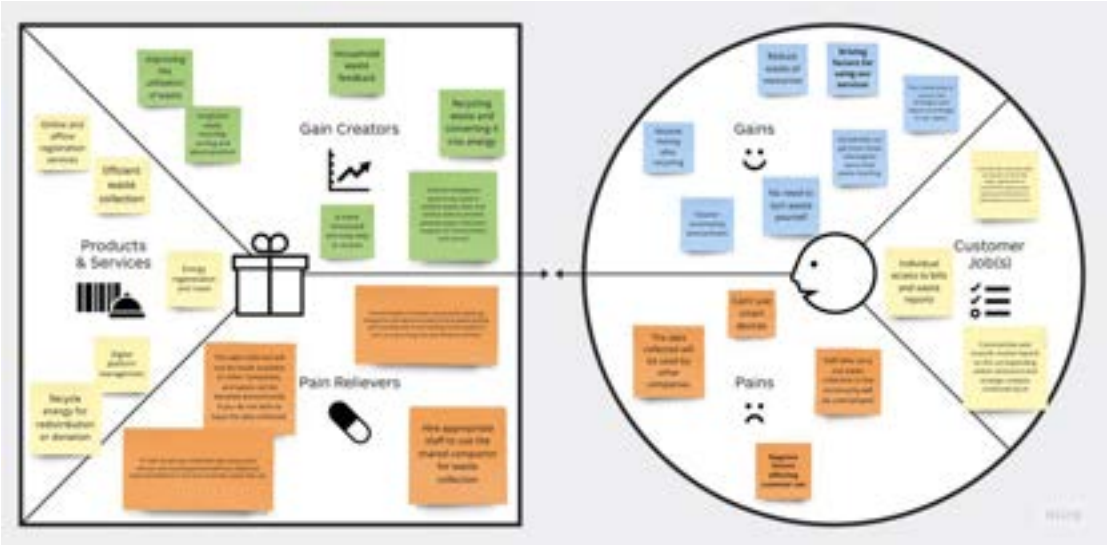
This smart bin will have a QR code, once scanned through phone/tab, it will directly take them to App Store/Play Store to download the app and get themselves registered to our system (Ecocycle). Add in your basic details about name, phone number and address. Customers can choose between getting energy gains as points and later enchasing them or can also choose to donate their energy gains if they do not want to get details about the system. These points will then be anonymously donated to the charity body. Within the app customers will have an overview about their kinds of waste generated per household, have information about how their area is maintaining a waste recycling system. They will have transparency about what amount of their waste was converted into energy gains, which will reflect as points on the app. People who do not have access to smart phones or are not handy with technology can get themselves registered to our system (Ecocycle) by filling in a simple form at the nearest office or with council. The customers need to provide their name, phone number, address, and electricity bill number. The energy gains (points) from the recycled waste will be deducted from their energy bills.



Picture 3: System flowchart, (Loughborough University, 2023)

The outcome of the concept will be in two parts – the user application for customers and a digital toolkit which will help other waste management companies assess and analyze their system.

Our value propositions



Picture 4: Value proposition, (Loughborough University, 2023)

- **Increased Efficiency:** AI algorithms will optimize collection routes, schedules, and resource allocation, which will help waste management companies reduce costs and improve the efficiency of their operations**.**

- **Improved Recycling:** AI can help identify recyclable materials and sort them more effectively, reducing waste and increasing the amount of material that can be recycled.

- **Environmental Sustainability:** By reducing waste and increasing recycling rates, AI waste management companies will help reduce environmental impact and promote sustainability.

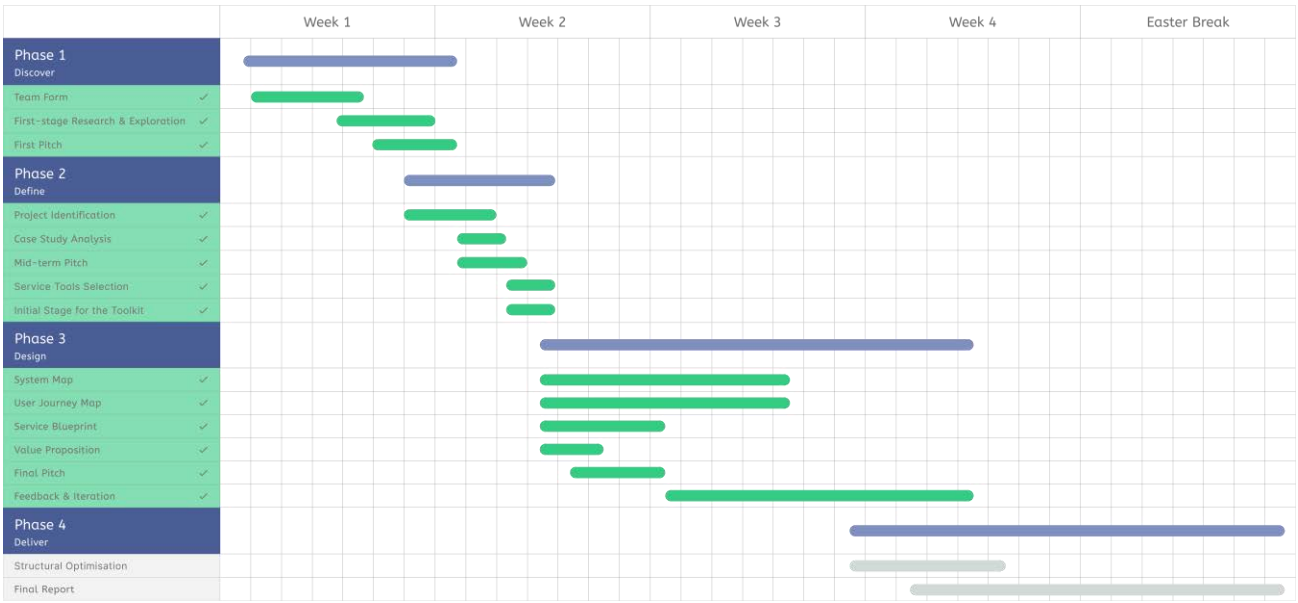
- **Better Customer Service:** AI can help waste management companies respond to customer inquiries and service requests more quickly and accurately, improving customer satisfaction.

