



BSc (Hons) CAD

How can sustainable design solutions be utilised in the packaging industry for improved circular creation, production, and disposal of food packaging?



ABSTRACT

Utilising sustainable design solutions in the creation of food packaging can improve the sustainability of the entire production process. These practices are set to advance and innovate with even greater outcomes for the future. However, the extent of its success today, to tackle the unsustainable consumption of the packaging industry, will be limited in isolation. The collective sustainability of the industry is also dependent on external variables, such as economic viability. Nonetheless, the increased normality of consumer sustainability, through ethical lifestyle and consumption choices, will combat these factors and potentially accelerate the shift to the complete circularity of all packaging in the future.

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Acronym Glossary

A-BIM	Building Information Modelling and Artificial Intelligence.
AD	Algorithmic Design.
AI	Artificial Intelligence.
BIM	Building Information Modelling.
CAD	Computer Aided Design.
CAM	Computer Aided Manufacturing.
COP26	26 th Conference of the Parties (United Nations).
EDP	Eco-design Principles.
EPR	Extended Producer Responsibility
FEA	Finite Element Analysis.
GD	Generative Design.
GHG	Green House Gas.
GPGP	Great Pacific Garbage Patch.
LCA	Life Cycle Analysis.
NPO	Non-Profit Organisation.
PLA	Polylactic Acid.
PPT	Plastic Packaging Tax
PSS	Product Service System.
RTE	Ready-to-eat.
R&D	Research and Development.

Glossary

Biodegradable	A material capable of being broken down by living organisms.
Biomass	Organic material that can be used as fuel.
Bioplastic	A biodegradable plastic made from biological material.
Biopolymers	A chain of large molecules made from living organisms.
Cradle-to-cradle	A sustainable strategy that mimics the regenerative cycle of nature where waste is reused.
Circular & Circular Economy	An industrial system that prolongs the use of resources and waste for as long as possible.
Closed-loop	A process that involves the reuse of waste during product for further uses.
Compostable	A material that will naturally break down into natural by-products.
Deep-Tech	Technological discoveries in science and engineering that impact industry and human life.
e-commerce	The electronic buying and selling transactions over the internet.
Eutrophication	A process caused by the pollution from pesticides in a body of water that becomes overgrown and damages biodiversity.
Microplastic	Extremely small pieces of plastic debris.
Remanufacture	The building of a previously made product for further use.
Styrene	A petroleum by-product that is used to make plastics and resins.
Virgin material	A raw material.

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INTRODUCTION

This dissertation explores sustainability and food packaging. A narrative that represents a personal interest and relates to industry aspirations after university. In packaging, cradle-to-cradle design is particularly fascinating, especially how biomass from food packaging waste could be repurposed. This circular model of consumption is ultimately one of the most sustainable ways to extend the life of packaging.

There is ever-increasing demand and equally expanding sustainability commitments within the stakeholders of the packaging industry. This thesis aims to investigate and critically analyse the present trends, problems, and future solutions. Moreover, it will identify the next steps, and potential barriers, towards a more environmentally friendly system.

Thesis Statement:

The current rate of consumption in the food packaging industry is not sustainable. To prevent further degradation to the environment and conserve natural resources, stakeholders must utilise sustainable and efficient solutions such as Computer Aided Design (CAD) tools to reduce waste and integrate a fully circular economy.

Aim:

To explore how the application of more sustainable practices across the design, manufacture, and disposal of food packaging can improve the environmental benefits and sustainability of the production life-cycle.

Objectives:

1. Explore the current industry trends and key players in the wider packaging industry to identify to what extent these are sustainable.
2. Highlight the direct impacts (social, environmental, & economic) of these current trends in the design, production, and disposal of food packaging.
3. Identify the future predictions of current industry practices in food packaging.
4. Examine any factors within future trends that would impact the sustainable design, production, and disposal of food packaging.
5. Review how strategies within digital design could pose as the potential solution to the sustainable future of the food packaging industry.

Thesis Structure:

This thesis is structured in the following chapters: Introduction, Literature Review, Methodology, Results & Analysis, Discussion, and Conclusion.

Introduction – This sets the scene of the thesis and provides an overview of the important subjects that will be referred to throughout the dissertation, with a clear set of aims and objectives to help inform this narrative.

Literature Review – The collation of relevant literature to explore the current context of the thesis topic and understand the place of the thesis question in relevance to existing evidence.

Methodology – All research and time management was carefully planned, conducted, and analysed in line with the strategy explained and visualised in the methodology chapter.

Results & Analysis – This formally presents the results of the primary research. The themes of each method are summarised, with a concise breakdown of relevant results.

Discussion – The summary of results from the secondary and primary research are brought together to discuss the correlations and contrasts between data sets. The limitations and recommendations of the study are also present in this chapter.

Conclusion – The final chapter provides a short overview of the relationship between the outcomes of the discussion and the original thesis question, aims and objectives. This wraps up the research and concludes the dissertation.

LITERATURE REVIEW

This section is structured to examine the journey of the secondary research, starting from the general packaging industry onto the niche of food packaging. To the present and future implications of the food packaging industry, and exploration of CAD and related design practices.

1. The Current Market Trends in the Packaging Industry

The first area of literature explores the current rate of design, production, and disposal in the packaging industry. This was selected from 2019 onwards to maintain validity and relevance. The majority agreed that the increased demand for food, combined with accelerated population growth – 70 million by 2030 - (*FutureAgenda*, 2021) and impact of COVID-19 on 'social, economic, and environmental norms' (Bullet, 2021), has changed the course of the food packaging industry.

Consumers demand 'ready-to-eat (RTE)' produce that is convenient but also eco-friendly, and in response producers have introduced initiatives, such as biodegradable packaging, to meet sustainability goals set by the government (e.g., COP26) (PR Newswire, 2021a). This positive overview is further supported by collective industry investment to design packaging that is environmentally-friendly (PR Newswire, 2021b). This illustrates the domino effect of sustainability as a trend and solution in tackling unsustainable production. Similarly, the supermarket Tesco boosted their eco-efforts by partnering with TerraCycle in 2020 to bring Loop to the UK, an initiative where food packaging is made from stronger materials (e.g., aluminium) so that vessels can be 'returned, cleaned, and reused' (Bullet, 2021).

Conversely, other sources question the efficiency of these efforts as being too challenging to decrease the ecological impact whilst making economic gain (Thomas NetNews, 2019). However, Waitrose and Partners, the leading UK supermarket in the reduction of packaging waste (see **Figure 1.0**), is set to 'increase reusable and unpackaged ranges' (Bullet, 2021). This proves that making small changes over time will offset economic loss (Thomas

NetNews, 2019). There is also evidence of changing consumer attitudes, as revealed in an EcoFocus Trends survey, where 8 out of 10 shoppers agreed that being eco-friendly is ‘common sense’ (PR Newswire, 2020).

The supermarket plastic league table

		Reduced plastic	Reusables	Reduction commitment	Reuse commitment	Recycling	Supply chain	Transparency
1.	Waitrose	60%	60%	78%	48%	29%	76%	91%
2.	Aldi	42%	40%	71%	41%	40%	59%	81%
3.	M&S	67%	30%	22%	24%	43%	46%	77%
4.	Lidl	40%	30%	46%	35%	54%	63%	98%
5.	Sainsbury's	33%	50%	72%	22%	67%	56%	91%
6.	Tesco	11%	70%	63%	63%	47%	76%	89%
7.	Asda	29%	70%	30%	59%	26%	46%	80%
8.	Co-op	22%	50%	57%	11%	43%	59%	80%
9.	Morrisons	9%	40%	46%	48%	49%	54%	91%
10.	Iceland	22%	60%	63%	19%	11%	22%	57%

Colours
 Green: good
 Yellow/orange: needs improvement
 Red: poor

Figure 1.0 – Supermarket Plastic League Table (Greenpeace, 2021)

However, this still fails to consider that single-use food packaging - 900,000 tonnes annually contributed by supermarkets (Lewis, 2019) - will continue to saturate the market value chain. It is universally accepted that supermarkets aren't doing enough and should become as 'sustainable as the waste they are responsible for.' The impacts of COVID-19 lockdowns on retail and packaging production, from panic-buying (Bullet, 2021) to consumer expectations for plastic container use due to hygiene concerns (PR Newswire, 2021a), have interrupted producers in meeting their sustainability pledges. This normalisation of packaged produce proves that plastic is still a leading product choice in the food and general packaging industry. Although, to what extent does this impact the environment and human health?

2. Implications of the Food Packaging Industry

This section explores the extent the food packaging industry contributes to the depletion of the world's environment and resources. Most sources hailed plastic packaging as the main culprit, with only a few diverse discussions on packaging and the environment. Overall, this literature was educational, with some promotional business pieces still having relevance due to the authors' professional industry and sustainability credentials.

The consensus was that the creation of all packaging damages the environment and human health to some extent, from greenhouse gas (GHG) emissions to litter clogging water streams (*Eco To Go Food Packs*, 2020). One standpoint by Food Print, a research Non-profit Organisation (NPO), claimed that the packaging industry has a lack of concern for social and environmental wellbeing. This is somewhat exaggerated but aligns with the widespread viewpoint that plastic food packaging – generating '40% of the global demand' – is the biggest contributor in the current climate crisis (FoodPrint, 2019). The magnitude of this is illustrated by two plastic islands (see **Figure 1.1**) between North America and Japan called 'The Great Pacific Garbage Patch (GPGP)', that is 'three times the size of France' (*Eco To Go Food Packs*, 2020).



Figure 1.1 – Diagram of The Great Pacific Garbage Patch (WorldAtlas, 2021)

Other sources agreed that fossil-based packaging is damaging to marine and land biodiversity (Ncube *et al.*, 2020), but also worryingly harms humans. This can occur via the ingestion of microplastics, or food contaminated by potentially toxic chemicals, such as

styrene, in the linings of disposable packaging items. This proves the need to equally balance the safety of packaging contents with the risk to human health.

Packaging is vital in the food system, along with other industries like pharmaceuticals (FoodPrint, 2019). This is true for supermarkets, who rely heavily on packaged goods to maintain hygiene and preserve produce. On the other hand, the latest alternatives, such as bio-plastics (PLA), biodegradable and compostable materials, convey the effort of stakeholders to make responsible changes. These natural materials (see **Figure 1.2**) are considered the solution because they can decompose (*Eco To Go Food Packs*, 2020) and eradicate the excess waste of the traditional production process (Dufaylite, 2020).



Figure 1.2 – Snact's Compostable Packaging Waste Degrading (Eco & Beyond, 2021)

However, even these have an 'ecological price tag' (*Eco To Go Food Packs*, 2020), with the resources PLA production requires (FoodPrint, 2019) and pesticides that result in the eutrophication of surrounding marine biodiversity (Mendes *et al.*, 2021). The environment can also be threatened by the incorrect disposal organic packaging, that can ruin the 'purity' of regular recyclables if mixed, resulting in entire bins sent to landfill (*Eco To Go Food Packs*, 2020). This highlights that all packaging has environmental consequences (Mendes *et al.*, 2021), with even traditional packaging (e.g., glass) requiring substantial energy to produce or recycle. Will the shift from linear production ever occur? (Carter, 2021), when the convenience of food packaging is still prioritised above the environment.

3. Future Synthesis – Projections of the Food Packaging Industry

The future population increase and excessive demand for food is set to exacerbate the impacts to our climate. It was challenging to locate relevant academic sources on this future synthesis, and therefore demonstrates a literature gap.

COVID-19 has dramatically impacted consumer shopping behaviour, from the increase of e-commerce to consequently, the accumulation of unsustainable packaging waste. Other sources voiced more positive outcomes with food packaging, as magnified consumer attitude for sustainability, encouraged manufacturers to re-structure how products are packaged (Payne, 2021). Madl (2021) also discussed that the transportation stage is set to change, by encouraging better delivery efficiency, via 'smart warehouses' that release drones and 'driverless trucks'. This innovation aims to reduce fuel consumption and make this part of the life-cycle completely carbon neutral.

However, consumer awareness is preventing any such progress. Often seen through customers being ignorant of any improvements and dismissing them (especially supermarkets) as an act of self-interest (Supermarket Perimeter, 2021), despite the stated 67% worldwide believing in the importance of recyclable packaging (Payne, 2021). A recent initiative that relies on consumer participation is 'Loop Reuse Stations' by Tesco (Loop, 2021b), where customers return empty packaging (see **Figure 1.3**) that is carbon neutral after three cycles (Payne, 2021). Judging by this conclusion, the ethical future of food packaging rests on better communication between consumer and producer. The increased investment at the use stage of the packaging life-cycle, as well as design, is required (Supermarket Perimeter, 2021).



Figure 1.3 – Tesco and Loop's Reusable Packaging Return Bag (Loop, 2021a)

Alternatively, this doesn't consider the projected 'eco-warrior' perspective of the next generation, which sees 83% of younger people open to spending more for sustainably packaged products. This also conveyed their view against single-use plastic and the push to completely remove this material, but unfortunately industry reliance on plastic makes this practically impossible to achieve in today's market. A plausible solution is the sole use of recycled plastic, instead of virgin material, to reduce the impact to the environment overall and demonstrate sustainability efforts (Payne, 2021).

Furthermore, today's end-of-life infrastructure is arguably unsuitable to process the current rate of disposal, as only two-fifths of the 40% of plastic packaging in the European Union is recycled (*COST Association*, 2021). This leaves most waste as litter or in landfill, reinforcing that the justification of plastics and 'total recyclability' (*Supermarket Perimeter*, 2021), lies in the future advancement of the UK's food packaging waste facilities. Whereas a more viable solution is the predicted inclusivity of design innovations. This is valid as innovation in the packaging sector is critical in producing new eco-friendly applications (Madl, 2021). Although, this also adheres to recent government-enforced sustainability policies, such as 'Extended Producer Responsibility' (EPR), making producers responsible for packaging throughout its life (Croner-i, 2021). Overall, food freshness and safety must be balanced with environmentally-sound packaging production.

4. The Future of Sustainability in the Food Packaging Industry

There are multiple solutions that support the sustainable future of food packaging. Whilst there was adequate information on this subject, finding concrete data on sustainable design practices within packaging proved more challenging.

According to *Edge2Edge* (2021a) – sustainable packaging company - key players are starting to make sustainable commitments that will demonstrate benefit over time. This includes the commercialisation of re-usable food packaging, evident in the collaboration between Loop and Burger King, set to incorporate ‘reusable containers’ into their menu (see **Figure 1.4**). These partnerships within the production chain makes sustainability possible by filling gaps in their production or disposal processes. It is now more viable for retailers, especially since the non-recyclable packaging boycott, to work towards sustainability goals and meet market demand. Leading the way is John Lewis, and their pledge to make own-branded packaging completely ‘recyclable, reusable, or home composted by 2023’ (Internet Retailing, 2021).



Figure 1.4 – Burger King and Loops Reusable Food Packaging (*Edge2Edge*, 2021b)

A diverging trend is the emergence of ‘smart packaging’, such as ‘bio-polymers’, as a biodegradable alternative to plastic. An article on the future of food packaging by MDPI (scientific journal database) also agrees this will enhance packaging’s ‘antimicrobial and light blocking properties’ (Sani *et al.*, 2021). However, COVID-19 may have hindered these efforts, despite the reduction of carbon emissions, as minimal industrial activity revealed drawbacks in our linear economy. Even the commercial potential of biodegradable and compostable packaging is limited by inefficient composting infrastructure (Duncan *et al.*,

2021). However, GreenBiz (media against climate change) suggests this argument is only valid in the short-term impacts of smart packaging, rather than measured environmental benefits overtime. This drive for longevity is also present within the digital design industry, having arguably more successful measures that could be applied within the design of sustainable food packaging.

Design is key in innovating new products but is also regarded as the most impactful to the environment (Curran *et al.*, 2020), and therefore sustainability should be focused on this stage. This is conveyed by stakeholders introducing 'Eco-Design Principles (EDP)' and 'Product Service System (PSS) Models' (Anthesis, 2021). Whilst a traditional concept, eco-design is proving to be valuable for food packaging, as again illustrated by Loop. Their re-use initiative (PSS strategy) means leasable items can be monitored across the life cycle to minimize waste (Acaroglu, 2020).

Conversely, negative implications are more likely in the packaging manufacturing process (Anthesis, 2017). Although 80% of impacts are supposedly 'locked-in' with design, (Acaroglu, 2020), manufacturing by-products are increasingly harmful to the surrounding wildlife. This contrast illustrates the conflict within this research, however as mentioned throughout this review, true sustainability can be achieved by the application of strategies across all stakeholders (Curran *et al.*, 2020). Although Eco-design is a core tool in circularity, its success is prohibited by several issues. LCA helps to decrease emissions in a design process but is also a 'time and cost-intensive task' (Anthesis, 2017) that wouldn't be as commercially viable with the economic and social pressures already on the packaging industry.

Nonetheless, the digital design solution predicted to disrupt the market for sustainable packaging is artificial intelligence (AI) via the medium of CAD. Digimind ('Deep-Tech start-up'), are pioneering a platform (see **Figure 1.5**) to help creators achieve eco-friendly and low-cost packaging in one workflow (Packaging Europe, 2021a). This sets a good precedence for how sustainable design could be the catalyst the industry needs.

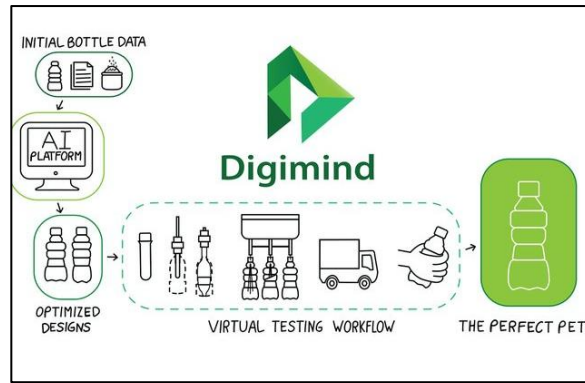


Figure 1.5 – Digimind's Sustainable Packaging Design Workflow Platform (Packaging Europe, 2021b)

5. The Digital Design Industry & Sustainable Food Packaging

The constant sustainable development within the disciplines of digital media design could provide a closed-loop system for each stage of food packaging production. The academic information around these themes were limited, and the only reliable sources were from industry and company platforms. According to an article on sustainable creative industries by the US Academy of Arts University, digital design is now more aware of its environmental impact.

Graphic design, traditionally consuming large quantities of paper/plastic, has shifted to more eco-friendly materials and printing chemicals. Similarly, industrial design has changed to create plastic-free products and packaging (Academy Contributor, 2020). These 'safe and sustainable' approaches are the most successful in the 'pre-market-design phase' (EEA, 2021). Also vocalised by Autodesk, the leader in CAD software products, that 80% of a product's environmental cost is 'locked-in' at conceptualisation (Fogel, 2021). Regardless, this consideration dismisses the responsibility of the entire UK industrial sector. Despite continued regulations, from EPR (Granskog *et al.*, 2021) to the recent United Nations Conference of the Parties (Davy, 2021), a survey by the 'British Chambers of Commerce' (2020) revealed that two-thirds of businesses don't have a sustainability policy. In truth, the main catalyst for businesses, voiced in a paper from ScienceDirect (publication database) on packaging production, is pleasing consumers for economic gain (Civancik-Uslu *et al.*, 2019).

The endless evidence on how well sustainability dimensions provide environmental and humanitarian benefits, demonstrates the generalised scope of the previous point. The strategies that best 'design-out' the negatives in food packaging production are Eco-design (Pigosso *et al.*, 2019) and Life Cycle Analysis principles. In fact, when combined, it is easier to identify areas for EDP's to provide further environmental and economic gain (Civancik-Uslu *et al.*, 2019). Nevertheless, the future influence of digital media practices will be hindered by several factors. Issues with ED methodologies, mentioned in other parts of this review, include how LCA is unable to measure the complete impact of packaging and products without all the 'indicators', like littering (Pires, 2021). Similarly, the extent of EDP's on a project's success is still unknown and can negatively impact a project by increasing production costs, or depleting product quality (Pigosso *et al.*, 2019).

Alternatively, the extent of the short-term problems with EDP's and similar initiatives are incomparable, as CAD is set to be part of the disruptive solution to bridge food packaging and sustainability. CAD covers multiple disciplines, from product design to architecture, that involve the use of highly efficient (Yong, 2021) computer systems (Flynt, 2019). CAD contributes to the sustainable merit of a project via the mediums of Building Information Modelling (BIM), Finite Element Analysis (FEA, see **Figure 1.6**) and Generative Design (GD). BIM is a workflow tool that contains information about a model from design to build (Autodesk, 2021a), and according to an established UK Architectural Firm, provides sustainable benefits by indicating economic and environmental costs. Indeed, the future of BIM (A-BIM) will involve AI and 'algorithmic design' (AD) to generate simulations that replicate a projects ecological impact (Quattro Design, 2021).

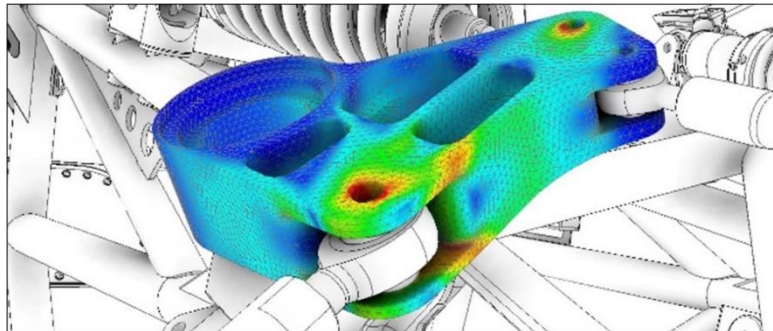


Figure 1.6 – Example of Finite Element Analysis (Autodesk, 2021b)

This shows how the negative impacts in the early design stage can be combated. Autodesk also promotes the opportunity to design-in environmentally-sound features via Generative Design (GD) and FEA software environments. Where AI models numerous versions of one design, or even better for packaging design, FEA performs multiple simulations and tests all within one step (Fogel, 2021). Therefore, a viable product can be executed without touching real life resources and funding but can also be implemented into today's practical (CAM) and digital (CAD) processes in the packaging industry. The only barrier is that CAD is cost intensive, from software packages to technology with the latest processing power (Flynt, 2019). Unfortunately, excessive cost is already hindering packaging producers from investing in more eco-friendly methods and R&D. In the progress to sustainable production, economic viability is a greater variable than previously thought.

SUMMARY

Sustainable design practices could be applied within the context of the food packaging industry, especially with the normalisation of AI, as a solution for a more circular economy. However, insufficient recycling infrastructure and consumer awareness in packaging disposal are impeding on current efforts against linear production. This suggests resolving these issues is equally important for the success of future sustainability initiatives, through more quality education for consumers and regenerative facilities for end-of-life stakeholders to process packaging alternatives. Primary research will allude to unanswered questions found in the literature review, such as concrete evidence of sustainable design practices within food packaging design. It will also reveal new perspectives for this study and continue to enlighten a personal passion for sustainability and packaging.

METHODOLOGY

Secondary Research:

The literature review contained information from a diverse range of databases and industry credible websites, to maintain relevance and clarity. The efficiency of this process was maintained by Google Drive to organise sources, Mendeley to cite these findings, and Microsoft Excel as a means of time management. The depth of topics discussed meant time management was vital, through a successful combination of spreadsheets - a calendar (**Appendix A**) to schedule tasks, and a Gantt chart to track challenges and milestones (**Appendix B**). In the event of losing access to broadband and benefits of the university library databases, all sources were also organised and referenced in Microsoft Word.

Primary Research:

Qualitative and quantitative methods were used to expand the scope of the primary research. In combination, these approaches can gather diverse and concise information that is easily interpreted. Quantitative methods provide numerical and statistical results to reveal correlations and pattern related trends, whilst qualitative provides verbal and detailed results to reveal new theories and form arguments. Primary research is critical because it is an accurate and first-hand account of a relevant subject. This also fills any gaps that can arise during secondary research, and instead conveys current context to inform the structure and content of the primary methods.

Methods:

The methods consisted of an interview, survey, and questionnaire. These were viable because of the ability to target a set variety and number of respondents. The survey was aimed at a broad audience to gather public opinion of the average consumer. The questionnaire and interview were for expert input from industry stakeholders, aimed at individual companies. These groups represent the outstanding themes in the secondary research, including consumers (10 – 60+ years), packaging companies and supermarkets. This variety of data sources intended to achieve the thesis objectives.

The collection period was three weeks (2nd – 20th March) to provide adequate time to distribute methods, wait for results and respond to enquiries. For statistically valid data, there needed to be at least 25-30 responses. Any less could have impacted the solidity of the thesis question but would still provide scope for discussion because of the first-hand nature of primary research. A unique opinion of one respondent could offer more value than thirty respondents who may have been uninformed in the study. The data analysis strategy depended on whether the method was quantitative or qualitative. The survey with close-ended questions, was presented in a visual format to identify trends and anomalies and make them easy to interpret. The questionnaires and interview, with more open-ended questions, required thorough reading to categorise opinions as discussion pointers or arguments.

