Sustainable Entrepreneurship Project

Adoption Factors to Food Waste Management Technologies

an Empirical Analysis of the Hospitality Industry

Candidate: Sara Santoriello (S6081762)

Supervisor: Sven Killian

Co-assessor: Emma Folmer

MSc Sustainable Entrepreneurship

University of Groningen

Campus Fryslân

Table of Content

Abstract

This research investigates the key factors influencing the adoption of food waste management technologies in the hospitality sector, with a particular focus on the technological, organizational, and behavioral barriers that hinder their implementation. Drawing on the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), the study combines quantitative data from 70 survey respondents with qualitative insights from an expert interview. The findings reveal that while hospitality professionals recognize the value and potential benefits of food waste technologies, especially in terms of cost savings and sustainability, challenges such as lack of infrastructure, limited training, and organizational resistance remain significant obstacles. Notably, individuals in sustainability-focused roles and those early in their careers showed higher levels of technology acceptance. This study contributes to a better understanding of adoption dynamics in hospitality and highlights the need for more supportive environments and targeted engagement strategies to facilitate the transition toward more sustainable practices.

Introduction

Food waste refers to the loss or disposal of edible food intended for human utilization that occurs at various stages of the food supply chain, including production, processing, distribution, retail, and consumption. The causes of this phenomenon vary, stemming from inefficiencies during food chain production, consumer behavior, and improper management (Parfitt et al., 2010).

In developed nations, food waste predominantly occurs at the retail and consumer levels, driven by over-purchasing, improper storage, and rigid aesthetic standards (Todd & Gill, 2019). Conversely, in developing nations, food waste is more common during production and processing stages due to inadequate infrastructure (Kibler et al., 2018). Addressing food waste has become increasingly urgent due to its profound environmental, economic, and social implications, as highlighted by the Sustainable Development Goals (United Nations, 2015). With 770 million people suffering from hunger and an additional 280 million experiencing high food insecurity last year, tackling this challenge is imperative for the well-being of our planet and its people.

The Food and Agriculture Organization (FAO, 2014) estimated that approximately one-third of the global food supply is wasted annually, a data confirmed by the United Nations Environment Programme (UNEP, 2021), which found that 17–33% of food produced worldwide is discarded. This wastage contributes substantially to greenhouse gas emissions and resource depletion. Within the hospitality sector, which includes hotels, restaurants, and catering services (HORECA), 12% of total food waste is generated (Dhir et al., 2020), primarily due to improper storage, overproduction, and excessive portion sizes. To illustrate, studies conducted in Finland and Switzerland reveal that approximately 18–20% of food prepared in food services is wasted during preparation and handling (Silvennoinen et al., 2015; Betz et al., 2014).

While the hospitality industry has made notable progress toward sustainability over the past decade, food waste management remains a persistently underdeveloped area. Waste management, in this context, refers not only to the collection, transportation, treatment, and disposal of waste, but also to the regulation and monitoring of these processes, and importantly, to strategies for reducing waste generation through reuse, recycling, and process improvements (DESIPA, 1997; Hyde et al., 2003). For this study, food waste management is understood as a set of practices aimed at preventing or minimizing waste creation, enhancing the quality and safety of waste handling, and promoting recovery and reuse.

Despite growing awareness, the sector continues to lack systematic and preventive approaches to food waste. Filimonau and De Coteau (2019) argue that current practices are largely reactive, often addressing waste only after it is generated. Papargyropoulou et al. (2016) similarly emphasize that reducing food waste requires a holistic perspective that takes into account operational inefficiencies, staff behavior, and customer habits. However, the lack of detailed data on food waste in foodservice contexts, particularly when compared to the data-rich environments of food production or retail, makes it difficult to build targeted strategies (Martin-Rios et al., 2020). As a result, foodservice managers often implement waste management practices through trial and error, lacking tailored guidance or best practices.

In response to these challenges, several technological innovations have been developed. Companies such as LeanPath, Winnow, Kitro, and Orbisk have introduced AI-powered tools that assist commercial kitchens in monitoring, analyzing, and reducing food waste. These technologies typically integrate smart scales, image recognition, and predictive analytics to track what is being wasted, when, and why, offering data-driven feedback to improve inventory control and production planning (Ellen MacArthur Foundation, 2020). For instance, Leanpath

offers an integrated platform combining smart scales, tablets, and cloud-based software to record and analyze food waste events in real time. Kitchen staff weigh wasted food items, categorize the reasons for disposal (e.g., overproduction, spoilage, or trimming), and receive immediate feedback through visual dashboards. The system then aggregates this data into reports that highlight recurring waste patterns, enabling chefs and managers to make data-informed decisions to adjust menus, improve purchasing, and modify preparation practices. Some versions of Leanpath's technology even integrate AI-driven recommendations, flagging problematic trends and suggesting tailored interventions. Case studies provided by the company show that kitchens using their system have achieved food waste reductions of 25–50% within the first year of implementation. However, despite these promising outcomes, adoption across the hospitality sector remains sporadic. According to Martin-Rios et al. (2020), this slow uptake is due to several interrelated barriers: the high upfront investment required for these tools, the additional need for staff training, and resistance to change within organizational cultures. While technology is frequently cited in the literature as a key innovation in food waste management, it has rarely been investigated in depth through applied studies, especially within hospitality settings. This shows a surprising gap between how often digital tools are referenced in sustainability research and how infrequently they are actually examined or implemented on the ground.

Although recent work by Muzondo et al. (2023) has begun to explore the adoption of such technologies, much of this research focuses on the food retail sector rather than hospitality. This leaves a crucial gap in understanding: why has the hospitality sector, despite its high levels of food waste and intense operational complexity, been so slow to integrate these emerging tools into everyday practice? Traditional methods, including manual tracking or informal kitchen routines, continue to dominate food waste management in restaurants, hotels, and catering

businesses (Filimonau & De Coteau, 2019).

Addressing this gap by investigating the specific technological, organizational, and behavioral barriers that limit adoption could lead to more targeted interventions and help bridge the divide between theoretical potential and practical implementation. This study contributes to that effort by exploring these issues through the lens of the UTAUT2 model (Tamilmani et al., 2021), a framework used to understand the factors influencing technology adoption by analyzing users' perceptions, motivations, and behavioral intentions, offering new insights into how and why adoption decisions are made (or avoided) in real hospitality environments.

Research Objectives

While, as previously mentioned, there is already a lot of research on the environmental and economic impacts of food waste, many studies don't fully consider the different types of hospitality businesses and the challenges they face. For example, small restaurants or cafés often deal with limited staff, tight budgets, and day-to-day pressures that make it harder for them to adopt new technologies, challenges that are very different from those of large hotel chains (Muzondo et al., 2023). Also, although the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), which will be discussed in greater details in the following section, is commonly used to study how people adopt new technologies, it hasn't been applied much in the area of food waste management. Tamilmani et al. (2021) suggest that using a model like UTAUT2, which looks at several factors at once, can help us better understand why people do or don't adopt certain technologies, but, despite this fact, many existing studies focus only on one or two issues, like cost or ease of use, without considering the bigger picture.

This study tries to fill the gap mentioned above by focusing on the following main research question: *What are the key factors influencing the adoption of food waste management*

technologies in the hospitality sector, and what technological, organizational, and behavioral barriers hinder their adoption? To support this question, it also explores: *How do organizational roles and resource availability influence attitudes toward adopting food waste technologies in hospitality settings?*

This research aims to explore how people working in the hospitality industry perceive food waste management technologies, considering both the perspectives of technology providers and end-users. By applying the UTAUT2 framework, the study links real-world challenges with theoretical insights to better understand the factors that encourage or hinder adoption.

The findings are intended to support a range of stakeholders in the hospitality sector. Industry professionals can become more aware of technologies that align with their operational needs, while technology providers can refine their offerings to better serve their clients. Policymakers may also draw on these insights to design incentives and support systems that encourage more sustainable practices. This research also supports Sustainable Development Goal 12.3, which aims to cut global food waste in half by 2030. Overall, the study hopes to offer useful ideas and real solutions that support a more sustainable future for the hospitality industry.

Theoretical Framework

To investigate the factors influencing the adoption of food waste management technologies in the hospitality sector, this study draws on the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) as a core theoretical framework. Developed as an extension of the original UTAUT model, UTAUT2 incorporates additional constructs, such as hedonic motivation, price value, and habit, to better account for user behavior in consumer-oriented contexts (Tamilmani, Rana, & Wamba, 2021). The model assesses technology adoption across several dimensions: performance expectancy, effort expectancy, social influence, facilitating conditions, and user experience. These elements capture both the rational (e.g., expected benefits and ease of use) and emotional (e.g., enjoyment and habits) drivers of technology acceptance, making UTAUT2 a comprehensive framework. The model's main constructs were selected for this study due to their relevance to the complex decision-making environments found in hospitality settings. Performance expectancy refers to the extent to which users believe the technology will improve their work outcomes. In food service contexts, this could include better efficiency, reduced costs, and enhanced sustainability efforts. Effort expectancy deals with how easy the technology is perceived to be. In fast-paced kitchens or hotel operations, if a system is seen as difficult or time-consuming, it can quickly be rejected regardless of its potential benefits. Social influence addresses how much users feel they are expected by others (such as managers, colleagues, or external stakeholders) to adopt a certain tool. Facilitating conditions reflect users' perceptions of the support available to help them use the technology effectively, such as infrastructure, training, or technical assistance.

In addition to these functional dimensions, UTAUT2 also considers more experiential and

long-term factors. Hedonic motivation captures the pleasure or satisfaction users derive from using the technology. For example, many food waste technologies provide real-time feedback and visualizations of waste reduction progress, which can foster a sense of accomplishment. Price value examines whether users believe the benefits of the technology outweigh its costs, which is especially relevant in the budget-conscious hospitality sector where initial investments often determine adoption decisions. Lastly, habit considers how ingrained certain behaviors are and how easily new technologies can be incorporated into existing routines. In hospitality, where many tasks are repeated daily and often under pressure, understanding the role of habit is crucial for predicting long-term engagement with technology.

These dimensions were included in this research not only because of their theoretical grounding, but also because they align with the realities of hospitality environments, where both personal attitudes and organizational conditions must be considered to understand adoption behavior. The use of UTAUT2 thus enables a multi-faceted analysis that goes beyond isolated variables and instead captures the interplay between motivation, practicality, and organizational culture.

This research is situated within a pragmatic epistemological paradigm, which aligns well with the use of UTAUT2. Pragmatism, rooted in the work of Dewey, Peirce, and James, emphasizes practical solutions to real-world problems and values methodological flexibility over strict adherence to philosophical dichotomies like positivism versus constructivism. As Creswell (2021) explains, pragmatism supports the use of both qualitative and quantitative methods depending on the needs of the research question. This approach views knowledge as context-dependent, shaped through interaction between the researcher and the subject of study.

Within this epistemological stance, UTAUT2 serves not only as a theoretical framework but also as a practical lens that allows to identify barriers and enablers to technology adoption. Its

constructs enable a nuanced exploration of both the cognitive and experiential dimensions of adoption. For example, hedonic motivation captures the pleasure or satisfaction users derive from engaging with a technology, meanwhile, the construct of habit addresses the inertia or reinforcement of past behaviors, offering insights into long-term engagement with technology.