- **Data-Driven Insights:** Through AI waste management, the system will gather and analyze data on waste generation and disposal, providing valuable insights that can inform future decisions and strategies. The data collected will not be visible to another company.

- **New Job Opportunity:** Hire appropriate staff to use the shared compactor for waste collection and replacing dangerous and laborious tasks by increasing positions such as supervision and operation etc.

Method & Methodology

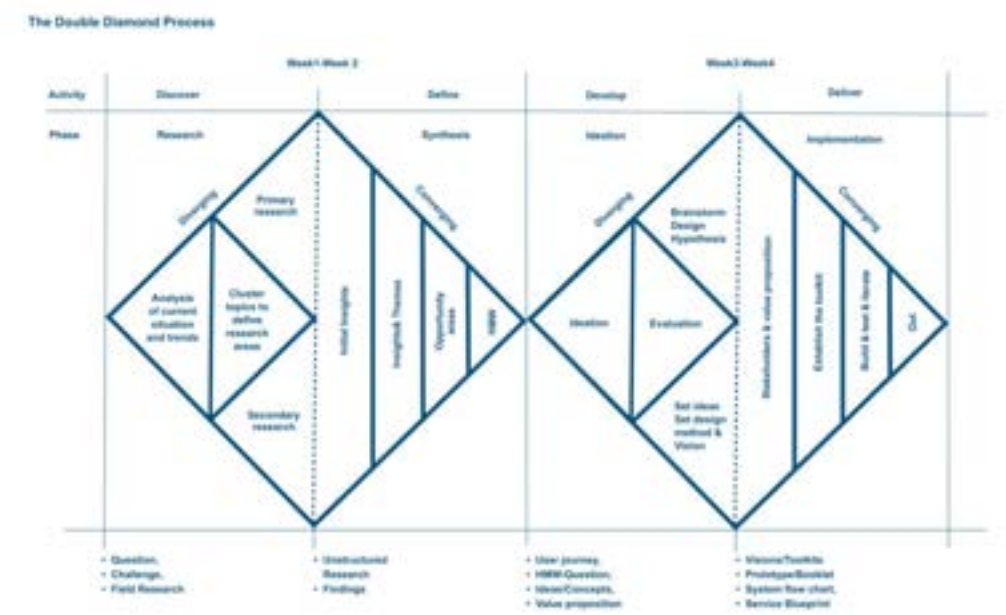
Timeline



Picture 5: Timeline Picture, (Loughborough University, 2023)

Using the Four Phases of the Double Diamond Model - Discover, Define, Develop and Deliver as a guideline, our team builds a timeline for project management. Each phase is divided into multiple tasks and the tasks are all allocated clearly to each team member with a specified deadline to help improve efficiency and convenience of project management.

Double Diamond

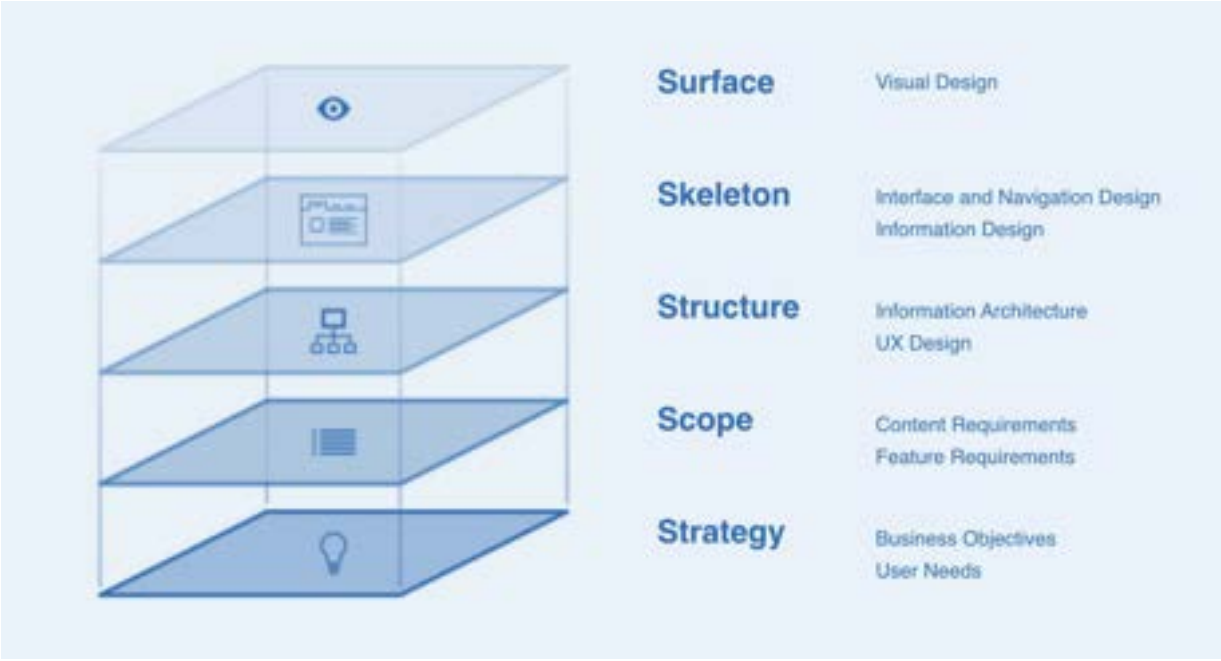


Picture 6: Double Diamond Process, (Loughborough University, 2023)

Along with the timeline, our project also uses the Double Diamond Model and its four key phases, including Discover, Define, Develop and Deliver, for the design process.

