# What´s cooking guys?-

# A study on responses to food waste and related energy & water consumption in the food service sector

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# Abstract



**Keyword**s: Food Waste, Causes, Prevention, Reduction, Quick Service Restaurants, Best Practices, Change Management



New legislation, rules and regulations concerning food waste creation mostly aim at private households and not the industry sector. This thesis is broaching on the issue of food waste within the food service sector to tackle the problem on a managerial level. The research question tries to answer in which way the food service sector, with special focus on Quick Service Restaurants (QSRs), can reduce and prevent food waste and related energy and water consumption. As part of the methodology, the research area was determined by making use of the Ishikawa diagram which represents causal relationships to determine main causes for food waste. Three main areas were defined as men, methods and environment. The most common responses towards the causes were identified. All responses that met the criteria to be a best practice example, according to the literature analysis, were clustered in a matrix. The literature analysis also led to the development of a change management strategy for food waste, energy and water reduction. All processes, occurring in a food & beverage area of a QSR that could be linked to the different best practices were than analysed by using the five-step-extrapolation approach developed by Edoardo Ongaro to determine common factors that would make it possible to use the process also in different organizations. Result was a catalogue of different actions and routines that makes it possible to determine whether an organization is on the right track already with their environmental management or needs more assistance. This catalogue therefore functions also as a tool which was used to evaluate how far the investigated case studies have come in their environmental change management strategy.

# Executive Summary

Food waste creation has gained more and more public attention in the last couple of years. But, especially when it comes to new legislation, the focus lies mainly on private household consumption. Even though there are other, more urgent, sources of food waste creation, for example in the food service sector. Therefore research with regards to prevention and reduction within the food service industry should not be neglected because the Food Service Sector is responsible for almost 12 million tons per year in the European Union alone (EC 2010). This master thesis is broaching on the issue of food waste within the food service sector to tackle the problem on a managerial level. The research question was designed to answer in which way the food service sector, with special focus on Quick Service Restaurants (QSRs), can reduce and prevent food waste and related energy and water consumption. First step was to find a working definition of food waste itself. Following the American Environmental Protection Agency (AEPA, 2012) definition, food waste is "uneaten food and food preparation waste from residences and commercial establishments such as grocery stores, restaurants, bars and company cafeterias".

In the methodology, the area of research was determined by making use of the Ishikawa diagram (Ishikawa, 1982). The Ishikawa diagram represents causal relationships. This specific root-cause-analysis determines the main causes related to food waste. Three main areas were defined as 'men, methods and environment' (Section 3.2.4). Here it was distinguished between causes that are under direct influence of the restaurant, e.g. order mistakes or external aspects like the weather or seasonality (Fig. 9). Then the most common responses towards the causes were identified (Fig. 10). For example in the area of 'men', raising awareness with the employees, setting targets and implementing forecasting systems could be named as responses. All the responses that met the criteria to be a best practice example were picked by comparison with help of a literature analysis (Fig.11).

The literature analysis also led to the development of a change management strategy for food waste, energy and water reduction (Fig 12 as part of Fig 13). All processes, occurring in a food & beverage area that could be linked to the different best practices were than analysed by using the five-step-extrapolation approach developed by Edoardo Ongaro to determine common factors that would make it possible to use the process also in different organizations (Fig.5) (Ongaro, 2009). Result was a catalogue of different actions and routines that makes it possible to determine whether an organization is on the right track already or needs more assistance. This catalogue therefore functions also as a tool which was used to evaluate how far the investigated case studies have come in their change management process in comparison to the previous developed strategy (example Fig 18).

It was found that all three case examples, QSRs belonging to a chain that operates globally, had already implemented many different actions and routines but were still lacking a common management approach other than saving resources. The main findings included the amount of food waste produced during one day for all three test restaurants ranging between 150 kg up to an estimated 1000 kg for the largest QSR (Chapter 4.2.3 Fig 16). Specific causes (Chapter 4.3) or responses, for and to food waste, were for example different holding times for

products like French fries and menu adjustment by replacing French fries with boiled potatoes. Cost savings including calculations on energy and water efficiency (Chapter 5.1, Fig 17), showed possible savings in a range from 1560 – 2650 euro per year for the different example restaurants. Their compliance with the developed catalogue of actions and routines against food waste (Fig 18) and the identification of their position in terms of change management is discussed in chapter 5.2 and chapter 5.3.

The main recommendations were to increase communication of the food waste issue to all stakeholders including the guests of the restaurants, to implement a knowledge management system on a companywide global level to make use of the already existing best practice knowledge in some of the restaurants. As well as implementing routines for measuring and monitoring their in- and outputs to make success measurable in KPIs and allow global benchmarking of QSRs that are similar in size.

The conclusion was that food waste creation needs to get more attention from industry in general and that one of the investigated restaurants was doing exceptionally well but can still not be rated as best practice. The other restaurants need to catch up on the implementation of effective responses but were on the right track, too. With more research and following the recommendations all three restaurants will be able to become high performance restaurants and will lead others to a more sustainable way of operation too. They will be able to function as example not only within their own chain of QSR but within the food service sector overall.

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## Abbreviations

ARM, Adaptive Resource Management

BCFN, Barilla Center for Food &Nutrition

BPR, Best Practice Research

BRIC Countries, Brazil, Russia, India, China

CIBSE, Chartered Institution of Building Services Engineers

$CO_2$, Carbon Dioxide

CSFG, Catering for Sustainability Future-Group

EC, European Commission

EPA, Environmental Protection Agency

EU, European Union

F& B, Food and Beverages

FAO, Food and Agriculture Organization

FIFO, First In, First Out

GHA, Green Hospitality Award

HORECA, Hotel, Restaurants and Catering

NGO, Non-Governmental-Organization

PDCA, Plan Do Check Act

QSR, Quick Service Restaurants

RHRS, Refrigerant Heat Recovery System

SMED, Swedish Methodology for Environmental Data

SRA, Sustainable Restaurant Association

UK, United Kingdom

USDA, US Department of Agriculture

WRAP, Waste Resource Action Program

WWF, World Wildlife Fund

# Foreword

"The important thing, she decided, was to stay calm. There was always a logical explanation for everything, even if you had to make it up or look under a rock!"

– Terry Pratchett, from "Soul music"

The time at the institute was an amazing time and I had a look under many different rocks. Therefore there are a couple of people that I would like to thank.
First of all, I would like to thank Charlotte Leire for being a great supervisor and support through out the thesis process. Without your patience and flexibility, this would have been a much harder journey.
Furthermore I would like to thank Håkan Rodhe for listening, black humour and giving good advice and Åke Thidell for hugs, good humour and equally good advice.
Birgitta Olofsson for being just amazing! Without you, I would have been lost so many times in Sweden and if you should ever need to leave the tute, it will be the sadest day in history.
Tess and Marcus, my travel companions, on the search for reliable data on the other side of the world. I had the honour of sharing laughs, great ideas and awesome food with them. Both of you made this an unforgettable adventure and taught me a lot. No more babysitting for now and I will keep my watch synchronized - promise!
Last but not least I would like to thank Lars Hansson for making Sweden a true home, sharing all his knowledge about truly everything from firedrills to early Swedish history, great taste in movies and lots of photographs to record wonderful memories.

Writing this thesis was a very interesting time in my life with lots of fantastic opportunities and challenges. It was not only the start of a new project but also the end of my time at the IIIEE where I was able to meet so many lovely people that will have a place in life till we are grey and old. Even though we all came from different backgrounds and countries we found things we had in common and it was great working with all of them. The possibility to work together with a company on a real life problem during the thesis project, not only helped me to better my understanding of large organizations but also undergo lots of positive lessons in intercultural communication. In general, I learned two things: a) there is logical explanation for almost everything and b) for some things, there just isn't.

I would like to dedicate this thesis to my uncle Christoph who passed away during the thesis project and my family, especially my parents and brothers. My parents gave me the possibility to always go which ever way I wanted, always encouraged and supported me, however crazy the idea was. The best sentence a parent could say a week before the hand-in, reminded me that we can get through everything together. "You know, university titles are completely overrated! If you do not pass, I have at least taught you how to tile a bathroom and what hard work is."

Thanks!

# 1 Introduction

World-wide population is growing and therefore also food consumption is taking a leap forward. In correlation with consumption stands also the increasing amount of waste. This also includes the growing number of biodegradable waste (food waste). According to the Food and Agriculture Organization (FAO, 2011), the total global food waste is estimated to be 1.3 billion tons which is equal to one third of the total food production that was meant for human consumption.

So while parts of the world are struggling to get the recommended amount of daily calorie intake, it has become a habit of the developed countries to even throw away food that would be still fit for consumption. The same FAO study pointed out the social issues linked to food waste. The food waste of 220 million tons produced by industrialized countries equals the entire food production of the sub-Saharan continent. During the last century, food production in the developed world has increased because new technologies and processes during the cultivation have given us the possibility to easily overcome problems like pesticides or aridity. On top of that the growing incomes of families, allows us to access more food with a higher quality standard. The developed world has in this way almost beaten food scarcity. This has a bad impact on our behaviour towards food in general. The low price and the variety of food offered has led to a higher acceptance of food waste.

A US Department of Agriculture (USDA) study from 2007 showed that almost 30% of the food that was intended for consumption is wasted ever year in the US. Therefore the per-capita-waste-production totals in 109 kg in the US (Venkat, 2011). This comes mainly from individuals, restaurants and food services. In Europe the amount totals to 89 million tons, which is around 180 kg of food waste per person, only taking into consideration food that had been processed before (Eurostat, 2006). In Sweden this adds up to 72 kg (Avfall Sverige, 2011) per person per year.

Both retailers and consumers play a role in the growing amounts of food waste. An example for higher acceptance of avoidable food waste in the developed world, is the large amount of cucumbers, carrots and bread that gets thrown away every day in the European Union by producers or retailers due to the fact that they do not conform with the norm and thus do not "appeal" to the eye of the consumer (Stuart 2009; EC No 1221/2008).

The FAO study has also shown that the spending of an average family on food has decreased in proportion to their annual income by almost 25% compared to 70 years ago, but still products like milk get sold under their actual value.

Many countries have recognized the problem of food waste and are now setting goals to reduce the amounts wasted. The European Union (EU) has released a revised waste framework directive (European Commission, 2011, Directive 2008/98/EC) which asks all members to develop a waste prevention program till December 2013. This is part of the overall strategy of 2020 about a resource efficient Europe. To promote the efforts of the European Parliament, 2014 will be the "European year against food waste" (European Parliament News, 2012). One of the aims is to reduce the amount of avoidable food waste by 50%. However, progress is slow because not all countries have a consent on common measurement, recycling systems or waste stream separation and are more stuck in the old approach of finding end-of-pipe solutions and the avoidance of landfilling (Council Directive 1999/31/EC). A study by the European Commission found that the food waste issue has only become relevant to the consumer since 2009. The commission identified different awareness

campaigns among the EU 27. 39% started in 2009 and the majority in 2010 and the number of stakeholders involved is still increasing (EC, 2010).

Industry contributes largely to the generation of avoidable food waste, for example the agricultural sector as mentioned above, but also the retailers (BCFN, 2010). Especially the HORECA (Hotel, Restaurants and Catering) sector (also referred to as food service sector in this study) is responsible for a large part of avoidable food waste, e.g. due to food health and safety rules. But also because of handling mistakes or consumer demands. In Europe alone the food service sector produces around 14% of the total amount of food waste.(EC, 2010) A number of environmental impacts can be traced back to food waste, for example water and energy consumption, loss of biological diversity as well as $CO_2$ emissions. A study conducted in 2012 involving a restaurant chain from the UK (300 stores) estimated the amount of $CO_2$ emissions that would have been landfilled, if no prevention measures had been taken, to three million kilogram. (Biogen Greenfinch, 2009). This shows that food waste needs to be reduced not only because of ethical or economic factors, but also to improve the environmental impacts food waste has on ecosystems globally.

## 1.1 Problem definition and scope

The problem of food waste creation has been recognized on a global level but still there is a discussion about how to deal with the different causes and how to respond to them and to what food waste really is. As mentioned above, one of the problems in the EU is that there is no common understanding of the definition of food waste between the different countries, even though there is EU Framework Directive that should function as a guideline. The definition in some of the member states can be far more extensive and detailed than the one mentioned in the directive or the other way around.

All definitions of food waste distinguish between two main areas that are involved in the generation of food waste:

- The consumer that contributes with waste from his private residences,
- And the industry serving the consumer, contributing with waste from retailers, restaurants and café/catering (HORECA sector).

The HORECA Sector can be defined as part of the food service industry preparing and serving food and beverages. The term consists of the abbreviations of the words Hotel, Restaurant and Cafes. It also includes canteens and QSRs, Quick Service Restaurants. (WRAP, 2008) now looking specifically at this sector a study by the European Commission (EC) showed that the food service sector accounts for 14% of the food waste which would equal to around 12 million tons each year. (EC, 2010).

While a lot of research has been focused on the area of waste prevention of residential food waste, related consumer behaviour, causes and responses, there is still research needed on responses to food waste in the food service sector. Only a small amount of studies have looked at food waste prevention in restaurants, even though identifying the causes within this sector gives us the possibility to tackle the problem at its root and respond with a fitting strategy.

The main causes have already been identified and discussed and are generally agreed to be: (BCFN 2012; Marthinsen et al, 2012; Reisinger& Monier, 2011)

- Excess purchases
- Excess portions prepared
- Over portioning of the guest
- Difficulty in correctly understanding the labelling
- Errors in food storage
- Lack of training of personnel

Interesting to see here is that almost all of the causes that were identified can be traced back to human error and wrong routines. Many authors have looked at ways to evolve those routines to prevent food waste. However often the biggest problem is the resistance towards the change coming from employees, not from the management level (Mintzberg, 1983). Due to this, it is important to develop change management strategies with the aim to optimize routines, processes and essentially reduce the amount of food wasteand the related energy and water consumption, and have the employee as a key focus point and put special attention on communicating the importance of the change.

Change management strategies could easily be developed with focus on the food service sector and therefore offer an orientation point to employers on how to deal with resistance and change. Employee empowerment with drive for innovation also plays a key role in this process since the company's main asset are the employees and the employees often have the best overview of how, for example, a production process can be optimized.

Some of the causes of food waste can be linked to cultural differences. China is a good example for such differences. In the Chinese culture, one as a guest is required to leave food on the plate to signal the host that one had a sufficient meal. Leaving food on a plate in a restaurant can signal status as well (Hofstede, 1980). Even though times have changed and the younger generation rather finishes their meals or makes use of so called "doggy bag" (taking home of the lef-tovers), the change in mind set is slow and the older generation needs outside factors to influence them.

Another example of culture influencing meals are the United States of America where extra-large portions are served to the guests to give them the feeling that portion size equals value.

As mentioned before, food waste in the food service sector can also be linked to the environmental impacts of energy and water consumption. And therefore reducing costs. Studies by the Irish and the US Environmental Protection Agency (EPA) have shown that the costs related to energy and water can be significant and already be influenced by simple choice of equipment (IEPA, 2008).

Much information that is available on food waste and its related impacts is more of practical nature, as is the sector in itself. A lot of published articles come from Think-tanks that have prioritized the food waste problem or scholars in preparation of the European year of food waste. Only few scholars have targeted the food service sector specifically.

Considering the background, the purpose of this study is to help to close the knowledge gap on the possible responses in the food service sector to prevent and reduce food waste and its related environmental impact of energy and water consumption. It will do so by providing input that could be used to:

- develop a change management framework with employee focus, and
- create a catalogue of different tools and best practices used in the industry that can serve as a blue print to others.

The findings of this work will then be reflected upon, using a case study of a QSR.

## 1.2 Research question

With regards to the problem definition the research question can be formalized as

*"In which way can the food service sector, with special focus on Quick Service Restaurants, reduce and prevent food waste and related energy and water consumption?"*

To help answer the research question, a set of sub questions has been formulated:

- What are best practices in general? How can they be defined? What are the critique points of analysing?
- How can the implementation of a change management strategy help with the reduction of food waste? How can a change management strategy be developed from best practices?
- How can all of the above be applied to the case of the QSR?
- What could be any related cost reductions with regards to food waste and related energy and water consumption?

## 1.3 Audience

This study addresses actors within the food service sector (HORECA) as well as industries linked to this sector, like food retailers or equipment manufacturers. It also aims for the scholars, organizations, policy makers, leaders, and other actors who are going to work on the implementation of the new EU Waste Directive. The outcome of this study will provide them with ideas of what has to be done when actors of the food service industry want to make a change in mind set and which areas need more emphasize to ensure an effective implementation, specially in terms of resource efficiency and cost reduction.

## 1.4 Disposition

The following will outline the different chapters of this study.

Chapter 1 defines the problem this research is focusing on. It also identifies the possible scope and the audience. Furthermore it introduces the research question and it justifies the need for this study

In Chapter 2, the methodology is outlined. Based on the specific research questions an analytical framework/theory is introduced and limitations to the research are shown. The scope is presented in more detail by using an Ishikawa diagram.

Chapter 3 presents the literature analysis, looking at the responses to common causes, change management strategies, best practices in the food service sector which contribute to the implementation of the responses.

Chapter 4 presents the findings to the case examples. It looks at the case company in general, the process taking place from the kitchen to the consumer and it introduces survey results, measurements and responses from the case examples.

In Chapter 5, the analysis of the findings will be presented. The case examples are compared to findings made in the literature review, like different factor determining best practices and a suitable change management strategy.

Chapter 6 discusses the different choices that were made with regards to the methodology and possible learnings taken for next projects.

Chapter 7 summarises the main findings and lessons learned in the course of this research, highlights main research contributions and provides suggestions for further research.

# 2 Methodology

## 2.1 Method

This chapter describes the methodology used during the research. The methodology builds on different tools and methods of data collection. These together are used as a distinctive framework that supports the scope of the thesis. For the data collection, a triangulation approach was used to increase the reliability of the research. This is important due to the fact that a pre-literature study conducted prior to the start of the research, showed the lack of data in the area of food waste and the specific industry branch. The qualitative methods chosen include non-standardized interviews, visits, different observations as well as a case study. Quantitative methods chosen to support the research were sample data collection and a survey. These will be explained in more detail further on in this chapter.

## 2.2 Research framework

A pre-study was conducted previous to this research, and the results helped to determine to focus on the different responses known to food waste within the food service sector.

Still the first step was to gain a gyroscopical overview of problems surrounding food waste in general before looking at the different responses.[1] Because food waste can be seen as imperfection of the production process (because it can be related back to different costs and impacts), the Ishikawa diagram was chosen to determine different focus areas (Ishikawa, 1982)[2]. The Ishikawa diagram was developed by Kaoru Ishikawa in 1968 to show the relation between a cause and a specific event. The Ishikawa diagram serves as a quality improvement tool and has been first used in the car manufacturing industry to stream line processes for example. In the Ishikawa diagram, also called Fishbone-diagram, every cause for an event in the process can be equivalent to an imperfection. The causes can be grouped into main categories which are then tested by different why-questions. The original categories were People, Methods, Machines, Materials, Measurements and Environment (Ishikawa, 1982).

Due the scope of the research, the main focus was on categories of people, methods and environment. Nevertheless some causes and responses that are mentioned in this paper might be crossing the thin line to some of the other categories. So by determining the different causes in those categories, the full extent with regards to the responses, in the food service sector was understood better.

Based on the research framework deriving from the Ishikawa diagram, I decided to look for responses that are known as best practices for food waste management, energy and water consumption in Food & Beverage (F&B) areas. 'Best practices' published in literature and industry related journals were identified. The collected best practices within the food service sector were tested for their theoretical practicality by following Edoardo Ongaro's five-step extrapolation theory (Ongaro, 2009). Ongaro who is professor for International Public Service Management at the University of Northumbria, suggests the first step of the theory to be the

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[1] The term "gyroscopical" is often used in human resource management and describes an approach of finding a holistic viewpoint or perspective on a sitatuion. It was mostly coined by Prof. Frank Vonk and Prof. Joop Finke recently and originates from the field of physics as a vector quantity that represents the product of a body's rotational inertia and rotational velocity about a particular axis. Meaning it moves into every possible direction.

[2] Ishikawaw, K., " Guide to quality control", 1982, Asian Productivity Organization

identification of the function, that the best practice helped to perform. For this research it means the reduction of food waste and different related resources (water and energy). The second step is to define exactly what the practice is about. In the third step the practice must be described in detail stating how the system around the practice is operating and how the practice is taking advantage of the way the system operates. In the fourth step all the effects of the practice on the system and its surroundings must be described. In the last step the main process context factors need to be identified, meaning in which context and under which conditions (causal mechanism) has the practice worked to find out whether the practice might be applicable to different scenarios, in simple words what was the common denominator between the process and the practice.(Ongaro, 2009)

Best practice criteria used in this research are based on criteria and routines that have been developed from the Green Hospitality Award (GHA), ISO 14001 audit criteria and best practices that were mentioned in literature. The GHA in itself was identified as a best practice initiative by the European Commission for food waste prevention in 2010, as part of their final report on food waste prevention in collaboration with the BIO Intelligence Service. For the purpose of this study, it was therefore singled out as leading example to develop process context factors.

The research objective was to develop a catalogue of actions and routines that can help to identify process context factors from best practices on food waste reduction, prevention and related energy and water consumption. Aim was to compare the catalogue to a case study example and to see which actions or routines were suitable for integration into a change management strategy process. As second objective a change management strategy for the food service sector was developed to offer practical guidance on focus areas. The catalogue and the change strategy are interlinked because identifying different routines and actions can be seen as an essential part for the process to start.

## 2.3 Research philosophy

A tool to determine the further direction of the research is the "research onion" promoted by Saunders et al (2009). By following the different layers of the "onion" the most suitable methodology can be identified and then be interlinked to the chosen research framework. This helps to not leave out important aspects and to structure the research. The following section will introduce the choices made for the different levels presented in the diagram.

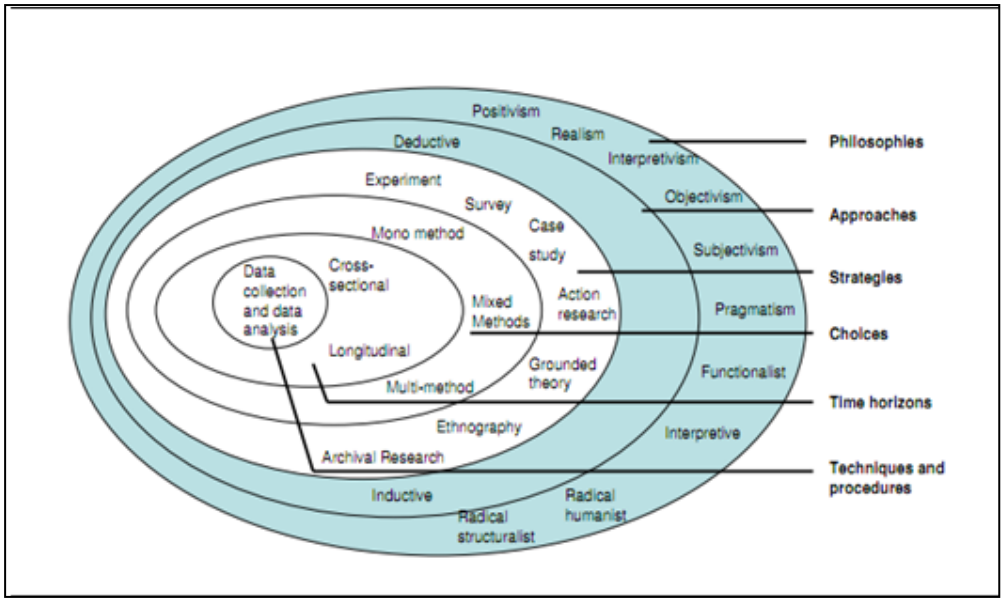


*Fig 1 Research Union according to Saunders, 2009*

According to Figure 1, the first choice is the one of the research philosophie. The idea of realism is based on the belief that a reality exists, which is independent of human thoughts and beliefs. Social processes and forces have an effect on people, for example social media websites, without people actually realizing that they can influence their own behaviour, understandings and interpretations, too. For example the choice not to use a social media website. Realism recognizes that people are not scientific objects to be studied, the importance of understanding people's socially constructed interpretation, broader social forces and structure of processes that influence the nature of people's views and behaviours (Saunders et al., 2009). Following this research philosophy, with regards to change management strategies, acknowledges the problem often raised by literature: every change management process stands or falls with the support of the workforce. It also agrees with best practice research (BPR) literature that social mechanisms are an essential part of researching the success of best practices (Bardach, 2008, Ongaro, 2009). Researching in this direction gives the possibility to identify behavioural problems and fits therefore the use of the case study.

