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Food waste reduction concepts for stakeholders in the food supply chain and auxiliary organizations

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Meinen Töchtern Liliane, Jenni und Rebecca und
meinem Ehemann Michael

We must become the change we wish to see in the world.

Mahatma Ghandi (1869-1948)

Kurzfassung

Ziel der vorliegenden Arbeit war die Entwicklung von Unterstützungskonzepten zur Reduktion von Lebensmittelabfällen (LMA) in der Ernährungswirtschaft. Diese richten sich zum einen an privatwirtschaftliche Unternehmen, wie lebensmittelverarbeitende Betriebe, Händler und Großverbraucher. Zum anderen werden Organisationen adressiert, wie wissenschaftliche Institute, politische Institutionen oder private Initiativen, deren Ziel es ist, Hilfsinstrumente für privatwirtschaftliche Unternehmen zu entwickeln, um diese in ihrem Bestreben zu unterstützen, LMA zu reduzieren.

Zunächst wurden Fallstudien zur Lebensmittelabfallvermeidung in drei Gemeinschafts-verpflegungseinrichtungen (Krankenhaus, Cafeteria, Seniorenheim) durchgeführt. In den beteiligten Organisationen wurden die anfallenden Mengen an LMA zu Studienbeginn ermittelt und die Problembereiche, die zur ihrer Entstehung geführt haben, identifiziert. Weiterhin wurden Maßnahmen zur Reduktion der LMA entwickelt, umgesetzt und evaluiert. Basierend auf den Erkenntnissen der drei Fallstudien wurde das erste Unterstützungskonzept entwickelt. Dieses berücksichtigt die Notwendigkeit für ein ganzheitliches Unterstützungskonzept, das nicht nur zu einer Reduktion von LMA innerhalb der Unternehmensgrenzen führt, sondern die gesamte Wertschöpfungskette mit in den Blick nimmt. Um das zu erreichen wurde ein PDCA-Zyklus (Plan-Do-Check-Act) so angepasst, dass die relevanten Stakeholder der Wertschöpfungskette innerhalb partizipativer Projektelemente in den Prozess der LMA-Vermeidung einbezogen werden.

In den Fallbeispielen konnten im Seniorenheim die LMA signifikant von 21.4% auf 13.4% reduziert werden, ebenso in der Cafeteria (19.8% zu 12.8%). Im teilnehmenden Krankenhaus dagegen stagnierte der Anteil (25.6% und 26.3%). Allerdings gingen dort sowohl die tägliche Ausgabemenge, wie auch LMA pro Person zurück. In den beteiligten Einrichtungen wurden fünf Problembereiche identifiziert, die zur Entstehung der LMA beitragen, dazu zählen: Informationen über LMA, Kommunikation, Speisendarbietung, Speisenbestellung und -ausgabe sowie Kundenbedürfnisse. Die Fallbeispiele zeigten den Bedarf an einer wertschöpfungskettenübergreifenden Zusammenarbeit, um LMA nicht stufenweise zu verschieben. Weiterhin demonstrierten die Fälle die Notwendigkeit, relevante Stakeholder, wie Mitarbeitende verschiedener Abteilungen, das Management aber auch Lieferanten und Kunden, mit in den Maßnahmenentwicklungsprozess einzubeziehen, um Motivation und die Übernahme von Verantwortung zu steigern. Abschließend wurde auf Grundlage von Erfahrungen aus unterschiedlichen LMA-Projekten in der Ernährungswirtschaft ein Benutzerleitfaden für das Unterstützungskonzept erstellt. Der Leitfaden fasst die notwendigen Schritte eines LMA-Vermeidungsprojekts zusammen. Er veranschaulicht die Ziele der einzelnen Schritte, präsentiert Ansätze zur Durchführung, und beschreibt in welcher Form Ergebnisse dokumentiert werden können. Der Leitfaden erleichtert seinen Benutzern somit die Anwendung des Unterstützungskonzeptes zur Verringerung von LMA.

Für die Entwicklung des zweiten Konzeptes wurde zunächst analysiert, wie die Organisationen (z.B. wissenschaftliche Institute, politische Institutionen oder private Initiativen), die Hilfsinstrumente gegen Lebensmittelverschwendung für Unternehmen der Lebensmittelwirtschaft entwerfen, unterstützt

werden können. Dies beinhaltete die Herleitung eines Marketingkonzeptes, dass es unterstützenden Organisationen ermöglicht, marktorientierter zu arbeiten, indem sie zuerst den Bedarf ihrer Zielgruppe ermitteln, darauf basierend marktorientierte Hilfestellungen entwickeln, und diese abschließend bei der Zielgruppe bekannt machen.

Das Konzept wurde am Beispiel der LAV-Plattform[1] (LAV – Lebensmittel Abfall Vermeiden) getestet. Diese wurde von einer unterstützenden Organisation unter Beteiligung von Praxispartnern und Branchenverbänden für die Zielgruppe der klein- und mittelständischen Unternehmen der Ernährungswirtschaft entwickelt. Die Fallstudie zeigte, wie die unterstützende Organisation, in diesem Fall ein Forschungsinstitut, systematisch durch den Marketingprozess, von der Entwicklung der Plattform bis hin zu ihrer Bekanntmachung in der Branche, geleitet wird. Für die LAV-Plattform wurden öffentlich zugängliche Instrumente gegen Lebensmittelverschwendung gesammelt, eine Vorauswahl getroffen und diese strukturiert nach Anwendungsziel und Marktsegment in Form einer Toolbox zur Verfügung gestellt. Die Benutzerfreundlichkeit der Plattform wurde durch die am Entwicklungsprozess beteiligten Praxispartner und Branchenvertreter bewertet: Der Gesamteindruck der Plattform erhielt eine 1,6 (auf einer Skala von 1 bis 6, mit 1 = sehr gut, 6 ungenügend) und ihr Potenzial zur Vermeidung von LMA eine 7,2 (auf einer Skala von 1 bis 9, mit 1 = sehr schlecht, 9 = sehr gut). Basierend auf den gewonnen Erkenntnissen dieser Fallstudie wurde das Marketingkonzept in einem Nutzerleitfaden für unterstützende Organisationen zusammengefasst.

Die beiden entwickelten Konzepte richten sich an alle relevanten Akteure (unterstützende Organisationen sowie Akteure der Lebensmittelwertschöpfungskette), die einbezogen werden müssen, um LMA zu reduzieren. Aus diesem Grund leisten beide Konzepte einen wichtigen Beitrag dazu, LMA im Handel und beim Verbraucher bis 2030 zu halbieren und entlang der Wertschöpfungskette zu reduzieren, so wie es das politische Ziel der „Agenda 2030 für nachhaltige Entwicklung“ der Vereinten Nationen vorsieht, zu dem sich auch die Bundesregierung bekannt hat.

[1] www.lebensmittel-abfall-vermeiden.de/ (eingesehen am 19. Mai 2019)

Abstract

The objective of this thesis was to develop concepts to support the reduction of food waste in the food sector. The concepts are targeted to private companies, such as manufacturing businesses, retailers, and large-scale consumers, as well as to organizations that support the former in their food waste reduction approaches. Mostly, these auxiliary organizations include research organizations, political institutions, or private initiatives.

First, this study looked at three food waste reduction cases: a hospital, a cafeteria, and a residential home. In these organizations, this project included identifying the initial quantities of food waste and the most problematic organization-specific areas that led to it, followed by developing and implementing measures to reduce these problems. Based on the conclusions from these cases, the next step was to develop the first support concept. It responds to the need for a holistic approach that would contribute to achieving food waste reduction beyond the boundaries of any single company. This was accomplished by incorporating participatory elements into the concept. Next, the study adapted a PDCA (Plan–Do–Check–Act) cycle for the reduction of food waste, by integrating relevant stakeholders into participatory project steps.

In the case studies food waste in the residential home was reduced significantly from 21.4% to 13.4%, as well as in the hospital cafeteria (19.8% to 12.8%). In contrast, food waste remained on a constant level in the hospital (25.6% and 26.3%). However, figures from the hospital did indicate a reduction of the food provided and wasted per person and per day. In the participating organizations five problematic fields leading to food waste were revealed: information on food waste, communication, product presentation, food ordering and supply, and customer needs. These cases demonstrated the need to integrate all relevant stakeholders, such as inter-divisional employees, management, suppliers, and customers, into a holistic food waste reduction approach in order to increase commitment and taking over of responsibility. At the end, a “Manual for Managers” described and summarized the concept as a whole. This manual serves as a guideline for managers who wish to reduce food waste in their respective organizations. It summarizes the approaches applied in the different steps and illustrates how the results of each step can be documented. It also lists the goal of each step and thus brings to mind why the different tasks need to be accomplished. It facilitates the application of the participatory concept and helps managers to complete the relevant steps one by one.

The second concept dealt with an analysis of how auxiliary organizations can be supported in developing tools and transferring them to their target demographic. This entailed developing a marketing concept that would help auxiliary organizations to become more market-oriented. The concept developed in this thesis demonstrates what auxiliary organizations need to do in order to identify the attributes a support tool needs to have for it to be appealing to users. Furthermore, the concept illustrates how it would be possible to optimize the transfer of these tools to the different

target groups.

This second concept of support was put into practice and tested using the LAV platform[2] (LAV – Avoiding Food Waste, from the German "Lebensmittel Abfall Vermeiden") as a case study. This case demonstrated how an auxiliary organization, in this case a research institute, was systematically guided through the process of developing the LAV platform and transferring it to its desired target group. The LAV platform was specifically set up and targeted to SMEs in the German food sector that wished to reduce food waste in their operations. The LAV platform compiled various applicable tools from academia as well as from industry, and the most suitable tools were made available in a toolbox. The tools were classified according to topic and market segment. The effectiveness of the concept was assessed by SMEs and industry organizations that evaluated the platform's user-friendliness. It was rated according to two categories. In one category, the overall performance of the platform was rated 1.6 (on a six-point scale where 1 is the best and 6 is the worst, analogous to German school grades). The second category assessed the extent to which users considered the platform to be a useful tool for preventing food waste. The average rating on a nine-point scale (where 9 was the best) was 7.2. Finally, the concept was summarized in the "Marketing Campaign Guide", which presents a systematic and target-audience-centered approach. This guide leads organizations through the various steps of a marketing campaign, from defining the required benefits of a new product or service to ultimately launching it. It comprises the eight steps of research, planning, pretesting, implementing, monitoring, recycling and revision, transfer, and raising follow-up financing.

Both concepts developed in this thesis contribute to addressing the holistic challenge of fighting food waste, because these concepts support all relevant players (auxiliary organizations as well as actors directly in the food supply chain) who need to be involved in food waste reduction efforts. In this way, both concepts make an important contribution to reaching the Sustainable Development Goal (SGD 12.3), to which the EU and its Member States have committed, of halving per capita food waste on the retail and consumer level by 2030, and reducing food waste during production and manufacturing.

[2] www.lebensmittel-abfall-vermeiden.de/ (accessed on 19 May 2019)

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1 General introduction

1.1 Food waste – Definition, quantities, and the tools available to reduce it

The United Nations' Sustainable Development Goal (SDG) #12 is "Ensure sustainable consumption and production patterns"; one component of this is to halve food waste at the retail and consumer level, and to reduce food losses along the food value chain (SDG 12.3) (UN 2015).

"Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)" (Östergren et al. 2014). According to this definition by Östergren et al. (2014), food waste includes any food that is discarded, incinerated, composted, left unharvested or plowed under, or decomposes anaerobically, goes into the production of bioenergy, or goes into the sewer or a landfill. In contrast, food is not considered as food waste if it is valorized or converted to animal feed, used for biobased materials or used for biochemical processing. Food that is donated to charity is also outside the definition, since it is consumed. Östergren et al. (2014) argued that food waste could be further classified as edible or inedible.

Kranert et al. (2012) subdivided food waste into three categories: avoidable, unavoidable, and partly avoidable. Avoidable food waste can be attributed to different consumer habits; unavoidable food waste includes non-edible parts such as bones or banana peels, as well as edible parts that are sometimes discarded by necessity. Potato peels are an example of food waste that is partly avoidable. For potatoes that are boiled or baked in the skin, the peels do not occur as food waste, since they are part of the meal, while for pure boiled potatoes, they accrue as food waste. Apple skins and bread crusts are other examples of partly avoidable food waste.

Other definitions make a distinction between "food waste" and "food losses", depending on what point along the value chain the food is discarded. According to Hafner et al. (2013), food waste occurs at the end of the food value chain, at the level of large-scale consumers (such as the hospitality and catering sector) or at the end consumer, while the term "food losses" is applied to food discarded at the beginning of the value chain, during production and manufacturing. Aulakh and Regmi (2013) have defined "food waste" as the loss of edible food that can be attributed to human action or inaction at the consumption stage (e.g. not consuming food between when it was stored and its deterioration, or because serving sizes were too large).

In contrast, they defined “food losses” as food that has been lost due to shortcomings in infrastructure or management.

Roodhuyzen et al. (2017) concluded that there was no generally accepted standard for the differentiation of wasted food into “food losses” and “food waste.” For this reason, and also to enhance the legibility of this thesis, the term “food waste” is also used synonymously for the term “food losses.”

Wasting food ultimately means wasting all the resources that have been used for processing, transportation, and storage. Several studies have compared the environmental impact of avoidable food waste in terms of different categories, such as its global warming potential (in CO_2 equivalents), or water depletion (Tonini et al. 2018). Globally, one third of all food produced is lost along the food supply chain between farms and the consumer (FAO 2013). This food waste accounts for 3.3 gigatons of CO_2 equivalent, which would make worldwide food waste the third-largest CO_2 contributor after the total emissions of the USA and China (FAO 2013). Food waste in developing countries tends to occur during the stages of production, handling, and storage, while in developed countries, the consumption stage is the largest contributor to food waste (Lipinski et al. 2013). In Europe, food waste amounts to 88 million tons (Stenmarck et al. 2016). In a study of Germany by Kranert et al. (2012), the authors found that total food wasted along the value chain from manufacturing to consumption amounts to 11 million tons annually. Noleppa and Cartsburg (2015) also included primary production in their study, in which they determined that annual food waste in Germany amounted to 18 million tons. They found that the largest part is caused at the consumption stage, with end consumers responsible for 39% (7.23 million tons), and large-scale consumers, such as food service facilities or restaurants, causing 18% (3.40 million tons) of the food wasted. Retail, manufacturing, and primary production each represent 14% of Germany’s food waste (see Figure 1.1).

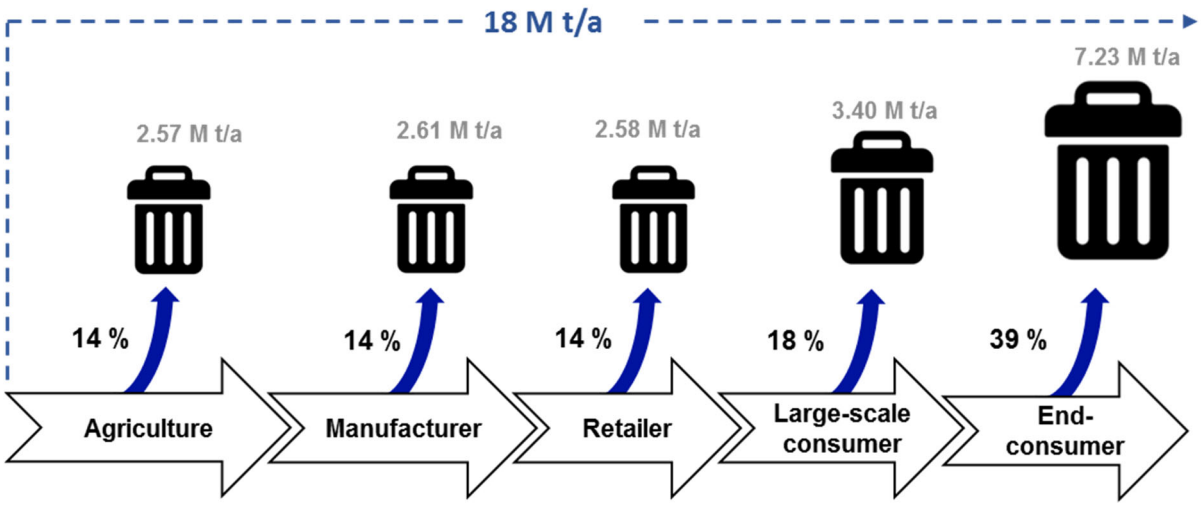

Figure 1.1. Food losses and food waste along the German food value chain (own illustration based on Noleppa and Cartsburg 2015).

The data on food waste quantities which is currently available for Germany has a variety of shortcomings: The losses determined by Noleppa and Cartsburg (2015) were calculated from a limited database for Germany, which was complemented by data from international studies. The authors themselves described the databases available as being rather diffuse and inhomogeneous, which led to significant uncertainty regarding the loss rates they determined. For consumers, a new study was recently published by the GfK (a consumer research association) (GfK 2018). The GfK determined food waste quantities for consumers in North Rhine-Westphalia, and found that on average, consumers waste 23 kg of "avoidable" food annually. Their findings were based on diary records by consumers and were set up in accordance with recommendations published by REFRESH (van Herpen et al. 2016). The method applied by the GfK and the quantities determined could be used as a national consumer baseline. However, reliable data for primary production, manufacturing, retail, and large-scale consumers is still missing. Another aspect that needs to be considered is the diversity of the food sector. For instance, the market of large-scale consumers includes several segments, such as individual catering (private restaurants or system gastronomy) and public catering. The latter can be further split into catering businesses from the sectors of education, business, or care. Each segment faces different challenges related to their specific target group. Their business environment is strongly influenced by their financial resources and correspondingly their personnel capacities or technical facilities as well. All these given situational factors have an impact on the individual level of food waste of each organization. Therefore, it is also necessary to introduce useful benchmarks for the individual segments of the food industry.

