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Sustainable New Service Development: Insights of Food Wastage Data – Case: University Catering Unit

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Abstract

There are clear implications that sustainable new service development (SNSD) is not only part of the future, but also an important part of contemporary service operations. However, evaluation methods in this field remain underdeveloped. This paper offers one example of how contingent data on operation performance and waste streams could be used to improve SNSD. Specifically, this research quantifies the amount of food waste produced by a typical managed catering business unit to evaluate this data as a measurement of the efficiency of operations management. In this research, sustainable new service development was studied empirically by employing a case study. Authors used data simulation to bring insights to SNSD. Another purpose was to create new, easily applicable metrics for the future SNSD work outside the case study unit.

This study contributes to the area of new service development (NSD) by offering the utility of a case study-based simulation as a development tool. Results indicate how small changes in menu planning, production processes and demand management can create positive and significant financial and environmental outcomes. Our results link together the literatures on contingent operations awareness, the triple bottom line paradigm and SNSD to create a baseline condition for the future sustainable hospitality development.

Keywords: service, sustainability, development, corporate social responsibility, CSR

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Introduction

Even as the global economy turns to focus more on services, arguments about environmental sustainability continue to focus largely on the trade of goods. In part, this makes sense since decoupling value from resource use is more straightforward for services than it is for goods production. However, the environmental footprint of service industries is far from sustainable.

This paper examines the idea of Sustainable New Service Development (SNSD) following the conclusions by Aragon-Correa and Rubio-Lopez (2007). This paper explores their conclusions in the context of food and hospitality services, which concern the management of material and people. Specifically we use a restaurant case study to ask: how can waste management data be used to increase efficiency and effectiveness of hospitality operations. The research had two objectives:

1. To measure the amount of waste produced by a single managed catering business unit.
2. To evaluate the potential of using insights from food wastage data in SNSD

According to research by Halonen (2015), the role of sustainability data affects both commercial purchasing policies and consumer attitudes. Thus, we hope that the answers to these research questions will lead to more efficient hospitality operations by increasing awareness among catering practicioners and consumers of the role of sustainability in services.

Research Problem

Globally, as much as one third of produced food is lost. From this massive amount of nutrition waste, 35% is wasted during consumption. (Gustavsson et al., 2011.) If we look at the nutritional value lost in the food production value chain, final-stage consumption remains the largest cause of waste in five out of seven global geographical areas (Figure 1).

The share of consumption-stage waste is rises with the income level of the population. Thus, the scale of the problem is likely to increase as the standards of living rise.

According to Lipinski et al. (2013), the food loss can be categorized by five stages in the production and consumption chain:

1) Production
2) Handling and storage
3) Processing and packaging
4) Distribution and market
5) Consumption in the form of food purchased by consumers, restaurants, and caterers but not eaten

Authors focused their research on the last stage, because it is the largest source of waste in western societies. While there is a broad literature on the topic of food waste, there is a clear gap in our understanding of how to develop and measure sustainable new services. In addition, there is a need for sustainability metrics in a form of unambiguous customer requirements. Several studies have shown that poorly managed sustainability requirements have a drastic effect on the development process and, most of all, on the end result of service development (Almefelt et al., 2006; Aurum and Wohlin, 2005; Barney and Aurum and Wohlin, 2008; Hull et al., 2011).

This case study looked into a single business unit that serves daily 330 customers on average. Management tracks the number of customers on a daily basis by using data from the cash register/automated inventory system. The unit is operated by a global franchise, which has been granted a Finnish Standards Association's (SFS) environmental certificate.

Due to the nature of services, empirical data collection during a service development process should include components other than the end product (Spohrer and Maglio, 2010b; Grönroos, 2011). A lack of empirical data from actual service-enabling processes can lead to situations in which it is impossible to compare obtained results to a set development goal.

This analysis follows the definitions of waste used by Gustavsson et al. (2011) "Global food losses and food waste" report published by Food and Agriculture organization of the United Nations (FAO) to make this study comparable to prior ones.

Corporate social responsibility (CSR) activities emphasize social or environmental issues. Thus terms like "green" and "environmental" are used in practice as synonyms for "sustainable". Development of these areas in the service context is being referred as sustainable new service development.

This paper consists of five sections. The first two sections review the literature on the subject and describe how this paper contributes to existing research in the area of sustainable new service development. The third section describes the research methodology. Sections four and five are the results and conclusions with suggestions for further research and limitations of the study.

Corporate Social Responsibility

Corporate Social Responsibility (CSR) is a term describing actions meant to promote positive outcomes for the surrounding community and society (Schubert et al., 2010).

In the CSR context, "sustainability" refers to sustainable development - defined originally as meeting the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland et al., 1987). In the business context, sustainable development is linked to the so-called triple

bottom line thinking, which notes that companies should measure their success not only by economic but also in environmental and social terms (Elkington, 1997).

This area of business development has been studied for decades but the increasing effects of climate change and negative impacts of globalization have brought the issue from academia and media to boardrooms (Moir, 2001). Discussion about companies' initial motivation to implement CSR is ongoing, but typically two types of drivers are identified: CSR can be either internally or externally driven (Masurel, 2007; Bonilla-Priego et al., 2011). The former is connected to goals such as increasing profitability or developing competitive resources, whereas the latter is driven by legal regulations or explicit stakeholder expectations. Shareholder and stakeholder value perspectives have been clear dividers of the discussion, but whether it is even possible to separate these two from each other (Johnson et al., 2008).

Opportunities to enhance operative savings and increase firm value in the industry from socially responsible operations serve both approaches (Kang et al., 2012). This requires a thorough contingent analysis of business environment as a whole. Very good examples of this are a Leadership in Energy and Environmental Design (LEED) certified and LEED qualified building projects in the US hotel industry illustrated by Butler (2008). In his study, Butler shows the positive financial effects and stakeholder attitudes of green policies. Also, reference points like LEED offer an opportunity to describe the need for resources in the form of requirements (Butler, 2008).

New Service Development

New Service Development (NSD) is a relatively new subject, and as a result, comprehensive studies - especially in the area of innovation - are scarce (de Mark, 2010). According to Sanden (2007) 40% of sales in service organizations are created by service products, that were developed within the previous 5 years. Authors combined the principles of sustainability and generic service development into the idea of sustainable new service development (SNSD). SNSD combines the principles of NSD but takes into account the triple bottom line paradigm.