Interview

An interview can provide unique and anecdotal data. Regarding this study, an interview guarantees unplanned and transparent results which increases the authenticity of responses, unlike surveys that can be edited. Therefore, this method was vital for gaining face-to-face expert insights and new theories to enrich the thesis discussion.

The interview was conducted with the director of a sustainable food-packaging company (Company A), specialising in bespoke CAD design. Their direct ties to food packaging and CAD has made them an invaluable candidate, especially in combination with the other methods. This industry expert, alongside public opinion harnessed in the survey, will better encapsulate the presence of sustainability across the packaging industry. The interview was undertaken on the 15th of March 2022. The locality of the company HQ increased the efficiency of the methodology. The director agreed to a face-to-face event, this enabled a clear and flowing exchange, and observation of their response behaviour. Furthermore, the interview was also audio recorded. This provided concrete evidence that sped up the transcript and analysis process.

The main risk of the interview was response bias. A past internship at Company A could have influenced the director's responses. As a contingency, a section of questions were designed to counter the director's own opinions. 'Are there any components within your design, production, and overall product life-cycle, that can cause harm to the environment?' In fact, familiarity between both parties steered conversation and stimulated a constructive and educational debate.

Survey

A survey can gather data from groups of people and reveal their perspective on a topic. This method was suitable for targeting the consumer audience because these make up the biggest percentage of individuals as a stakeholder group. Surveys are quick and light-hearted, and don't require previous knowledge of a subject. They should also avoid complex vocabulary. The distribution of this method on social media suited these parameters further, with the wide range of potential users as respondents.

The survey aimed to highlight how the average consumer perceives packaging and sustainability. The publishing platform was Facebook, posted into three private groups – friends and family (620 members), university peers (341 members), and 'Plastic Free & Sustainable Living in the UK' (2.8K members). This extensive reach was devised to gather numerous responses in a short time. The method was curated in Google Forms, previous positive experience with this platform proved its reliability, including the automatic generation of result graphs. This sped up the data collection and analysis process. Regarding data protection, the Google account holder has sole accessibility and control over the form contents and shareable link.

The survey questions were simplified to ensure a variety of age and academia groups could interpret the information. This also meant the survey experience was pleasant, instead of inconvenient to the respondent, and minimises a lack of engagement that could invalidate their answers. 'Which of the following packaging materials do you consider to be sustainable?' The risk of this method was respondent bias, with the inclusion of fellow peers and family members. This can be an advantage however, as such familiarity means more time and effort is inputted because of their wish benefit the study. There was also a question that requested the respondents age. This was to tie back to the secondary findings and see whether age truly impacts views on sustainability.

Questionnaire

A questionnaire gathers data from a smaller group or individual, who are well established and knowledgeable in the presented topic. This method is perfect for harnessing this experience from experts, like the stakeholders in the study, in the detailed responses a questionnaire requires. Whilst a survey would be inadequate, with limited time and space for responses, which is more viable for acquiring data that is based-on shorthand opinions rather than theory.

The questionnaire was targeted to companies and business within eight stakeholder groups – Packaging Companies, Environmental Agencies, Waste Disposal Authorities, Digital Design and CAD experts, and CAD packaging companies. These were frequently referenced in the secondary research, and so are valid points of exploration. Eight questionnaires were curated and sent to at least two companies per group. This extensive goal aimed to collate a diverse and contrasting selection of data, key in the comprehensive exploration of any field. The method was distributed via formal email communication, designed with the same parameters as the survey (clickable link). A Google Form, rather than a typed document minimised potential transfer issues like software differences. During the data collection period, it was important to regulate the email channel and allocate time to seek alternative contacts (if unresponsive).

The questions were curated depending on the stakeholder group and to suit the more industry-aware nature of the respondents - 'Is sustainability a key part of your company's current innovations/processes, in relation to your packaging products?' There were some similar questions that linked back to the thesis statement. These aimed to gauge their perception of this, and how this differed in each group, with a variety of open and close-ended questions to keep the participants engaged. There was little risk of bias, compared to the other methods, with the lack of familiarity and limited communication to these contacts prior to the study. The major risk was receiving little to no responses, even a polite decline to the request.

Time Management:

Orchestrating a time management strategy was critical to the success of the primary research and completion of the remaining dissertation. The workload of this assignment was efficiently balanced with other university projects via a visual calendar (**Appendix C**) and Gantt chart (**Appendix D**), with previous success with these methods in other academic writing projects. The primary research was conducted in the middle of March to enable enough collection and analysis time, critical for next dissertation chapters. The contingency parameters put in place considered the risks of each method.

The questionnaires posed the greatest risk. This method relied on large-scale companies taking the time out of their busy schedules to respond. The other substantial risk was the influence of new COVID-19 restrictions. This could have impacted the respondents willingness to take part and worse, interfere with the interview. However, these wouldn't be critical to the studies progress. Regarding the interview, this could be conducted over video call. Today's modern technology and recent events means resources like Microsoft Teams are well-accepted methods of communication. A lack of questionnaire responses may be more of a challenge. One solution could be repeated communication to unresponsive companies over a three-day period. Or more directly, contact via their LinkedIn and social media accounts. This would also be affective for the survey, directly contacting peers and businesses through social media would guarantee some additional data.

Appendix E shows this dissertation time management calendar. It presents all tasks towards the completion of the primary research and dissertation assignment. To maintain motivation and progress throughout, there were a series of goals put in place (see full list in **Appendix F**). These were important milestones allocated to set days to minimise stress but maintain workflow. This is illustrated by 'Goal 6' – the achievement of this number of survey responses by this point means data presentation would be completed within the allocated time. If these goals weren't met, due to lack of response or other academic commitments, several protocols would be introduced to maintain progress. This includes the consistent monitoring of all methods throughout weeks six, seven, and eight. Any extended lull could be countered by republishing or conducting research for further industry contacts.

RESULTS & ANALYSIS

The results were collected via qualitative and quantitative methods. These were curated for the desired target audience, published, and monitored over a set period. Across the board, the response numbers were positive – thirty for the survey, plus two interviewees. Despite perseverance, there was some disappointment regarding the questionnaires, with limited feedback from all desired stakeholder groups. However, valid and quality results were still achieved.

Method Analysis:

All results were analysed via thematic analysis. This method was highly effective at identifying and concisely summarising relationships within, and across all methods. Reference and familiarity of the repeated topics in the secondary results also helped the cohesion of this analysis technique. The colour coded key below (see **Figure 1.7**) was also used to highlight important phrases and identify potential themes throughout the results.

KEY:	Repetition	Generalised	Irrelevant	Point of Interest
Director =			Employee =	

Figure 1.7 – Primary Results Analysis Colour Code

RESULT 1: 'Company A' Interview

Company A represents a key player in the sustainable food packaging market. Interviewing the director and an employee with varied experience provided inclusive insights. The major themes across both results presented an overview of their current and future perspective of sustainable packaging. See **Appendix G** for results excluded from the main body and **Appendix H** for the full interview transcripts.

Sustainability & Packaging

Company A has a strong drive for sustainable change in the packaging industry. The collective results emphasised how sustainability isn't just a movement, it's a permanent part of their ethos. They focus on making their products as natural as possible, with a successful strategy of sourcing sustainable materials, sugarcane (bagasse), from an equally ethical supplier.

The Presence & Awareness of Digital Practices

The company has over a decades experience in the food packaging market. This experience is key in the sustainable progression of their products, rather than design practices such as CAD tools. Whilst being unaware of CAD's current potential for sustainability in design, they were open to CAD's future involvement with AI, and acknowledged the potential of these tools as they develop.

The Producer, Market, & Consumers

Fibre packaging, and other alternatives, are more expensive to source and produce. This puts Company A at a price disadvantage. However, the sustainability movement is making this more acceptable to consumers. The pandemic forced economy over ecology, hampering the progression of major stakeholders in achieving past sustainability goals and policies.

'Company A' Interview Analysis

<p>Q2: Is sustainability a key part of your company's current innovations/processes, in relation to your packaging products?</p>
<p>A: Yes, most definitely. We have been working to provide a sustainable alternative to one particular part of the food packaging market for more than a decade. It's driven us half mad and kept us going on the holy grail of producing a ready-meal tray that goes in the oven and the microwave in sustainable materials, and we have done it. We are one of the first in the world.</p>
<p>A: Well, I should hope so, yes. Okay, so yeah, I would say it is key because obviously riji trays are compostable, so and are made from a product that would otherwise be buried or burned. So, it does use a waste by-product. That's just one part, but obviously, especially when it comes to getting B-Corp stuff, you have to really consider the bigger picture. So, they think about everything, so the amount of water used to make the product, the transport. The entire life cycle has to be considered, but as fair as were considered, as much as we can obviously, obviously sustainability is at the forefront.</p>

Figure 1.8 – Interview Q2

Both interviewees strongly agreed to this question (**Figure 1.8**) and proved the collective goals of the company surrounding sustainability in the food packaging market. Their packaging, compostable oven-and-microwave-safe products, was one of the first alternatives in the ready-meal market. The packaging material is also sustainable because it is a waste by-product of the sugar industry.

<p>Q3: Do you have a method, tool, or software in your design/production process that helps your products become more sustainable?</p>
<p>A: There is no software that helps us to do this, this is just born of experience and knowing, trying what to avoid. If there were software, I'm sure we'd find it useful. But it's mostly our experience of knowing what we're trying to avoid, being fossil fuels and high energy costs to make things, so it's pretty basic sort of sights on the project.</p>
<p>A: I would say our supplier, obviously, as they are the ones who choose the by-product to make our product.</p>

Figure 1.9 – Interview Q3

The director was unaware, but not closed to the idea that digital tools can aid the sustainability of packaging. Instead, they reiterated that their decades experience in the packaging industry informs design and production choices. The employee elaborated that along with the material, the supplier was also important.

<p>Q3a: Please explain answer to question 3 (give examples).</p>
<p>A: Were trying to make the thing as natural as possible. So, for example, right now the majority of ready meal trays in the country are packed in plastic, or aluminium, but the vast majority in plastic. Something called C-PET, and C-PET is far from being sustainable, anyway. So, some alternatives to that are what I call would 'Hybrids'. Some people claim you can separate, for example a sandwich wedge, the cardboard, the carton board, the card, from the plastic. I've yet to know anyone who routinely does that. It's a hybrid-part solution and its far from complete or totally successful and in my opinion is a waste of time. But it shows the intention to try and do something.</p>
<p>A: Method in choosing our supplier. We work with a few key suppliers, that have BRC as well, so we know that there kosher and that sort of stuff. Obviously, we recycle as well. Where we can, especially if we have reject trays, we take them back and use them, otherwise they get chucked in the recycling.</p> <p>**production and disposal stage**</p>

Figure 2.0 – Interview Q3a

Overall, it is clear that the packaging material and material supplier are the key practices that maintain the sustainability of Company A's packaging.

<p>Q3b: Do you use any form of Computer Aided Design to make your design and production process become more sustainable? (CAD/CAM etc.)</p>
<p>A: Not to make it more sustainable per say in using design. We use design for a new item for example, to show people the look on 2D paper and the dimensions of a new product, but I can't honestly link that to sustainability. The sustainability element is going to come from the material that is used, the manufacturing methods that are employed to make it, and of course, if you can design something which is effective and uses less material then that saves resources and that makes things more sustainable. But to say that it would be sustainable by using a software package or design element would be inaccurate. Currently.</p>
<p>**interviewer stimulates interviewee with a point on Company A's past efforts and future ambition to introduce 3D printing and CAM into their product prototyping process from recycled/plastic alternative materials (e.g., PLA)**</p> <p>PLA isn't from recycled plastic. PLA is basically polylactic acid, which is basically starch, normally from maize and it's a bio-plastic which is degradable under the right heat conditions. The reason we have made 3D samples is a mixture of reasons, including speed to be able to create something for somebody to physically hold, stick their product into it if they want to just to see how it looks to see if what they've imagined is actually suited by the design and the size of the item they are looking to use. That's the main reason for using it to be able to short circuit the design time from making a fully-fledged sample that takes quite a bit longer. Yeah, it does save materials.</p>
<p>A: That is slightly beyond my knowledge, but I wouldn't be surprised if we did. Our team in China, Hong Kong, they are our intermediary, so we do tend to work with China. They obviously send us blueprints; I can't go into too much further detail I'm afraid.</p> <p>**CAD team in China**</p>

Figure 2.1 – Interview Q3b

The 'use' of CAD for the sustainability of their products and production processes is not deliberate. Yet, the employee highlighted that CAD is already successfully integrated into their design process, with their factory and CAD team in China, who design product blueprints to manufacture. However, both were aware and positively optimistic of CAD's larger role in the future, especially as they also plan to use 3D printing to prototype client ideas to save materials.

Q3c: In a packaging product life cycle, would the greatest level of sustainability be achieved if sustainable design practices were applied at every stage of the production process?

Now companies like Kellogg's and Proctor and Gamble, are already aware, I know this from conversations with people and companies like Unilever, are already aware of the driving energy and force behind the sustainability movement. Which is like a stone rolling down a hill, its picking up more and more moss as it goes, it won't stop, it will just get bigger and bigger. So, there aware of having to change things so where their using heavy duty plastic bottles for example, to hold detergent liquid, there thinking about how we can change that. Now, it will be quite a while before all those things change, but yeah it its way.

A: The thing is, I think, especially with big companies, they can afford to look at the entire process, like I said before, when trying to apply for B-Corp and ethical stamps of good deeds, you do have to consider the entire life cycle. However, being pragmatic, not all companies especially smaller companies, can't really afford to look at the entire thing.

Figure 2.2 – Interview Q3c

These ambiguous answers suggest that this is maybe an unobtainable question (Figure 2.2) in today's industry, with the slow adoption of sustainability in packaging. Perhaps, this idea is only obtainable in the future when sustainability is more scalable and inclusively affordable.

Q4: How will Extended User Responsibility (EPR) impact your company?

A: Extended Producer Responsibility wont impact us a great deal, because were primarily not really plastic materials, but of course packaging per say needs to be carefully managed. So were not really too worried about EPR.

Mostly because what we're trying to do and are having some success with some customers is to promote natural fibre-based products which of course can be composted and we've had a recent result from the Open University that shows that it can and of course can also be recycled which we've got a pulpability certificate, so yeah. EPR is really about cutting down on the amount of plastic that is leaching into the environment.

Figure 2.3 – Interview Q4

Extended Producer Responsibility (EPR) is unlikely to impact Company A because their packaging is compostable. Yet, this still encouraged them to obtain 'compostability' certification. They still have a responsibility to educate potential customers who could incorrectly dispose of their packaging and harm the environment.

<p>Q5: Are there any stages/components within your design, production, and overall product life-cycle, that can cause harm to the environment?</p>
<p>A: Are there any stages or processes in our product life cycle that can cause harm to the environment, no, but like anything, if we were not mindful of waste, whether it be energy, water, or anything else, which of course we are mindful of, for simple commercial reasons, then that would be harmful. You know, as ludicrous as it sounds, if you leave an electric light on outside all the time it's just doing absolutely no good but it's just consuming power, that power has to be generated somewhere. We're all aware now that fact this country has been running on a great deal of fossil fuels imported from overseas including Russia which is not a great idea.</p>
<p>A: The most harmful aspect is possibly the transport, transport and relying on people to dispose of it how they're supposed to dispose of it. I can't remember how many containers, 40-foot containers get lost at sea every year, it's quite a few. With our stock it should be too bad because it time it would just degrade hopefully. So, you've got to consider what if that does happen.</p>

Figure 2.4 – Interview Q5

The director appeared to be slightly biased by the idea that a constant drive for sustainability decreases any environmental impact. Whilst the employee rightly identified that the transportation and disposal stages in their product life cycle have the greatest potential to harm the environment.

<p>Q5a: How do you plan to minimize the environmental impact of your company in the future?</p>
<p>A: Well, my focus is on how can we make the products that we produce as efficient and as less damaging to the environment as at all possible.</p> <p>Now to weigh that up, what I mean is this. So, if we can make for example, a food container, a tray that's to be used on an airline, and we can make it in a slightly lighter weight, and it still performs and it uses slightly less energy to make it. Then that would be the kind of thing we would drive towards. Now, if you get it wrong and you increase your wastage, you've gone through the barrier and you've had a crash because the whole idea of packaging is to protect the product its conveying. So, in simplest terminology, we will always be looking to do the most with the least.</p>

Figure 2.5 – Interview Q5a

A: The thing **is transport** is one of those **nessasery evils** unfortunately, a **company** that we did work with in the past, they were **developing electric vehicles** for their lorries. So, that's **probably the next step. **carbon neutral delivery****

Figure 2.5 – Interview Q5a

Despite the generalised nature of this response, it appears that addressing these two stages would meet Company A's aspiration to become as efficient and eco-friendly as possible.

Q5b: There is evidence to suggest that innovations in Computer Aided Design processes and software could be the key contributor in the production of more sustainable packaging in the future (e.g., Artificial Intelligence).

What are your thoughts on this statement?

A: I'm **not** sure I'm really **qualified enough** to answer because I'm not a **high-tech person**, but I'm aware of the fact that **AI that can't be, shouldn't be underestimated** and is going to have an incredible impact. How that's going to affect the production of product, I'm not entirely sure, but I'm pretty certain it will do.

I think the **harvesting of information** which of course we've seen with organisations like Google and so on, has been an incredible revelation over the years to know how things work and **analysing that information which AI can do quite quickly** is probably going to lead to clues to what's working and what needs to be better attended to. I'm sorry I'm not particularly sure I can give you a great answer.

A: It's very interesting. **I hadn't thought about how a technological advancement could help environmental factors.** Not even going that far back, I think our **process would be a lot slower**, especially as were dealing with things **internationally**, if we ever do get a **CAD product**, we say can we have a **mock up** and we get it **within the day**, and it gets sent off. So, things happen so **quickly** now. **I guess** it can **contribute to an environmental factor** as its all taken care of online. Otherwise, it would have to be printed and posted. **That's a very wide statement.**

Figure 2.6 – Interview Q5b

It is evident that Company A has not fully considered how CAD and similar technologies could benefit the sustainability of their products. However, they were aware of how without these practices, their current design process would be less efficient. Therefore, with the likes of AI, the speed and sustainability of their design process would be completely transformed.

Q6: Do you agree with the public assumption that the food packaging industry and supermarket retailers are the greatest contributors to the excess waste and negative impacts of the packaging industry?

A: That's a really cute question. Do I think that the retail industry and the supermarkets are the greatest contributors to waste in the environment? I'm not sure I do agree or be it they've all got more to do and I think there aware of it and the main are doing something about it.

A: In a perfect world I would have liked to have done some research to be able to have said one way or another. My knee jerk reaction is probably is that there probably the biggest, so generally yes, however I'm very aware that there not the only one. So maybe.

Figure 2.7 – Interview Q6

The majority disagreed, but also made rather ambiguous statements that proved their 'on the fence' attitudes. This is understandable, considering supermarkets are a major stakeholder and contributor in the packaging industry, but have already been taking steps towards sustainability.

Q6a: Please explain answer to question 6.

A: It's going back to the nessasery evils again. In my dissertation I asked people what concerns them the most; Food packaging waste or food waste, because I found out in my own research, that in a study, food lasted a lot longer if it was wrapped in plastic, compared to not being wrapped in plastic. So, yeah which is the worst, would you rather have better, more environmentally-friendly packaging but it doesn't necessarily last as long, or no packaging, but your food may go off. So, something needs to be done absolutely. I'm going to go maybe

Figure 2.8 – Interview Q6a

The interviewees presented a viable argument against question six (Figure 2.8), and again, referenced the concept of the 'necessary evils.' The protection of certain goods that hold great importance for human life is why plastic remains necessary, and without, such wastage would pose an equally greater risk of environmental harm. Therefore, compared to other industry players, supermarkets shouldn't receive as much negativity.

<p>Q6b: Do you think consumers play some role in the sustainability of packaging?</p>
<p>A: Most definitely because they have enormous influence over what it is the retailers want to provide them with. If everyone said right, I don't like that Kellogg's box. It's just absolutely ridiculous that its three times the size that it needs to be, and they stopped buying it, then Mr Kellogg's would either have to reduce their packaging box for it to be appropriate for the size of the contents or go out of business. So of course, customers and the public have a huge role to play, and the great news is, in my opinion and my experience of talking to people that is exactly what is happening now. People are questioning it rather than just accepting it.</p> <p>**Retailers trying to get ahead of the curve**</p>
<p>A: Yes. I don't know if you remember this much but, if it becomes a movement, then people start paying attention. So, I remember, quite a few years ago now, people started posting back Walkers packets of crisps. It's quite funny because Walkers had to put up a thing that said stop sending us your stuff, and people started sending back, literally a sticking label on a packet of crisps, because they wanted Walkers to be more environmentally responsible. That then prompted the response from Walkers, that they are now working with TerraCycle, and it's because of those people acting</p>

Figure 2.9 – Interview Q6b

Consumers were seen to positively contribute to the sustainability of packaging. It reiterates the power of sustainability as a movement that drives change, as explained in their anecdotes (Figure 2.9). Indeed, they have a considerable role to play in the industry, to the extent of shaping the future and economic stability of key packaging companies.

<p>Q7: How do you balance economic viability with eco-friendliness with your packaging products?</p>
<p>A: It's a really good question, because it's very tough, because no matter how clever you're doing things in the sustainable packaging world, you cannot do it at any price. There is an acceptable cost level that can be born for a product. Now, the good news is this, I've been pushing this whole discussion for more than a decade and I can remember for example, speaking to retailers ten years ago like the Co-op and they were using a plastic ready-meal tray, and they still use them today, that would cost around about 5p and our product was always going to be more expensive than that and still is. At one point, everybody in the market was saying it's got to match the plastic price. The shift now is enormous, because while the market is still largely in C-PET for a variety of reasons, there is a huge interest now in starting the change to other products and the really great news is that the recognition of an acceptable price difference, and that's the key phrase the acceptable price difference, is being recognised as necessary.</p>
<p>more. That is something which is a difficult thing to achieve for a variety of reasons, oil is cheap, making it into packaging on modern machines that have been developed over many, many years is incredibly high speed. High speed means low manufacturing costs.</p>
<p>The alternative of using fibres and the technology to make that is comparatively much slower, to manufacture, there's work going on to find ways to increase that, but it's always going to be more expensive because of the nature of the way it's made. The long-term projection is that because of taxation, which is how it will be dealt with I think, oil-based fossil fuel plastics will become more expensive, they will be penalised when they're not able to be recycled or not recycled, and fibre based natural products will become more available, will be produced in higher quantity, the technology and the drive to improve the manufacturing methods and the materials that are used will improve, and will become less expensive comparative to where they are today and I think there will be coming together, closer to those price points.</p>
<p>A: It's a difficult one. Again, we are almost relying on consumers saying this needs to change, and then when companies, especially the big companies, say it's going to cost more, enough of the need to say we don't need to care. The director has probably already said but our packaging is considerably more expensive than plastic, and it's trying to get them to understand.</p>
<p>Yes, it is more expensive, but it's so much more environmentally-friendly. So, we almost need to target, especially when it comes to selling, the right people. It is even down to contacting the right people within a company,</p>

Figure 3.0 – Interview Q7

This question in **Figure 3.0** was also designed to stimulate a mixed discussion from the interviewees. The cost and accessibility of sustainability were frequently referenced in this interview. This is because Company A's packaging is more expensive, the fibre material and production processes are slower. However, they aren't prepared to compromise on ecology for economic gain. This price difference is now more acceptable, thanks to the spread and push for sustainability in every aspect of society. Overall, this interview provided a comprehensive review of how the design and production of a sustainable alternative is achieved and could change in the future.

RESULT 2: Targeted Questionnaire

Out of the eight stakeholders targeted, only two companies in the - 'Packaging Company & Digital CAD Design Expert' group responded. This was not detrimental however, as their direct connections to the study niche had the potential to fill previous literature gaps. Also, the range of age groups in the company representatives, 20-29 and 60+, provided a plethora of conversation points. For consistency, the previous themes were carried over for this data analysis. **Appendix I** shows excluded results.

Sustainability & Packaging

The importance of sustainability to a company can affect the extent of its success. The choice of packaging material is guaranteed to increase the sustainable merit of packaging, alongside the creation of a design brief. Sustainable materials mitigate the negative impacts of the end-of-life stage, but the greatest sustainability is achieved when considerations are implemented from the outset.

The Presence & Awareness of Digital Practices

CAD is linked to sustainable merits in the design of packaging. CAD amongst other technologies are used to create bespoke packaging, to decrease project time and required resources, but increase efficiency. The current success of companies using these practices, in combination with the predicted innovation in CAD, is valid evidence to suggest that sustainable packaging will be the industry norm in the future.