In the Discover phase, our team uses diverging research methods to better explore service trends and define the research areas. In the Define phase, we utilize the insights that were gained from user research to develop a clearer problem statement and remain consistent with the design brief, using the method of secondary research and unstructured scope research. In the Develop phase, we start diverging again and put emphasis on ideation and evaluation. We create user journey map, system flowchart and service blueprint at this stage to better understand the user's need and pain points related to waste recycling. A low-fidelity prototype and toolkit of the digital services are then produced based on these three maps. Finally, in the Deliver phase, we iterate the prototype and the toolkit based on user testing feedback. We specify our stakeholders and build a value proposition on top of that as well.

Five Elements of User Experience



Picture 7: Garrett, J. J. (2011). *The elements of user experience user-centered design for the web and beyond*. New Riders.

To improve the user experience of our stakeholders, we use the theory of the five elements of UX design created by designer Jesse James Garrett (Garrett, 2011). The five elements are strategy, scope, structure, skeleton, and surface.

Strategy lays a solid foundation for the rest of the elements as it is the heart of any product. Our project first defines the business objective as to use artificial intelligence (AI) to help solve the waste recycling and management problem in UK residential areas, and concludes user need as hoping to better recycle household wastes as well as having a better management method for waste disposal based on primary and secondary research.

After that, our team creates a user journey map, a system flowchart, and a service blueprint to help clarify the rest four layers.

Within the Scope layer, the team illustrates feature requirements which shows the main functions of our product (using AI for waste management, improving garbage recycling rate through AI waste segregation, and rewarding families with high recycling rates, etc.), and content requirements which includes all written and visual information that we want to include showing people how they are doing with waste recycling, achieving information transparency by showing the entire system process, providing part of the data to the community and government to help understand the garbage collection situation, etc.).

For the Structure layer, our team uses the user journey to examine if the information architecture and user experience design of our product is reasonable or not and to ensure a logical user experience which responds to user requests in the easiest way.

The last two layers, which are Skeleton and Surface, focus more on detailed design including interface and navigation design, information design and visual design. Based on previous layers, the team creates a practical design of prototype at this stage and utilizes user testing for better iteration.

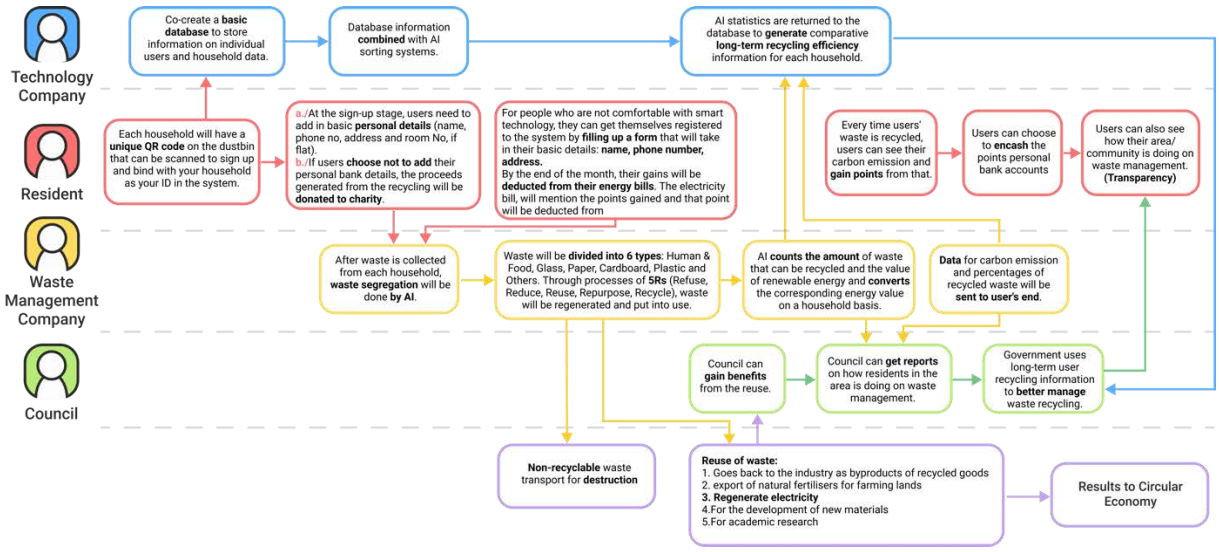
User Journey Map

Picture 8: User Journey Map, (Loughborough University, 2023)

This project uses a user journey map to visualize the steps users take in receiving recycling services, from initial awareness to using the application and receiving feedback and rewards. The purpose of the map is to identify pain points and opportunities for improvement in the user experience and includes the following sections:

- Stages and Behaviors: the user's overall service stages and behaviors.
- Thoughts and Feelings: The user's emotional state and thoughts when interacting with the service or product.
- Pain points: any issues or problems that the user encounters during the journey.
- Goals and opportunities: the user's basic goals and areas where the service experience can be improved.
- KPIs: This section covers some of the stakeholders and service reward systems used to link front and back office and user feedback.

System Flow Chart



Picture 9: System Flow Chart, (Loughborough University, 2023)

The system flowchart is built based on the previous contents, connecting our key stakeholders together.

The system starts operating from the residents' side. First, each household will be provided with a dustbin, which will have a unique QR code. Once scanned, residents can get themselves registered into the system. Add in their names, phone numbers, house/flat numbers. They also have the option to opt out of sharing their details, in that case their energy points will get transferred to charity accounts linked to people's welfare. After waste is generated, it will be collected by the agency, and AI will help segregate the waste. Waste will be divided into 6 types - Human & Food, Glass, Paper, Cardboard, Plastic and Others, and it will go through the 5Rs process - Refuse, Reduce, Reuse, Repurpose, Recycle. The non-recycled waste will be removed. Rest of the byproducts will be divided for industrial use in making recycled goods, fertilizers for farming lands, regenerating electricity, for research industry, for development of new materials.

AI counts the amount of waste that can be recycled and the value of renewable energy and converts the corresponding energy value on a household basis. The council will get reports on how residents in the area are doing on waste management.

The data obtained from the carbon emission and the percentage of recycled waste will be sent to the consumers. These gains will be reflected on their apps as points, which can be cashed in by them later. A part of the community who have not signed up to observe their gains, that sum of

money will be given to the charity. Users can also see how their area/community is doing on waste management, to gain transparency about the system.