Services are processes created and consumed simultaneously by the service provider and consumer (Grönroos, 2006). There are several academic definitions of a service (Gummesson, 2010; Kotler, 2007; Spohrer and Maglio, 2010a; Vargo and Lusch, 2004), and some significant differences exist between them. As Bharadwaj's et al. (1993) research illustrates, factors like equipment intensity (automated service, like ATM) versus people intensity (personal banking service) and service delivery process (served vs. self-service) differentiate services even within same industries. Intensity of the service process and modification variability also dictates both development and operations of a service product. Intensity refers to the amount of

customer's participation in a service process and in general hospitality services are considered to belong to so-called high-contact intensity operations. High-contact intensity operations require participation from the customers' part, but rather limited amount of customization (Bullinger et al., 2003). Also, a study by Melton (2007) clearly underlines the importance of frontline employee and customer participation to service development across different service industries.

NSD is a multifunctional and multidisciplinary process. Its purpose is to create new, desired service outcomes in co-creation with a customer (Spohrer et al., 2008). The purpose of the new service development is to enhance the profitability of existing offerings, attract new customers to the firm, improve the loyalty of existing customers and open markets of opportunity (Menor et al., 2002).

Our approach assumes that the customer obtains service benefits created by the service provider. The main development and management area in service development is capability utilization, since it enables the final service offering (Grönroos, 2006; Vargo and Lusch, 2004). This capability utilization aims to create service outcomes of a process, developed and consumed simultaneously with a service provider and end user, as described by Manor, Tatikonda and Sampson (2002) and Grönroos and Voima (2013) among others. Communication between all parties involved with development process should be transparent, open and most of all fact-based.

Sustainable Hospitality Operations: A Divided Responsibility?

The importance of market scanning in hospitality product development is significant in two different dimensions illustrated by Veflen Olsen and Sallis (2006). Their work divides scanning into narrow (micro) and broad (macro) scanning. Narrow scanning focuses on day-to-day information, while broad scanning tries to find factors, which might have significant effect on the long-term effects of the company or the industry. The purpose of thorough scanning is to reduce the service producer's uncertainties in the three areas in production process and planning: market, creative and process uncertainty (Anderson and Joglekar, 2005).

There are already several environment management systems in use in the hospitality industry, and based on the research by Font (2002), there are over 100 ecolabels in use. On top of this, there are industry-specific best practices and codes of conduct, intended to increase green thinking and awareness. Ecolabels are meant to assure customers and other stakeholders that the product itself, processes used to produce a product and the whole management system is managed according to a certifier's requirements (Chan, 2009).

Green attitudes of consumers have been a topic that has received a fair amount of attention in the academia during the past years. These studies range from individual consumer's willingness

to pay premium fees for environmentally sustainable services to the effects of more sustainable services. But hospitality industry as a whole has not been at the forefront of green operations development (Kang et al., 2012; Szuchnicki, 2009; Chan and Lam, 2001).

Marketing literature (Weber et al., 1989; Szuchnicki, 2009; Kotler, 2007) emphasizes psychographic segmentation, which is based on their values and actual motives for consumption as a means to reach existing and potential customers. For example, according to Kujanen (2013), higher education correlates with more conscious consumption behavior and greener attitudes towards consumption. Market responsiveness is also found to be one of the nine key areas in service development in hospitality industry (Ottenbacher and Gnoth, 2005).

Research Methodology

Many studies of sustainable development in the service industry are based on fragmented industry data (De Jong and Vermeulen, 2003). In this research, sustainable new service development was studied empirically by employing a case study. The methodology was chosen because Yin (2003, p. 2) states that: "a case study research would be the preferred method, compared to the others, in situations when:

1) The main research questions are "how" or "why" questions;
2) a researcher has little or no control over behavioral events;
3) And the focus of study is a contemporary (as opposed to entirely historical) phenomenon."

Data triangulation is typically used in case studies (Johansson, 2003; Yin 1994). The purpose is to cover as many aspects of a single case as possible and enable further generalization of the results by reasoning, as illustrated by Johansson (2003).
The five collection methods used are:

1) Literature review
2) Documentation (previous research)
3) Direct observations
4) Interviews
5) Data simulation

This successful research method has also been introduced by (Ranta and Takala, 2007).

Case study unit

The case study restaurant offers publicly subsidized student meals. It is operated in a university of applied science under a global franchise, which has been granted a Finnish Standards Association's (SFS) environmental certificate. The unit operates in the same building as a franchise hotel and uses hotel kitchen premises, equipment and personnel in its operations. Also, unit has

to take into consideration its international client base.

The government organization responsible for the subsidization scheme, Finnish Social Insurance Institution (KELA), funds student restaurants meal-by-meal based on legislation that prescribes the general requirements for the subsidies. These general rules state the maximum price and the contents of the meal. For example, a subsidized meal has to include a drink, salad, bread and a spread in addition to the main dishes (KELA, 2012). Health and nutritional aspects are mentioned, but sustainability is not. The legislation is accompanied by a more detailed but non-binding set of guidelines, which do mention sustainable development as an aim to be addressed in student restaurants (KELA, 2011).

A vast majority, roughly three quarters of daily revenue, is generated from lunchtime sales. Customer base is divided between university personnel (27%) and students (73%). (Karjalainen, 2015). This information underlines the importance of students as a source of revenue.

Collection of empirical data

The data collection process took place during the week of April 16, 2015. A sample of 150 observations was collected from a sample frame of 1569 lunchtime customers. Five different teams of six research assistants collected the data, and at least one member of the research team was present at all times to help assist the teams and ensure that good academic procedures were followed throughout the data collection process.

Data was collected from two randomly chosen, separate client groups. Due to a limited time frame and time-consuming data collection method, a daily sample was restricted to 30 individuals. The first group consisted of customers collecting their meals, and the other group of those delivering their dishes to washing-up and to a bio-waste collection bin. The arrangement was done in order to reduce research bias

The first observation subject was randomly chosen, subsequently, every fifth customer was selected. A similar systematic random selection process was adopted in waste measurement.

Each portion was measured menu item by menu item, while a client collected it from a self- service line. Measurement was done using two separate scales, whose accuracy was controlled using a standardized comparison weight.

During the research period, a unit served 20 different dishes or side dishes and three types of bread along with milk, water or sour milk. There were 79 different ingredients used during the observation period.

The amount of energy and the price of the measured ingredient were calculated per 100 g, based on the information gathered from purchasing database. The total amount of energy and price of the portion for each individual dish was calculated. Initial results were gathered in spreadsheets to facilitate statistical analysis, which allowed researchers to compare results between the

individual units of observation.