There are several different reasons why food is wasted. A lack of awareness about the

topic of food waste is a general problem for all stages of the supply chain (Kreyenschmidt et al. 2013). Retail specifications that lead to rejected food on the supplier side for fresh fruits and vegetables (Monier et al. 2010; Noleppa, Cartsburg 2015) also incur food waste, as does deficient knowledge about food quality on the part of the consumer, or unclear best-before labels (Quested, Murphy 2014). The consumer discards edible food that is perceived as being spoiled simply because it has reached its best-before date. Changing lifestyles of consumers, who demand high flexibility as well as large portion sizes from retailers, further contribute to food waste on the consumer level (Parry et al. 2015; Parfitt et al. 2010; Langen et al. 2015). Moreover, the high availability and low prices of food products contribute to food waste and lead to high consumer expectations, e.g. for bakery products where customers expect full shelves shortly before closing time (Ritter et al. 2015).

Kranert et al. (2012) also stated that for food service facilities, inappropriate internal organization of production and serving processes result in the wasting of food. This starts with inadequate storage of raw materials or a lack of calculation basics for production planning, and ends with portion sizes served to the customer that are too large, and also relates to insufficient communication among all relevant staff members, i.e. cooks in the kitchen fail to obtain information about special customer needs (e.g. for vegetarian food). Gunders (2012) has summarized the drivers for food waste in food service as large portions, inflexibility in chain-store management, and pressure to supply enough food and large menu choices all the time. Mackenzie et al. (2011) identified poor stock rotation or inappropriate storage of stock, overproduction, poor preparation, and inadequate portion control techniques as the main reasons for food waste in the hospitality sector. The aforementioned examples demonstrate that the root causes for food waste vary depending on the type of food product, the level, and the organization of the supply chain (Kreyenschmidt et al. 2013).

To reduce the amount of waste, there are already more than 500 tools published in the English or German language available for free on the Internet. These attempt to support companies in the food sector in their food waste reduction efforts (Strotmann et al. 2017). These tools can be categorized by the following goals: analysis and planning, raising awareness, measuring and monitoring, procedures, and benchmarks and best practices. The different tools focus on collecting or monitoring food waste data (e.g. food waste calculators, manuals to measure food waste). Moreover, they also include films or posters to help raise awareness or to educate staff, and other materials incorporate concepts that concentrate on recycling or avoiding food waste for use in business. The tools have mainly been developed in the context of academic

projects or by governmental programs (e.g. by the World Resources Institute[3], the Waste Action and Resources Programme (WRAP)[4], EPA Ireland[5], or the German Institute of Sustainable Nutrition (iSuN)[6]).

Figure 1.2 illustrates the origin of these support tools: the largest number of tools have been developed in Great Britain (216), of which most result from WRAP, followed by Germany (96) and the USA (80) (Strotmann et al. 2017).

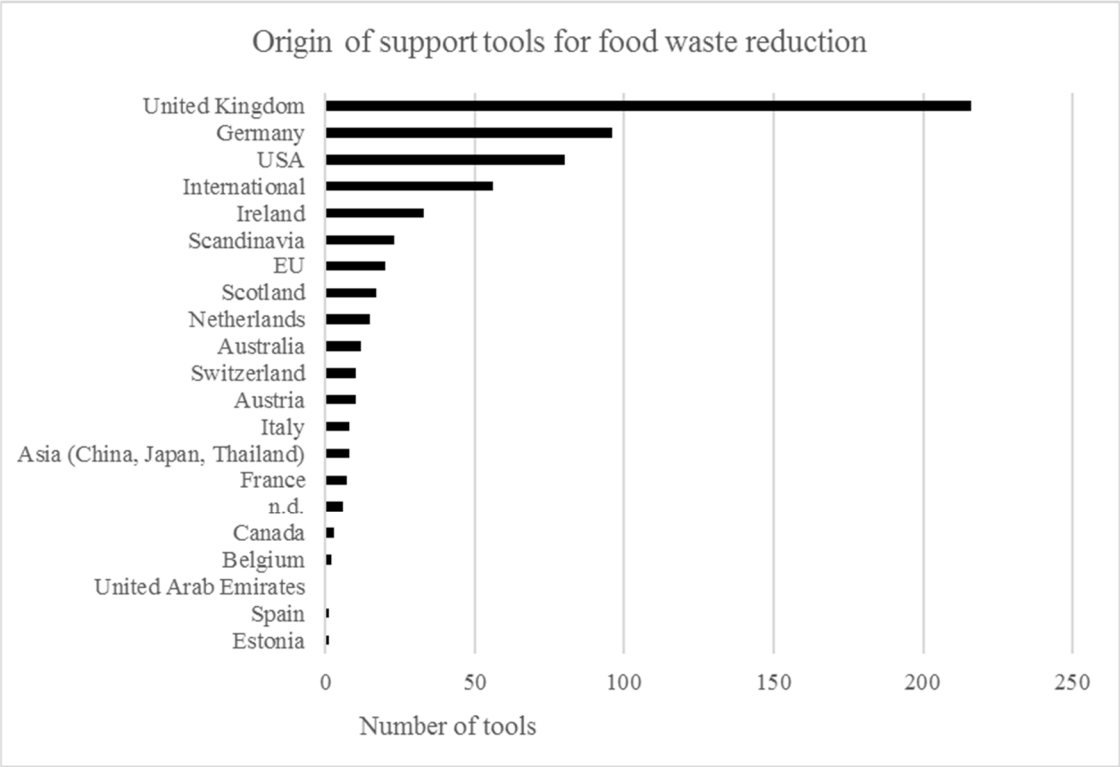

Figure 1.2. Origin of support tools for the reduction of food waste available in the English or German language (Strotmann et al. 2017).

1.2 European research on food waste

The reasons for studying food waste have changed in the last few decades. In the health-care sector, food waste was often a focus when determining health and nutritional effects on specific target groups. In hospitals, for example, food waste has been used as a measure to determine the nutritional intake of hospitalized patients (Almdal et al. 2003; Barton et al. 2000b, 2000a; Edwards, Nash 1999; Dupertuis et al. 2003; Iff et al. 2008). Wasted food in hospitals

[3] www.wri.org/ (accessed on 19 May 2019)
[4] www.wrap.org.uk (accessed on 19 May 2019)
[5] www.epa.ie/ (accessed on 19 May 2019)
[6] www.fh-muenster.de/isun (accessed on 19 May 2019)

has also been investigated to compare different catering practices (Sonnino, McWilliam 2011; Ofei et al. 2014) or to analyze the effects of menu changes on patient satisfaction (Connors, Rozell 2004; Donini et al. 2008; Goeminne et al. 2012). For instance, Williams et al. (1998) compared the amount of food wasted in the use of different food serving systems for patients undergoing cancer therapy and found that room service improves patients' food intake. For residential homes, Grieger, Nowson (2007) and Nichols et al. (2002) used plate waste to determine the nutrient intake of residents.

During the last few years, the research focus of food waste has been expanded to address the economic, social, and environmental effects of food waste. Such studies emphasize, for example, that reducing food waste offers economic benefits (Engström, Carlsson-Kanyama 2004; Barton et al. 2000b; Wales Audit Office 2011; Betz et al. 2015; Lee et al. 2013). Current discussions on food waste are also held in the context of sustainable nutrition. This concept, introduced by Koerber (2014), describes a rather holistic view of the food waste issue. The concept of sustainable nutrition encompasses five dimensions and relates to all stages of the food supply chain, rather than to individual businesses: primary production, food processing, distribution, preparation of meals, and waste disposal, including transportation. The five dimensions describe the relationship between nutrition and the environment, the social order, the economy, good health, and culture. It is holistic insofar as it considers multidimensional interactions within the food supply chain (Koerber et al. 2016). In this expanded context, food waste is no longer only considered an intra-organizational problem, but rather a social challenge, since in times of scarce resources, sustainable nutrition is becoming increasingly important with regard to the finiteness of resources, such as land, energy, water, or other assets (Willersinn et al. 2017; Beretta et al. 2017; Dou et al. 2016; Gjerris, Gaiani 2013; Halloran et al. 2014).

On a political level, reducing food waste contributes to fulfilling the requirements of the United Nations' Sustainable Development Goals (UN 2015). SDG 2, for example, calls on countries to "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture"; the reduction of food waste and losses at all stages of the supply chain, from production to the end consumer, is a requirement for the sustainable use and protection of natural resources. SDG 12.3 calls for halving food waste at the retail and consumer level and reducing food losses along the food value chain. SDG 13, "Climate Action", calls for the reduction of greenhouse gas emissions. SDG 13 is based on the Paris Agreement, according to which greenhouse gas emissions should be reduced by 80-95% by 2050 compared to 1990

levels in order to limit the increase in average global temperatures below 2 degrees Celsius (with a target limit of 1.5 degrees Celsius).

The increasing importance of food waste reduction is also reflected in European research projects, which have focused on that issue (e.g. SUSFOOD, Horizon 2020). Some projects are targeted to specific industries and businesses of the food sector (e.g. the Interreg projects ECOWASTE4FOOD, 2017-2020, or STREFOWA, 2016-2019). They aim to gather existing best practices, share relevant knowledge, and/or raise public awareness about the topic of food waste. Other projects focus on the development and implementation of a common European Policy Framework for food waste prevention (FUSIONS, 2012-2016). The following paragraphs detail some important projects that are relevant for this thesis.

From 2012 to 2016, the FUSIONS project ("Food Use for Social Innovation by Optimising Waste Prevention Strategies"), funded by the European Commission's Framework Programme 7, dealt with harmonizing the definitions of food waste, assessing different methodologies and sources of information in an effort to gather more reliable data, and identifying opportunities to improve the efficient use of food. In addition, recommendations and guidelines for a common European food waste policy framework were developed during the FUSIONS project (Vittuari et al. 2016). Currently (2015-2019), the REFRESH project ("Resource Efficient Food and dRink for the Entire Supply cHain"), funded by the EU's Horizon 2020 Framework Programme, is working on reducing avoidable food waste and enhancing the valorization of food resources. The researchers are analyzing the drivers of food waste and working to support better decision-making among businesses and consumers. REFRESH harness existing initiatives and expands them to advance, evaluate, and ensure the transfer of social, technological, and organizational insights and practices concerning the reduction of food waste. As a result, REFRESH members can develop frameworks for action (e.g. Eisenhauer, Bottermann 2016) and aid legislators and policymakers in combating food waste. Another exemplary initiative is WRAP, the "Waste Resource and Action Programme", based in the UK. This successful initiative is not just driving change in the area of "food and drink" but also in "clothing and textiles" and "electrical and electronic devices". For the "food and drink" sector, WRAP has set up different agreements to foster the efficient use of resources and to combat food waste. The "Hospitality and Food Service Agreement" was active from 2012-2015. The goal was to reduce food and associated packaging waste by 5% by the end of 2015; this was in fact exceeded, with 11% being saved (measured as CO_2 emissions) (WRAP 2016). For the UK grocery sector, including manufacturers, retailers, and households, the

carbon impact could be improved by the Courtauld Commitment. The current (2025) Courtauld Commitment involves 156 organizations that are collaboratively taking action along the entire food chain to fight food waste. For consumers, WRAP has initiated a campaign known as "Love Food Hate Waste". The campaign raises awareness about food waste and offers easy solutions for the consumer to save food.

1.3 Political programs in Germany addressing the reduction of food waste

The German government has adopted the UN's SDG 12.3 and has committed itself to the EU's objective of halving food waste at the retail and consumer level, and reducing food losses respectively along the food value chain. To reach this goal, the German cabinet adopted the National Strategy to Reduce Food Waste (BMEL 2019) in February 2019. This strategy focuses on keeping the entire food value chain in view, from primary production to final consumers. To reduce food waste, the strategy introduced four fields of action: *politics, business, changing behavior of all actors involved,* and *potential of research and digitalization*. In the *politics* field of action, the "Indicators" working group (which was established as part of Germany's Sustainable Development Strategy) has been working on defining segment-specific indicators for food waste. Its goal is to define baselines based on 2015 data. Furthermore, the working group coordinates reporting on food waste to monitor the success of food waste reduction activities. The working group comprises various actors from politics and research. These include the Thünen Institute[7] (research), the Federal Statistical Office (Destatis), and various federal ministries involved in food waste reduction. Secondly, as part of the "politics" field of action, communication must be improved to link together the activities of the different ministries and the states (*Länder*). This dialogue forum is to be coordinated by the Federal Ministry of Food and Agriculture (BMEL). In addition, dialogue forums will be held for each part of the food sector. One goal of these dialogue forums is to elaborate specific measures for food waste, together with food companies, civil society organizations, and representatives from politics and business. These dialogues should also support the "Indicators" working group in identifying appropriate methodologies for the different sectors. The first forum was launched on 20 February 2019 for the hospitality and catering sector. In the second field of action, *business*, companies from the food sector are requested to improve their processes in order to save resources and save costs accordingly. Companies are asked to analyze and monitor their production processes to identify the spots where food waste occurs and measures can be started.

[7] www.thuenen.de/ (accessed on 19 May 2019)

Moreover, the strategy calls for businesses to implement food waste-reducing activities into their daily business routines. The companies are particularly requested to apply innovative logistics systems to optimize the quantities of products ordered and delivered. The *business* field of action also calls on companies to analyze the intersection among different sectors and develop measures in the dialogue forums, which should then be implemented. Furthermore, the strategy requests companies to consider the interests of different external stakeholders as a means to reduce food waste. In order to increase the appreciation of the food products and to decrease food waste by the consumer, the companies should revise their marketing efforts. The third field of action of the strategy, *changing behavior of all actors involved*, hopes to achieve a higher appreciation of food by a variety of means, such as public-relations campaigns (e.g. "Too Good for the Bin"), the use of social media campaigns, and educational approaches. The latter not only target children, students, and apprentices; they also aim to give training staff and teachers information that they can use in the classroom. The *potential of research and digitalization* represents the fourth field of action. This field calls on businesses to use innovative means of digitalization, such as forecasting systems to better plan production volumes or digital tools to identify sources of food waste.

The National Strategy to Reduce Food Waste is intended to bundle the activities of all the different federal ministries involved in food waste reduction together; reducing food waste is a common element of four different governmental programs (see Figure.1.3): The National Program for Sustainable Consumption (Nationales Programm für Nachhaltigen Konsum) (BMUB et al. 2017), the Waste Prevention Program (Abfallvermeidungsprogramm) (Jaron and Neubauer 2013), the Climate Action Plan 2050 (Klimaschutzplan 2050) (BMUB 2016), and the German Sustainable Development Strategy (Deutsche Nachhaltigkeitsstrategie) (Die Bundesregierung 2016).

Figure.1.3. Germany's National Strategy to Reduce Food Waste in the context of four German political programs dealing with the reduction of food waste, and the ministries involved (BMJV: Federal Ministry of Justice and Consumer Protection, BMEL: Federal Ministry of Food and Agriculture, BMU: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety).

The extent to which the different programs require the reduction of food waste and the proposed actions in the programs vary. The following paragraphs give a brief sketch of these programs and their specific objectives related to the reduction of food waste.

The National Program for Sustainable Consumption (BMUB, BMJV, BMEL 2017) was published in a joint effort by three ministries: the Federal Ministry for the Environment, Nature Conservation, Building and Nature Conservation (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, BMUB, now: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, BMU), the Federal Ministry of Justice and Consumer Protection (Bundesministerium der Justiz und für Verbraucherschutz, BMJV) and the Federal Ministry of Food and Agriculture (Bundesministerium für Ernährung und Landwirtschaft, BMEL). The overarching goal of the program is to continuously raise public awareness about the topic of sustainable consumption. This program supports the necessary structural transformation in society and the economy to achieve more sustainable consumption patterns

on the demand side. Furthermore, the program is intended to enhance the professional exchange of all social actors and support synergies in implementation. The program lists 172 specific tasks from various fields, one of which is the field of nutrition. In this field, one important task is increasing the appreciation of food as a resource, and thereby reducing the occurrence of avoidable food waste. One of the specific activities that the program suggests is reducing food waste at events organized by public authorities. Another activity is intensifying the interaction of actors along the food value chain. In addition, the program calls for carrying out research to understand the effect the best-before date has on consumers' waste behavior. A further proposed action is developing target-group-specific information on the best-before and expiration dates for different consumer groups. It is in this context that the BMEL conducted its "Too Good for the Bin" campaign, which aims to reduce food waste in private households. In March 2017, the Competence Center for Sustainable Consumption was set up by the Federal Environmental Agency (Umweltbundesamt, UBA) in order to coordinate the implementation of the National Program for Sustainable Consumption. The Competence Center for Sustainable Consumption brings together all federal ministries (e.g. the BMEL, the BMUB and their subordinate agencies, such as the Federal Office for Agriculture and Food (Bundesanstalt für Landwirtschaft und Ernährung, BLE) the Competence Center for Sustainable Procurement (Kompetenzstelle für nachhaltige Beschaffung, KNB), and the UBA itself). The four major areas of activity of the Competence Center for Sustainable Consumption include: 1) formative and organizational support of the implementation of the National Program for Sustainable Consumption; 2) the supply of information services related to sustainable consumption; 3) the coordination of scientific services deemed necessary for sustainable consumption as regards the implementation of the program, and coordination of the respective federal ministries involved; and 4) the coordination and support of the National Network of Sustainable Consumption (Nationales Netzwerk Nachhaltiger Konsum). The latter is a social platform that was initiated in January 2017. It is supported by 200 actors from business, academia, politics, and civil society. It aims to develop tangible ways to implement the National Program for Sustainable Consumption and facilitate sustainable consumption patterns among the public. The network has the goal of fostering a practice-oriented and interdisciplinary dialogue, seeking to integrate the relevant social actors into the implementation process. Moreover, the Network aims to gather, analyze, and disseminate best practices as well as deriving actor-specific measures, mobilizing actor commitment, and securing options for funding. Since its foundation, three network meetings have been held to foster exchange among the relevant actors.