The research philosophy of Interpretivism on the other hand, is the necessity to understand the small details of a specific real situation or the hidden reality behind it. Every business situation is unique and consists out of complex details, influenced by a particular set of circumstances and the individuals acting around it. Due to this, people make interpretations based on the interactions and the different situations they find themselves in. Therefore the aim of the researcher applying interpretivism is to seek understanding of the subjective reality of those taking part in the study and drawing results. With regards to the BPR by Ongaro (2009) used in this research to identify responses to food waste, it is important to understand that the research philosophy of interpretivism lies at its core. Ongaro suggests that not all best practices are applicable to all other business situations because mechanisms, routines and operational environments can consist out of completely different factors (Ongaro, 2009). The different best practice research approaches will be discussed in the literature review, chapter three.

Because of the main focus of this research, the overall methodology is based on a combination of realism and interpretivism.

## 2.4 Research approach

Based on Saunders et al (2009), Figure 1, two approaches were identified that were useful to consider for this research: the deductive approach and the inductive approach. The empirical approach is an inductive thinking method which can be used when there is no suitable existing theory can be found in the area of research. As this research incorporates setting up a framework through secondary research which in the later stages shall be tested through comparing it to the data collected in the case study, a mixture of the inductive and deductive approach will be used, i.e. the abductive approach. Abduction appears with a surprising occurrence, which will lead to doubt on the correctness of a general rule. A new rule has to be developed and defined in order to illustrate the surprise. Finally it has to be shown that the single occurrence is liable to the new rule that people perceive it as a logical solution to the existing problem.

## 2.5 Data Collection Methods

A triangulation method was used to validate the collected data, consisting of a literature review, interviews, primary data collection and observation.

### 2.5.1 Literature review

Knowledge about food waste, best practices and change management was collected through a literature analysis of different journal articles and books found through different search engines, databases and the Lund University library. Most of the literature was recent, but when the topic of food waste reduction or prevention was reviewed, most literature was based on the work of the European commision for food waste prevention, government organizations like Waste Resources Action Program (WRAP) in UK, the Bio Intelligence Service and different legislative texts. Most of the information comes from the website archive of the European Union and different environmental protection agencies which means a limitation in academic references used. With specifics to water and energy consumption related to the food service industry only a small number of articles and reports could be found. Those were mainly published by the industry itself and more of practical nature than academically orientated. Information for the case study and some of the best practices come from company internal documents and internet sources linked to different companies and organizations like the Sustainable Restaurant Association (SRA) or McDonalds.

### 2.5.2 Interviews

Interviews were conducted with different actors connected to the case company in the different countries chosen for this study and several experts familiar with food waste in the food service industry.[3] The interviews were semi-structured-open-ended-questions and had a rather informal nature. Interviews were conducted with co-workers in management positions with regards either to the sustainability or/and the food & beverage department in the company used for the case study. The average length of the interviews was 60 minutes.The interviews were recorded and than analysed. The interviews gave valuable insights into the case company. More interviews were done on an informal basis with different co-workers from all levels. Those interviews also consisted out of semi-structured-open-ended-questions. The interviews were slightly shorter, around 20-30 minutes. While the more formal interviews with the management members were recorded, it was not practical to record the interviews with the floor staff since these were conducted during work time of the employee, for example in the dishwashing area or the kitchen with a lot of background noise of the machinery. Instead detailed notes were taken of the different interviews and than analysed. All participants received the same or similar questions to make it easier to compare the data between the different case study examples. Only a couple of times were follow-up questions needed.

In addition, three expert interviews were conducted to see whether the results from the interviews would be similar to the findings from the case study and the literature. One expert was from a global acting QSR chain which is a competitor to the case company and two came from different non-profit-organizations (NGOs) in food waste reduction field. The interviews were also a useful tool to test different theories or discuss the different best practices with regards to food waste reduction.

The total number of interviews for this research project was 22.

[3] List of interview partners only available on personal request to the author.

It is very important to say that the project was conducted together with a colleague that also specializes in food waste prevention but is more focused on technical aspects, as in cleaner production. The data from the interviews was collected together, and even though we research different fields, (management tools versus cleaner production) our studies are based on the same case studies and on similar collected interview data. Some of the data mentioned will be therefore also available in other pieces of published literature. Nevertheless each of us analysed the data according to their own research field and in their own efforts.

### 2.5.3 Primary data collection

Primary data collection was conducted on different dimension of the case company. An example was measuring the possible outflows of food waste at the case company. All waste was collected from the different streams, customer kitchen, co-worker's kitchen, customer restaurant and co-workers restaurant over a certain period of time (one full working day 8:00 till 22:00). Starting an hour before the restaurant opening till closing of the restaurant. The weight of the waste was then measured, coffee grind and sauces were measured separately. As a result is was possible to determin which area would produce the most food waste during one day and compare the different case studies to each other. All other observations mentioned were made at the case company too. Observations were recorded in writing and using photographs.

Furthermore a small online survey was conducted among customers of the restaurant chain in the Netherlands and Sweden to test some of the results from the literature analysis and the case study itself. Because the survey was also distributed on a social media platform, this means that the participants could have been at any of the restaurants of the chain in either one of the countries Sweden or the Netherlands. For example one person could have been to a restaurant in Delft, the other one in Amsterdam. Nevertheless, the data collected was very useful since it was specific to the restaurant chain and the restaurants operate similar in every country. The survey sample was selected completely at random from a bigger sample known to the researcher and the survey was anonymous. Questions were mostly closed end questions or asked the participant to range their choice on a Likert-scale. Only the last question was an open ended question. The survey had 217 participants and the data was then analysed in relation to the research question.

### 2.5.4 The case study

To analyse the collected actions and routines from best practices on their real practical quality, three different QSR were chosen as a case study. All three restaurants belong to the same franchise but were located in different countries. One in Shanghai, China; one is located in Delft, the Netherlands and one in Gothenburg, Sweden. Due to its operational size and the global activity the franchise owner has identified reduction of food waste and related energy and water consumption in their F&B departments as an important issue. All three restaurants are defined as QSR. The restaurants offer little table service (only cleaning activities) but the food served is of high quality. (Internal F&B document, 2010) The menu consists of several plate-served foods, so the restaurants cannot be classified as a fast food restaurant, such as in the case of McDonalds for example.

## 2.6 Limitations

The research presented does not provide a complete background picture on sustainability or food waste. View and behaviour of the domestic households/ customers to the food service sector, QSRs in particular, have been left out entirely since this would take up more resources than researcher can provide.

Another limitation to this study is that the research framework consists out of two different approaches that together form the basis for the analysis of the findings. The first one is the Ishikawa diagram to determine causes for food waste. The second one is the extrapolation approach from Edoardo Ongaro. A weakness of the Ishikawa diagram is that only the following categories were looked at: methods, men and environment, while the other categories materials and machines, were left out. This was based on a personal choice with regards to prior acquired knowledge and the advice of the academic supervisor to avoid too much overlap with another food waste study conducted at the same faculty. But this might limit the study in terms of technical aspects that could have helped with the energy and water reduction. A limitation of the five-step-extrapolation approach is, as also often discussed in BPR, the subjective choice of the criteria to identify a best practice, as well as the proper identification of the underlying social mechanisms. Ongaro's approach was formerly developed to compare the possibility to implement policies in the public sector but in this case was used to identify "best practices" (also known as smart practices) in the private industry. The change management strategy suggested, that derived from the literature review is limited to the food service sector but also offers the opportunity, after some changes, to be adopted by other industry sectors.

Furthermore, the case study locations are limited to only one company, franchiseholder, and to the geographical locations of Sweden, China and the Netherlands. It might be possible to apply the suggestions to other companies within the food service sector, but only because the best practices collected in the literature study are of very specific practical nature. Another problem conducting the research was the language barrier encountered during a visit to Sweden and China, since I am not fluent in any of them. Data collected might be not reliable due to misunderstandings in the translation. Furthermore this might have led also to an unreliable set of data collected in China. Also it was only possible to conduct the survey in the Netherlands and Sweden online which meant that the participants from the sample have been to a restaurant of the chain but maybe not to the particular case example under investigation. Also customers in China might have shown a total different reaction to the questions asked, for example the portion size. Therefore it lacks their point of view which might have changed some of the findings. The different cultural background of participating individuals and the researcher (teachers, stakeholders, staff in general) are a limit to the research as well as they might have influenced the perception of added value and the conclusions. Another limitation is that the research was conducted together with a colleague so the research is largely based on the same data that has been collected (interview partners, the waste measurements and observations) even though we are researching different fields of interest. This can lead to confusions when looking at both papers presented. Nevertheless it was also of advantage because four eyes see more than two.

# 3 Literature analysis

## 3.1 The Food Service Industry (HORECA)

The HORECA Sector can be defined as sector of the food service industry preparing serving food and beverages, consisting of the abbreviations of the words Hotel, Restaurant and Cafes. **(**The Oxford Dictionary of Abbreviations**,** 1998**)** Due to the abbreviation one might think that the sector only covers those above, but the HORECA sector also includes QSRs, canteens as well as pubs and bars. Especially QSR play an important role on the global market because they often belong to a big franchise. This means that something works in one restaurant in a positive way, the odds that it will work in the other restaurant, because of a similar set up, will be very high. A QSR distinguishes itself from a restaurant by two main points. First of all it serves only food that can be served very quickly, secondly it offers minimal service to the customer, e.g. no waiting of tables, the customer choses at a counter and then takes care of the meal himself. Examples of such a restaurants are Subway, McDonalds, La Place or the IKEA Restaurant.

Marthinsen et al (2012), with reference to WRAP, divides the hospitality sector into two parts for their report. The profit and the cost sector. The profit sector includes the above mentioned facilities, while the cost sector can be defined as business that provides the same hospitality services but the main function is not to make a considerable profit. Classic examples include university or hospital canteens. In this report, I will look at different methods to prevent and reduce food waste in the profit sector, focusing on QSRs, unlike some of the other reports that also look at the cost sector (Marthinsen et al, 2012).

## 3.2 Food Waste

### 3.2.1 Definition

In the EU is no common understanding of the definition of food waste between the different countries present, even though there is EU Framework Directive that should function as a guideline. So while in the EU, food waste is often defined as "the whole of the discarded products of the food supply chain which, for economic or aesthetics reasons, or for closeness to the expiry date, despite still being edible and therefore potentially intended for human consumption, in the absence of a possible alternative use, are eliminated and disposed of, producing negative effects from the environmental point of view, economic costs and missed revenues for companies" (EU, 2011), the definition in some of the member states can be far more extensive and detailed or the opposite.

For example in Great Britain. As part of the WRAP, a non-profit organization that was founded in 2000 and is supported by the British government, food waste can be divided into three main categories of a) unavoidable food waste, b) possibly avoidable and c) avoidable food waste. Unavoidable food waste includes the waste deriving from the preparation of food and drinks, that cannot be eaten anymore, like peels, while avoidable food waste includes food and drink products that are thrown away even though they could still be eaten, for example fruit with dents( WRAP, 2009). By increasing customer awareness a reduction in food waste can be seen but it is clearly not enough.

On a global level lots of similarities can be found between the different definitions. In China, food waste management is often left to the municipalities themselves. While in the rather rural provinces and areas food waste is not separated and collected by waste fraction, in general mismanaged and landfilled, big urban areas have a better grasp of the problem on their porch. Shanghai, one of the world's mega cities with 23 million inhabitants, is one of the most

progressing cities in left-over- and food waste management in China, together with Beijing, and since late 2012 even has the possibility to push through penalties because their waste management was turned into a legal decree. According to the Decree, food waste is defined as "food leftovers and food processing wastes produced in the activities of food processing, restaurant service and unit canteens excluding citizens' domestic garbage." (Translated from Decree no 98 of the Shanghai Municipal People's Government from December 2012)

In the US, food waste has been defined by the EPA (US EPA, 2012) as "uneaten food and food preparation waste from residences and commercial establishments such as grocery stores, restaurants, bars and company cafeterias". For the purpose of this research the definition is the most fitting because it also puts a special stretch on the food service sector.

Looking at the different definitions critically and the global development, I think it can be said with quite a bit of certainty that it will take a long time before common ground will be found. Which is not a problem in itself as long as the problem behind it gets more attention by the responsible authorities.

Literature has identified some of the main causes of food waste already. One of the most extensive studies to identify different causes within the food service sector comes from the European Commission (EC 2010). The study generalizes some of the causes and gives an overview of other European countries. Causes for food waste can occur at all stages of the food supply chain and can be divided into food losses or food waste. According to the BCFN, the food chain consists out of six main areas as described in figure two below. (BCFN, 2012)

Not all food waste is the same. Under closer inspection, one can find different kinds of food waste, as explained later on in this chapter. Literature also distinguishes between food losses and food waste. Food losses occur in the early stage of the food supply chain, production, harvesting and the first processing (number 1 and 2 in figure two), while food waste occurs during the industrial processing, distribution and the end usage phase (restaurants and domestic households) (Parfitt et al., 2010).

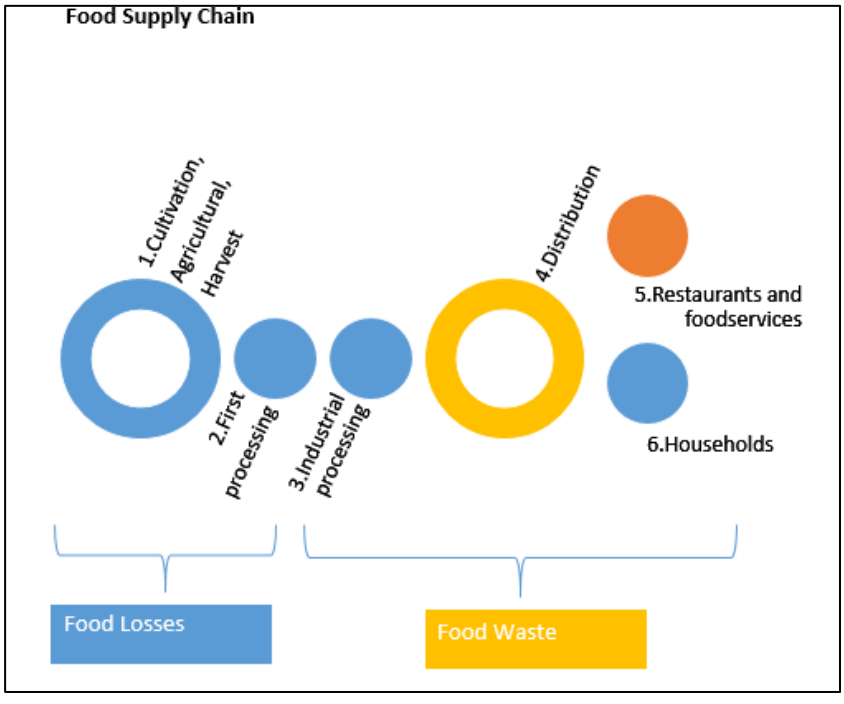


*Fig 2 Overview of the food supply chain according to BCFN 2012*

### 3.2.2 Trends affecting the supply chain

Literature has identified three main trends affecting the food supply chain. The first trend is noticeable in developed countries where the distances that the food has to travel between the place of harvest and final consumer has gotten bigger and bigger over the past century. While in the 1950 the distance between the place of production and the final consumer was not more than 60 km, nowadays the average distance within the European Union is at least double (BCFN, 2012). Transporting the food even for longer distances is common when looking at fruits and vegetables. Technological development is a big factor. Back in the days the possibilities to cool down the products was very restricted, while today cooling or freezing are not a problem anymore. Neither is the development of new technologies that allow the fruit to ripe in a slower pace while it is being shipped by abstraction of oxygen for example.

The second trend identified, is the strong change in the diets especially in the BRIC countries (Brazil, Russia, India and China). People consume fewer carbohydrates such as noodles, bread, wheatproducts etc. but increasingly consume fresh meat, fish, vegetable and fruits which require special care during processing and distribution due to their perishability. The increase in consumption of those products can be linked to the families' income that has increased especially in China.

Globalization is the third evident trend identified. Nowadays it is possible to buy fruit produced in the southern hemisphere in a European supermarket. Mass distribution of goods around the globe has become possible due to better logistical strategies and is also expected by the customer. The local supermarket has become the melting pot of different diets. The supermarkets have replaced the different retailers and they have become the intermediaries between the supplier and the consumer. (BCFN 2012; Marthinsen et al, 2012; Reisinger & Monier, 2011; Gustavsson et al, 2011)

In the European Union a lot of non-profit organizations, as well as governmental initiatives, try to promote locally sourced food and trying to oppose globalization. The fight about the trend of change in diet and its health benefits or disadvantages is ongoing between experts.

### 3.2.3 Causes of Food Losses and Food Waste in general

The major trends listed above (globalization, technical development and change in dietary) hint to the different causes responsible for the food losses and food waste either in developed or likewise in developing countries. One of the main causes for food waste can be pinpointed down to the first stage of the food supply chain. According to the BCFN "different techniques for preparing the soil, seeding (seeds selected, treated seeds, seeding time, etc.), and cultivation (proper use of water, fertilizers, pesticides, and other agrochemicals) can result in completely different yields" (2012). Different climates can affect the increase in food waste as well. Floods or insufficient rain can destroy entire harvests. One current example are the floods in the eastern part of Germany, where scholars have estimated that 40% of the harvest is lost and rotting on the field due to flooding (Statistisches Bundesamt Bereich Landwirtschaft, 2013). While most causes of food waste occur in the developed world, there is almost no food waste in developing countries after the point of processing. Mostly due to efficiency and the urge to use as much as possible, because of the lack of other resources.

In general it can be said that the causes for losses in the beginning of the food supply chain can be linked to inefficient agricultural strategies, limited resources of the farmers, premature harvests to quench the needs of the retailers, badly developed infrastructure, storage facilities that are not sufficient, climate, aridity and the wrong usage of pesticides (BCFN, 2012; Gustavsson 2011; Stuart 2009.)

Further down the line, during the distribution phase when the food products are transported to the retailers, the causes already look a little different and can be narrowed down even more. The major cause for food waste at this stage is forecasting. Forecasting is a very complex process and is often influenced by outside factors like the weather or even public holidays like Christmas for example. Wrong forecasting of the consumers demand leads to wrong orders and this in return will lead to big quantities of food in the inventory which will surpass its best before date or cannot be sold before it naturally spoils. In almost every country surpassing the best before date means that food security laws then require the retailer to discard of the product, even though the best before date is often just set by the producing industry itself and does not necessarily mean that the product is not fit for consumption anymore. In fact, there is a difference between the phrase "best before", which refers to an evaluation of food quality and "use by", which refers to food safety (WRAP 2008).

Food safety restrictions can also lead to recalls of products. This is often human error through wrong labelling or flaws during the production process. This in return can lead to food scandals like the one recently encountered where horse meat was found in products of several retailers. Not only do the retailers have to discard all products to protect the consumer but the consumer behaviour is then also influenced and makes forecasting the demand extremely difficult. Having said that, it is probably reasonable to think that an increase in food waste is unavoidable (Marthinsen et al, 2012).

Another cause for food waste is the limit of technology. This can either mean the conservation or packaging of the food (BCFN, 2012). Another example could be that keeping the products fresh (cold chain) is not ensured in a proper way. Estimations were made that a lot of food goes to waste due to old cooling or freezing facilities or because the machines conserving the food or packaging it did not function in a proper way.

To biggest cause of food waste during the last stage of the food supply chain are the consumers itself. This is the reason for modern literature to often investigate consumer behaviour. A lot of the research that looks at the consumer behaviour, has its origin in the WRAP program of the British government. Due to the WRAP programme it was possible to even distinguish between causes for normal household consumption and consumption in the HORECA sector. It was found that not only most people have very limited knowledge about methods to reduce our food waste, even worse; a lot of people simply do not care because it is too much of an inconvenience. The only consumer group that shows similar behaviour to consumers in developing countries are university students, probably due to the financial limitations.

Consumer behaviour in itself is often a very difficult factor influencing the levels of food waste. While buying the food, consumers often pick the product that is longer edible according to the "best before" date on the package. Therefore a lot of products stay on the supermarket shelves that otherwise would be fine to eat. Consumers also like to fall for promotional offers in the supermarkets and because of this, end up with excessive quantities of food which they cannot use up in time.(WRAP, 2008) Consumers also tend to simply ignore the information printed on the product packaging about the storage of the product.

As already mentioned during the introduction, cultural background can be a factor influencing the food waste levels too. For example, a study conducted in the US showed that families with an Hispanic background waste 25% less food then non-Hispanic ones, because wasting food is socially not accepted.(Jones, 2006) Another factor that influences the generation of food waste is gender.

Muth et al (2006), proved in their study on consumer behaviour and food conversion factors that women waste more on average than men.[4]

As can be seen in this section, many of the causes for food waste are interlinked, for example not keeping the cold chain at all times can be due to a lack of training by the staff handling the food product. No proper training can also mean that staff is not following the "First in, First out"- principal (FIFO) which usually would ensure stock rotation. If stock is not rotating, the best before date will be reached earlier. Tackling one cause can therefore help to tackle others as well.

### 3.2.4 Causes for Food waste in the Food Service Industry

Looking at the specific causes of food waste occurring in the food service sector it is important to distinguish between two sources of food waste. The food waste generated by the customer which can also be called plate waste and the food waste coming from the kitchen which comes mostly through preparation of the food, for example peeling potatoes. A WRAP study from 2012 had a closer look on plate waste and the consumer behaviour within a restaurant. During this study it was shown 41 % of consumers thought that their portion size was too big and that this was the reason for their plate waste. Another 11 % in this study admitted that they had ordered too much and because of it left plate waste. The European Commission came to a similar conclusion during their study (2010). It was also found that visitors of QSRs tended to leave less waste than guests visiting a proper restaurant.