By combining quantitative data (e.g., presence of patterns) with qualitative insights (e.g., user perceptions), this research aims to develop a holistic understanding of technology adoption and possibly incentivize the implementation of scalable, tailored solutions for managing food waste in hospitality settings.

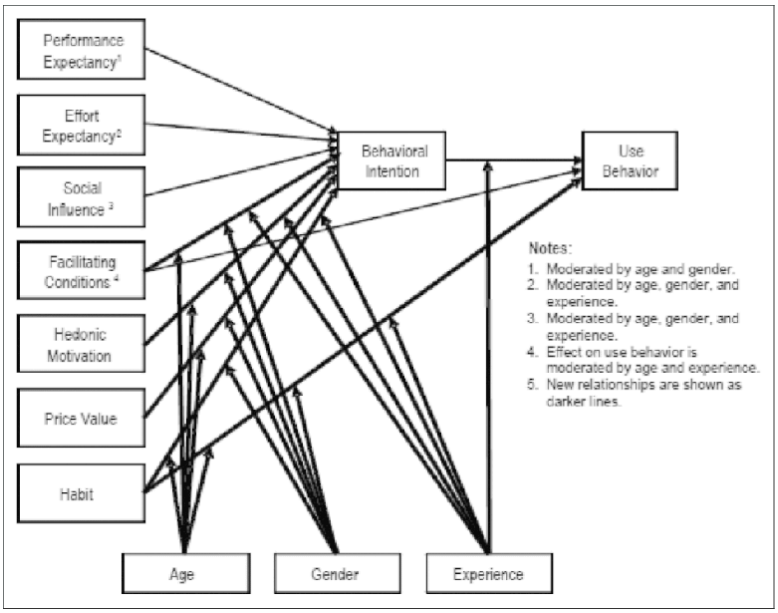

Figure 1: UTAUT 2 Framework (Venkatesh et al, 2012)

Methods

Methodological Approach

This research adopts a mixed-method approach to explore the adoption of food waste management technologies within the hospitality sector. By combining qualitative and quantitative methodologies, this approach enables a comprehensive investigation of the research topic, capturing both detailed insights from technology providers and broader trends among hospitality professionals. This methodological choice is particularly suited to the complexity of the subject, given the multifaceted influences (technological, behavioral, and organizational) that shape technology adoption in the hospitality industry.

Initially, the research design intended to include multiple semi-structured interviews with representatives of key technology providers, such as Leanpath, Winnow, Kitro, and Orbisk, in order to collect diverse supply-side perspectives. However, despite repeated efforts to establish contact with representatives from Winnow, Kitro, and Orbisk (through emails, LinkedIn messages, and contact forms) no responses were received. As a result, the qualitative component of this research relied exclusively on one extensive and in-depth interview conducted with a Representative of Leanpath. While this limitation narrows the range of provider insights, the interview offered rich, detailed data on the operational, behavioral, and organizational barriers to technology adoption in food service environments, particularly from the standpoint of a globally recognized leader in the field.

The interview lasted approximately 40 minutes and was conducted online with prior consent (Appendix A). It was audio-recorded and subsequently transcribed verbatim by the use of Otter.AI and consequently manually revised (Appendix B). The transcribed data was then

analyzed using semantic thematic analysis through the Atlas.ti platform. Through inductive coding, key themes such as resistance to change, operational constraints and perceptions of return on investment emerged. These themes played a crucial role in informing the development of the survey instrument used in the quantitative phase.

Due to limitations in conducting multiple expert interviews, the survey was primarily structured around the theoretical dimensions outlined in the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), while also integrating key insights from the interview with Leanpath. The questions were carefully developed to reflect the core constructs of the UTAUT2 model (such as performance expectancy, effort expectancy, social influence, and facilitating conditions) as well as additional influencing variables including age, gender, and years of experience. Although the interview helped shape specific items related to real-world barriers like usability challenges, perceived return on investment, and daily operational pressures in commercial kitchens, the overall design and layout of the questionnaire were theory-driven, ensuring comprehensive coverage of the behavioral, organizational, and demographic factors relevant to technology adoption. The specific mapping between individual survey questions and the UTAUT2 constructs will be examined in greater detail in the Discussion section, where the connections between theory and participant responses are more closely explored.

The online survey (Appendix D.), aimed at hospitality professionals throughout different regions of Europe, opened with an explanatory section to establish a common understanding of food waste management technologies. Participants were told that the survey was anonymous and designed to understand perceptions, expectations, and barriers regarding digital tools (such as smart scales, AI-powered analytics, digital dashboards, predictive planning tools, and mobile data-entry interfaces) used by hotels, restaurants, and catering services to monitor and reduce

waste. They were invited to rate 18 statements on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree), skip any item if they wished, and to complete 4 additional questions on demographic and organizational context (age, gender, job role, years of experience)). This introduction ensured that all respondents, regardless of prior familiarity, shared a clear conceptual reference for the technology under study.

The survey was hosted on Google Forms and disseminated via LinkedIn, Instagram, and personal networks across Europe, yielding 70 responses (with some items, such as the social-pressure question, answered by 59 participants). Responses were manually reviewed and exported to Google Sheets, where initial summary statistics, such as percentage distributions and means for each item based on actual respondent counts, were computed. In the first stage of analysis, these survey results were examined in relation to the core constructs of the UTAUT2 framework, helping to identify preliminary patterns of agreement or disagreement with key adoption factors, as is later explained in detail in the discussion section. Following this, a second phase of analysis was carried out in which responses were factor-mapped and grouped into eight thematic categories Product Knowledge, Problem Awareness, Technology Acceptance, Strategic Relevance, Normative Pressure, Waste Reduction Experience, Resources Availability, and Process Fit. The categories were specifically created for this research to organize the survey questions into coherent groups based on their content. This classification helped connect the survey items with the main themes of the study and allowed for a more in-depth statistical analysis, including factor mapping and regression. Product Knowledge refers to participants' familiarity with food waste technologies and their understanding of available tools and services. Problem Awareness captures their recognition of food waste as a pressing issue within their workplace. Technology Acceptance measures the general openness and perceived usefulness of

implementing new food waste technologies. Strategic Relevance reflects the extent to which these technologies are seen as contributing to broader business goals, such as efficiency, cost reduction, and sustainability. Normative Pressure assesses the influence of peers, industry norms, and potential regulations on adoption behavior. Waste Reduction Experience focuses on the staff's past engagement with waste minimization efforts and whether reducing waste is already part of their daily routines. Resources Availability examines the perceived access to infrastructure, training, and organizational support necessary for successful implementation. Finally, Process Fit evaluates how well these technologies are believed to align with the workflows and time constraints of a fast-paced kitchen environment.

Negatively worded items were reverse-scored (6 minus the original value) to maintain scale directionality, and each participant's factor score was calculated as the mean of its constituent items.

Rigorous regression analyses followed through the use of an AI tool (ChatGPT o4-mini), first fitting simple linear models in which Technology Acceptance was regressed on each of the other seven factors individually, and then estimating categorical models with demographic predictors, such as job role, gender, years of experience, and age group. All statistical outputs were reviewed and interpreted in Google Sheets for clarity and reproducibility. Despite the limitation of relying on a single expert interview, this mixed-methods strategy yields both rich, context-sensitive insights and robust, empirically validated patterns, thereby enhancing the study's validity and relevance to real-world hospitality operations.

Ethical considerations

The topic of this thesis does not present significant ethical considerations as it does not involve the collection of sensitive data. However, the anonymity and confidentiality of participants will be rigorously upheld throughout the research process.

All participants in both the qualitative and quantitative studies will be required to provide informed consent by signing a consent form before taking part. For the semi-structured interviews, participants will be given the option to explicitly state whether they consent to their name or company being mentioned in the thesis. This will be achieved through a designated column in the consent form, which all interviewees must complete and sign. If no such explicit consent is provided, anonymity will be strictly maintained.

For the surveys targeting hospitality professionals, anonymity is inherent to the data collection process due to the statistical nature of the analysis. No identifying information will be collected, ensuring that respondents' privacy is fully protected.

An application for ethical approval will be submitted to the appropriate Ethics Committee, and a copy of this application will be included in the appendix of the thesis (Appendix E.).

Results

This section presents the key findings from the qualitative interview and quantitative survey. Guided by the UTAUT2 framework, the results highlight technological, organizational, and behavioral factors shaping technology adoption.

Qualitative study

In this section, I present the findings of a semi-structured interview with a Representative from Leanpath. The interview provides an in-depth practitioner perspective on the adoption dynamics of food waste technologies in hospitality environments. Drawing from a semantic analysis of the interview (see Table 1), the key themes are outlined below, along with their connection to the survey instrument developed in the second phase of this study.

Theme	Interview Excerpt (Paraphrased)	Question Number
Cost Savings as Primary Driver	Leanpath was founded to reduce costs through efficiency; financial motive was the initial driver.	Q7, Q13, Q16
Operational Barriers in Food Service	Kitchens are fast-paced, highly tactical; hard to prioritize tech adoption amidst daily pressures.	Q12, Q14
Perceived Ease of Use and Usability	Solutions must be seamless and non-intrusive; busy chefs avoid data-heavy tools.	Q12
Organizational Commitment	Adoption often depends not on the frontline users, but on whether leadership is willing to make food waste prevention a priority.	Q3
Staff Engagement and Behavioral Change	Behavior change tools and coaching are central; engagement is key to tech success.	Q3, Q5, Q6, Q11
Technology Awareness and Education	Education is better now but previously was a major barrier; commitment still lacking.	Q12, Q17
Return on Investment (ROI) Perception	ROI is clear, but perception of upfront cost is still a barrier.	Q7, Q8
Environmental vs Financial Motivation	Environmental benefits exist but aren't always prioritized in decision-making.	Q2, Q3, Q9, Q10
Adoption Resistance Despite Proven Benefits	Despite case studies, only ~4000 sites out of millions use Leanpath.	Q1, Q2, Q18

Table 1: Semantic connection between Interview and Survey

One of the first and most emphasized points in the interview was the foundational motive behind Leanpath's development: cost savings. According to the Representative, "Leanpath really started with a financial focus to help food service organizations reduce their costs and that's how it all began." He noted that food service organizations typically waste "anywhere from four to ten percent of purchases," making the economic benefits of adoption particularly compelling. This insight directly informed several survey items, particularly those investigating cost as a perceived barrier to adoption (Q7, Q13, Q16 in the survey).

The conversation then moved to the daily realities of kitchen operations. The Interviewee described food service environments as extremely tactical and fast-paced, stating, "the last thing we want to do is run out of food… excessive production can be viewed as a hedge against risk management." Kitchens operate under constant time pressure, making additional tasks like data entry feel burdensome. These comments were instrumental in shaping survey questions related to time and operational barriers (Q12, Q14).

Ease of use emerged as another significant concern. The Interviewee emphasized that "you need to give them an easy process, one that won't take a lot of time," highlighting that kitchen staff typically avoid overly technical solutions. This directly connects to the construct of effort expectancy from UTAUT2 and was mirrored in survey questions addressing perceived usability (Q12).

Staff engagement and behavioral change were frequently highlighted. The Interviewee explained, "we have a number of behavior change tools... helping to coach clients to use the

technology to its maximum benefit." This theme connects to multiple survey questions exploring staff involvement and sustainability culture (Q3, Q5, Q6, Q11).