Government can use the long-term user recycling information to better manage waste recycling. AI statistics are returned to the database to generate comparative long-term recycling efficiency information for each household.

Service Blueprint

Picture 10: Service Blueprint, (Loughborough University, 2023)

After completing the user journey and system process map, we sorted out the service process and used a service blueprint to explain. The blueprint includes all touchpoints, processes and interactions involved in delivering the service to identify areas of service improvement and to ensure consistency across all stakeholders involved in the service. Its content includes the following sections:

- Timeline: analysis from the front and middle of the service.

- Front office: user behavior (in relation to waste collection and AI detection sorting systems), the app side of the service, community, and government support, etc.

- Backend: waste management infrastructure, backend technical management, online and offline technical support.

- Touchpoints: points of interaction between users and the service, including depositing waste and receiving feedback on the sorting process.

- Channels: Methods of service delivery, including physical and digital channels.

- People: Stakeholders involved in service delivery, including users, waste management service providers (factories), recycling facilities (AI technology) and government departments (community and regulatory).

- Process: The steps involved in providing a service, including waste collection, sorting, and disposal.

Digital Toolkit

Prototype（Details pages are in the appendix）

The prototype we have developed is a digital tool that demonstrates artificial intelligence to intelligently detect the actions of waste sorting and recycling services. It allows the user to interact with the service and provide feedback on the sorting process.

To create this prototype, we used a user-centered design approach to ensure that the final product meets their needs and expectations. We also used design thinking principles, such as rapid prototyping and iterative design, to refine the prototype and incorporate user feedback.

The prototype included a mobile application that users could download and use to sort their waste. The app includes a feature that allows users to authorize their waste to be analyzed by an artificial intelligence detection system to determine the appropriate sorting category. The app provides users with instant feedback on the sorting process, including whether the waste has been sorted correctly.

In addition to providing users with feedback on the sorting process, our prototype app also includes a reward system that encourages users to recycle and sort their waste correctly. Users

can accumulate points for each item they recycle or sort correctly, which can then be redeemed for rewards like discounts on energy bills or donations to environmental charities.

The rewards system is designed to motivate users to engage in the waste sorting and recycling process and to promote long-term behavioral change. By providing tangible benefits for proper waste management behavior, we hope to encourage users to continue using the app and make waste sorting and recycling a regular part of their daily lives. We have also incorporated user feedback throughout the design process to ensure that the reward system meets users' expectations and is aligned with their values and priorities.

Picture 11: Hi-Fi Prototype, (Loughborough University, 2023)

SWOT of Prototype

- **Strengths:**

The prototype uses innovative artificial intelligence technology to improve waste sorting and recycling, which can significantly reduce waste pollution and improve efficiency. The prototype

includes a user-friendly interface and a reward system that motivates users to engage in the waste sorting and recycling process, which may help to promote long-term behavioral change.

The prototype was developed using a user-centered design approach and an agile software development methodology, which enabled extensive testing and evaluation to ensure that the application was effective and user-friendly.

- **Weaknesses:**

The prototype relies on the accuracy of an artificial intelligence detection system to correctly identify and sort waste, which may not always be reliable and may lead to errors in the sorting process (but is more efficient than manual). The reward system may not be effective in motivating all users to participate in the waste sorting and recycling process, especially those who are not motivated by rewards or those who do not see the benefits of proper waste management practices.

The prototype may face barriers to adoption due to a lack of awareness or trust in the technology, particularly among older or less tech-savvy users.

- **Opportunities:**

The prototype could be further refined and expanded to include additional features, such as education on best practices for waste reduction and recycling, which could increase user engagement and promote environmental sustainability.

The prototype could be integrated with existing waste management systems, such as municipal recycling schemes, to improve the overall waste management process and reduce pollution rates.

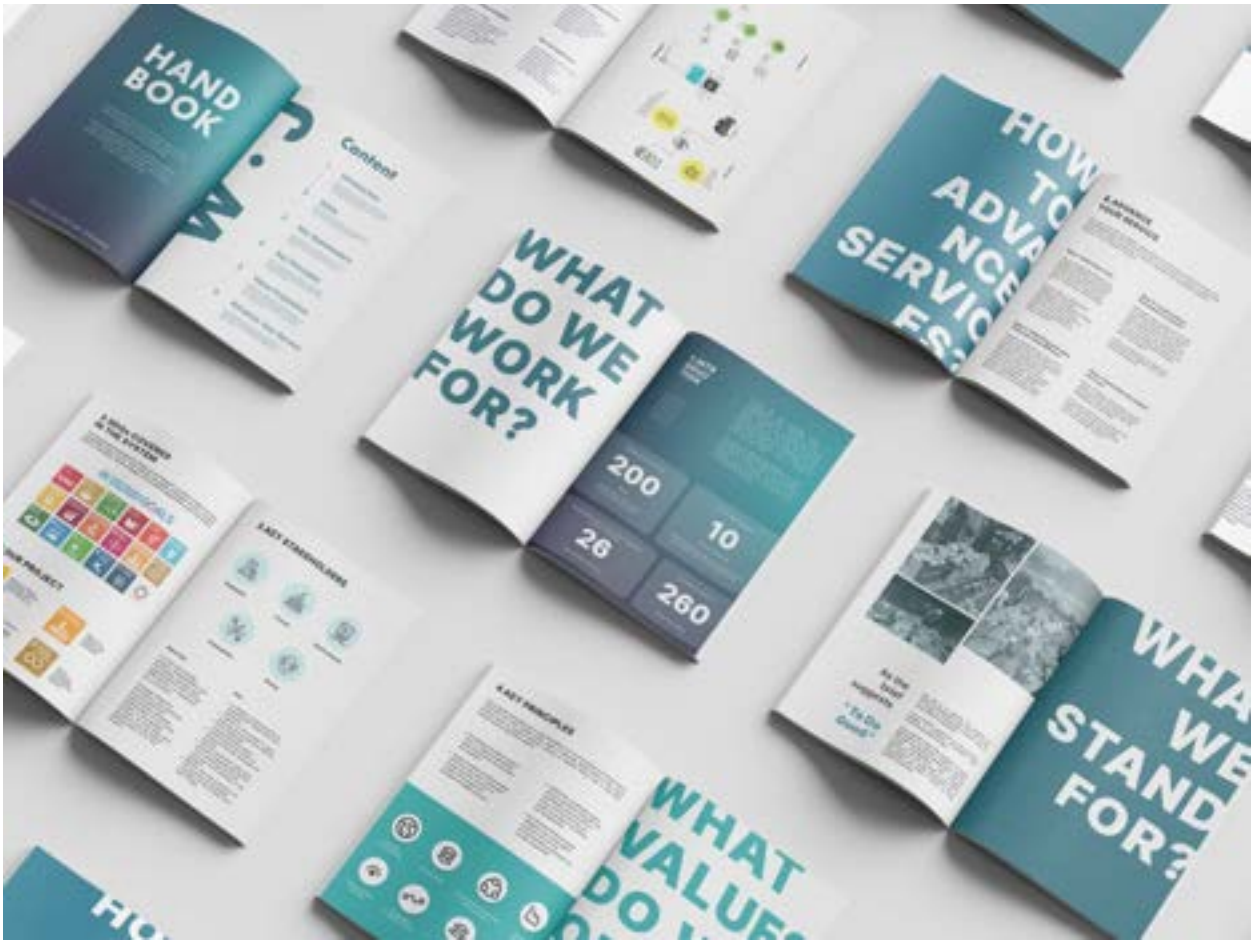
The prototype can be marketed to businesses and organizations to reduce waste management costs and improve sustainability practices.