The Producer, Market, & Consumers

Insisting the use of sustainable materials equally benefits the reputation of the producer and their client. Utilising renewable resources in the production process can offset unavoidable emissions. Most consumers lack general understanding of how to dispose of packaging. Therefore, stakeholders should take responsibly for their own packaging. Economy versus ecology is invariable, sustainable packaging is rarely economically efficient, and like most alternatives, is more expensive because of the cost to build.

‘Packaging Company & Digital CAD Design Expert’ Questionnaire Analysis

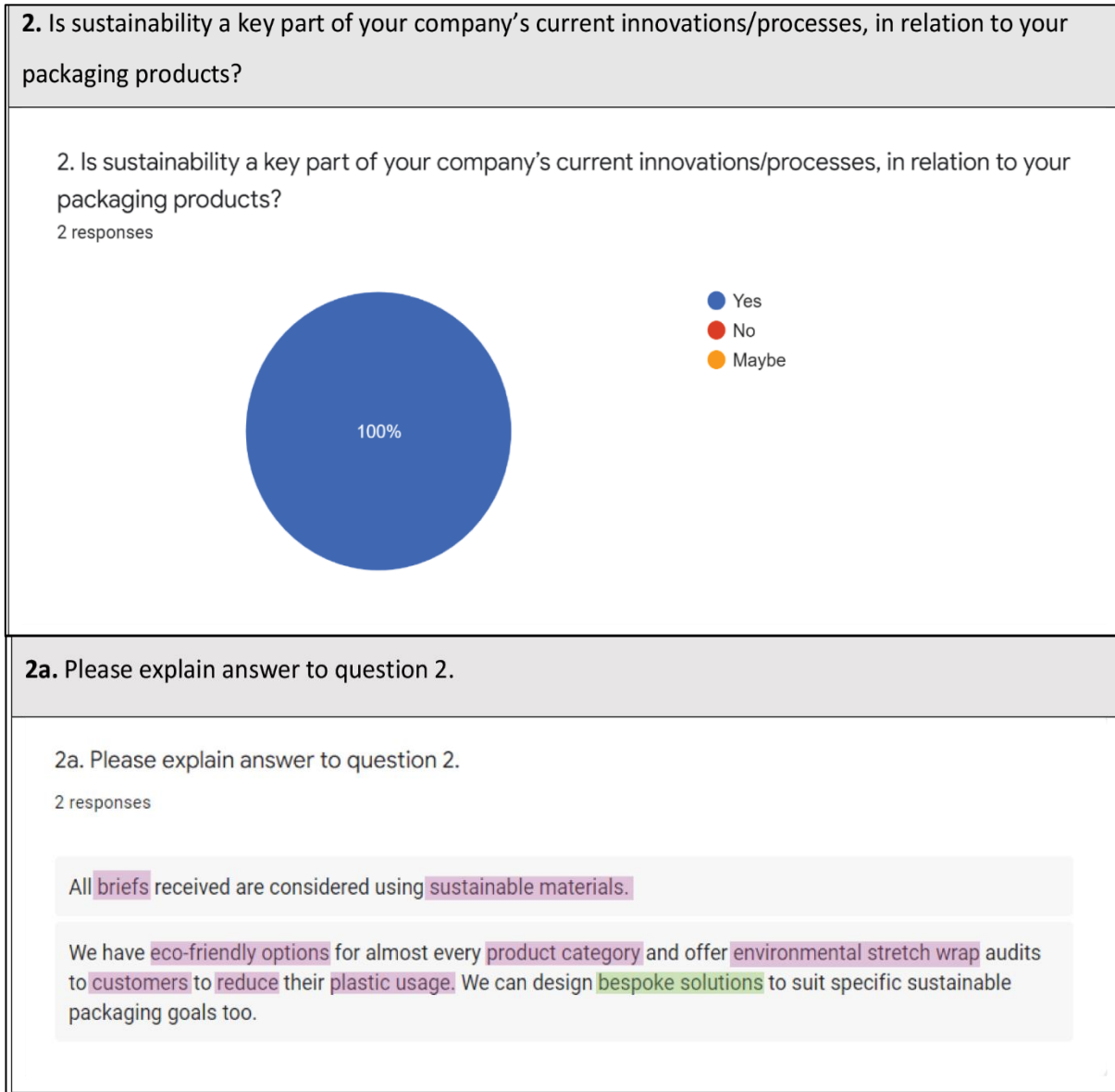


Figure 3.1 – Questionnaire Q2, Figure 3.2 – Questionnaire Q2a

Figure 3.1 shows that sustainability is a key part of these companies current processes and packaging products. The common application of this sustainability is through the material choices offered to clients during the design process (Figure 3.2). This is also beneficial for the sustainable merits of their customers.

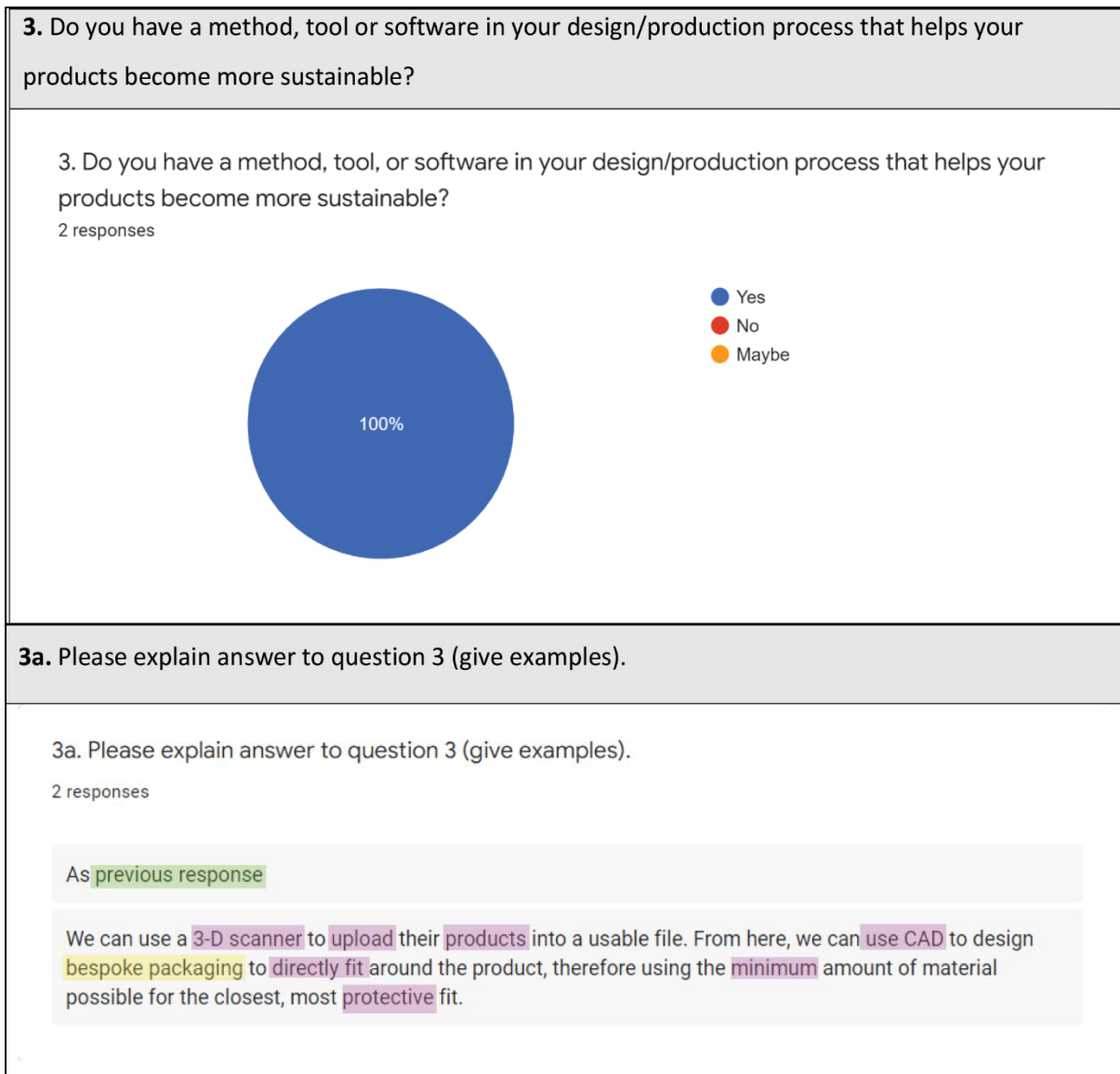


Figure 3.3 – Questionnaire Q3, Figure 3.4 – Questionnaire Q3a

It is evident that both companies have a set strategy that increases the sustainability of their products (**Figure 3.3**). For example, one reiterates in **Figure 3.4** that material choice is key for sustainability and proves that it is a well-practised component in their design process. Another revealed the use of a '3D scanner' to digitally implement a product into the CAD environment. Therefore, the packaging is designed for a perfect fit and functionality, saving resources, time, and money, and increases the sustainability of the entire life cycle.

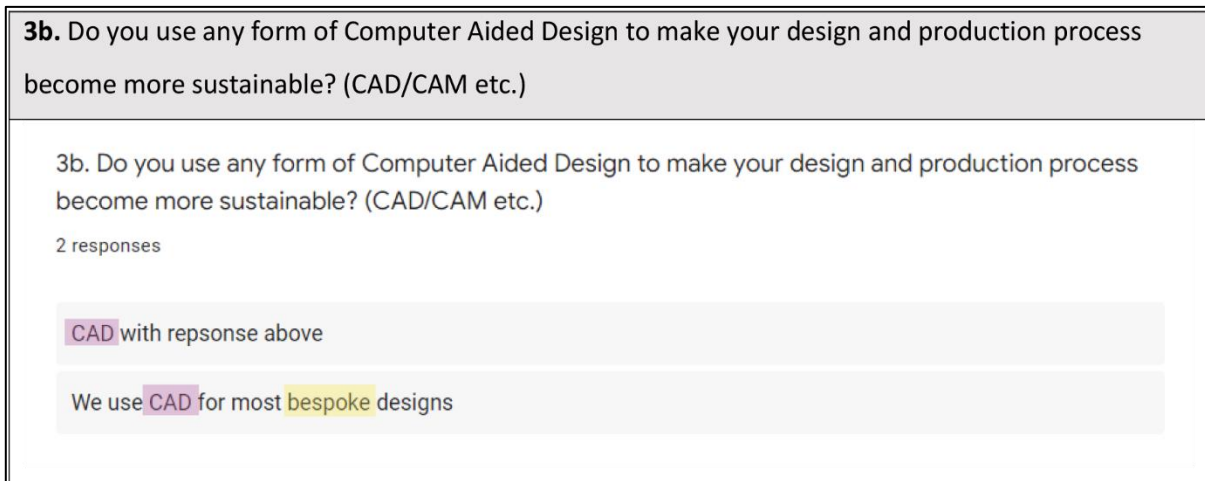


Figure 3.5 – Questionnaire Q3b

Figure 3.5 restates that CAD and similar forms of technology are used successfully to make their production process and packaging products more sustainable.

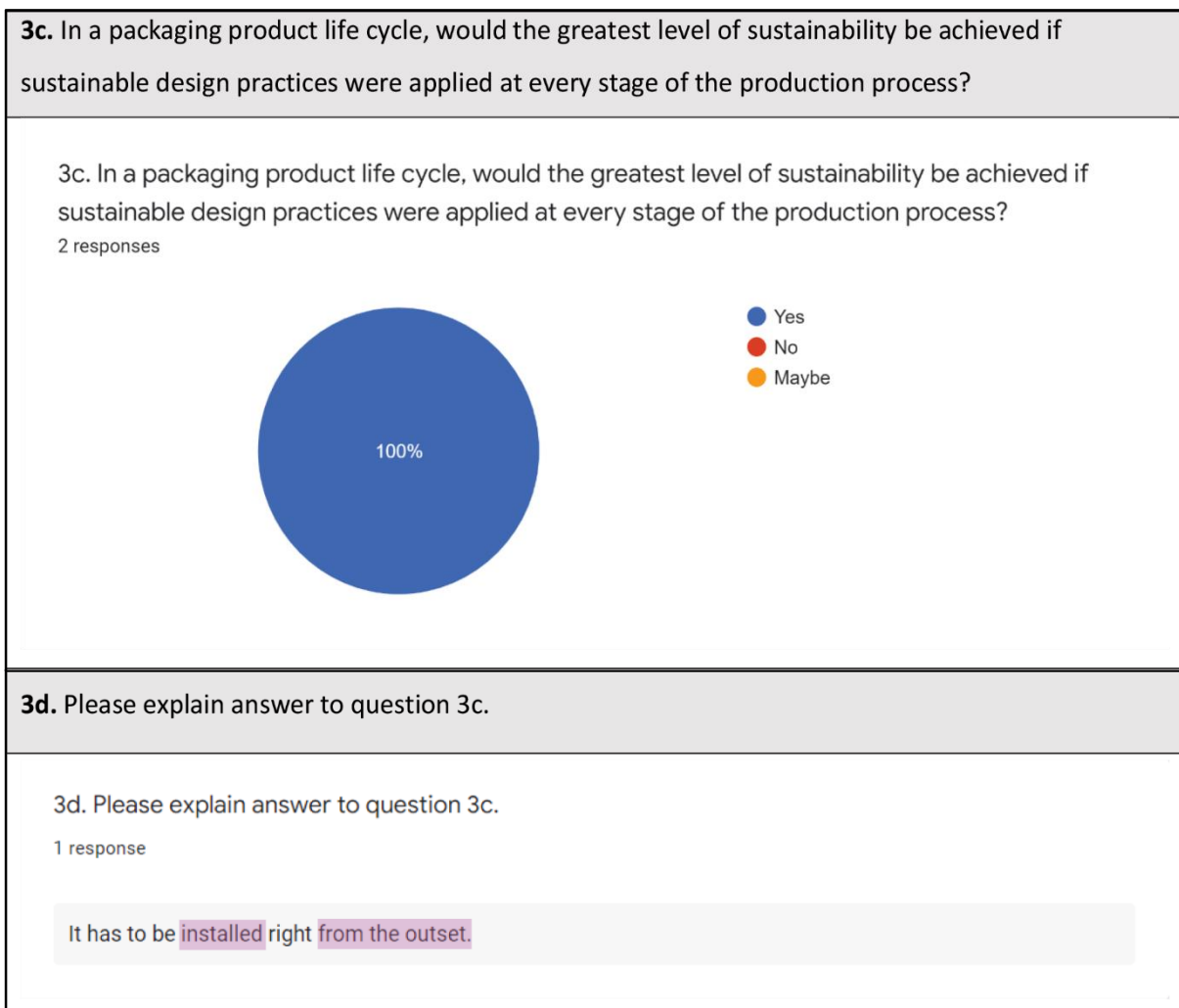


Figure 3.6 – Questionnaire Q3c, Figure 3.7 – Questionnaire Q3d

The statement in **Figure 3.6** was strongly agreed with. However, reasoning behind one perspective was elaborated (**Figure 3.7**), that the extent of sustainability can be even greater if these practices or considerations are applied from the outset. This is a creditable judgement because these companies are commercial proof that implementing these practices, through eco-friendly material choices, has measurable success.



Figure 3.8 – Questionnaire Q4a

The first diverging perspective (**Figure 3.8**) in the questionnaire regarded the relationship between their company and the pending Extended Producer Responsibility (EPR) policy. Despite agreeing that the policy won't impact their products and commercial functionality, one representative questioned whether the policy would aid product sustainability. Perhaps, it was interpreted that this would occur externally to the practices already in place.

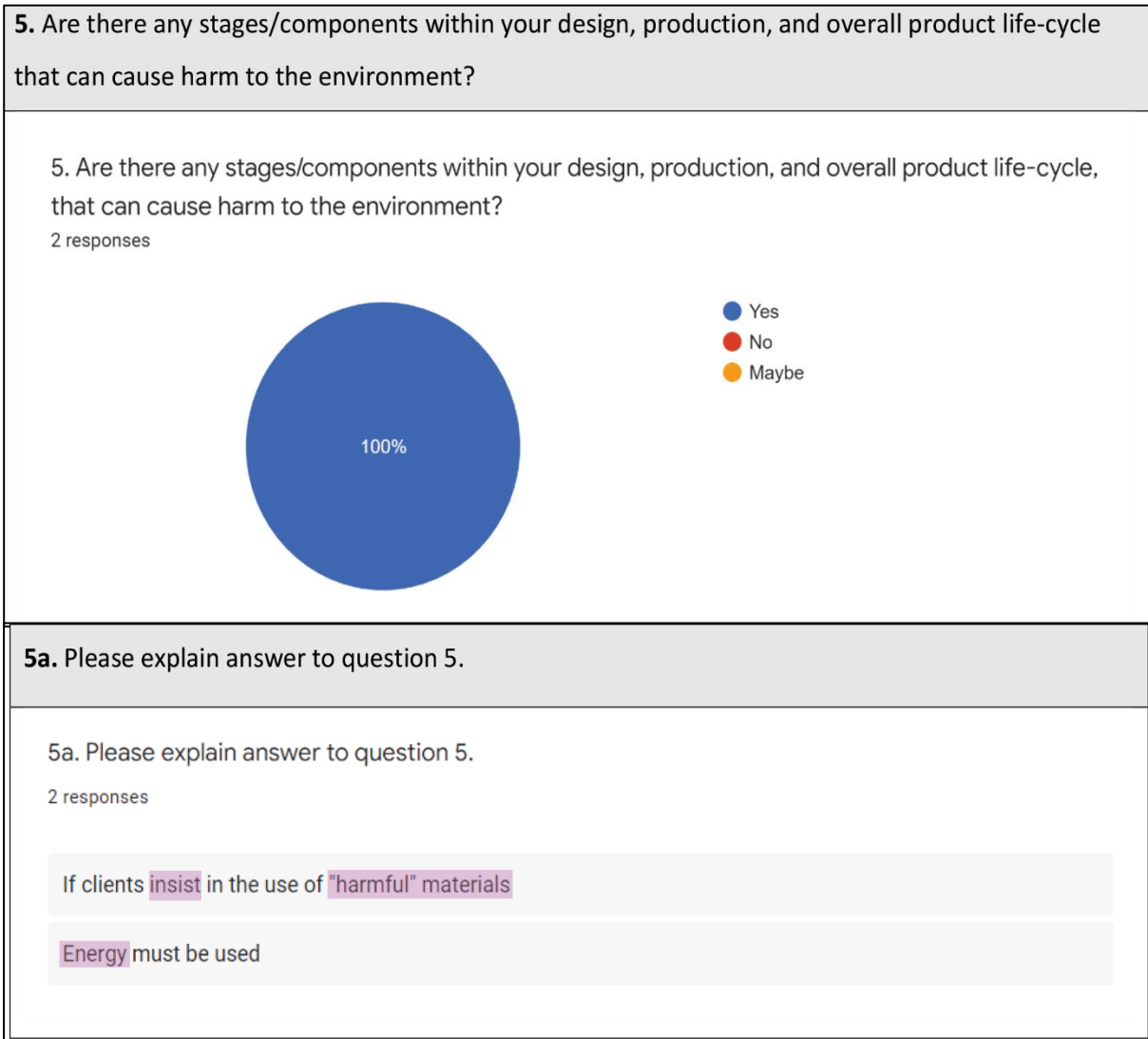


Figure 3.9 – Questionnaire Q5, Figure 4.0 – Questionnaire Q5a

The stages considered to be the most harmful varied in **Figure 4.0**. The first related back to material choice, that even when presented with greener alternatives, clients have still demanded or needed unsustainable packaging materials. This also applies to the necessary energy and water required to design and produce packaging, these conditions are unavoidable and critical for economic stability.

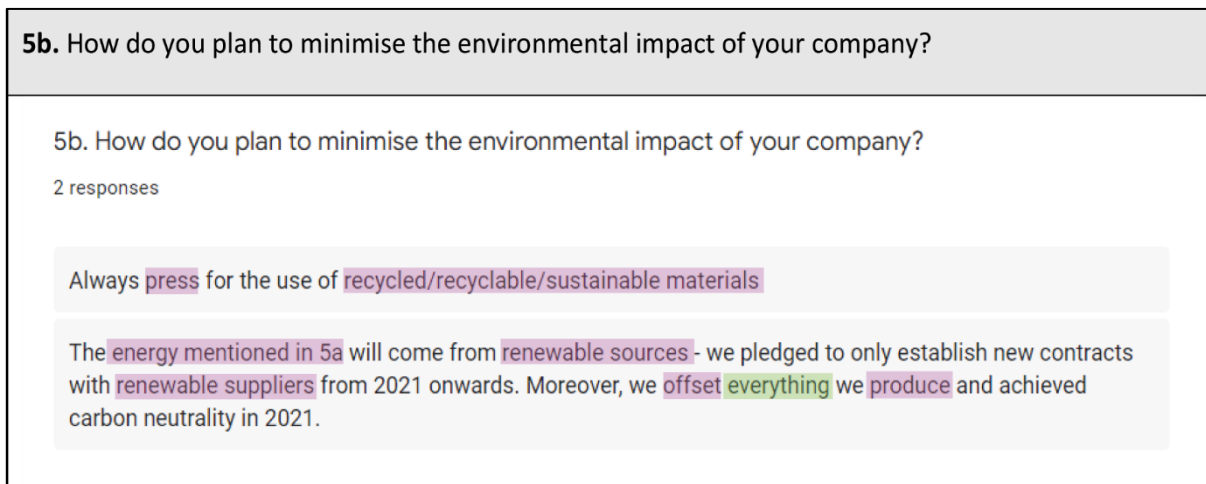


Figure 4.1 – Questionnaire Q5b

These responses (**Figure 4.1**) illustrate how they plan to address the environmental pitfalls of their packaging life cycles. The enforcement of only recycled and sustainable materials, and the removal of the less eco-friendly options. The necessary resources required in the design process, such as electricity, should be renewably sourced. It appears that environmental drawbacks can drive further improvements in packaging companies.

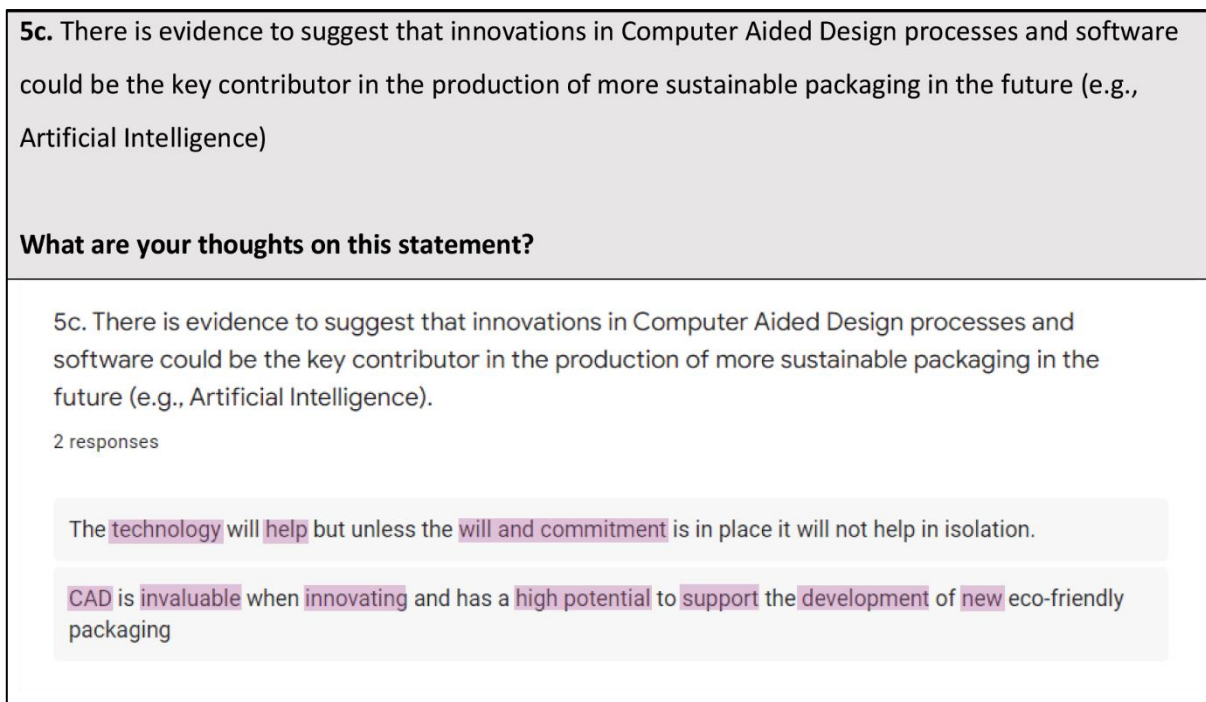


Figure 4.2 – Questionnaire Q5c

Adopting CAD for sustainable merit is already utilised by these stakeholders (**Figure 4.2**), and so deemed it 'invaluable,' along with AI, for future innovations in sustainable packaging. However, one respondent highlighted that this would not be as successful in isolation, even

with the economic means, especially if a company lacked sustainable drive and belief in their ethos or goals.