The total amount of unspecified bio-waste was measured after the lunch period each day and possible issues reflecting to the observation day's results were discussed with the head-chef of the unit on the spot.

Data about overall waste was also collected, in order to find and compare the main source of the waste in the unit. This information was collected after each day by scaling the ingredients of the waste bin. The amount of total plate waste could not be added to the consumption waste without further analysis, because the total amount of waste included parts of ingredients such as skin, bones, peels and other non-edibles, which are not included in food wastage by the FAO standards. Also paper napkins are thrown to the bio-waste bin, which adds-up to the weight of the waste bin.

Interviews and documentation

Although wastage information itself offered insight into sustainable new service development, there were still gaps in our understanding of the process. This impacts operations because even after analysis, researchers had to seek alternative explanations for poor financial results, which came to the authors' attention after the interviews.

As a part of the data triangulation method used here, authors interviewed both the head chef of the unit and other members participating in the production process. Specifically we sought their views on the efficiency and the effectiveness of the existing CSR and eco-label policies. We also collected historical data by interviewing the previous head-chef of the unit and analyzing results from previous development cases.

Interviewees articulated an obvious need to streamline business processes from a financial management point of view. This must be done while simultaneously following the guidelines of the SFS eco-label and satisfying a demanding customer base. They also expressed an underlying will to use more organic ingredients in food preparation, but implementation of this is limited by a higher purchasing price (Erkkonen, 2015.) Despite the existing SFS eco-label, organic food ingredients were not demanded to meet eco-label's certification criteria.

Different approaches to the CSR and SNSD required as objective information about the existing operations as possible. This information needed research data, which took both financial and environmental aspects in to consideration.

Data simulation

We implemented a business simulation to introduce statistical data into the analysis. Simulated data offers insight into how service provision could be developed, thus providing an opportunity to create metrics, which could be used to track progress during the service development process.

There were 150 direct observations of customers' buying behavior. In order to innovate on the methods used in the field of

SNSD, we simulated answers using the whole sample frame. The focus of the observations was on the financial value of the ingredients and nutritional value in the form of amount of energy customers received in the dishes.

Computer-aided simulation of business systems and business processes is a well-established way to study systems and processes (Proctor, 1994; Laguna and Marklund, 2005). However, there must be an underlying structure in a homogeneous set of selected variables. Therefore, the collected data was initially analyzed (Appendix 1) using SPSS software to assure that it met the requirements for further statistical analysis. Distribution of both price /dish and energy / dish was analyzed and outliers were dropped.

Simulations require the use of pre-defined rules, including distributions and weighting factors. This allows interaction based upon trends, norms and incomplete information (Hansford et al., 1992). Keeping this in mind authors made sure that variables were statistically and conceptually valid so that further analysis was statistically sound following the guidelines by Hair et al. (2006).

Initial statistical analysis (see Appendix 1) showed that customers' purchasing data was normally distributed. During the second phase of analysis, the authors computed the normal probabilities using the NORMINV function. This function returns the inverse of the normal cumulative function for the specified mean and standard deviation, which were calculated from the observed data. These results were simulated to respond to the actual number of customers during each day of the data collection period and sampling frame.

Lehtonen and Seppälä (1997) describe the need for data reduction as a benefit of data- simulation. In our case the purpose of the simulation was quite the opposite, but the goal of the simulation was in line with their study. One of Lehtonen's and Seppälä's (1997) key findings was, that the main difficulty and disadvantage of simulation is the data collection process. This statement underlines the importance of simulation to help focus development on key development areas in a service system organization. The inter-functional and inter-disciplinary nature of service provisions is hard to analyze without data simulation as described by Hansford et al. (1992) due to a vast amount of data from various service processes. Dependency on the several information management systems, which enable the final service delivery emphasises the use of simulation (Kano et al., 2005). Also, Pasivirta and Kosola (2007) and Hansford et al. (1992) emphasise simulation as one of the development tools in a situations where possibilities to actual observation are limited.

Results

The research had two objectives:

1. To measure the amount of waste produced by a single

managed catering business unit.

2. To evaluate the potential of using insights of food wastage data in SNSD

Following the principles of methodological triangulation, several research iterations, in which different research methods were utilized, took place.

In the early stages of the observation period, it became clear that the actual amount of "plate waste", food bought but not consumed, was surprisingly small. Due to our research approach in which we followed the principles laid–out by FAO, the authors wanted to measure ingredient waste as precisely as possible. The purpose of this was to create food waste segments following the criteria FAO uses. This approach did not enable before-and-after measurements from the same customers, since in a single unit the word-of-mouth of the on-going observation created a significant risk of measurement bias. Also, the small number of wastage observations did not make it possible to simulate statistically viable wastage results. However, aggregate results offer enough information to draw conclusions. A comprehensive, 269 ingredients table of food wastage by customers is given in Appendix 2.

The smallest amount of unspecified waste was produced on a same day as smallest plate waste results were observed. Also, the third day of the observations did not meet the requirements set to the institutional catering served by universities with the average energy value of 306 kcal. The lower average energy content of Friday resulted lower unspecified waste, but there was no effect to other wastage results. The lower number of overall customers could explain this. These results are illustrated in the Table 2.

The data collection method made it possible to divide wastage according to main ingredients. These results show a large portion of salad and salad buffet among the wastage. Among the other major sources of food waste were side orders and meat. The overall results are shown in Figure 4.

Climate impacts of the food wastage

An essential part of CSR is management of the environmental impacts of operations. In the analysis of the environmental impact of the waste, climate impacts were used as a proxy for overall environmental impacts. The assumption is that the same drivers such as energy, fertilizer and land use are causing both the most significant climate impacts as well as other, more local environmental degradations. The climate impacts of different food items were estimated based on a set of guidelines developed by the Finnish Environment Institute (Nissinen et al., 2010). Estimating the environmental impacts of food, taking into account the whole life cycle, is notoriously difficult, and therefore, the values depicted in Figure 3 should be considered only as indicative.

The production of meat has a larger environmental

footprint compared to produce like vegetables. Also, due to the time of the year, the majority of ingredients were imported, most likely causing a higher environmental impact.

Based on our estimations, some observations of the climate footprint of different food items can be made. Despite the fact that meat represented 18% of the wastage, its climate impact was as high as 39% of the overall impact. A large amount of the overall impact was caused by salad and salad buffet. These ingredients had the highest overall environmental impact of 47%. One has to bear in mind that their share was clearly the largest of all the waste ingredients. As mentioned in the case description, offering salad is a mandatory requirement for a student restaurant. A breakdown of wastage figures is given in Appendix 2.