- **Threats:**

The prototype may face competition from other waste management and recycling technologies, which could limit its adoption and market share. The prototype may face regulatory barriers or legal challenges related to the use of AI and data privacy.

The prototype may face negative perceptions or reactions from some users or stakeholders, particularly those who are skeptical of AI or consider waste segregation and recycling to be a low priority issue.

Handbook (detailed pages are in the appendix)

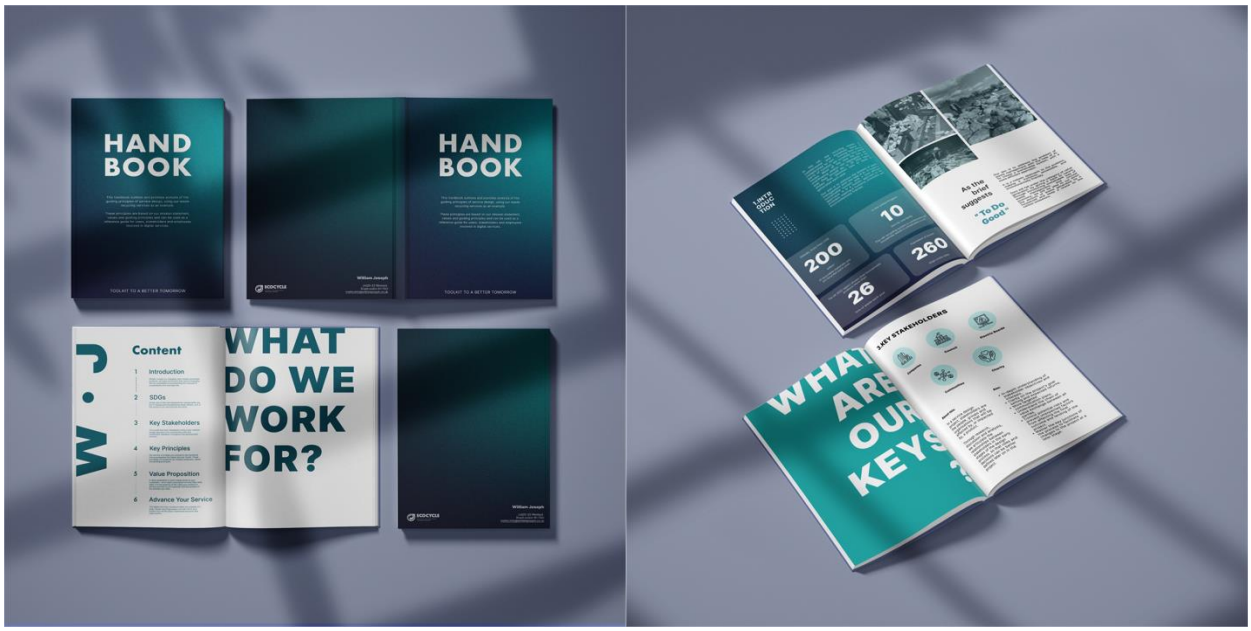


Picture 12: Handbook, (Loughborough University, 2023)

In addition to the prototype, our digital service toolkit includes a manual of principles. As a document, the manual outlines the guiding principles of service design and provides analysis, using a waste recycling service as an example.

Our service principles are outlined in the handbook that accompanies the Digital Service Toolkit. These principles are based on our mission statement, values, and guiding principles. Our mission is to promote proper waste separation and recycling practices, encourage sustainable behavior and contribute to a cleaner, healthier environment. Our values include accessibility, efficiency, sustainability, and transparency. Our guiding principles are designed to ensure that the service is user-centered, data-driven, and privacy-focused.

It serves as a reference guide for users, stakeholders and employees involved in the digital service, ensuring that everyone is on the same page and aligned with the goals and values of the service. In the case of the recycling service project we offer, for example, the handbook includes things like the service's mission statement, its values and principles, and details about how the application works and the reward system. In addition to this. The brochure can also provide information on how the service collects and uses data, and how the service ensures user privacy and security. Outlines the principles and value proposition of our service and can be used to test and validate the trustworthiness of digital services. The toolkit has been developed using a user-centered design approach and incorporates user and stakeholder feedback throughout the development process.