Another crucial barrier discussed was leadership commitment. The Interviewee stressed, "it's really about the commitment among organizations to embrace the technology," emphasizing that "leadership amongst organizations to make the commitment" remains a significant hurdle. Although awareness of food waste technologies has increased, actual adoption is lagging due to insufficient organizational prioritization. Consequently, survey questions were designed to measure both prior awareness and the degree of active consideration of food waste solutions (Q12, Q17).

On the topic of return on investment (ROI), The Interviewee reported tangible benchmarks: "typically the return on investment for sites is anywhere from two to seven." Yet, despite these compelling figures, adoption resistance remains prominent due to upfront costs or perceived implementation difficulties. This contradiction directly informed survey items related to ROI perception and cost-benefit analysis (Q7, Q8).

The Representative from Leanpath also addressed the psychological and cultural dimensions affecting adoption. He remarked, "the environmental value is significant but not always prioritized in decision-making." Businesses often require direct operational or financial incentives to act, leading to survey questions contrasting financial and ecological motivations (Q2, Q3, Q9, Q10)..

Additionally, the discussion revealed that survey questions 1, 2, and 18 explicitly address adoption resistance despite proven benefits. The Interviewee highlighted this explicitly, stating, "we're very early in the space... there are millions of food service organizations around the

globe... we're operating with over 4,000 sites," thus illustrating the gap between potential benefits and actual adoption.

In conclusion, the semi-structured interview with The Representative from Leanpath provided critical qualitative insights into the multifactorial nature of technology adoption in food service environments. The conversation touched on economic, operational, behavioral, and cultural barriers, many of which were later operationalized into survey questions. These themes reflect real-world complexities and provide a valuable foundation for constructing a theoretically grounded and practically relevant survey instrument that will be further analyzed in the following sections.

Quantitative Study

The quantitative phase of this study was based on the distribution of a structured survey which received responses from 70 individuals working within the hospitality industry. While participation in the survey was relatively strong, it is important to note that respondents were not required to answer every single question. As a result, a few questions received fewer than 70 responses, for instance, the statement "There is social pressure within my professional network to adopt environmentally responsible technologies" (corresponding to Q18) was answered by only 59 participants. This variability in response count was taken into account when interpreting the results.

To begin the analysis, I first calculated the distribution of responses across the five-point Likert scale (from 1 = strongly disagree to 5 = strongly agree) for each individual survey question. Rather than assuming a uniform number of respondents, the percentages were calculated based on the actual number of responses to each specific question to provide a more accurate picture of how each item was perceived by those who answered it. Following this step, I computed the

average score for each question to identify general trends in agreement or disagreement across the sample.

Each survey question was then categorized according to its thematic focus into one of eight semantic factors. These factors, which were developed based on both the interview insights and relevant literature, are as follows: Product Knowledge (Q1, Q17), Problem Awareness (Q2), Technology Acceptance (Q11, Q13), Strategic Relevance (Q3, Q7, Q8, Q9), Normative Pressure (Q10, Q18), Waste Reduction Experience (Q4, Q5, Q6, Q15), Resources Availability (Q16, Q12), and Process Fit (Q14). The thematic categorization was essential for linking specific survey items to broader constructs. After obtaining average scores for each question, I proceeded to calculate factor scores. To do this, I first renamed the lengthy question text columns into a simplified Q1–Q18 format for clarity and consistency, then each factor was then matched to its corresponding question numbers, following the categorization previously described. All responses were converted into numeric values on the standard Likert scale (1 to 5), allowing for quantitative computation. Two questions, Q12 and Q13, were reverse-coded items, meaning they were phrased negatively compared to other questions. To align their interpretation with the rest of the items, I applied a reverse scoring formula (6 - original score), ensuring that higher values consistently indicated stronger agreement or higher levels of the measured construct. With this transformation complete, I calculated each participant's score for each of the eight factors by averaging their responses to the relevant questions. For example, a respondent's score for Product Knowledge was the average of their answers to Q1 and Q17, and their Technology Acceptance score was the average of Q11 and the reversed Q13.

The next phase involved exploring the relationship between these factors. To begin, I conducted a series of simple regression analyses where Technology Acceptance was treated as the

dependent variable (Y), and each of the remaining seven factors served as independent variables (X), one at a time. This approach helped reveal how each construct, considered individually, might influence attitudes toward adopting food waste technology. The results of the simple regression analyses, in which each thematic factor was individually tested as a predictor of Technology Acceptance, revealed relatively low levels of explanatory power across the board. Product Knowledge showed a weak and statistically insignificant negative relationship with Technology Acceptance ($\beta = -0.042$, $p = 0.52$, $R^2 \approx 0.006$), while Problem Awareness demonstrated a similarly small and non-significant positive association ($\beta = 0.042$, $p = 0.45$, $R^2 \approx 0.008$). Strategic Relevance exhibited virtually no effect on Technology Acceptance ($\beta = 0.003$, $p = 0.95$, $R^2 \approx 0.0001$), and Normative Pressure also had a minimal impact ($\beta = 0.026$, $p = 0.72$, $R^2 \approx 0.002$). Waste Reduction Experience resulted in a slightly stronger but still non-significant negative coefficient ($\beta = -0.052$, $p = 0.29$, $R^2 \approx 0.016$). Notably, Resources Availability was the only factor to approach significance, showing a modest positive effect on Technology Acceptance ($\beta = 0.175$, $p = 0.10$, $R^2 \approx 0.042$). Lastly, Process Fit had a negligible and non-significant negative relationship with Technology Acceptance ($\beta = -0.048$, $p = 0.44$, $R^2 \approx 0.003$). Overall, none of the individual factors demonstrated a statistically significant effect on Technology Acceptance, though Resources Availability showed a marginal trend ($p = 0.10$). These results suggest that while certain factors may hint at potential influence, none alone explain a substantial portion of variance in attitudes toward adopting the technology.

To further investigate the predictors of Technology Acceptance, I treated “job role” as a categorical independent variable. In this regression model, “Chef / Kitchen Staff” was used as the baseline category. The model showed that the job category explains about 30.6% of the variance in Technology Acceptance, and the overall relationship between job role and

Technology Acceptance was statistically significant. However, when looking at individual roles, only Sustainability Coordinators reported a significantly higher level of Technology Acceptance compared to Chefs. The differences for other job categories, including Managers, Owners, and unspecified roles, were not statistically significant.

Next, I analyzed gender as a categorical predictor, by setting "Female" as the reference category. Although males and individuals who did not report their gender showed slightly higher average scores in Technology Acceptance compared to females, these differences were not statistically significant. Therefore, the model overall did not demonstrate a meaningful relationship between gender and Technology Acceptance, with only about 6.1% of the variance explained.

I then examined years of experience in the hospitality industry as a predictor of Technology Acceptance, using the 1–3 years experience group as the reference. Only participants with less than one year of experience showed a statistically significant increase in Technology Acceptance compared to the baseline group. The other experience categories (4 to 7 years and more than 7 years) did not show significant differences. The model was marginally non-significant but suggested that early-career professionals may be more open to adopting new technology.

Finally, I used age group as a categorical predictor, with 25–34 years as the reference group, but unfortunately this model showed no statistically significant differences in Technology Acceptance across age groups. Although there were slight variations (such as higher scores for respondents under 25 and lower scores for older age brackets) none reached significance.

These findings, illustrated statistically in the table below (Table 2.), suggest that adoption is not driven by any single factor, but rather by a combination of role-based responsibilities, perceived support, and contextual readiness. The results highlight the importance of organizational positioning and suggest that internal culture and support mechanisms may be just as important as

the technology itself. These insights lay the groundwork for the next chapter, where both the qualitative and quantitative findings are interpreted in more depth to better understand how real-world attitudes align with theoretical expectations and where the most pressing barriers to adoption continue to persist.

Job role	**Gender**	**Years of Experience**	**Age**
❖ $R^2 = 0.306$ ❖ Adjusted $R^2 = 0.251$ ❖ $F(5, 63) = 5.546$ ❖ $p < 0.001$ ❖ Manager/Team Leader: $\beta = +0.127$, $p = 0.182$ ❖ Other: $\beta = +0.214$, $p = 0.318$ ❖ Owner/Executive: $\beta = +0.048$, $p = 0.801$ ❖ Sustainability Coordinator: $\beta = +1.298$, $p < 0.001$ ❖ Unknown: $\beta = +0.548$, $p = 0.126$	❖ $R^2 = 0.061$ ❖ Adjusted $R^2 = 0.032$ ❖ $F(2, 66) = 2.13$ ❖ $p = 0.127$ ❖ Intercept (Female): 2.96, $p < 0.001$ ❖ Male: $\beta = +0.18$, $p = 0.083$ ❖ Unknown: $\beta = +0.54$, $p = 0.180$	❖ $R^2 = 0.095$ ❖ Adjusted $R^2 = 0.053$ ❖ $F(3, 65) = 2.27$ ❖ $p = 0.088$ ❖ Less than 1 year: $\beta = +0.875$, $p = 0.030$ ❖ 4–7 years: $\beta = -0.097$, $p = 0.324$ ❖ More than 7 years: $\beta = -0.125$, $p = 0.549$	❖ $R^2 = 0.048$ ❖ Adjusted $R^2 = 0.005$ ❖ $F(3, 65) = 1.10$ ❖ $p = 0.354$ ❖ Under 25: $\beta = +0.360$, $p = 0.378$ ❖ 35–44: $\beta = -0.091$, $p = 0.370$ ❖ 45–55: $\beta = -0.390$, $p = 0.187$

Table 2: Categorical Regression Analysis Results

Discussion

This research set out to examine the key factors influencing the adoption of food waste management technologies in the hospitality sector, with specific attention to the technological, organizational, and behavioral barriers that may hinder adoption. In addition, the study aimed to explore how organizational roles and resource availability affect the attitudes of hospitality professionals toward adopting these technologies. These goals were pursued using a mixed-methods approach supported by the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), which provided a comprehensive theoretical framework for analyzing adoption behavior in a practical context.

The findings from both the survey and the qualitative interview with the Representative from Leanpath reveal several important insights into the dynamics of adoption. Starting with the main research question, one of the most prominent factors that supports the uptake of food waste technologies is the perception of their usefulness. Performance expectancy, one of the primary constructs of UTAUT2, was reflected in survey responses that indicated agreement with the idea that these tools could reduce operational costs, improve efficiency, and enhance the sustainability image of hospitality businesses. Specifically, questions Q7, Q8, and Q9 received average scores of 3.7, 3.7, and 3.8 respectively, pointing to an overall positive perception of what these technologies can achieve. These findings echo what The Representative from Leanpath shared during the interview, when he stated, "Leanpath really started with a financial focus to help food service organizations reduce their costs."

Likewise, the hedonic motivation to adopt such technologies emerged as another positive driver. The enjoyment or satisfaction derived from using technology (especially in seeing real-time progress) was highlighted by an average score of 3.8 in response to Q11. The Interviewee also

confirmed the importance of visible impact, emphasizing that "making food waste data visible and transparent" plays a critical role in sustaining engagement. This suggests that the experience of using the technology, not just its practical outcomes, is a key consideration for users.