Paradoxically, in the waste phase, the impact can actually be considered to be positive, since in Helsinki, organic waste is separated and is either composted or used in biogas production. Also, a growing role of biofuels as a source of energy for transportation is predicted to rise from 1,5 % to 6,8 % by the year 2030 (Mykkänen, 2016). A significant source of bio-energy is bio-waste generated by households and commercial food providers. This increasing role of bio-fuels will also reduce the final environmental impact of food waste.

From the life cycle point of view, of course, this is not the case, since much more energy and resources go into production of the food than can ever be recovered by recycling. Thus it is more reasonable to measure the impacts of the waste based on the impacts of the original food items, not the type of waste. Based on the interview data, this was also the line of thinking in the restaurant management. Their focus was on purchasing local and organic material and reducing unnecessary waste.

Efficiency and effectiveness of the operations

The initial research objective was to analyze the efficiency and effectiveness of the operations with respect to CSR. Thus, the researchers focused on the early stages of the consumption. This included the serving of the ingredients as final dishes and the customers' service process and their effects on the CSR of the unit. The rationale was that positive CSR findings, which gave financial incentives to the catering operator, would be more easily adapted. Development of sustainable new services demands a comprehensive process development among all the participants in the service process. Therefore, the authors included also a food production process and demand management processes to the research. Due to a research focus, purchasing policies were excluded, despite their importance to CSR and successful SNSD.

The researchers knew in advance that outside regulations set by the Finnish Social Insurance Institution (KELA) dictated largely how day-to-day servings were planned and offered to the student customers. These regulations set constraints on the price of the individual ingredients and, on the other hand, the demands on the energy and nutritional values of the meals and their components.

This highly regulated business environment creates even more demand to efficiency from the service provider's point of view. Service provider's hands are tied by the public funder, whose regulations do not necessarily take sustainability in to account as a regulating factor. With very little negotiating power, all the catering operators operating in a subsidized environment face similar challenges as the case unit due to a metrics (the maximum price and the contents of the meal) used to follow their efficiency and effectiveness.

Data from the simulated results were used (Appendix 3) to draw conclusions, create SNSD metrics and to prescribe clear development suggestions, which would take into consideration the following:

- official nutritional guidelines
- financial aspects
  - from a buyers' side
  - from a supplier's side
- CSR

The researchers created a set of indicators from the analyzed data set. These indicators/ratios were:

- calorie/price
- price/portion
- production waste

The first figure was created to help suppliers understand how efficiently their operations were able to produce the necessary amount of energy to answer the demand set by official guidelines. The figure was calculated as an average price for each calorie. If the average calorie amount was low or average, but the total production price of the dish was high, the supplier's production efficiency was poor. If the operator did not succeed in producing enough calories at the acceptable price, it was not efficient for the buyers (university) perspective and ineffective for the final users. Based on the simulated data (Appendix 3), there were large deviations in efficiency over different periods of time. The results are illustrated in Figure 4.

This ratio gives a good overall view of operational efficiency, but its dependency on two (or more) characteristics requires further explanation. The ratio suggests poor performance during the last three days, but this is a result of two separate issues. On Wednesday, the amount of energy is below official guidelines (minimum of 500 kcal/day), and costly ingredients draw the figure down on Monday, Thursday and Friday.

The final figure of interest is the production waste. Data collection concentrated on the production of eatable food, not the raw ingredients. The rationale behind this came from the FAO report, which clearly shows that over-manufacturing is a larger problem than preparation wastage. The data collection method overcame the flaws in the cash register and inventory management system, and the results indicated a clear overproduction of the

dishes. On Tuesday, the vegetable casserole (1) was bought by only two customers out of the 30 observed customers, the celery soup (2) by only 1/30, on Wednesday, only a single customer bought lentil curry (3) and on Thursday, pea soup (4) was favored by only two individuals. When these figures are multiplied to correspond to the total amount of customers, and proper confidence levels are taken into account, results for these days are as follows:

- Tuesday (1) CI 95% [2, 17], (2) CI 95% [2,18].
- Wednesday (3) CI 95% [1,17]
- Thursday (4) CI 95% [2, 18].

According to the former and the present head chef of the observed unit, the minimum number of portions prepared for a lunch is 30. As results show, wastage is mainly caused by poor menu management. Observations show that several kilos of prepared food are thrown away as waste every single day.

Conclusions and Discussion

This study assessed the potential of using different types of wastage data as a source for SNSD. Results indicated that the importance of contingent information for SNSD was high. This data should be presented to all participating parties in the most transparent manner, as suggested by prior studies. In his research regarding adaptive supply chains, transparency is a mandatory component to achieve greatest velocity and ability to manage variability (Davidrajuh, 2006). The price of ingredients per portion is a figure followed throughout the catering industry. Students' meals are subsidized by the government, production prices should be closely monitored, and alterations should be minimal in order for production to be efficient.

These elements are crucial, to new service development's mission to create new, desired service outcomes that satisfy customers' requirements. Also, increasing awareness of environmental sustainability cannot be neglected if the industry aspires to satisfy customers and achieve better financial results (Green et al., 2007).

The main source of the global food waste is the purchase of food by consumers, restaurants, and caterers, that is left uneaten. Unfortunately, results did not make an exception to this. The small role of plate waste supports current studies conducted by Häyhtiö (2016), and production waste figures corroborate industry averages illustrated by Koivupuro et.al., (2010) and Silvennoinen (2012). The average amount of food waste in the institutionalized catering is slightly over 20%. This figure includes preparation waste, service waste and plate waste. Industry averages for the following areas are 4,3%, 10,4% and 5,4% respectively.

Without any normative framework, it has been operators' responsibility to follow the principles of CSR, but this is about to change. A new European Union wide purchasing directive will

demand more transparent and precise traceability of goods and services in order to push service providers to increase their overall transparency (Hankinnat, 2016). As an end result, it is likely to increase the need to develop services and service metrics following the principles of SNSD.

Therefore, in the process of sustainable new service development both narrow and broad methods should be utilized. It can be concluded, that factors affecting sustainable service development, decision-making and capability management represent either of the two scanning areas:

- environmental awareness in the service company (narrow)
- environmental awareness of the consumers (broad)
- process development to create cost reduction (narrow)
- suppliers demand (narrow and broad)
- employee satisfaction (narrow)

(Kassinis and Soteriou, 2003)

Since food life cycle assessments are very complex, the only practical way for the restaurant to reduce the environmental impact of the stages prior to preparation and consumption is to rely on external certificates and key assumptions in purchase decisions, like preferring organic or local food. The actual effects of these decisions, however, remain unclear thus limiting their usefulness for service development.