As for the kitchen waste, literature agrees that often too much food is prepared and served (WRAP 2013, BCFN, EC 2010). Left overs are the result of this. A big problem causing kitchen waste, especially in the QSRs, is the different holding time of the prepared products. A prime example for this are chips (french-fries). Their maximum holding time is only seven minutes. Because it is often very hard to forecast the demand, a lot of those short time products get prepared to ensure a constant flow of goods for the customer, this in return causes costs in terms of energy and water too. It was also found that buffets often require a bigger amount of food prepared then a menu card which also causes food waste (WRAP, 2009).
Closely related to issue with the left overs are also the doggy bags. In some countries the use of doggie bags is not allowed, because the service industry cannot ensure that the consumer will follow food safety regulations on his/ her way home. Meaning that in case of sickness of the consumers, the producer of the food could still be held liable. This is also a reason why food that could be still eaten is thrown out.

The amount of food waste is also linked to the different season, for example in the summer a lot of fresh fruits or vegetables are prepared, therefore the amount of unavoidable food waste increases. Literature also shows that it is often difficult to see, the real amount of food that is actually wasted within the food service sector. While a lot of the QSR outsource food preparation further up the food supply chain an actual restaurant with a la carte menu will produce more unavoidable food waste because they prepare onsite.

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[4] Authors' side note: Doing a little research on gender behaviour myself during my expert interviews, it turned out that two out of three female experts agree, that Muths research result, might come from the fact that men apparently have a different understanding of what is still edible or not. So they might produce less food waste but have a greater economic impact on the health system because of it. One did not dare to comment on the issue because she shares her office with men. I strongly suggest further research in this area.

Similar to consumer households no or incorrect planning of purchases can lead to excessive amount of food in the storage. This can often lead to problems to integrate everything into the menu before the food passes its best before date. Similar to the lack of awareness of the consumer, the lack of staff training can lead to similar results. WRAP identified wrong preparation and one storage also as one of the main causes for avoidable food waste. The Ishikawa diagram, shown in Figure 3 below, groups the possible causes for foodwaste to the different categories. Only the categories "men" and "methods" can really be influenced even though the category of environment can be responded too by some of the aspects from the other two categories. This will be explained in more detail further on in this chapter.

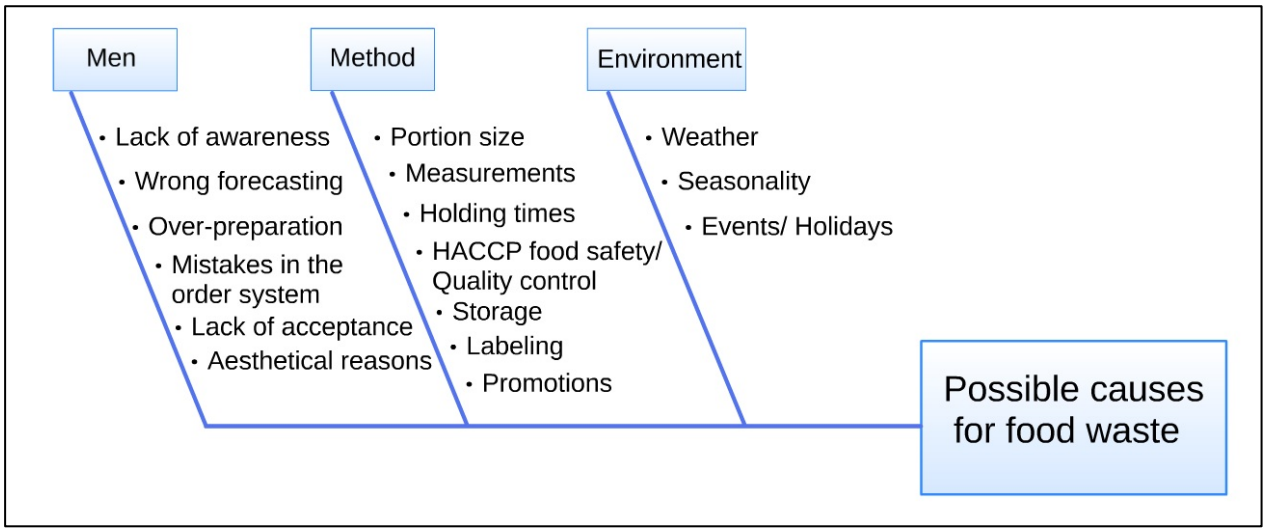


*Fig 3 Ishikawa Diagram for possible causes of food waste, Hackfurth, 2013*

### 3.2.5 A Quantification of the Losses within the Food Service Industry

An accurate quantification of the food wastes and food losses is almost impossible because the different studies conducted have used different measurement techniques and methodologies to get to their results. Only in the study of the UK based Sustainable Restaurant Association (SRA), waste streams from kitchen and customers were separated. The study was conducted in 10 different restaurants and measured the waste over one day, distinguishing between spoilage, waste from preparation and the waste from the customers. The average waste per day was around 60 kg, with around 70 % from the kitchen (preparation and 5 % spoilage) and 30 % from the customer. This would equal to ~500 gram of food waste per customer per day. The SRA study was especially important because its' methodology of data collection was so precise and it is easy to replicate the data collection with different sample sets.

The study conducted by the EC analysed the different food wastes on bases of national research within the EU 12 and 15. This study looked at different stages of the food supply chain like retail, wholesale and the hospitality sector too. Its aim was to calculate the amount of waste produced per person per year in the food service industry. Estimates were made that the total amount of food waste in Europe amounts to 89 million tons every year. This would mean that the average citizen in the EU15 would generate only ~30 kg of waste every year. Food services contribute to this total with 14%, which equals around ~ 124 million tons per year. But the data was not really sufficient to calculate the waste of the average restaurant. (EC, 2010). Other studies point to even higher amounts. According to the Eurostat data from 2010 the food waste per capita per year was 579 kg in the Netherlands, 227 kg in Sweden, 238

kg in the UK and 126 kg in Germany, to name a prominent few. In France the total waste generated by the industry was 6.26 million tons, two million tons come from the food sector. According to the BCFN, one meal is the reason for at least 150 g of food waste from the preparation to the consumption (2012).

A data collection from Swedish Methodology for Environmental Data (SMED, 2010) estimated 99000 tons to be generated by the restaurants only based on a sample of 56 restaurants. Swedish school canteens attributed 3 % (26,000 tons). Goal of this study was to estimate the total amount of food waste by all Swedish restaurants. The calculation was based on comparing the Swedish waste data per year per restaurant against the number of employees per restaurant.

A study by WRAP in 2012 was by far the most useful one. It was the only study that also looked into possible responses to the food waste problem. The aim of the study was to calculate the total quantity of all waste produced by the hospitality sector in the UK. Its methodology was rather complicated because the study took a lot of different factors into account. It broke down the hospitality sector into four different main groups: a restaurant, pubs, hotels, QSRs; Sample size was 138 venues in total. In the analysis the waste was sorted into 37 categories. The result was that on average 44% of food waste came from restaurants and 51 % of food waste was from the QSRs. Overall six million tons were disposed off. This percentage was then the baseline to calculate further average amount per restaurant per employee per day. Despite the methodology the WRAP study gave a good starting point for setting best practice baselines and targets (WRAP, 2011). The study also looked into the amounts that could be classified as avoidable or unavoidable food waste. The study found that 30% of the food waste in a QRS restaurant is avoidable while in a normal restaurant set up even 67% is avoidable.

### 3.2.6 Energy and Water Consumption related to Food Waste and its costs

In addition to, for example cars, households and large industry, the food service industry is also responsible for carbon dioxide emissions, e.g. through food waste that has been landfilled. A study by UK based company Biogen Greenfinch (2009) looked at the emissions created by the restaurant group "Whitebread". It was estimated that if not given to an anaerobic digester for recycling, the food waste of the 300 different outlets would have otherwise been landfilled and could have produced three million kilograms of carbon dioxide emissions. Energy and water consumption related to food waste can also generate carbon dioxide emissions, create resource scarcity and be the reason for high operating costs.

In his article `Making the kitchen greener´ Kevin Tyson, project manager for a company that develops equipment for the food service sector, tries to identify points in a commercial restaurant kitchen where savings can be achieved. He finds that in the UK, a restaurants kitchen "needs 2.5 times more energy per square foot than other commercial buildings" (Tyson, 2010). Tyson also estimates that the energy costs per kilowatt hour for a small restaurant business range from 8.3 Euro cent up to 25 Euro cent depending on the equipment and regional electricity price.

In comparison a study conducted by the "Catering for sustainability future"-group (CSFG) and the Institution of Building Service Engineers (CIBSE) in 2009 had identified the average energy costs per cooked meal in the United Kingdom. As can be seen in figure 4 below, QSRs are not directly mentioned but they are comparable to the energy usage of a snack bar because they serve similar food items, for example hamburgers and fries, and use similar kitchen equipment to produce them. The average meal size is 500 grams per serving (WRAP, 2010)

| Average energy costs per cooked meal in Euro per 500 gram | |
|---|---|
| Snack bars | 4.64 cent |
| Coffeshop | 8.12 cent |
| Steak House | 20.88 cent |
| High Class Restaurant | 31.32 cent |
| Hotel Restaurant | 41.76 cent |
| Catering Service | 12.76 cent |

*Fig 4 Average energy costs per cooked meal according to CIBSE and CSFG, 2009*

Now taking into consideration that, for example, a deep fat fryer used in a snack bar can use up to 11000 kWh of energy only in one year (~ 3000 Euro), the calculated 4.64 Euro cent energy usage per meal does not seem that big of an amount but will add up to a significant number that could have been prevented by simply reducing the amount of kilowatt hours the deep fat fryer has been in use.

Looking at 0.9 million tons of avoidable food waste in the UK for the food service sector (WRAP, 2011), equivalent to 18 million meals wasted, this results in 82,8 million Euro per year that companies lose due to over production, bad forecasting, storage problems etc. in the UK only.

In early 2013 the US National Restaurant Association released an industry report which also included forecasts for energy and water usage. The report showed that food service operators had heavily invested into ways of saving energy, energy efficient lightning being number one. This also includes different light circuits for all areas in the restaurant and daylight sensors for light that are positioned close to windows. This way lights can be turned of or dimmed when not needed or the sensor makes it possible to respond to naturally available light in the room by measuring the amount of Lux present. Large companies such as Osram and Philips even offer their clients to conduct a light audit and help them to install entire light management systems. For a smaller restaurant (140m2) this could be an investment of around 5000 Euro but the payback time is under 3 years when done in a proper way (Osram, 2013). Eighty percent of all operators were investing into new light fixtures in 2012. (USNRA, 2013)

Fifty percent of operators exchanged their kitchen equipment in 2012 and another 55% is planning to exchange their equipment during 2013. For the major equipment changes, operators are looking at are energy efficient refrigerators, air conditioning systems and steam cooking appliances. This shows that the change that new appliances can make are significant (USNRA, 2013). A good example comes from the UK where Hilton Hotels conducted an energy audit to see which appliances or processes in their F&B area consumed the most energy. On top of the list was the extractor fan. Here many different factors in the kitchen play a role one being the over production of food and bad forecasting. The fan which was running on the highest level, 24 hours long, used 220.67 kWh per day also because a lot of times food was produced but then not even consumed. In response to the audit, new equipment was installed (Cheetah energy control system, Food Industry Technology), which monitored the cooking activity and therefore was able to adjust the speed of the fan to match the conditions. Because of the new system consumption decreased to 105.59 kWh per day which represent total annual savings of around 14000 Euro or 40,3569 kWh (Hilton,2012 from interview).

Much of the electricity consumed in restaurants is generally dispersed and wasted as heat (for example through dishwasher waste water, refrigerator waste heat and heat from exhaust hoods). However, studies estimate that over 50 % of this waste heat can be recovered. Thus

reducing electricity consumption, for example for heating water in a dishwasher, can make a significant change. There is three main possibilities: refrigerant heat recovery systems (RHRS), spiral tube heat exchanger from exhaust air; and dishwasher grey water heat recovery systems.

Heat recovery devices are likely to have low investments and relatively short payback periods. For example, the Novothermic Dishwasher Heat Exchanger (NVX2060) claims to cut hot water costs by 50 % and have a return on investment of less than one year for larger establishments.[5] Also, a study in Ireland found that retrofitting exhaust hood heat recovery systems in five small-scale restaurants cost an average of 400 Euro and had a payback period of around 5 years (Onyango et al, 2012). The return on investment was found to be higher for larger restaurants.[6] It is however often difficult to retrofit heat recovery systems in already existing restaurants, but should be considered for new builds.

Many products served in QSRs can be fried, main example being French fries. Most foods are fried between 163°C to 178°C. The energy input needed to operate an electric fryer ranges from 2 to 27 kWh. The UK EPA advices to use ENERGY STAR qualified fryers which only use one kWh. This can mean an 80% energy saving in comparison to the old fryers.

Another main consumer in the kitchens that get overlooked easily is an industrial steamer. They are not only high in energy usage but also water. Old steamer models are boiler-based and use over 150 litres of water per hour. New, high efficiency models are operating without a boiler or a drain and use less energy and water (4 -8 litres per hour). Due to improved insulation, heat loss is reduced, a more efficient steam delivery system helps to steer the actual water consumption.

Because only 3% of the earth's water reserves are fresh water, water efficiency has become a relevant topic recently. A study conducted by WRAP and the World Wildlife Fond (WWF) estimated that the amount of avoidable food waste and the related water consumption, the water footprint of the waste, has already reached 280 litres per person of water every day which is higher than the UK daily average in household usage. This would total in an annual amount of 6.2 billion cubic metres (WRAP, WWF, 2011).

The US EPA has estimated that QSRs use on average between 1800 and 5600 litres (2012) per meal served (around 500 g) that equals 12 litres of water. In countries with high costs per litre fresh water this means a significant cost to the restaurant.This is even more when the water needs to be heated.

On top of the list for water consuming kitchen machinery is the dishwasher. While old models of dishwashers easily used 500 litres of water per hour, newer models only need 33 litres. One of the most recent models (Maidaid Halcyon), uses as little as 15 litres and only 2.5 litres per rinse water cycle as an example of technological advancement. It has been stated that for optimal energy efficiency, a dishwasher model with a heat recovery condenser is the best solution because it saves water as well as energy. Savings can also be made with the installation of low-flow-pre rinse-spray-valves. Newer valve models help not only to save water but also save energy that is used for heating it up. The new models only use six litres per minute which is a saving of up to 14 litres compared to the older models (Lundquist et all, 2008). A much cheaper possibility is also to train staff into manually clean and scrap the dishes beforehand.

[5] http://www.novothermic.com/519-2/

[6] http://www.academia.edu/1766874/Waste_to_Worth_Evaluation_of_the_potential_of_waste_heat_recovery_technology_within_the_Commercial_Kitchen_Environment_in_Northern_Ireland

This way less water is used and the organic content of waste water is reduced. It also reduces the amount of energy needed to rinse the dishes with hot water. Therefore it is also important to not only reduce the amount of water consumed but also the amount of related energy used, unless it is energy produced by a renewable energy source onside, like a solar panel for example.

In general, small changes can lead up to big differences and savings later on. One of those examples are water flow restrictors for all sinks to reduce the volume of the water but also just offering one pre-set-temperature at the sinks or the replacement with an high efficiency spray valve. A normal spray valve uses up to 15 litres of water while a newer model uses less than six liters.

In conclusion it should be said here that literature agrees that even with the best appliances untrained staff will not achieve optimum efficiency results.

### 3.2.7 Responses to Food Waste in the Hospitality Industry

As already seen in figure 3 there are many causes for food waste that can be linked to the food service industry. Since a lot of the stakeholders are aware of those causes, responses have been developed to successfully reduce the amount of food waste generated. One of the major examples is the variety of food that the customer expects on a menu. Instead of only a few choices of high quality, a large quantity is on display at all times even shortly before closing which leads to a higher amount of left overs. A typical response to this is the change in menu and the role out special promotion before closing to sell off some of the left meals.

**a) Raise Awareness**

Another cause for food waste in the food service industry is the lack of awareness among customers and employees. In response many non-profit and governmental organizations have launched big awareness campaigns. One example is the food campaign that was launched in the UK by WRAP in 2008 "Love food, hate waste!". The campaign was well promoted also due to government funding and was considered very successful. Because of the campaign it was possible to save 137000 tons of food waste since its start. Schools kitchens taking part in the campaign were able to reduce the waste by 35%. The campaign consisted of communication in restaurants and big supermarket chains, TV advertisement, poster and billboard campaign and educational presentations in the participating schools.

Another example to raise awareness was a nationwide released educational program in the Netherlands making it obligatory for third tertiary students to get acquainted with environmental topics during their study. Food waste is one of them. Constant education of the public is a key factor and food waste should not be as highly acceptable as it is nowadays. A change in social context could have a positive outcome (NHO AISHEE, 2010).

Looking at the food industry in detail, staff training is needed to ensure a) that staff knows how to sort their waste, b) can change the ways of food preparation and c) can be a leading example to the customer.

Training can also be a response to the lack of acceptance of a helpful tool. Instead of throwing a meal out, in a lot of countries customers ask for a doggy bag, but in some countries this is not socially acceptable (Monier et al., 2010; Nordic Council of Ministers, 2011). But when the staff team is highly aware of the food waste problem, the social behaviour could change and people could take their left overs back home. An example of a campaign to promote the use of doggy bags was released by the SRA in October 2011. "Too good to waste" is at the moment only targeting restaurants in London. The initiators believe that a 20% reduction in

food waste (around 42000 tons) is possible. When the set target is reached the SRA would also like to involve more cities and restaurants into their project. (Interview SRA, 2.8.2013)

**b) Change portion size**
Another cause for food waste is the portion size in some restaurants and countries. While in some cases, customers experience the portion size as to big, others think it just fine or too small. Offering different sized portions and therefore respecting the wishes of the customer is also a helpful reduction possibility to the food service industry. This can be done by either changing menus or portioning tools used in kitchens and integrating such use into the employee training.

TGI Fridays is promoting different portion sizes very successfully in Ireland and the German restaurant association is promoting the so called "Rentner-Teller" (senior citizen portion) to accommodate the need for smaller portions (DEHOGA, 2013).

**c) Monitoring and measuring**
A lot of stakeholders do not measure their food waste which also leads to the fact that staff and management are not aware of the quantities thrown out. Good organization, monitoring and measuring are very important components to set targets for food waste reduction**.** According to Lean Path, one of the leading US organizations in providing food waste solutions for restaurants, often monitoring and measuring restaurant food waste can reduce production and thus save money (Lean Path, 2012). The report of the Nordic council of ministers finds the same. Physically measuring the waste every day will reduce related costs in the long run because it improves the forecasting systems and increases staff awareness. (Nordic Council of Ministers, 2012). Eurest, a Danish based catering firm with international operation, started monitoring and measuring how much food waste they produce in Sweden. They saw significant improvement and a reduction in their food waste. From this experiment, Eurest has not only developed action points for further reduction but also proper target for the next three years. In all of this staff and customers are equally involved. (Nordic Council of Ministers, 2012, Eurest, 2011)

Practical responses were tested by a big global hotel chain offering incentives for guests of their restaurant as well as the employees using the staff canteen. In competitions departments can win overnight travels for reaching certain food reduction targets. When asked employees confirmed that they now also reduced food waste at home and try to influence others in their environment to do the same. Because in many countries companies have to pay for their collected food waste, a reduction can also lead to a decrease in the overall department costs. An example here is Ireland where the collectionfee for a company is set by weight of the collected waste and ranges from 230 Euro to 360 Euro per tonne in Dublin (Thorntons Waste Collector Interview, July 2013)A big five–star hotel in Dublin saved over 6000 Euro in 2010 by implementing simple reduction measures.(Information taken from Interview).

**d) Forecasting and planning**
Correctly predicting the right amount of customers is also a big issue which in normal restaurants can often be solved with having a reservation system. Another response often practiced by staff canteens is to let the employees sign up for different week days, on which the employee wants to make use of the food offer. This promotional tool is often linked to a special offer like a reduced price or a free meal at the end of a month. This helps to predict the amount of food that needs to be prepared instead of over preparation.

**e) Menu planning** can reduce the food waste at the end of the day as well. Some of the leftovers of the day can be used in another meal the next day with right handling and storage.

This allows for an extra choice on the menu and also reduces the costs because items do not need to be bought again. Looking at a study that was published by the SRA in 2012, special processes were offered to employees to recycle products that were otherwise even counted as food waste like orange peel. (SRA, 2012)

**f) Routines**

As mentiond before, wrong storage is also a big problem eventhough it can easily be solved. One of the work routines should be, to go through the storage at the end of the day to ensure a) all facilities are properly working, b) everything is correctly labelled and c) everything is correctly stored in cold storage, freezer or other facilities.

Because holding times for products are often short, leftovers need to be thrown away for food safety reasons. Meals on the menu should be changed to recipes using items with longer holding times, like cooked potatoes instead of French fries.

A study conducted by the Council of Nordic Ministers showed how food service operators prioritized different actions taken to reduce food waste. This study was especially interesting because it investigated the wishes of the main stakeholders in the food service industry and brought a reliable result. 54% answered that they will focus on optimizing their food purchasing routines. The study found that often food is purchased in either too large quantities or if it is not even needed. Some operators have in response to this problem, started to use management programs that register every item that is in storage and every item used is scanned out. This has taken several weeks to function properly but the time effort and costs were worth it because some of the operators were able to reduce their food waste by 12% (Interview Swedish restaurant 20th of July). This type of management program also eases the menu planning.

Many of the operators that took part in the study also suggested national target setting so that they could use the targets as orientation for further development within their organizations.

## 3.3 Best practices

The term "best practice" is very common in industry and is often used for a practical solution to a problem occurring in a process. Because of this, best practices play an important role in fighting the problem of food waste in the food service sector. But the market is full of the term "best practice" and it is hard to tell what has been established as a real best practice or what is just randomly called a best practice.

Looking at available literature, many problems are connected to the term "best practices". Often "best practices" are chosen without applying a methodological recognized framework. Therefore Best Practice Research (BPR) is described as too subjective. Furthermore literature cannot agree on what a best practice actually is, because there is no consensus or whether it should be called best practice or good or smart practice. Generalizing it can be said that literature on BPR can be very confusing (Myers et al, 2004).

To overcome these problems, I choose to define best practices as a "process and activity that has shown in a practical situation to be the most effective, efficient […]" following the suggestion of de Vries (2010). This is rather important looking at the food service industry because one of the restrictions is the time limit to serve the customer. So in case a practice hinders the main objective to serve the customer within a certain quality frame and time frame it will not be of much help to the business to apply the practice, no matter how sustainable it might be. According to Tuominen et al (2004) and Vesely (2011), the definition should

emphasize on the function of the practice and offer the stakeholder an orientation help in the transformation process.

Comparing the literature, academics agree that the aim of BPR should be to observe examples in different settings in order to make a generalization with regards to principles and management theories (Overman et al, 1994). Literature also agrees on the fact that best practices rely heavily on the PDCA or so called Deming circle. PDCA is an acronym for Plan, Do, Check, Act; describing continuous learning, exchange of feedback and reflection on what works in reality and asking 'why' on a constant basis (Senstroem et al, 2006).

### 3.3.1 Best practice theories

First it needs to be said that literature about best practice theories is based on the assumption that best practices need to be identified to further development of public-policy-making. But because best practices are also well known in the private sector, most theories can also be applied here. The following section will investigate the use of private sector application.

Best practices can be a tool to a successful change management. BPR distinguishes between two key elements as source for a best practice, target sites and source sites. 'Target site' describes the institution where working processes need to be improved while 'source sites' are the institutions where working processes are already optimized and which can act as an example for the target site. (Vesely, 2004) So in this report, the 'source site' might be companies that were identified to use best practices and the 'target site' will be the case study examples used furtherone in the thesis.