The Waste Prevention Program (Jaron and Neubauer 2013), published by the BMUB,

also includes an aspect of reducing food waste. The formulation of such a waste prevention program was required according to Section 33 of the Circular Economy Act (Kreislaufwirtschaftsgesetz, KrWG). The activities outlined in the Waste Prevention Program address different players along the food value supply chain. Regarding the reduction of food waste in businesses, the plan demands a start to action and agreements between public organizations and the industry / retail sector. The plan further calls for sensitizing consumers to waste in order to change their purchasing behaviors and consumption patterns to more sustainable ones, thus reducing domestic food waste. These activities along the food value chain should be accompanied by action by the federal government. Such action should further raise awareness about the topic of food waste and increase the appreciation of food as a resource. The Waste Prevention Program also presents more specific activities and will evaluate their effectiveness. There are three activities recommended in the plan that specifically deal with the reduction of food waste. The first task (#17) has the goal of optimizing order management to reduce food waste in the catering sector. It describes setting up voluntary training arrangements among governmental organizations, trade associations in the retail sector, and businesses of the catering sector in order to better adjust the supply and demand of food. The second task (#18) targets businesses, encouraging them to measure, monitor, and reduce their waste streams, including food waste, by a targeted amount. It relies on voluntary agreements between federal ministries or governmental agencies on the one hand and trade associations or business in the retail sector on the other. The advantage of such a voluntary agreement is that both parties are more likely to have the will to reach the set goals. The third task (#28) in the Waste Prevention Program works to understand the causes of food waste among the different actors along the value chain and to counteract them accordingly. It describes concerted activities related to the whole food value chain, including producers, processers and industry, and the retail sector. In 2014, the UBA funded a study entitled “The development of tools to prevent food waste”, which was conducted by Jepsen et al. (2016). This study described the environmental impact of food waste and offered recommendations about measures to update the Waste Prevention Program.

The Climate Action Plan 2050 (BMUB 2016), published by the BMUB, is the third program that calls for the reduction of food waste. The German government adopted this plan based on the outcome of the Paris Climate Change Conference in 2015. The German Climate Action Plan updated the interim reduction targets and the greenhouse gas reduction target for 2050, and underpinned it with specific measures. The Paris Agreement stated that the increase in average global temperatures should be kept below 2 degrees Celsius (with a target limit of

1.5 degrees Celsius). To reach this goal, the European Union committed itself to reducing greenhouse gas emissions by 80-95% by 2050 compared to 1990 levels. Germany has also committed itself to reaching this long-term goal. For 2030, the intermediate goal of Germany's Climate Action Plan 2050 is to reduce greenhouse gas emissions by at least 55% compared to 1990 levels. The action plan defines five areas of action: 1) the energy sector; 2) industry, trade, commerce, and services; 3) transportation; 4) buildings; and 5) agriculture and land use. The reduction of food waste is one of the activities proposed in this plan, falling under Area 5 – agriculture and land use. The activity also refers to SDG 12.3 of the United Nations, halving food waste by 2030.

The German Sustainable Development Strategy (Die Bundesregierung 2016) is the last of the programs dealing with the reduction of food waste. This strategy was published by the federal government of Germany. It includes specific targets and measures for an entire range of political issues. All federal institutions are supposed to contribute to achieving the given targets by taking measures in their respective fields. The first version of Germany's National Sustainable Development Strategy was published in 2002. Since then, it has been revised continuously, with the latest version being launched in January 2017. Within this sustainable development strategy, the federal government has sought to balance economic, environmental, and social requirements. The strategy is based on the 17 global goals for sustainable development (SDGs) (UN 2015) of the 2030 Agenda. Given the fact that roughly one third of the food produced globally is wasted, the reduction of food waste contributes to a more sustainable world in numerous ways. For example, SDG 2 calls on states to "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture"; for this, the reduction of food waste and losses at all stages of the supply chain, from production to the end consumer, is necessary to achieve the sustainable use and protection of natural resources. SDG 12.3 calls for cutting food waste in half at the retail and consumer level, and reducing food losses along the food value chain. The measures proposed in the German strategy include different activities, such as providing information and raising awareness (specifically continuing and further developing the "Too Good for the Bin" campaign) by the federal government. The national goals set out in Germany's National Sustainable Development Strategy are continuously being reviewed. Related to this, the strategy requires data availability and quality on avoidable food losses to be improved.

1.4 The limitations of existing food waste reduction strategies

Not only have politicians called for a reduction in food waste (see Section 1.3 above); it also offers economic benefits for companies in the food sector (see Section 1.2). However, many businesses in the food sector in Germany face the challenge of high cost pressures, low staff capacities, and time constraints, which leaves them little room for other work than daily work routines. This is caused by the fact that they are subject to a highly competitive market structure, where the five biggest food retailers have a market share of more than 70% (BVE 2016). Moreover, most of the businesses are considered small and medium-sized enterprises (SME). For example, more than 99% of the businesses in the German hospitality sector are part of this group (Söllner 2014), which often lacks extra capacities to initiate extraordinary projects. Hence, SMEs in particular need support in implementing initiatives to counteract food waste.

Nevertheless, there is already a large number of readily available support tools to reduce food waste (see Section 1.1). However, it is unclear if those tools provide a significant benefit for SMEs in the food sector, as the tools are distributed on the Internet. Companies might not even know about their existence, and searching for them requires personnel or time capacities. Furthermore, the benefits of the tools may only be worthwhile if they are applied by a specific area of the food industry, or by a specific group of employees. For instance, tools published in the English language may be hard to understand for employees of German SMEs with lower qualifications. This is a limiting factor for the tools' use in practice. One crucial aspect for the successful application of such tools is that they need to be developed and marketed according to their target audiences' needs. In other words, the tools need a market orientation, which implies a focus on the specific target audience (e.g. bakeries, butchers, or the hospitality and catering sector) (Andreasen, Kotler 2014). However, as a study of the UK, the USA, and Australia revealed, nonprofit organizations often lack such market orientation, since they are still dominated by an organization-centered mindset in which marketing appears to be primarily defined by promotional activities (Dolnicar, Lazarevski 2009). While in profit-oriented businesses it is common sense that a market and customer orientation is necessary for commercial success, nonprofit organizations still need to work on adopting an audience-centered mindset (Meffert et al. 2015; Homburg, Becker 2000; Kotler, Keller 2006; Vahs, Brem 2015).

Attention should also be paid to the underlying reasons for food waste, which are diverse (see Section 1.1). Viewed from an individual business's standpoint, the "problem" may be

solved by shifting food waste to the preceding or following step of the supply chain. However, simply shifting food waste from one stage to the next is obviously no real solution. For example, for hospitals, reducing serving losses should not lead to increasing patients' plate waste. This has already been recognized by researchers and politicians. For example, Sonnino and McWilliam (2011) called for a more integrated approach that would take into consideration all groups along the food supply chain in hospital catering, or Koerber (2014) who considered all stages of the food supply chain in the concept of sustainable nutrition (see Section 1.2). Politicians have also demanded intensified interaction of the different actors of the food value chain, e.g. in the German Waste Prevention Program (Jaron, Neubauer 2013). In order to reduce the total amount of food waste along the whole food supply chain, a practical approach is required, which enables managers to involve all of the different relevant stakeholders. In hospital catering, for example, such an approach must involve all relevant stakeholders involved in food supply and consumption. This group comprises actors from management and from production, as well as staff from the dishwashing area, service and nursing staff, and also patients and suppliers.

As this all demonstrates, concepts that support managers of SMEs from the food sector in their food waste reduction efforts are still missing, especially concepts that respond to the need for a holistic food waste reduction approach, as called for by government and academia. In addition, concepts that improve the marketing orientation of support tools counteracting food waste and that facilitate the availability of such tools for their intended users are also currently unavailable.

1.5 Objective, research questions and design of the thesis

The objective of this thesis is to develop concepts to support the reduction of food waste in the food sector, i.e. for SMEs in manufacturing, retail, or large-scale consumption (hospitality and catering sector). Another objective is to develop guidelines for the application of such concepts for their intended users. The thesis therefore develops two concepts, targeting different groups of users. The first concept is targeted to managers from the food sector, such as from manufacturing companies, retailers, or firms with large-scale consumption, supporting them in their efforts to carry out food waste reduction projects. This concept also responds to the need for a holistic food waste reduction approach that contributes to food waste reduction beyond the borders of a single company. The second concept developed in this thesis attempts to improve the market orientation of support tools to reduce food waste. It thus addresses auxiliary

organizations, such as research organizations, political institutions, or private initiatives, that develop the support tools.

This leads to the following research questions:

1. What is the status quo of organizations from the food sector regarding the occurrence of food waste, i.e. the quantities present as well as the different challenges leading to food waste? How can this status quo be evaluated, and how can food waste be reduced?

2. How can a concept be set up that would support managers of SMEs from the food sector in their food waste reduction efforts in a way that would lead to a holistic rather than an organization-centered food waste reduction approach, thus avoiding the shifting of food waste along the food supply chain?

3. How can auxiliary organizations, such as research organizations, political institutions, or private initiatives that intend to support companies in the food sector in their food waste reduction efforts, themselves be supported in becoming more market oriented? In other words, what would aid auxiliary organizations in systematically completing the process of developing food waste reduction tools, and successfully transferring them to their intended users?

The next following paragraphs outline the design of this thesis in more detail; Figure 1.4 depicts this.

Section 2 discusses three organizations from the food sector chosen as case studies. The cases include a hospital, a hospital cafeteria, and a residential home. Each case study undergoes an analysis determining the initial quantity of food waste, as well as identifying the most challenging aspects of food waste; this analysis ultimately contributes to finding solutions how to reduce the level of food waste. To determine the status quo regarding the occurrence of food waste, a process analysis was carried out to identify the processes and structures present in each organization. This meant gathering relevant information using a document analysis, complemented with observations and interviews. In addition, the research involved measuring the amount of food waste for two weeks to determine the initial level of food waste. The information from the process analysis was then analyzed; this analysis necessitated bringing together the relevant actors along the food supply chain in workshops. These actors included representatives of management, kitchen employees, service workers, the nursing staff in the hospital and the residential home, and representatives from the food supplier. After this, the

next step was to reduce food waste by developing and prioritizing various measures with the various stakeholders in a participatory approach. Finally, the effectiveness of the food waste reduction initiative was determined by conducting a second food waste measurement after the measures had been implemented.

Section 3 presents the development of a food waste reduction concept targeted to managers of SMEs from the food sector (Concept #1). The concept is based on the experiences gained from the preceding analysis described in Section 2 and from other national and international food waste reduction projects, as well as on literature research on participatory management and Total Quality Management (TQM). Based on the conclusions drawn from the case studies and the information gained from the literature, the next step was to set up a holistic food waste reduction concept. This involved using a participatory approach, in which the relevant stakeholders, such as employees, managers, suppliers, or customers, were integrated into the different steps of the food waste reduction process. The participatory approach was able to foster a holistic solution for the problem of food waste, rather than shifting it to preceding or subsequent process steps. Moreover, it was capable of raising awareness and improving employee commitment and responsibility. The participatory elements were embedded into a five-phase concept, which was then adapted to the PDCA (Plan–Do–Check–Act) cycle applied in TQM. Finally, the concept was summarized in the "Manual for Managers".

Section 4 of the thesis describes the development of a second food waste reduction concept (Concept #2). This concept was targeted to auxiliary organizations, such as political or research institutions, that intend to support companies in the food sector in their efforts to reduce food waste. This concept was based on an analysis of current literature on marketing for nonprofit organizations. It was also summarized in a manual, the "Marketing Campaign Guide". The guide offers a systematic and target audience-centered approach, steering auxiliary organizations through the various steps of a marketing campaign. Section 4.5 highlights tests of the practicability of the concept, by applying it in a case study developing and transferring the "LAV" platform (LAV – Avoiding Food Waste, from the German "Lebensmittel Abfall Vermeiden"). This platform gathers food waste reduction tools for SMEs of the food sector in Germany and structures them by topic and market segment. In this case study, SMEs from the food sector as well as branch associations participated in the development and transfer process. Their input was used to customize the platform's structure and layout, and optimize the platform's prototype. Market research with the participating organizations followed in the form of web-based surveys and group discussions. The final step in this case study, was to evaluate

the effectiveness of the platform by conducting web surveys with the participating organizations. Interviews were conducted to determine the optimal way to transfer the platform to its market.

Section 5 summarizes the results of this thesis and finishes with concluding remarks which are related to the findings obtained in Sections 2 to 4 and which are brought into the context of the current political discussion on food waste in Germany.

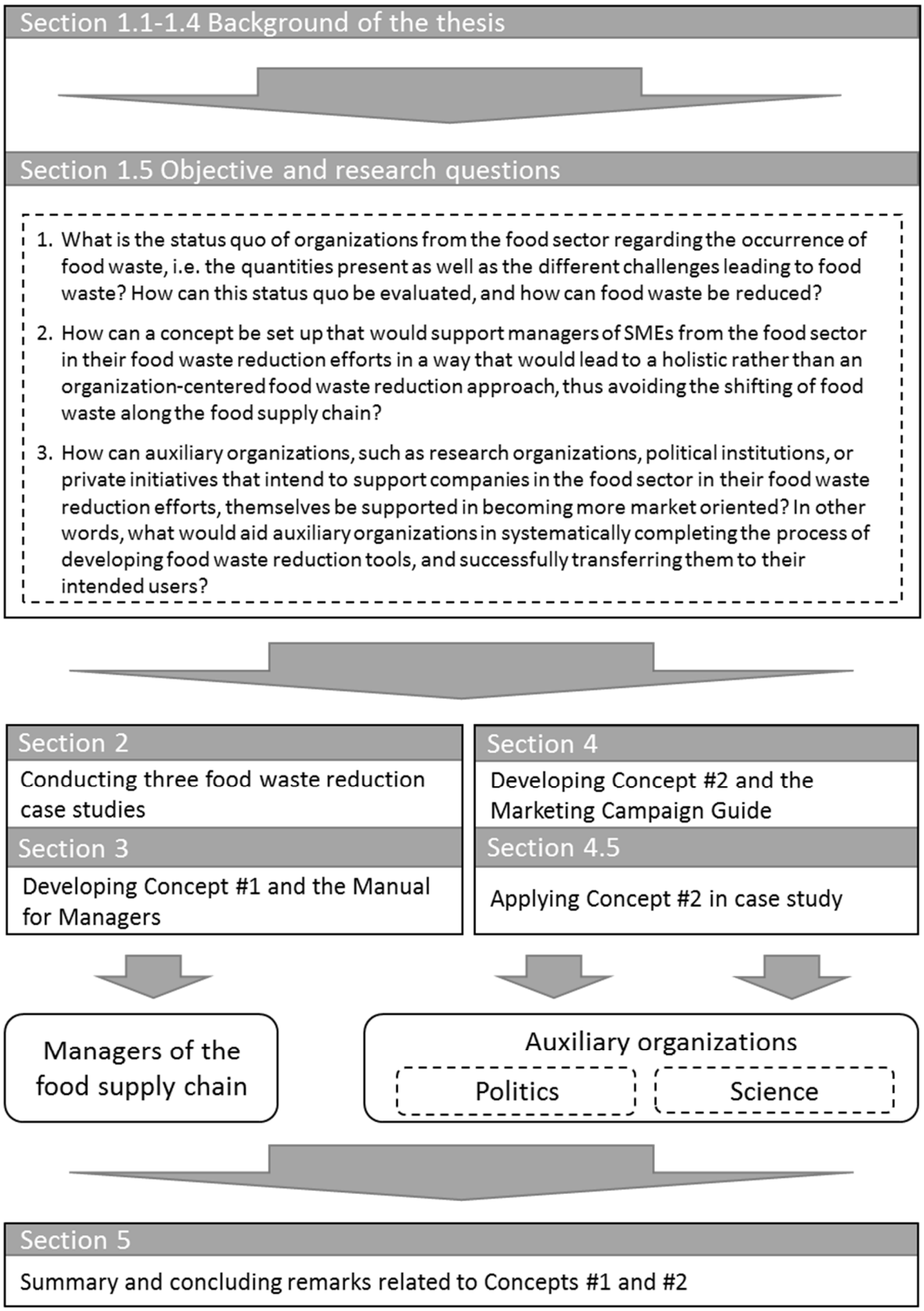

Figure 1.4. Structure of the thesis "Food waste reduction concepts for stakeholders in the food supply chain and auxiliary organizations".

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2 Comparing food provided and wasted before and after implementing measures against food waste in three healthcare food service facilities

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2.1 Introduction and objectives

Kranert et al. (2012) found that 65,000 tons of food are wasted in hospitals and 93,000 to 145,000 tons in nursing and residential homes each year in Germany. In addition to the discarded food, all resources used during agricultural and industrial production and transport are also wasted. This contradicts the concept of sustainable nutrition (Koerber 2014) which, in times of scarce resources, is becoming increasingly important with regard to the finiteness of resources, such as land, energy, water, and other assets. For this reason, politicians and customers expect the food industry and caterers to accept responsibility for their diners, society, and the environment (Rückert-John 2007).

In their review article, Williams, Walton (2011) summarized the literature on the extent of plate waste occurring in hospitals until 2011. They found a median plate waste of 30%, with a wide range from 6 to 65%, reported in 32 international studies. Findings of current research coincide with earlier results. Sonnino and McWilliam (2011) determined that total food waste in three Welsh hospitals ranged from 19% to 66%. In the Irish 3-year Green Healthcare Programme of the Environmental Protection Agency, 37% and 49% of the food prepared for and provided to patients was wasted (EPA 2013). Similar findings were revealed in a Portuguese study, in which Dias-Ferreira et al. (2015) found that an average of 35% of food served was not consumed by patients but discarded as waste. In the study by Ofei et al. (2014) conducted in a Danish hospital, unserved food items totaled 50% of every lunch and supper for wards with a satellite kitchen as well as 42% and 65% for wards without a satellite kitchen. The above findings reveal a great reduction potential for food waste in the healthcare sector.