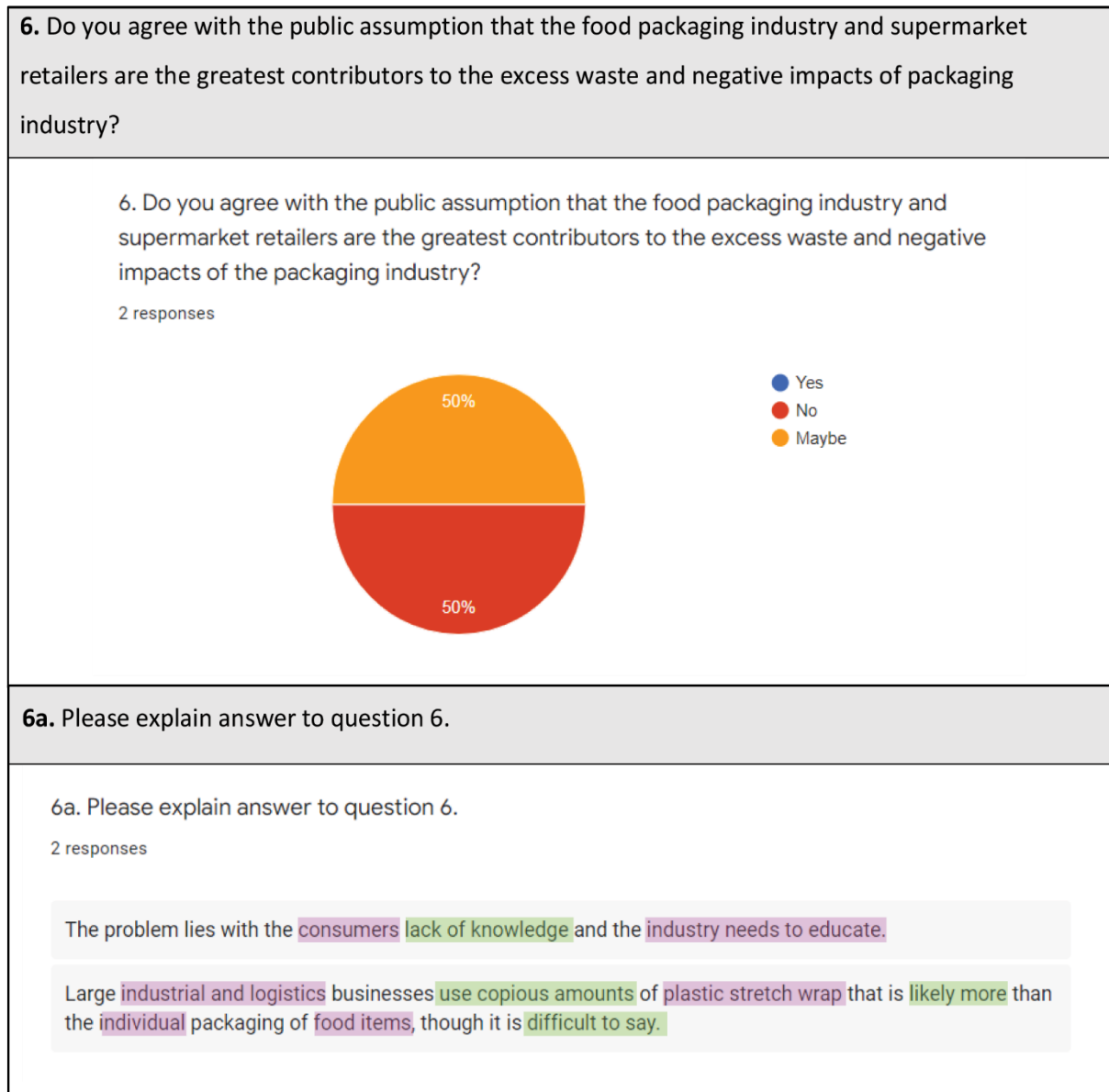


Figure 4.3 – Questionnaire Q6, Figure 4.4 – Questionnaire Q6a

The question in **Figure 4.3** was designed to reveal strong assumptions surrounding supermarkets and the environment. Consumers were suggested as an even greater contributor (**Figure 4.4**), regarding packaging and end of life. Despite neglecting the increasing number of ethically minded individuals (vegetarians, vegans), the equally growing market of complex eco-materials proves the viability of this proposal.

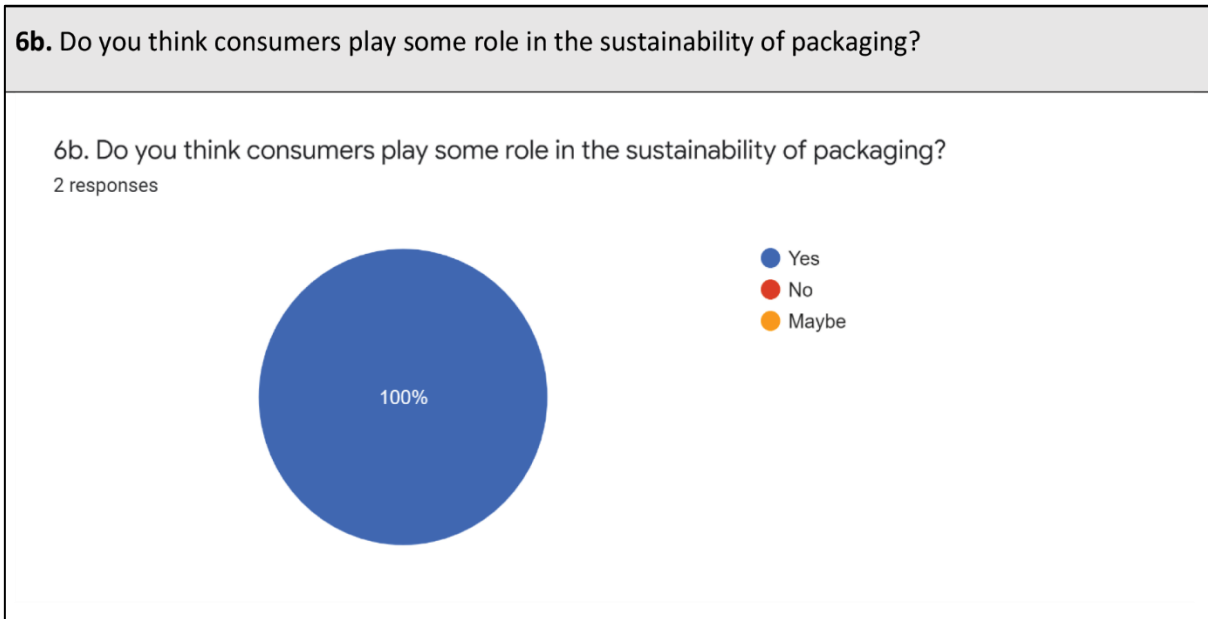


Figure 4.5 – Questionnaire Q6b

Figure 4.5 proves the minor bias shared by both respondents, revealed in the previous question. Consumers are one of the major contributors to the impact the packaging industry has on the environment.

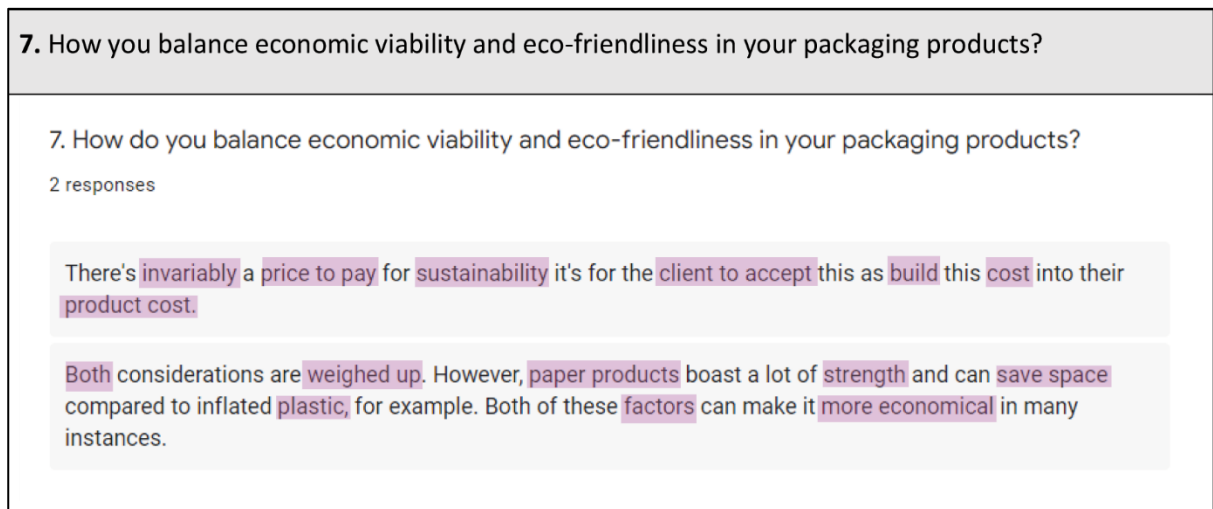


Figure 4.6 – Questionnaire Q7

Economic and environmental viability is a challenge for all stakeholders, and is invariable when it comes to the design of sustainable products. The cost to make and retail sustainable packaging is high, but the environmental cost is considerably low. Whilst this accounts for the majority of alternatives, there are some exceptions for lighter materials. Paper and card can be more economical than heavier and less eco-friendly packaging.

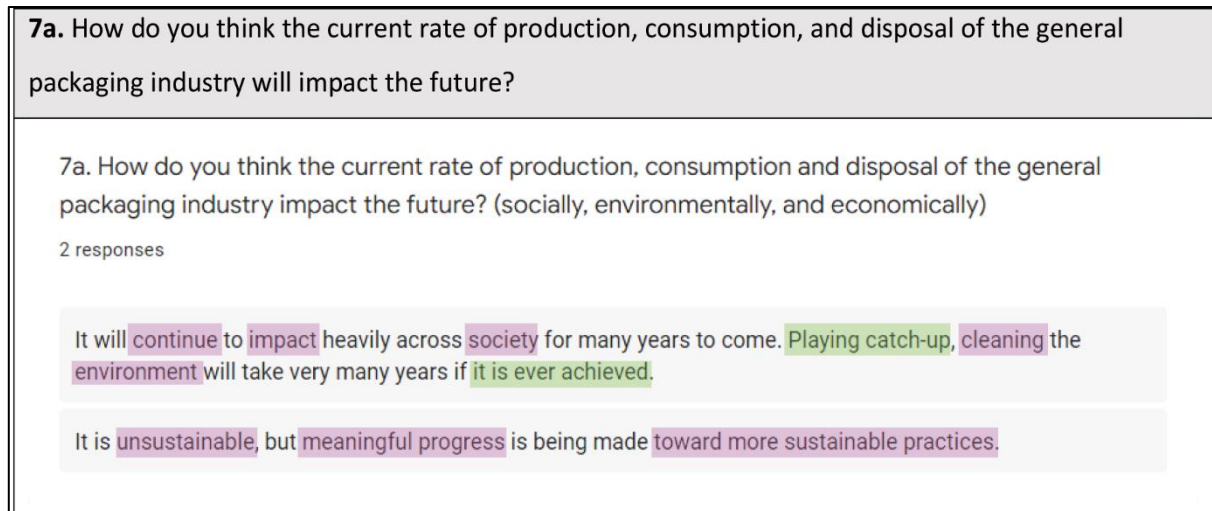


Figure 4.7 – Questionnaire Q7a

Interestingly, both companies presented alternative scenarios on their perspective regarding the future of the packaging industry (**Figure 4.7**). One proposed, with arguably cynical undertones, the idea of ‘playing catch-up’, which suggested this representative has had extensive experience and has witnessed changes over the years that have tried and failed. Whilst the other held a more balanced outlook, and acknowledged that it is currently unsustainable, but ‘meaningful’ progress being made. These two companies are contributing to the progress and overall movement of sustainability. They demonstrate how in the future, with the increase and normality of sustainable practices in the packaging industry, there will be measurable ecological benefits in the innovation of sustainable design.

RESULT 3: Public Perspective Survey

The sample size was adequate for collating supportive evidence. The spread of ages of the respondents (referred to as consumers), with varied life experiences and opinions, should further benefit the result quality. However, organising numerous responses was challenging and meant the analysis stage required extra time. The simplified nature of the survey altered the theme categories, but still relate to the study. See **Appendix J** for the remaining results.

The Consumer Market, Products & Packaging

The consumers were more likely to purchase a product based on the visual appeal of its packaging. They were also unaware of the environmental benefits of alternative materials, still preferring glass and tin, and widely avoiding plastic. Despite good intentions, the desire or need for a product was more important than environmental concern, or worse, some didn't care. There appears to be an issue of accessibility to sustainable packaging, namely, cost, time, and availability of these materials where they shop. Overall, the consumers believed that supermarkets, producers, and manufacturers are the most environmentally harmful stages in the packaging industry.

Waste & Disposal

A substantial number of consumers believe that recycling is important, but not all base this judgement on environmental concern. There is a general misunderstanding of how to correctly recycle packaging, and some were unaware of the risk to the environment.

The Future of Packaging

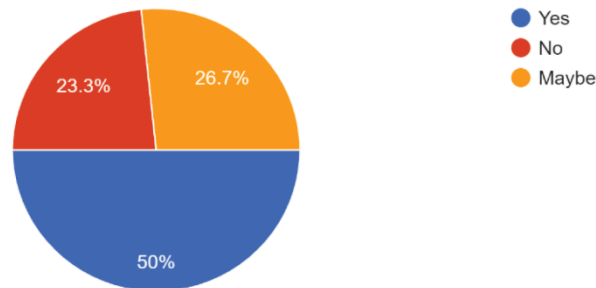
Consumers strongly agreed that packaging needs to be more sustainable, eco-friendly, and reusable, and not reliant on plastic. They demonstrated a desire for action and sustainable change, but also doubted that this would occur. The barrier to this change was believed to be larger companies reliance on plastic, with agreement that sustainable packaging reduces environmental harm, but not in isolation.

‘Sustainability & Packaging; Public Perspective’ Survey Analysis

2. When purchasing products online or in a supermarket, does the packaging effect your buying decisions/habits?

2. When purchasing products online or in a supermarket, does the packaging effect your buying decisions/habits?

30 responses



2a. Please explain your answer.

2a. Please explain your answer.

26 responses

If the packaging looks to be of higher quality/ have a certain aesthetic that entices me more to buy than if something were 'poorly' packaged.

If its eye-catching

I'm more inclined to buy something packaged in cardboard, or if the packaging is recyclable, however, I'm not going to avoid buying something because of the packaging

If there's an option with less plastic I'll buy that but if a product I want is only packaged in a lot of plastic it won't stop me from buying what I need. As a student it is hard to always find time to source out environmentally friendly options if they are not accessible in my local supermarket.

I try to purchase goods that are not over packaged - cakes need to have only two wrappers not individually wrapped for example

I never thought about looking at the packaging when buying products

Figure 4.8 – Survey Q2, Figure 4.9 – Survey Q2a

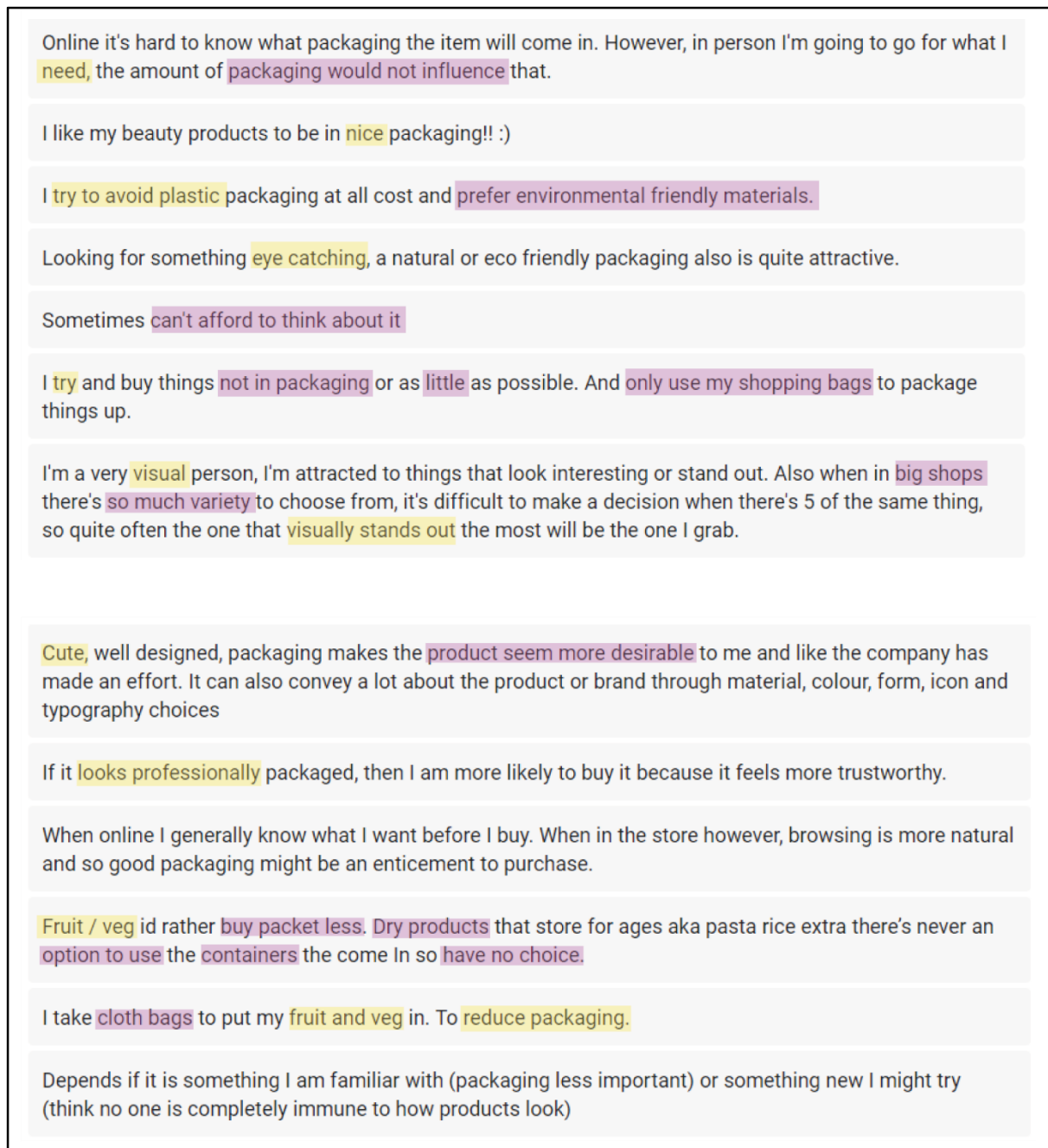


Figure 4.9 – Survey Q2a

The 50/50 split of results in **Figure 4.8** shows a substantial difference in opinion, or uncertainty, on the importance of packaging when purchasing goods. Consumers are more likely to purchase packaging based on visual and aesthetic appeal, rather than eco-friendliness (**Figure 4.9**). On top of this, the desire or need for an item also persuades the purchaser. The variables of cost, time, and accessibility, shapes the behaviour of all consumers, even those who intend to be more ethical. The passion behind the choices of the eco-individuals was equally evident, especially in their bias against plastic and preference of eco-friendly materials.



Figure 5.0 – Survey Q3

Despite the spread of perception regarding the importance of product packaging, the majority in **Figure 5.0** were aware that packaging disposal can harm the environment. The small percentage in disagreement could be interpreted as being nonchalant towards packaging.

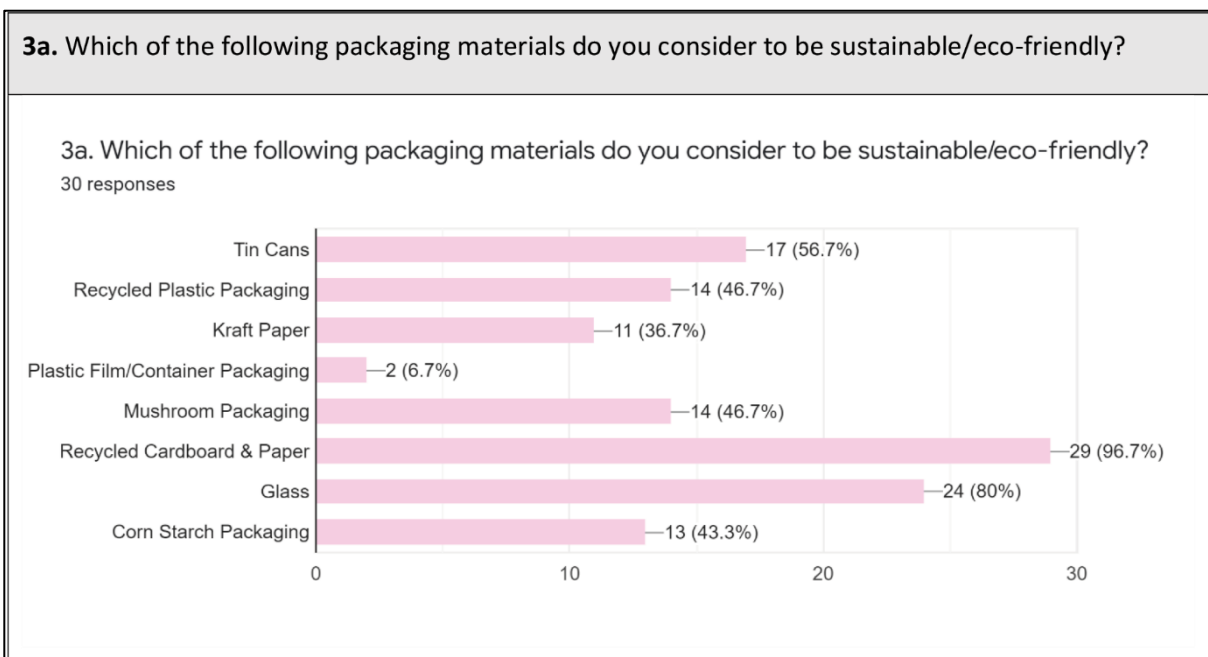


Figure 5.1 – Survey Q3a

In **Figure 5.1** consumers rightfully perceive ‘Recycled Cardboard & Paper’ as the most sustainable packaging material. However, this is the only alternative material selected within the top three choices. The remaining eco-materials had similar scores. This suggests that

general knowledge on these materials is yet to be common knowledge, whilst traditional packaging materials like card, tin, and glass, are the most actively recycled. Therefore, familiarity and handling influences favorability.

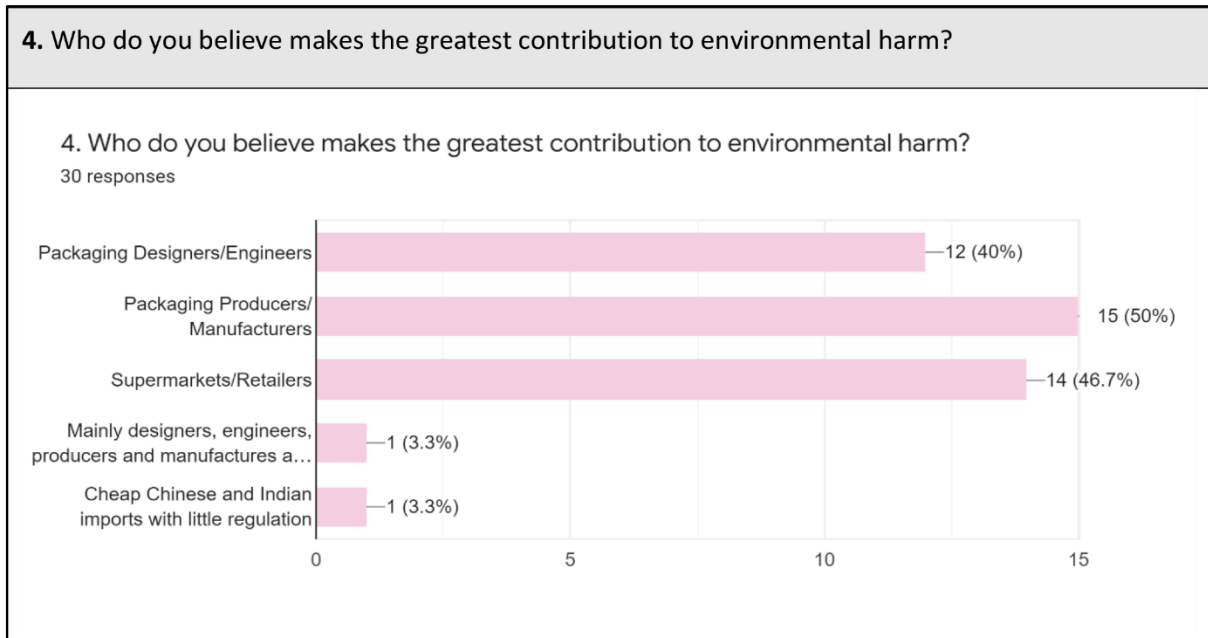


Figure 5.2 – Survey Q4

The most harmful stakeholders were deemed the 'Packaging Producers/Manufacturers' in **Figure 5.2**. An expected result, as most associate industrial activity with mass pollution and emissions in factories, to diesel-guzzling vehicles for global transportation. Not far behind was 'Supermarkets/Retailers'. This intermediary between product and consumer often receives a constant barrage of negativity in the media surrounding packaging. This, alongside first-hand experience during their weekly shop, reveals the influence behind the potential consumer bias against supermarkets.