Broad and narrow scanning are, as our work indicates, not separate areas within the SNSD. Both areas have a significant weight with respect to our case study unit, so neither can be neglected. Then again, this work manages to show what the possible obstacles are, when both areas are covered in the manner needed to achieve SNSD goals. The role of an outside regulator in SNSD, such as KELA, should not be overlooked. External operators play an important part as a source of information and regulations needed to conduct SNSD.

The work also shows the importance of well-managed operations. The role of accurate data, which is in an easily utilizable form among all the stakeholders, is crucial and should steer day-to-day development work. As Qin et al. (2009) have shown, deviations in pre-assumed service quality and food quality have effects on the overall customer satisfaction. Thus financial results are jeopardized and principles of the triple bottom line paradigm neglected.

For the case restaurant, the most significant factor in the environmental impact was the food served, and in particular, its identity, origin, and the amount wasted. The biggest source of waste is the food that goes untouched, that is, which is prepared but never delivered to customers because demand is lower than expected. Although some of it can be recovered and reused, it is unnecessary waste that could have been eliminated without any service implications. This finding was, as stated already earlier, unfortunately in line with industry averages. On the other hand, this case study showed how to effectively investigate industry wide food waste issues.

There is ongoing discussion around the topic of CSR and green approaches to the hospitality industry. This paper used another approach: a detailed case study and simulation of initial results. Simulation enhanced the ability to analyze initial data and draw more accurate results from a limited amount of data. This method should be further developed. More detailed and sophisticated service models should also be used while assessing the service processes and their environmental effects during the different service processes.

Analyses showed that the data, which is collected throughout the service processes, is crucial for SNSD. The inter-functional and inter-disciplinary nature of services demands knowledge of each participant's role in the end result. Transparency in service production helps create a responsible corporate culture that is line with customer requirements. Organizational development, which enables CSR in its various forms, is the result of a comprehensive and, most of all, constant continuous development of variables affecting the end results.

Having said that, positive results from the material flow and waste data measurement can also be achieved by the front line employees, but not without systematic screening of operational efficiency and effectiveness metrics, as our research shows. These screening mechanisms should be implemented to all on-site activities at the production phases as an integral part of a workflow. Simple metrics like efficiency ratio introduced in this paper can help operators to start to follow their material flow, enabling them to alter their production to procedures in order to meet all the stakeholder requirements sustainably. Daily comparison between the amount of dishes sold to the planned amount, measurement of unspecified waste and tighter portion control are just a few examples of easily adapted screening mechanisms. Also, more precise demand projections based on the historical data and utilization of simulations based on this data should be considered.

Based on the results, production processes and changes to the service intensity should be changed in the case unit. Current forms of self-service reduce service provider's ability to control portion sizes and material consumption. This poses a challenge for predicting daily consumption and leads to overproduction of food. Reduction of different dishes served during the lunchtime is also recommended. Limited consumption of several main courses indicates clear need to this.

While relying on certifications in purchases is a simple way to include CSR in the operations, focusing on contingent issues and operational activities is more suitable in achieving pay-offs in multiple dimensions. It is especially useful in combining different types of performance goals such as service quality, economic viability, regulatory compliance and environmental impacts.

Relying *only* on a certifications can exclude areas crucial to SNSD, such as operational efficiency, and focus the CSR activities to meet certification needs instead of contingent issues, which can more heavily impact actual sustainability, as our research indicates.

Also, operational activities create a constant and steady stream of information, which can be interpreted and used to the needs of SNSD. It is also a form of information used in the day-to-day operations management, aiding communication between different stakeholders even with sometimes contradicting goals. Partial information can be found from a number of sources, but the legacy of new product development and a great deal of competing approaches to CSR make research and development a challenging task.

Limitations of the Research

The limitations of this study are twofold:

- generalization of results from an individual case study;
- poorly managed menu management operations in the case study unit.

The first limitation is, as stated earlier, in the nature of a case study, as the first of its kind to be conducted.

The authors' suggestion for future research in SNSD development and research is that it should focus on empirically demonstrating the relationships between operational variables and their importance to the SNSD processes. Success in SNSD requires analyzed data drawn from the analysis of trends in the acknowledged key success factors. Full understanding of these key requirements in the short and long term is essential to the efficiency and effectiveness of SNSD activities.