Other studies from the food service sector that address the economic perspective of food waste emphasized that reducing food waste also offers financial benefits. Engström and Carlsson-Kanyama (2004) found in four Swedish service institutions that there is a 20% loss on average, with plate waste accounting for about 50% of waste as the single largest source. They extrapolated that 287 million additional portions could be served from food discarded in the food service industry in Sweden, and calculated economic losses of €657 (SEK 6030, July 2003) per day for the four restaurants under investigation. Barton et al. (2000) estimated that the food wasted on four hospital wards was worth £139,655 (€160,889, June 2017) during the four-week measurement period. The Wales Audit Office (2011) determined that the cost of unserved meals on 62 wards was approximately £1.5 million (€1.7 million, June 2017) per annum. For an Italian school caterer serving 510 meals per day, Falasconi et al. (2015) calculated an economic value of €381.90 per day for food wasted. Betz et al. (2015) calculated

that food wasted in two food service institutions amounted to CHF170,216 (€156,742, June 2017) per annum.

Reducing food waste in an organization can be referred to as a continuous improvement process (CIP) as applied in Total Quality Management (TQM) (Brüggemann, Bremer 2015). Such an improvement process generally involves the following steps: Analyze the problem, Identify solutions, Implement measures, and Review results. Whereas most of the above studies analyze the problem or identify solutions (e.g., Betz et al. 2015; Goonan et al. 2014), the study at hand is innovative, as it involves all steps. The status quo in three food service facilities of the healthcare sector is analyzed, the reasons for food waste are determined, and measures are developed accordingly in a participatory approach. Further, the measures are implemented and their effectiveness is controlled by measuring food waste before and after implementation. The participatory elements applied in the case studies address the need for a comprehensive approach revealed by Sonnino and McWilliam (2011), who called for a more integrated approach considering all groups along the food supply chain that encounter food waste at the hospital level. The present study takes into account of the fact that the catering service does not only involve kitchen staff, but also several other independently operating groups of employees in such institutions, such as nurses, dieticians and order assistants, who are integrated into the development and implementation process. Further, the participatory approach includes steps aimed at raising employees' and customers' awareness of food waste, addressing the gap identified by Kranert et al. (2012), who found that there is insufficient knowledge on the emergence of food waste in an organization. In addition, this study provides key figures (e.g., daily plate waste per person and food wasted in relation to food provided) concerning three German food service facilities from this sector, which can be compared to those provided in other (international) studies. This complements the figures for total waste quantities for the German healthcare sector provided by Kranert et al. (2012).

The aim of this study is to determine the quantities of food waste and the problematic fields leading to it, as well as to develop counteracting measures and to test their effectiveness in three different service institutions, taken as case studies. The case studies comprise: first, food provision of hospitalized patients in a hospital; second, the catering service of a hospital cafeteria; and third, food provision in a residential home. The effectiveness of the measures is determined by analyzing quantities of food provided and wasted before and after implementing the measures. Furthermore, this study targets to provide practical advice to managers of other healthcare food service institutions wishing to counteract food waste in their organizations.

2.2 Characteristics of the three organizations under investigation

The case studies involve three German institutions which, for reasons of confidentiality, will be called the a) hospital, b) cafeteria, and c) residential home. Table 2.1 summarizes the food supply characteristics of these three institutions. The hospital has 367 beds; patients admitted receive three meals per day. The hospital has medical centers for urology, gynecology, general pediatrics, and neonatology. It also has centers for general medicine, internal medicine, cardiac or renal diseases, diabetology, and breast diseases. The hospital also specializes in surgery, especially general, abdominal, hand, trauma, and reconstructive surgery. In the hospital, a tray service is used to supply all three meals. Meals are prepared, portioned, and delivered to the hospital by a central processing kitchen (CPK). Warm dishes are prepared according to the cook & chill procedure. The hospital kitchen is responsible for regenerating warm food components on the trays and transporting the trolleys with the meals to the wards. After that, responsibility for food delivery to patients is passed on from the kitchen staff to the nurses. So-called order assistants take patients' orders every morning. Patients choose from a fixed variety of food components for the next day's meals. Breakfast and dinner consist of "bread meals", where patients select the type and number of slices of bread required plus spreads, sliced cheese or meats. They can also opt for yogurt or fresh fruit. In Germany, lunch is traditionally served as a warm meal, consisting of a soup, main dish and dessert. Patients can choose from three main dishes. Special dietary needs are determined by doctors and medical staff, representing the basis for order assistants' requests. Orders are submitted electronically to the CPK.

The second institution, the cafeteria, offers meals, snacks, and drinks to medical staff and hospital guests. Sandwiches, cakes, snacks, and desserts are served throughout the day. In addition, two warm meals are offered at lunchtime, as well as ready-to-serve meals in the afternoon. The warm meal supplied for lunch is also prepared by the CPK. Unlike the lunches serves to patients, which are delivered readily portioned on trays, the cafeteria receives bulk containers, which its service staff have to regenerate. Guests decide there and then which dish they want, which is placed directly on a plate by cafeteria staff. All the other food items offered are delivered by local stores and prepared by the cafeteria staff. Sandwiches and rolls are made fresh every day, as well as the salad for the salad lunch buffet and the desserts, which are delivered as convenience products. The ready-to-serve meals available in the afternoon until closure at 5 p.m. are refrigerated convenience products such as schnitzel or meatballs with either salad or rolls. They are either preprepared in the morning and stored cool until ordered, or prepared on request.

The residential home is the third organization under investigation. It accommodates 74 seniors in 69 single rooms and double rooms. The institution's food service facility manages and organizes residents' orders and processes suppliers' deliveries. Residents' rooms are grouped into eight living units, each of which has a multifunctional community room with a kitchen and dining area. Residents can choose whether they want to eat in a group or alone in their rooms. In addition to the living units with long-term residents, the residential home also has a daycare facility where seniors can stay from 8 a.m. to 4 p.m., including breakfast and lunch. 72 of the 74 long-term residents use the meals service regularly; only two residents are fed via a special enteral tube. Food is supplied to residents as follows: a warm lunch is supplied by the CPK (the same one that supplies a) and b)). Meal components are supplied in bulk containers and regenerated by the food service department. Residents choose from two different main dishes for lunch, which they order from a menu list the week before. Breakfast and dinner consist of bread meals prepared by the food service facility of the residential home. They can choose different bread or roll varieties and different spreads, sliced meats and cheeses. They are also offered a special dinner component that varies every day, which is either a savory or a sweet dish in addition to the bread ordered. Residents state their preferences for breakfast and dinner once on arrival, after which changes are made regularly.

Table 2.1. Summary of food supply characteristics in institutions a), b), and c).

	Hospital a)	**Cafeteria b)**	**Residential Home c)**
		Breakfast	
Supplier	Tray service supplied by CPK	Snacks, rolls, cakes delivered by local stores and prepared by cafeteria staff	Groceries supplied by wholesaler and local bakery
Composition	Bread meal that patients order daily from a set list for the next day	Individual customer's choice, free-flow system	Bread meal either prepared by staff according to residents' stated preferences or individually by residents in table groups
		Lunch	
Supplier	Tray service supplied by CPK	Menus supplied in bulk by CPK, regenerated by cafeteria staff	Menus supplied in bulk by CPK, regenerated by staff
Composition	Warm meal that patients order daily from a menu plan for the next day	Customer places individual order after viewing the meals, free-flow system (warm meal offered at lunch time)	Warm meal that seniors order from a menu plan a week before delivery

		Dinner[1]	
Supplier	Tray service supplied by CPK	Snacks, cakes delivered by local stores and wholesaler	Groceries supplied by wholesaler, individual trays prepared by internal food supply dept.
Composition	Bread meal that patients order daily from a set list for the next day	Individual customer's choice, free-flow system	Bread meal and savory or sweet dish, either prepared by staff according to residents' stated preferences or individually by residents in table groups

[1] Cafeteria closes at 5 pm

2.3 Methodology

2.3.1 Phases applied in the case studies

The approach applied in the case studies comprises five phases (see Figure 2.1) beginning with an analysis of the actual state, where the structures and processes of the food service facilities are identified by process analysis. This analysis is subdivided into a visit and a measurement part, both taking place on-site at the food service facilities, and an off-site analysis phase. In the measurement part, quantities of food provided and wasted are determined over a two-week measurement period, referred to as the reference measurement (#1). During the visit phase, relevant information is gathered following observations and interviews. The interviewees are members of the food supply chain, such as service assistants, the kitchen manager, or nursing staff. In the analysis phase of the process analysis, all of the information collected during the interviews, observations, and measurements is evaluated, forming the basis for the next project phase, the development of measures to counteract food waste (see Figure 2.1). The measures are then implemented in Phase 3. In Phase 4 "Review of results", a control measurement (#2) of food waste is conducted and the results are compared with those of the reference measurement. The effectiveness of the measures implemented is assessed in Phase 5 and, where applicable, corrective actions are proposed to the management of the food service facilities.

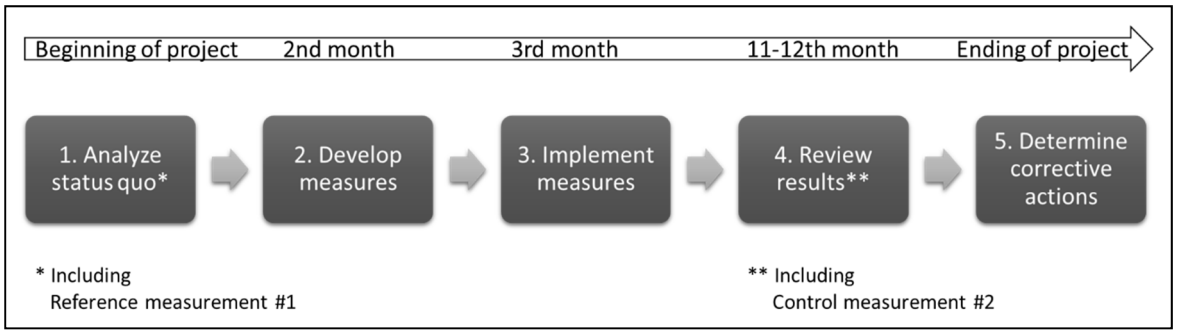

Figure 2.1. Phases of the approach applied in the case studies.

2.3.2 Measurement: Selection of waste categories and food Classes

The food waste categories and food classes used in this study are based on the definition given by Betz et al. (2015), who subdivided food waste into three categories: preparation losses, serving losses, and plate waste. They subdivided food waste into seven classes: "(1) meat/fish, (2) starch accompaniments, (3) vegetables, (4) fruit, (5) desserts, (6) other (e.g. sauce, soup, ketchup, cheese), and (7) unavoidable losses (e.g. banana skins)". These classes are modified to reduce complexity and simplify the measurement process. This approach provides a detailed picture of the waste composition, allowing to develop specifically adjusted measures.

Table 2.2 provides an overview of the food waste categories for each meal relevant in the study and the food classes to which losses are allocated. In the cafeteria, meals are split into lunch and other meals, with the latter category including all items sold except for lunch components. For the hospital and the residential home, meals are subdivided into breakfast, lunch, and dinner. In the hospital, only three food classes are applied in order to simplify the separation process in the dishwashing area. The "packaged food" food class analyzed for the hospital includes packaged foodstuffs such as coffee milk, sugar, spreads, cakes, and fresh fruit. The "miscellaneous" food class includes all other foodstuffs served, e.g. lunch dishes, mash, soups, etc. For breakfast and dinner, the third food class "bread" is applied, which includes slices of bread and rolls served to patients.

Patients', customers', and residents' plate waste for all meals at each institution is measured. In the cafeteria, serving losses occurring due to bulk delivery from the CPK and other food items sold, such as cakes and sandwiches, is determined. For the residential home, serving losses occurring due to bulk delivery from the CPK is weighed. For breakfast and dinner, this waste category is not applicable (N/A), since residues from meal preparation, such as open packages of cheese or bread are stored and used to prepare the next meals. Serving losses do not apply for patients' food supply in the hospital either because meals consist of preportioned trays delivered by the CPK.

Table 2.2. Waste categories (PW: plate waste; SL: serving losses) and food classes applied for each food service facility for reference and control measurements.

Hospital a)	Cafeteria b)	Residential Home c)
Breakfast **PW** • Bread • Packaged food • Miscellaneous	Other meals* **PW / SL** • Miscellaneous	Breakfast **PW** • Bread • Sliced meat, cheese, other spreads • Miscellaneous
Lunch **PW** • Miscellaneous • Packaged food	Lunch **PW / SL** • Meat/fish/egg-based components • Starch-based components • Vegetables/salad • Dessert • Non-avoidable • Miscellaneous	Lunch **PW / SL** • Meat/fish/egg-based components • Starch-based components • Vegetables/salad • Dessert • Non-avoidable • Miscellaneous
Dinner **PW** • Bread • Packaged food • Miscellaneous		Dinner **PW** • Bread • Sliced meat, cheese, other spreads • Miscellaneous

*Other meals include all items sold in cafeteria except for lunch components.

2.3.3 Measurement: Determination of food provided and wasted

Quantities of food waste is determined by weighing using electronic scales. Exact weighing is decided to be better for this purpose than the visual estimation of food waste described by Kirks and Wolff (1985) or Kandiah et al. (2006). Weighing is performed by employees from the three organizations who are trained in advance on how to separate food waste into the specified food classes and, where applicable, distinguish between serving losses and plate waste. Plate waste is documented on weighing lists, including the date, meal, and food class. Serving losses are recorded on delivery notes provided by the CPK. Hence it is possible to allocate serving losses directly to the corresponding food component delivered.

Weights of food provided by the CPK are obtained from delivery notes for the food delivered in bulk containers. Weights of food components preportioned on trays in the CPK are either taken from the ERP system once the manager had confirmed the validity of the data or from calibration lists obtained from the CPK management. Weights of breakfast and dinner

items in the residential home and quantities of the various articles offered in the cafeteria are provided by the relevant kitchen managers.

2.3.4 Measurement: Date and period

Two measurements are conducted at each institution; the first is referred to as the reference (#1) measurement and the second as the control (#2) measurement. The time span between the two measurements at the three institutions is seven to nine months. During this time, measures aimed at improving resource efficiency, i.e. optimizing the food produced and reducing food waste, are developed and implemented. The waste measurement period is chosen to represent the average eating and food waste producing behavior of patients, customers, and residents. For this reason, bank holidays or holiday periods are not included in the measurement phase and it is taken care that there is no mass disease outbreak leading to unusual measurements. The intended measurement time is two whole weeks, including weekends.

2.3.5 Measurement: Quantitative analysis of the results for food provided and wasted

The waste quantities documented and production figures are processed in MS Excel and statistical analysis is performed using IBM SPSS Statistics 24. From the given data, the following values are calculated and graphically presented for the first and second measurement (subscript *i* refers to specific measurement day *i* and *n* to the total number of days during the measurement period):

I. Comparison of food provided and wasted: average total waste rate ($\overline{WR}$)

$$\overline{WR} = \frac{\sum_{i=1}^{n} WR_i}{n} = \frac{\sum_{i=1}^{n} (food\ wasted\ /food\ provided\ )_i}{n} \quad (1)$$

II. Comparison of food provided and wasted (rate of serving losses ($\overline{SL}$), rate of plate waste ($\overline{PW}$))

$$\overline{SL} = \frac{\sum_{i=1}^{n} SWR_i}{n} = \frac{\sum_{i=1}^{n} (serving\ losses\ /food\ provided\ )_i}{n} \quad (2)$$

$$\overline{PW} = \frac{\sum_{i=1}^{n} PWR_i}{n} = \frac{\sum_{i=1}^{n} (plate\ waste\ /food\ provided\ )_i}{n} \quad (3)$$

III. Distribution of food wasted among meals: average waste share ($\overline{WS}$)

$$\overline{WS} = \frac{\sum_{i=1}^{n} WS_i}{n} = \frac{\sum_{i=1}^{n} (waste\ per\ meal/waste\ per\ day)_i}{n} \quad (4)$$

IV. Food provided ($\overline{\text{FPpP}}$) and food wasted per meal as serving losses ($\overline{\text{SLpP}}$) or plate waste ($\overline{\text{PWpP}}$) per person per day

$$\overline{\text{FPpP}} = \frac{\sum_{i=1}^{n} (food\ provided\ per\ meal/number\ of\ diners)_i}{n} \quad (5)$$

$$\overline{\text{SLpP}} = \frac{\sum_{i=1}^{n} (serving\ losses\ per\ meal/number\ of\ diners)_i}{n} \quad (6)$$

$$\overline{\text{PWpP}} = \frac{\sum_{i=1}^{n} (plate\ waste\ per\ meal/number\ of\ diners)_i}{n} \quad (7)$$

The results of the two measurements are compared and change rates are determined. Statistical analysis (two-sided t-test for unpaired two samples with $p < .05$ considered statistically significant) is used to determine whether differences in the values of reference and control measurement are coincidental or can be attributed to the changed settings.

2.3.6 Development of measures of improvement

A participatory approach is chosen for the development of measures. The aim of the approach is to increase employee commitment and assumption of responsibility. Measures of improvement are developed in collaboration with the different groups of employees involved by making use of their knowledge and experience. The groups include management and kitchen staff, as well as nursing staff and social workers, or even non-employed actors, such as residents' relatives. The concept takes up the recommendations of Donini et al. (2008), who suggested involving all employee groups to establish a good communication structure for improving the quality of hospital catering services, and of Goonan et al. (2014), who stated: "A planning workshop, designed to bring management and kitchen staff together to brainstorm ideas for short- and long-term food waste reduction initiatives, is an obvious place to start."