Figure 5.3 – Survey Q5

The majority of consumers in **Figure 5.3** considered that recycling is important and ‘worth the effort,’ and even suggests an awareness of the value of these materials beyond their predetermined use.

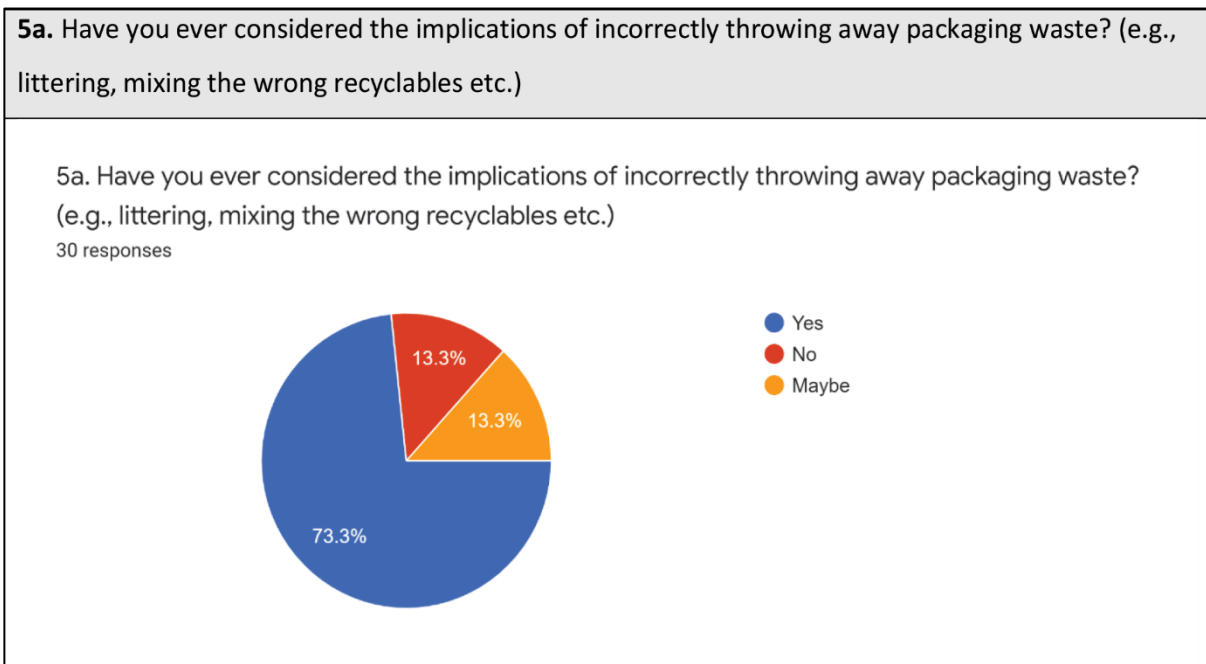


Figure 5.4 – Survey Q5a

In a surprising contrast to **Figure 5.3**, over a quarter of respondents hadn’t yet considered, or didn’t care, about the implications of incorrectly disposing of packaging waste. Despite those in agreement, this result in **Figure 5.4** is concerning and reinforces the idea that consumers lack general knowledge of packaging materials, recycling, and disposal.

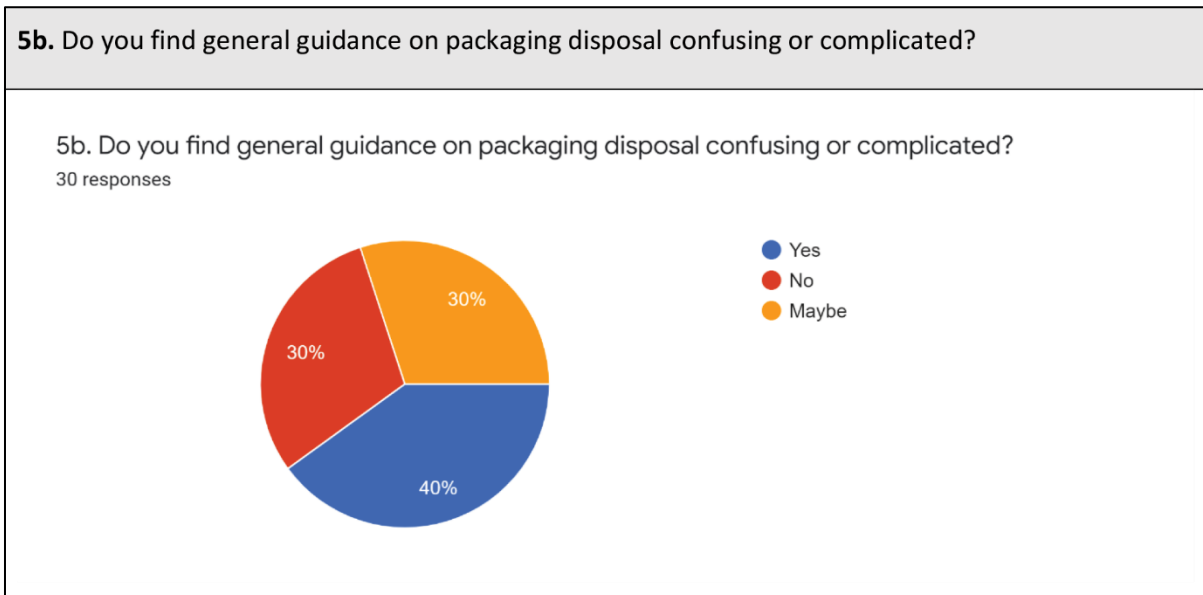


Figure 5.5 – Survey Q5b

This almost equal spread of results across all choices (**Figure 5.5**) confirms the notable need to improve current guidance on how to correctly dispose and recycle packaging. If there was greater awareness of the damage and pollution that mistreatment can cause, like that of plastic, the future understanding and in turn the environment, would dramatically benefit. Simplifying the convenience of end-of-life tasks would benefit all consumers, especially with the influx of new sustainable alternatives.

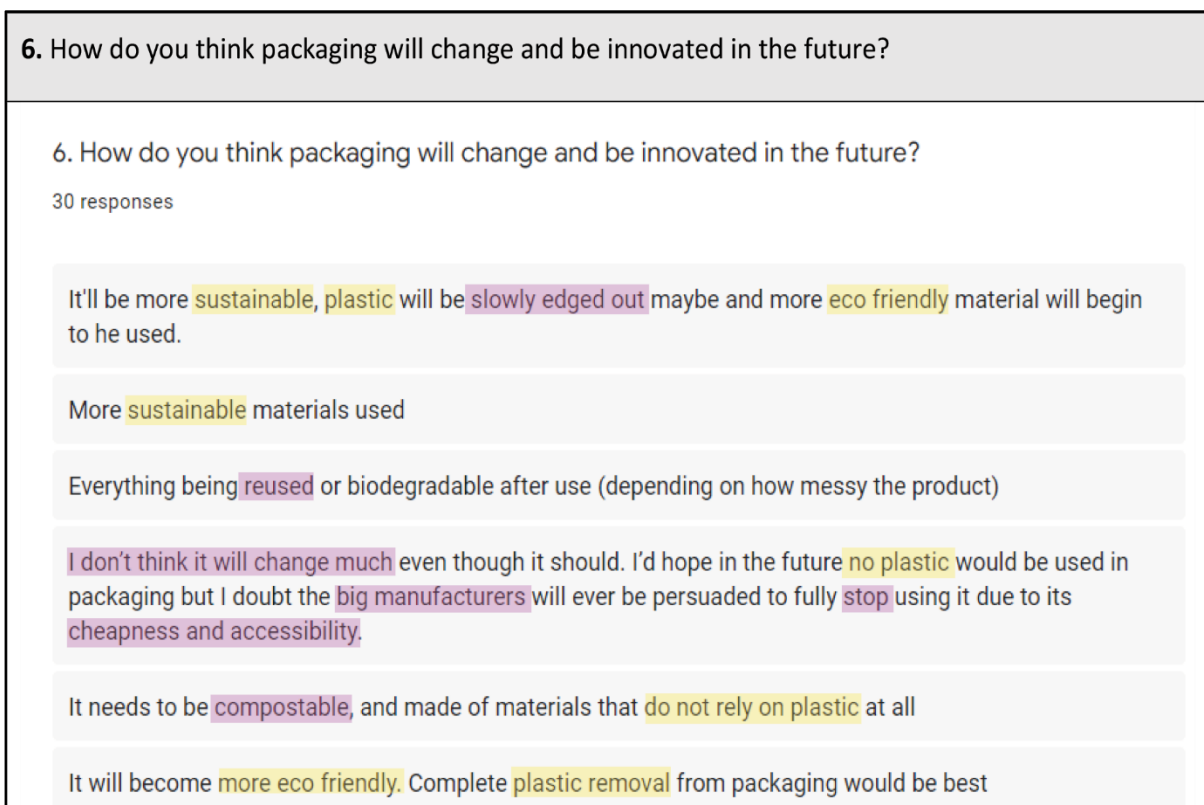


Figure 5.6 – Survey Q6

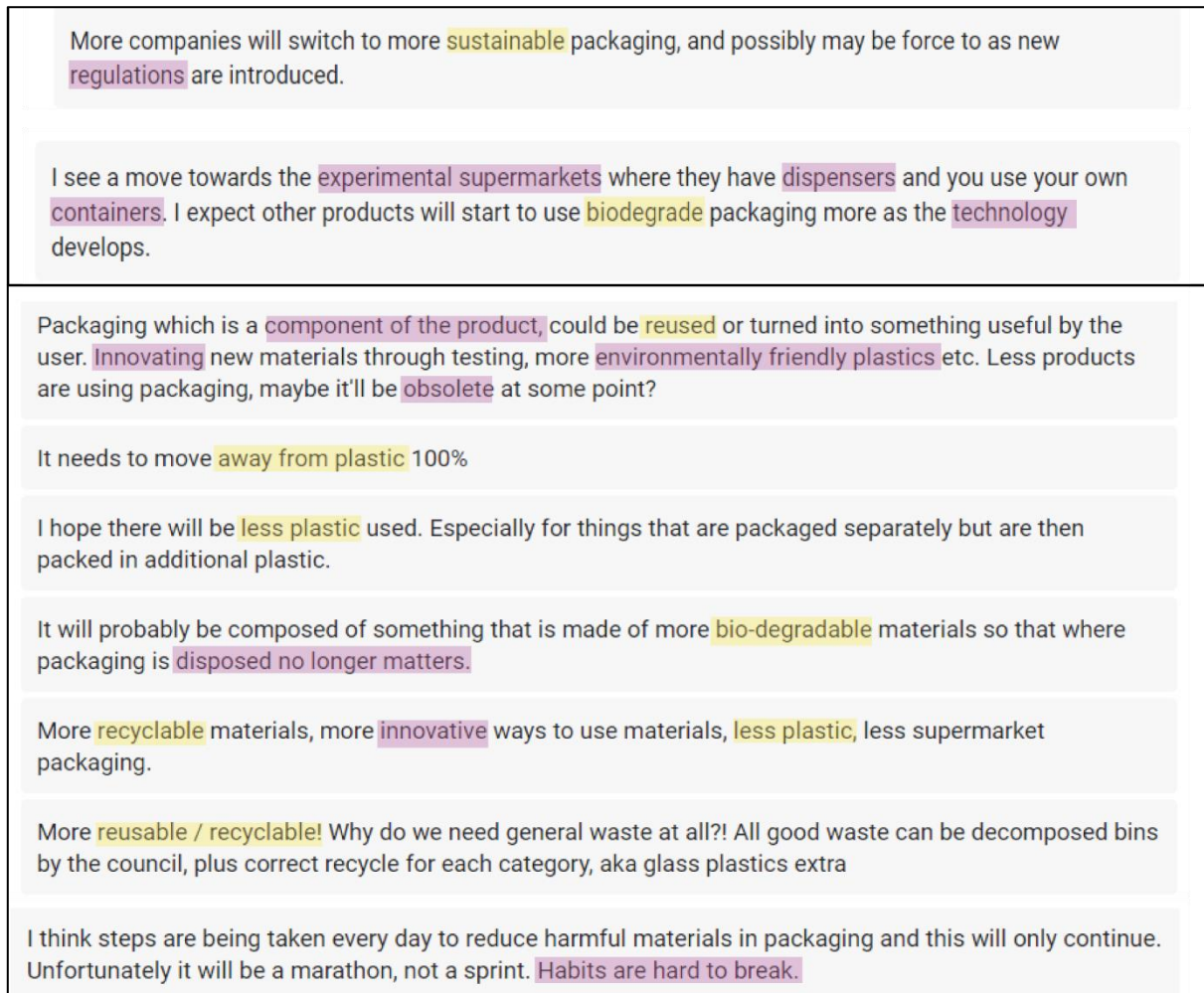


Figure 5.6 – Survey Q6

The open-ended nature of the question in **Figure 5.6** stimulated the consumers on the future of packaging, with their previous answers in mind. There was a frequent desire and belief in the need for more sustainable and eco-friendly packaging, with valid suggestions of how this could be achieved. This illustrates a perceived importance of sustainability, and that packaging must become less ecologically harmful. Several had a perspective of the bigger picture and expressed valid doubt that with unsustainable materials still at large, will this change ever occur?

6a. Do you think sustainable packaging can reduce how much the packaging industry damages the environment?

6a. Do you think sustainable packaging can reduce how much the packaging industry damages the environment?

30 responses

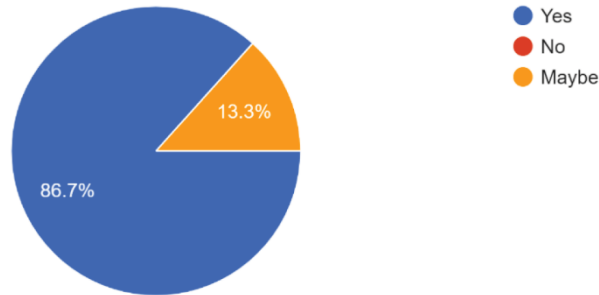


Figure 5.7 – Survey Q6a

The consumers had a predominantly optimistic view of the future value of sustainable packaging, and how it could reduce the extent the industry harms the environment (**Figure 5.7**). This shows a clear determination to support and provoke sustainable change. Their comments in **Figure 5.8** (below) revealed interesting ideas, including the desire to make packaging ‘disappear,’ and how this would be achieved with biodegradable materials. Although sustainable, this admiration is misplaced, and demonstrates a lack of understanding of what alternatives can decompose into, or more importantly, that this is not possible in landfill.

6b. Please explain your answer (if you can).

6b. Please explain your answer (if you can).

21 responses

If you use **unsustainable** and **non recyclable/non biodegradable** packaging it will only add to the growth of **landfill** and the **gasses** that are produced to make the material.

Easy enough to become **carbon neutral** if the packaging being used is **eco**, the **power for machines** used is **sustainable** and the workers are vegan

If the packaging is **biodegradable** it will degrade over time and **not stay in the environment**.

It's simple **get rid of plastic** - and **make the other alternatives compostable** so when they go to landfill they **disappear**

Sustainable packaging would **help reduce the environmental impact**, however there are also **other parts** of the **industry** that will likely have effects too that will **need to be addressed** - but it would definitely significantly help!

Using **sustainable** packaging does **reduce their impact on the environment**, not much to explain.

Recyclable, biodegradable materials require **minimal or no raw materials** to produce beside leaving smaller **carbon footprint**. **Combined** with **innovative** packaging methods the industry's **environmental impact** may be further **reduced**.

If produced as the main packaging material, it could **replace single use plastics** and dramatically decrease the **carbon footprint** of the **creation and disposal process**

If we are able to **move away from plastics** more it would be good, but it also **depends** a lot on what the **recycling** people end up doing with it equally, if even green packaging is still just ending up in landfills its not a lot of use.

Through **sustainably sourcing materials** and having **ethical practices** (looking after workers etc.) it will cause less damage, especially if disposed of correctly

Reusing plastic. Using glass rather than plastic. **Less demand for plastic will mean less supply needed**.

Figure 5.8 – Survey Q6b

Despite sharing this sustainable determination, as in **Figure 5.6**, some perceived that there are wider issues to address, and that sustainable packaging wouldn't decrease the industries impact alone. It was expressed that creation, production, and manufacture stages have greater impact, or even that instead of making new packaging, existing waste (recyclables) should be better utilised in the future to clear landfills. Overall, this survey provided the opportunity to gain insight into the perspectives of the public, who are at the at the epicentre of the packaging industry.

SUMMARY

The consistent themes within the results backed up and enhanced the secondary findings, objectives one to three, as well as validating the thesis question and objectives four to five. The practice of choosing ethical materials guarantees sustainability, and increased circularity of packaging. Furthermore, CAD and related technologies (CAM) can successfully increase the sustainable merits of the design process and packaging product life cycle. Consumers also have a considerable role in the sustainable merit of packaging. Despite sustainable intentions, most chose desire over ecology, and lack awareness of the value of alternative materials and handling at the point of disposal. This alludes that three variables, namely cost, time, and accessibility, impact the extent of packaging sustainability.

Several points also presented unexpected perspectives. The collective power of sustainability as a movement, influenced by increased eco-awareness, contributes to the innovation and progression of sustainability across the packaging sector. However, if sustainable efforts are executed in isolation to other environmental pitfalls, there is limited performance of the packaging and environmental benefits. Moreover, there are stakeholders who still lack awareness and expertise in relation to digital design practices (CAD) on the efficiency and sustainability of packaging, and therefore hamper the extent of their own ecological and commercial successes.

DISCUSSION

The outcomes of the secondary and primary evidence shared consistent themes - design for sustainability, waste and disposal, education and awareness, and accessibility. These results equally supported and reproached the thesis question, to what extent can sustainable design improve the circularity in the creation, production, and disposal of food packaging?

Sustainable design practices and CAD can contribute to the circular production of packaging. These according to Pigosso *et al.* (2019), broadly known as Eco-Design (ED) principles, are strategies to 'design-out' the environmental pitfalls associated with packaging production. **Figures 3.2** and **4.1** illustrate the measurable environmental benefits of ED's. The use of eco-friendly materials, recyclable or degradable (*Eco To Go Food Packs*, 2020), like Company A's food packaging (**Figure 1.8**), are key in regenerative packaging production. CAD and other digital media practices, predicted to improve with AI and 'algorithmic design' (*Quattro Design*, 2021), are already solutions in sustainable packaging design (**Figure 3.5**). In **Figure 3.4**, CAD is utilised to produce viable packaging in the first attempt. This bespoke strategy increases project efficiency, saves valuable funds, and accelerates the sustainability of the entire product life cycle. However, sustainable design practices also come with disadvantages, including the cost intensity of digital media and CAD software (Flynt, 2019). More importantly, if utilised in isolation (**Figure 4.2**), without addressing other issues like excess transportation emissions (**Figure 2.5**), there will be limited environmental and economic gain.

In fact, looking beyond design at the wider industry, the secondary results alluded to several factors directly hindering the sustainability of food packaging. Efficient infrastructure across a packaging life cycle will better facilitate sustainability. Inadequacies in today's end-of-life infrastructure renders it unsuitable to process the current disposal rate of packaging (*COST Association*, 2021), leaving most useful materials in landfill or as litter (Supermarket Perimeter, 2021). Additionally, the lack of educational infrastructure for consumers on how to correctly dispose of this waste (**Figure 2.4**) leads to environmental repercussions (**Figure 5.5**). Limited awareness on alternative materials, conveyed with biodegradable packaging in **Figure 5.8**, or the contamination of recyclables (*Eco To Go Food Packs*, 2020), can thwart sustainable efforts at design and production.

However, consumers aren't completely to blame and do demonstrate ecological intentions (**Figure 4.9**). Producers and retailers, especially supermarkets, arguably have more responsibility over their packaging (**Figure 4.4**), soon to be more with EPR (Croner-i, 2021). Therefore, leading stakeholders like Waitrose and Partners, already attempting the reduction of packaging waste (Bullet, 2021), should simplify the delivery of information to make disposal a convenient task for all.

The primary evidence introduced new concepts to the study, influences that dictate the extent packaging can be sustainable. This inspired the concept, 'The Variables of Sustainability' - cost, time, and accessibility. These variables limit the extent the industry can be sustainable, with the cost of sustainability; sourcing materials from ethical material suppliers (Employee, **Figure 1.9**), and the 'slow' nature of the manufacturing process (**Figure 3.0**). Also, even with adequate funding, the lack of access or expertise in sustainability tools, as with Company A (Director, **Figure 1.9**), means that the sustainable success of packaging products is limited. Consequently, it is still unviable to completely utilise sustainable design solutions for sustainable packaging design, production, and disposal (**Figure 2.2**). Nevertheless, the power of consumer influence is set to accelerate and normalise sustainable growth for the better of the environment and food packaging industry.

Despite neglecting the sustainable efforts of stakeholders (Supermarket Perimeter, 2021), to purchasing products based on packaging appearance rather than the environment (**Figure 4.9**), consumers now agree that eco-friendly packaging is important for the future health of the environment (**Figure 5.6**). This collective drive for sustainability is set to expand thanks to the next generation of eco-warriors (Payne, 2021). They are publicly calling out some of the most plastic-reliant food packaging companies, such as Walkers Crisps (**Figure 2.9**), to take environmental action or risk economic loss. The normality of sustainable consumption and application of ED strategies across all stakeholders (Curran *et al.*, 2020), is critical in balancing out the cost, time, and accessibility of sustainability. This will also increase the inclusivity and affordability of eco-friendly solutions beyond packaging design, including transportation (Madl, 2021) and manufacturing. Therefore, the circular creation, production, and disposal of all packaging will be more viable in the future.

Limitations of Study:

In spite of the positive insights and discussion throughout this study, the niche nature of the subject did result in several limitations. There was minimal academic information on sustainability and food packaging, similarly with sustainable design. This limited the specificity of some parts throughout the dissertation, and although still relevant, mainly referenced the general packaging industry. In future, specialist subjects should be simplified for the sake of secondary data collection.

The lack of results for the targeted questionnaires, despite success in the other methods, also limited the specificity and extent of the results. This potentially hampered the discovery of evidence in relation the success of sustainable design practices in food packaging, a knowledge gap revealed in the literature review.

Recommendations:

This study could be a point of reference and inspiration for individuals on a similar career path in the digital media industry. The literature review provides a simplified explanation of the different facets within the packaging industry. Furthermore, the distinctive relationship of packaging, sustainability and CAD, could have practical applications in the future. Also, perspectives in the primary findings could inspire further research, once the predicted innovation within these fields comes into fruition, and help in the progression of packaging design.

Overall, sustainable design practices can contribute as solutions for the increased sustainability of food packaging. However, there are barriers in the packaging world that currently prevent the facilitation of complete sustainable packaging production.

CONCLUSION

This dissertation has thoroughly explored sustainability and food packaging. The collation of theory and first-hand data has provided a concise overview of the industry, and therefore, a valuable foundation of knowledge and preparation for future employment. The thesis investigation, in line with the set question, aims and objectives, has identified that sustainable design solutions can improve the circular creation, production, and disposal of food packaging.

Digital media practices across multiple disciplines, with CAD and AI integrated innovation set to be the disruptive medium, can improve the efficiency, environmental merit, and sustainability of the packaging production process. Nonetheless, observation of the wider industry questions the extent that this proposal would facilitate success at all stages. The future sustainability and plausible existence of a circular economy in the packaging industry is not obtainable through sustainable design alone. The responsibility needs to be allocated to all stakeholders involved within the value chain to disrupt the linear nature of the current market.

To accelerate the necessary changes, and most importantly, address the excess waste and environmental pitfalls of the packaging industry, these main factors also need to be considered. The use of renewable energy and other resources to combat pollution in the manufacturing and transportation stages. The increased efficiency of the packaging waste disposal facilities for alternative materials, and the better education for consumers to simplify the journey from use to disposal. Despite the prevalence of future demographic and potential epidemic pressures, the widespread acceptance of sustainability in consumers, and shift towards more ethical consumption, will also become part of the solution in the future. The cohesion of all stages and the power of consumer influence will be the catalyst towards a more regenerative and environmentally friendly system for food packaging, and the wider packaging world.