However, while these motivating factors are clearly present, the research also uncovered significant barriers that align with the second part of the main research question. One such barrier is the lack of facilitating conditions. Questions Q16 and Q17, which assessed whether organizations had the necessary infrastructure and training support, scored only 3.0. Similarly, Q6, which addressed whether staff received proper training on food waste reduction, also scored 3.0. These results point to a consistent theme: although hospitality professionals see the value of these tools, many do not feel they have the resources or support needed to implement them. This was reinforced in the interview with Finn, who emphasized that “it's really about the commitment among organizations to embrace the technology and to report on results."

Another challenge is related to effort expectancy. Although participants acknowledged the potential of these technologies, they also expressed concern about how disruptive or time-consuming their implementation might be. Q12 and Q14 (both addressing usability and disruption) received lower scores (3.3 and 3.1), highlighting a perceived operational burden. Finn’s observation that "you need to give them an easy process, one that won’t take a lot of time" aligns closely with this concern and suggests that simplicity and ease of integration are essential features for widespread adoption.

Behaviorally, the results also showed that food waste reduction has not yet become habitual practice in most kitchens. Question Q15 received an average score of 3.1, indicating that waste reduction is not yet a routine behavior. This aligns with UTAUT2’s recognition that habit

significantly influences long-term adoption, and it highlights a need for not just training, but cultural change (Tamilmani et al., 2021).

In terms of social influence, the findings were moderate. Q10 and Q18 scored 3.6 and 3.4 respectively, suggesting that while peer and regulatory expectations are present, they are not powerful enough to drive adoption alone. This is consistent with previous studies like Filimonau and De Coteau (2019), which note that the hospitality industry often lacks a coordinated strategy for sustainability initiatives.

Turning to the sub-question, this research also examined how organizational roles and the availability of resources affect attitudes toward technology adoption. The regression analysis provided some particularly valuable insights here. While most individual variables did not significantly predict technology acceptance, the role of the respondent did. Sustainability coordinators, compared to chefs and kitchen staff, showed a significantly higher level of acceptance ($p < 0.001$). This suggests that individuals whose responsibilities align with sustainability goals are more receptive to adopting new technologies and may serve as internal champions for change. The Representative from Leanpath also confirmed this idea during the interview, pointing out that "individuals want to be part of... an organization that's exhibiting responsible behavior," which indicates that sustainability culture within the workplace influences staff attitudes.

Resource availability, although not statistically significant, showed a marginal trend ($p = 0.10$), reinforcing the earlier interpretation that access to infrastructure and support can positively influence attitudes toward adoption. This connection between perceived resource sufficiency and readiness for adoption reflects what has been discussed in literature by Muzondo et al. (2023), who emphasized that lack of organizational capacity often delays innovation implementation.

Interestingly, demographic variables like gender and age did not significantly affect attitudes, but those with less than one year of experience in the industry were more likely to accept the technology ($p = 0.030$). This suggests that early-career professionals may be more adaptable and open to new practices, perhaps because they have not yet developed strong routines or resistance to change. It aligns with a broader understanding in the adoption literature that openness to innovation can be influenced by one's professional background and experience level (Venkatesh et al., 2012).

One aspect of the research that particularly strengthens its contribution is the triangulation between the qualitative and quantitative data. While the average survey results were generally moderate, they found strong echoes in the qualitative interview with Finn. This kind of alignment enhances the validity of the findings and provides a fuller picture of both the enablers and constraints faced by professionals in real-world settings. It shows that even if individual survey items do not reach high significance statistically, they are meaningful when situated within a broader context of expert perspectives and existing literature.

Still, the research is not without its limitations. While the results offer a grounded understanding of adoption factors and barriers, the overall findings are constrained by the sample size and distribution. The survey received 70 responses, but these were unevenly spread across roles and business types, limiting the depth of analysis for specific hospitality categories. Similarly, although the interview with The Representative from Leanpath was rich and informative, it represented the perspective of a single technology provider. Had more time been available, a broader sample of both survey participants and interviewees could have been collected.

If I were to conduct this study again, I would approach the selection of participants more strategically. Instead of trying to broadly represent all segments of the HORECA industry, I

would focus on a single segment, such as catering services or mid-sized restaurants, where I could ensure a higher number of responses and better category-specific insights. This could have helped avoid the relatively average results observed in the survey, where most questions scored around a 3, offering limited contrast and minimal standout trends.

Lastly, collaborating, even indirectly, with a real-world organization like Leanpath brought valuable insights into how theoretical models like UTAUT2 function in practice. The interview highlighted differences in language and priorities between academic theory and professional application. For example, where UTAUT2 emphasizes constructs like hedonic motivation, professionals like The Representative from Leanpathspeak in terms of "satisfaction" and "engagement." These parallels illustrate the importance of bridging academic and practical perspectives, and they underscore the value of applied, real-world engagement in conducting meaningful research. Overall, this study contributes to the growing conversation on sustainability and digital innovation in hospitality by identifying not only what drives the adoption of food waste management technologies but also what inhibits it. The UTAUT2 model proved a useful lens, particularly in illustrating the contrast between perceived benefits and actual implementation challenges. By addressing both the technological and human dimensions of adoption, this research hopes to offer a clearer pathway toward integrating sustainable technologies in hospitality operations and supports ongoing efforts to meet Sustainable Development Goal 12.3: halving global food waste by 2030.

Conclusion

This research set out to explore the adoption of food waste management technologies within the hospitality sector by asking two central questions: what are the key factors influencing the adoption of these technologies, and what technological, organizational, and behavioral barriers hinder their implementation? In support of this inquiry, a sub-question was posed to examine how organizational roles and resource availability shape attitudes toward adoption. By integrating the UTAUT2 model and adopting a mixed-methods approach, the study sought to connect theoretical insights with real-world observations, offering a grounded understanding of both drivers and constraints in the adoption process.

The research confirmed that the perceived usefulness of food waste technologies (captured in the UTAUT2 construct of performance expectancy) plays a key role in shaping professionals' openness to adoption. Participants recognized that such technologies can help reduce operational costs, improve workflow efficiency, and enhance the sustainability profile of hospitality businesses. These findings were not only evident in the high-scoring survey items related to cost-saving and efficiency but were also echoed in the qualitative interview with The Representative from Leanpath.

Closely related to this is the emotional and experiential aspect of adoption, represented by the construct of hedonic motivation. Many participants responded positively to the idea of seeing real-time reductions in food waste, highlighting a psychological satisfaction that supports continued use. The Interviewee’s remark about the importance of making food waste data "visible and transparent" further validates this point, suggesting that design features that engage users can significantly contribute to sustained behavior change. These insights offer an important

addition to the literature, as they extend beyond purely rational factors to include emotional engagement as a relevant consideration for developers and decision-makers.

Despite this positive outlook, the study revealed several barriers that continue to limit the broader implementation of food waste technologies. One of the most significant is the lack of facilitating conditions, which includes limited infrastructure, insufficient training, and a lack of leadership commitment. Survey responses related to organizational readiness received average scores around 3.0, reflecting uncertainty or limited confidence in the support structures needed for successful adoption. This was reinforced in the interview, where The Representative from Leanpath emphasized that "it's really about the commitment among organizations to embrace the technology." Without adequate investment in resources and a top-down push from leadership, the introduction of new systems is likely to falter.

Another important insight pertains to effort expectancy. Participants expressed concern over the perceived complexity and time demands associated with food waste technologies. Lower average scores on questions about usability and potential disruption suggest that professionals view these tools as potentially burdensome in already fast-paced environments. As The Interviewer noted, "you need to give them an easy process, one that won’t take a lot of time." These insights point toward a need for simplified, user-centered designs that align with existing workflows rather than disrupt them.

Behavioral inertia also emerged as a relevant theme. The construct of habit within UTAUT2 highlights the role of established routines in shaping adoption, and this study found that reducing food waste has not yet become a consistent behavior in many workplaces. The low average score on the habit-related question (Q15) suggests that adoption is unlikely to happen organically and

may require targeted interventions such as training, performance incentives, or internal culture shifts to encourage change.

Social influence and normative pressures were present, but only to a moderate degree. Participants acknowledged some peer and regulatory expectations but did not consider these sufficient to compel adoption on their own. For policy makers and industry associations, this highlights a clear opportunity: stronger incentives, clearer guidance, and formal sustainability standards could promote wider adoption.

With regard to the sub-question on organizational roles and resource availability, regression analyses offered valuable insights. While most background characteristics did not significantly predict technology acceptance, job role did. Sustainability coordinators, in particular, were significantly more open to adopting food waste technologies compared to chefs and general staff. This suggests that individuals with explicit responsibility for environmental performance are more engaged and informed, and perhaps more empowered, to advocate for change, which reinforces the idea that internal culture and staff roles can either accelerate or inhibit progress.

Another variable that showed some promise was resource availability, which approached statistical significance in predicting attitudes. This finding could imply that without clear access to infrastructure and support systems, enthusiasm for new technologies may not translate into actual implementation.

Demographic variables such as age and gender showed no significant correlation with adoption attitudes, though years of experience offered one interesting exception. Participants with less than one year of experience reported higher openness to adopting food waste technologies than more seasoned professionals. This could be interpreted as a generational or experiential effect, newcomers may be less resistant to change or more aware of digital tools. This finding, although

modest, could inform training and recruitment strategies that leverage the openness of early-career professionals as champions of innovation and sustainability.

Taken together, these findings suggest that technology adoption in the hospitality sector is shaped by a mix of practical, emotional, and structural factors. On the one hand, professionals see clear value in these tools and respond positively to their potential. On the other hand, limitations in training, infrastructure, and organizational commitment present great challenges. This tension highlights the importance of a holistic approach that goes beyond offering a good product to also fostering a supportive environment for adoption.

From a theoretical perspective, this study confirms the relevance of the UTAUT2 model in understanding technology adoption in complex, context-specific environments like hospitality. The combination of constructs provided a useful structure for analyzing survey data and framing the results of the qualitative interview.

In practical terms, the findings carry several implications. For managers and decision-makers in the hospitality sector, the results highlight the importance of organizational readiness, user-friendly design, and leadership commitment. Technology providers can draw on these insights to improve the alignment of their products with user needs, focusing on ease of use and integration with daily workflows. Policymakers and sustainability advocates, meanwhile, may find this research useful for designing regulations, incentives, or awareness campaigns that promote a stronger culture of waste prevention.

As for the value of this research, its main contribution lies in its effort to bridge theory and practice. While much has been written about the potential of food waste technologies, relatively few studies have examined why they are not more widely adopted, especially from the combined perspective of users and providers. These findings also speak directly to the research gap

highlighted by Martin-Rios et al. (2020), who pointed out that despite the frequent mention of digital and data-driven solutions in sustainability literature, there is a notable lack of applied research examining how these technologies are adopted in real foodservice settings. Their work stressed the need for more empirical insights into the everyday challenges faced by foodservice operators attempting to integrate innovative waste management tools. By combining quantitative data from industry professionals with qualitative insights from a technology provider, this study contributes to closing that gap. It moves beyond theoretical discussions by offering practical evidence of the disconnect between technological potential and actual implementation, and it highlights how adoption is often constrained not by the tools themselves, but by organizational culture, structural limitations, and uncertainty about long-term value. In this way, the research reinforces Martin-Rios et al.'s (2020) call for more context-specific, operationally grounded studies that explore the messy realities of change in hospitality environments.