Picture 13: Handbook, (Loughborough University, 2023)

Conclusion

The present research summarizes a waste management initiative that aims to enhance trash recycling and management in UK residential areas by utilizing artificial intelligence (AI) technology. The project team concentrated on establishing an effective toolbox to address the rising problem of waste depletion and underlined the need to promote sustainable energy use and waste management.

Humanistic ideals and a dedication to human welfare were included into the team's project principles, which included inclusion, accessibility, creativity, consciousness, teamwork, and ethical practices. The team created the project's business purpose and user demands through primary and secondary research, with the goal of better recycling domestic garbage and improving waste disposal management.

The team created a digital application that demonstrated how AI technology could automatically recognize garbage sorting and recycling activities, hence improving waste management practices in residential settings. To bolster their research, the team looked at the waste management practices of two organizations, IKEA UK&IE and Greyparrot, both of which have made strides in this area. The effort sought to create a sustainable and innovative societal trend by changing from centralised to decentralized energy systems. The team's purpose for this project was to highlight the importance of garbage management and to assist organizations in implementing efficient and effective waste management practices to maintain a safe and clean environment.

In summary, the waste management project was motivated by the team's dedication to human welfare and included AI technology to promote sustainable energy use and garbage management. The project's goal was to enhance waste management practices in UK neighborhoods by developing a digital tool that demonstrated the intelligent identification of garbage sorting and recycling operations. The team's emphasis on diversity, creativity, cooperation, and ethical practices contributed to the project's success.

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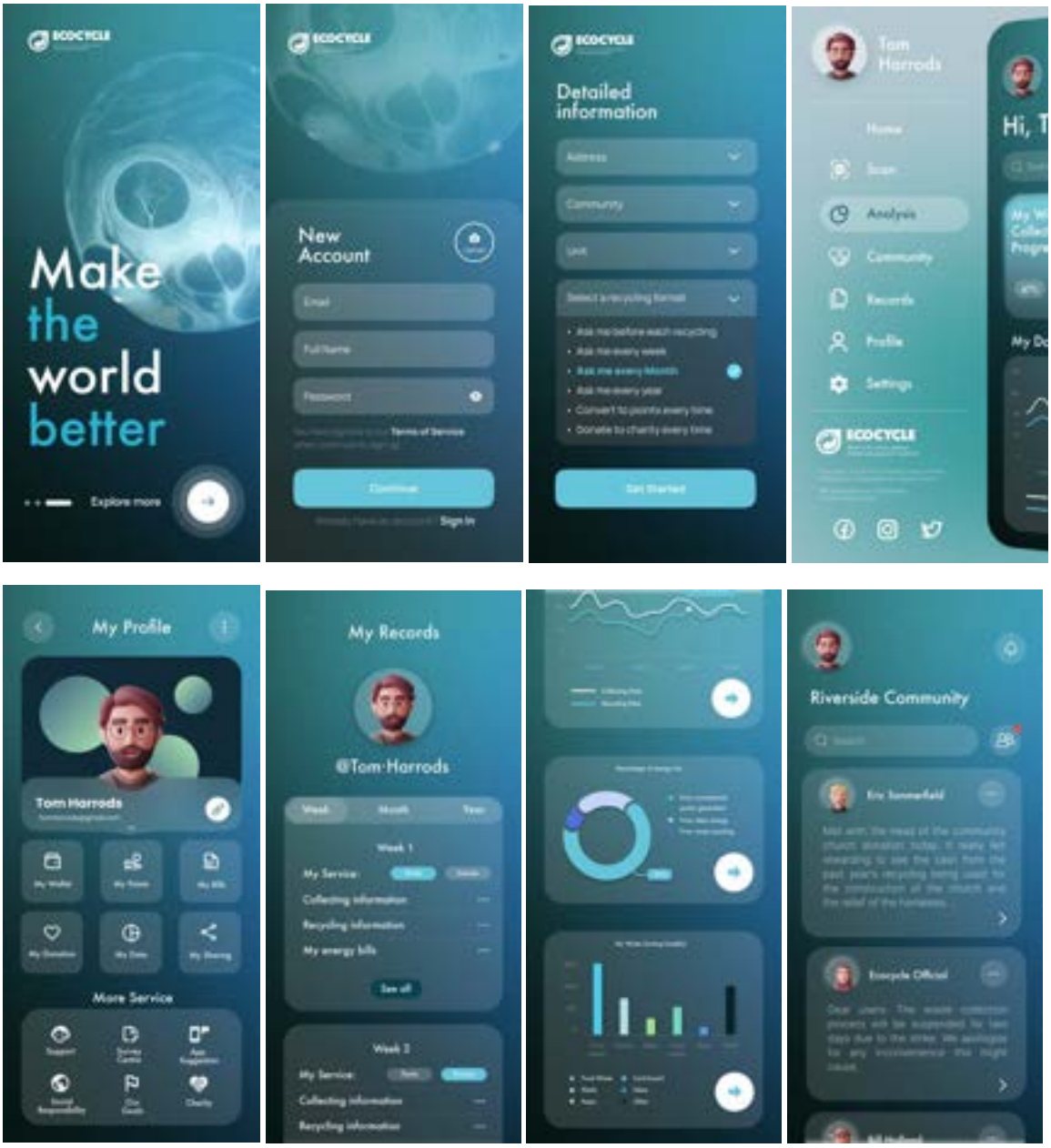
Appendix