One of the main authors in best practice literature is Bretschneider. He argues that best practices mean that they are only "best" when being compared to any other practical course of action that should achieve the same goal. (Bretschneider et al, 2005). When analysing a best practice case, he identified two conditions that must be met to offer a valid analysis. First of all the cases that are supposed to be compared must be 'complete', meaning that we must find all comparable cases because otherwise we might leave out a case that is better and exists outside the sample therefore we will not be able to call it a best practice anymore. Secondly, the cases must offer the same conditions.

Bretschneider himself mentions these two conditions also in his limitations, because the completeness of the sample is often physically impossible to achieve for the researcher which brings me to the major flaw. Because of this difficulty researchers following his theory often use a tiny very specific sample, either geographical or temporary limited, to narrow down the sample size and to validate their research. For me, this is a paradox in itself, because, as Bretschneider already remarked, there might be something outside this small sample which offers a better solution. To compare the cases in a sample, the production theory is used. The number of outputs of a system is linked to the inputs, to see what combination of both is necessary to reach a specific production goal. The production theory allows us to identify the best example case in which the "best possible process transforms inputs into outputs" by identifying their relationships (Bretschneider, 2005). Here it is critical what the researcher counts as input and output, since this often depends on the measurability of the factors and the subjectivity of the researcher.

Furthermore a causal theory needs to be established between the process action and the output, to ensure that the causes that are responsible for the outcome can be controlled by the producer in some way. Bretschneider uses statistical techniques to identify those relationships to ensure the comparability of the cases. An example from a kitchen could be scrambled eggs.

The desired output is 500 grams of scrambled eggs, so the input could be three eggs, four or even ten eggs. To now establish the causal theory, Bretschneider would identify the average weight of an egg used in the process, the amount of eggs used to reach the desired output and then ensure that in all cases investigated, only eggs are used that lie within the same weight range to compare which process uses the least eggs to get the 500 gram end result. Now scrambled eggs is probably not the best example since the process is pretty much the same all over the world and it would be hard to argue what the best practice is. The biggest flaw that was identified with regards to Bretschneiders theory, came from Ongaro in 2009 in which he stated that there are many examples where the outputs cannot be assessed in terms of unit in production, for example in the field of strategic management. In my own experience we often want to assess how a certain institution has reached a goal but this happens often based on qualitative measures and these can hardly be quantified.

The second theory comes from Bardach. He criticizes Bretschneider already on the terminology that he is using because Bardach sees the term best practice as misleading because we are not able to identify all cases which solve the problem we have at hand, so he prefers the term "good practice" (Bardach, 2007). While others think that it is always necessary to invest before seeing a result, Bardach seeks to demonstrate that good practices exist that come at zero or little costs but still are beneficial to the stakeholder. He does remark that there are probably not that many good practices at low costs but some must exist. In contrast to Bretschneider, Bardach does not really define the term "good practices" nor does he look at a theoretical basis for choosing them. He just explains a good practice as "anything that aims to exploit, or take advantage of, some latent opportunity for creating value on the cheap" (Bardach, 2000). Bardach distinguishes between two main aspects that underlie a good practice: Essentiality and Support. When referring to an essential aspect, he means something that causally makes a good practice occur and is of value. The supportive aspect stands for something that increases the effectiveness but does not guaranty the valued effect like essential aspect on its own like employee training (Bardach, 2007). Instead of the causal theory he uses the term "mechanism", so complex social issues and behaviour can also be integrated into the research. (Bardach 2008). He defines a mechanism as something explaining a social phenomenon which is less abstract then a "common law" but more defined than just a mere description of its nature.

Picking up the limitations from both theories, Edoardo Ongaro suggests in 2009 that one case study on its own can already provide enough data for the development of an extrapolating practice. According to Ongaro, the theory is about changing processes when "the causal reconstruction of the events of the experience under investigation is carried out, based on theoretical sources, like social mechanisms. Social mechanisms can be defined as systematic sets of statements that provide a plausible account of how two entities are linked to one another by moving beyond simple co-variation and investigating the causal texture of social phenomena."(Ongaro 2009)

At first this sounds very complicated but once understood, is easier for the researcher to work with than, for example, Bretschneiders approach. With extrapolating practice, Ongaro means a practice that is easily transferable into a different setting and will there achieve the same or very similar result as on the source site. He simply suggests to identify two factors or statements and how those were interlinked, to find out in which way one can make the same statement happen at the target site under the same conditions again. Ongaro constantly answers the "why"- question on social behaviour by oberserving and interviewing. He bases his definition of social mechanisms on Elster (1989) and Hedstroem (1998). They all agree that a social mechanism can be defined as a rigid, systematic set of statements that make up the social phenomenon itself and is widely recognized as such. An example for such a social

phenomenon could be unwritten rules that people still stick to, like washing ones hands before dinner. The systematic set of statements would be in this case that we get told as children that hygiene is important, that one shouldn't eat with dirty hands, etc. With this approach, he questions the fact that Bretschneider does not take social behaviour into account but also picks up on the fact that with Bardachs theory not all possible examples are taken into account. So a single case study when analysed theoretically on the causal texture of the different changes occurring, can be of great value to stakeholders when looking for inspiration on how to optimize their own processes and therefore already offer Bardachs valued essential effect.

### 3.3.2 The Five-Step Extrapolating Theory

The five-step extrapolating theory was developed by Edoardo Ongaro as response to limitations found in other Best Practice theories. The extrapolating theory is based on the reverse engineering approach to identify different factors that all together form a best practice. Meaning that at the source site the entire process is looked at in detail from end (final product) back to the start of the production to identify them. This reverse engineering process makes it possible to use theoretical knowledge from people involved and the selection of the different factors, influencing the process. So the approach systematically links the practice in question to the opportunities available. The theory also looks at possible failures and the specific situation and therefore also identifies the solution. The main limitation, which is often encountered by Ongaro, is how to conduct the analysis at the source site in a way that the target site can apply the practice as well. For each process the related design feature, the process context factors and their relation to each other need to be identified. A process context factor is "defined as situational factor within the practice that is under investigation that is not a process design feature but provides the opportunities for a process design feature so it can function at its best" (Ongaro, 2009). It represents a specific condition in a change process. This can either be linked to technical possibilities or to the social behaviour displayed by the involved party at the source site. An example for a process context factor in the case of food waste could be a kitchen machine in use or a course that the chef has taken back at restaurant school. According to Ongaro, the process context factor allows one to identify the frame in which the process is still applicable to a possible target site.
Here an example (Please also see Fig.5):
If one chef has taken a course at school A on how to slice meat in a special way, but another chef has taken a different course at school B, the knowledge acquired on how to slice meat is different but might still overlap a little. Chef B produces more food waste than Chef A because more meat is wasted. Putting Chef A in a kitchen, being the chef is a process design feature while the way the chef does something is the process context factor. The chef is part of the production line and the final meal served to the customer is the end product. The end result of Chef A and Chef B going to different restaurant schools, is that meat gets sliced in different ways and both chefs have had training. The process context factor that results in the best practice is in this example the previous knowledge acquired by Chef A on how to do something in the most efficient way. The special way on how to slice meat gives him the possibility to function at his best and produce less meat waste. The production line in its total, functions at its optimum. Both chefs have had training therefore conditions are similar and it is possible to transfer the practice from source (Chef A) to target site (Chef B). So a best practice can be generalized under the transferal and application of the process context factor from the source site to a different target sites. Ongaros approach distinguishes between a processes design feature and process context answering the questions "how does the system work?" and "how does the practice interfere with the system?"

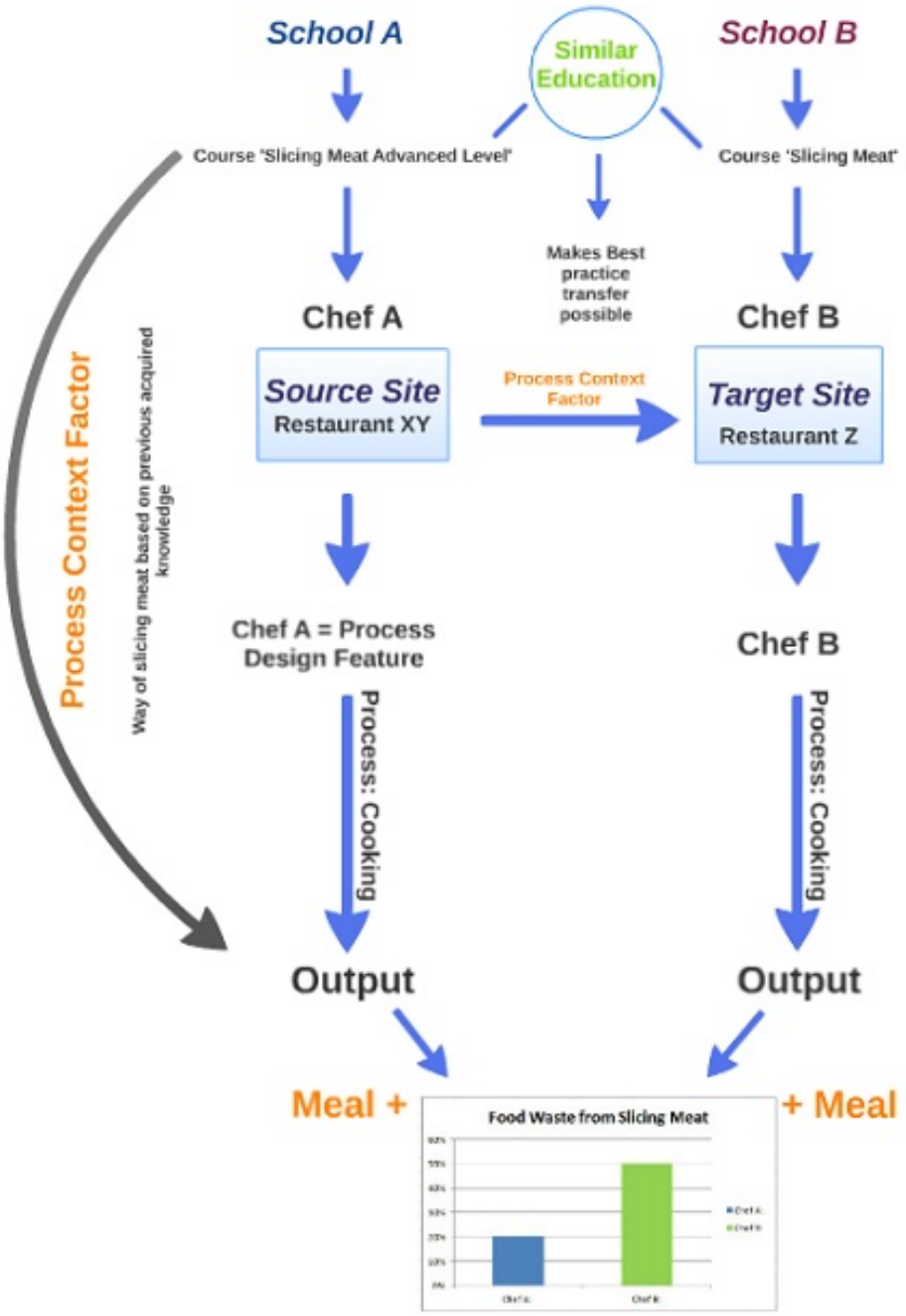


*Fig 5 Best Practice Transferal Example, Hackfurth 2014*

The first step in the five-step extrapolating theory is to identify the function that needs to be performed and to find out if it was the practice made the function successful. The second step is to define exactly what the practice is about. In the third step the following questions are helping to describe the practice: a) how does the system work in detail? And b) how does the practice take advantage of the way the system operates?

The fourth step identifies all the effect that can be linked to the practice, like the results, failures general performance and the side effects. The last step then identifies the process context factors meaning under which conditions does the good practice work and can also be

applied to a possible target site. Figure 4 shows the whole approach in a simplified version for a better understanding.

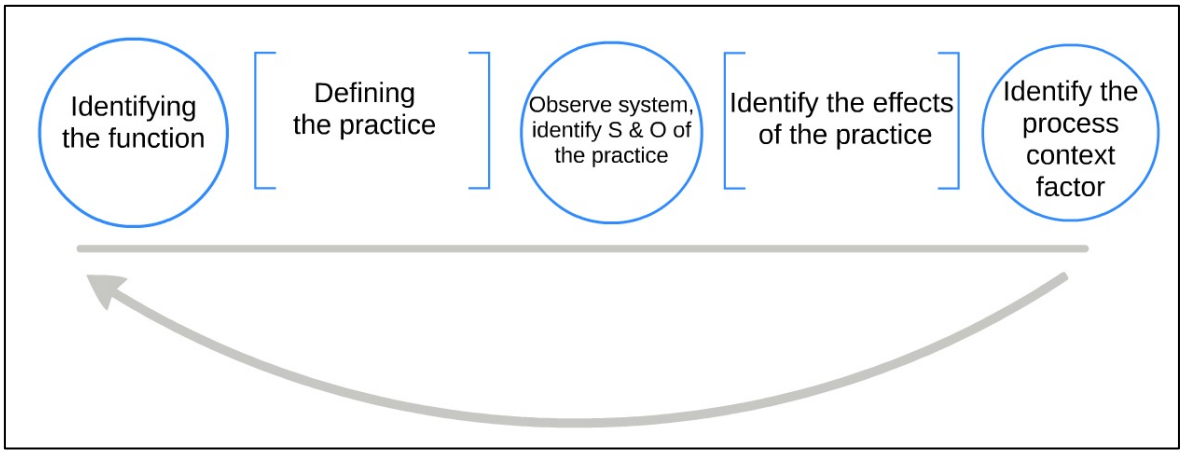


*Fig 6 Simplyfication of Ongaros five step extrapolation approach (2009)*

** S& O stands for strength and opportunities*

### 3.3.3 Best practices in the food service industry on avoiding food waste

After researching different theories and limitations of the very same, one might ask "Why are best practices a useful tool to tackle the food waste problem?"

Because the food industry that causes the food waste is a highly practice orientated industry that from own experience and generalisation will respond to occurring changes better when it was tested before and comes from among their own industry. I choose best practice research to make use of the long experience of others with the topic and with the industry, hoping that this will inspire change.

In academic literature only few authors looked at the identification of best practices. An example is "the preparatory study on food waste" of the European Commission (2010) which identified 106 different initiatives in the EU 27. Among those initiatives, best practices were chosen too. All best practices focused on the reduction at source and were divided into the categories awareness campaigns, information tools, training programs, logistical improvements, waste measurement activities, research programmes and regulatory measures. Some of the best practices mentioned in this study were looking at different areas of the supply chain like retailers. For the purpose of this study, I only looked at the ones for the food service industry.

One of the "good" practices identified is a food redistribution initiative from Italy. Together with private sector businesses (canteens and retailer), the "Buon Samaritano" (Good Samaritan) collects uneaten meals at the end of the day and distributes them to charity organizations in the community of Turin. This way, 8.1 tons of food were prevented from being landfilled. Food redistribution organizations are becoming increasingly popular in Europe. Other well-known examples are "Die Tafel" in Germany or "Fair share" or "the dinner exchange" in the UK. Most of those initiatives are non-profit organizations that are not supported by the government. The Good Samarita is one of the few exceptions and does receive some governmental funding.
Another good practice that was identified is a governmental initiative in Great Britain "WRAP". They are not only promoting the reuse and the recycling of food, they are

specialized in research around food waste, including the food service industry. WRAP is mentioned in literature a lot of times with their awareness campaigns "Love food, hate waste" and "This is rubbish". Another example comes from Germany "Zu gut fuer die Tonne" (translates to "Too good for the bin"), also a governmental initiative.

As mentioned before it is hard to find sufficient data on food waste prevention in restaurants because often it is not measured in the food industry or only if local municipalities charge for the food waste when collected. One of the good practices found by the European Commission that focuses on the waste data collection is Eurest from Denmark. Eurest is a catering service. During the European week for waste reduction, Eurest measured their waste in 25 restaurants and two coffee shops. Continuous measurements and publication of those to the staffteam and customers helped to reduce the food waste by 23% all over their business units.

Another prime example of best practices coming from the QRS sector itself is McDonalds. Not only have they adjusted their forecasting which is now electronically overseen but also their food waste recovery. With the so called "Wall", customers in Sweden have the possibility to sort their own waste and also separate between liquids and solid food waste. In other European countries, staff separates the waste instead. In comparison the recycle rates are almost equal to the customers sorting which is also due to the high awareness level of waste separation in Sweden. In Italy, McDonalds uses a machine to separate their liquids from solid food waste to reduce the costs for waste collection which are based on volume and weight (Super Lizzy; Interview with McDonalds Sweden and Italy June 2013).

The Green Hospitality Award (GHA), funded by the Irish Environmental Protection Agency (IEPA) as part of the national waste prevention program, is a certification tool for businesses, especially tourism and food service related, to prevent the overusage and saving of resources. It was also categorized by the European Commission as a best practices. Businesses and organizations that want to acquire the certification must follow certain standards and criteria to reach either Bronze, Silver, Gold or Platinum level. To reach each of the certification levels, criteria must be met in the area of environmental management with regards to the aspects of waste, water, energy, green purchasing, social responsibility and biodiversity. The criteria is said to be very tough and only a few businesses have reached very high certification levels yet. High certification is equal to a complete engagement of all staff and the continuous commitment to environmental business development.

## 3.4 Change Management Strategies

Looking at the common causes for food waste generation three key problems have been identified: the lack of awareness, the lack of communication about the problem and the need for change. Responding to those causes is of special importance now that the European year of food waste is approaching and also as a reflection of active work towards the reduction goal of food waste by 50 % by 2020 (EU Commission, 2010).

The literature suggests a few models that integrate solutions to all identified problems. One example is Caroline van Leenders "Tien tips for slimme sturing" ("Ten advises on smart leading"). Her approach can be described as 'helicopter'- approach looking at the organization from all perspectives. Figure 5 shows a simplification of her approach for better understanding.

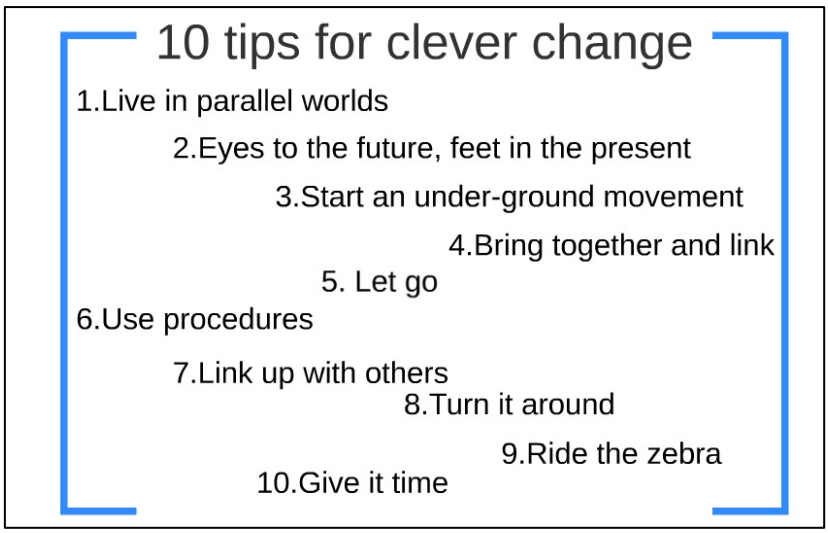


*Fig 7Simplyfication of Leenders "Ten tips for clever change", Hackfurth 2013*

During the first step different levels, macro, meso and micro level are identified. On the macro level big trends in sustainability are promoted like globalization and climate change. On the meso level, dominate structures within the system play a central role for example pricing within industry or subsidies. On the last level, Leenders suggests that the individual actions of the organization itself needs to be looked at. Constant questioning is needed to keep the overview. The strategy behind it is to evaluate the organizations strength and link the different organizational dimensions together. Since the thought behind implementation of a change strategy is the reduction of food waste, this would be on the meso and micro level.

During the second step it is advised to find a small starting point within the main system, so after accepting the small changes, the change of the main system is treated less reluctant by the stakeholders. In the third step it is advised to clearly plan out the current situation and the future vision like zero food waste and check on a regular basis if it the system moves towards the right direction.

During the fourth step, synergies for knowledge transfer need to be created within the organization. The next step is one of the most difficult ones because it involves the employee at a high personal level. Sharing ideas and the development of team work structures to share the success and therefore further the organizational development is challenging in an environment of individual success. Staff training with guidance is essential to this step. The sixth step promotes the development and the usage of already existing routines to break resistance and to push forward. Furthermore the development of working groups is advised. The key is to link the right competences together to turn around the resistance within the organization into positive actions.

The ninth step explains the principle of zebra commitment. Means that the top management is supportive of the innovative ideas but the middle management is in most cases not because they are busy with their day to day routines and do not have the time for implementing new routines. Therefore it is the middle management that needs to be targeted with awareness campaigns showing them the advantages of the new food waste reduction strategy. Last but not least Leenders introduces step ten which sets the temporal limitations of the change strategy. Change takes time, so planning the organizational strategy in long terms rather than short term strategic goals is important. Still short term goals are needed for the organization to keep the staff team motivated by reaching them and ensuring that the organization is on track.

The essence of this model is therefore to create positive feedback loops within the organization since change in non-linear.

Another theory is introduced by Donella Meadow. In her theory, Donella Meadows analyses the creation of feedback loops in her book "Thinking in systems". While Leenders looks directly into practical application of her theory Meadows first describes simple systems in theory and later advices on the practical implications.

"Thinking in Systems" tries to show the reader, by using examples from day to day life, the complexity of systems. At first Meadows shows the importance of control and feedback loops and their importance in a system by using the example a thermostat controlling temperature in a room. She defines a feedback loop as a "mechanisms that allow a change in a stock to affect a flow into or out of that same stock."("Thinking in Systems", p.25). She shows how effective a system can work when all control mechanisms and feedback loops work at the same strength, but it also shows what happens if they don not, a system failure so to say. What she tries to explain is that everything which happens in a system has a consequence and influences behaviour. Therefore systems can be in a fragile state. Meadows also gives the example of "System Zoo" with which she describes the fact that no systems exists in perfect isolation and that there are always outside factors influencing. If a system has become too large (or too simple), they can get to complicated to be actual useful to the stakeholders involved. Meadows introduces here the term of system oscillation, an instability in the feedback loops that can cause problems in the system.

The system zoo example also explains what happens to systems that have non-renewable resources as in inflow and how they eventually will crash because added profits do not match increased costs. Meadows uses the example of oil reserves but in the case of our food waste problem and the related and energy and water consumption this problem might occur in the future with water as a resource. Meadows also defines characteristics of a system that is working well, resilience, self-organization and hierarchy. Opposing those she also introduces different system problems. A so called "system trap" can be focusing on one single event rather than looking the entire flow. Another one is to take not into account that something small, which is changed in the system, can eventually lead to something much bigger. Here bigger is not always better. Another problem can be setting of boundaries. Similar to the best practice research the setting of system or research boundaries might be good to simplify matters but might not reflect the full scale of samples in or out flows or factors from the outside world.
Last but not least Meadows describes the concept of bounded rationality which means that people within the system act in rational self-interest which will lead to an overall system failure in the long run. Environmental damage can be an example for system failure. If everyone working in a kitchen thinks "Oh it's ok, if I leave the freezer open just for a minute" and 90 people work in that kitchen, 90 minutes of energy costs and $CO_2$ emissions will be the result.
To escape the traps, Meadows describes different leverage points where stakeholders can interact with the system at hand. The points suggested are similar to the ones Leenders suggests but are more organized on the level of organization and communication.

