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Description of the Pilot: Using Artificial Intelligence for predicting food demand and optimizing menus

Background Information:

- **Implementers:** Sodexo Oy, University of Helsinki, City of Vantaa (Food Waste Ecosystem Project)
- **Timeline:** Year 2025-2026
- **Location:** Helsinki

Background:

According to a report published by the Natural Resources Institute Finland (Luke) in November 2024, food services in the Finnish capital region generate approximately 18.5 million kilograms of food waste annually. In terms of 0.5 kg restaurant portions, this corresponds to about 37 million discarded meals. This equals roughly 30 wasted portions per resident of the metropolitan area per year.

Most of the food waste, around 9.6 million kilograms annually, comes from serving waste, meaning food left on serving lines or prepared for them.

The goal of the Food Waste Ecosystem project is to create a shared circular-economy-based food ecosystem in the Finnish capital region. The idea is to identify opportunities to streamline current processes, prevent and reduce food waste, share best practices, utilize surplus food more effectively, and create new business opportunities.

To strengthen the link between commercial opportunities and food waste reduction, the Food Waste Ecosystem project invited **the University of Helsinki's Untangling People Flow** research team to present their **AI Menu Planner** to ecosystem partners at the beginning of 2025. The aim was to demonstrate how attractive menus can be designed while simultaneously reducing food waste.

The University's AI Menu Planner is a software algorithm, or recommendation engine, that identifies menu combinations that are both popular with customers and associated with the lowest levels of food waste. The system analyses historical restaurant data to forecast menu options that minimise food waste and carbon footprint, while maintaining strong point-of-sale performance and customer demand.

The application operates on the University's MegaSense backend server, where demand forecasting and optimisation models are processed. Users access the recommendation services through a web-based interface, allowing managers to explore menu options and planning scenarios directly through a standard web browser.



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The key challenge is that the adoption of AI-based planning tools in the food service sector remains limited compared with many other industries. This is despite the significant potential of AI to reduce food waste through improved demand forecasting, optimisation of food ordering and preparation, and stronger data-driven decision-making.

Sodexo, a major global food service provider, is interested in applying AI to improve operational efficiency and sustainability. The company has access to extensive restaurant data that can be used to better understand customer demand patterns and predict food consumption. This creates an opportunity to apply advanced analytics and machine learning to reduce food waste while maintaining service quality.

In this pilot project, Sodexo aimed to increase its understanding of how AI can support data-driven decision-making, particularly in predicting customer flows and optimising menu planning and food waste management. The study therefore focuses on demonstrating how AI tools can translate operational data into actionable insights for more efficient and sustainable food service operations.

Food Safety (or other relevant safety perspective): Not relevant.

Sustainable Development Perspective

Optimizing demand forecasting reduces food waste and thus decreases the environmental and climate impact of food services. It also contributes to efficient use of resources when loss is minimized, which can have significant positive economic impacts on the profit margins of food service operations.

Description of SODEXO Experiment

The purpose of this experiment is to apply the University of Helsinki's AI Menu Planner to a Sodexo food waste case study. The AI Menu Planner was originally developed as a cost-efficient application to support high-level food service management in optimizing menu planning across multiple restaurants up to six weeks in advance. Its objective is to maintain high customer return rates by offering attractive menu options while minimizing food waste, including kitchen production waste, serving line waste, and plate waste. The original application was developed for the University of Helsinki's Ylva Unicafe restaurants at the Kumpula and Viikki campuses in Helsinki.



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Adapting the AI Menu Planner for Sodexo required a detailed understanding of their supply and demand dynamics, nutritional constraints, and operational impacts such as food waste generation over time. Food service supply is influenced by a combination of nutritional guidelines, customer expectations, and operational considerations. For the Sodexo case study, several planning constraints were incorporated into the model. These include ensuring that the same protein is not repeated within the same day's menu, avoiding repetition of the same dish within a four-week rotation, including at least one popular or "favourite" dish each day, offering fish twice per week, and ensuring that a vegan option is always available.

To forecast demand and estimate resulting food waste, a machine learning model was developed linking menu composition to observed waste patterns using restaurant time-series data. The model was trained using two years of menu and food waste data from the Sodexo Metropolia Myllypuro food service location. This time-series learning approach enables the system to understand how different menu combinations influence customer choices and waste generation.