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APPENDICES

Appendix A – Semester One, Secondary Research Task Manager Calendar

MONTH/DAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	WEEK
OCTOBER	11th	12th	13th	14th	15th	16th	17th	4
			Source & Reference	Organise & Prepare				
	18th	19th	20th	21st	22nd	23rd	24th	5
			Source & Reference	Organise & Prepare				
25th	26th	27th	28th	29th	30th	31st	6	
Source & Reference	Organise & Prepare					Organise & Prepare		
NOVEMBER	1st	2nd	3rd	4th	5th	6th	7th	7
	Source & Reference					Organise & Prepare		
	8th	9th	10th	11th	12th	13th	14th	8
			Source & Reference	Print Out Research Tables	Identify Key Trends, Anomolies. (AREAS & ALL DATA)		Type Up Results and Plan next Steps	
	15th	16th	17th	18th	19th	20th	21st	9
	Summarise each area SET OUT PARAGRAPH STRUCTURES							
22nd	23rd	24th	25th	26th	27th	28th	10	
Literature review (1st Point)		Literature review (2nd Point)		Literature review (3rd Point)	Literature review (4th Point)	Literature review (5th Point)		
NOV/DEC	29th	30th	1st	2nd	3rd	4th	5th	11
Literature review (5th Point)	Peer Review							
DECEMBER	6th	7th	8th	9th	10th	11th	12th	12
	Methodolgy		Time Management Visuals					
	13th	14th	15th	16th	17th	18th		13
Conclusion			Final Check & Submit	Semester 1 Over/ RESEARCH REPORT DUE	XMAS BREAK!!!			

KEY	
On Campus	
RESEARCH TOPIC 1	
RESEARCH TOPIC 2	
RESEARCH TOPIC 3	
RESEARCH TOPIC 4	
RESEARCH TOPIC 5	
Type Up/Proof etc.	

Appendix A shows the task manager for semester one. This helped to organise the entire process of drafting the literature review from start to finish. It also made the overall experience less stressful than it would have been without this management in place.

Appendix B – Semester One, Research Report Project Gantt Chart

Appendix B (below) shows the semester one Gantt Chart for the literature review module. This lists every task, from week one until submission, carried out in the journey of completing the assignment. The colour code shows tasks along the way that were challenging, or a key milestone that enhanced the work process. The biggest hurdles were working out the thesis question, researching literature on CAD and packaging, and cutting down the word count before submission.

These challenges were tackled via various solutions, including preliminary research to help work out the thesis question, using Boolean terms to refine research results, and taking the time to read through a draft of the report to identify any parts that weren't critical in the outcome.

TASK/ROLE/OBJECTIVE	WEEK 1						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Initial Brain Storm & Sketched Ideas							
Initial Research Strategy & Avenues							
Initial Research - Dissertation Ideas & Inspiration							
TASK/ROLE/OBJECTIVE	WEEK 2						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Initial Research - Dissertation Ideas & Inspiration							
Initial Research - Moodboard							
Initial Research Verdict & Next Steps							
Developed Mindmap & Refinement of Dissertation Topics							
Plan out Narrative of Dissertation							
Look at past paper examples							
TASK/ROLE/OBJECTIVE	WEEK 3						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
WORK OUT DIS QUESTION							
Plan out Structure of Research Report (Examples)							
Plan Out Research Strategy (Primary & Secondary etc.)							
Plan Out Research Timeline/Research Tables (Organise Content)							
TASK/ROLE/OBJECTIVE	WEEK 4						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
START SECONDARY RESEARCH (AREA 1)							
Complete Intro, Thesis Statement, Aims & Objectives							
TASK/ROLE/OBJECTIVE	WEEK 5						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
START SECONDARY RESEARCH (AREA 2)							
Work Out Thesis Statement							
TASK/ROLE/OBJECTIVE	WEEK 6						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
TASK/ROLE/OBJECTIVE	WEEK 7						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
START SECONDARY RESEARCH (AREA 4)							
TASK/ROLE/OBJECTIVE	WEEK 8						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
START SECONDARY RESEARCH (AREA 4a)							
TASK/ROLE/OBJECTIVE	WEEK 9						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Print Out Research Tables							
Organise, Highlight and Prep Literature for Analysis							
TASK/ROLE/OBJECTIVE	WEEK 10						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Area 1 Type Up							
Area 2 Type Up							
Area 3 Type Up							
Area 4 Type Up							
Area 4a Type Up							
TASK/ROLE/OBJECTIVE	WEEK 11						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Area 4a Type Up							
Conclusion & Methodology Type-up							
TASK/ROLE/OBJECTIVE	WEEK 12						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Edit & Proof Read Research Report							
Complete References Table							
TASK/ROLE/OBJECTIVE	WEEK 13						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Add Appendices, Images & Contents							
Final Proof Read							
SUBMIT ASSIGNMENT							

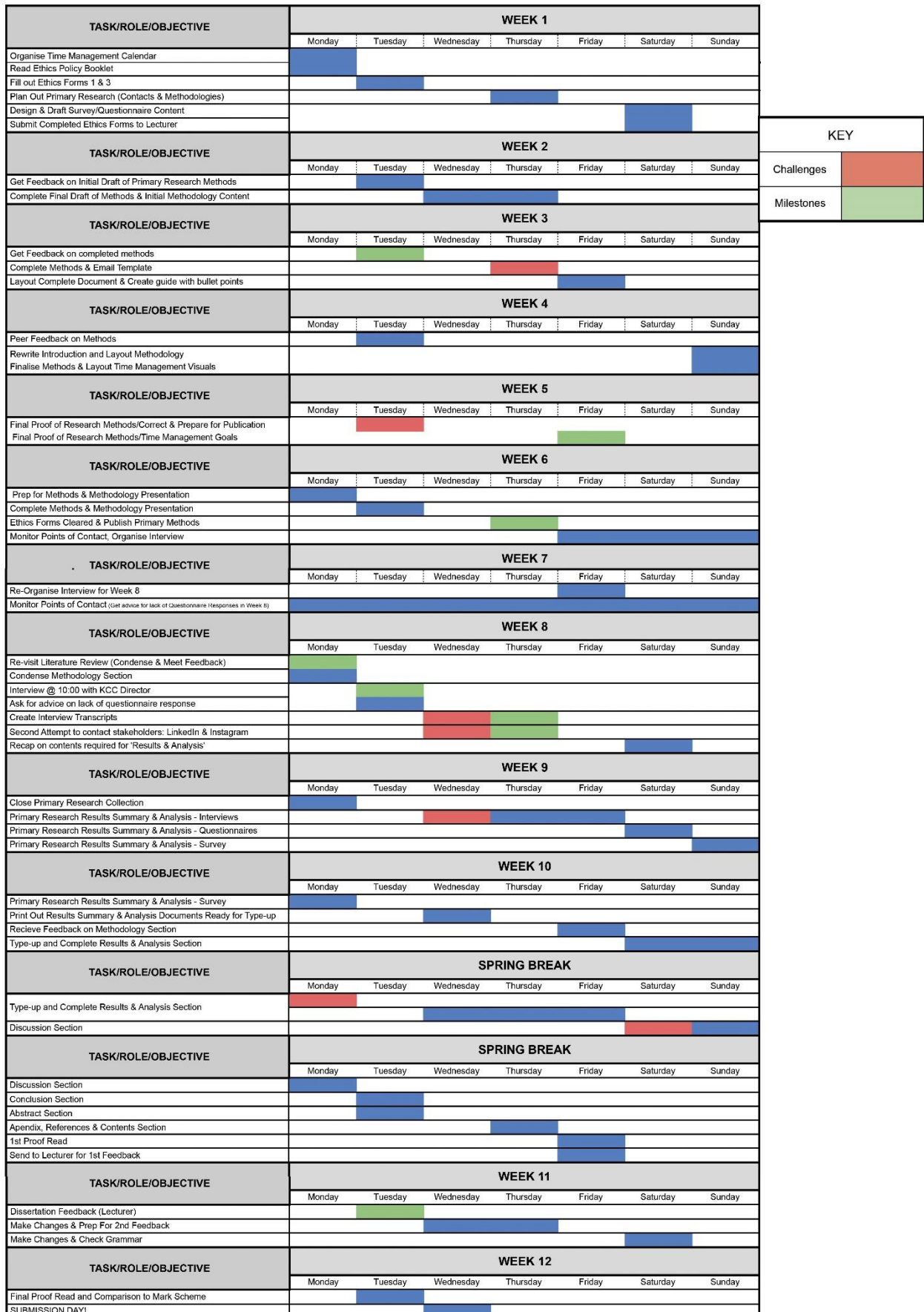
KEY	
Challenges	
Milestones	

Appendix C – Semester Two, Project Task Management Calendar

MONTH/DAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	WEEK	KEY	
JANUARY	24th Time management (Digital Calendars) Initial Ideas Mind Map & Sketches	25th About Primary Re. (Ethics & Forms)	26th Initial Research & Inspiration (Mood board /Images etc.)	27th Plan & Prepare Primary Research (Ethics Forms)	28th Continue Research + Initial Research & Ideas Verdict (Choose Idea)	29th Plan & Prepare Primary Research (Ethics Forms)	30th Organise Design Process Initial mind map & sketches	1	On Campus	
JAN/FEB	31st Ideation & Development Research (moodboard) (Commercial Example)	1st Ask about Ethics Forms & Primary Re. Ideas (Continue Research)	2nd Ideation & Dev. Research (Developed paint/cut sketch/outcome ideas)	3rd Plan & Prepare Primary Research (Work out day for interview & survey) Look at Feedback/EVERYTHING !!	4th Primary Research	5th Initial Ideas & Inspiration Research (Moodboard) Initial Research Verdict	6th Networking type up	2	Personal Project	
FEBRUARY	7th Finalised Idea & CAD (FINISH CAD TEST & TYPE sketch/model/planning)	8th Ask about/Proof Primary Research Surveys etc.	9th START CAD MODEL	10th Finalize Primary Research	11th Dissertation Layout (Word Doc & Use Notes)	12th Developed Idea & Final Research/sketch checklist (Mood board)	13th Finalised Layout Wireframe Sketches Finalised Content	3	Dissertation	
	14th CAD MODELLING (Research - Sus Goal 10)	15th Peer Feedback (Final Design) PRINT OUT	16th LAYOUT & THEME VISUAL CONTENT	17th	18th CAD MODELLING/ REVISION MODEL (improvements/next steps)	19th	20th FINALISE PRIMARY RESEARCH Write Methodology/Time management Look at Introduction	4	Portfolio Practice	
	21st CAD MODELLING	22nd Prepare for interview (PRINT OUT SHEET)	23rd FINAL MODEL & VISUALISATION (Complete & Present Visualisation)	24th SCHOLAR PAPER FINAL MODEL & VISUALISATION	25th FINALISE METHODS CREATE TIMELINE VISUALS	26th SCHOLAR PAPER FINAL MODEL & VISUALISATION	27th	28th	5	Reading Week
FEB/MAR	28th Prep Presentation Methods/Methodology	1st Presentation for Dissertation so far. Ask about Forms !!	2nd VISUAL CONTENT	3rd PUBLISH PRIMARY METHODS	4th VISUAL CONTENT	5th SCHOLARSHIP CONFERENCE VISUAL CONTENT	6th	6		
MARCH	7th VERBAL CONTENT	8th Progress Presentation	9th Completed Booklet	10th Start Website Stuff	11th	12th	13th	7		
	14th Read Through Litreview & Google How to reference images/figures	15th Ask for advice on Questionnaires Final Peer Feedback INTERVIEW KCC @ 10:00	16th Wait For Results/Industry Communication	17th LinkedIn/Instagram Questionnaires Type Out Interview Transcript Make New Event Dates	18th Transmedia - Make 3rd Year Programme Add Transmedia Content to Folder	19th Recap on Content Required in 'Results & Analysis'	20th	8		
MARCH/APRIL	21st	22nd Ask about Methodology/Questionnaires Get further feedback	23rd CLOSE RESULTS	24th Sort Out/Prep/Visualise Results (Visual/Verbal Graphs, Charts etc.)	25th	26th Sort Out/Prep/Visualise Results (Visual/Verbal Graphs, Charts etc.)	27th	9		
	28th	29th TRIP TO LONDON	30th Print out Summary & Analysis Pages ready for type up TYPE UP NETWORKING	31st	1st	2nd Results & Analysis	3rd	10		
APRIL	4th Results & Analysis	5th Prep for Send to Printers Conversation with Printworks	6th	7th Results & Analysis	8th	9th Discussion	10th	11	SPRING BREAK	
	11th Discussion	12th Abstract Conclusion	13th	14th (Contents) Appendix 1st Proof Read	15th SEND DIS FOR FEEDBACK READ THROUGH	16th PRIMARY RESEARCH TRIP TO VAN GOGH IMMERSIVE EXPERIENCE	17th			
APRIL/MAY	18th	19th	20th PROOF READ DISSERTATION & ADD REFERENCES/BIB/APENDIX/FIGURES	21st	22nd	23rd	24th	12		
	25th Prep for Community Canvas Presentation (Add Improvements & Ask for Feedback)	26th Canvas Presentation	27th Finalise Dissertation Submission	28th Website Type up Finish Gantt Charts	29th	30th	1st			
MAY	2nd	3rd	4th SUBMIT DIS!!!! DISSERTATION DUE	5th	6th	7th	8th	13		
	9th SUMBIT PORTFOLIO & WEBSITE	10th	11th	12th TRANSMEDIA SHOW (BUSINESS PITCH)	13th	14th	15th Think about Cancelling Subscriptions/Plan Out Before June	13		

Appendix C conveys the time management tool used to monitor tasks for all remaining university projects, plus other commitments. This was critical in the success of all these projects, with the magnitude of work expected within a short span of time. It also helped in the regulation of time outside of studies, as taking breaks from assignments is important to avoid the risk of burnout.

Appendix D – Semester Two, Dissertation Project Gantt Chart



Appendix D shows the individual Gantt chart for drafting the remaining dissertation chapters in semester two. From the methodology to concluding the entire thesis, this project was very challenging and time consuming. Whilst **Appendix E** was for tracking the various tasks required within each chapter, the Gantt chart above documented the issues and milestones (indicated by the colour code) of each week.

The primary data collection and discussion stages were the most difficult. A lack of responses from companies for the Targeted Questionnaires was disheartening after the success of the other methods. Also, substantial data from both the literature review and results made refining this information down for the discussion rather intimidating.

The solution for these issues also came at an important milestone during the project. During the brilliant and well received interviews, the interviewees interjected the idea of contacting companies on LinkedIn and Instagram to solve the lack of responses. After following this advice, an additional company kindly stepped in and brought the questionnaire up to two responses. The discussion issue was solved by drawing out key themes and structuring them as pointers to inspire ideas, but to also keep the section as concise as possible.

Appendix E – Semester Two, Dissertation Time Management Calendar

MONTH/DAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	WEEK
JANUARY	24th	25th	26th	27th	28th	29th	30th	1
		Ask/Check - Primary research Ethics & Forms	READ ABOUT QUANTITATIVE & QUALITATIVE RESEARCH (HANDBOOK)	Plan & Prepare Primary Research (Ethics Forms)		Plan & Prepare Primary Research (Ethics Forms)		
JAN/FEB	31st	1st	2nd	3rd	4th	5th	6th	2
		Ask/Check - Ethics Forms & Primary Re. Ideas			Plan & Prepare Primary Research (Contacts/Emails)	Plan & Prepare Primary Research (Surveys etc.)		
FEBRUARY	7th	8th	9th	10th	11th	12th	13th	3
		Proof Primary Research Surveys etc.		Finalize Primary Research Methods (Surveys etc.)				
	14th	15th	16th	17th	18th	19th	20th	4
			GOAL 1: Complete 1st Draft of Methodology					5
21st	22nd	23rd	24th	25th	26th	27th	GOAL 2: Complete Methods	
							GOAL 3: Organise Interview	Reading Week
FEB/MAR	28th	1st	2nd	3rd	4th	5th	6th	6
		Ethics Form Check	GOAL 4: Send Out Methods		GOAL 5: At Least 20 Survey Responses			
MARCH	7th	8th	9th	10th	11th	12th	13th	7
		GOAL 6: At Least 25 Survey Responses	WAIT FOR RESULTS/INDUSTRY COMMUNICATION					
	14th	15th	16th	17th	18th	19th	20th	8
		WAIT FOR RESULTS/INDUSTRY COMMUNICATION					GOAL 7: Close Results	
MARCH/APRIL	21st	22nd	23rd	24th	25th	26th	27th	9
		Ask/Check - Primary Re. Results/Pres.	Organise, Present & Explain Results (Visual/Verbal Graphs, Charts etc.)					
	28th	29th	30th	31st	1st	2nd	3rd	10
	Discussion & Analysis	Ask/Check - Corrections in Initial D&A Writing	Discussion & Analysis					
APRIL	4th	5th	6th	7th	8th	9th	10th	SPRING BREAK
		Discussion & Analysis						
	11th	12th	13th	14th	15th	16th	17th	
	Conclusion					Abstract (Contents/Title)		
APRIL/MAY	18th	19th	20th	21st	22nd	23rd	24th	11
		PROOF READ DISSERTATION & ADD REFERENCES/BIB/APENDIX						
	25th	26th	27th	28th	29th	30th	1st	12
	PROOF READ DISSERTATION & ADD REFERENCES/BIB/APENDIX							
MAY	2nd	3rd	4th	5th	6th	7th	8th	12
	Finalise Dissertation Submission		SUBMIT DIS!!!!					
		9th	10th	11th	12th	13th	14th	15th

Similar to **Appendix A**, the visual above shows the task manager for the dissertation project. However, this contains the all-important time management goals (**Appendix F**), allocated to set weeks within the project period to stay on track. Therefore, more time could be given to the more substantial chapters, such as the results and analysis.

Appendix F – Set Goals For Primary Research Methodology

1. Complete first draft of methodology section by **Week 4**.
2. Organise and complete primary methods by end of **Week 5**.
3. Organise interview by the end of **Week of 5**.
4. Send out primary methods by end of **Week 6** (Ethics forms).
5. Have at least 20 survey responses by the middle of **Week 6**
6. Have at least 25 survey responses by the start of **Week 7**.
7. Close collection period and bring presentation and analysis by **Week 7/8**.

Appendix F illustrates the complete list of the time management goals set as part of the primary research methodology.

Appendix G – ‘Company A’ Director & Employee Excluded Results

Interviewee – ‘Company A’ Director

Q1: How old are you?

A: +60

Q2a: Please explain answer to question 2.

A: We have been working to provide a sustainable alternative to one particular part of the food packaging market for more than a decade. It’s driven us half mad and kept us going on the holy grail of producing a ready-meal tray that goes in the oven and the microwave in sustainable materials, and we have done it. We are one of the first in the world.

Q4a: Do you think this policy will help your business become more sustainable and efficient?

A: It doesn’t really affect us but is going to impact on businesses that haven’t necessarily given it due attention in the past.

Q6a: Please explain answer to question 6.

A: The thing to remember about packaging and about food packaging is the protection it affords the food, which has a very great carbon footprint and of course, we have to safely transport product to the point of consumption so that our population can thrive. If you just randomly pick on the supermarkets as being the main contributor, and I'm sure they've got their part to play in this and they know they have too.

Then you forget how it is that the end product is being handled by the public and by industry, and by councils and so on. Now the good news about all of this is that in a couple of years' time we will have mandatory nationwide food waste collections, and that is a very significant point because at that point there will be an opportunity to use it as a vector, as a means of getting compostable food packaging back, and when that happens, a lot of the stuff that we see that's current waste like the tops of trays that hold food like this **touches empty plastic food tray** where the plastic is not in meaningful number to make any kind of sense and it's not easily identifiable to be able to recycle.

So, if you were able to use a compostable film on that, which is possible, and that went into the compost bin, and it was taken back and it was recycled as compost you stop pollution and you gain extra material. Now, people are aware of that. The thing about plastic packaging and oil-based packaging is that it has been incredibly successful at doing its job because we've used so much of it, it's a bit out of control and we've got to find better alternatives, but you've got to be able to do the job in the first place of getting the product home safely. If you don't, you end up with a kind of colossal wastage in production that you used to have in remote parts of the world; Africa and Russia, and places like that where they didn't have proper packaging.

So yes, it's a complicated answer we need to do things better, but it's not just the supermarkets and the good thing is, the more people talk about it and the more customers ask for it the more they'll pay attention to it

Q7a: How do you think the current rate of production, consumption and disposal of the general packaging industry impact the future? (socially, environmentally, and economically).

A: The current state is in a process of change, there's no two ways about it. Those changes have started and the real kick off was after November 2017 with the Blue Planet 2 programme with Sir David Attenborough. Bluntly, in my opinion during 2018, the supermarkets were punched drunk, and they were trying to figure out what to do and came up with a number of initiatives that meant that they started to, for example, eradicate polystyrene because there's no easy way of recycling it out of the supply chain, so people using polystyrene items were asked to desist. Still a hell of a lot of it used at the moment for things like coffee cup lids, but it started and that was in 2019 when it got going.

Then 2020 came along with a pandemic and put everything back in its box, and it's been like that for quite a while and it's the early part of this year we've starting to see things moving again. So, I'd say we had a freeze frame for two years, 2020 and 2021 was like oh my goodness we just got to deal with Corona virus and all the problems that have come along and some of the stuff that happened with Brexit and we don't have time to think about this. Well, the thing is, the commitments the supermarkets made about reducing their single use plastics, called SUP's, the commitments they made to reducing SUP's was time related, and they got two years closer to it and they haven't done enough. So, there now beginning about how can we do things quicker. Also, because of lack of staff in the right places in factories and wanting to feed the nation that

weren't going out to restaurants and things, everybody was consuming at home, so the volume of sales went up and the availability of getting product became tighter. So, in fairness to them, they had a job to manage the supply chain, so we didn't run out of things but that's eased up a bit now thanks to the vaccination programme. Getting back to something more like normal.

Interviewee – 'Company A' Employee

Q1: How old are you?

A: 20 – 29 years old.

Q4: How will Extended User Responsibility (EPR) impact your company?

A: We say compostable trays ****referencing their riji product**** because they do have to be composted. I know the director has had to stress that in the past, saying you know you can't just drop it in the street and expect it to degrade.

****must have the right conditions****

With regards to our current line of product it is a tray, with the general consensus that its used as a ready-meal, generally people wouldn't eat in that out and about. Then again, it can be applicable across takeaway foods and that sort of stuff, so then you get into festivals and all that sort of stuff.

Can you rely on people not to be scum bags and just drop it, no. I think the government can do more, especially when it comes to food waste management. So, I think it's absolutely barmy that

Eastleigh, does Winchester have,

****no****

So, Eastleigh have food waste collections, there under Hampshire County Council obviously, so why doesn't anyone else have accessibility? So, I think the government can do more in that

respect, that intern should then extend user responsibility (EUR) because then people should be able to put, we I don't know if we have certification yet. I think we have informal certification for composability, but anyway.

Once we get that thing that says it's okay to put into compost, then the trays can be put into compost. Compost heaps as well, there becoming a bit more mainstream as well, especially community compost heaps. So, I think as long as people have the tools to do good, as long as people have the access and tools to do good, they should be able to do it. It's when they don't, that's when they go off-piste, and its understanding and education as well. The director may have already mentioned that riji trays, if there not cleaned out and put in the recycling, they will just be sent to landfill because there not clean. **contaminate** So, people need to know that.

Otherwise, they'll just go its paper, in the recycling it goes. That's why it's so important to get composability in because if anything, it reduces the amount of work, because then people can just go it's got food in it, it's going in the food waste.

mentioned separating/washing mono-materials for recycling by hand

I had a wrap and it said peel here to remove the plastic from the paper. It's absolutely crazy to expect people in their lunch time to peel away at this thing. People need it to be easy, simple, and quick, and doing that

Q7a: How do you think the current rate of production, consumption and disposal of the general packaging industry impact the future? (socially, environmentally, and economically).

A: I'd love to know where we would be if COVID-19 hadn't happened. I bet that gets mentioned a lot. There's a big movement in flexitarianism, that's obviously where you flip between the two, and a heck of a lot of veganism, especially people who remain vegan after Veganuary, so especially with the vegans, veganism and environmentally-friendliness come hand in hand borderline.

I think COVID-19 may have been a wake-up call especially for environmentally-friendly people, a lot of companies especially, as we were just coming out of COVID, they were very reluctant to change because all they were doing was focusing on staying afloat, they put environmentally-friendly things on the back burner. I like to think it will change for the better, because it has too, it has too. I think COVID-19 may have hampered it, but I think we don't have much of a choice.