The following leverage points were identified:

1. Numbers
2. Buffers
3. Stock and flow structure
4. Delays
5. Balancing feedback loops

6. Reinforcing feedback loops
7. Information flow
8. Rules
9. Self-organization
10. Goals
11. Paradigms
12. And transcending paradigms (Meadows, 2008)

In relation to food waste, the leverage points "numbers, balancing and reinforcing feedback loop, information flow, rules, self-organization, goals and paradigms" are especially important. All of them can be related back to communication between the different stakeholders of the restaurants, the staff, customers, and supplier's etc. And therefore represent the main focus area of this study.

Similar to Leenders, Holling developed adaptive environmental assessment and management. Adaptive resource management (ARM), is a structured as a repetitive process of decision making. Even though Hollings Theory is already from 1978 it is important due to the fact that is based on active learning patterns within a system which is very useful for the food service industry especially the QSR restaurants. Holling suggests that with monitoring of the system at hand, uncertainties in the process can be reduced over time. Therefore the decision making process becomes faster and easier. One or more objectives can be influenced and new opportunities within a design process arise for the management. Because it is based on a learning process it improves the long term planning similar to the PCDA circle mentioned earlier. Adaptive management is a tool which should be used not only to change a system, but also to learn about the system in more detail, its limits and possibilities (Holling, 1978). According to Stankey et al, summarizing Hollings approach, "the challenge in using the adaptive management approach lies in finding the correct balance between gaining knowledge to improve management in the future and achieving the best short - term outcome based on current knowledge" (Stankey and Allen, 2009). Meaning that often the setting of the targets for the specific system will determine the short term success which will in return have a long-term survival effect on the change process.

Social and scientific processes play an important role in adaptive resource management. The focus processes are time management, control, building syntheses, evaluate strategic alternatives and communication of those. Optimization of those processes can only be reached if there is transparency from the management to include all stakeholders at the same level. Adaptive management can be divided into either passive adaptive management or active adaptive management, depending on how learning within the organization takes place. Passive adaptive management means that after the learning process only results are measured for example reaching a certain energy reduction target. Active adaptive learning on the other hand means that the learning process itself is part of the objective. (Holling, 1978; Waters, 1986). Both styles change when new knowledge is gained and the optimal strategy is found according to the updated model. According to Holling, actively adaptive policies are technically very difficult to implement, which prevents it being more commonly used but linking them to the best practice theory. The active adaptive management approach is very important when determining process context factors.

Key factors of both approaches are:

- Repetitive decision-making (evaluating results and adjusting actions on the basis of what has been learned);
- Feedback between monitoring and decisions (learning);

- Explicit characterization of system uncertainty through multi-model interference;
- Measurement of statistical interferences which are proof that a hypothesis is true; and
- Embracing risk and uncertainty as a way of building understanding.

The three main components of adaptive management in environmental practice are:

- **"Testing Assumptions** is about systematically trying different actions to achieve a desired outcome. This involves using specific knowledge to decide on the best known strategy. Data is constantly collected to find out if the assumption is true.

- **Adaptation** means to involve changing assumptions to react to new or different information obtained through the monitoring process and experience.

- **Learning** is about the documentation of the team's planning and implementation processes. Focus is on the internal learning process." (Holling 1978)

To summarize the adaptive management style the model presented in Figure 7 has been developed. It shows the most important stages that should be followed by an organization.

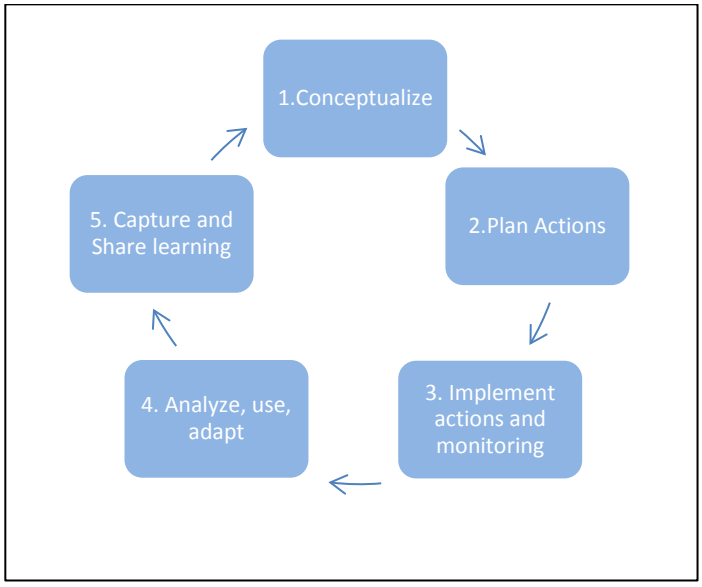


*Fig 8Change management Model formed after Hollings suggestion from 1978*

## 3.5 Summary & Findings from the literature review

From the literature review the following aspects were established.

The research aims at the food service sector especially QSRs. Following the American EPA definition, food waste is "uneaten food and food preparation waste from residences and commercial establishments such as grocery stores, restaurants, bars and company cafeterias". The three main areas of the research are 'methods, men and environment' following the Ishikawa root cause analysis as identified in section 3.2.4, common causes can be summarized as seen in table 9 below.

| Common Causes Of Food Waste | | |
|---|---|---|
| **Men** | **Methods** | **Environment** |
| Lack of awareness | Portion size | Weather |
| Wrong forecasting | Measurements | Seasonality |
| Too much preparation | Holding times | Events/holidays |
| Order mistakes | HACCP food safety/Quality control | |
| Lack of acceptance | Storage | |
| Aesthetical reasons | Labelling/ Handling | |
| | Promotions | |

*Fig 9 Summary of possible causes as described in the Ishikawa Diagram Section 3.2.4*

The main responses to the causes, previously identified in the Ishikawa diagram are summarized in figure 10 below. Because environmental causes in itself cannot be addressed with an active change they are not mention in figure 10. They can only be responded to from the viewpoint of the other two response categories, men and methods. For example heavy rain increases the number of visitors therefore the forecasting system needs to be adjusted.

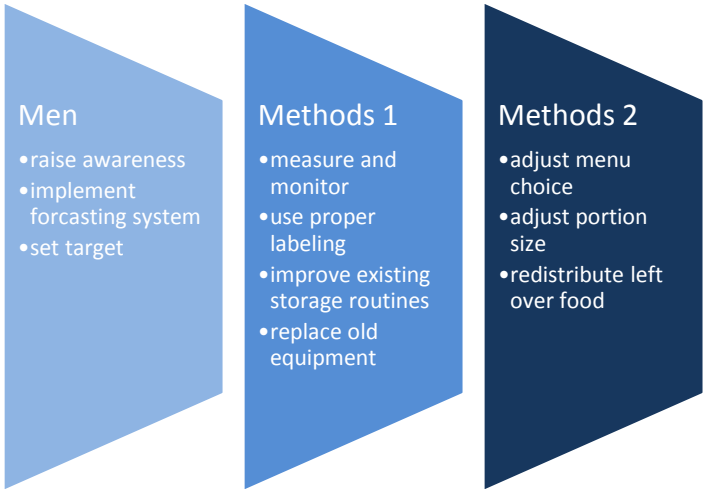


*Fig 10 Summary of main responses to causes of food waste, Hackfurth 2013*

### 3.5.1 Energy and water consumption

A side effect of food waste, is the waste of other resources, especially energy and water. The high usage for energy also causes $CO_2$ emissions. Those side "effects" can also be addressed by implementing some of the responses mentioned in figure 9.

The energy costs per cooked meal are estimated to be 4.64 Euro cents and on average 12 litres are used in the kitchen for a 500g meal (IEPA, 2008). Literature advises to change older equipment for more energy and water efficient machines and also suggests to implement simple measures like light sensors and water flow restrictors to achieve savings. Employee training on resource management plays an important role as well. Many companies are

specializing in equipment development and work closely with restaurants to test new technology. Best practices of resource efficient restaurants can be a great example to others and lead the way in the industry.

### 3.5.2 Best practice findings

Looking at all the best practices, it is key to identify common factors, actions and routines, certain baselines which make it possible to replicate the best practice process in other restaurants, too.

The five-step extrapolation approach by Ongaro was chosen to determine process context factors that made it possible to transfer a best practice from source site to target site. A process context factor is "defined as situational factor within the practice that is under investigation that is not a process design feature but provides the opportunities for a process design feature so it can function at its best". This is why I choose to first analyse the criteria of the GHA for the highest certification level (Platinum), different companies previously identified as best practices by the EU 27 report and some of the ISO 14000 criteria, to identify a common "best practice"-holders approach.

One example of an analysis of common factors and comparison between the three best practice sources is "monitoring and measuring" of waste streams. The figure below shows the findings of the ISO catalogue, GHA and EU 27 company examples and had identified "measuring and monitoring" as a common "best practice" action. This analysing approach had been repeated in relation to the most common responses to food waste as seen in *Figure 10*.

| **ISO14001** | **GHA certification criteria- Restaurants & Bars,** | **Company example**<br><br>**"Zu gut für die Tonne", WRAP** |
|---|---|---|
| Data collected from monitoring and measurement can be analysed to identify patterns and obtain information.<br>Knowledge gained from this information can be used to implement corrective and preventive action.<br><br>**Point 4.5.1** | Separate Waste into Recyclables, Food, Landfill, Hazardous/WEEE waste streams and manage and measure them<br><br>**Ref WST2** | "We measure all our waste. This way we can see if we reduced waste in one of the waste streams."- **ZGFDT Interview June 2013**"We always advise to the restaurants taking part in our projects that they start to measure their different waste streams. Also their food waste."-**WRAP Interview June 2013** |

*Fig 11 Example criteria comparison best practices, Hackfurth 2013*

Only when examples for the most common response to foodwaste were found in all three source areas I would rate them into a main focus area. Seven main focus areas were identified that all literature sources put special emphasis on and in which action was taken to accomplish energy and water savings and food waste reduction:

- Environmental management to prevent food waste
- Related water consumption
- Related energy consumption
- Purchasing
- Awareness creation & CSR

- Monitoring and measuring
- Routines

Similar focus areas are used to reach the highest certification level of the GHA.

The main goal was to compile different actions from these seven main focus areas that had led an organization to the development of best practice routines and that led to the internal identification of the process context factors. Putting this in correlation with Ongaors approach, "setting goals" could be an example. The "setting a realistic goal" based on the experience of the manager, for example, would be the process context factor in this case, the manager as being part of the process would be a "design feature". So reviewing the organizations mentioned in literature that are known for their best practice, often followed the actions and routines shown in figure 12 below.

Following Ongaros extrapolation approach, the criteria and actions in figure 12 all achieve the identification of the function (reduction of food waste), the identification of the practice (done and described by the EU commission in their report), the place of the practice within the system and its effects (for example the result could be an energy reduction in the dishwashing area as system) and finally the identification of the process context factor (a situational factor that gets the best out of the practice as part of the system, can be statistical measured, taught and replicated).
Figure 12 therefore represents a supporting tool to environmental manager, relating to all four stages of the PDCA circle as mentioned earlier meaning that they might be able to implement the best practice at the target site if they are able to make use of the known process context factors.

Some of the process context factors identified, that made the extrapolation (transferal from source to target site) possible were:

- Special training that the stakeholders had received previously
- Special equipment
- Experience
- Flexibility in menu planning
- Measuring of resources and ingredients used

Following these actions and routines too, does not necessarily mean for another company, that the outcome will be another "best" practice and not all criteria fit every organization but following these actions will have positive effects. In the end a best practice will always be the result of an innovation process started by individuals that work towards a solution to a common problem. But just simply fulfilling the actions and routines will not help the cause. Figure 12 needs to be part of a bigger change management plan that will also allow to follow up and further development. In combination, an organization can therefore reach a new level of more constructive actions related to resource use.

Therefore in conclusion it can be said that, with regards to this section, best practices are a special category of responses to food waste. They are difficult to establish with an analytical framework supporting them. They are often used in industry but difficult to find in academic literature.

## Environmental Management for Food waste prevention

- Collect data on the businesses environmental impacts
- Develop KPI for food waste, water, energy/CO2 emissions- to allow for environmental benchmarking
- Write an environmental policy for restaurant
- Set reduction targets for food waste
- Write a SWOT analysis for food waste. Found opportunities develop an action plan
- Extensive staff training on the issue and its prevention and reduction
- Annual review of performance and set new targets for the next year
- Food Portion Size– Different portion sizes should be offered to accommodate the guest needs
- Donate Food left overs to charities
- Regular Customer research on the menu items, portion size, and customer awareness
- Provide opportunity for visitors to "Carbon Neutral" their visit

## Awareness Creation & CSR

- Give information to customers on how they can be environmentally responsible during their visit, like sorting their waste
- Promote healthy eating options like different vegetarian meals
- Create awareness about food waste
- Offer doggy bag options where possible
- Use food items with environmental certification like KRAV,Bio

## Related Water Consumption

- Water audit to identify equipment with highest usage rate
- Operate a leak detection routine for dishwashing area
- Install and manage a grease trap to intercept FOG in the kitchen area
- Water flow restrictors on taps in the F&B department
- Installation of sub meter for dishwashing and kitchen areas
- Change to water efficient equipment

## Related Energy Consumption

- List of the major energy using equipment throughout the F&B department (Energy audit)
- All lights in use are listed including their type, class, wattage and measured/ estimated length of time in use annually
- Lights in use are divided into different electrical sections.
- Staff understands how hot water is produced
- Staff understands how heating/cooling operates and is distributed throughout the building
- Energy efficient bulbs need to be installed
- Automatic light controls
- The refrigerator should be positioned and regulated according to energy saving principles
- Sub meter for energy consumption in the kitchen

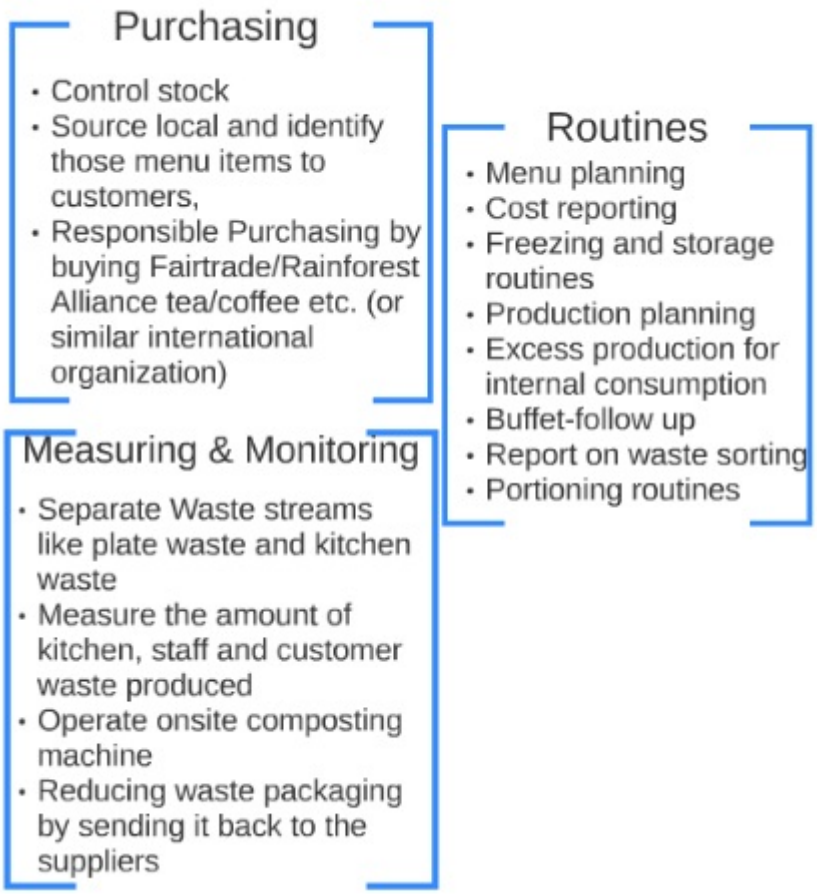


*Fig 12Actions and routines that help the identifiaction of process context factors, Hackfurth 2013*

### 3.5.3 Suggestions for a change management strategy

The actions identified earlier indicate whether the company is on the right track or needs some changes to get a grip on their food waste problem and their resource usage. So the best practices routines in figure 12 are used as a tool pointing to an appropriate change management strategy. With regards to the previously identified main focus areas to respond to food waste, "men, methods and environment", the factors especially target the most common problems of change management; communication and resilience. At the moment literature does not offer a change management strategy that specifically fits the needs of the food service industry but taking Hollings strategy into consideration such a strategy needs to function on the active adaptive approach meaning that the industry is so practical orientated that it needs continuous learning and development. Thus based on the above mentioned strategies of Leender, Meadows and Hollings and the expert interviews conducted, I would like to suggest the following six-phase change management strategy for the food service sector.

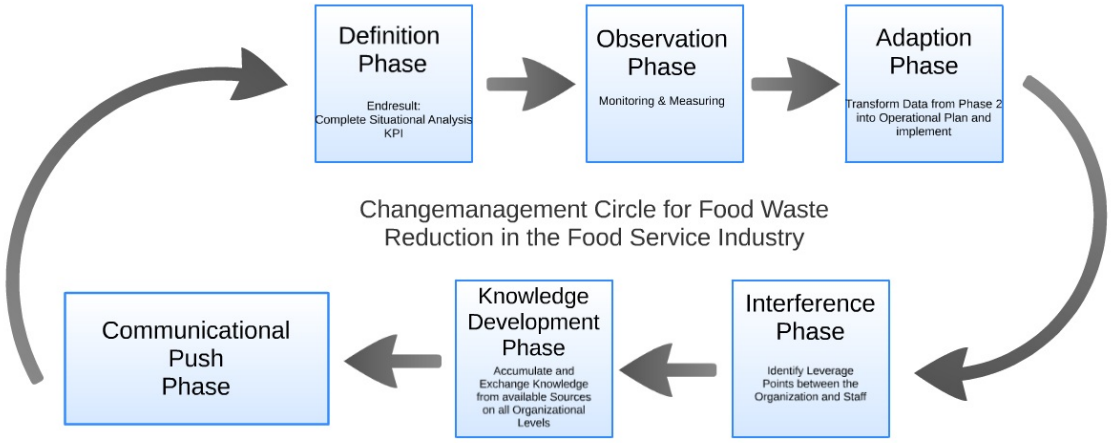


*Fig 13 Change management strategy with focus on the food service sector developed by Hackfurth, 2013*

During the first phase of the changemanagement circle the restaurant needs to define the initial scope, vision, goals and targets on sustainability in general and the reduction of food waste in particular. This also means that a baseline must be set for waste outflows of the different restaurant areas (kitchen & customer waste). In this phase it is very important to already communicate to all staff members what is going on in the background, so they can prepare themselves and also watch more closely how they follow certain routines. End result of the first phase is a complete situational analysis of the restaurant and the development of key performance indicators.

In the second phase new monitoring and measuring routines are introduced in different trainings to all staff members to involve them in the process. In this phase the pressure on staff is extremely high because it is asked of them to implement or change working routines while still ensuring that daily operations run smoothly. Here patience and guidance from all management levels is needed. Change takes time so clearly not everything will work out fine during the first try. The new measurement and monitoring routines include the weighing of spoiled products, the food waste from the kitchen preparation and the food waste from the customers. It is also important to check upon the recycling percentage and how much of the waste produced is avoidable or unavoidable. Strictly reporting on the developed key performance indicators will help in later stages to track the development and to detect hick ups in the processes.

The following phase is the adaption phase. Here it is helpful to check the restaurant against the developed criteria from the previous chapter since it may open up opportunities to implement routines that might lead to a best practice development. It is also a usefull tool because it helps to determine which aspects need more focus like waste sorting for example. In this phase all data collected during the previous phase will be analysed and transformed into an operational plan. In this phase it is also important to review goals and targets that were set during the definition phase and maybe adjust them if necessary. All goals set should be "smart goals" (specific, measurable, achievable, realistic and timed) (Doran, 1981).

A very important phase is the interference phase. In this phase resistance needs to be identified (here it does not matter if it might be a newly adapted process from the previous phase or staff which is not happy about the change). Similar to Meadows, leverage points with the system as a whole need to be identified to create opportunities of interaction. Very

common examples for leverage points within the food service industry would be the information flows including feedback, rules within the operation, the goals that were previously set and the different system outflows. In case the problem lies within the staff team special focus needs to go towards updating the information flows.

In the knowledge development phase, exchange between the co-workers and external sources needs to happen about the new routines. This phase is like a system check-up in which ideas are followed up, the routines and goals are reviewed again and the restaurant can benchmark itself against the other restaurants in similar processes. This way everyone can profit from each other's experience on food waste reduction and together ideas can be taken a step further. This phase is heavily based on continuous learning and testing and can also function as a platform for the development of a knowledge management system that interlinks the different stakeholders.

The last phase is the communicational push phase. Meaning that in one push campaign the efforts, which the restaurant is making, will be communicated to the different stakeholders like the municipality, the local restaurant association or the suppliers but most of all to the consumer. If consumer awareness of the food waste problem grows than it will be easier for the restaurants to approach the consumer and together change behaviour by adopting common responses. Once the restaurant has reached this final phase, it needs to return to step one to review the entire process. Therefore the strategy always stays up to date.

# 4 Case Study & Findings

## 4.1 Company Overview and general findings

As already mentioned in the methodology chapter, the case study consists out of the review of three QSRs in three different countries, China, Sweden and the Netherlands. The production in the kitchen is minimal because most of the preparation is outsourced. The restaurants all belong to the same QSR franchise chain which operates on a global level. The restaurants all cater for a bigger department store. The three examples fit in their description to a subcategory of QSR, "the fast casual restaurants" meaning that they offer high quality food rather than the normal range of a QSR but still only offer minimal table service. (Observation, F&B manual) The restaurants are a supporting business to the main business. The concept is serving high volumes at the lowest price possible at its core without making misuse of anyone that is part of their supply chain. (Internal document 2012, page 20).

Different reduction targets have been set for water and energy consumption with the chains main F&B department but none was set for food waste, in contrast to the fact that they have identified food waste as a problem. They hope for example for an energy reduction of at least 40% till 2015 in their main Dutch restaurant. This also aligns with the survey result of 88% of the customers putting great effort into saving resources like energy and water at home. It is important for the restaurants to be a front runner in the field of resource efficiency. Out of the survey conducted among 217 participants that have visited a restaurant either in Sweden or in the Netherlands, 86% of all participants see themselves as highly environmentally concerned. So this is a relevant area to take action in. All actions taken can also give them the advantage of a unique selling point. But at the moment only 23% of all participants think that the restaurants are actively working to reduce their environmental impact. Only 23% of the customer can name an environmental initiative promoted by the restaurant (UTZ coffee and recycling bin are the majority). Very little is communicated to the customer. This is also related to the fear to be benchmarked and compared with other QSRs (Interview F&B manager). However one of the main responses to food waste mentioned in literature is to create customer awareness. At the moment only 14 of the survey participants felt encouraged by their visit to behave more environmentally friendly at home. Therefore there is still a lot of room for improvement. 84% of the participants perceive food waste as a relevant topic to them. 14 % rate themselves as very concerned and take action, while 37% feel concerned and 33 % realize it is a problem but are not highly concerned.