Once validated, the demand model was integrated into the AI Menu Planner to provide recommendations that optimise menu design while reducing food waste. The demand forecasting model and recommendation engine run on MegaSense servers, allowing Sodexo management to access forecasts and planning tools through a web-based interface. Managers can query the system up to six weeks in advance, receiving recommended menu options that balance customer appeal with minimized waste outcomes.

Results and Lessons Learned

The Sodexo pilot experiment provided important insights into how artificial intelligence tools can be developed and implemented to reduce food waste in real-world restaurant operations. The primary outcome of the study was the identification of the sequential processes required to successfully deploy AI-based decision-support systems in an active food service environment. Unlike many sectors where operational structures are more standardised, the restaurant industry operates with highly diverse processes, commercial practices, and supply chains. As a result, a significant portion of the work focused on understanding Sodexo's operational dynamics, including supply and demand patterns, nutritional planning constraints, procurement processes, and the operational drivers of food waste over time.

One of the most significant findings relates to the **transferability of AI tools between service providers**. Each restaurant operator has unique operational rules and menu planning logic, meaning that an AI system such as the AI Menu Planner cannot simply be transferred from one organisation to another without adaptation. The core algorithms remain applicable, but



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the constraint structure, operational assumptions, and decision-making processes must be customised to reflect the specific service provider's environment.

Another critical lesson concerns **data quality in operational restaurant settings**. Restaurant environments are fast-paced and operationally complex, which often results in incomplete, inconsistent, or noisy datasets. In this pilot, a substantial share of the project effort was devoted to data validation and preparation. Approximately 80% of the research team's time was spent assessing, cleaning, and structuring the available operational data before reliable modelling could begin. This highlights that successful deployment of AI in food service requires not only advanced algorithms but also strong data governance and data management practices.

The study also highlighted the need for service providers to clearly distinguish between **forecast-based demand models** and **recommendation systems**. Demand forecasting models can be evaluated using traditional performance metrics by comparing predicted and observed values, such as customer numbers, point-of-sale transactions, and associated food waste for specific menus or service periods. In contrast, recommendation models operate differently. Their effectiveness can only be fully evaluated if the recommended menus are implemented exactly as suggested. In practice, however, restaurants rarely follow automated menu recommendations strictly over extended periods, such as six-week planning cycles, due to operational flexibility, supply availability, and managerial preferences. This creates challenges for evaluating recommendation systems in real operational contexts.

Another important outcome relates to the **appropriate level of use within the organisation**. The AI Menu Planner is most effective as a strategic decision-support tool for senior management responsible for overseeing multiple restaurants and coordinating large-scale procurement and menu planning. At this level, the system provides insights into trends, waste patterns, and menu performance across the organisation. At the individual restaurant level, however, operational conditions vary considerably, including customer demographics, demand variability, and kitchen processes. For this reason, local-level implementation often requires customised models that reflect the specific operational characteristics of each site.

Despite these challenges, the pilot demonstrated clear benefits when the AI Menu Planner is applied appropriately. The system helps identify menu items and combinations that consistently generate higher levels of waste and highlights menu options that perform well in terms of both customer demand and waste reduction. For service providers operating multiple restaurants, this provides valuable insights into patterns that may otherwise remain hidden in large datasets. The system also improves planning for seasonal variations, holidays, and special events, where demand patterns can change significantly.



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From an operational perspective, the AI Menu Planner reduces the complexity associated with managing large and diverse menu portfolios, which can involve millions of possible menu combinations. By simplifying decision-making processes and providing forward-looking insights, the system enables both management and operational staff to better understand their working environment and anticipate demand in the coming weeks. This improved situational awareness can reduce uncertainty in food preparation planning, leading to lower levels of waste and reduced operational stress. AI-assisted menu planning supports the efficient use of personnel resources. As the experiment advances, we will gain a clearer understanding of the reliability of AI-generated data by assessing how forecasts align with realized demand.

Looking ahead, future development of the AI Menu Planner could focus on **real-time operational intelligence**. One promising direction is enabling the model to update itself dynamically during meal service. For example, the system could generate hourly forecasts of point-of-sale activity and expected food waste for the next hour of service. This would allow kitchen teams and managers to adjust food preparation volumes in near real time, further improving efficiency and strengthening the link between AI-based forecasting and operational decision-making.

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