The participatory approach comprises focus group workshops in the period between the reference and control measurements in each of the three organizations. Table 2.3 summarizes the elements of the focus group workshops and their aims.

Table 2.3. Elements of focus group workshops conducted as part of the participatory approach and aims of the elements.

Elements of Focus Group Workshops	Aim of the Element
Presentation of facts and figures related to food waste in general and organization-specific based on results of measurement #1	• Creating awareness of the problem • Motivating employees
Brainwriting (Klebert et al. 2006) (Why do you think food waste occurs in your organization?)	• Involving workshop participants • Gaining insight into practice • Motivating employees
Clustering of ideas (What are the main aspects leading to food waste?)	• Stimulating debate among participants • Identifying key points for food waste based on employees' perspective
Joint development of measures (How do you think food waste could be avoided?)	• Stimulating debate among participants • Developing measures • Creating commitment and psychological ownership
Selection of measures to be implemented (Please cast three votes to the measures you consider best for avoiding food waste.)	• Democratically prioritizing measures by participants
Setting of timeline and to-do list	• Jointly choosing and prioritizing measures for implementation to increase acceptability and create ownership • Defining employees in charge and required tasks and deadlines to ensure timely implementation of measures

Focus groups are applied to learn about the psychological and sociological interrelation of the staff involved (Kepper 2008). Another reason for choosing this approach is that the employees should become very committed to the project, which should be achieved by creating psychological ownership. As Umble and Umble (2014) stated, psychological ownership of ideas is critical to generating true enthusiasm and commitment to the project. By becoming involved, employees are supposed to overcome their personal reservations with regard to the anticipated changes. Instead, they should identify with the measures in order to improve their implementation and to obtain sustainable results, i.e. long-lasting effects in improving resource efficiency. The interdisciplinary teams include a number of different participants. Besides two researchers (one as moderator, one for record keeping) the following employees take part in the workshops. For the hospital, the team includes the head of nursing services, two nurses, two order assistants, a dietician, the hospital kitchen manager, and a representative from the CPK. For the cafeteria, two members of the service staff, the kitchen manager, a representative from the CPK, one nursing staff member (in the role of a diner at the cafeteria) take part in the workshop. In the residential home, the kitchen manager, one service staff member, four nursing staff members, the director, the quality manager, and the social worker participate in the

workshops.

2.4 Results

2.4.1 Results of the participatory approach to determine measures of improvement

Table 2.4 summarizes the measures developed in the study. The measures are structured into five categories: Information, Communication, Products, Processes, and Customer needs. These measures are implemented between measurement #1 and #2 (see Figure 2.1).

Table 2.4. Summary of measures improving resource efficiency in the food service facilities of a hospital (a), cafeteria (b), and residential home (c).

Topic	Summary of Measures, Indication of Relevance in Organization a) Hospital, b) Cafeteria, and c) Residential home
Information on food waste	• Sensitize employees to the topic of food waste (by providing posters and involving the management) (a, b, c) • Train order assistants to optimize order taking (better matching of ordered quantities to patients' needs) (a) • Train cafeteria staff to fill up the salad buffet (b) • Sensitize customers to the topic of food waste (design a poster) (a, b) • Sensitize residents and their relatives to the topic of food waste I
Communication	• Analyze the flow of communication along the supply chain (from CPK to customer) to identify gaps (a, b, c) • Organize workshops with employees from different departments in order to improve communication • Establish continuous feedback processes along the supply chain (a, b, c) • Provide information on the nutrition biography of patients and residents to the order assistants and personnel concerned (a, c)
Product presentation	• Configure food catalogue with detailed description of breakfast and dinner items (a) • Reduce the wide range of items offered for breakfast and dinner, and review quality (a) • Limit deliverable quantities of spreads and toppings to order per person (a) and link them to ordered quantity of bread slices or rolls (a) • Introduce fixed assortment for kitchens on wards (a)

Food ordering and supply	• Change order and delivery process to account for new admissions and discharges better (a) • Designate a central person in charge of ward kitchens (a) • Individualize the process of food supply to serve individual needs better I
Customer needs	• Identify and consider target group-specific needs I • Change portion sizes according to target group-specific standards and their needs (a, b, c) • Train service employees with regard to portion sizes (b, c) • Analyze # of meals consumed & customer preferences to better meet # of meals ordered from CPK (b) • Offer action weeks, increase attractiveness of menu (a, b, c)

2.4.2 Summary of quantitative results for waste measurements

The results of the quantitative analysis of reference (#1) and control (#2) measurements are summarized in Table 2.5 and Table 2.6 for the three organizations (hospital, cafeteria, and residential home).

Table 2.5. Summarized rates of serving losses, $\overline{\mathbf{SL}}$, plate waste, $\overline{\mathbf{PW}}$, and total waste, $\overline{\mathbf{WR}}$, (in % ± standard deviation) per meal for the hospital, cafeteria, and residential home for measurements #1 and #2.

	Serving losses (%)		**Plate waste (%)**		**Waste rate (%)**	
	#1	**#2**	**#1**	**#2**	**#1**	**#2**
			Hospital			
Breakfast	N/A		28.7±9.4	30.3±9.6	28.7±9.4	30.3±9.6
Lunch	N/A		18.5±5.2	18.6±3.6	18.5±5.2	18.6±3.6
Dinner	N/A		45.0±10.0	42.5±13.9	45.0±10.0	42.5±13.9
Total					**25.6±4.6**	**26.3±4.4**
			Cafeteria			
Lunch	23.5±13.8	16.6±8.1	3.5±2.4	1.8±1.5	27.0±12.6	18.4±8.9
Other	1.1±1.4	.2±.3	.0±.0	.0±.0	1.1±1.4	.2±.3
Total					**19.8±8.3**	**12.8±6.6**
			Residential home			
Breakfast	N/A		12.9±2.8	7.5±1.2	12.9±2.8	7.5±1.2
Lunch	13.4±9.5	6.2±3.9	12.5±4.4	10.9±2.9	25.9±10.8	17.1±3.1
Dinner	N/A		19.4±7.9	12.8±2.6	19.4±7.9	12.8±2.6
Total					**21.4±6.7**	**13.4±1.4**

Table 2.6. Summarized quantities of average food wasted per person per day as plate waste, $\overline{\mathbf{PWpP}}$, serving losses, $\overline{\mathbf{SLpP}}$, and food provided, $\overline{\mathbf{FPpP}}$, (in g ± standard deviation) for the hospital, cafeteria, and residential home for measurements #1 and #2.

	$\overline{\mathbf{PWpP}}$ (g)		$\overline{\mathbf{FPpP}}$ (g)		$\overline{\mathbf{SLpP}}$ (g)	
	#1	**#2**	**#1**	**#2**	**#1**	**#2**
			Hospital			
Breakfast	86±28	75±24	301±12	251±27		
Lunch	168±49	127±29	909±157	681±70		N/A
Dinner	131±29	116±36	292±25	277±40		
			Cafeteria			
Lunch	36±23	18±17	602±108	662±171		N/A
			Residential home			
Breakfast	40±10	30±5	309±47	399±23		N/A
Lunch	87±31	76±17	702±96	718±111	97±74	46±32
Dinner	75±31	46±10	388±41	363±47		N/A

*valid for warm lunch menu; salad from the buffet sold separately was included; serving losses due to an excess number of meals delivered by the CPK were excluded from calculation of $\overline{\text{FPpP}}$; **portion size in hospital includes in-between snacks (e.g. cake, yogurt) delivered with each meal

Table 2.5 summarizes average waste rates ($\overline{WR}$ ± standard deviation) per meal for the three organizations. Where applicable, total waste was split into the waste categories serving losses and plate waste. Table 2.6 summarizes the average daily waste quantities in grams occurring per person and per meal (± standard deviation) for the three organizations. For the hospital, only plate waste was relevant, since all meals are provided on trays and any food waste originated entirely from tray waste. In reference to Sonnino and McWilliam (2011), plate waste from untouched meals was not recorded separately, but included in the plate waste volume. For the cafeteria, plate waste per person was also calculated. Serving losses were not calculated per person because they occur from excess quantities of meals ordered from the CPK. Serving losses were analyzed separately in Section 2.4.4. For the residential home, both daily serving losses and plate waste per person and per meal were determined.

2.4.3 Results for the hospital a)

Data was based on 14 days of measurement #1 and 13 days in #2, since data was incomplete for one dinner. $\overline{WR}$ in the hospital was 25.6% (#1) and 26.3% (#2) (Table 2.5). The slight increase between measurements #1 and #2 was not statistically significant (p = .854).

Summing up $\overline{\text{FPpP}}$ for breakfast, lunch, and dinner resulted in daily average food provided per person of 1,502 g for measurement #1 and 1,209 g for #2 (see Table 2.6). This represents a 20% reduction in the average quantity of food served daily per person. Serving losses did not apply, plate waste per person, $\overline{\text{PWpP}}$, decreased by 17% from 385 g to 318 g

daily. Both reductions were considered statistically significant, with p = .000 and p = .014, respectively.

For both measurements, lunch created the largest proportion of waste, at 43% (#1) and 40% (#2), respectively. Dinner accounted for 34% (#1) and 35% (#2) of waste; breakfast accounted for the lowest proportion of waste, at 23% (#1) and 25% (#2).

2.4.4 Results for the cafeteria b)

Serving losses and plate waste in measurement #2 were recorded for 14 days, whereas plate waste in measurement #1 was only recorded for nine days. Results for measurement #1 were therefore based on the nine-day period. The total waste rate, $\overline{WR}$, for all food provided (Table 2.5) decreased from 19.8% to 12.8%, which was a statistically significant (p = .036) reduction.

Lunchtime $\overline{\mathrm{SL}}$ and $\overline{\mathrm{PW}}$ fell from 23.5% to 16.6% and 3.5% to 1.8%, respectively. However, the changes were not considered statistically significant (p = .143, and p = .052) for either waste category. $\overline{\mathrm{SL}}$ for other food products sold fell significantly (p = .030) from 1.1% to 0.2%. No plate waste occurred for such products in either measurement. For both measurements, #1 and #2, the majority of food waste (99%) was produced by lunch.

The food provided per person, $\overline{\mathrm{FPpP}}$, for the warm lunch meal, excluding salad from the buffet, was 602 g and 662 g for measurements #1 and #2, respectively. Values were calculated without serving losses from excess meals delivered by the CPK. The increase was not statistically significant (p =.362). Plate waste per person, $\overline{\mathrm{PWpP}}$, was reduced significantly from 36 g to 18 g per meal (p = .037).

Another analysis performed in addition to waste measurement referred to the number of lunch meals delivered and sold (see Table 2.7). The cafeteria received lunch meals from the CPK and sold them after regenerating bulk containers. An average of 25.1% of the delivered meals were left unsold in measurement #1, and 27.2% in measurement #2; the slight increase was not statistically significant (p = .722).

Table 2.7. Comparison of lunch meals ordered from the central processing kitchen (CPK) and sold in the cafeteria during measurements #1 and #2, and average surplus (in %).

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Surplus
Measurement #1															
Ordered	105	110	105	105	100	60	70	110	110	130	110	100	60	70	**25.1%**
Sold	95	110	95	75	87	36	46	81	98	97	62	78	26	48	
Measurement #2															
Ordered	105	110	100	110	110	45	65	110	110	120	130	95	45	65	**27.2%**
Sold	84	93	61	84	87	25	38	98	110	89	67	57	28	57	

2.4.5 Results for the residential home c)

During measurement #1, weighing lists for three days could not be used for analysis owing to inappropriate completion. For this reason, results for #1 were based on an 11-day period. For organizational reasons, the period for measurement #2 had to be reduced to one week. The total waste rate determined for #1 was 21.4% and 13.4% in #2. It was reduced significantly ($p = .003$). Both $\overline{PW}$ for breakfast (12.9% / 7.5%) and dinner (19.4% / 12.8%) were reduced significantly, with $p = .000$, and $p = .049$, respectively, whereas the change for lunch (12.5% / 10.9%) was not considered statistically significant ($p = .383$). However, serving losses for lunch were reduced significantly ($p = .043$) from 13.4% to 6.2%.

Summing up, the daily food wasted per person results in a total of 300 grams for all meals for measurement #1 and 199 grams for #2. The reduction was statistically highly significant ($p=.009$). The average quantity of food provided did not change significantly ($p = .085$), amounting to 1,399 grams for measurement #1 and 1,481 grams for #2.

Lunch caused the largest share of waste, at 61% (#1) and 62% (#2) respectively. Dinner accounted for 23% (#1) and 22% (#2), with breakfast leading to the least waste (15%) for both measurements.

2.5 Discussion

2.5.1 Comparison of the results obtained in a), b), and c) with other studies

Several international studies have determined food waste in hospitals. Compared to Williams and Walton (2011), who summarized the findings of 32 studies in hospitals, food waste determined in the hospital, at 25.6% and 26.3% discarded in measurements #1 and #2, was within the range of 6 to 65% and was lower than the median plate waste of 30% they calculated. Sonnino and McWilliam (2011) found that food waste was especially high on

elderly rehabilitation wards, determining waste rates of 19% to 66% in three Welsh hospitals. Compared to these results, the findings were in the lower range. The findings for the hospital represented an average number for the entire hospital; they were not differentiated by the wards' medical profiles. The findings were also lower than those determined by the Irish Environmental Protection Agency (EPA 2013), which determined waste rates of 37% to 49%, and the findings of Ofei et al. (2014), who found waste rates of 42% to 65%, depending on whether or not the service system included a satellite ward kitchen. The results for the reference measurement of 385 g of average food wasted per person per day coincided with the findings of Goeminne et al. (2012), who determined an average of 384 g of food waste for their control group. With their Meals-on-Wheels distribution approach, they achieved quantities of food waste as low as 81 g per person per day. Compared to their reduction of 79% following their intervention to change the service system, the 17% reduction to 318 g of food waste achieved in this study was relatively small. This could be attributed to the fact that they offered a more individual catering service style to patients, which took greater account of their specific needs.

In the cafeteria, a surplus of more than one fourth of lunch meals ordered from the CPK coincided with the findings of Garrone et al. (2014), who established a model to predict food waste along the supply chain. They stated that the main source of surplus food in the food service industry is due to overproduction following errors in demand forecasting.

The results for the residential home were in line with the findings of Hackes et al. (1997), who found that a tray service generated more food waste in a retirement community than waiting staff table service and a family-style service. Although lunch food waste (serving losses and plate waste) was reduced to 122 g per person per day between measurements #1 and #2, this value was still higher than the findings of Eriksson et al. (2017), who measured 90 g per person of waste for lunch in an elderly home. This indicated there was further room for improvement. The findings were in agreement with the findings of Halloran et al. (2014), who analyzed food waste reduction options for different actors of the supply chain in Denmark and suggested that production closer to the customer results in less food waste. The results are in accordance with a statement given by Tincher (in McCaffree 2009), a consultant to the long-term health-care industry, who stated: "…Food waste is reduced by improving communication systems between the dietary department and the resident or nursing staff…". All information available with regard to nutritional requirements needs to be transferred to the kitchen staff who provide the food. For example, nutrition biographies documenting quantities consumed and preferences for special foodstuffs offer valuable information, which should not only be available to nursing staff but also to those who prepare the food.

2.5.2 Hospital a)

Hospital food waste ($\overline{WR}$) was 25.6% and 26.3% in measurements #1 and #2. Merely considering these two figures would generate an incomplete picture, which could easily be misinterpreted as stagnation or even a worsening of the food waste situation before and after the implementation of measures. However, considering that both average quantities of food served and wasted per person per day fell significantly by 20% and 17%, respectively, reveals a different, positive picture.

A direct quantitative effect from a specific action could not be inferred, since the effectiveness of single interventions was not measured. However, the greatest reduction effects can be attributed to two actions that were implemented. Firstly, menu composition and portion sizes were revised by the CPK management. Secondly, the order taking process was improved. The order taking process started with menu assistants asking patients what they want to eat. It also related to the number of items that could be ordered. One example: the number of toppings for bread meals was linked to the number of slices of bread or rolls ordered. Initially, some patients ordered a large number of toppings for just two slices of bread to pick so that they could choose what they liked best at the time of consumption. In addition, order assistants were trained not to encourage patients to order additional in-between snacks. The method of offering products has changed. Products were specified in greater detail and the request mode changed. For instance, whereas order assistants used to ask: “Would you like a yogurt and fresh fruit”, they then asked: “What would you like to order, cherry yogurt or an apple or a pear or an orange?” While in the first case, patients ordered both with a single “Yes”, not knowing exactly what they were getting, they then needed to decide precisely and state what they want. In addition, it is crucial for information about patient discharges and admissions to be transferred to the kitchen immediately in order to reduce overproduction and unnecessary meals. This measure also enhanced patient satisfaction, because it was annoying for patients to receive a different meal to the one ordered simply because they had been transferred from one ward to another. Analyzing flows of information on patient nutrition, especially at departmental interfaces, provided a useful picture and created impetus for further improvement and missing feedback loops.

All measures together have led to a reduction in the average food quantity provided per patient from 1,502 g in the first measurement to 1,209 g in the second one. The revised plans comply with DGE (German Association for Nutrition) standards nevertheless, and guarantee sufficient nutrient intake for patients.