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Figures, Images and Tables

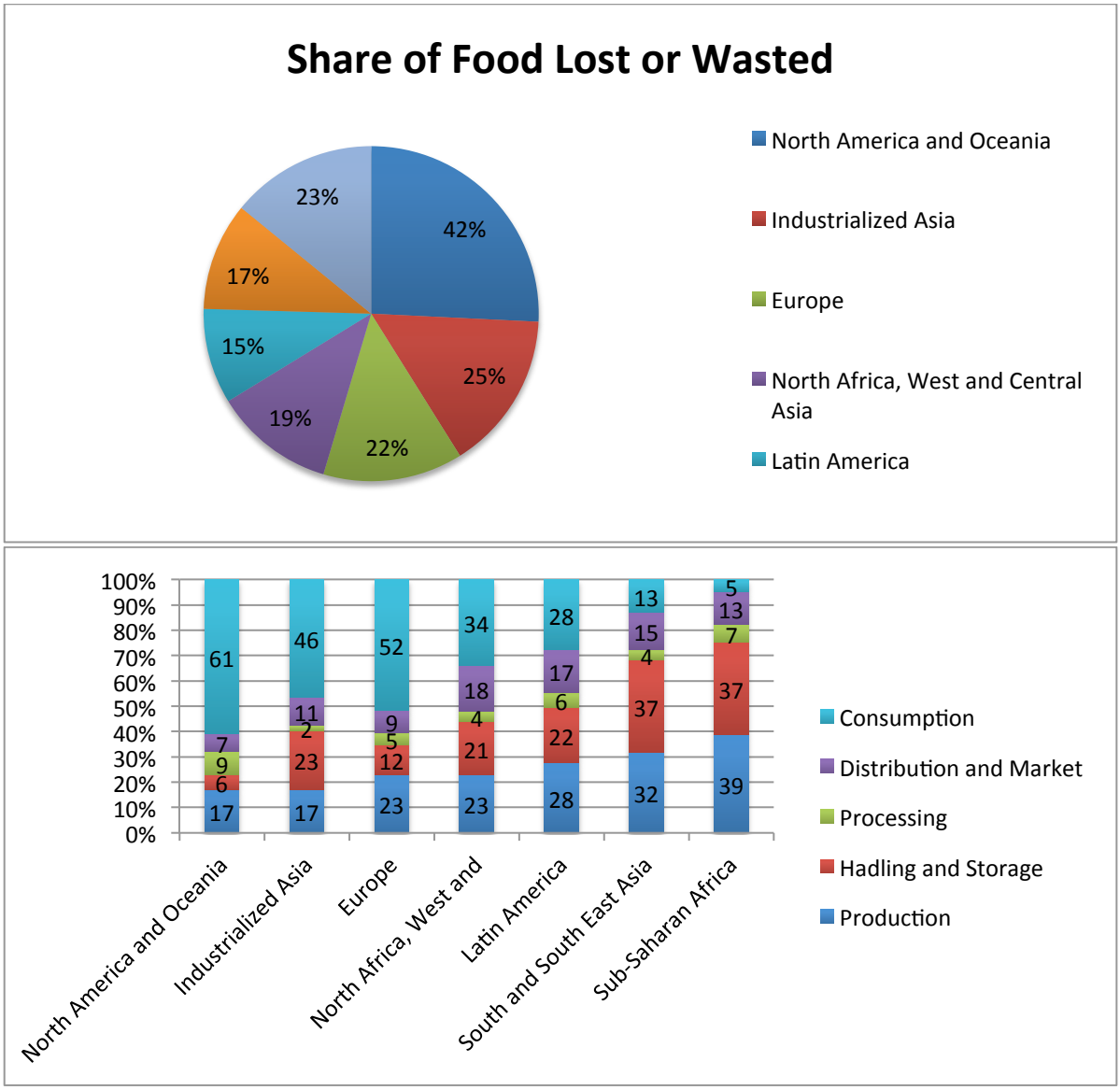

Figure 1, Share of total food available that is lost or wasted, Source: Lipinski et.al, 2013, p 9.

Monday	13,5 kg
Tuesday	19,5 kg
Wednesday	8,5 kg
Thursday	13,5 kg
Friday	11,5 kg

Table 2, The amount of unspecified waste

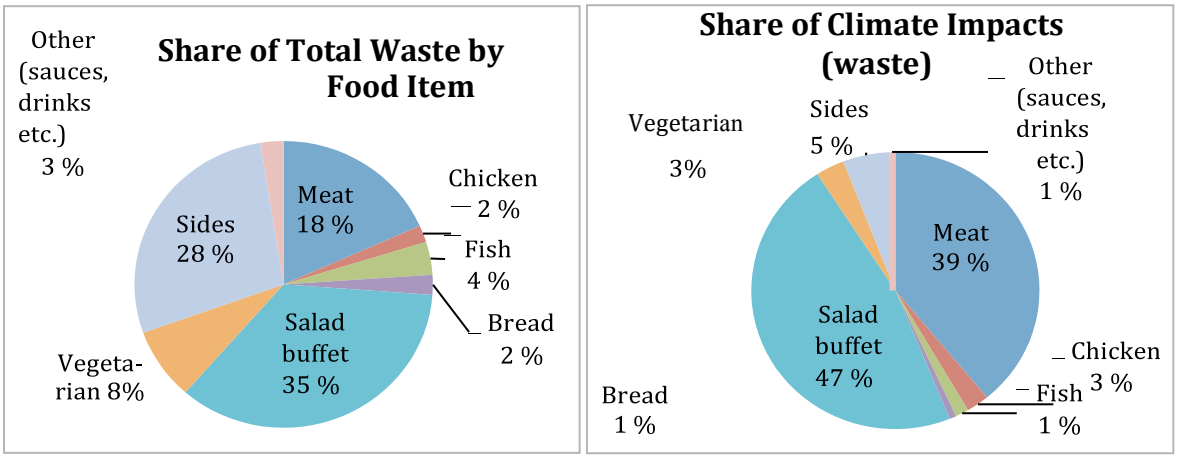

Figure 3, Share of total waste and climate impacts by food item, N=83

Efficiency ratio, counted as average calories / average price of ingredients / simulated data	**Day**	**Ratio**	**Mean energy**	**Mean price**
	Monday	**302,96**	751,70 kcal	€ 2,48
	Tuesday	**594,77**	732,47 kcal	€ 1,23
	Wednesday	**235,25**	312,76 kcal	€ 1,32
	Thursday	**247,55**	559,31 kcal	€ 2,25
	Friday	**220,76**	422,27 kcal	€ 1,91

Figure 4, Efficiency ratio

Appendix 1, Daily distribution of the **original** data (N=150) / 5 days(n=30)

Monday

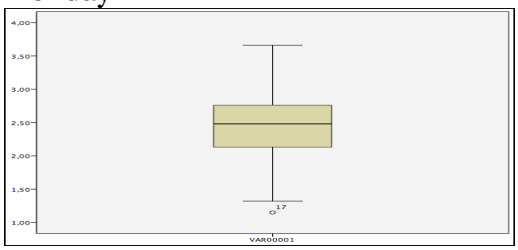

Figure 1, distribution of dish prices, n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00001 is normal with mean 2,497 and standard deviation 0,67.	One-Sample Kolmogorov-Smirnov Test	,200[1,2]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

[2] This is a lower bound of the true significance.

Figure 2, Test of normal distribution, dish prices, n=30

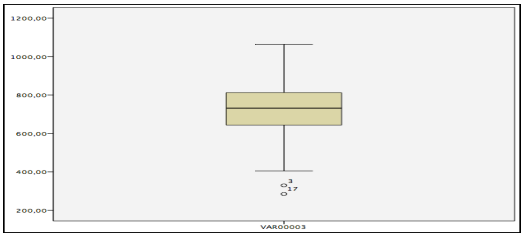

Figure 3, distribution of energy value, n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00003 is normal with mean 729,320 and standard deviation 187,11.	One-Sample Kolmogorov-Smirnov Test	,155[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

Figure 4, Test of normal distribution, energy value, n=30

Tuesday

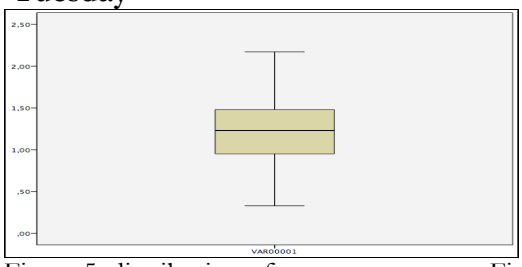

Figure 5, distribution of dish prices, n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00001 is normal with mean 1,223 and standard deviation 0,45.	One-Sample Kolmogorov-Smirnov Test	,200[1,2]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

[2] This is a lower bound of the true significance.