Appendix H – ‘Company A’ Director & Employee Interview Transcripts

Interviewee – ‘Company A’ Director

Date - 15/03/22

Location – ‘Company A’ HQ.

Duration – 26:44

Audio Recording - Yes (any irrelevant comments will be removed in transcript)

Written Notes – Yes (see scanned notes)

Q1: How old are you?

A: +60

Q2: Is sustainability a key part of your company’s current innovations/processes, in relation to your packaging products?

A: Yes, most definitely

Q2a: Please explain answer to question 2.

A: We have been working to provide a sustainable alternative to one particular part of the food packaging market for more than a decade. It’s driven us half mad and kept us going on the holy grail of producing a ready-meal tray that goes in the oven and the microwave in sustainable materials, and we have done it. We are one of the first in the world.

Q3: Do you have a method, tool, or software in your design/production process that helps your products become more sustainable?

A: There is no software that helps us to do this, this is just born of experience and knowing, trying what to avoid. If there were software, I’m sure we’d find it useful. But it’s mostly our experience of knowing what we’re trying to avoid, being fossil fuels and high energy costs to make things, so it’s pretty basic sort of sights on the project.

Q3a: Please explain answer to question 3 (give examples).

A: Were trying to make the thing as natural as possible. So, for example, right now the majority of ready meal trays in the country are packed in plastic, or aluminium, but the vast majority in plastic. Something called C-PET, and C-PET is far from being sustainable, anyway. So, some alternatives to that are what I call would ‘Hybrids.’

So, you have, for example, carton board, some people call it card, and that card will work as a replacement for plastic up to a point, but it doesn’t have a moisture barrier and what they

have done, a bit like with coffee cups is that they've lined it with polyethylene, that gives it the moisture barrier. The problem is its unrecyclable.

Some people claim you can separate, for example a sandwich wedge, the cardboard, the carton board, the card, from the plastic. I've yet to know anyone who routinely does that. It's a hybrid-part solution and its far from complete or totally successful and in my opinion is a waste of time. But it shows the intention to try and do something.

Q3b: Do you use any form of Computer Aided Design to make your design and production process become more sustainable? (CAD/CAM etc.)

A: Not to make it more sustainable per say in using design. We use design for a new item for example, to show people the look on 2D paper and the dimensions of a new product, but I can't honestly link that to sustainability. The sustainability element is going to come from the material that used, the manufacturing methods that are employed to make it, and of course, if you can design something which is effective and uses less material then that saves resources and that makes things more sustainable. But to say that it would be sustainable by using a software package or design element would be inaccurate. Currently.

interviewer stimulates interviewee with a point on Company A's past efforts and future ambition to introduce 3D printing and CAM into their product prototyping process from recycled/plastic alternative materials (e.g., PLA)

PLA isn't from recycled plastic. PLA is basically polylactic acid, which is basically starch, normally from maize and it's a bio-plastic which is degradable under the right heat conditions. The reason we have made 3D samples is a mixture of reasons, including speed to be able to create something for somebody to physically hold, stick their product into it if they want to just to see how it looks to see if what they've imagined is actually suited by the design and the size of the item they are looking to use. That's the main reason for using it to be able to short circuit the design time from making a fully-fledged sample that takes quite a bit longer. Yeah, it does save materials.

Q3c: In a packaging product life cycle, would the greatest level of sustainability be achieved if sustainable design practices were applied at every stage of the production process?

A: We can all be more sustainable. Including the big companies, you mentioned. The good news is that rather than being purely a side issue to many companies, which I think frankly it was a number of years ago to state that they had a sustainability programme or a sustainability officer. There are now some companies who are reaping some very significant additional benefits in terms of extra market penetration and sales by demonstrating that they have become more sustainable.

A recent example of this would be an article I read about the Carlsberg organisation that managed to make some huge strides forward, and as a result of being recognised for that got their product, I can't tell you too much about the details because I don't know too much about it, listed just about everywhere. So, when the success of that occurred, and I'm sure that's been watched by many organisations, the sales director called in the sustainability manager and went what more can we do. So, this was a change in approach, this was seen as being a positive advantage.

Q3d: Please explain answer to question 3c.

A: Now companies like Kellogg's and Proctor and Gamble, are already aware, I know this from conversations with people and companies like Unilever, are already aware of the driving energy and force behind the sustainability movement. Which is like a stone rolling down a hill, its picking up more and more moss as it goes, it won't stop, it will just get bigger and bigger. So, there aware of having to change things so where their using heavy duty plastic bottles for example, to hold detergent liquid, there thinking about how we can change that. Now, it will be quite a while before all those things change, but yeah it its way.

Q4: How will Extended User Responsibility (EUR) impact your company?

A: Extended Producer Responsibility wont impact us a great deal, because were primarily not really plastic materials, but of course packaging per say needs to be carefully managed. So were not really too worried about EPR.

Mostly because what we're trying to do and are having some success with some customers is to promote natural fibre-based products which of course can be composted and we've had a recent result from the Open University that shows that it can and of course can also be recycled which we've got a pulpability certificate, so yeah. EPR is really about cutting down on the amount of plastic that is leaching into the environment.

Q4a: Do you think this policy will help your business become more sustainable and efficient?

A: It doesn't really affect us but is going to impact on businesses that haven't necessarily given it due attention in the past.

Q5: Are there any stages/components within your design, production, and overall product life-cycle, that can cause harm to the environment?

A: Are there any stages or processes in our product life cycle that can cause harm to the environment, no, but like anything, if we were not mindful of waste, whether it be energy, water, or anything else, which of course we are mindful of, for simple commercial reasons, then that would be harmful. You know, as ludicrous as it sounds, if you leave an electric light on outside all the time it's just doing absolutely no good but it's just consuming power, that power has to be generated somewhere. We're all aware now that fact this country has been running on a great deal of fossil fuels imported from overseas including Russia which is not a great idea.

Q5a: Please explain answer to question 5.

A: **Shook head**

Q5b: How do you plan to minimize the environmental impact of your company in the future?

A: Well, my focus is on how can we make the products that we produce as efficient and as less damaging to the environment as at all possible.

Now to weigh that up, what I mean is this. So, if we can make for example, a food container, a tray that's to be used on an airline, and we can make it in a slightly lighter weight, and it still performs and it uses slightly less energy to make it. Then that would be the kind of thing we would drive towards. Now, if you get it wrong and you increase your wastage, you've gone through the barrier and you've had a crash because the whole idea of packaging is to protect the product its conveying.

So, in simplest terminology, we will always be looking to do the most with the least.

I think that's what the whole EPR thing is going, and the PPT, the Plastic Packaging Tax, is going to make people think about. How can I do this with less materials? and how can I do it with better materials? And the PPT, which I think is going to fail, is going to be the first start and there will be other things to follow.

Q5c: There is evidence to suggest that innovations in Computer Aided Design processes and software could be the key contributor in the production of more sustainable packaging in the future (e.g., Artificial Intelligence).

What are your thoughts on this statement?

A: I'm not sure I'm really qualified enough to answer because I'm not a high-tech person, but I'm aware of the fact that AI that can't be, shouldn't be underestimated and is going to have an incredible impact. How that's going to affect the production of product, I'm not entirely sure, but I'm pretty certain it will do.

I think the harvesting of information which of course we've seen with organisations like Google and so on, has been an incredible revelation over the years to know how things work and analysing that information which AI can do quite quickly is probably going to lead to clues to what's working and what needs to be better attended to.

I'm sorry I'm not particularly sure I can give you a great answer.

****Anecdote about focusing on the source of the problem, rather than trying to improve or add to the consequences of the problem****

Q6: Do you agree with the public assumption that the food packaging industry and supermarket retailers are the greatest contributors to the excess waste and negative impacts of the packaging industry?

A: That's a really cute question. Do I think that the retail industry and the supermarkets are the greatest contributors to waste in the environment? I'm not sure I do agree or be it they've all got more to do and I think there aware of it and the main are doing something about it.

Q6a: Please explain answer to question 6.

A: The thing to remember about packaging and about food packaging is the protection it affords the food, which has a very great carbon footprint and of course, we have to safely transport product to the point of consumption so that our population can thrive. If you just randomly pick on the supermarkets as being the main contributor, and I'm sure they've got their part to play in this and they know they have too.

Then you forget how it is that the end product is being handled by the public and by industry, and by councils and so on. Now the good news about all of this is that in a couple of years' time we will have mandatory nationwide food waste collections, and that is a very significant point because at that point there will be an opportunity to use it as a vector, as a means of getting compostable food packaging back, and when that happens, a lot of the stuff that we see that's current waste like the tops of trays that hold food like this **touches empty plastic food tray ** where the plastic is not in meaningful number to make any kind of sense and it's not easily identifiable to be able to recycle.

So, if you were able to use a compostable film on that, which is possible, and that went into the compost bin, and it was taken back and it was recycled as compost you stop pollution and you gain extra material. Now, people are aware of that. The thing about plastic packaging and oil-based packaging is that it has been incredibly successful at doing its job because we've used so much of it, it's a bit out of control and we've got to find better alternatives, but you've got to be able to do the job in the first place of getting the product home safely. If you don't, you end up with a kind of colossal wastage in production that you used to have in remote parts of the world; Africa and Russia, and places like that where they didn't have proper packaging.

So yes, it's a complicated answer we need to do things better, but it's not just the supermarkets and the good thing is, the more people talk about it and the more customers ask for it the more they'll pay attention to it.

Q6b: Do you think consumers play some role in the sustainability of packaging?

A: Most definitely because they have enormous influence over what it is the retailers want to provide them with. If everyone said right, I don't like that Kellogg's box. It's just absolutely ridiculous that it's three times the size that it needs to be, and they stopped buying it, then Mr Kellogg's would either have to reduce their packaging box for it to be appropriate for the size of the contents or go out of business. So of course, customers and the public have a huge role to play, and the great news is, in my opinion and my experience of talking to people that is exactly what is happening now. People are questioning it rather than just accepting it.

****Retailers trying to get ahead of the curve****

Q7: How do you balance economic viability with eco-friendliness with your packaging products?

A: It's a really really good question, because it's very tough, because no matter how clever you're doing things in the sustainable packaging world, you cannot do it at any price. There is an acceptable cost level that can be born for a product. Now, the good news is this, I've been pushing this whole discussion for more than a decade and I can remember for example, speaking to retailers ten years ago like the Co-op and they were using a plastic ready-meal tray, and they still use them today, that would cost around about 5p and our product was always going to be more expensive than that and still is.

At one point, everybody in the market was saying it's got to match the plastic price. The shift now is enormous, because while the market is still largely in C-PET for a variety of reasons, there is a huge interest now in starting the change to other products and the really great news is that the recognition of an acceptable price difference, and that's the key phrase the acceptable price difference, is being recognised as necessary.

So, we don't have to match the C-PET price, and by the way, with oil prices, C-PET and other plastics are going to get more expensive, still cheap, but still expensive to clean up in the environment. So, for example, we are at a price disadvantage to cheap oil-based plastics of at least double, many companies are much more than that, so we are between double and a bit more. That is something which is a difficult thing to achieve for a variety of reasons, oil is cheap, making it into packaging on modern machines that have been developed over many, many years is incredibly high speed. High speed means low manufacturing costs.

The alternative of using fibres and the technology to make that is comparatively much slower, to the factor of about twenty times slower. This then makes it a more expensive product to manufacture, there's work going on to find ways to increase that, but it's always going to be more expensive because of the nature of the way it's made. The long-term projection is that because of taxation, which is how it will be dealt with I think, oil-based fossil fuel plastics will become more expensive, they will be penalised when they're not able to be recycled or not recycled, and fibre based natural products will become more available, will be produced in higher quantity, the technology and the drive to improve the manufacturing methods and the materials that are used will improve, and will become less expensive comparative to where they are today and I think there will be coming together, closer to those price points.

I still think fibre will still be more expensive, but I think it will get to the point whereby, well it doesn't matter if your tray costs 10p and their tray costs 7p now, because we don't want it, we want this ****referencing Company A's products****, and we know that it can go and be composted for example, and it can be got out of the way. So, you can't ignore the whole question of ecology and you can't afford to ignore the whole question of economy because even with the most wonderful invention, if your too expensive, people don't buy it. So, we keep working away in the divine belief, faith that there will be an inflection point where it comes together.

Q7a: How do you think the current rate of production, consumption and disposal of the general packaging industry impact the future? (socially, environmentally, and economically).

A: The current state is in a process of change, there's no two ways about it. Those changes have started and the real kick off was after November 2017 with the Blue Planet programme with Sir David Attenborough. Bluntly, in my opinion during 2018, the supermarkets were punched drunk, and they were trying to figure out what to do and came up with a number of initiatives that meant that they started to, for example, eradicate polystyrene because there's no easy way of recycling it out of the supply chain, so people using polystyrene items were asked to desist. Still a hell of a lot of it used at the moment for things like coffee cup lids, but it started and that was in 2019 when it got going.

Then 2020 came along with a pandemic and put everything back in its box, and it's been like that for quite a while and it's the early part of this year we've starting to see things moving again. So, I'd say we had a freeze frame for two years, 2020 and 2021 was like oh my goodness we just got to deal with Corona virus and all the problems that have come along and some of the stuff that happened with Brexit and we don't have time to think about this. Well, the thing is, the commitments the supermarkets made about reducing their single use plastics, called SUP's, the commitments they made to reducing SUP's was time related, and they got two years closer to it and they haven't done enough. So, there now beginning about how can we do things quicker. Also, because of lack of staff in the right places in factories and wanting to feed the nation that weren't going out to restaurants and things, everybody

was consuming at home, so the volume of sales went up and the availability of getting product became tighter. So, in fairness to them, they had a job to manage the supply chain, so we didn't run out of things but that's eased up a bit now thanks to the vaccination programme. Getting back to something more like normal.

Further comments: No.

Interviewee – 'Company A' Employee

Date - 15/03/22

Location – 'Company A' HQ.

Duration – 32:45

Audio Recording - Yes (any irrelevant comments will be removed in transcript)

Written Notes – Yes (see scanned notes)

Q1: How old are you?

A: 20 – 29 years old.

Q2: Is sustainability a key part of your company's current innovations/processes, in relation to your packaging products?

A: Well, I should hope so, yes.

Q2a: Please explain answer to question 2.

A: Okay, so yeah, I would say it is key because obviously riji trays are compostable, so and are made from a product that would otherwise be buried or burned. So, it does use a waste by-product. That's just one part, but obviously, especially when it comes to getting B-Corp stuff, you have to really consider the bigger picture. So, they think about everything, so the amount of water used to make the product, the transport. The entire life cycle has to be considered, but as fair as were considered, as much as we can obviously, obviously sustainability is at the forefront.

Q3: Do you have a method, tool, or software in your design/production process that helps your products become more sustainable?

A: I would say our supplier, obviously, as they are the ones who choose the by-product to make our product.

Q3a: Please explain answer to question 3 (give examples).

A: Method in choosing our supplier. We work with a few key suppliers, that have BRC as well, so we know that there kosher and that sort of stuff. Obviously, we recycle as well. Where we can, especially if we have reject trays, we take them back and use them, otherwise they get chucked in the recycling.

****production and disposal stage****

Q3b: Do you use any form of Computer Aided Design to make your design and production process become more sustainable? (CAD/CAM etc.)

A: That is slightly beyond my knowledge, but I wouldn't be surprised if we did. Our team in China, Hong Kong, they are our intermediary, so we do tend to work with China. They obviously send us blueprints; I can't go into too much further detail I'm afraid.

****CAD team in China****

Q3c: In a packaging product life cycle, would the greatest level of sustainability be achieved if sustainable design practices were applied at every stage of the production process?

A: The thing is, I think, especially with big companies, they can afford to look at the entire process, like I said before, when trying to apply for B-Corp and ethical stamps of good deeds, you do have to consider the entire life cycle.

However, being pragmatic, not all companies especially smaller companies, can't really afford to look at the entire thing.

Q3d: Please explain answer to question 3c.

A: So, I think it must be scalable. I think we should expect the big companies to do more for the environment than small companies because they have the manpower and the literal money to be able to do that.

Do I think they should then pass, obviously with a great amount of environmentally-friendliness comes a higher cost and most people know that now. Do I think that they should pass that onto the customer, not really, because there big enough.

****cost****

Q4: How will Extended User Responsibility (EUR) impact your company?

A: We say compostable trays ****referencing their riji product**** because they do have to be composted. I know the director has had to stress that in the past, saying you know you can't just drop it in the street and expect it to degrade.

****must have the right conditions****

With regards to our current line of product it is a tray, with the general consensus that its used as a ready-meal, generally people wouldn't eat in that out and about. Then again, it

can be applicable across takeaway foods and that sort of stuff, so then you get into festivals and all that sort of stuff.

Can you rely on people not to be scum bags and just drop it, no. I think the government can do more, especially when it comes to food waste management. So, I think it's absolutely barmy that Eastleigh, does Winchester have,

****no****

So, Eastleigh have food waste collections, there under Hampshire County Council obviously, so why doesn't anyone else have accessibility? So, I think the government can do more in that respect, that intern should then extend user responsibility (EUR) because then people should be able to put, we I don't know if we have certification yet. I think we have informal certification for composability, but anyway.

Once we get that thing that says it's okay to put into compost, then the trays can be put into compost. Compost heaps as well, there becoming a bit more mainstream as well, especially community compost heaps. So, I think as long as people have the tools to do good, as long as people have the access and tools to do good, they should be able to do it. It's when they don't, that's when they go off-piste, and its understanding and education as well. The director may have already mentioned that riji trays, if there not cleaned out and put in the recycling, they will just be sent to landfill because there not clean. ****contaminate**** So, people need to know that.

Otherwise, they'll just go its paper, in the recycling it goes. That's why it's so important to get composability in because if anything, it reduces the amount of work, because then people can just go it's got food in it, it's going in the food waste.

****mentioned separating/washing mono-materials for recycling by hand****

I had a wrap and it said peel here to remove the plastic from the paper. It's absolutely crazy to expect people in their lunch time to peel away at this thing. People need it to be easy, simple, and quick, and doing that is none of those things.

Q4a: Do you think this policy will help your business become more sustainable and efficient?

A: N/A ****Answered in previous question****

Q5: Are there any stages/components within your design, production, and overall product life-cycle, that can cause harm to the environment?

A: The most harmful aspect is possibly the transport, transport and relying on people to dispose of it how they're supposed to dispose of it.

I can't remember how many containers, 40-foot containers get lost at sea every year, it's quite a few. With our stock it should be too bad because it time it would just degrade hopefully. So, you've got to consider what if that does happen.

Q5a: Please explain answer to question 5.

A: N/A ****Answered in previous question****

Q5b: How do you plan to minimize the environmental impact of your company in the future?

A: The thing is transport is one of those necessary evils unfortunately, a company that we did work with in the past, they said they were developing electric vehicles for their lorries. So, that's probably the next step.

****carbon neutral delivery****

Hopefully, but that was said quite a few years ago and I have not seen one electric vehicle from them. However, it's going to be flipping hard to do, a car is at most for electric vehicles, that's a couple of at most, then you've got a lorry having to pull a lot more than that. I'm not surprised it's not been possible quite yet, but it will come.

With regards to the product, I think we are doing the best we can, were doing a heck of a lot better than a lot of companies. One big sticking point we actually have is modified atmosphere packaging, so as things stand. Are you familiar?

****no****

So, say you've got a fresh bit of beef that's very red and juicy, very nice, to keep that looking like that and keep it fresh, it needs to be packed in a modified atmosphere, which means they pump, I think CO₂ into it, or they suck air out of it, so it's literally sealed in its own environment. Our trays can't really do that at the moment, the director is working on it, but at the moment it can't be done. So, some enquiries we've had have said can you do modified atmosphere packaging, and we've had to say I'm very sorry but no.

So, in order to appeal to a wider range of companies or people that's probably the next thing that we need to look at.

Q5c: There is evidence to suggest that innovations in Computer Aided Design processes and software could be the key contributor in the production of more sustainable packaging in the future (e.g., Artificial Intelligence).

What are your thoughts on this statement?

A: It's very interesting. I hadn't thought about how a technological advancement could help environmental factors. Not even going that far back, I think our process would be a lot slower, especially as we were dealing with things internationally, if we ever do get a CAD product, we say can we have a mock up and we get it within the day, and it gets sent off. So, things happen so quickly now. I guess it can contribute to an environmental factor as its all taken care of online. Otherwise, it would have to be printed and posted. That's a very wide statement.

Q6: Do you agree with the public assumption that the food packaging industry and supermarket retailers are the greatest contributors to the excess waste and negative impacts of the packaging industry?

A: In a perfect world I would have liked to have done some research to be able to have said one way or another. My knee jerk reaction is probably is that there probably the biggest, so generally yes, however I'm very aware that there not the only one. So maybe.

Q6a: Please explain answer to question 6.

A: It's going back to the necessary evils again. In my dissertation I asked people what concerns them the most; Food packaging waste or food waste, because I found out in my own research, that in a study, food lasted a lot longer if it was wrapped in plastic, compared to not being wrapped in plastic. So, yeah which is the worst, would you rather have better, more environmentally-friendly packaging but it doesn't necessarily last as long, or no packaging, but your food may go off. So, something needs to be done absolutely. I'm going to go maybe.

Q6b: Do you think consumers play some role in the sustainability of packaging?

A: Yes. I don't know if you remember this much but, if it becomes a movement, then people start paying attention. So, I remember, quite a few years ago now, people started posting back Walkers packets of crisps. It's quite funny because Walkers had to put up a thing that said stop sending us your stuff, and people started sending back, literally a sticking label on a packet of crisps, because they wanted Walkers to be more environmentally responsible.

That then prompted the response from Walkers, that they are now working with TerraCycle, and it's because of those people acting up, is what caused this thing. So, I think as long as there are enough people and they shout loud enough, they will start paying attention.

Q7: How do you balance economic viability with eco-friendliness with your packaging products?

A: It's a difficult one. Again, we are almost relying on consumers saying this needs to change, and then when companies, especially the big companies, say it's going to cost more, enough of the need to say we don't need to care. The director has probably already said but our packaging is considerably more expensive than plastic, and it's trying to get them to understand.

Yes, it is more expensive, but it's so much more environmentally-friendly. So, we almost need to target, especially when it comes to selling, the right people. It is even down to contacting the right people within a company, you don't want the person who just looks at figures, you want to contact the person who is able to see the bigger picture or is already an environmental champion.

****it goes back to circularity, the bigger picture****

Q7a: How do you think the current rate of production, consumption and disposal of the general packaging industry impact the future? (socially, environmentally, and economically).

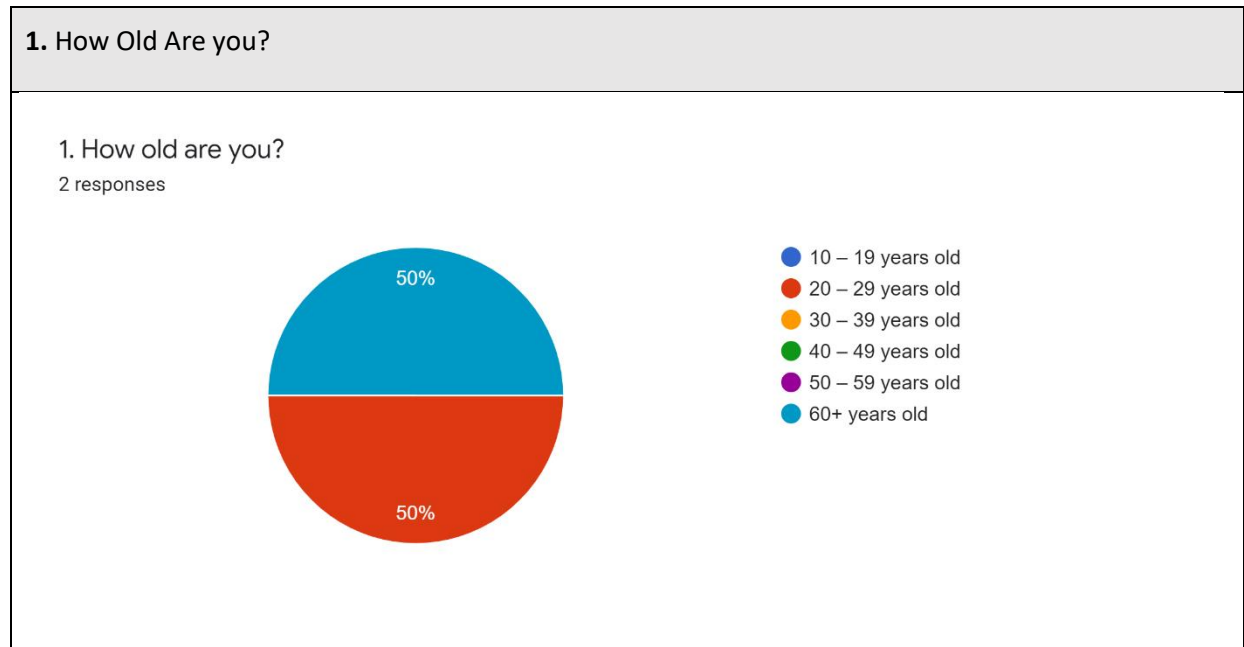
A: I'd love to know where we would be if COVID-19 hadn't happened. I bet that gets mentioned a lot. There's a big movement in 'flexitarianism,' that's obviously where you flip between the two, and a heck of a lot of veganism, especially people who remain vegan after Veganuary, so especially with the vegans, veganism and environmentally-friendliness come hand in hand borderline.