Some of the restaurants of the chain have already shown great reduction efforts by implementing routines and practices against food waste. But because there is a lack of communication between the different restaurants and the head offices nationally as well as international, not all practices are known to the managers in charge. Because of this lack in communication, many practices get lost in the system which is a pity because utilizing the staff's ideas can lead to great successes.

Most of the ingredients for the restaurants come from European food sources but for example the meat products for the Chinese market must also be produced in China. In general the company tries to source locally, for example products from the vegetable range like carrots, salads and potatoes, but due to the large volumes needed this is not possible at all times. This is also the reason why it is almost impossible to use ecological certified food items because this would empty the market (Interview F&B manager, July 2013). The ingredients are usually prepared (e.g. pre-pealed), handled and transported to the restaurants by third-party companies. Almost every product used in the restaurant is either ready to serve or was pre-cooked and then frozen, it can be heated up and cooked to finish quickly. For example, salads

only need to be assembled in the restaurant kitchen. The general rule is that the kitchen prepares 50 % food which comes from the so called global range, like spaghetti with tomato sauce and 50 % from the local range like, for example in China, a local noodle dish.

The F&B area affiliated to the main restaurant consists of an kitchen area, which also provides food for the staff restaurant and is directly connected to the service, a loading area where materials, incoming orders and waste is stored and handled, two dishwashing areas, one for the kitchen utensils and one for the dishes that come from the customers and sometimes a cooled waste storage, depending on the country the restaurant is situated in. The staff restaurant is always connected to the backside of the kitchen to be able to serve both restaurants at the same time. Only in bigger restaurants that are connected to a larger store, the staff restaurants have their own staff kitchen with a couple of appliances like a fridge and an oven. In some of the stores extra office space is attached in which case the staff from the office will also use the staff canteen. The staff kitchen and normal kitchen share the dishwashing and storage area. The kitchen area usually consists of a working space where the food can be prepared and the generic kitchen equipment like steam ovens. Usually it is cooked in or on electrical appliances. The kitchen also includes a cold storage, walk-in-fridge and a walk-in-freezer. The kitchen is mostly set up so that the freezers and fridges are not placed directly next to the ovens which saves energy required for cooling and heating.

### 4.1.1 The process from production to customer in general

Depending on the size of the restaurant, the set up sometimes differs but the main elements stay the same.

**Restaurant**

The customer enters the restaurant and follows a self-service line in which he first passes an area with desserts, pre-packaged foods and drinks. Then the customer enters a serving area in which he can order hot meals from the kitchen staff, waiting behind a counter. Selection is made out of a small menu that is communicated via signs. One can also see how the food is prepared because it is possible to watch parts of the kitchen in the background when looking over the counter of the serving area. The meal is assembled for the customer according to a menu card to ensure the same portion size per customer. According to a survey conducted for this research it was found that 40% of the customers would have wished for a wider range of portion sizes. Nevertheless were the meals finished by 67% of the participants. From the serving area the customer can then move forward to a salad bar, sometimes soup and bread is served there as well. In other restaurant set-ups, soup is available at the serving area. The customer pays and in the following continues to the beverage area of the restaurant where he can serve himself pre-purchased drinks like coffee or soft drinks from taps. It is possible for the customer to refill the glasses or mugs when wanted.

After consumption of their meal the customers are asked to empty the table and place their serving trays in the indicated area. Again depending on the set up of the restaurant, this can either include sorting their own waste into provided bins and place the tray on a conveyer belt which ends in the dishwashing area or place the trays including all their unsorted waste in a dedicated serving tray area where staff picks up the trolleys with the full trays later. The survey also showed that in restaurants offering waste sorting options, 76% of the customers make use of them. Furthermore it was found that 94% of the customers also recycle into the different waste fractions at home. 18 % of the 94% rate themselves as a very good in recycling, while 43 % admit small mistakes and 33% admit that they are just average at recycling.

When arriving in the dishwashing area all waste left on the tray is then sorted into paper, glass, plastic fractions by the dishwasher room staff. Some restaurants also distinguish between residual and organic waste. Food which is left over from the cold cabinet is either stored to be used the next day or will be disposed of by the kitchen team at the end of the day. Food that is left over from the hot meals will be disposed of after its holding time ended or at the end of the day. In general it can be said the company follows extensive rules around food storage to waste as little as possible. All restaurants use the same labelling system. Food that needs to be stored will be stickered with the information when it was prepared or de-frozen, since when it already has been stored and when the estimated use-by date is. According to the length of the time stored the labels colour is changed every day. When food in storage comes closer to its use by date it is checked whether it can be used maybe in a staff meal or needs to be thrown away. Sometimes food items are sold at a lower price or are given away for free in the staff canteen.

Another aspect that is the same for every restaurant of the chain is the 'Food Health and Safety'-protocol. It is based on the Dutch national standards, one of the hardest to reach worldwide. For many restaurants following those standards is a big challenge because they are much more extensive than their own local legal requirements. Nevertheless finds a restaurant itself in the position to be confronted with a stricter local regulation, they of course have to follow local regulation.

**Staff restaurant**

The staff restaurant functions in a similar set-up. The food served there is prepared in the main kitchen (or the staff kitchen). Staff can normally choose between a local vegetarian and a local meat option. This also requires more onsite preparation and usually regional ingredients are used. Some staff restaurants offer a bigger choice which can also include different desserts, salads or sandwiches. The employee serves himself and therefore portion size can differ from time to time, even though a sample plate is provided. The employee pays for his main meal and can continue to a salad bar and a beverage area. The prices in the staff restaurant are lower than in the customer restaurant because the company subsidises the staff meals. But in general it is said by the company that a staff member should never be treated differently than a customer (Interview F&B manager, July 2013). Like the customer of the main restaurant, the employee is asked to clear his table and sort his waste into fractions (organic and residual) and place the cutlery and plates away in the provided bins. Soft drinks, hot beverages and a small fruit selection is offered during the whole day for free.

**Dishwasher room**

The dishwashing area is an important control point for the F& B area. Not only are dishes cleaned but waste is sorted here too. All restaurants use dishwashing machines from the same brand but they may differ in size and production year. Some restaurants use older models where dishes have to be collected in trolleys and are manually put into the dishwasher while other restaurants use a conveyer belt technique where dishes are placed on the belt by the customer, so the staff does not necessarily need to leave the kitchen to collect the dishes. Before the dishes enter the machine, waste that is still on the tray is sorted into different fractions: glass, plastics, residual and organic waste. Left over liquids are usually put down the sink. The dishes and cutlery are sorted and then put through the machine where they are first pre-rinsed and then go through a full washing cycle. At the end of the machine the clean and dried cutlery and dishes are sorted again and then redistributed to the restaurant. The machine is usually given a quick clean after the busy lunch hours and then a proper clean after closing

time. In most cases the dishwashing machine is not connected to a separate water metre but is thought to consume the most water.

**Waste area**

In the waste area of the kitchen several waste fractions are collected and then further transported to either the waste recovery area (glass, paper, carton, plastic) or the food waste storage where it is then collected by the waste company. The amount of organic waste collected differs from time to time and can be strongly influenced by outside factors like weather or national holidays.

Also in some countries, not all waste is sorted in the way it should be because recycling further down the line cannot be ensured. One major rule, that is enforced throughout the whole company is that no organic waste should go to the landfill. The company sticks to the food hierarchy pyramid that had been developed by the US EPA shown in figure 12.

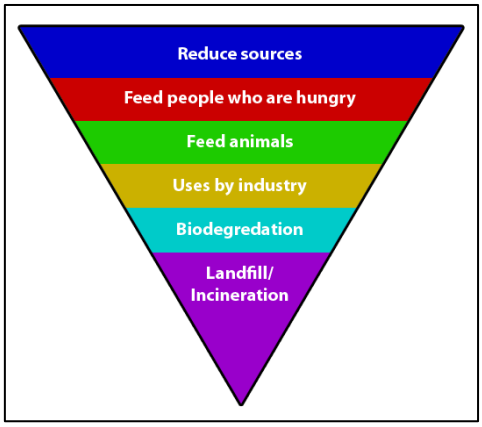


*Fig 14 Taken from US EPA: Food Waste Hierachy*

## 4.2 The Case Study Findings

### 4.2.1 Introduction

All restaurants taking part in this study have volunteered by themselves which also lines up with the fact that the company has also observed the major trends surrounding the topic of food waste and is interested in finding solutions.

| | China, Shanghai | Sweden, Gothenburg | Netherlands, Delft |
|---|---|---|---|
| Floor Size of the Restaurant | 2480m³ | ~ 1200m³ | 1703m³ |
| Number of employees | 52 | 90 | 90 |
| Number of Items Sold | 14555 | 4729 | 11,040 |
| Items per customer | 3.8 | 2.2 | 4.9 |
| Customer tickets | 3806 | / | 2264 |

*Fig 15 Comparison summary of the case study examples, Hackfurth 2013*

**Example 1: The Netherlands**

The restaurant in Delft was chosen as a case study because it is directly located next to the headquarters of the franchise owner. With 1703 m³ it is also one of the biggest ones in Europe. When new ideas and technology need to be tested than this restaurant functions as the concept leader. Everything gets put to the test with the customer here first and is than rolled out into the other quick service restaurant of the chain. The restaurant functions as a good example within the company and also provides benchmarking data. One of the new technologies being tested is a food grinder system for example. This restaurant is classified as "top level interest"–case. Because of its position as a leading example the pressure to perform well is high and therefore the willingness to take risks in trying new ideas is bigger than in other restaurants of the chain.

**Example 2: Sweden**

The restaurant in Gothenburg is rather small compared to the other two case examples but currently has the same amount of employees. In the near future though the number of employees will be decreased to fit the demand. The restaurant is classified as medium level interest case. It was chosen because its size, set up and location resembles the majority of the chains restaurants. In general the restaurant has implemented many of the ideas that were suggested by their country head office but struggles to gather all key performance indicators to benchmark themselves with other Swedish stores. The implementation of new ideas is looked at rather sceptical unless it has been a proven success before.

**Example 3: China**

Even though the restaurant in Shanghai is the biggest one of the case examples with the most meals served, it is the one that was expected to perform the lowest. The restaurant was chosen because China is an important emerging market with growing numbers of citizens. It is especially important to counteract problems like food waste or resource scarcity at an early stage. So it is important to observe and analyse in the "starting phase" to prevent what might occur in other restaurants in China later. The restaurant is located next to the Chinese head office of the company and therefore not only serves the customers and staff of the restaurant but also the headoffice staff. The Shanghai restaurant was expected to perform the lowest due to the fact that it struggles with the implementation of the suggestions of the franchise owner. Some information is lost in translation or takes too long to be translated while other ideas are just not feasible to implement in the country. Because of the political situation and governmental goals, other issues like energy savings are also ranked a higher priority than food waste.

At the moment no target for food waste reduction has been set on a global level and not every restaurant is able to provide the KPIs for a global benchmark. The main incentive for reducing food waste, related energy and water consumption at the moment, is the decrease in related costs for the company. Also none of the participating restaurants has set a goal to decrease food waste even though all of them are actively trying to avoid food waste in the kitchen.

### 4.2.2 The process

**Restaurant**

Like described above the customer selects his food in the quick service restaurant by following a self-service line till he reaches the hot meal section where he is then helped by one of the

staff members. In the Delft restaurant customers can use two serving lines which are both open during the day. In Gothenburg the restaurant has also the possibility to use a second serving line and usually does so during the peak hours. In the Shanghai store are even 3 serving lines at the disposal of the customer during peak hours and two lines during the rest of the day.

The three example restaurants do not differ in the food preparation except for the different local dishes on the menu. Still only minimal amounts of food are effectively processed onsite. Due to the forecasting and planning system all three restaurants use, overproduction of food takes only place in rare cases. In the Delft restaurant the forecasting works so well that up to the day of company visit, the forecast had only been off by 3 % for the entire year (F &B manager, June 2013). Both other examples were only slightly above the Dutch three percent but looking at the entire year these results should be seen as a companywide achievement. This systems states exactly how much food needs to be prepared by the staff and takes into consideration what is still in storage. The system works for hot and cold dishes.

A main difference observed in the three examples was the portion size in the restaurants. A too large portion size can lead to big amount of consumer plate waste. Extreme amounts of plate wastes were observed in China. This starts already with the fact that according to the recipe cards provided, a Chinese average meal weighs around 360 grams which is 40 grams more than the average Dutch and Swedish dish. The biggest proportion of the meal consisted of 160 grams of rice. "Serving the customer fast" being one of the main attributes to a quick service restaurants, it was also no wonder that in the Chinese restaurant often the portion size was not checked for accuracy due to the large waves of customers flooding the restaurant at lunch time. And this was not in the disadvantage of the customer! The contrary was the case, staff rather put a little bit more than too little. As an example while eating in the restaurant myself, I ended up with a 600-gram meal!

During the observation it also became very obvious that there was no possibility to maybe offer different portion sizes to the customers because of the high volume of customers. Another reason for the big average size of the Chinese meal is more of an external factor than an internal one. Chinese people in general come from a culture where leaving food on the plate is socially accepted, even signals wealth to others and is a compliment to the host. Furthermore it is part of the Chinese food culture to try a lot of little portions to have a bigger variety of food. Having one big meal like the restaurant serves it, is new to them so they still order several plates to be able to taste the different meals. Another problem that the kitchen staff faced was the amount of rice leftovers in the serving dishes. When the rice got a bit colder in the tray, it developed a stickiness that comes close to cement which makes it very difficult for the staff team to get all food out of the dish and requires blunt force. This can lead to several kilograms of avoidable food waste every day. On the positive side it was observed that a lot of people in the Chinese restaurant make use of a so called "doggy bag", a plastic box in which they can transport their left overs home. This was not observed in Sweden and is against food safety regulations in the Netherlands, because the restaurant cannot ensure that the customer stores the leftovers in the proper way while being on his way home. The doggy bags become more and more popular in China and also the Chinese government has started a new campaign in which politicians are asked not to waste anymore food while being on official dinners. This will hopefully also have an effect on the customers.

Another difference that was observed in the example restaurants was the disposal of the waste after the customer is done eating. In the Gothenburg restaurant, the customer is asked to sort his own waste and then place his tray with the dishes on a conveyer belt which leads into the dishwashing room. In the Delft restaurant, the customer also places his tray with the dishes on

a conveyer belt but leaves his entire waste on the tray. In Shanghai the customer is asked to leave his tray with all his dishes and waste in a trolley in designated areas to be collected by kitchen staff later on.

**Staff kitchen**

In the staff kitchens and restaurants were only a few differences noted. While Delft and Shanghai offer a vegetarian and a meat option consisting out of local dishes, Gothenburg has dedicated an entire day per week to serve only vegetarian meals to the staff team. The vegetarian day is perceived by the staff team mainly positive and members of the team that want to eat something else bring their own meal from home. In the Delft store two menu options are served. Both are presented to the consumer with a sample plate. A choice of different salads is also availabe. In China a buffet with local dishes is served as well as a special section with food options from the global range. This is offered because the staff restaurant also caters for the headoffice with international guests.

A common problem for all staff restaurants seems to be the forecast the amount of staff members eating at the restaurant each work day. The number of staff that comes to visit the restaurant, changes according to different shift plans and number of workers present. For restaurants that also cater for the staff from the head office, it was suggested that bigger groups with visitors let the kitchen manager know beforehand if they will attend lunch but sometimes it happens that even though the food was pre-ordered the group decides to eat out which leads to big amounts of food waste. Like the customers, the staff will sort their waste and clean away their dishes after they have eaten.

**Dishwashing room**

The most significant differences were observed in the dishwashing room. All three restaurants have models of the same dishwasher brand but from different production years. They are said to be energy and water efficient but of course only if they function in the proper way.

In the Shanghai restaurant some functions of the dishwasher were not working, for example the sensor that steers the pre-rinsing valves. As a result, the water coming from the valves was constantly running, also with no plate passing by. Furthermore the spray injector connected to the sensor was also broken which meant that the dishwasher team had to pre-wash all the dishes before putting them into the machine. They did so by keeping the water constantly running in a sink that was positioned next to the machine sometimes even overflowing because the drain was clogged. Calculating that a normal tap runs at at least 12 litre per minute, 2880 litres were lost only during lunchtime from that one sink, not calculating the amount of water the dishwasher used up for a cycle by itself. The machine was also leaking and about 2 cm of water was standing on the floor in the entire area around the machine. The staff team was also supposed to sort the waste into the different fractions but due to the amount of extra work and customers that needed to be served, no efficient sorting took place. This is the reason why daily leakage routines are an absolute must! Both machines in Gothenburg and Delft were working in the way they were supposed to and waste was sorted commendable.

**The Food Waste Management**

The management of the food waste is very different in each of the restaurants. While the franchise holder has the general rule that no food waste should go to landfills, in Shanghai it is not sure what happens to the organic waste after it has been collected. The municipality

collects the organic waste every day and charges per bin that is disposed off. Different options were proposed to what happens next in the chain. It was suggested that the municipality delivers the waste to the farmers surrounding the mega city, so they can use it as food for the pigs. Others suggested that it is composted or still landfilled. Also the Shanghai restaurant never measured how much organic waste they actually dispose of and all numbers acquired are based on estimation and observation. This is in complete contrast to what is happening in the Delft restaurant. Here a new food grind system is being tested that grinds the food and then dewaters it. Three grinding stations have been installed, in the staff restaurant, the dishwashing room and the main kitchen. The grinder reduces the volume of the food and the dewaterer takes away up to 30 percent of the weight of the waste by discharging liquids after centrifuging the waste. This way the costs for the waste pick up were reduced and the food can go to composting or can be used in an anaerobic digester. Delft functions as good example. In Gothenburg the food waste is collected once a week by a contractor and is then brought to incineration. Here it would be interesting to look at other options.

The Delft restaurant is also the only participant that had collected precise information on their waste amounts, weights and costs which are reliable over a longer period of time. One of the company standards is to record the costs of avoidable pre-consumption-food waste, for example food items that have gone bad in the storage but when going through the different waste reports it seemed that the Shanghai restaurant produced less storage waste than the Delft restaurant and the Gothenburg restaurant even though a lot more food waste was produced in the kitchen. From this it could be concluded that the Shanghai store might have not recorded all waste produced.

### 4.2.3 The food waste measurement

To gain an overview of the amounts of food waste produced during one day of operations measurements were conducted in Delft and in Gothenburg. It was not possible to repeat the measurement in the Shanghai restaurant. The following data was collected.

| | Delft | | | Shanghai | Gothenburg | | |
|---|---|---|---|---|---|---|---|
| | **Customer Restaurant** | **Staff Restaurant** | **Total** | **Total*** | **Customer Restaurant** | **Staff Restaurant** | **Total** |
| **Total waste (kg)** | 102 | 55 | 157 | 1500 | 71 | 31 | 102 |
| **Waste per Customer ticket** | 0.06 | 0.09 | 0.07 | 0.4 | 0.04 | 0.4 | 0.2 |
| **Unavoidable food waste (kg)** | 11 | 3 | 14 | 405 | 11 | 13 | 24 |

*** based on an estimation made by the food & beverage manager**

*Fig 16 Results of Waste Measurment taken in the case example restaurant, Hackfurth/Drewitt 2013*

The measurements in the Delft and the Gothenburg restaurant were taken on a day which was rated as 'slow'. As the diagram shows the numbers from the Shanghai restaurant are only based on estimations made by the food and beverage manager. But they seem realistic from observations of the trays and customer tickets for that day. Looking at the big picture it is difficult to compare the Shanghai restaurant to the other two examples because it differs so much in size and sales numbers. In comparison, the Gothenburg restaurant has the lowest

amount of food waste of the three examples but it is also the smallest according to the floor size and it caters for less people. Especially in comparison to the Delft restaurant, Gothenburg even produces a higher amount of food waste. With only a low number of customers Gothenburg already reached 71 kg of waste while the Delft restaurant with a significantly higher amount of customers reached only 102 kg in total. For the measurements taken in Delft, the staff did not use the grinder system but collected seperatly to gain more accurate measurements of what was thrown out for that day. So while Delft had a higher number of visitors in the customer and staff restaurant, they only had a total amount of unavoidable food waste of 14 kg. The Gothenburg restaurant had 24 kg. Though it has to be noted that a reason for the high amount of unavoidable food waste, like potato or carrot peels, might be the weekly vegetarian day that was offered to staff.

## 4.3 Causes of and responses to food waste within the example cases

All three examples are fighting with the common causes of food waste in the categories men, methods, and environment. The findings presented are mainly based on the interviews with staff and observations made in the different restaurants. While in one restaurant some causes might be more evident than in the other, they all share a number of common causes and common responses.

### 4.3.1 Causes

In the Shanghai restaurant for example the most urgent causes for food waste in each category are the lack of awareness of the problem itself with staff not belonging to the management. Also the big portion sizes and the complete lack of measurements contribute to the food waste problem. Staff is trained on environmental issues in general but not all staff receives the same training within the restaurant. Some receive training on the use of chemicals while others receive a general recycling training. This is also linked to the fact that the dishwashing team in the Shanghai restaurant comes from a third party company. This can lead to a problem because the dishwashing team is also responsible for sorting the customer food waste stream. From observation it can be said that it is extremely difficult to sort up to the expected standards when handling the volumes that the dishwashing team is confronted with in this particular restaurant. Checking the food waste bin from time to time for proper sorting is not one of the priorities of the shift leaders. Also the dishwashing team does not receive the recycling training like the other employees do. The biggest creator of food waste within the Shanghai restaurant is the customer, yet the problem is not communicated to the customer at all because other messages are prioritized by the communication team. This is to a certain level understandable because the customer should not be patronized during a visit but rather encouraged in a positive way and the messages should fit the main goals. But trying to avoid the problem with the main originator will not help in the long run. As mentioned before the portion sizes are rather large as can be seen from the different recipe cards. Unless there will be external factors arising that will change the Chinese attitudes towards food waste in general a smaller portion size is urgently needed and the menu offered needs to be adjusted to consumer behaviour. Another problem is the uncertainty about the waste outflows of the restaurant. Everything that the restaurant can sell later on the recycling market is tediously weight and recorded. But because there is no value related to the food waste but only pick - up costs, which are a fixed value every day, no one really takes the time to measure the volumes. Furthermore the waste recorded for spoiled items does not line up with what it should be considering the size of the restaurants. Nevertheless an accurate measurement and recording of the waste could be turned into cost savings. Also the constant weather change in the city with lots of rain and humidity can sometimes form a problem causing food waste because the visitor numbers will deviate from the actual forecast.

In the Delft restaurant on the other hand, all staff of the restaurant is aware of the problem and is actively working towards reduction. Here the main causes are short holding times, food safety and adjustment to the forecasts during the day. A lot of the meals on the menu are served in combination with potatoe-based side dishes. One of them being French fries with only seven minutes holding time. So instead of trying to offer only two potatoe-based side dishes with longer holding times, the customer is given many different choices. Like the Shanghai restaurant, Delft is dealing with high visitor volumes especially for the breakfast time. The restaurant is also not measuring their food waste on a regular basis, but still management has a better idea of the amounts thrown out because of the installed grinder system and the costs that are much higher than in Shanghai. The team responds rather well to causes from the environmental category meaning that, unless the Netherlands is suddenly caught in a heat wave (like in the recent summer 2013), weather does not influence the daily routines and forecasting as extremely as in other examples. Still the biggest problem is taking the risk to adjust the forecast during the running operation for the day, for example for the breakfast buffet. The guests are used to finding the breakfast buffet completely filled even when breakfast will end a couple of minutes later which also is cause for a lot of food waste.