Figure 6, Test of normal distribution, dish prices, n=30

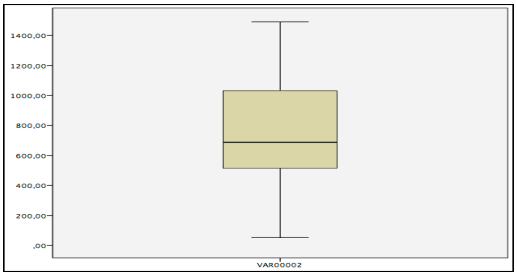

Figure 7, distribution of energy value, n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00002 is normal with mean 746,502 and standard deviation 367,41.	One-Sample Kolmogorov-Smirnov Test	,200[1,2]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

[2] This is a lower bound of the true significance.

Figure 8, Test of normal distribution, energy value, n=30

Wednesday

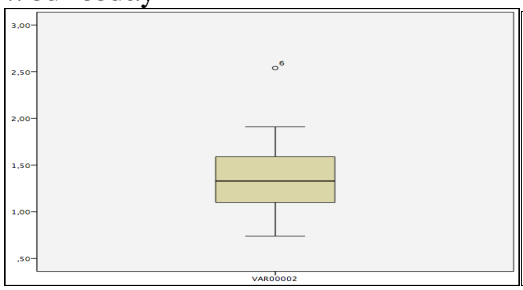

Figure 9, distribution of dish prices, n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00001 is normal with mean 2,497 and standard deviation 0,67.	One-Sample Kolmogorov-Smirnov Test	,200[1,2]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

[2] This is a lower bound of the true significance.

Figure 10, Test of normal distribution, dish prices, n=30

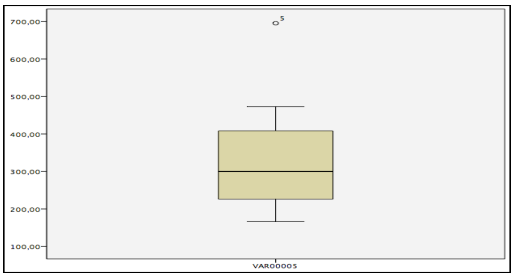

Figure 11, distribution of energy value, n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00005 is normal with mean 319,325 and standard deviation 118,84.	One-Sample Kolmogorov-Smirnov Test	,200[1,2]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

[2] This is a lower bound of the true significance.

Figure 12, Test of normal distribution, energy value, n=30

Thursday

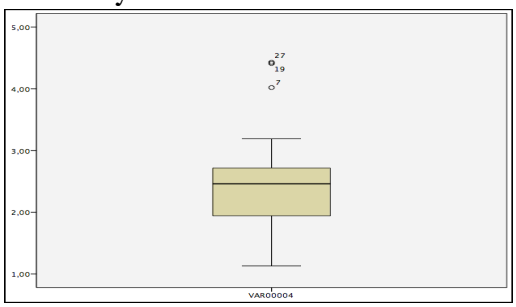

Figure 13, distribution of dish prices, n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00004 is normal with mean 2,277 and standard deviation 0,55.	One-Sample Kolmogorov-Smirnov Test	,056[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

Figure 14, Test of normal distribution, dish prices, n=30

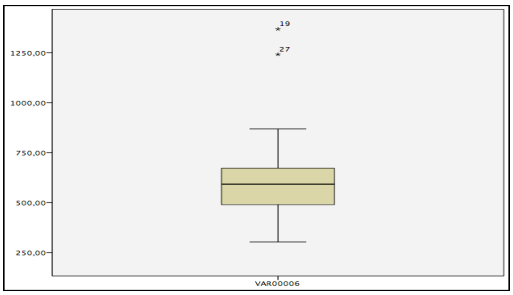

Figure 15, distribution of energy value, n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00006 is normal with mean 556,251 and standard deviation 140,59.	One-Sample Kolmogorov-Smirnov Test	,200[1,2]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

[2] This is a lower bound of the true significance.

Figure 16, Test of normal distribution, energy value, n=30

Friday

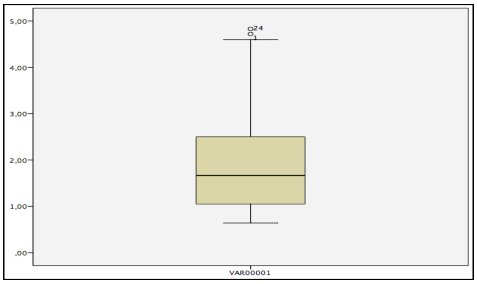

Figure 17, distribution of

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00006 is normal with mean 1,967 and standard deviation 1,11.	One-Sample Kolmogorov-Smirnov Test	,054[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

Figure 18, Test of normal distribution, dish prices, n=30

dish prices, n=30

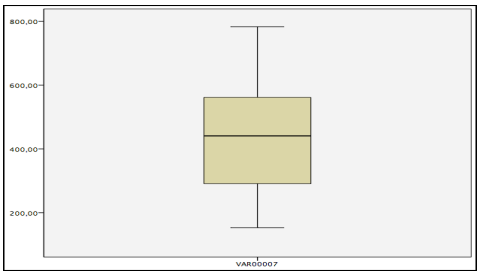

Figure 19, distribution of

n=30

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of VAR00007 is normal with mean 435,755 and standard deviation 167,34.	One-Sample Kolmogorov-Smirnov Test	,200[1,2]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Lilliefors Corrected

[2] This is a lower bound of the true significance.