I think COVID-19 may have been a wake-up call especially for environmentally-friendly people, a lot of companies especially, as we were just coming out of COVID, they were very

reluctant to change because all they were doing was focusing on staying afloat, they put environmentally-friendly things on the back burner. I like to think it will change for the better, because it has too, it has too. I think COVID-19 may have hampered it, but I think we don't have much of a choice.

Further Comments: No

Appendix I – Targeted Questionnaire Excluded Results



4. How will Extended User/Producer Responsibility (EPR) impact the sustainability of your company?

4. How will Extended User Responsibility (EPR) impact the sustainability of your company?
2 responses

Should **not affect** our business as **sustainability** is **involved in all briefs**

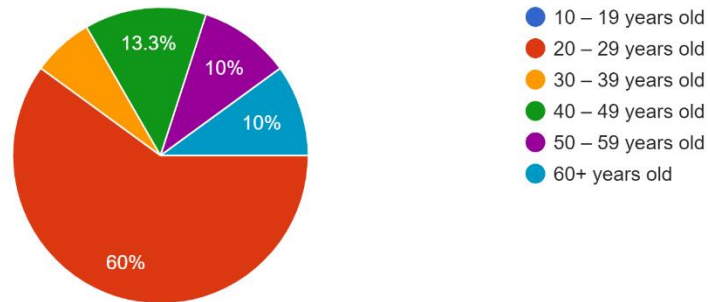
Our **market research** indicates that many **customers** would rather **pay more** for **sustainable packaging** so our **approach** to providing these products will be **unchanged**

Appendix J – Public Perspective Survey Excluded Results

1. How Old Are you?

1. How old are you?

30 responses



Appendix K – (Form 1 Triage 23092021) for Primary Research Approval

Winchester University: Ethics Form 1



RESEARCH ETHICS FORM 1

WHAT LEVEL OF REVIEW DO I NEED?

GUIDELINES

This form is for staff and students. It will help you identify the level of review needed for your project. Before completing it, you need to:

1. Read *The University Research Ethics Policy*.
2. If you are a student, discuss the ethical aspects of your project with your supervisor.

It is your responsibility to follow the University's Policy on the ethical conduct of research and to follow any relevant academic guidelines or professional codes of practice pertaining to your study when answering these questions.

The questions and checklist in this proforma are intended to guide your reflection on the ethical implications of your research. Explanatory notes and further details can be found in the Policy document.

Winchester University: Ethics Form 1

SECTION 1**DETERMINING WHETHER YOU REQUIRE ETHICS REVIEW**

YOUR RESEARCH
Project title: How can sustainable solutions be utilised in the packaging industry for improved circular creation, production, and disposal of food packaging?
Your name: Lucy Hopkins

1.	Is the proposed activity classified as Research or Audit /Service Evaluation or similar?	
	<input checked="" type="checkbox"/> Research	<input type="checkbox"/> Audit or Service Evaluation
	<p>Use the Policy to help you answer this question. If the proposed activity meets the definition of research (see the policy), CONTINUE.</p> <p>If the activity is an audit or a service evaluation, STOP. You do not need to seek ethics approval, but you do need to formally register your project with UREC, along with a project outline. To do this complete Form 2.</p> <p>If you are unclear what type of activity you are undertaking, please refer to the Policy for additional types.</p>	
2.	Does the research involve living human participants, human samples or data derived from individuals who may be identifiable through that data?	
	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
	<p>Use the Policy to help you answer this question.</p> <p>If you answer NO, SKIP to QUESTION 6 and CONTINUE.</p> <p>If you answer YES, CONTINUE.</p>	
3.	Is the research being conducted for a medicinal purpose?	
	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
	<p>Use the Policy to help you answer this question. See Appendix 2 - FAQs and definitions.</p> <p>If you answer YES, and think your research comes under the definition of 'for a medicinal purpose,' it will need to be scrutinised by the Committee. Please email the Committee Chair (ethics1@winchester.ac.uk) for further guidance on what to do.</p> <p>If you answer NO, CONTINUE.</p>	
4.	Does your research require external ethics approval or review?	
	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
	<p>For example, from the NHS or another overseeing body. Use the Policy to help you answer this question.</p> <p>If you answer NO, CONTINUE.</p> <p>If you answer YES, you need to formally register your project with UREC, along with the relevant external ethics approval. To do this complete Form 2.</p>	
5.	Is the project underway and, the researcher or PI, has moved institution to Winchester?	
	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
	<p>If you answer YES, please read the following:</p> <p>If the research began when the PI was employed at another institution but has subsequently moved to Winchester, and the project has previously been subjected to ethics scrutiny at that institution, then it need not go through ethics review again. The outcome of ethics review by that institution should be communicated to UREC for formal recording. To do this complete Form 2 and include evidence of the previous ethics approval.</p>	

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Winchester University: Ethics Form 1

	<p><i>HOWEVER, if there have been significant changes to the original research design which have ethical implications or recruitment of a cohort of participants will be undertaken through Winchester, then the project will require ethics review and you should apply for approval, CONTINUE.</i></p> <p><i>If you answer NO, CONTINUE.</i></p>	
6.	Is the research collaborative?	
	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
	<p><i>If you answer YES:</i></p> <ul style="list-style-type: none"> • <i>where the Principal Investigator (PI) of the research is located at another institution, it is their responsibility to seek ethics approval, including partner research sites. The outcome of ethics review by that institution should be communicated to UREC for formal recording. To do this complete Form 2 and include evidence of the previous ethics approval.</i> • <i>where the PI is located at Winchester, then the project will undergo scrutiny as per Winchester's Ethics Policy, CONTINUE.</i> <p><i>If you answer NO, CONTINUE.</i></p>	
7.	Is the research being conducted in another country?	
	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
	<p><i>If you answer YES, please read the following:</i></p> <p><i>Where a project is conducted in another country, the researcher should consider if it is possible to obtain ethics review by a local research ethics committee or other relevant body. The outcome of such a review by that institution should be communicated to UREC for formal recording, along with a project outline. To do this complete Form 2.</i></p> <p><i>If this is not possible, the project should be reviewed by the University of Winchester, either at Faculty level or Committee depending on the nature of the proposed work, so CONTINUE.</i></p>	
8.	Does the research involve the use of documentary material, papers, literary works, or archive documents <u>in the public domain</u>?	
	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
	<p><i>Use the Policy to help you answer this question.</i></p> <p><i>If you answer NO because the works are in a private archive or closed collection, do the following: complete Form 2, including details of the nature of the private /closed collection and provide evidence of the permission to use this material for research purposes.</i></p> <p><i>If you answer YES, you need to formally register your project with UREC, along with a project description. To do this complete Form 2.</i></p>	
9.	Does the research involve the animals?	
	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
	<p><i>If you answer NO, CONTINUE.</i></p> <p><i>If you answer YES, you need to formally register your project with UREC, along with a copy of the relevant licence (if required). To do this complete Form 5.</i></p>	
10.	Does the research involve environmental interventions?	
	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
	<p><i>If you answer NO, CONTINUE.</i></p> <p><i>If you answer YES, you need to formally register your project with UREC, along with a copy of the relevant licence (if appropriate). To do this complete Form 2</i></p>	
11.	Does the data you will collect contain <i>any</i> information that could be linked back to participants or that might identify them (e.g., name, address, photo, voice, email)?	
	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No

Winchester University: Ethics Form 1

	<p><i>If you answer NO, you need to formally register your project with UREC. To do this complete Form 2.</i></p> <p><i>If you answer YES, CONTINUE.</i></p>
--	--

 Reaching the end of these questions, **either** you will have been directed to complete a specific additional form **or** you should continue to section 2.

If you are still unsure whether you need ethics review or not, please re-read The Policy and email your query to ethics@winchester.ac.uk with details of your project.

Winchester University: Ethics Form 1

SECTION 2**DETERMINING THE LEVEL OF ETHICS REVIEW REQUIRED**

<i>Please mark with an ☒ as appropriate</i>	YES	NO
<p>Does the research involve individuals who are vulnerable?</p> <p><i>For example: vulnerable children, over-researched groups, people with learning difficulties, people with mental health problems, young offenders, people in care facilities, including prisons. For a note on research with children, see Appendix 2 of the Policy.</i></p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Does the research involve individuals in unequal relationships e.g., your own students?</p> <p><i>Please note:</i></p> <ol style="list-style-type: none"> 1. <i>students recruited via SONA are not considered 'your own students.' If you intend to recruit widely across the University or your Faculty (e.g., through snowball sampling or a mail shot) you do not need to consider such students as your own, even if some participants may be students, you are directly involved with. Only tick "yes" if you are targeting your own students specifically.</i> 2. <i>if you are an undergraduate or postgraduate student carrying out research with children in either a school or early years setting, these DO NOT come under the category of your 'own students.'</i> 	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Will it be necessary for participants to take part in the study without their knowledge and consent at the time?</p> <p><i>For example: covert observation of people in non-public places, use of deception. See Appendix 2 of the Policy.</i></p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Will the study involve discussion of sensitive or personal topics?</p> <p><i>For example: (but not limited to) participants' relationships, emotions, sexual behaviour, experience of violence, mental health, gender, race / ethnicity status or experience, political or religious affiliations. Please refer to the Policy.</i></p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Is there a risk that the highly sensitive nature of the research topic might lead to disclosures from the participant concerning their own involvement in illegal activities or other activities that represent a threat to themselves or others which may need onward reporting?</p> <p><i>For example: sexual activity, drug use, illegal activities, or professional misconduct.</i></p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Might the research involve the sharing data or confidential information beyond the initial consent given?</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Might participant anonymity be compromised at any time during or after the study?</p> <p><i>For example: will the research involve respondents using the internet, social media, or other visual /vocal methods where respondents may be identified?</i></p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Is the study likely to induce severe physical harm or psychological distress?</p>		

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Winchester University: Ethics Form 1

	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Does your research involve tissue samples covered by the Human Tissue Act (2004)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Is there a possibility that the safety of the researcher may be in question? <i>For example: research in high-risk locations or with high-risk groups.</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Does the research involve creating, downloading, storing, or transmitting material that may be considered to be unlawful, indecent, offensive, defamatory, threatening, discriminatory or extremist? <i>If you answer YES to this question, you must also contact the Director of IT Services, who must provide approval for the use of such data.</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Answering **NO** to **all** these questions means your project is eligible for Faculty level ethics review. You now need to complete Form 3.

Answering **YES** to **any** of these questions means your project will require Committee ethics review. You now need to complete Form 4.

Appendix L – (Form 3 Faculty Level Scrutiny 02092021) for Primary Research Approval

Winchester University: Ethics Form 3



RESEARCH ETHICS FORM 3

FACULTY REVIEW

GUIDELINES

This form is for staff and students. It will help you set out the ethical aspects of your project that need to be reviewed. Before completing it, you need to:

1. Read *The University Research Ethics Policy*.
2. If you are a student, discuss the ethical aspects of your project with your supervisor.

It is your responsibility to follow the University's Policy on the ethical conduct of research and to follow any relevant academic guidelines or professional codes of practice pertaining to your study when answering these questions. This includes providing appropriate information sheets and consent forms and ensuring confidentiality in the storage and use of data.

The questions in this proforma are intended to guide your reflection on the ethical implications of your research. Explanatory notes and further details can be found in the Policy document.

If any aspect of your project changes during the course of the research, you must notify the Chair of UREC.

Winchester University: Ethics Form 3

SECTION 1

YOUR DETAILS			
1.1.	Your name: Lucy Hopkins		
1.2.	Your department: Digital Media		
1.3.	Your Faculty: Business, Law, and Digital Technologies		
1.4.	Your status:		
	<input checked="" type="checkbox"/>	Undergraduate Student	<input type="checkbox"/> Staff (Professional Services)
	<input type="checkbox"/>	Taught Master	<input type="checkbox"/> Staff (Academic)
	<input type="checkbox"/>	Research Degree Student	<input type="checkbox"/> Other (please specify below)
1.5.	Your university email address: l.hopkins.19@unimail.winchester.ac.uk		
1.6.	Your telephone number: 07514041656		
	For students only:		
1.7.	Your degree programme: BSc (Hons) Computer Aided Design		
1.8.	Your supervisor's name (s): Marina Brkljac, Rhys Lockley		
1.9.	Your supervisor's department : Business, Law, and Digital Technologies		
1.10.	Your supervisor's email (s): marina.brkljac@winchester.ac.uk rhys.lockley@winchester.ac.uk		

Winchester University: Ethics Form 3

SECTION 2

YOUR RESEARCH	
2.1.	Project title: How can sustainable solutions be utilised in the packaging industry for improved circular creation, production, and disposal of food packaging?
2.2.	Start date: 21 st February 2022
2.3.	Expected completion date: 11 th March 2022
2.4.	Expected location of data collection: University, Online, Relevant Industry Premises. (e.g., school, workplace, public place, University premises etc.)
2.5.	Has funding been sought for this research?
	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2.6.	If so, where have you applied for funding?
2.7.	Has the funding been granted?
	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Pending
2.8.	Is the research collaborative? (e.g. co-investigators from another institution, at or with another organisation or colleagues in another department)
	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	If yes, which?
2.9.	Is Disclosure and Barring Service clearance required for your study? It is your responsibility to contact the Disclosure and Barring Service (DBS) to confirm whether or not clearance is needed prior to commencing recruitment or data collection. More information here
	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2.10.	Will your research be informed by guidelines from a professional association or specific, agreed standards of practice?
	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	If yes, which?

Winchester University: Ethics Form 3

SECTION 3**PROJECT DESCRIPTION**

Please provide a brief description of your project in non-technical language (between 500-1000 words). This should include details of the research rationale, aim(s), research question(s), context (linking to some relevant literature), and methods (including details of participants, data collection (including examples /descriptions of any audio or visual stimuli to be presented to participants), data analysis) to be used. You should state any ethical issues that you have identified and how these will be dealt with. This overview should contain sufficient information to acquaint the reader with the principal features of the proposal. A copy of the full proposal may be requested if further information is deemed necessary.

Please use this section to list documentation that may be relevant to your application and append it to the submission (e.g., consent forms, information sheets, questionnaires etc.).

My project explores sustainability in the packaging industry, with a personal niche of food packaging. My perspective on these topics related to how the current rate of production, consumption and disposal of these industries is unsustainable, and therefore could be minimised via sustainable design practices (e.g., CAD). The outcomes of my literature review, that explored these topics as part of my dissertation, revealed contrasting viewpoints and gaps in current knowledge. This included outcomes that equally supported and disproved my thesis question, that all linked to a greater need to solve the issues related to existing packaging. For example, the inefficiency of the current waste and recycling system, and a lack of quality education to help consumers correctly dispose of packaging. Overall, these outcomes provided the perfect points to take forward and apply within the project primary research. The aim of this practical exploration is to cover a variety of target audiences, both industry professionals and the public, to reveal the current trends and future expectations of today's packaging industry. This is key in successfully producing a critical and diverse discussion.

The main target audiences for the primary research include my university peer, friend, and family members. These individuals represent the public and consumer perspective on packaging and sustainability. The second cohort consists of relevant industry professionals and creators, like 'P&G' for packaging producers, 'Greenpeace' as the environmental stakeholders, the 'Hampshire County Council' to cover local recycling and waste disposal, and software/design companies such as 'Autodesk'. This would account for the necessary digital design and CAD insights. The final group would consist of leading retailers from the commercial packaging market, such as 'Amazon' or 'Ikea', who are heavily involved in the production of packaging for consumer goods. I also want to focus on supermarket/grocer businesses, such as 'Tesco', who would fulfil the criteria my dissertation niche. This would reveal data on the latest packaging developments from the perspective of stakeholders who are regularly criticised in relation to excess waste and plastic consumption.

I plan to use of both quantitative and qualitative research methods to deliver the outcomes of my literature review. Any questionnaires and surveys will include open and closed questions, depending on the recipient and dedicated time frame, to guarantee a diverse range of responses. The mainly qualitative method, an interview with a key player in the packaging industry, would give me the opportunity to receive in-depth answers and potentially healthy debate on the topics discussed.

Winchester University: Ethics Form 3

A digital survey would be the most suitable method for the consumer perspective group, distributed to participants via my personal and the Digital Media Department Facebook pages. Google forms is the most viable tool for online surveys because I can easily control the privacy of the shareable link in the Google Drive. The questionnaires would be sent to the prospective party via email communication. Presenting the questions in an attached word document would make it convenient to send and receive the data securely. Additionally, I plan to conduct a face-to-face survey with members of the public outside relevant venues (e.g., supermarkets, university shops etc.). The number of questions in this survey would be kept to a minimum and recorded via a tally to keep the data collection efficient and cause the least inconvenience or difficulty to the participants involved.

To briefly touch on ethics, each methodology carried out within my study would consider the following parameters in line with professional research and data protection practice expected by the University of Winchester. This includes how participants are allowed to consent to the removal of any information that could be linked to them – e.g., a company name, age etc. Steps will also be taken to ensure participants are aware what their data will be used for, how long it is held for before being destroyed (once formally presented), where it is held (secure personal Google Drive), and finally, that they have the right to cease participation for any reason and withdraw from the study.

See below for examples of how the primary research methodology will be designed and the expected question formats.

Examples of Survey & Questionnaire Design

GENERAL CONSUMER SURVEY

Welcome to my survey on packaging and sustainability, as part of the primary research required for my university dissertation. This explores the packaging industry and how sustainable design practices could be used to make every stage of the process more sustainable, for the sake of our future environment. I believe the solution lies in the environmental merit of the practices and tools within Digital Media Industries, especially in innovations involving artificial intelligence, such as Computer Aided Design.

I would like to hear your opinions and impressions of these topics by answering the questions below. Please feel free to be completely honest and share further thoughts in the final section. By completing this survey, you may gain a new perspective on packaging as a valuable resource in protecting our goods, but how this can also impact our environment.


All data collected in this survey will be stored in a private Google Drive folder and will be destroyed after the study is complete. Any participants have the right to withdraw themselves from the study or request the removal of data that may identify them.

I consent to my data being used for the purposes of the study explained above:

YES NO

1.

Thank you for taking part in this survey!



If you have any further questions, please contact:

EMAIL: l.hopkins.19@unimail.winchester.ac.uk MOBILE: 07514041656

TARGETED QUESTIONNAIRE
(Industry Professionals & Creators)

Welcome to my survey on packaging and sustainability, as part of the primary research required for my university dissertation. This explores the packaging industry and how sustainable design practices could be used to make every stage of the process more sustainable, for the sake of our future environment. I believe the solution lies in the environmental merit of the practices and tools within Digital Media Industries, especially in innovations involving artificial intelligence, such as Computer Aided Design.

I would like to hear your opinions and impressions of these topics by answering the questions below. Please feel free to be completely honest and share further thoughts in the final section. By completing this survey, you may gain a new perspective on packaging as a valuable resource in protecting our goods, but how this can also impact our environment.


All data collected in this survey will be stored in a private Google Drive folder and will be destroyed after the study is complete. Any participants have the right to withdraw themselves from the study or request the removal of data that may identify them.

I consent to my data being used for the purposes of the study explained above:

YES NO

1.

Thank you for taking part in this questionnaire!



If you have any further questions, please contact:

EMAIL: l.hopkins.19@unimail.winchester.ac.uk MOBILE: 07514041656

Winchester University: Ethics Form 3

FACE-TO-FACE GENERAL PUBLIC SURVEY

Would you be interested in taking part in a 5-question survey about packaging and sustainability. It is as part of the primary research required for my university dissertation.

By completing this survey, you may gain a new perspective on packaging as a valuable resource in protecting our goods, but how this can also impact our environment.

I consent to my data being used for the purposes of the study explained above:

YES NO

1.			2.			3.		
YES	NO	UNSURE	YES	NO	UNSURE	YES	NO	UNSURE
4.			5.			6. What age bracket do you fall into?		
YES	NO	UNSURE	YES	NO	UNSURE	10 – 19 years		
						20 – 29 years		
						30 – 39 years		
						40 – 49 years		
						50 – 59 years		
						60+ years		

Example Of Questions & Verbal Content

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TARGETED QUESTIONNAIRE
*(Industry Professionals & Creators)**

Questions

PACKAGING COMPANY & CAD DESIGN

*Change some questions depending on chosen contact^

1. Is sustainability a key part of your current and future innovations/processes, in relation to your packaging products?

Yes No

1a. If **Yes**, or **No**, please explain why.

[Comments]

2. Do you have a specific method, tool, or software that helps a stage in your design/production process that helps the overall product become more sustainable?

Yes No

2a. If you said **Yes**, please detail (if you can) what this is and how it works.

[Comments]

2b. Do you use any form of Computer Aided Design software, machinery etc. to help make your design and production process more sustainable?

[Comments]

SECTION 4

REFINING THE LEVEL OF ETHICS REVIEW REQUIRED

Revised October 2018

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<i>Please mark with an <input checked="" type="checkbox"/> as appropriate</i>		YES	NO
1	Does the research involve members of the public in a research capacity as co-researchers? (I.e. as in participant research where involvement extends beyond data collection)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	Is there a risk of over-disclosure that may put the participants at risk or cause them any anxiety?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3	Will tissue samples (including blood) be obtained from participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4	Will the study require the co-operation of a gatekeeper for initial access to participants? (E.g. to students at school, to members of self-help group.)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5	Is the right to withdraw from the study withheld at any time, or not made explicit?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6	Is there any reason participants may feel obliged to participate in the study against their will?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8	Will the research involve administrative or secure data that requires permission from the appropriate authorities before use?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
10	Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
11	Are there payments to researchers /participants that may have an impact on the objectivity of the research?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
12	Is there any cause for uncertainty as to whether the research will fully comply with the requirements of the General Data Protection Regulation (GDPR) (2018)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
13	Does any part of the project breach any codes of practice for ethics in place within the organisation in which the research is taking place?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
14	Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants? Please note: for fast track review, it is expected that the study will not involve invasive, intrusive or potentially harmful procedures of any kind.	<input type="checkbox"/>	<input checked="" type="checkbox"/>
15	Is pain or more than mild discomfort likely to result from the study?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
16	Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life? (E.g. involve prolonged or repetitive testing.)	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answer **YES** to *any* of these questions, please use the next section to indicate which question you have said yes to, describe the ethical issue in the context of your study and how you will address it. If you have answered **NO** to all questions, complete section 6.


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SECTION 5

ADDITIONAL INFORMATION AND AMENDMENTS
<p><i>Use this space to address ethical issues highlighted by the checklist in section 4, or to amend an original submission.</i></p>

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SECTION 6

DECLARATION	
<p>I have read and understood the University of Winchester Research Ethics Policy and confirm that adequate safeguards in relation to the ethical issues raised by this research can and will be put in place. I am aware of and understand University procedures regarding Health and Safety. I understand that the ethical aspects of this project may be monitored by the University Research Ethics Committee.</p> <p>I understand my responsibilities as a researcher as described in the University of Winchester Research Ethics Policy.</p> <p>I declare that the answers above accurately describe the research as presently designed and that a new application will be submitted should the research design change in a way which would alter any responses given in Form 1 or here.</p>	
<input checked="" type="checkbox"/> I confirm that if a Risk Assessment is required I will complete it and have it co-signed by my Supervisor or Head of Department before data collection takes place.	
<input checked="" type="checkbox"/> I confirm that, if DBS clearance is required for my project, then I will seek it before the start of my project.	
<input checked="" type="checkbox"/> I confirm that my research does not include risks that might cause it to be excluded from coverage by the University's insurers.	
<input checked="" type="checkbox"/> I confirm that I have appropriate insurance for this research.	
Researcher's signature: 	Date: 29/01/2022
In addition, for students (undergraduates, masters, postgraduate, research): The student has the skills to carry out the proposed research. I undertake to monitor the student's adherence to the relevant research guidelines and codes of practice.	
Supervisor's signature: R.Lockley	Date: 01/03/22
2nd Supervisor's signature: Marina Brkljac , 02.03.2022	

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Please submit this form along with Form 1 to your Faculty Head of RKE or nominee (staff /PGR) or your supervisor (taught postgraduate students).

Please remember to append any forms or documents that may be relevant to your application (e.g. consent form, information sheet, questionnaire(s) etc.). Your form cannot be considered unless it is submitted with the required supporting documentation. Omitting to do so will delay the ethics review process.