In Gothenburg the main causes identified are over-production in the staff canteen and the lack of measurement. Because the kitchen team has little indication how much staff will make use of the canteen, they face over-production many times per week. Often left-over meals can be stored in the fridges to be used as an ingredient in another meal but still the avoidance of the production of the food in the first place could save resources. Again there is a lack of measuring the outflows.

### 4.3.2 Responses

All three cases already implemented some common responses to be more environmentally friendly. For example the UTZ (Mayan language for 'good') certified coffee offered in the restaurants. UTZ guarantees that all workers on the coffee plantation are trained in the usage of water and resources in general. Because coffee grind is classified as food waste using UTZ certification as part of the supply chain saves resources. Lots of the fish used in the meals are MSC certified and at least one item on the menu is organic.

Two of the major responses to food waste are proper storage routines and forecasting. Both, storage routines and forecasting work exceptionally well at all three case examples. The Shanghai restaurant has even developed a storage tool which helps to save plastic wrappers by using closed food trolleys systems with transparent plastic doors. The food is prevented from being in contact with any contamination source and there is less spoilage due to water condensation, for example with the salads. Furthermore plastic containers are being offered that the customers can purchase for 1 Yuan which reduces the onsite waste for the restaurant. Those containers function as a doggy bag. For some customers this even functions as a proper take out option. In the Delft restaurant this response is not allowed due to local food safety regulations but Delft has developed different techniques to reduce their waste volume. Because of the grinding system installed the volume of the waste in the Delft restaurant went down and they are now even considering onsite composting. Because the restaurants operate really cost conscious the unavoidable food waste from the preparation is already minimal.

Another common response is practiced in the Gothenburg restaurant where food left overs are redistributed to a non-profit organization that in return offers meals to people in need. Unfortunately for the organization this kind of food redistribution is only possible on special occasions of the year when a buffet is offered to the customer. Outside of those buffets the amounts of food waste produced that still could be donated are too little.

In general it can be said that all three cases might not have proper goals and reduction targets yet but they have understood the urgency of the topic and are working hard to reduce in many different ways. Still there is room for improvement especially on the customer side.[7]

[7] The analysis section has been largely developed on data that has been collected together with my colleague during visits to the three different case examples.

# 5 Analysis

Comparing the case study examples to the literature findings becomes very significant when looking at several main areas of the review for example the quantification of the food losses, the responses and the change strategy behind it. All findings from the analysis are based on the observations made in the different restaurants, the survey and the interviews held.

## 5.1 Quantification of the losses and related costs

When looking at the measurements conducted in the three case restaurants, it can be said that even though the numbers seem very high at first, they are well within the average identified by the literature. For example the SRA study mentioned an average waste per day around 60 kg, 0.5 kg per customer for restaurant that were smaller in size then the ones mentioned in the case study. Therefore looking at the totals of 157 kg (Delft) and 102 kg (Gothenburg) is a more than expectable outcome. Both restaurants also stay significantly under the estimated plate waste of 500 grams. While two of the restaurants excel, the Shanghai restaurant falls complete out of range. The total estimated 1500 kg would be four times more than the average. The 400 grams plate waste per customer for the Chinese restaurant is still under the estimated UK average though (SRA, 2010). The WRAP study found similar results but based them mainly on the number of employees. For example looking at a 90-employee-QSR the estimated amount of food waste for the entire restaurant would be 156 kg per day in the UK. Taking the result of the measurement 157kg x 313 + 320kg (double the amount on busy days) x 52 (estimated busy days) than the restaurant in Delft would produce 73 tons per year, 83 tons less than estimated. For Gothenburg with soon 60 employees the calculation for one year would be 102x 313+204x 52 around 43 tons 33 tons under the estimated UK average. This is also due to the fact that both restaurants have already implemented some common measures against food waste like forecasting and storage routines like suggested by the Nordic council of ministers (2011). The WRAP study also mentioned that 30% of the food waste in a QSR is avoidable, this would mean 21.9 tons of avoidable food waste for the Delft restaurant and 12.9 tons for the Gothenburg restaurant.

| | Delft | Gothenburg |
|---|---|---|
| Food Waste per year in tons | 73 | 43 |
| Avoidable Food Waste in tons | 21.9 | 12.9 |
| 500 gram meals wasted | 43500 | 25800 |
| Extra Energy costs in Euro per year | 2032 | 1197 |
| Water lost due to wasted meals in l/m3 | 525 | 309 |
| Extra water costs per year | 610 | 360 |
| Total amount that could have been saved in Euro | 2642 | 1557 |

*Fig 17 Summary diagram possible cost savings, Hackfurth 2013*

The UK EPA had identified the costs of energy per meal to be 4.64 Euro cent per 500-gram-meal. For the Delft restaurant the amount of avoidable food waste would equal 43.800 "500-gram"-meals wasted. This equals an extra energy cost of €2032 for the restaurant. For the Gothenburg restaurant 25800 meals are wasted which would equal €1197 in energy costs. According to the US EPA around 12 litres of water is used per 500-gram-meal that means that with 43800 "500-gram"-meals in Delft also 525.6 l/m3 of water are wasted. For Gothenburg

309.6 l/ m3. This equals extra costs of 610 Euros (based on 1.16 Euros per l/m3) for Delft and in Gothenburg 360 Euros.

## 5.2 Responses, Best practices and Process Context Factors

Comparing the cases to responses to food waste found in literature it needs to be said that even though they might not have fully picked up upon all possible responses yet, they are using several reduction strategies already. Not picking up on all the responses is also linked to the fact that no one so far had really looked at all the causes throughout the case examples because to the restaurants the most important causes had been linked to costs and those had been successfully responded to. In the following it was determined to what extent the case examples already fullfill the criteria and actions that had been identified (Fig. 12), to establish the process context factors that could be taken from the source site to the target site (the restaurants) and that are needed to implement best practices. The list consists out of seven main response areas (Fig. 12), to known causes and can be traced back to the Ishikawa diagram (Fig. 3). The areas are environmental management, water consumption, energy consumption, awareness creation and CSR, purchasing, routines and measurement & monitoring.

### 5.2.1 Environmental management

The first response area can be summarized as "environmental management" factors. In literature it is often said that the first step is to make a decision to agree on the problem itself. All three case examples have collected data on the environmental impacts of their businesses. Also all three have developed key process indicators for food waste, water and energy/ $CO_2$ emissions to benchmark. Not in all cases though, the data regarding the KPIs was collected strictly in the way it should have been because of different reasons. For example the Gothenburg restaurant has trouble to fill in the KPIs on a regular basis because they do not have full access for example to the data from their waste collector, while the Shanghai restaurant seems to base some of the numbers available on estimations purely. All three restaurants have developed an environmental policy for their business but none of them have set proper reduction targets for their food waste yet. But the Delft restaurant has developed an action plan on what the next step should be. Even though staff is informed about the problem and fully aware, no proper training on waste reduction has been offered to the staff in either of the restaurants yet. Also because of the lack of set reduction targets, there is an annual review on how the restaurants are doing but this does not take food waste into consideration. Again only the Delft restaurant tries to also review waste factors. A big cause for all the food waste is the portion size of the meals. But different portions sizes are only offered for one meal on the menu which does not necessarily help to accommodate the guests' wishes. The large volume of edible left overs are usually thrown out, except in the Gothenburg restaurant. Here food donations are made when a buffet is offered to the guest e.g. with Christmas or food is reused in the staff canteen. None of the restaurants asks food waste specific questions in their customer research but they do ask food waste related questions in the staff survey. The last factor that was identified from literature was that many restaurants offered their guests to carbon neutralize their visit. This is also not possible in the case examples yet, but might be a future option.

### 5.2.2 Water consumption

Food waste and excess water consumption are closely related. On average 12 litres of water are used to prepare 500 grams of food (US EPA). Hence the amount of water consumed in a restaurant can lead to an increase in costs. Therefore it is important to identify the kitchen equipment with the highest consumption rate. None of the restaurants has conducted a water audit as such but they are aware of the consumption of the equipment used. Other than that

all three case examples are applying a leak detection program more or less successfully. The staff member closing after the last shift will check for visible leaks when closing down the restaurant, the problem is that some leaks are not handeled during the different day shifts when they occure more frequently. To not increase their environmental impact, grease traps are installed in all of the kitchens as well as water flow restrictors reducing consumption to 6 litres per minute. Only the Delft restaurant has installed a sub metre on the most consuming piece of equipment, the dishwashing machine.

### 5.2.3 Energy Costs

Similar to not conducting the water audit, no energy audit has been carried out, the usage of the equipment has been noted on the list with machinery description but is not checked again when operating and the building structure in some of the case examples does not allow for retrofits of metres. Another problem causing high energy consumption is that the restaurant lightning cannot be turned on and off on different circuits in the case examples but only in the Delft restaurant. But all three restaurants are either changing or have already changed to energy efficient light bulbs and LEDs. In the Shanghai and Delft restaurant automatic light controls have been installed and the kitchen set up is based on energy saving principles for all three restaurants. None of the case examples has a sub metre to measure the energy consumption of the kitchenarea and the equipment in more detail, even though literature strongly suggests measuring & monitoring.

### 5.2.4 Awareness creation and CSR

The biggest problem to all three case examples is that the customers are not aware of the food waste problem. This is why the category of awareness creation is extremely important. Only the Gothenburg restaurant gives its visitors advice on how to be more environmentally friendly by sorting their waste by printing information on their waste station itself. But none of the restaurants inform their customers of the actual problem of food waste. Neither do they inform their guests about healthy eating patterns including portion sizes. Only the Gothenburg restaurant involves their staff team in a vegetarian day in the canteen. Gothenburg and Shanghai are also offering the option of taking home food left overs. The restaurants in general do not follow an official environmental certification but a study by Fredrika Klaren showed that the company has implemented 50 of the 52 ISO criteria of the 140001 certification scheme, on a voluntary basis without even realizing before theat their internal standards fit the criteria. A reason for not implementing environmental certification schemes are the high costs and the high effort to comply repeatedly.

### 5.2.5 Purchasing

Purchasing products locally is a normal purchasing routine to all three of the restaurants. Usually those items come from the vegetable range. But the origin of the products is not communicated to the customer. All three restaurants practice responsible purchasing, for example the coffee offered. With responsible purchasing it is meant that fair-trade products are bought that ensure fair conditions for suppliers and producers. Responsible purchasing can also mean for example, that only environmentally friendly chemicals are used to reduce the restaurants environmental impact. Extensive purchasing routines have been developed to ensure no overstocking and food safety standards. Furthermore is at least one meal in the restaurant of organic origin.

### 5.2.6 Routines

Routines in general play an important role because they are usually developed in the head office and then rolled out to all other restaurants in the chain. But restaurants do also have a choice in what they implement and some routines might not be suitable for all restaurants. All

three case examples have implemented menu planning like suggested by the Nordic council of ministers. They also use routines for production planning, freezing and storing food items and cost reporting. Only the Gothenburg restaurant developed a routine to redistribute left-overs from excess production. Both Gothenburg and Delft have implemented routines to follow up on the buffets.

### 5.2.7 Measurements and monitoring

The last response category is measuring and monitoring. Only the Delft restaurant is separating the different waste streams of food waste coming from the customers and the kitchen. This happens via a measuring sensor installed in the tubing of the grinding system which transports the waste to the de-waterer. This also allows the restaurant to measure the amount of kitchen waste only produced. Other than these fractions nothing is measured which also makes it difficult in later stages to benchmark and recognize success or failure of the different routines. The diagram below summarizes the criteria.

In general it can be said that the restaurants are on a good track but they do need to put more effort in some of the aspects measuring and monitoring being the main focus.

## Environmental Management to Prevent Food Waste

| Action: | Shanghai | Gothemburg | Delft |
|---|---|---|---|
| - Collect data on the businesses environmental impacts | Yes | Yes | Yes |
| - Develop KPI for food waste, water, energy/$CO_2$ emissions- to allow for environmental benchmarking | Yes, but often based on estimation | Yes, but not collected on continuous basis | Yes |
| - Write an environmental policy for restaurant | Yes | Yes | Yes |
| - Set reduction targets for food waste | No | No | No |
| - Analysis the current situation for food waste creation in the restaurant. Next step is the development of an action plan | No | No | Yes |
| - Extensive staff training on the issue and its prevention and reduction | No | No | No |
| - Annual review of performance and targets | No | No | Yes |
| - Food Portion Size– Different portion sizes should be of fered to accommodate the guest needs | Only available with one meal | Only available with one meal | Only available with one meal |
| - Donate food left overs to charities | No | Yes when there are buffet leftovers | No |
| - Regular customer research on the menu items, portion size, and customer awareness | No | No | No |
| - Provide opportunity for visitors to "Carbon Neutral" their visit | No | No | No |

## Related Water Consumption

| Action: | Shanghai | Gothemburg | Delft |
|---|---|---|---|
| - Water audit to identify most water consuming equipment | No | No | No |
| - Operate a leak detection routine for dishwashing area | Yes | Yes | Yes |
| - Install and manage a grease trap to intercept FOG in the kitchen area | Yes | Yes | Yes |
| - Water flow restrictors on taps in the F&B department | No | Yes | Yes |
| - Installation of sub meter for dishwashing and kitchen areas | No | No | Yes |
| - Change to water efficient equipment | Yes | Yes | Yes |

## Related Energy Consumption

| Action: | Shanghai | Gothemburg | Delft |
|---|---|---|---|
| - List of the major energy using equipment throughout the F&B department (Audit) | No | No | No |
| - All lights in use are listed with the wattage and can be turned off in separate sections | No | No | Yes |
| - Staff is trained on hot water production | No | No | No |
| - Staff understands heating and cooling operations | No | No | No |
| - Energy efficient lightbulbs/LEDS are installed | Yes | Yes | Yes |
| - Automatic light control sensors are installed | Yes | No | No |
| - The refrigerator should be positioned and regulated according to energy saving principles | Yes | Yes | Yes |
| - Sub meter for energy consumption in the kitchen | No | No | No |

## Awareness creation & CSR

| Action: | Shanghai | Gothemburg | Delft |
|---|---|---|---|
| - Give information to customers on how they can be environmentally responsible during their visit like sorting their waste | No | Yes | No |
| - Promote healthy eating options like different vegetarian meals and portion sizes | No | Yes | No |
| - Create awareness about food waste | No | No | No |
| - Offer doggy bag options where possible | Yes | Yes | No |
| - Guest surveys | Yes | Yes | Yes |
| - Gain Environmental certification | No | No | No |

## Purchasing

| Action: | Shanghai | Gothemburg | Delft |
|---|---|---|---|
| - Source locally and identify those menu items to customers | No | No | No |
| - Responsible Purchasing by buying Fairtrade/Rainforest Alliance tea/coffee etc | Yes | Yes | Yes |
| - Offer organic or ecological certified food products | Partially | Partially | Partially |
| - Purchasing routines to control stock | Yes | Yes | Yes |

## Routines

| Action: | Shanghai | Gothemburg | Delft |
|---|---|---|---|
| - Menu planning | Yes | Yes | Yes |
| - Cost reporting | Yes | Yes | Yes |
| - Freezing and storage routines | Yes | Yes | Yes |
| - Production planning | Yes | Yes | Yes |
| - Routines for excess production for internal consumption | No | Yes | No |
| - Routines to follow up on buffets | No | Yes | Yes |
| - Reporting on waste sorting | No | No | No |
| - Routines of right portioning | Yes (but not followed through) | Yes | Yes |

## Measurements and monitoring

| Action: | Shanghai | Gothemburg | Delft |
|---|---|---|---|
| - Separate Waste streams like plate waste and kitchen waste | No | No | Yes, via grinder |
| - Measure the amount of kitchen waste produced | No | No | Yes, via grinder |
| - Measure the amount waste disposed of by the staff and customers | No | No | No |
| - Operate onsite composting machine | No | No | Not yet |
| - Reducing waste packaging by sending it back to the suppliers | No | No | No |

*Fig 18 Case example comparison, based on interview results and observations, Hackfurth 2013*

## 5.3 Change management strategy

Analysing the collected data from above and comparing it to the suggested change management strategy it is clear to see where the different restaurants got stuck in applying their change management process. They identified the problem but did not take an organized approach but one that is merely solving some of the symptoms by saving costs and not treating the problem at core. They lack the change of mind set and the follow up/control from the top of the company.

None of the restaurants has identified, neither the scope of the problem, nor set targets or goals connected to food waste reduction. KPIs were set up but there is no full situational analysis of the restaurants available which makes it also really hard to actually track the KPIs over a longer period of time. So the question raised is "If no one knows what the actual problem is, how can a routine be developed that will deal with the problem?"

Nevertheless all three case examples use glimpses of different phases and focus areas from the entire change process which leads to the assumption that they could adapt quickly with a sorted approach.

During the second phase the restaurants should inform their staff about the problem. A good way of doing so is to find leverage point in communication similar to Meadows. Either meetings or special trainings dealing with the reduction of food waste can be such points.

**Measuring routines need to be implemented** and also be discussed with the party collecting the waste. In some European countries there is also the possibility for bigger companies to arrange a "single pickup" with their waste collector to even weigh the entire waste truck over a certain period of time, meaning that the truck will only contain the waste collected from that specific company (example Ireland). This way changes in the waste amounts can be tracked down more easily while the company itself does not need to go through time consuming weighing routines on a weekly basis. The restaurants need to get on top of their inflows and outflows. If nothing is measured one will never find out what is actually wasted. That also means that routines need to be developed to measure the inflows and recording them.

The adaption phase is where it already ends for the case examples in terms of a proper change management process. Because there is almost no data collected in the monitoring and measuring phase there will be no possibility to analyse the data in a way that it will result in an operational action plan. One possibility is to still determine the processes that will enable the development of process context factors but goals and targets are needed to fully implement those. Therefore the next important step after implementing the measuring routines will **be to set smart goals.**

Only on fully completing the first three phases it is advisable to carry on with the rest of the change management process.

# 6 Discussion

When looking at the methodology, theoretical key findings and the analysis of this study from a gyroscopical approach it can be said that the research question was mainly aimed to identify possibilities in the food service sector to reduce food waste. I can say that I personally think that it did fill the suggested research gap at least partially. Of course further research in this area is needed. Conducting this study revealed especially the need for more comparative studies which follow similar ways of measuring food resource inflows and waste outflows or in general similar calculations on energy and water consumption, so they become more comparable. Finding such comparability would make a generalization of results on a European or even global level easier, for example with focus on actual amounts food waste produced and the related costs. When this is achieved the focus can switch more to the actual implemented best practices. Comparative data will help to identify the strengths of the best practices and also give the possibility to extrapolate the practices from the company where the practice was invented, to the target sites. Also from an academic point of view more "best practice"- case studies would be helpful to form an overall guideline on how restaurants can make a difference and create more awareness of the actual problem The obvious lack of such literature also explains some of the methodological choices that were made during this research and the need for development of a more specific change management strategy that aims at the specific industry. Nevertheless the suggested change management strategy encounters the same problem as the best practices identified: more comparable data is needed to see whether this change strategy is actually possible in its implementation. Therefore other possible research questions could focus on the areas of food waste prevention in the food service sector, better waste management within the supply chain, the exact amounts of food waste produced broken down to country and industry levels and the development of possible policies and European legislation regarding food waste. The following could be just a few examples:

- In which way can the food service sector support the development of new waste prevention programs and new strategies of food waste reusal within QSRs?
- In which way can food waste- and related energy-and water-consumption-prevention and reusal be supported through new European legislation and possible policies?
- What could be possible responses to food waste with regards to the focus area of 'Material and Machines' of the Ishikawa diagram and how can they be integrated into a change management strategy?
- In which way can change management strategies be implemented more successfully in the food service sector?
- What are the amounts of food waste produced in X restaurants in the country Y over period Z (longterm)?

The research question was legitimate because it helps to raise awareness of the main problem food waste with the specific audience during the European year against food waste. Only when everyone is aware of the problem, new solutions can be implemented. In hindsight answering the research question, was achieved by the application of the suggested methodology, but with different methodological choices, could have provided an even bigger picture of the current situation than it did. The study does not reflect on food waste issues that are connected to food production at the beginning of the food supply chain nor on the processing stage before it reaches retailers, though literature suggests that the harvest and the first processing are already responsible for big food losses (Marthinsen et al, 2012, Stuart, 2009, BCFN, 2010).

The use of only three areas (Men, Method and Environment) of the Ishikawa diagram, as starting point of the methodology, might have reduced the research area but provided a reasonable scope in consideration of time restrictions to the project, prior knowledge and other studies that were soon to be published with similar topics (prevention of plagerism) which can be seen as a weakness to my own research but also as a strength at the same time because it allowed to distribute efforts more evenly on the specific focus areas. The other categories of 'Machines and Materials' were left out because they clearly showed responses to food waste that are of a more technical nature, like cleaner-production-approaches, and the research gap around these two categories is already well filled to a certain extent and need to focus on technical innovation. Those two categories can offer a "quick fix" for food waste reduction for a lot of companies because they have a high return on investment in a hsort period of time, but are not 'long-term'- oriented like suggested in the change management theory and help to change the initial behavioural error. Focusing on the three areas is also a strength because only focusing on this very specific research area allowed to take on the problem at it's very cause and not only helped to treat the symptom which is often done when looking at 'Machines and Materials'. Even though it will take more time, management effort and investments to "fix" things on a long term basis by using the three focus areas, it will lead to a change in mindset within the company which can be a future warrant for a healthy and innovative economical situation.

Another factor that influenced the research results was the choice of the case studies since the research was primarily focused on the food service sector, specifically on the HORECA and QSRs. The choice to focus on the globally acting QSR allowed to compare the restaurants directly because they should operate in the same way in every country present and therefore occurring differences from the standard, for example through different food preparation means, was not an issue. Nevertheless, the main difficulty in assessing the different restaurants was the influence of external factors. For example in China, the different cultural background clearly influenced the amount of customer plate waste. This made it hard to compare the collected data objectively. Here it would have been a great opportunity if collecting waste data in China would have been possible like in the other two restaurants in Europe. Both restaurants that were looked at in Europe had a similar cultural setting but still were different when, for example, looking at plate waste. Both, economic reasons and high education on food waste issues, didn't allow pinpointing a specific difference between the two European restaurants. Another weak point which was a combination of theoretical and methodological choice was the calculation of the water and energy consumption of the different restaurants and the transferal of the units into 'meals wasted'. The calculation itself was based on a suggestion by the CIBSE and included the main energy and water consumption of the restaurant, the consumption of the kitchen, the size of the restaurant and kitchen and the total amount of avoidable food waste. This approach to calculate the energy and water consumption per wasted meal is lacking both, the social factor and a bigger time frame to check whether consumption rate and therefore the food waste really went down over time when measures were implemented or not. Even more so, this has put me in the position that the energy consumption per wasted meal for each of the case study restaurants are based on an estimation because the kitchens usage pattern are unknown and because there are no separate meters installed nor was the exact floor size of one of the restaurants known nor was the exact outflow of food waste measured over a longer time period. Even though there were a lot of assumptions made those were still based on data that had been collected previously and from different studies in literature therefore the results are reliable but rather need further research and confirmation. A better approach for future research would have been to pick three sample restaurants from each of the countries collect the data for all of them over a longer time period (six to eight weeks) and then compare the results again. Nevertheless the data collected during the interviews and the observations made were really useful and helped

to back up the data from the measuring experiment. Applying the triangulation method, to give the study more validity, was therefore a good choice.