2.5.3 Cafeteria b)

Food left on plates in the cafeteria at lunch time, $\overline{\text{PWpP}}$, was relatively low in measurement #2, at 18 g. This was the lowest value compared to lunch plate waste in the hospital (126 g) and residential home (76 g). This result could be attributed to several facts: firstly, customers chose what they wanted to eat immediately before consuming the food, to suit their appetite. They did not need to choose their food a day or a week in advance. Secondly, they saw and smelt what they were ordering and were given no surprises. Thirdly, they had to pay for their food at the till in the cafeteria, unlike the hospital patients and residents, who paid indirectly by way of their contributions to health insurance or residential living expenses. There was no plate waste for other foodstuffs apart from lunch. Besides the three main reasons mentioned above, this could also be attributed to the fact that some of these items are consumed outside the cafeteria, where it was not possible to detect any waste incurred.

Serving losses, $\overline{\text{SL}}$, at lunch, including leftovers from warm meals delivered by the CPK and from the salad buffet, were 23.5% (#1) and 16.6% (#2) of the volume produced. However, the reduction was not statistically significant ($p = .143$). There was still a high proportion of unsold warm meals, which remained at a constant level of around one in four meals being discarded (see Table 2.7). The kitchen manager stated that the main reason for the high level of serving losses from warm lunch components was the unpredictable number of consumer orders. The number of meals ordered varied for several reasons. In general, demand at the weekends was lower than on weekdays. An analysis of past menus showed that no rules could be applied to lunch menu preferences. Whereas a certain menu was preferred in one menu cycle, it differed in the next menu cycle. Past shortages have led to unsatisfactory situations, resulting in customer complaints, mainly from hospital staff having lunch at the cafeteria. The management wanted to avoid dissatisfaction due to insufficient food quantities, so a safety margin is applied, often resulting in excess quantities.

Serving losses for other foodstuffs sold during the day were low in measurement #1 and #2, at 1.1% and 0.2%. The alignment of quantities produced and ordered was optimized by using cooled convenience products, which could be stored and sold over longer periods. The quantity of freshly delivered products such as rolls and sandwiches were prepared exactly in accordance with quantities demanded. Rather than supplying excess quantities, it was considered acceptable for some items to be sold out.

Overall, concepts needed to be developed to deal with the excess of lunch meals delivered by the CPK and not sold to customers.

2.5.4 Residential home c)

Average total waste fell by 37%, from 21.4% to 13.4%. This was a highly significant reduction following the implementation of several measures developed specifically for the residential home. These measures were related to the catering situation, residents' needs, and the staff involved. In measurement #1, the food service facility prepared most meals in the central kitchen of the residential home and then delivered trays to the dining area of each living unit. After delivery, nursing staff were responsible for distributing the food to the residents. As a consequence, personnel preparing the food (kitchen staff) had no direct contact to residents. This process was optimized by closing the gap between kitchen staff and residents. The entire catering situation was revised, leading to the following situation: at mealtimes, kitchen staff worked within the kitchen areas of each living unit, supporting the nursing staff. Contact between kitchen staff and residents became much closer, leading to a more individual catering situation. Residents' specific daily needs, such as a large appetite or the wish to change sandwich spreads, were more likely to be noticed and could be applied immediately to the composition of each meal. Moreover, if a senior had an infection or a loss of appetite, portion sizes could be reduced accordingly. This reorganization of the food supply situation helped decrease food waste per person from 300 g to 199 g.

Moreover, it was very useful to have detailed facts about the waste categories. Measurement #1 revealed that serving losses contributed most to food waste. Hence, an emphasis was placed on developing measures aimed at reducing serving losses. In order to overcome this problem, the kitchen manager changed the lunch preparation process by regenerating smaller batches. More food was then only regenerated when specifically ordered. This was also the case for meat products, for example. Hence the cooling chain was not interrupted and chilled lunch components delivered by the CPK were kept for later use (e.g. for preparing a savory dish, such as macaroni or beef salad for dinner).

Compared to the hospital, less food waste was generated per person per day (#2: hospital 318 g, residential home 199 g). This could be attributed to the fact that more individual needs were considered in the residential home.

It was vital to ensure that the objective of reducing food waste would not contribute to malnutrition in the elderly. The case studied showed that the two principles of a) enhancing the nutritional situation by bringing kitchen staff closer to residents and applying a more individual catering approach in the institution and b) decreasing food waste can go hand in hand.

2.6 Conclusion

It was possible to improve the process of food supply in all three organizations (hospital, hospital cafeteria, residential home), leading to significant reductions in food waste. A comparison of the three organizations revealed that less food waste was generated in the residential home, where demand could be planned relatively precisely. It was not possible to predict precisely demand for meals required for hospitalized patients or those sold in the cafeteria; this led to untouched reserve meals in the hospital and serving losses in the cafeteria.

Five major categories of measures were identified: information, communication, products, processes, and customer needs. Food service facilities supplying the healthcare sector need to consider the specific characteristics of their target market, i.e., for the five categories:

- Information on food waste: Sensitization to the topic of food waste is important since employees and customers need to understand the relevance of reducing food waste. Visualizing the quantities of food waste (e.g. by calculating the number of disposed yogurts or wasted meat portions per year or by calculating the economic loss associated with food waste) helps transferring the message to the relevant stakeholders. Moreover sensitization must not only be targeted to employees or customers. It must also address relatives who take care of their family members. Relatives should be aware that measures such as reducing portion sizes are aimed at reducing food waste rather than saving costs at the expense of patients or residents.
- Communication: The food supply chain in the healthcare sector usually involves nursing staff or other assisting personnel. Managers should analyze the flow of communication along their supply chain from the kitchen to the customer, and improve communication especially at departmental interfaces (e.g. organizing workshops with employees from the different stages, such as nurses, dieticians, kitchen and service staff, and order assistants, to improve communication). They should further establish continuous feedback processes along the supply chain. For instance, this could involve determining the process of handing over the residents' nutrition protocols when shifts change in a residential home.

- Product presentation: Depending on the type of service and order taking process applied, patients and residents are unable to see and smell the food they order. For hospitals, food catalogues or menus that precisely define foodstuffs could be introduced. If patients know exactly what they are ordering, e.g. strawberry jam rather than just jam, or raspberry yogurt rather than just fruit yoghurt, they are less likely to waste it. A target group-specific language when creating menus should be applied. Modern terms used in trendy restaurants will not be appropriate in residential homes and may lead to misunderstandings and confusion about the food being served.
- Food ordering and supply: Managers should change order and delivery processes to take better account of new admissions and discharges in hospitals, and designate a central person to be in charge of ward kitchens. If possible, the process of food supply should be individualized to better serve individual needs. A regular feedback process on food waste, including all stages of food supply from the kitchen to residents/patients, should be installed to raise awareness of food waste and to transfer information on wasted items to the relevant staff in the kitchen. An example is the introduction of food waste protocols which must be completed by the staff of the dishwashing area on a daily basis and which deliver information on serving losses and plate waste for the kitchen staff planning and cooking the meals.
- Customer needs: Hospitalized patients and residents have specific needs that need to be identified, such as their health status and dietary needs, as well as their customs and habits. Menu composition and the description of components should be adapted to the target group. Elderly people like different food to younger people, and need it to be prepared to suit their needs, e.g. softer vegetables or gravy to facilitate chewing and swallowing. Kitchen staff need to understand their customers' specific dietary needs and eating habits. Making residents' nutrition biographies available to food service assistants helps them to understand the specific needs of residents and patients.

Creative solutions are necessary to optimize the organization-specific processes of food supply in the healthcare sector. Generally, a shifting of food waste along the supply chain should be avoided (Göbel et al. 2015). Reducing plate waste by an increased individualization of food supply should not result in larger serving losses.

2.7 Need for further research and limitations of the study

The following limitations apply to the study: the food waste situation before and after

implementing all measures at once was analyzed. For this reason, a direct quantitative effect from a specific measure cannot be inferred. Future research should test the effectiveness of individual measures to counteract food waste. To this end, food waste should be measured before and after single interventions. In addition, target group-specific needs and expectations should be studied more closely to better match the characteristics of the food delivered and expected by customers. This includes meal composition and preferences, as well as the atmosphere of the dining area and the presentation of meals on menus. Moreover, reference and control measurements took place in different seasons. The food waste level may have been affected by different weather conditions. Moreover, the menu composition in measurements #1 and #2 was different. Hence, if customers preferred some menus in one of the measurements, this may also have influenced the results. The duration of measurement #2 in the residential home was reduced to seven days for organizational reasons. This shorter measurement period may also have affected the food waste level identified. If the menu contained preferred menus during this period, this may have led to a lower food waste level.

The results showed the importance of having meaningful key figures. Future research should therefore identify sector-specific key figures in order to establish benchmarks, which enable companies of the food sector to assess their own position in comparison to others. Support of the management is a basic requirement for the success of food waste reduction projects. Managers should therefore be convinced that food waste reduction will be worthwhile from an economic perspective. Hence, researchers should also further investigate how to economically evaluate their findings on food waste reduction.

The case studies revealed that the management of all three organizations was willing to execute the food waste reduction initiatives. However, at the same time it was exposed to time restrictions and needed assistance in conducting the workshops to develop measures of improvement. Further research should therefore also focus on how to support management in executing food waste reduction initiatives, i.e. how to identify and implement measures of improvement, and on how to integrate all employees involved in order to gain their commitment in organizational change processes.

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3 A participatory approach to minimizing food waste in the food industry – A "Manual for Managers"

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3.1 Introduction and objectives

In Germany, 18 million tons of food are wasted annually on its way from the farm to the end-consumer (Noleppa, Cartsburg 2015). Before entering the retail or consumer level, the food produced has undergone various process steps along the food value chain, starting with agricultural production. During these processes, resources such as energy, water, and other materials are necessary for the conversion of the raw material to the end product. Therefore, wasting food also includes discarding all the other resources which have been used during production and transport. In times of scarce resources, the efficient use of land, energy, water, and other assets is crucial. Moreover, politicians and customers have called on the food industry to accept social responsibility for its impact on customers, society, and the environment (Rückert-John 2007).

Previous research has focused on determining food waste and the underlying reasons for it, either from the producer or consumer perspective (Katajajuuri et al. 2014; Göbel et al. 2015; Kranert et al. 2012; Garrone et al. 2014; Garrone et al. 2016; Eriksson et al. 2014). Several tools and concepts have been introduced, which enable managers along the value chain to analyze the status quo in their institutions and which present measures to combat food waste. Examples include the *Food Loss & Waste Protocol* (FLW Protocol)[8], a multi-stakeholder partnership, which has developed the global FLW Standard; WRAP's (Waste and Resources Action Programme) pack entitled *Taking Action on Waste Information Sheets*[9];Zero Waste Scotland's guide, *The ultimate guide: Monitoring and measuring food waste*[10]; a *Checklist* introduced by United against Waste[11]; the *Checklist for manufacturers and retailers* issued by "genießt uns", a German governmental initiative[12]; the *Food Waste Audit* guide from FoodSave[13]; and the *Manual for caterers and suppliers—Reducing food*

[8] http://flwprotocol.org/ (accessed on 19 May 2019)

[9] www.wrap.org.uk/content/taking-action-waste-information-sheets (accessed on 19 May 2019)

[10] www.resourceefficientscotland.com/sites/default/files/Guide%20Monitoring%20Measuring%20Food%20Waste%20Mar18_0.pdf (accessed on 19 May 2019)

[11] www.united-against-waste.de/downloads/dehoga-checkliste.pdf (accessed on 19 May 2019)

[12] www.geniesstuns.de/wp-content/uploads/2014/10/20141029_J069-Lebensmittelcheck-Lebensmittelwirtschaft-2i-2.pdf (accessed on 19 May 2019)

[13] www.foodsave.org/wp-content/uploads/2014/09/FoodSaveDIYWasteAudit-fin.pdf (accessed on 19 May 2019)

waste together developed by the Institute of Sustainable Nutrition (iSuN)[14]. These tools represent only a small sample of the more than 500 concepts and tools that are available in German and English (Strotmann et al. 2017). Nevertheless, recent studies have also revealed a need to integrate employees into the approaches applied. For example, in a study conducted in a Welsh hospital by Sonnino and McWilliam (2011), the authors discovered the need for a more integrated approach that takes into account all groups along the food value chain to counteract food waste. Until now, concepts have focused on waste reduction at the various stages of the supply chain by conducting problem analysis. Such an approach, however, fails to offer a holistic concept that integrates employees, customers, and other relevant stakeholders into the process of problem analysis, and the development or implementation of measures to counteract food waste. Such a comprehensive concept must be applied in order to benefit from employees' knowledge and experience, to gain a better understanding of customers' motivations and attitudes, and to enhance their commitment to the task of food waste reduction. Such a participatory concept, which is both solution-oriented and stakeholder-oriented, not only provides information on how to analyze the status quo and general measures to apply, but also enables managers to identify organization-specific problem areas and develop solution-oriented measures by integrating the relevant stakeholder groups involved in the processes along the food value chain.

In this study a participatory concept is introduced that supports companies of the food sector in their effort to reduce the quantity of food wasted. A five-phase concept with participatory elements is developed based on experiences gained in food waste reduction projects in the food sector as well as on principles of Total Quality Management (TQM). The concept is applicable for all food companies along the food value chain, belonging to the crafts sector, industry, retail, or large-scale consumers. Special attention is paid to the participatory approach of identifying reasons for inefficiency and developing counteracting measures, where employees and other relevant stakeholders are integrated into identification and change processes. In the projects, the participatory concept was applied for several reasons. The concept is suitable for transferring knowledge back and forth in this transdisciplinary collaboration between research and business. In addition, the participatory approach enables the development and implementation of company-specific food waste reduction measures as opposed to applying a predesigned concept that covers rather general

[14] www.fh-muenster.de/isun/downloads/leitfaden-grosskuechen-lebensmittelabfaelle-vermeiden.pdf (accessed on 19 May 2019)

measures and fails to consider company-specific needs. Moreover, the participatory approach integrates employees in decision-making processes, fostering their willingness to assume responsibility and enhancing their commitment to the project. The approach also strengthens communication among different business units, resulting in greater appreciation of each other's work.

It is another objective of this study to summarize the findings in a tool for mangers. Therefore, the "Manual for Managers" is presented, which is a support tool for managers wishing to reduce food waste. This tool was developed based on the experiences gained in the case studies. The manual structures and summarizes the approaches applied in each step of the project phases.

Sections 3.2-3.5 deliver the following information: Section 3.2 provides an overview of the food waste reduction projects in which the participatory concept was developed and of the methodology applied. Section 3.3 outlines the concept and the experiences gained during its application in the projects in greater detail. Section 3.4 consists of a discussion of the challenges faced in the projects, and, finally, in Section 3.5, the Manual for Managers is presented, which is developed based on the experiences gained.

3.2 Overview of the projects and methodology applied

The participatory concept, as a means to reduce food waste, was developed based on the experiences gained in three food waste reduction projects (see Section 2). The aim of all projects was to reduce food waste on both the production and consumer level.

a. Reduction of food waste in public catering

The aim was to reduce food waste in public catering. This study involved eight participants from industry, five caterers (including the kitchens of a residential home, a school, a hospital, a work center for the disabled, and a university dining hall) and three wholesalers. For this study, it was important to select partners that cover downstream parts of the supply chain (wholesalers and caterers) in order to jointly develop measures to ensure that food waste is not simply shifted from one part of the supply chain to another. Process analysis and quantitative measurements of food waste were conducted, and practicable solutions were developed to enable the institutions to operate more economically by saving on costs of production and disposal, by offering their customers fresh meals in sufficient quantities, and by reducing any unnecessary and irresponsible waste of resources. Close cooperation between caterers and wholesalers in the project allowed for the development of

both practical and economically competitive as well as environmentally conscious solutions to the problems described. The project design included a waste management period in the catering companies before and after implementing measures against food waste. This measurement was completed in four of the five catering facilities, since, in the meantime, one organization dropped out of the project (Göbel et al. 2014).

b. Reduction of food loss for bread and bakery products

This study involved six bakeries, the Chamber of Trades, bakery guilds, a consultant, and several bakery suppliers, as well as bakers' associations. It focused on delivering industry-specific and product-specific solutions for the reduction of food loss. Special attention was paid to the interaction between bakeries/retailers on the one hand, and consumers on the other. Partners were chosen to represent the different stakeholders of the bakery industry (Ritter et al. 2015).

c. Reduction of food waste in healthcare organizations

The partners consisted of three hospitals and two residential homes. Processes along the food value chain were studied and improved in order to reduce food waste. In addition to the material flows, the study also investigated communication flows to enhance communication of the various employee groups associated with food supply (Teitscheid et al. 2015).

The methodology applied in the case studies employed different qualitative and quantitative methods (see Figure 3.1), selected on the basis of their suitability for the transdisciplinary collaboration between the research institute and the businesses involved. The methodology was designed to complete the tasks of data generation and analysis as well as to facilitate the joint development and implementation of measures to reduce food waste with the relevant stakeholders. The methods fostered transdisciplinary exchange between research and business as well as among employees of different business units.

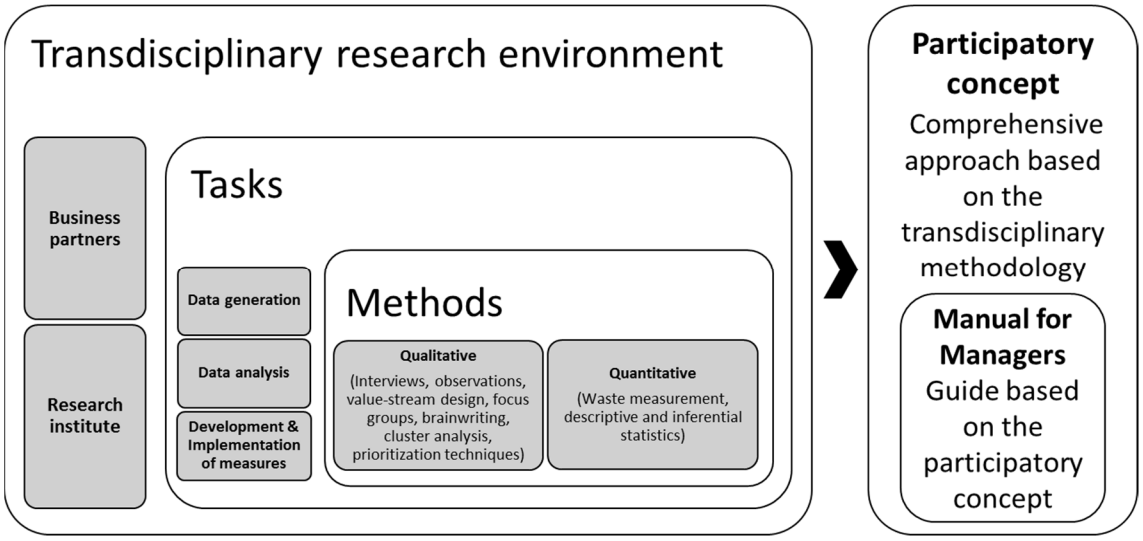

Figure 3.1. Methodology of reducing food waste and the resulting participatory concept and Manual for Managers.