1. Cases

NAME		INTRODUCTION	FINDING
(The AI-powered waste analytics system for the circular economy)		***Single-stream waste recycling*** robots are programmed to pick and sort items according to specific needs.	Powerful technology not only ***reduces operating costs*** and provides ***cleaner materials***, but also allows people to take on more important and valuable roles. Robots are better suited to replace personnel for dirty work.
WAGABOX (Innovative wasted gas energy recovery from landfill gas)		WAGABOX® is a breakthrough technology for ***landfill gas recovery***. Combining membrane filtration and cryogenic distillation, it guarantees the production of high-quality biomethane (renewable natural gas) that can be injected directly into the natural gas distribution network, regardless of the oxygen and nitrogen concentration in the raw gas.	The WAGABOX® technology recovers up to 90% of the methane contained in the raw gas, guaranteeing an energy yield far superior to recovery solutions based on electricity production. Biomethane production is injected directly into the natural gas distribution network to supply homes and businesses.
binary brains (AI technology from Binary Brains that ensure a reduction in food waste and a stronger financial sustainability)		Automated purchasing recommendations with Binary Brains were used to ***streamline the purchasing process***, optimise storage space and quickly identify and resolve over-servicing issues. Purchase recommendations are regularly emailed out and integrated into their procurement system.	Using AI intelligent algorithms to solve problems at the source of waste not only ***provides accurate ordering quantities***, but also ***saves significant time***
AMP (Applying AI-powered automation to economically and sustainably improve our global recycling system.)		By applying AI to digitise images, data on a variety of different materials is captured and the materials are then automatically recycled to help with the ***socio-economic cycle***.	The use of AI robots not only saves the expensive cost of manpower, but also increases the accuracy and efficiency of waste recycling and, most importantly, allows for the evaluation of operations through intelligent algorithms that measure value data.
IKEA (Fighting Food Waste With Artificial Intelligence)		IKEA has partnered with Winnow Vision to help kitchen teams reduce waste and increase efficiency by ***automatically collecting food waste*** with the support of artificial intelligence. It has reduced food waste by 50% and saved 1.2 million meals. Efforts have been made to reduce food waste and to recycle.	Smart electronic scales + cutting-edge artificial intelligence ***scanning devices clearly provide people with the exact type*** and ***weight of food waste***. A deeper awareness of the huge values of food waste. Greatly ***reduced statistical processes and time***.
greyparrot (The AI-powered waste analytics system for the circular economy)		The platform uses artificial intelligence driven computer vision software to ***increase transparency and automation in recycling***. Monitor 100% of your waste and maximise the value from it.	Designing waste in economic systems, creating new approaches to the circular economy in the framework of designing recovery and regeneration economies.

2. Prototype


ECOCYCLE
Make the world better
Explore more
New Account
Sign In
Detailed information
Tom Harrods
Hi,
Home
Scan
Analysis
Community
Records
Profile
Settings
My Profile
Tom Harrods
More Service
My Records
@Tom·Harrods
Week 1
My Service
Collecting information
Recycling information
My energy bills
See all
Week 2
Riverside Community

3. Handbook


HAND
BOOK
This handbook outlines and provides analysis of the guiding principles of service design, using our waste recycling services as an example.
These principles are based on our mission statement, values and guiding principles and can be used as a reference guide for users, stakeholders and employees involved in digital services.
TOOLKIT TO A BETTER TOMORROW


Content
1 Introduction
2 SDGs
3 Key Stakeholders
4 Key Principles
5 Value Proposition
6 Advance Your Service


WHAT
DO WE
WORK
FOR?


1.INTR
ODUC
TION
200
10
26
260

As the brief suggests

" To Do Good "

Our aim is to address the problem of waste management with the help of AI. To create a sustainable system, with a more efficient approach.

It is a holistic approach to the problem, making it inclusive, accessible, and environmentally friendly.

Ours will fall under the category of value generation by giving it back to nature, through introducing sustainable way of waste management, and circular economy, we will be able to cut down the amount of waste generated by a household and keep a check on the carbon emissions.

WHAT WE STAND FOR?

2.SDGs COVERED IN THE SYSTEM

The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice.

SUSTAINABLE DEVELOPMENT GOALS

IN OUR PROJECT

Ensure access to affordable, reliable, sustainable and modern energy for all.

Make cities inclusive, safe, resilient and sustainable.

Aims to build resilient infrastructure, promote sustainable industrialization and foster innovation.

Ensure sustainable consumption and production patterns.

WHAT ARE OUR KEYS?

3.KEY STAKEHOLDERS

About this:

In a service design project, stakeholders are the people, groups and organisations that will be affected by, or impacted by, a product.

Through research, discussion and analysis, we articulate the relationships between stakeholders in the early stages of the design process, so that roles and decisions can be better defined later on in the project.

Aim:

- In-depth understanding of stakeholder objectives and interests.
- Clarity on the project's goal setting and expected returns.
- More targeted communication plans.
- Understand the chain of value exchange between all parties.
- Control potential risks and prevent unexpected factors from affecting the final outcome and landing of the project.
- Master the key junctions of the process to facilitate changes to the project at a later stage.

4.KEY PRINCIPLES

Good design principles are a solid foundation for service design and should reflect important and clear design intent, both to describe design goals at the overall product level, to support decision making on specific issues, and to help align people around important matters.

- The design principles include a focus on digital sustainability while ensuring the functionality and usability.
- These principles prioritize energy efficiency, the use of renewable energy, and the reduction of waste in the design and operation of digital services.
- Additionally, sustainable digital services should be designed with accessibility and inclusivity in mind, ensuring that they are usable by people of all abilities and backgrounds.
- By following these principles, designers can create digital services that are both environmentally sustainable and socially responsible.

WHAT VALUES DO WE OBSERVE?

5. VALUE PROPOSITION

Increased Efficiency:

AI algorithms will optimize collection routes, schedules, and resource allocation, which will help waste management companies reduce costs and improve the efficiency of their operations.

Improved Recycling:

AI can help identify recyclable materials and sort them more effectively, reducing waste and increasing the amount of material that can be recycled.

Environmental Sustainability:

By reducing waste and increasing recycling rates, AI waste management companies will help reduce environmental impact and promote sustainability.