It was also a good approach was to first identify the causes, then the responses and to identify the best practice measures taken by other parties in the industry. The best practices helped to set up the criteria framework which helped to determine whether the restaurants are on the right track or not and helped to determine the point in their change management process they are at. However the main problem with the specific best practice criteria is that it is not known, if there was a chance to really investigate all best practices available in industry for their process context factors or if there are other practices that have not been published yet that might have offered better criteria. Also the choice of the investigated best practices can be seen as highly subjective though it was tried to prevent subjective choices through guidance provided by the expert interviews. Looking a bit more critically on the suggested change management strategy, it is naturally not the reinvention of the wheel since the main obstacles to change are often similar or the same in different organizations, but it offers more specific advice with regards to the industry under investigation which can be an advantage because not all stakeholders have a) the necessary time to go through all available strategies to find the most fitting to their company b) nor the financial means for a trial and error period without putting the business at an unnecessary risk.

Looking at the generalizability of the research results it can be said that both developed tools, criteria catalog and change management strategy, from this research can be useful to any restaurant that operates in similar ways (QSRs), also normal restaurants, cafes, pubs, bars or even a snack bar for that matter. All industry specific causes are identified and therefore the restaurants can already start by determining which ones apply to them. As well as looking at the most common responses listed in this study which can be copied by at least some stakeholders in the food service industry. But this study also showed one of the main issues with the general application of solutions presented, all the outside factors influencing a restaurant. On a global scale it will almost always be impossible to find a common solution, even though we have a common problem. For example in the case study, the food waste problem needs to be addressed on a much smaller scale, country wise because every country has their own specific causes or responses, cultural backgrounds and beliefs. The success of implementing possible solutions also relies on the company culture or governmental legislation in the specific country therefore looking for a global fix is not a reasonable approach unless it is from a technical site of things. Nevertheless the suggested change management strategy allows taking some of those factors into consideration and is therefore applicable to many restaurants. Both, criteria catalogue and change management strategy, can also be used in other industry sectors but need some small changes to them. Global technical solutions like the replacement of old equipment are reasonable on a large scale too.

# 7 Conclusions

When presented with a question about a solution, Albert Einstein suggested that if given one hour to save humanity he would rather spend "fifty-five minutes on defining the problem and only five minutes on finding the solution." This defines indirectly the main problem that became obvious from the analysis and findings and also suggests the urgency of the topic of food waste prevention. At the moment we are spending 59 minutes on finding solutions without really having determined what the real definition of the problem is.

Therefore the main research question was formulated to determine "in what way the food service sector, with special focus on Quick Service Restaurants, can reduce and prevent food waste and related energy and water consumption". Sub-questions helped to answer the main question by focusing on best practice examples and change management strategies and food waste related water and energy consumption. The subquestions were:

a) What are best practices in general? How can they be defined? What are the critique points of analysing?

It was found that best practices are a "process and activity that has shown in a practical situation to be the most effective, efficient […]". It lets the process function at its best possible level. One of the main critique points was that in BPR often a theoretical framework that supports the choice of a certain best practice is missing. Choosing a best practice can be therefore highly subjective and is often difficult for the researcher. Also in terms of being sure to have seen every other process practice to make sure that the practice under investigation is really the very best.

b) How can the implementation of a change management strategy help with the reduction of food waste? How can a change management strategy be developed from best practices?

Food waste reduction is often a topic that is neglected by management because it is not necessarily connected to large financial savings therefore uninterresting. Most managers come from a cost saving approach. With this study I was able to show that quiet the opposite is the case. So a change management strategy can help the food service sector to become more sustainable on a general level but also with focus on the food waste, to reduce and prevent will result in savings, decreased $CO_2$ emissions by less landfilled waste. The implementation of a change strategy requires a change in mindset which will open the door to a better understanding of the staff team on why specifically food waste reduction can be important. This is mainly because of the related energy and water consumption. For managers the realisation that food waste reduction can also mean substantial savings is new but will help as an incentive to change. The best practices can help to develop a change strategy by giving valuable guidance on what already works in other restaurants but can not be the sole basis of such a strategy.

c) How can all of the above be applied to the case of the QSR?

In the case of QSRs the implementation of best practices and a change strategy can be fairly easy. Most QSR operate as franchises that means if one restaurant test the best practice and is successful, the chances that the other restaurants will be equally as successful are high since most QSR operate in the same way. Especially in a QSR it should be easy to implement different responeses to food waste as a part of a change strategy and gather results and important data already in a short period.

d) What could be any related cost reductions with regards to food waste and related energy and water consumption?

As already summarized in figure 16 possible savings differ on the implemented responses, starting from new equipment to light sensors to heat exchangers and so on. But can range from 1550 to 2600 Euro per year per restaurant only on reducing the amount of wasted meals and related energy and water consumption. This might not seem much at first but seen on a global scale for the different QSRs it will make a difference.

This study has filled an important research gap since most academic literature has focused on households instead of industry so far. Also the study fills the need for a managerial guideline and starting point for the restaurants as orientation point with the development of a) a catalogue of criteria that enables the development of process context factors which in return are an important factor in developing best practices and making them applicable to other companies and b) the development of a more industry specific suggestion for a change management strategy build on the implementation of the developed process context factors to enable extrapolation.

All three case examples investigated in this study have already implemented responses to some of the causes of food waste but more out of cost consciousness than seeing the need to get to the problems core. For them taking part in this study was an "out–of-the-box"- approach to gain more insides to the problem itself. More time needs to be spent on outlining the problem and possible focus areas than on just implementing some technical solution that will bring a quick fix rather than a long term result. The study highlighted the examples of three QSRs in the Netherlands, China and Sweden that belonged to the same chain operating on a global level.

The case findings pick up on the most common causes for food waste, lack or problems of forecasting systems, lack of awareness of the problem, wrong portion size, problems with storage routines and lack of measuring and monitoring in- and outflows and on the company internal responses to those. All three case examples are exceptionally good at forecasting and planning their menus accordingly as well as correctly storing all food items. These are processes that have been perfectionated and implemented in all restaurants of the chain. But going down to the employee levels, we can see some of the differences, for example the adaption to changes in the forecasting system always comes down to the decision of a single person in the process and the willingness to take a risk as can be seen in the example from the Netherlands. The importance of having the right portion size is also shown by looking closer at the Chinese case example, where the portion size is mostly influenced by a cultural need for big portions which in return leads to more customer plate waste which also means higher costs for the restaurant to discard of the waste. This can be solved by reviewing the different recipe cards and adjusting the portions on the recipe cards already. Furthermore a recommendation is to change the serving tools to smaller ones so the co-workers automatically start to hand out smaller portions. None of the three case examples is addressing the lack of awareness with their customers yet. Furthermore the measurement of food waste in two of the example cases showed that a lot the waste produced came from the customers as well as the employees themselves therefore it is important to pick up on the issue of food waste on a more obvious level for example through a focus campaign in the different restaurants. A survey conducted as part of this research showed that the customer in general is open to environmental topics and would appreciate a campaign. Here it is important to not patronize the customer during their visit but rather to encourage them by making their own

choices and appealing to their "feel good zone". A recommendation to raise the awareness with the customer is to mark the meals with small labels, similar to the symbol used for vegan meals. Those labels can be placed on the sign that advertises the dish itself and can consist out of a drop of water for a resource efficient meal or a symbol for organic dishes. All three restaurants have advertisement space left that could be used for the purpose of reaching the guest.

Looking at the picture as a whole it has become evident in the analysis that the case examples have stopped in their development towards food waste reduction as well as energy and water consumption for a couple of reasons. The Dutch restaurant is a leading example within the organization while the Swedish one is on a good way but needs adjustment. The Chinese restaurant will have to face some challenges in the future. It is low performing at the moment especially when looking at the actual amount of waste produced in comparison to the European counterparts. One of the main reasons for those big differences within the chain, is that they lack a collective management approach for food waste management and constant communication with all other restaurants and stakeholders about the problem. All restaurants, even though part of the chain, operate on the basis of trust and therefore also have the freedom in developing their own projects. This has advantages and disadvantages. One disadvantage is that this slows down the communication about the urgency of the problem and on the projects. The advantage is clearly that one restaurant can learn from the experience from the other.

But a positive example is that some restaurants have come up with ideas to tackle the food waste problem on their own. Some of the ideas even fit the best practice criteria catalogue but the other restaurants in the chain might not even know about the specific projects. Of course this is difficult considering the size of the chain and some of the ideas do get distributed but this needs to be addressed with a different tool and on a higher level. Part of the change management strategy that derived from the literature review is to implement a knowledge management system. This is not meant to create more work for the employees but rather giving them the opportunity and enabling them to share information with each other if they want. A way to organize such a system would be to integrate it as an online tool in the already excisting intranet. Or to set up a project engaging student as interns that analyse the different projects on a country level.

Benchmarking and comparing in such a big organization is of uttermost importance and can help to direct energy where it is needed and not to waste it maybe on projects that have already failed elsewhere. Furthermore innovation and change processes are based mostly on the actions and motivations of individuals and with the knowledge management system the individual is given a choice to share. This in return will also create awareness

The analysis also showed another main reason why there has not been further development. The lack of measuring and monitoring the inflows and outflows food and waste products from the different areas. Because it is unknown how much is actually lost in all of the restaurants, it is very difficult to determine the focus area and all of the new restaurants to the chain need to be equipped with weighing facilities for the food waste as well as separate meters for energy and water consumption for the main equipment and the different F&B areas.

As suggestion for further research I would recommend a case study to look more into the costs of energy and water consumption of a restaurant from a technology based perspective with energy and water audits determing the main consumers within the kitchen area. Also research is needed on the costs of food waste by actually measuring the in- and outflows of

food and waste in the most simple way so that the measurements can be replicated and therefore results can be benchmarked.

In conclusion it can be said that all three of the case examples have already achieved impressive results and are on the right track to improve. They cannot be classified as a best practice example, even though the restaurant in Delft is high performing and tries to be on top of the problem. The enthusiasm of the all staff, interview partners and experts to tackle this problem has been more than impressive though. A sentence that I did not hear that often before was "Yes of course we are doing some good things. But there is always room for improvement and we can do more!" and I am convinced that by further researching the problem, its causes and following the given advice to response, they will achieve exactly that bit of "more" that is needed!

For the food service sector in general, I hope that in the future, awareness about the food waste problem along the supply chain will keep increasing and that legislative measures as well as consumer force will bring a rapid change to the global situation. In the end we are responsible for shaping the future and with living in a world full of smart and innovative thinking people and well developed technology, food waste should not be a problem that needs reduction but only prevention.

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# 9 Appendix

## 9.1 Interview Partners

### Case study

### The Netherlands, June 2013

Interviews in the restaurant:

- Food and Beverage Manager
- Kitchen Manager
- Sustainability Specialist
- 3 x Kitchen staff

Interviews with Head Office members:

- Food and Beverage Specialist
- Food and Beverage Matrix Manager

### China, Shanghai, June 2013

Interviews in the restaurant:

- Food and Beverage Manager
- Maintenance Manager
- Kitchen Manager

Interviews with Head Officer members:

- Sustainability Specialist
- Food and Beverage Manager for China

### Sweden, Gothenburg, August 2013

Interviews in the restaurant:

- Food and Beverage Manager
- Maintenance Manager
- Kitchen Manager
- Sustainability specialist

Interviews with Head Officer members:

- Sustainability Specialist
- Food and Beverage Manager for Sweden

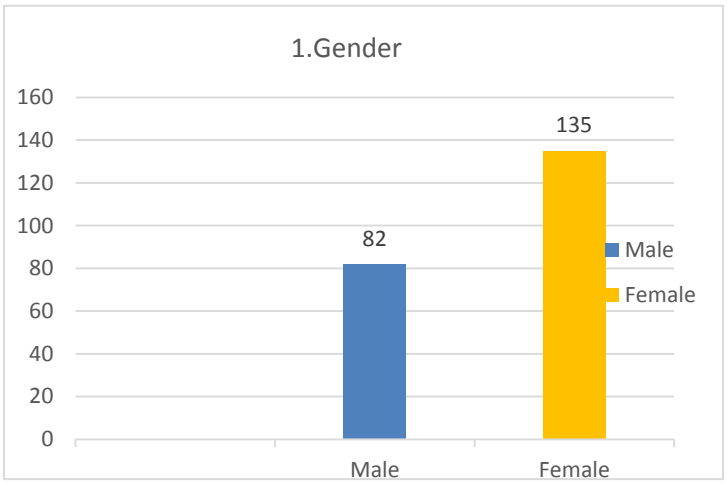
### External & Expert interviews

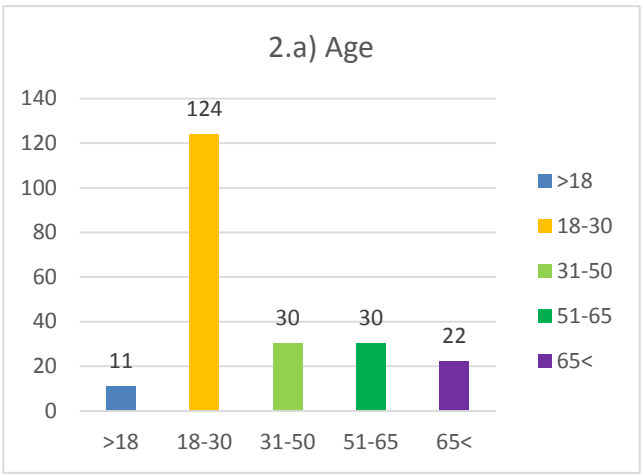
WRAP: 2 project leaders "Food Waste Resource Management", June and September 2013
´Zu gut für die Tonne': Project leader, August 2013

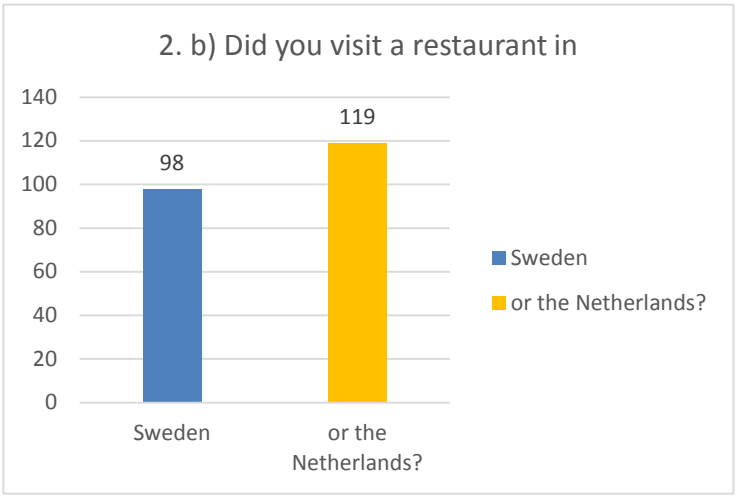
McDonalds: Head of Sustainability Itlay, July 2013
Head of Sustainability Sweden, July 2013

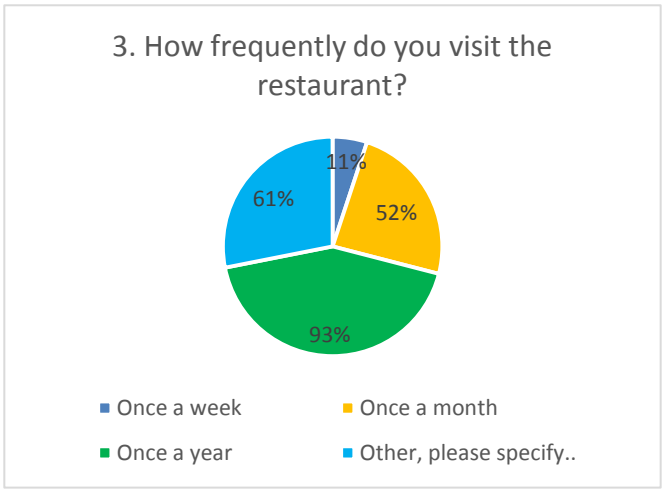
## 9.2 The Survey Results

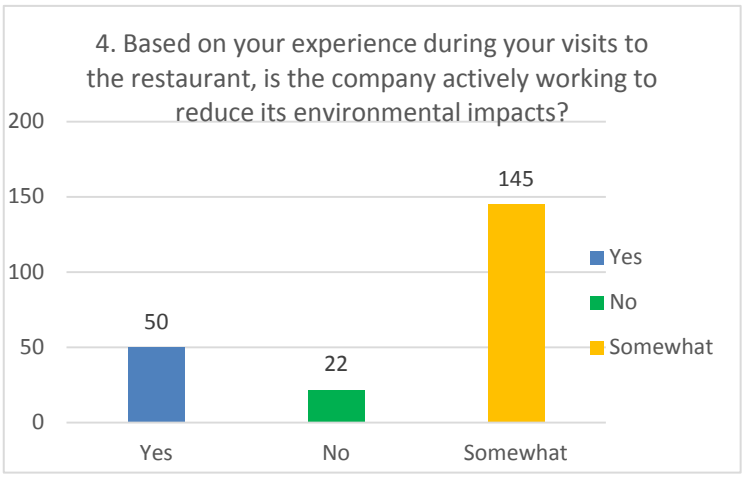
To determine the awareness level of the customers and to test which areas around the procees context factors case example companies need to focus on, a survey was conducted among 217 randomly picked participants in Sweden and the Netherlands.

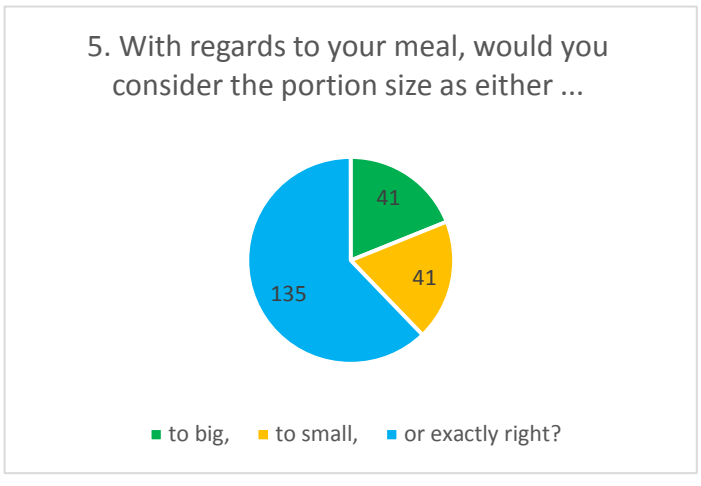


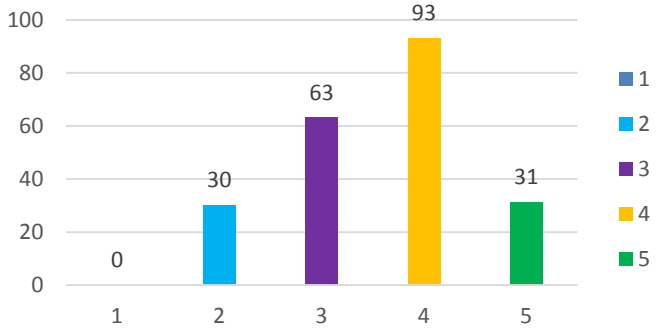



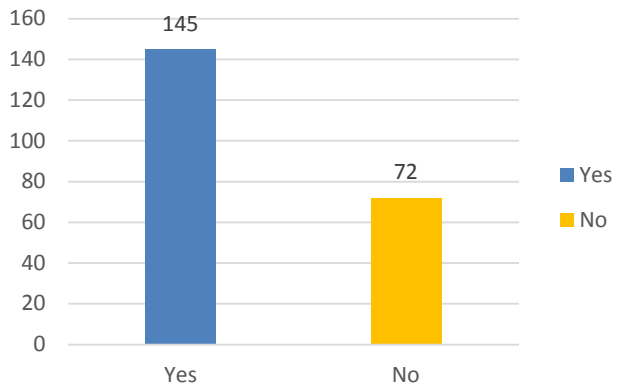



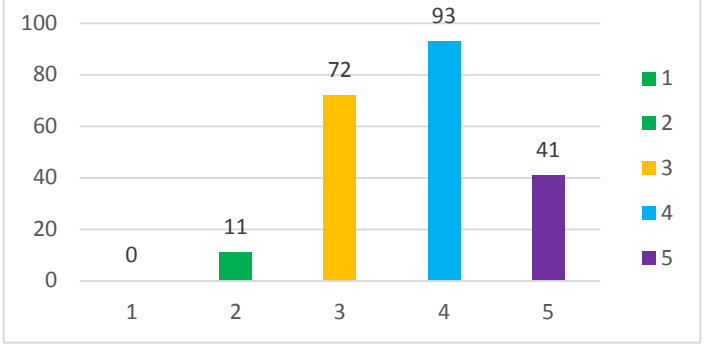
7. a) On a scale from 1-5( 5 being the highest), how concerned are you about the protection of the environment?



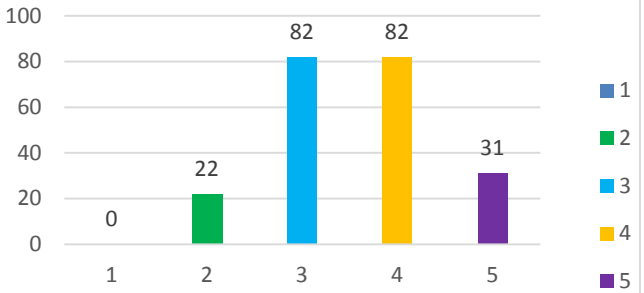

6. Did you finish your meal today?



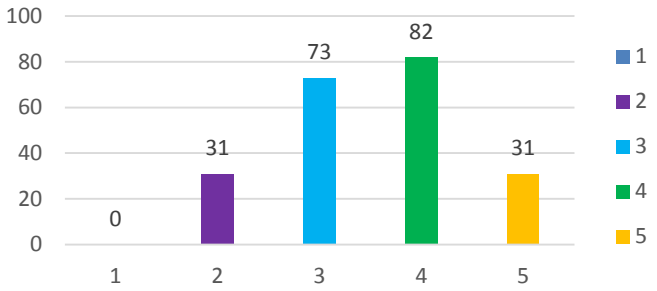

7. b) On a scale from 1-5( 5 being the highest), how well are you sorting waste at home?



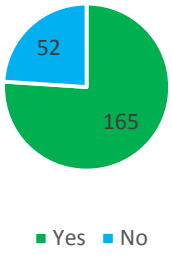

7. c) On a scale from 1-5( 5 being the highest), are you putting effort in saving resources, like energy and water, at home?



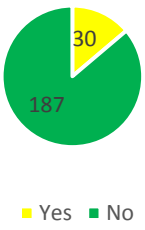

7. d) On a scale from 1-5( 5 being the highest), do you perceive food waste as a relevant topic to you?




8. Do you use the waste sorting options available to you in the store & restaurant?




9. Do you feel encouraged by your visit today, to behave in a more environmentally friendly way at home?




10. Can you give examples of environmental initiatives in the restaurant?