3.3 The five-phase concept to encounter food waste in a participatory approach

3.3.1 Overview of the participatory concept

The participatory concept is developed based on the data and the experiences gained in the case studies (see Section 3.2). This particular five-phase concept is adapted to the phases of a PDCA (Plan–Do–Check–Act) cycle, also known as a Deming cycle or Shewhart cycle (Shewhart 1986). It consists of five major phases (see Figure 3.2) and represents a continuous improvement process (CIP) applied in Total Quality Management (TQM) (Brüggemann, Bremer 2015). TQM deals with the continuous efforts undertaken by a company's management to improve the quality of their products and services. In the process, TQM distributes responsibility so that it achieves a certain level of quality among all employees associated with the product or service. In addition, TQM is a customer focused approach that considers customers' needs and constantly strives to adjust the quality of the product or service to the identified needs (Brüggemann, Bremer 2015). In line with the requirements of TQM, knowledge and experience of the groups involved are exploited in this study. Employees are integrated into the process of developing and implementing measures to counteract food waste. Therefore, it made sense to adopt the well-known PDCA cycle and integrate participatory elements.

The roots of participatory management go back to Frederik Taylor, who sought to improve efficiency of the job in the late 1800s (Shagholi, Hussin 2009), and Elton Mayo, who conducted the Hawthorne studies on productivity and working conditions at the Western Electric telephone manufacturing factory from 1924 to 1933 (Emmet 2005). Since then, diverse literature on employee/stakeholder involvement, or industrial democracy, has been published. In the 1980s and 1990s, researchers started to focus on employee motivation, productivity, and innovativeness, with the aim of providing businesses with a competitive advantage (Branch 2011). In recent studies, the scope of participatory management has been extended to projects involving multiple stakeholders. For this reason, a large number of studies applying participatory management can be found in the field of environmental sciences, where the natural and the human system is linked and different groups expand on mutually agreed solutions in a bid to protect the environment (Reed 2008; Martínez-Falero et al. 2013). Nutrition and health sciences is another field where participatory management is applied, as researchers need to understand patients' habits and attitudes in order to identify and offer adequate solutions (Cole-Lewis et al. 2016). No reports on the participatory concept can be found in the current literature on food waste. By applying the participatory concept, this study addresses the need for a comprehensive solution that integrates the technical food production system and the (human) stakeholders involved in the process of food production and consumption in order to counteract the problem of food waste.

As can be seen in Figure 3.2, the five phases of the cycle include a total of eleven consecutive steps, which either require being executed by project management alone or together with the relevant staff members (participatory elements).

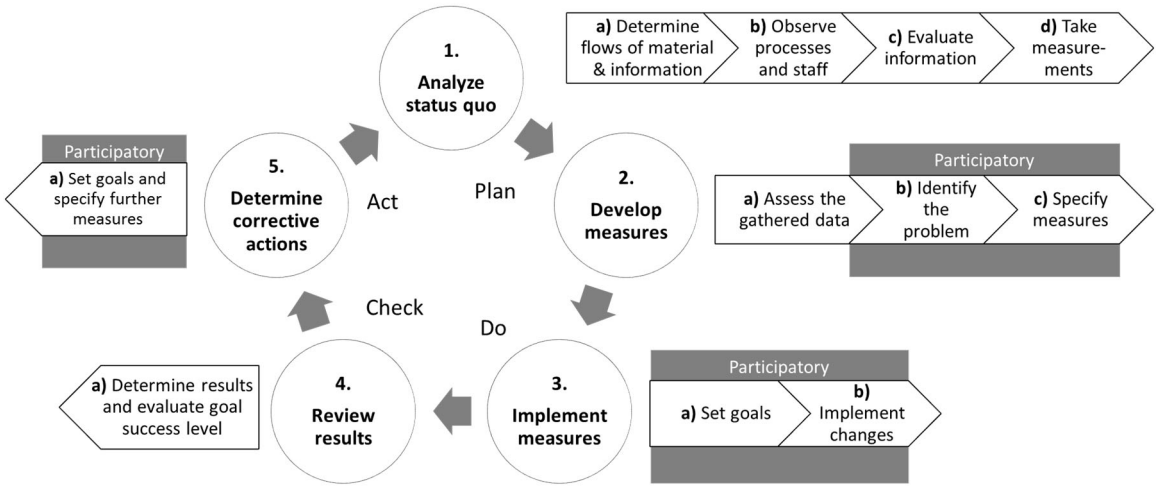

Figure 3.2. Project phases and analogy to PDCA (Plan–Do–Check–Act) cycle.

Generally, Phase 1 can be repeated after completing the first cycle, pursuing a continuous improvement process. Figure 3.2 provides an overview of the steps required in each of the five project phases. The first phase "Analysis of the status quo" means understanding the organization and the processes of interest and identifying organizational weaknesses with regard to the occurrence of food waste. In the second phase, a participatory approach is used for the "development of measures" to counteract wasting food as well as in the third phase, which is the "implementation of measures" part. The fourth phase comprises a "review of the results", after which the fifth phase, "evaluation and correction", follows, where the effectiveness of the measures is assessed with regard to the goals set previously, and corrective actions are specified, again using a participatory approach. The following Sections 3.3.2–3.3.6 present the concept and the methodology applied in greater detail.

3.3.2 Phase 1: Analysis of the status quo

The aim of Phase 1 is to provide an overall picture of the organization with the relevant processes and structures affecting food waste. This refers to the "Plan" phase of the PDCA cycle (see Figure 3.2). This phase is subdivided into a collection phase, where facts regarding the flows of information and material are gathered, an observation phase, where processes and staff behavior are observed, and a measurement phase, where the quantities of food waste are determined.

(a) Determination of information and material flows

The starting point of this step is a process analysis. The aim is to gather as much information as possible on those organizational structures and processes affecting the occurrence of food waste. This phase employs the methods of survey research and document analysis. Data on processes and structures is obtained by using organization-specific questionnaires and by analyzing the documents provided by the company management (waste records, floor plans, quality documents, etc.) in order to get a comprehensive view of organizational structures as well as of operational and supporting processes. As opposed to a material flow analysis, which quantitatively balances all masses, the material flow referred to in this context presents a qualitative description of the flow of material from the delivery of raw material to the distribution and/or consumption of the finished products.

In the study, the responsible contact person of the business partners was asked to fill in the questionnaires before an on-site visit was conducted. If the information was not obtained in advance, the relevant information was gathered in the form of an interview.

(b) Observation of processes and staff behavior

This phase focuses on completing a fuller picture of the relevant operational and supporting processes and structures of the organization. The methods of participant observation and interviewing were applied (Nykiel 2007). By observing processes and staff behavior, researchers can get an impression of the working atmosphere, habits and attitudes of staff, and the attitudes of particular employees can also be recognized. Furthermore, differences between defined and actual processes are identified.

In this study the participating organizations were visited in order to complete participant observation and the interviews. Relevant processes and were observed and staff members were interviewed in order to complete the picture and to verify the previously gathered information.

(c) Evaluation of information

The aim of this step is to reduce the complexity of the information collected through the document analysis, the survey, the interviews, and the observation. The condensed information serves as the basis for all of the following steps. Since it delivers facts about the handling of material and about product-related services (e.g., the serving of meals), it is necessary for planning the measurement process.

In this study, flowcharts based on the value-stream design by Erlach (2010) were used to graphically present structures and processes, including material and information flows.

Moreover, findings such as employees' special attitudes or discrepancies observed between the information provided and the actual state were documented.

(d) Taking of measurements

The aim of this step is to determine the quantities and the composition of the food waste occurring at the different stages of the value chain in relation to the food produced either by exact weighing with electronic scales, by visual estimation as done by Kandiah et al. (2006) and Martins et al. (2014), or by counting and calculating the quantity of food wasted. The amount of food produced is either weighed electronically, calculated according to the organization's ERP (Enterprise Resource Planning) system, obtained from the manager's documentation, or taken from suppliers' delivery notes, depending on the availability of data. Descriptive statistics is used to summarize the results of the measurements. The measurement period needs to be set so as to deliver a representative sample of results for the occurrence of food waste. In a catering company, for example, the measurement period needs to represent its customers' average eating and food waste-producing behavior. For this reason, bank holidays and vacation periods should not be included in the measurement phase. In addition, it needs to be verified, especially in health-care organizations, that there was no mass outbreak of disease during the measurement period, which would lead to irregular values. Measurements are planned in light of the preliminary analysis phase. A lack of forecasting accuracy and demand variation lead to food waste. For instance, caterers dealing with a varying number of guests may produce serving losses. Mismanagement of stock may result in storage losses. Therefore, before any measurements can be conducted, relevant waste categories, such as storage, production, or serving losses, overproduction, or plate waste, must be identified in order to determine where in the organization measurement stations should be installed. The values obtained from the measurement and corresponding statistical analysis deliver relevant inputs for the development of corrective measures in subsequent steps.

In this study, relevant waste categories of interest included storage, production, or serving losses, overproduction, or plate waste. Moreover, waste was subdivided into food classes as done by Betz et al. (2015) in order to reveal the components which contributed most to food waste. The food classes applied were individually chosen for each institution. While in one organization, processes enabled waste to be separated into the food classes meat/fish/egg-based components, starch-based components, vegetable/salad, dessert, non-avoidable, and miscellaneous, in another organization, only two food classes (miscellaneous and packaged food) were determined. The values obtained during the measurement were

transferred to MS Excel 2013 and IBM SPSS Statistics (Version 20.0. for Windows, Armonk, NY: IBM Corp.). The data obtained delivered information, such as, lunch caused 62% of the food wasted, dinner 22%, and breakfast 16%. From this data, the researchers could determine that among all meals, lunch offered the greatest potential for the reduction of food waste.

3.3.3 Phase 2: Development of measures

This phase constitutes the second part of the "Plan" phase of the PDCA cycle (see Figure 3.2) with the aim of developing and prioritizing measures to reduce food waste. It applies a participatory approach. Participation or participatory management means including employees in decision-making. In other words, contributing to the decision-making process is not limited to those who have formal power positions, but instead influence is shared with the rest of the members in the organization (Pardo del Val, Lloyd 2003). Decision-making in a participatory approach is a process, as opposed to the single act of choosing an option (Pardo del Val, Lloyd 2003).

The development of reasonable measures and their subsequent implementation requires an understanding of employees' decision-making processes as well as an understanding of the change processes occurring in an organization. The first premise in order to generate employee enthusiasm and commitment is to create awareness of the problem—the employees need to decide if a problem is worth solving in the first place. Therefore, it is helpful to understand the decision-making process, which is used in the subsequent steps. Ford and Fottler (1995) divided this process into the following phases, which help to address a given problem: (a*) the intelligence phase* where the problem is identified; (b) *the conception phase* where measures or alternatives are determined; and (c) *the implementation phase* where changes are applied in practice.

The aforementioned phases of the decision-making process (a), (b), and (c) are integrated into the five-phase concept (see Section 3.3). Phase 2 incorporates the intelligence phase (a), with the step "Identify the problem" and the conception phase (b), with the step "Specify measures". Finally, the implementation phase (c) is included in Phase 3 as the step "Implement changes".

Figure 3.3 illustrates how the decision-making phases were incorporated into the design of the case studies.

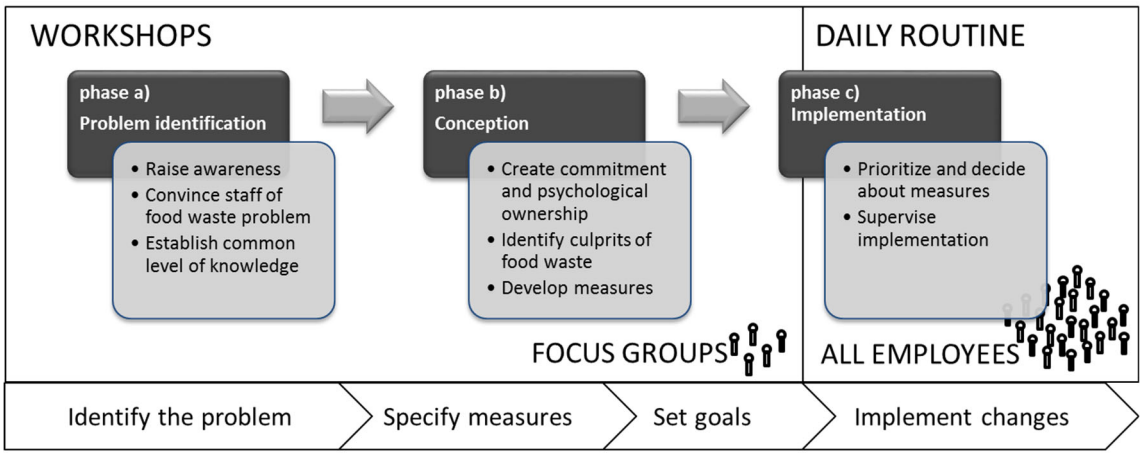

Figure 3.3. Application of the decision-making process (Ford, Fottler 1995) to integrate all relevant groups of employees into the participatory approach.

(a) Assessment of gathered data

In this step, all the information gathered in "Section Phase 1: Analysis of the status quo" is evaluated with the goal of identifying the relevant processes and structures which affect the occurrence of food waste, as well as the relevant staff members who need to be integrated into the further steps. Specific employees are identified whose experience may be beneficial to the development and implementation of measures. It is necessary to identify key actors in each department who can use their knowledge and experience to contribute to the process of developing corrective measures. When creating teams, hierarchical divisions should be ignored. Experience from the operations staff is as valuable as knowledge from management staff. While the latter group may be able to contribute with their knowledge on strategic decision-making, the first group has important detailed knowledge on operational processes in daily work routines.

The following key questions need to be answered before proceeding to the next step:

- What are the relevant core and supporting processes in the organization affecting the occurrence of food waste and what are the underlying organizational constraints (amount and qualification of staff; hierarchies; communication channels; cost structures; technical equipment; legal, political, or strategic constraints)?
- Do the observations and interviews coincide with the theoretical processes or does practical execution differ?
- Which departments and groups of employees are involved in the relevant processes and should they be involved in the process of developing measures?

- Are there specific employees whose experience could be beneficial for the development and implementation of measures?
- What are the key figures revealed by the measurement (e.g., quantities of material used and produced, relevant waste categories, waste ratios, financial impact of waste production)?

In the case studies, the flowcharts prepared in Phase 1 presented information on the flows of material and information in a clear and well-arranged way. They demonstrated the operational and supporting processes along the value chain, and revealed departmental interactions within the organization. Based on observations and interviews, it was possible to identify differences between the theoretical process description and its practical execution. The findings also included information on the qualification of staff, the working hours available, the technical equipment, the communication structures, and the cost structure; all this needed to be kept in mind during the following steps. Measurements of the waste also delivered information on efficiency with regard to the use of raw materials. It showed how much food was used to produce one product unit. For example, the first measurement in one catering organization revealed that the product unit "breakfast" weighed 301 g on average, whereas in the second measurement, the weight fell to 251 g. Moreover, due to the separation into food classes and waste categories, it revealed how much waste was produced, where in the value chain it occurred, and what it was composed of. For example, if the figures reveal that plate waste in a canteen is relatively high compared to other waste categories, this may be an indication that the quality of the food being served is inadequate or that portions are too large. On the other hand, high serving losses are an indicator of inaccurate demand planning.

(b) Problem identification

This step is dedicated to raising employees' awareness of the topic of food waste. The topic is introduced to the relevant employees (see Figure 3.3). Here, the process analyses and the waste measurements from previous steps provide valuable information which is intended to ensure that employees understand the necessity of improving resource efficiency. Since a participatory approach, relying on the employees to be key actors in developing measures to reduce food waste, is used, it is crucial to effectively convince them that a problem exists.

The relevant staff members were integrated into the project in workshops with focus groups (Kauffeld 2010). The concept of focus groups is adapted from qualitative marketing

research, where it has been used to obtain knowledge on customer motivation, attitudes, and expectations (Kamenz 2001). It is a means to identify, describe, and understand psychological and sociological interrelation (Kepper 2008). While in marketing research, interviews with focus groups are used to gain deeper insight into customer attitudes, in our case, focus groups revealed the attitudes of the various groups of employees (e.g., nurses vs. food order-taking assistants) about the topic of food waste as well as group attitudes about the work performed by other groups. Moreover, it delivered deeper insights into the way the different groups of employees interact and allowed the researchers to benefit from the knowledge and expertise of the employees involved.