That said, the research also has clear limitations. The most significant is the sample size and diversity of the survey participants. Although 70 responses offer a reasonable foundation for analysis, the small and uneven distribution across job roles and business types limited the granularity of the findings. Similarly, the qualitative component relied on a single expert interview, which cannot represent the full range of provider perspectives.

In conclusion, this research offers a perspective on the adoption of food waste management technologies in hospitality by exploring both the motivations for and the barriers to adoption, and by examining how individual roles and organizational contexts influence attitudes. While further research is needed to deepen and broaden these insights, especially in more specialized segments of the industry, the findings presented here can serve as a starting point for more informed, targeted, and ultimately successful efforts to reduce food waste in the hospitality sector.

References

Atlas TI. https://atlasti.com/

Betz, A., Buchli, J., Göbel, C., & Müller, C. (2014). Food waste in the Swiss food service industry: Magnitude and potential for reduction. 10.1016/j.wasman.2014.09.015

Creswell, J. W. (2021). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications.

ChatGPT 04-mini Advanced Reasoning Model. https://chatgpt.com/

Department for Economic and Social Information and Policy Analysis. (1997). Glossary of Environment Statistics. Waste management, Series F, No. 67, United Nations.

Dhir, A., Talwar, S., Kaur, P., & Malibari, A. (2020). Food waste in hospitality and food services: A systematic literature review and framework development approach. *Journal of Cleaner Production, 270,* 122861. https://doi.org/10.1016/j.jclepro.2020.122861

Ellen MacArthur Foundation. (2020). Reducing Food Waste, Increasing Profits: Winnow. https://www.ellenmacarthurfoundation.org/case-studies/data-backed-stories-that-drive-change

FAO. (2014). Food wastage footprint: Impacts on natural resources. Food and Agriculture Organization of the United Nations. https://www.fao.org/4/i3347e/i3347e.pdf

Filimonau, V., & De Coteau, D. A. (2019). Food waste management in hospitality operations: A critical review. *Tourism Management, 71,* 234-245. https://doi.org/10.1016/j.tourman.2018.10.009

Hyde, K., Miller, L., Smith, A., & Tolliday, J. (2003). Minimising waste in the food and drink sector: using the business club approach to facilitate training and organisational development. *Journal of Environmental Management*. http://dx.doi.org/10.1016/S0301-4797(02)00209-8

Kibler, K. M., Reinhart, D., Hawkins, C., Motlagh, A. M., & Wright, J. D. (2018). Food waste and the food-energy-water nexus: A review of food waste management alternatives. *Waste Management, 74,* 52-62. https://doi.org/10.1016/j.wasman.2018.01.014

LeanPath. (n.d.). Official website. https://www.leanpath.com

Martin-Rios, C., Hofmann, A., & Mackenzie, N. (2020). Sustainability-Oriented Innovations in Food Waste Management Technology http://dx.doi.org/10.3390/su13010210

Muzondo, T., & Jokonya, O. (2023). Business models and innovative technologies for SMEs: Factors affecting the adoption of emerging technologies to reduce food waste. (Chapter 7) https://benthambooks.com/ebook-files/sample-files/9789815196719-sample.pdf

Orbisk. (n.d.). Official website. https://www.orbisk.com

Otter AI. https://otter.ai/

Papargyropoulou, E., Wright, N., Lozano, R., Steinberger, J., Padfield, R., & Ujang, Z. (2016). Conceptual framework for the study of food waste generation and prevention in the hospitality sector. *Waste Management, 49,* 326-336. https://doi.org/10.1016/j.wasman.2016.01.017

Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: Quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences, 365*(1554), 3065-3081. https://doi.org/10.1098/rstb.2010.0126

Silvennoinen, K., Heikkilä, L., Katajajuuri, J.-M., & Reinikainen, A. (2015). Food waste volume and origin: Case studies in the Finnish food service sector. https://doi.org/10.1016/j.wasman.2015.09.010

Tamilmani, K., Rana, N. P., & Wamba, S. F. (2021). The Extended Unified Theory of Acceptance and Use of Technology (UTAUT2): A systematic literature review and theory evaluation. *International Journal of Information Management, 57,* 102269. https://doi.org/10.1016/j.ijinfomgt.2020.102269

Todd, E. C. D., & Gill, C. O. (2019). Impact of food waste on society, specifically at retail and foodservice levels in developed and developing countries. *Food Control, 105,* 40-49. https://doi.org/10.3390/foods13132098

United Nations. (2015). Sustainable Development Goal 12: Ensure sustainable consumption and production patterns. https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

UNEP. (2021). Food Waste Index Report 2021. United Nations Environment Programme.

Venkatesh, V., Tong, J., Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2002388

Winnow. (n.d.). Official website. https://www.winnowsolutions.com

Appendix A.

Informed Consent Form for Interview Participation

Project Title:
"*Adoption Factors and Barriers to Food Waste Management Technologies: A UTAUT2-Based Analysis of the Hospitality Industry"*

Researcher:
Sara Santoriello
Master's Student – Sustainable Entrepreneurship
University of Groningen, Campus Fryslân
Email: s.santoriello@student.rug.nl

Supervisor:
Dr. Sven Killian
University of Groningen

Purpose of the Study

This research project is part of a Master's thesis within the Sustainable Entrepreneurship program at the University of Groningen, Campus Fryslân. It aims to explore the current state of adoption of food waste management technologies within the hospitality sector—covering hotels, restaurants, canteens, and catering services.

While digital solutions like smart waste tracking tools, AI-powered analytics, and predictive inventory systems have been developed to reduce food waste, their uptake in the hospitality industry remains limited. This study investigates what drives or hinders the adoption of such technologies, with a particular focus on:

- Perceived barriers to adoption (e.g., cost, training, integration)
- Organizational readiness and behavioral resistance
- Perceptions of performance, usability, and return on investment
- Segments of the hospitality industry more likely to adopt such solutions
- The role of technology providers in facilitating adoption

The study uses the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) framework to guide its analysis. Data will be collected through semi-structured interviews with technology providers and surveys of hospitality professionals, particularly in the northern Netherlands.

The goal is to produce academically grounded insights that can help stakeholders better understand how to encourage the use of food waste management technologies as part of broader sustainability goals (e.g., SDG 12.3: halving food waste by 2030).

Participation Details

- You are invited to participate in a semi-structured interview lasting approximately 45 minutes.
- Your participation is entirely voluntary. You may withdraw at any point without any explanation or consequence.
- The interview will be conducted online.
- With your permission, the interview will be audio recorded to ensure accuracy in data collection.

Confidentiality and Data Use

- The data collected will be used solely for academic purposes in the context of the Master's Thesis project.
- All personal identifiers will be removed to ensure confidentiality unless you explicitly consent to be identified.
- All data will be stored securely in compliance with the University's GDPR policies and data protection regulations.
- Excerpts from the interview may be quoted anonymously unless explicit permission is granted for attribution.

Consent Options

Please check the boxes that apply:

☐ I consent to participate in this interview.
☐ I consent to the interview being audio recorded.
☐ I consent to being identified by name and/or company in the research output.
☐ I prefer to remain anonymous.

Participant's Name: _____
Participant's Signature: _____
Date: _____

Researcher's Signature: _____
Date: _____

If you have any questions or concerns about this research, please contact me at:
Email: s.santoriello@student.rug.nl
University of Groningen, Netherlands

Appendix B.

Transcript interview with The Representative from Leanpath

Speaker 1 (00:00):
We would be looking for a way to to improve to reduce costs through improvement efficiency and so that led to the idea to come up with a product that would help them reduce food waste in their operations and that led to the development of the early lean path trackers to help with that and that was back in 2004 later along the way in 2007 we patented

Speaker 1 (00:33):
the technology and really created the created the sector at that point and then ever since we've been growing with food service companies across the world so the interesting thing is that while there's so much environmental

Speaker 1 (00:47):
gain of course as you know in this space lean path started really started with a financial focus to help food service organizations reduce their costs and that's how it all began

Speaker 2(01:01):
yeah that's very interesting because I read many of the case studies listed in the website and I never thought of the financial focus honestly because I always read about like the amount of food waste that's reduced and these sort of things but it's not often mentioned the reduction of costs so that's very interesting then in your experience what are some of the most unique needs faced by different type of businesses in the hospitality industry and how does lean path address them

Speaker 1 (01:48):
we you know our studies have shown over time that food service organizations typically waste anywhere from four to ten percent of purchases right off the bat and so if you have a million dollar food spend or a million euro food spend for example you know you're losing anywhere from forty thousand to a hundred thousand euro per year right which is very significant and of course they have really high plate waste too right and so I think you know I think the UNEP recent UNEP report which you've probably seen you know cites that global food service operations contribute to twenty eight percent of the global food waste total so it's a big number it's a big problem so I think the first thing is for food service organizations to really

Speaker 1 (02:40):
to recognize the need to recognize the scope of food waste in their operations and the cost of that and that is you know very much increased over the last ten years but if you go back you know midway through our journey from inception to today

Speaker 1(02:60):
you know food waste was as we call it the elephant in the kitchen it was excessive but it was unaddressed it was this big thing out there that was kind of hidden somewhat invisible and it oftentimes wasn't a safe point of conversation for people to have because you know the assumption was

Speaker 1 (03:24):

of course we're doing everything to minimize our waste and run efficient operations so the first thing is to really recognize the need and the scope of food waste in your operations and then I think it's to recognize the the value of accurate data to address that because data is the basis of change and to get that data you need an automated measurement process to really you know to provide it and to get the food service operation on a committed path to reducing waste so all of that kind of you need to you need to recognize the need and you need to make a commitment to making measurement you know a normal everyday process in your kitchen and also to make

Speaker 1 (04:16):
this commitment to food waste reduction as a normal everyday part of operations too so that that I think is you know some of the key things that food service operations need to do when it comes to managing food waste

Speaker 2(04:30):
that's incredibly insightful

Speaker 1(04:33):
I'd add one more thing to that and after doing after doing that process I would say and they should really commit to reporting on that food waste too and the more transparent the reporting is the better because transparency will really motivate them to you know to continue to you know try and improve

Speaker 2 (04:56):
this might be a bit unrelated to my thesis but have you ever considered doing solutions for like individual households?

Speaker 1 (05:06):
um we have it's an interesting question and one that we get a fair amount as you know that the consumer food
consumer space is the highest percentage of food waste right and so we we often look at it and often think about it because it is such a big opportunity area the challenge for us in that space is that it's just hard to imagine consumers paying for hardware or even just the software only product which we've you know thought about to reduce their their waste one because the you know if you look at how much waste consumers have on an individual basis to to pay for a tracking tool to help them reduce it is you know that it's it's a tough window to to navigate there to make you know to make it um you know one that that a number a broad number of consumers would stick to and then just the general process of you know what percentage of the global process of population is really willing to commit to tracking all of their food waste on a daily basis so

Speaker 1 (06:24):
um you know that's probably pretty small and then you get to the complexities of of managing a software uh let's just say software only product across billions of people right it's a it's a it's a hard thing to do so i think it really all starts with the consumers and would they be willing to make some sort of a time investment and a cost investment in a product and then um that has been a challenge so and uh you know you've seen some things like um you're kind of getting at the edges of this like smart refrigerators and apps that tell people how to use what's in their refrigerator and those are all good yeah um but that's sort of that's in

Speaker 1 (07:12):
my opinion that's sort of where we're at right now and um listen we would love to just come up with a product for the consumer space we just haven't figured out what it is yet you can if you know one let me know okay i'll try to think think of

Speaker (07:24):
something um as for um your technology uh how does leanpath technology uh distinguishes itself from your competitors?