Better Customer Service:

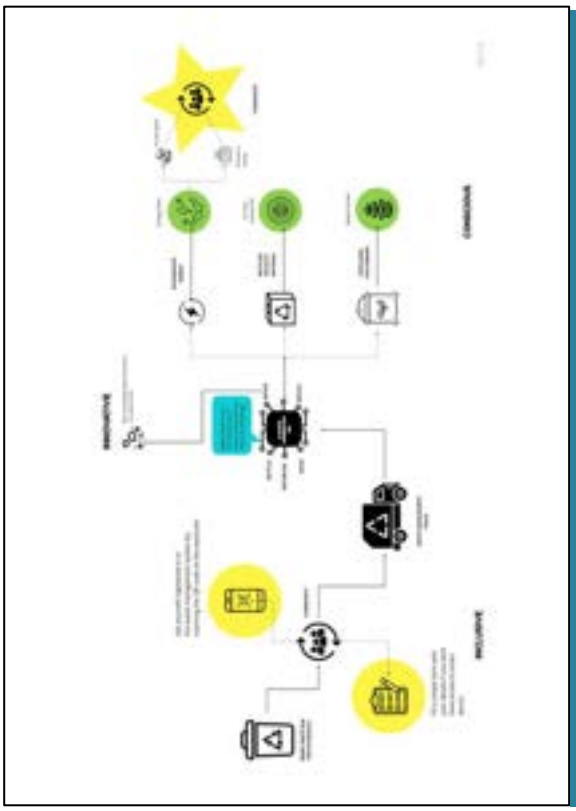
AI can help waste management companies respond to customer inquiries and service requests more quickly and accurately, improving customer satisfaction.

Data-Driven Insights:

Through AI waste management, the system will gather and analyse data on waste generation and disposal, providing valuable insights that can inform future decisions and strategies.

New Job Opportunity:

Hire appropriate staff to use the shared compactor for waste collection and replacing dangerous and laborious tasks by increasing positions such as supervision and operation etc.



HOW TO ADVANCE SERVICES?

6.ADVANCE YOUR SERVICE

For a start-up service design, case studies can keep your project focused and manageable when you don't have the time or resources to conduct a large-scale study, and it helps to describe, compare, evaluate and understand different aspects of the research problem.

Step 1: Selecting a case

Once you have developed your problem statement and research questions, you should be ready to select the specific case you want to focus on. A good case study should have the potential to:

Provide new or unexpected insights into the topic
Challenge or complicate existing assumptions and theories
Propose a practical course of action to solve a problem
Open up new directions for future research

Step 2: Constructing a theoretical framework

Although case studies focus more on specific details than on general theory, they should usually have some connection to theories in the field. In this way, the case study is not just an isolated description, but incorporates existing knowledge about the subject.

It aims to exemplify the theory by showing how it explains the case being investigated

Step 3: Collecting your data There are many different

research methods you can use to collect data about your topic. Case studies tend to focus on qualitative data using methods such as interviews, observations and analysis of primary and secondary sources (for example, newspaper articles, photographs, official records). Sometimes case studies will also collect quantitative data.

Step 4: Describe and analyse the case

When writing a case study, you will need to put all the relevant aspects together to describe the topic as completely as possible.

It is most important to analyse and apply the findings of the case study and incorporate them into your own design project.

RELATED CASE STUDIES

IKEA
greyparrot
binary brains
Futurism
AMP

HOW TO IMPROVE YOUR SYSTEM

OUR SERVICE PROTOTYPE

Make the world better

The prototype we have developed is a digital tool that demonstrates artificial intelligence to intelligently detect the actions of waste sorting and recycling services. It allows the user to interact with the service and provide feedback on the sorting process.

The app provides users with instant feedback on the sorting process, including whether the waste has been sorted correctly. In addition to providing users with feedback on the sorting process, our prototype app also includes a reward system that encourages users to recycle and correctly sort their waste. Users are able to accumulate points for each item they recycle or sort correctly, which can then be redeemed for rewards such as discounts on energy bills or donations to environmental charities.

4. Questionnaire

Principle Assessment Form		
Complete the product self-assessment by answering the questions in the toolkit below. You only need to answer yes or no. There are 30 questions in 8 categories in the toolkit. Get 15 yeses for a pass, 20 good and 25 excellent.		
Questions	**Remarks**	
More Inclusive, accessibility	**YES**	**NO**
Does it take into account certain people who are not sensitive to electronic devices, such as the elderly, for those who use the service?		
Has the interactive interface been designed with comfortable colours, text sizes and typography in mind?		
Does it use easy-to-understand text explanations and images?		
Does it have a feedback module to allow people to give		
Covers SDGs	**YES**	**NO**
Does it have clear SDGS targets for its digital products?		
Has it assessed the potential impact of these SDGS objectives accordingly?		
Does its service have a plan for the subsequent development of the SDGS objectives for the service?service?		
Economically sustainable and eco - friendly	**YES**	**NO**
Does it contribute to the development of a circular economy?		
Does it ensure that most of the raw materials obtained for the process and the waste produced are low polluting in the overall service process?		
Does it contribute to an environmentally friendly mindset?		
Does it provide a life-cycle assessment of the entire service process to identify potential environmental impacts?		
Energy Efficient	**YES**	**NO**
Is the energy it recycles throughout the process clean and affordable?		
Does it assess the footprint of the carbon cycle throughout the process so that a lot of carbon emissions are not wasted?		

Is it efficient in its use of energy in the process?		
Collaborative Approach	**YES**	**NO**
Does it give people the basic respect and right to information for those involved in the service?		
Does it take on board and amend any unreasonable feedback from people in a timely manner?		
Does it have appropriate mass organisations that can influence some of its decisions?service?		
Does it work with partners who share its sustainability values?		
Support ethical practices	**YES**	**NO**
Is it able to keep the privacy data it collects confidential?		
Does it evaluate its products accordingly and work to mitigate negative impacts?		
Does it give people the right to be informed?		
Does it and its partners have a comprehensive ethics policy in place?		
Does it have certain security mechanisms in place to ensure that users' privacy is not compromised?		
Simplifying the system	**YES**	**NO**
Does it perform rigorous calculations throughout the service process to ensure that human resources and energy are not wasted?		
Does it use a clear and concise language and presentation system for user interaction?		
Can people simply and directly understand its service processes?		
Sustainable on-going process	**YES**	**NO**
Does it contribute to the sustainability of the corresponding industries when establishing service counterpart plants?		
Does it contribute to the sustainability of cities?		
Does it promote the idea of sustainable consumption?		
Is it a sustainable value concept agreed with its partners?		