Figure 20, Test of normal distribution, energy value, energy value, n=30

Appendix 2, Break-down of wastage

MONDAY	Number of observations	Average Amount of energy waste (kcal)/ ingredient	Average € waste / observation / ingredient
Potatoes	12	23,18	0,24
Broccoli	0	0,00	0,00
Cheese	0	0,00	0,00
Salad	9	14,76	0,09
Onion	0	0,00	0,00
Oil	0	0,00	0,00
Flour	8	48,45	0,02
Meat	0	0,00	0,00
Cottage cheese	0	0,00	0,00
Fish	8	12,54	0,10
Sour cream	6	6,93	0,01
Bread	0	0,00	0,00
Milk	0	0,00	0,00

TUESDAY	Number of observations	Average Amount of energy waste (kcal)/ ingredient	Average € waste / observation /ingredient
Pasta	5	50,61	0,04
Oil	5	53,39	0,01
Pesto	1	26,67	0,04
Onion	6	1,45	0,01
Carrot	1	1,86	0,01
Leek	1	2,60	0,02
Champignon	1	0,96	0,02
Egg	5	9,72	0,01
Milk	6	9,87	0,02
Potato	1	10,03	0,10
Celery	1	4,09	0,02
Cream	1	6,42	0,02
Salad	9	17,77	0,11
Meat	4	15,50	0,06
Bread	2	23,90	0,04

WEDNESDAY	Number of observations	Average Amount of energy waste (kcal)/ ingredient	Average € waste / observation / ingredient
Rice	6	15,77	0,01
Onion	2	0,73	0,00
Garlic	2	1,05	0,01
Vegetable mix	6	2,71	0,02
Eggplant	2	1,07	0,01
Zucchini	2	0,87	0,01
Lentil	2	2,45	0,01
Potato	0	0,00	0,00
Carrot	0	0,00	0,00
Cream	0	0,00	0,00
Tarragon	0	0,00	0,00
Salad	7	14,56	0,09
Chicken	4	6,26	0,04
Tomatoe	2	1,12	0,01
Parsley	4	0,39	0,04
Bread	3	28,68	0,05
Milk	1	36,80	0,08

THURSDAY	Number of observations	Average Amount of energy waste (kcal)/ ingredient	Average € waste / observation / ingredient
Chickpea	0	0	0
Mayonnaise	0	0	0
Potatoe	13	44,01	0,45
Milk	13	4,67	0,01
Butter	13	26,31	0,03
Salad	13	12,97	0,08
Peas	1	66,30	0,12
Ham	1	30,60	0,13
Onion	3	4,19	0,03
Meat	2	91,38	0,16
Flour	2	28,64	0,01
Oil	2	14,76	0,00
Cream	2	24,38	0,06
Bread	1	78,87	0,15

FRIDAY	Number of observations	Average Amount of energy waste (kcal)/ ingredient	Average € waste / observation / ingredient
Bbeef	8	26,24	0,13
Sweet pepper	8	2,06	0,04
Onion	8	2,21	0,01
Potato	6	50,29	0,52
Egg	0	0,00	0,00
Onion	11	2,66	0,02
Garlic	3	3,47	0,02
Tomato	3	10,36	0,09
Salad	16	22,52	0,14
Bread	1	35,85	0,06
Milk	0	0,00	0,00
Flour	8	75,63	0,02

Appendix 3, Simulated nutritional and financial values

Monday

Statistics	NUTRI,simu	
VAR00008,		
N	Valid	302
	Missing	4
Mean		751,70
Std.,Error,of,Mean		8,60
Std.,Deviation		149,43
Range		819,22
Minimum		335,11
Maximum		1154,33
Percentiles	25	656,44
	50	748,01
	75	858,02

Monday

Statistics	CASH*simu	
VAR00009		
N	Valid	302
	Missing	4
Mean		2,4812
Std.'Error'of'Mean		0,03662
Median Std.'Deviation		2,45
Range		0,63638
Minimum		3,26
Maximum		0,89
Percentiles	25	4,15
	50	2,03
	75	2,45
		2,9325

Tuesday

Statistics	NUTRI,simu	
VAR00003		
, N	Valid	340
	Missing	0
Mean		732,471
Std.,Error,of,Mean		20,44916
Median		739,03
Mode		E355,82a
Std.,Deviation		377,06388
Range		2000,32
Minimum		E355,82
Maximum		1644,5
Percentiles	25	497,5
	50	739,03
	75	999,7575

a,Multiple,modes,exist.,The,smallest,value,is,show

Tuesday

Statistics	CASH*simu	
VAR0000		
4'N	Valid	340
	Missing	0
Mean		1,2315
Std.'Error'of'Mean		0,02436
Median		1,2263
Mode		C,11a
Std.'Deviation		0,4491
Range		2,5
Minimum		C0,11
Maximum		2,39
Percentiles	25	0,9107
	50	1,2263
	75	1,524

a*Multiple'modes'exist.'The'smallest*value'is'shown

Wednesday

Statistics'NUTRI'simu		
VAR00001'		
N	Valid	337
	Missing	0
Mean		312,7668
Std.'Error'of'Mean		5,30952
Median		308,1
Mode		188,19
Std.'Deviation		97,46986
Range		537,16
Minimum		37,8
Maximum		574,96
Percentiles	25	239,345
	50	308,1
	75	381,625

Wednesday

Statistics'CASH'simu		
VAR00002'		
N	Valid	337
	Missing	0
Mean		1,3295
Std.'Error'of'Mean		0,01621
Median		1,32
Mode		1,35
Std.'Deviation		0,29758
Range		1,87
Minimum		0,34
Maximum		2,21
Percentiles	25	1,15
	50	1,32
	75	1,52

Thursday

Statistics	NUTRI,simu	
VAR00003,		
N	Valid	340
	Missing	0
Mean		732,471
Std.,Error,of,Mean		20,44916
Median		739,03
Mode		E355,82a
Std.,Deviation		377,06388
Range		2000,32
Minimum		E355,82
Maximum		1644,5
Percentiles	25	497,5
	50	739,03
	75	999,7575

a,Multiple,modes,exist.,The,smallest,value,is,show

Thursday

Statistics	CASH*simu	
VAR00004		
N	Valid	340
	Missing	0
Mean		1,2315
Std.'Error'of'Mean		0,02436
Median		1,2263
Mode		C,11a
Std.'Deviation		0,4491
Range		2,5
Minimum		C0,11
Maximum		2,39
Percentiles	25	0,9107
	50	1,2263
	75	1,524

a*Multiple'modes'exist.'The'smallest*value'is'shown

Friday

Statistics'NUTRI,sim		
VAR00005'		
N	Valid	234
	Missing	103
Mean		422,27
Std.'Error'of'Mean		10,48777
Median		424,785
Mode		475,26
Std.'Deviation		160,43208
Range		937,97
Minimum		F72,76
Maximum		865,21
Percentiles	25	313,0525
	50	424,785
	75	519,4175

Friday

Statistics'CASH+simu		
VAR00006'		
N	Valid	235
	Missing	102
Mean		1,9128
Std.'Error'of'Mean		0,06641
Median		1,93
Mode		1.88
Std.'Dev		1,0180
Range		5,19
Minimum		E0,76
Maximum		4,43
Percentiles	25	1.24
	50	2,68
	75	