Speaker 1 (07:43):
we provide solutions for kitchens of all sizes so we make food waste tracking easy i think that is probably the first and foremost thing that food service operations look for um you need to give them an easy process um one that won't take a lot of time and one that provides valuable data that will lead to the results that we need so we through that process we we provide the critical data that's needed to drive change we provide a really highly effective dashboard um for um or food service organizations which

Speaker 1 (08:18):
you know full of you know really insightful charts and graphics and uh we provide daily reports that can be used to uh help um you know drive behavior uh change on a daily basis um we have a number of behavior change tools we have a coaching process we have a lot of culinary expertise so those are a lot of the things that um you know help us to address all of the the needs in food service operations um specific to you know going another level to really what sets us apart from others in the space um i would point to a few i would say um you know deep experience um that we've gained with um thousands of customers over the

Speaker 1 (09:11):
globe um were deployed in over 4 000 locations in over in 45-ish countries around the globe so um through that work you know over 20 years you really get a lot of experience on how to uh you know continuously modify your product to meet the needs of kitchens and cultures all over the globe so deep experience hard-won experience um yeah the global deployments with big food service organizations like google and like sedexo and compass um trackers that you know that are specifically designed to meet the needs of all kitchens um with image capability which is very helpful um and you know we this ranges from tablet solutions to desktop solutions to um floor scale solutions for for larger volume operations so um meeting the needs of all kitchens is important and then i guess one more i throw out is really deep culinary experience um we know kitchens very well and we have um really talented and experienced chefs um that work for us in you know food waste fighting capacity and they are very effective at helping to coach clients to use the technology to its maximum benefit and and reduce waste and operations so those are a few yeah thank you um

Speaker 2(10:44):
this kind of leads to my next question that is um are there specific segments in the hospitality industry like high-end hotels or catering companies that tend to adopt this type of technologies faster

Speaker 1 (11:11):
um it's a good question i you know i can't really speak in
specific terms to that really i think um all of i would say that all of those segments within hospitality are are
candidates for food waste prevention technology right um the the the way that i would frame it is that um

Speaker 1 (11:32):
you know sites that are mainly high volume over production sensitive operations um are good candidates uh you know sites with buffets um are very good um you know um you know sites with variables related to production right um you know a long um lunch period or a long dinner period where um you have you know varying numbers of people coming in and and you know all of these variables that can lead you to produce a certain amount

Speaker 1 (12:10):
which you know might be uh you know might be just some overproduction
um you know trim waste all sorts of things like that so really high volume over production sensitive sites are really the key drivers for this um i'd add one kind of nuance if you're looking specifically at you know hotels and such um you know remote locations um or those with environmental challenges probably have even more incentive right so if you were on a distant island if you're an island hotel or if you were you know in a in a uh place where um you know really you know a place like the northeast for example where you have water challenges and you have food um production challenges right your food costs tend to be higher your disposal costs tend to be higher and so that makes preventing food waste in the first place even more attractive so um a lot of a lot of factors like that i would say all of those segments that you mentioned are are really good candidates for um for our technology because at the end of the day you know catering catering services as well at the end of the day every food service organization benefits uh significantly from you know preventing um waste in their operations it's uh you know if you prevent waste in your operation you're you know you're saving you know the obviously right off the bat the associated costs but you're associated food cost but you're so you're saving the labor costs associated with producing food that goes to waste you're saving the utilities cost you're saving the disposal cost so

Speaker 1 (13:51):
all of those segments really valuable uh really benefit from from the technology thank you

Speaker5 (14:01):
um i did read a lot of your cases as i mentioned before and i was wondering if the results shared in those cases if you can say it um are reflect the typical outcomes of your solutions

Speaker 1 (14:22):
yeah they do um you know typically value proposition for us is um for our clients is that we um cut food waste by 50 percent some more you know some might be 45 percent 50 percent 60 percent um you know but but some even more um so 50 reduction broadly in food waste associated with that a two to six reduction in food costs typically the return on investment or um sites is anywhere from two to seven and as i say to people you know i used to be a controller and every controller would sign up for that all day long right um especially when you factor in the environmental benefits that come along with food waste reduction um prevention especially um and the um added benefit you know of engaging the workforce right this is a really challenging time for food service organizations to hire and to retain people and organizations individuals want to be part of some you know an organization that's exhibiting responsible behavior right and so

Speaker 1 (15:27):
i think um you know the financial benefits are there as i as i noted and are covered in those case studies and you know and on top of that the the environmental benefit and um and the benefit to the workforce i think it's uh
it's a really clear value proposition uh for food service organizations we as you know there's a global goal to cut food waste by 50 by 2030 um and we enable that right and so with the with the accuracy and the you know the the results that you gain with the technology it gives organizations um the ability to step up and make that commitment right and Sodexo has done that Compass has done that and Aramark has done that so um that's a really important point right the the effectiveness of the technology um seen by organizations that enables them to make that commitment to to uh the 2030 goal

Speaker 2 (16:26):
thank you um uh next question concerns the um the market share um as the unified theory of acceptance and the use of technologies suggests that fewer than 30 percent of organizations adopt new technologies

with a with a measurable uh return on investments would you say that these aligns with the adoption rate of um food waste management technologies

Speaker 1 (17:08):
um well that's interesting it's really it's interesting i'm glad
you um you brought that up that that theory um i i can't really say with specifics on um the percentage what i can say is that we're very early in the space even though lean path has been at this for 20 years um there's a long way to go in terms of adoption in multiple sectors and you know really we're scratching the surface a little bit um here there are you know millions of food service organizations around the globe right we are um operating with you know over 4 000 sites as i said before we're operating with a number of the largest food service organizations in the world and you know through that you have a lot of impact right because they're serving billions of meals a day um but there's a long way to go in in multiple sectors and i would say it's not if this is part of the question in my opinion it's not the technology that is limiting adoption um the technology works um you've seen some of the case studies you've heard some of the things i've talked about um it's you know it's it's proven um we you know i often say that

Speaker 1 (18:20):
you know the measurement piece of what we do is the is the easiest because we've done that for you know we've been developing those tools for 20 years um it's really about the commitment among organizations to to embrace the technology right and and to report on results once they do that so i think what's limiting adoption right now

Speaker 1 (18:44):
is leadership amongst organizations to make the commitment to deploying a food waste technology throughout their operations and um you know and and sticking to that and reporting transparently on their benefits and i think i think that's coming i think more and more organizations are doing that um but i think it's moving like off the sustainable development goal challenges i think it's moving too slowly and i think it um it it needs to move much faster because um as as you know the benefits from reducing food waste and especially preventing food waste around the globe are are are so substantial right the the linkages to all of the other sustainable development goals um you know that the benefit from food waste prevention are are really clear so um it needs to move faster organizations need to step up lead make make commitments and report

Speaker 2(19:53):
um this was going to be my next question about what do you think the barriers are from the adoption and i found in some academic papers um did they mention there the staff of the business or restaurant or hotel whatnot might be an issue in the implementation of the software due to um maybe a not well perceived ease of use like they might think of this solution like it can take extra steps um for for the kitchen staff or it can be onerous in term of employee times do you think these might be um yeah it's um yes that is a barrier there there are

Speaker 1 (20:48):
there are many barriers and and i'll go back to my my argument my point before about you know previously being a controller and if you look at all those financial benefits and you couple them with the environmental and the social gains um as i often say every controller would sign up for you know this product um all day long right um so i'll i'll give you a number here i think um there are this space seems to be fairly unique to me um in terms of barrier barriers to engagement there's um there's a high a relatively high bar for uh food service organizations to deploy food waste technology and i think you just kind of alluded to some of them but there's there are concerns and i i think broadly um the first one is food service organizations are very tactical in nature they have very um tactical daily goals right they have priorities that revolve around you know we're serving three meals uh to hundreds of people each um uh session

every day and the last thing we want to do is run out of food right and we we have uh we have to please a lot of customers with a lot of variety just in time so you have all of these pressures

Speaker 1 (22:21):
to um you know to meet on a daily basis as my my boss andrew often says food service is the only um organizational category that he knows where you can get fired three times a day breakfast lunch and dinner right and so that that really tactical mindset leads to actually really leads to an increase in food waste because food uh excessive production is viewed as a can be viewed as a hedge against as a risk management tool right if you've overproduced you're not going to run out and the thing to do is run out of food right so that's a big one um second i would say it's because of that really highly tactical mindset it's these are really busy operations so it's it's even hard to uh there's a degree of difficulty in getting into the mind space of food service leaders such that you can you know get them to free up enough time to engage with you for a conversation on the benefits of food waste prevention technology right they're so operationally focused so that's um another one just these are really busy organizations and it can be hard to um to to you know get them to engage and and along with that some of them you know they're they they get offered a lot of different products for various you know aspects of their operation and so there's a there can be a tendency to look at this as just another uh tool that is going to take time for me to engage in right so that's um that's one too and then as you alluded to there are concerns about is is the technology going to work um is it going to take uh cost me additional labor time um and are my people going to be able to use it effectively those are some really tactical concerns so those are all out there we deal with all of those and make tracking as easy and seamless as possible i'd say another one is chefs um want you know their focus is on producing high quality food right and so they don't necessarily want to be

Speaker 1 (24:48):
uh taking a lot of time looking at data and so we address that with um in a number of ways i said before by making that really easy to get really uh quick to capture um very impactful um so we make that data the portion easy um and then i would i know i'm giving you a lot here um i would add another kind of big theme and this is
getting a little bit into my academic side too sarah but i would say one of the themes that i've been talking a lot about is we the world loses and wastes 40 percent of production annually right it's a staggering amount you know there's not too many processes where where we as the global we waste that degree of that amount of something right and so that says something as you know about how much we value food in the first place right we clearly in developed countries at don't value food properly right otherwise we wouldn't lose and waste 40 percent of it and i think subliminal like if you go level deeper in that i think there is some reticence to engage in technology that is going to help reduce something that we don't value properly in the first place right and so that's a little bit of an academic theme on my part that i've been writing about a little bit but um and i haven't really seen that covered much in the literature but i think um i think it's there and i think as you do your research maybe think on that and and if you ever want to engage on that um give me a call we can but i think i think that's one and then kind of putting a bow on all of that is um we as an example of some of those things that i ticked off um back in the you know in in the covet area era when we were deep in coveted and um you like me were probably in a lot of webinars um because we kind of shifted and you know we did a lot of work on webinars too and

Speaker 1 (27:07):
part of that during that period i was in a lot of webinars where people were talking okay how when we come out of the pandemic how are we going to uh we we want to you know reduce food waste how are we going to do that and the for a period there a number of these conversations always started off with um you know there were some survey questions at the beginning of these webinars and one of the one of the key themes that emerged for me was there was a perception that uh and i put it into a sense that um food waste measurement is hard and it's expensive and so i was i was on a number of these and i went back to the number of the um NGOs that were driving this i said we need to flip that narrative and it's not food

waste measurement is hard and it's expensive but food waste measurement is easy and it's an investment in savings and um that investment savings part is big i mentioned the the measurement piece the metrology piece it is easy we've been doing it for 27 years it's the easiest thing that we do in our operation um the the second piece of that the the value piece we organizations need to um to make the connection between they need to see the benefit in terms of um as an investment savings so there is an upfront cost of food waste prevention technology but the benefit comes through reduced um food purchases and all those other things that i took off before and so it's it's really about viewing it not as an upfront cost but as an investment savings that yields that ROI savings that yields all those benefits i said so flipping that that theme and i said before in getting people to getting organizations to view um food waste measurement as a as a necessary investment in savings and part of responsible behavior and um not only good financially but responsible for the organization i think is uh is an important one so that's a lot there but um

Speaker 2 (29:08):
no that's actually so perfect honestly because i asked my supervisor if i could let you uh discuss some points that i had listed and he said no because they weren't um they weren't be uh elaborated as an interview question but you went through all of them so that was perfect actually and yeah i think the shorter vision it's overall the problem of why sustainability is not a common so i completely understand what you were saying um lastly i wanted to ask you uh if in your experience um would you value uh the lack of awareness for this type of solution as part of the um problem why they aren't still the standard practice yeah that's an interesting one i would

Speaker 1 (30:05):
say if you went back 10 years ago i would say about halfway through our journey to data i would say awareness was still an issue today i would say you know through the work of organizations like lean path and a lot of global ngo's that have been doing really good work um from 2015 until today um the awareness you know this past decade was really one about raising awareness of this challenge right and um i think that's that's come a long way and i think most uh i will say awareness in the food service sector they get this they understand the challenge awareness isn't an issue for food service operations now they they understand the scope and scale of

Speaker 1 (30:54):
food waste pretty well and their their um their ability to um engage on it i think the um i think the barriers to implementation are kind of what i alluded to before they get they they understand the situation very well um it's really it's really now about commitment and leadership to engage um you know it's it's as i said there are a number of there's a really high proof point for food service deployments and all those things that i ticked off before um still you know remain pervasive and so we're we're making progress um more and more organizations are making commitments and deploying but it's it's more than it um than it needs to be and i think just continuing to chip away at those barriers that i talked about um beyond awareness um and continuing to show the value uh and the the ease of with which these products can be used i think that um is is the way to go and also i think uh i think the regulatory environment is going to um is going to help advance accelerate the pace too you're seeing more you know you've seen you from farm to fork strategy is an eu commitment to cut food waste in half and we know we have a global goal and we we're seeing legislation by many states in the u.s to make commitments to minimize food waste and landfills and such so and methane commitments right which are critical in good ways so um that's what i would say it's it's really about leadership and commitment on the part of organizations to deploy

Speaker 2 (32:41):
thank you so much um well i guess this was all i have for this moment uh if you're interested i will get back to you with the insights i get from the surveys and um i will contact you if i have any additional question if that's possible

Speaker 1(33:06):
yeah that's great i hope that um i hope this was helpful sir and i was
out for as i said i i like the i'm glad you're doing the research it's a great project um and i'm glad to see more and more students like you engaging on it and uh it's uh it's it's such a critical uh problem and so much of it comes down to as i said valuing food value the food and food resources right and um that's what we need to to get to so thank you so much sir if you know you reach out if you have other other questions i'd love to see your when you're when you're done sure sorry for my camera no problem at all okay thank you have a good weekend yeah you too have a good rest of the day

…

Appendix C.

Interview Questions: Leanpath's case study

1. *The Origins of Leanpath:*
   Could you share the story of how Leanpath began and grew to establish such a renowned and trusted client base in the foodservice and hospitality industries?

2. *Core Features and Customization:*
   In your experience, what are some of the most unique needs and challenges faced by different types of hospitality businesses—such as hotels, restaurants, or catering services—when it comes to managing food waste?

   How does Leanpath tailor its solutions to address these specific needs and overcome the challenges you've identified?

3. *Competitive Edge:*
   From a technology perspective, how does Leanpath distinguish itself from competitors? Are there particular innovations that set Leanpath apart?

4. *Tangible Benefits for Clients:*
   What measurable outcomes, such as cost savings or operational efficiencies, have Leanpath clients reported after implementing your solutions? Do the results shared in your case studies reflect typical outcomes for businesses adopting your technologies?

5. *The Consumer Journey:*
   Could you walk us through the journey of a hypothetical hospitality business considering Leanpath, from initial interest to full implementation of your solutions?

6. *Adoption Trends in Hospitality:*
   Are there specific segments of the hospitality industry—such as high-end hotels, casual dining restaurants, or catering services—that tend to adopt Leanpath's technologies more readily?

   In your opinion, what characteristics make certain businesses more inclined to adopt food waste management solutions?

7. *Market Adoption of Food Waste Technologies:*
   The Unified Theory of Acceptance and Use of Technology suggests that fewer than 30% of organizations adopt new technologies with measurable ROI. Would you agree with this?

   How does this align with the adoption rate of food waste management technologies in hospitality?

8. *Addressing UTAUT2 Barriers:*
   Adopting new technologies in food waste management often comes with challenges that impact how readily they are embraced by businesses and staff. From your experience, what are some of the key barriers hospitality businesses face when considering implementing waste management solutions, such as concerns about ease of use, cost-benefit clarity, or resistance to change ?

9. *Insights from Academic Research:*
   In your experience, how significant is the lack of awareness about food waste management technologies, like those offered by Leanpath, as a barrier to implementation in the hospitality industry?

Appendix D.

Survey Questions & Scores

Survey Link :
https://docs.google.com/forms/d/e/1FAIpQLSdA478pDPbuIf-oCOqY7ElE2e8tT-v06qpQbZAwOJ4Iriw08g/viewform?usp=header

Likert Scale Questions	Avg	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
Q1: I am well-informed about the availability and benefits of food waste technologies (AI tools, smart scales…)	3.3	7.2	17.4	29.0	33.3	13.0
Q2: I believe food waste is a significant issue in the hospitality industry.	4.3	0.0	5.8	8.7	31.9	53.6
Q3: In my organization, food waste reduction is considered a strategic sustainability priority.	3.5	10.1	11.6	23.2	30.4	24.6
Q4: My organization currently monitors and records food waste in some form (e.g., manually or digitally).	3.2	15.9	15.9	21.7	21.7	24.6
Q5: We have implemented specific policies or procedures to reduce food waste.	3.3	13.0	15.9	18.8	29.0	23.2
Q6: Staff in my organization receive training or guidance related to reducing food waste.	3.0	17.4	18.8	26.1	24.6	13.0
Q7: Using food waste management technologies would help reduce operational costs in my organization.	3.7	5.8	8.7	24.6	34.8	26.1
Q8: These technologies would improve kitchen efficiency and workflow.	3.7	4.3	8.7	24.6	39.1	23.2
Q9: Food waste tracking systems would enhance our sustainability profile and public image.	3.8	4.3	7.2	21.7	33.3	33.3
Q10: There is social pressure within my professional network to adopt environmentally responsible technologies.	3.6	1.7	5.2	29.3	55.2	8.6
Q11: I would find it satisfying to see real-time reductions in food waste through dashboards and reports.	3.8	4.3	8.7	23.2	30.4	33.3
Q12: Implementing such technologies would require too much staff time and effort.	3.3	7.2	14.5	31.9	30.4	15.9
Q13: The upfront cost of food waste technologies is a major barrier to adoption.	3.6	4.3	13.0	21.7	36.2	24.6
Q14: Adopting new technology in a busy kitchen is too disruptive.	3.1	1.4	24.6	39.1	33.3	1.4
Q15. Reducing food waste is already a habitual practice in my workplace.	3.1	5.8	14.5	44.9	33.3	1.4
Q16: My organization has the necessary resources (infrastructure, staff, budget) to implement food waste technologies.	3.0	1.4	27.5	43.5	26.1	1.4

Q17: I am aware of support services and training available for implementing these technologies.	3.0	1.4	27.5	40.6	27.5	2.9
Q18: I believe that national or local regulations may soon require businesses to adopt such technologies.	3.4	0.0	14.5	37.7	40.6	7.2

Table D1: Likert Scale Questions and Responses Distribution

Demographic Questions	**Responses Distribution**
What is your age group ?	35-44: 59.4% 25-34: 36.2% 45-55: 2.9% Under 25: 1.4%
What is your gender?	Male: 66.2% Female: 33.8%
What is your role in the organization?	Manager / Team Leader: 55.1% Chef/ Kitchen Staff: 30.4% Owner/ Executive: 7.2% Other: 4.3% Sustainability Coordinator: 2.9%
How many years of experience do you have in the hospitality sector?	4-7: 52.2% 1-3: 40.6% More than 7: 5.8% Less than 1 year: 1.4%

Table D2: Likert Scale Questions and Responses Distribution

Appendix E.

Research Ethics Approval Form

Section A

Project Title: Adoption Factors and Barriers to Food Waste Management Technologies: a UTAUT2 based analysis of the hospitality industry

Name of Lead Researcher : Sara Santoriello

Name of supervisors: Sven Killian

Email of Researcher: s.santoriello@student@rug.nl Contact Tel No +393426046963

Estimated Start Date of Project 01/11/2024 Estimated End Date of Project 01/06/2025

Estimated Start Date of Fieldwork 01/01/2025 Estimated End Date of Fieldwork 01/05/2025

I confirm that I will (where relevant):

- Familiarise myself fully and consider the implications of the Data Protection Act and guidelines http://www.tcd.ie/info_compliance/dp/legislation.php;
- Tell participants that any recordings, e.g. audio/video/photographs, will not be identifiable unless prior written permission has been given. I will obtain permission for specific reuse (in papers, talks, etc.);
- Provide participants with an information sheet (or web-page for web-based studies) that describes the main procedures (a copy of the information sheet must be included with this application);
- Obtain informed consent for participation (a copy of the informed consent form must be included with this application);
- Should the research be observational and not in a public place, ask participants for their consent to be observed;
- Tell participants that their participation is voluntary;
- Tell participants that they may withdraw at any time and for any reason without penalty;
- Give participants the option of omitting questions they do not wish to answer if a questionnaire is used;
- Tell participants that their data will be treated with care to confidentiality, retained in an anonymised form and that, if published, it will not be identified as theirs;
- Inform participants of the relevant safe storage, retention and destruction policy of data to be followed;
- On request, debrief participants at the end of their participation (i.e. give them a brief explanation of the study);
- Verify that participants are 18 years or older and competent to supply consent or in the case of child/vulnerable group participant, obtain consent of both child and parent / guardian;
- Ensure that the duty of care towards vulnerable participants or when dealing with sensitive topics includes the provision of appropriate information and referral to aftercare supports;
- Declare any potential conflict of interest to participants.

Signed: Sara Santoriello Sven Killian

Lead Research / Student Supervisor (in case of student project work) Date 20/12/2025

Section B

Please answer the following questions (Y/N)		**(Y/N)**
1. Will any non-anonymised and / or personalised data be generated and / or stored?		n
2. Will your project involve any of the following?	Photographing Participants	n
	Audio Recordings	n
	Video Recordings	n
3. Does this research pose any risk of physical danger to the researcher?		n
4. Does this research pose any risk of mental harm to the researcher?		n
5. Will you give the potential participants a reasonable period of time to consider participation?		y
6. Does your study involve any of the following?	People who are, have been, or are likely to become your clients, students, or clients of the School	n
	Patients	n
	Children (under 18 years of age)	n
	People with intellectual or communication difficulties	n
	People in custody	n
	People involved in illegal activities	n
	People belonging to a vulnerable group, other than those listed above	n
	People for whom English / Dutch is not their first language	n
7. Is there any realistic risk of any participants experiencing a detriment to their interests as a result of participation?		n
8. Will you have access to documents containing sensitive data about living individuals? If yes, will you gain the consent of the individuals concerned?		n
9. Has this research application or any application of a similar nature connected to this research project been refused ethical approval by another review committee of the University or any external organisation?		n

If you answered yes to any of the above questions please explain with reference to the number of each question, how the identified potential research ethics issue will be handled. If there are any other potential ethical issues that you think the Committee should consider please explain them here. *There is an obligation on the lead researcher / supervisor to consider here any issues with ethical implications not clearly covered above.*

Section C

Research Proposal Template		
Project Title		**Word Limits**
List of any sources of funding or other research partners involved	- Key Academic Papers Provided by You Dhir, A., Talwar, S., Kaur, P., & Malibari, A. (2020). Food waste in hospitality and food services: A systematic literature review and framework development approach. Journal of Cleaner Production, 270, 122861. https://doi.org/10.1016/j.jclepro.2020.122861 Filimonau, - V., & De Coteau, D. A. (2019). Food waste management in hospitality operations: A critical review. Tourism Management, 71, 234-245. https://doi.org/10.1016/j.tourman.2018.10.009 - Papargyropoulou, E., Wright, N., Lozano, R., Steinberger, J., Padfield, R., & Ujang, Z. (2016). Conceptual framework for the study of food waste generation and prevention in the hospitality sector. Waste Management, 49, 326-336. https://doi.org/10.1016/j.wasman.2016.01.017 - Pirani, S. I., & Arafat, H. A. (2016). Reduction of food waste generation in the hospitality industry. Journal of Cleaner Production, 132, 129-145. https://doi.org/10.1016/j.jclepro.2015.07.146 Martin-Rios, C., - Hofmann, A., & Mackenzie, N. (2020). Sustainability-oriented innovations in food waste management technology. Sustainability, 13(1), 210. https://doi.org/10.3390/su13010210 - Martin-Rios, C., Hofmann, A., & Mackenzie, N. (2018). Food waste management innovations in the food service industry. International Journal of Hospitality Management, 72, 150-162. https://doi.org/10.1016/j.ijhm.2018.01.003 - Sandra van der Haar & Zeinstra, G. G. (2020). The impact of Too Good To Go on food waste reduction at the consumer household level. MSc Thesis. - Xiao, N., Martin-Rios, C., & Mackenzie, N. (2020). Innovations in food waste management: From resource recovery to sustainable solutions. Waste Management, 96, 203-214. https://doi.org/10.1016/j.wasman.2020.05.027 - Al-Obadi, M., Ayad, H., Pokharel, S., & Ayari, M. A. (2022). Perspectives on food waste management: Prevention and social innovations. Sustainable Production and Consumption, 30, 154-165. https://doi.org/10.1016/j.spc.2021.12.011 - Tamilmani, K., Rana, N. P., & Wamba, S. F. (2021). The Extended Unified Theory of Acceptance and Use of Technology (UTAUT2): A systematic literature review and theory evaluation. - International Journal of Information Management, 57, 102269. https://doi.org/10.1016/j.ijinfomgt.2020.102269 - Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Unified Theory of Acceptance and Use of Technology: A synthesis and the road ahead. Journal of the Association for Information Systems, 17(5), 328-376. https://doi.org/10.17705/1jais.00428 Ahmadzadeh, A., - Ajmal, M. M., Ramanathan, U., & Duan, Y. (2020). A comprehensive review on food waste reduction based on IoT and big data technologies. Journal of Cleaner Production, 272, 122753. https://doi.org/10.1016/j.jclepro.2020.122753 - Guillermo Garcia-Garcia, T., & Woolley, E. (2020). A methodology for sustainable management of food waste. Resources, Conservation and Recycling, 154, 104634. https://doi.org/10.1016/j.resconrec.2019.104634 - Todd, E. C. D., & Gill, C. O. (2019). Impact of food waste on society, specifically at retail and foodservice levels in developed and developing countries. Food Control, 105, 40-49. https://doi.org/10.1016/j.foodcont.2019.05.003 - Kibler, K. M., Reinhart, D., Hawkins, C., Motlagh, A. M., & Wright, J. D. (2018). Food waste and the food-energy-water nexus: A review of food waste management alternatives. Waste Management, 74, 52-62. https://doi.org/10.1016/j.wasman.2018.01.014 - Reyes, V., Bailey, G., & Hart, K. (2020). The potential for reducing food waste through shelf-life extension: Actionable insights from data digitization. Sustainability, 12(8), 3402. https://doi.org/10.3390/su12083402 - Betz, A., Buchli, J., Gobel, C., & Muller, C. (2014). Food waste in the Swiss food service industry: Magnitude and potential for reduction. Waste Management, 34(11), 1783-1791. https://doi.org/10.1016/j.wasman.2014.05.021 - Silvennoinen, K., Heikkilä, L., Katajajuuri, J.-M., & Reinikainen, A. (2015). Food waste volume and origin: Case studies in the Finnish food service sector. Resources, Conservation and Recycling, 96, 157-165. https://doi.org/10.1016/j.resconrec.2015.01.006 - Foundation, E. M. (2020). Winnow: Data-backed stories that drive change. Ellen MacArthur Foundation. https://www.ellenmacarthurfoundation.org/case-studies/data-backed-stories-that-drive-change - Shakman, A. R., Rogers, S. A., & Leppo, W. D. (2008). Systems and methods for food waste monitoring. U.S. Patent No. 7,415,375. - Delicious Data GmbH. (2020). Demand forecasts to optimize purchase planning. https://www.delicious-data.com/en/home - Motjolopane, I., & Ignitia, S. (2020). Business models and innovative technologies for SMEs: Factors affecting the adoption of emerging technologies to reduce food waste. Springer. https://doi.org/10.1007/978-3-030-78963-8	n/a

	- Paritosh, K., Kushwaha, S. K., Yadav, M., & Pandey, A. (2017). Food waste to energy: An overview of sustainable approaches for food waste management and nutrient recycling. BioMed Research International, 2017, 2370927. https://doi.org/10.1155/2017/2370927 - Otles, S., & Despoudi, S. (2015). Food management and waste reduction innovation: Addressing opportunities and challenges. Journal of Food Quality, 38(5), 321-332. https://doi.org/10.1111/jfq.12102 - Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: Quantification and potential for change to 2050. Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), 3065-3081. https://doi.org/10.1098/rstb.2010.0126 - United Nations. (2015). Sustainable Development Goal 12: Ensure sustainable consumption and production patterns. https://www.un.org/sustainabledevelopment/sustainable-consumption-production/ - Traill, W. B., & Meulenberg, M. (2002). Innovation in the food industry. Agribusiness, 18(1), 1-21. https://doi.org/10.1002/agr.10001	
Is this proposal associated with another research study?	no	n/a
Expected dates of commencement and completion	01/11/2024–01/06/2025	n/a
Abstract of the proposal	Food waste is a pervasive issue within the hospitality sector, contributing significantly to environmental degradation and resource inefficiency. With approximately one-third of all food produced globally going to waste, the hospitality industry plays a critical role in addressing this challenge. Innovative food waste management technologies, such as those developed by LeanPath and Winnow, offer promising solutions by enabling better monitoring, measurement, and reduction of food waste through data-driven insights and automation. However, the adoption of these technologies remains inconsistent, hindered by industry-specific barriers and a lack of comprehensive understanding of their potential.	150
Rationale and background of the proposed study	The hospitality sector generates significant amounts of food waste, making it a focal point for sustainability interventions. Despite advancements in food waste management technologies, adoption rates remain low due to challenges such as cost, operational complexity, and a lack of tailored solutions for the sector. With the urgency of achieving Sustainable Development Goal 12.3, which aims to halve food waste by 2030, it is critical to address these barriers and facilitate broader adoption of effective technologies. This study seeks to bridge the gap between innovation and practical implementation by investigating the adoption of these technologies within the hospitality industry, emphasizing their potential to enhance both environmental and operational sustainability.	100
Research question, aims and objectives	**Main research question: What are the key barriers and opportunities influencing the adoption of food waste management technologies in the hospitality sector?** This research aims to uncover the factors influencing the adoption of food waste management technologies in the hospitality sector, providing a holistic view of the challenges and opportunities within this critical area. To achieve this, the study sets out several objectives: 1. *Explore the current food waste management practices used by hospitality professionals, aligning these with academic*	100

	perspectives such as those offered by Martin-Rios et al. (2018). 2. *Identify technological, organizational, and behavioral barriers that hinder the adoption of food waste management technologies, referencing works like Motjolopane et al. (2020).* 3. *Assess the practicality and limitations of existing technologies, such as those developed by Winnow and LeanPath, as highlighted by the Ellen MacArthur Foundation (2020).* 4. *Develop actionable recommendations for enhancing the adoption of these technologies, aligning with Sustainable Development Goal 12.3, which aims to halve global food waste by 2030.*	
Outline of the research design	This research employs a mixed-method approach to ensure a comprehensive understanding of the research problem. The study is conducted in two phases: 1. Qualitative Phase: Semi-structured interviews with technology providers such as LeanPath and Winnow will be conducted to gather insights into the barriers, opportunities, and industry-specific challenges associated with food waste technologies. These interviews will follow a flexible guide, allowing participants to elaborate while ensuring alignment with the research aims. The findings will inform the design of the quantitative survey. 2. Quantitative Phase: Standardized surveys will be distributed to hospitality professionals operating in the northern Netherlands. These surveys will employ Likert-scale questions to measure attitudes, practices, and perceived barriers to technology adoption. Data collected will be statistically analyzed to identify trends and correlations, providing actionable insights for stakeholders. By integrating qualitative and quantitative findings, this research will provide a holistic understanding of the factors influencing technology adoption and propose practical solutions to enhance sustainability in the hospitality sector.	300
When research involves access to human participants outline fully where and how they will be recruited, inclusion and exclusion criteria and the exact role of any gate keepers involved	Participants for this study will be selected through targeted recruitment strategies to ensure relevance to the research objectives. Survey participants will be identified using the university network and invited through an explanatory email. The inclusion criteria for survey respondents are that they must currently work as hospitality professionals within the kitchen or administrative context. Additional candidates for the semi-structured interviews will be contacted by email, specifically targeting individuals employed by technology provider companies specializing in food waste management solutions. Where possible, these interviewees should hold sustainability-related positions to provide insights aligned with	n

	the study's focus. Exclusion criteria will not be applied beyond ensuring participants meet these specific professional roles. All participants will receive detailed information about the study's purpose and procedures before providing their consent. This approach ensures that the data collected is directly relevant to the topic while maintaining a diverse and representative sample of stakeholders	