(c) Specification of measures

During this step, the focus groups develop measures to counteract food waste. This part refers to the conception phase of the decision-making process. The employees should independently identify problematic processes in their daily work routines, and develop measures to counter these problems. The employees therefore participate in identifying problems within their daily work routines. Actual daily work routines may substantially differ from standard operating procedures for several reasons, such as ignorance or a suboptimal internal customer–supplier relationship between employees from two departments that nevertheless interact. Identifying these problems is the first step in the chain of initiating changes. Measures need to be tailored specifically to the working environment and the employee groups concerned with it. During the projects, workshops were held where the project participants used brainwriting to collect issues and ideas concerning food waste (Klebert et al. 2006). The results were categorized and refined, and led to the identification of key points to focus on. The participants agreed upon prioritization after discussing and assessing the importance of each aspect. Finally, employees and management jointly developed and prioritized measures to counteract food waste.

In a participatory approach, it is important that the project leaders stick to the principles of self-support and process orientation (Dittrich-Brauner et al. 2013), which means that the participants are not influenced during the workshops and directed towards a particular solution. The participants need to be encouraged to present their own ideas rather than have pre-prepared thoughts and solutions imposed upon them.

3.3.4 Phase 3: Implementation of measures

The aim of this phase, which represents the "Do" phase of the PDCA cycle (see Figure 3.2), is to help participants to determine specific goals to reach and to implement the measures they have developed earlier. In order to achieve sustainable results during the implementation phase, it is important to understand the stages of organizational change. Robbins (2001) describes the stages of organizational change by using Lewin's Three Step Model: *unfreezing, movement***,** and *refreezing*. In the case studies, "unfreezing" the present situation means identifying root causes and developing measures. Employees need to leave the equilibrium state, which is their daily work routines. During the movement step, the participants develop and implement options for change. Change requires driving forces, which direct behavior away from the status quo. Once measures are successfully implemented, the refreezing step starts, i.e., the changes are adopted into daily work life. The employees should become highly committed to the project; this can be achieved by creating psychological ownership. This is critical to generating true enthusiasm and commitment to the project (Umble, Umble 2014). If employees themselves develop the measures, they are more likely to overcome personal reservations about the changes. This means that they rather identify with the measures, thus improving the implementation and achieving sustainable results.

(a) Goal setting

It is essential to define the goals that are to be achieved. The more precise the goals are, the more specifically they can be addressed. Goals should also be operational, which means they are clearly defined in terms of their three dimensions of content, time, and extent, and it is important that the three dimensions for each goal are set at the beginning of the project. Goals may be subdivided into quantitative and qualitative goals. Quantitative goals can be measured. They relate to the key figures determined by the reference measurement, such as "reducing average food waste from 32% to less than 25%", "decreasing the raw materials needed per produced unit by 10%", or "decreasing lunch serving losses by 25%". Management may also decide to set qualitative goals, such as "improving communication between departments *x* and *y*". Evaluating the achievement of qualitative goals is more difficult than for quantitative goals, since there is no key figure presenting the progress. Management, therefore, needs to set standards in order to make qualitative goals observable. Table 3.1 provides an example of a qualitative goal and an option for making it observable.

Table 3.1. Sample for the evaluation of a qualitative goal by a survey.

Possible Aspects to Evaluate the Goal "Improve Communication"	Survey	Required Standard
Provision of completed lists on patients' nutritional status (transfer of information from nurses to menu assistants)	How often are the completed lists with the required information available? • 100% (daily) • 75% of days • 50% (every other day) • 25% of days • 0% (never)	e.g., min. 75%
Delay in the order-taking process due to incomplete lists on patient's nutritional status	What is the average delay per week caused by incomplete lists? • More than one hour per week • 40–60 min per week • 20–40 min per week • Less than 20 min per week	e.g., max. 20–40 min
Number of regular team meetings	How often are team meetings held? • More than once per month • Monthly • 6 times per year • 3 times per year • Less than 3 times per year	e.g., min. 6 per year
Satisfaction of staff with communication	Do you agree that communication among staff members is good: • Strongly disagree • Disagree • Neither agree nor disagree • Agree • Strongly agree	e.g., min. 50% "agree"

(b) Implementation of changes

The point of this step is to decide on which of the prioritized measures to implement in order to reach the goals set in the preliminary step.

In this study, this involved the focus groups jointly deciding on which measures to implement. This meant determining deadlines and actions, the employees in charge of each measure, and the timeline for implementation. All the information regarding the implementation was summarized in a project schedule and progress was also documented in the schedule.

In the implementation phase, it is important to disseminate the measures developed to all relevant employees. The subsequent implementation of measures and the accordance with the schedule needs to be monitored, e.g., by interviewing the person in charge each month.

3.3.5 Phase 4: Review of results

In the fourth phase, (see Figure 3.2), the goal is to review the current status in order to assess whether or not the goals were achieved. This phase refers to the "Check" phase of the PDCA cycle (see Figure 3.2).

Determination of results and evaluation of goal success level

The necessary data is collected according to Phase 1 (see Section 3.3.2), i.e., by conducting an observation, an interview, or a measurement. Data recollection in the evaluation phase may be limited to data where goals have been set to allow for a comparison of results obtained and goals set. The data gathered is compared to the data obtained in Phase 1 at the beginning of the project, where quantitative and qualitative goals were set. For quantitative goals, the project managers assess as to whether changes in the key figures are considered statistically significant and whether or not the objectives have been achieved. For qualitative goals, there should be an analysis of whether or not the results coincide with the standards set.

3.3.6 Phase 5: Determination of corrective actions

The aim of the fifth phase, "Corrective actions", is to specify further actions that are necessary after assessing the degree of goal achievement in the preceding phase. This phase corresponds to the "Act" phase of the PDCA cycle (see Figure 3.2).

Goal setting and specification of further measures

If the goals set are achieved, no corrective actions need to be specified. However, it is important to determine how performance beyond the project period can be continued, and whether or not it is realistic to expect further performance improvements. If the answer to this is positive, new standards need to be set. In cases where objectives are not achieved, the reasons for non-achievement need to be identified and corrective actions need to be specified. The question of which of the three goal dimensions - insufficient time, unclear content, or inappropriate extent - that has led to failure also must be answered. This can best be accomplished by integrating the relevant employees. They have implemented the measures in their daily work routines, and thus have gained valuable experience which can explain why the measures were successful or not. If corrective actions are specified, a new monitoring plan also needs to be established.

3.4 Challenges experienced with the participatory concept

The participatory concept was applied in different case studies (see Section 3.2). The following section lists the challenges experienced with the application of the concept in the cases under study.

- Gaining the support of management (management acting as a role model)

Management was very supportive in most organizations. In one catering company, however, management did not take the effort of reducing food waste seriously. Weighing lists in the first waste measurement period were not properly completed when the research team was not present. Moreover, comments were made in the workshops such as "It doesn't matter, it is only food waste", or "Our boss doesn't care anyway". This behavior demonstrated by employees reflected the management's attitude and revealed how important management support is. This catering company did not complete the project, but instead dropped out before any measures could be specified and implemented.

- Using participation as a motivator

Many employees gave positive feedback as they were happy to be able to give input and present their ideas for reducing food waste. For them, it was important to have the workshops and the informal talks in between, since their daily work routines did not provide such a platform for exchange. However, there were also burdens regarding inter-departmental communication which needed to be overcome first in order to establish a level of trust among employees. In one hospital, there was a lack of communication between the menu assistants taking patients' orders and the nursing staff. As an example, the menu assistants thought that the nursing staff felt superior and were always too busy to provide them with the necessary information on the nutritional and health status of special patients. However, the nursing staff were unaware of the impression they gave. By bringing the different groups of employees together, appreciation of the other group's work was enhanced, dissatisfaction decreased, and measures were developed jointly.

- Dealing with the diversity of the target group and raising employee awareness

Raising awareness for the topic of food waste is crucial, as it influences employees' commitment and motivation to participate. The challenge was to convince all groups of employees that it was worth committing to the projects. While the pure presentation of facts and figures of quantities and associated costs of the food wasted were convincing for managers, the other groups of employees or customers needed to be addressed in a different way. For this reason, the presentation of facts was adapted to the respective target groups. As an example, in order to demonstrate the amount of food wasted in a residential home, a more descriptive style of language (as well as images) was applied to present the results to the residents than was used to present the same facts to the management.

- Dealing with the limited time constraints

Although most employees were willing to support the study, time in the partner organizations was often a limiting factor. Since the employees were busy with their daily work routines, it was important to offer them predesigned support tools. These tools facilitated the implementation of measures. Examples of such tools included weighing lists for waste measurements, waste calculators for catering companies, and training material for bakery sales staff.

3.5 A "Manual for Managers"

The Manual for Managers (see Table 3.2) is a food waste reduction tool and can be applied by managers or others (researchers, consultants) wishing to combat the waste of food in an organization. It is based on the experience gained from the case studies in which the participatory concept was applied. The participatory concept was specifically developed for the case studies presented in Section 3.2. It consists of five phases, which comprise eleven consecutive steps (see Section 3.3). The Manual for Managers summarizes the approaches applied in the different steps and illustrates how the results of each step can be documented. It also lists the goal of each step and thus brings to mind why the different tasks need to be accomplished. It facilitates the application of the participatory concept and helps managers to complete the relevant steps one by one. Managers themselves may have become blind to shortcomings in their own company processes. Therefore, applying this guide will enable them to scrutinize existing processes and get a more holistic view of their organization.

Table 3.2. Manual for Managers: A step-by-step guide for the application of the participatory approach to combat food waste (overview of project phases, approaches applied, and results obtained).

Step	Optional Approaches	Aim of the Approach	Documentation
Analyze current state			
(a) Determine material & information flows	Interviews and questionnaires related to processes (flows of information and material)	Understanding relevant operational and supporting processes	Completed questionnaires Quality documents Data records Waste records Floor plans
(b) Observe processes and staff behavior	Observations	Receiving information on structures and processes Gaining experience about the working atmosphere, habits and attitudes of staff, recognizing particular employees' attitudes Detecting differences between defined and actual processes	Notes of observation
(c) Evaluate information	Processing of information by value-stream design (Erlach 2010)	Structuring the information gathered Reducing complexity of the information	Material and information flow charts
(d) Take measurements	Classification of food produced and wasted into relevant food classes and waste categories Determination of quantities of food produced and wasted by weighing, visual estimation, or processing of production figures from the ERP system, or other quantity documentation (e.g., delivery notes) Statistical analysis of data	Obtaining knowledge on the quantities produced and on the percentage wasted Providing facts and figures for economic evaluation Identifying food classes and waste categories to focus on	Various production and waste figures (e.g., total production volume and waste, average waste, average waste per person, average produced quantity per day or per person, average waste per food class or per waste category)
Develop measures			
(a) Assess the gathered data	Waste measurement analysis Assessment of documentation received Comparison of theoretical processes with observations made Answering of key questions	Identifying weaknesses along the value chain with regard to the transfer of material and information Determining relevant processes to focus on Identifying departmental interfaces and selecting staff for focus groups	Documentation of findings List of participants for focus groups
(b) Identify problem	Workshop with focus group, phase a) (see Figure 3.3)	Creating awareness of the problem Motivating employees	Minutes of the workshop

	Presentation of facts and figures		
(c) Specify measures	Workshop with focus group, phase b) (see Figure 3.3) Brainwriting Clustering of ideas Joint development of measures	Achieving participation of relevant employees Identifying key points for food waste based on employees' perspective Creating commitment and psychological ownership Developing measures	Minutes of workshop Photo documentation of results
	Implement measures		
(a) Set goals	Analysis of qualitative goals and identification of measureable elements Determination of standards that should be targeted for quantitative and qualitative goals	Making qualitative results measurable Setting goals to give emphasis to the project Defining the basis for development of measures	Documentation of goals
(b) Implement changes	Workshop with focus group, (phase c) (see Figure 3.3) Selection of measures to implement Democratic prioritization of measures by participants (e.g., "low hanging fruits first") Setting of timeline and to-do list, definition of employees in charge Implementation of measures into daily work routines Transfer into practice (all employees)	Jointly choosing and prioritizing measures to implement in order to increase acceptability and to create ownership Setting a timeline and to-do list, defining employees in charge to assure timely implementation and to set up project schedule Transferring workshop results into practice to achieve the goals set	Project schedule/catalog of measures Minutes of workshop Revised process descriptions
	Review results		
(a) Determine results and evaluate degree of goal success level	Observations Interviews Measurement of production volume and food waste Questionnaires to assess qualitative goals Comparison of reference and control data for qualitative and quantitative goals	Examining and documenting new current situation Determining whether or not goals were achieved Determining if measures were successful	Documentation of observations and interviews Completed questionnaires Weighing lists Documentation of key figures before and after implementation of measures Reports on goal achievement
	Determine corrective actions		
(a) Set goals and specify further measures	If goals were not achieved: analysis of reasons and return to Phase 2	Assessing how realistic the goals set were and determining new goals Understanding why goals were not achieved and altering measures accordingly	Documentation of analysis Revised project schedule/catalog of measures

3.6 Discussion

The reasons for food waste on the manufacturing and retail level, as well as in the catering industry, have been widely discussed (Garrone et al. 2014; Kranert et al. 2012; Sonnino, McWilliam 2011; Ritter et al. 2015; Engström, Carlsson-Kanyama 2004; S. Lebersorger 2014; Mena et al. 2014; Jepsen et al. 2016; Kaipia et al.; Kreyenschmidt et al. 2013; Eriksson et al. 2015; Waskow et al. 2016; Sanaa I. Pirani, Hassan A. Arafat 2016). Exceeding internal sell-by dates and varying demand often lead to the wastage of food (Garrone et al. 2014; S. Lebersorger 2014; Shakman 2014). Counteractive measures, such as efficient demand planning and improved forecasting accuracy, have been proposed in order to avoid such losses. Technical solutions already exist. Examples include intelligent food logistics (e.g., smart distribution practices such as FEFO, first expired first out) (Jedermann 2014), and predictive analysis used for machine learning (Glatzel et al. 2016), which may result in the more efficient handling of food products along the value chain. However, the food value chain is a sociotechnical system in which machines and people work hand in hand to produce food and related services. Hence, technical solutions address only one side of the system, whereas comprehensive approaches additionally integrate the relevant stakeholders (employees, customers, etc.) into the optimization process. To this end, it does not suffice to merely raise people's awareness of the topic of food waste. Rather, they must be integrated into the challenging task of developing and implementing measures to combat food waste. The participatory concept applied in this study addresses the need for a comprehensive solution.

With the participatory concept, significant reductions of up to 39% of the food wasted could be reached in five companies (Göbel et al. 2014; Teitscheid et al. 2015). Hence, the concept contributes to meeting the Sustainable Development Goal (SGD 12.3) the EU and Member States have committed to which means halving per capita food waste at the retail and consumer level by 2030, and reducing food losses along the food production and value chain.

The majority of the 377,000 food companies in Germany, including the crafts sector, industry, retailers, and large-scale consumers, are classified as SMEs (small and medium-sized enterprises) (BLL 2014). The quantity of food wasted by these companies amounts to 8.59 million tons annually (Noleppa, Cartsburg 2015). The companies compete on a highly competitive market, as the five biggest food retailers in Germany have a market share of more than 70% (BVE 2016). Considering the strong competition on the market, these SMEs face a situation of high cost pressures, often leading to low staff capacities and time constraints which hinder the implementation of food waste reduction projects. Research also confirmed that the

companies that implemented the participatory concept, all of them SMEs, also have a high workload, which leaves them little room for extra projects outside of their daily work routines. The companies require assistance and easy access to support tools in order to complete food waste reduction projects.

Therefore, the participatory concept with its Manual for Managers (see Section 3.5) provides useful assistance for such SMEs with its systematic approach to fight food waste. Managers are guided to complete their food waste reduction project one step at a time, yet the results can reveal inefficiencies in core and supporting processes. A food waste reduction strategy which uses the participatory concept could be integrated as part of the TQM approach of a company. However, no food waste reduction tool and no management system will lead to the desired outcome if it is not supported by the top management. Organizations announcing the reduction of food waste as one of their goals solely for publicity reasons are likely to fail if the corresponding strategic approach is missing. In order to be successful, top management must formulate a strategy, inspire employees, live the system, and assign the required resources.

Another advantage of the concept presented here is its participatory approach, which makes use of experience and knowledge. The experiences of this study gained with the participatory concept correspond with those of other authors who have also applied a participatory approach. They likewise found that commitment and trust increased following stakeholder participation (Evers et al. 2016) and experienced the participatory approach as a useful method for capturing the knowledge and experiences (Cole-Lewis et al. 2016) of different groups of employees along the food value chain. Moreover, they described the participatory approach as being capable of reducing internal conflicts among individuals (Dutra et al. 2015). This advantage was also perceived in this study, who found that participation helped groups to gain a better understanding of other groups' work. The participatory approach scrutinizes existing structures of communication and supports the personal exchange of different intra-organizational units. Where employees with different functions, qualifications, and professional backgrounds physically or virtually meet, they need to understand each other and agree on the processes and actions to be taken.

However, reducing food waste in one company should not lead to the shifting of food waste to other parts of the value chain, such as to suppliers or customers (Engström, Carlsson-Kanyama 2004). Fighting food waste is not a matter of a single company. Furthermore, 14.2% of the food wasted in Germany occurs on the production level, whereas the major part (39.3%) is produced by the end-consumer (Noleppa, Cartsburg 2015). Perry et al. (2015) noted that it is necessary to integrate the consumer into food waste reduction efforts as well. Hence, initiatives

aimed at decreasing food waste along the whole value chain need to shift the boundaries from an intra- to an inter-organizational level and involve all actors of the value chain (Richter, Bokelmann 2016; Göbel et al. 2015). The participatory concept takes account of this requirement by its application of focus groups that allow bringing together the multiple stakeholders of the food value chain. The cooperation of multi-stakeholders is also an approach supported by Halloran et al. (2014) and Derqui et al. (2016), who state that this could raise awareness of food waste. It is important to stimulate a debate on the quality of food to increase its appreciation. Only by doing so can goal conflicts, such as increasing revenues vs. wasting less on the consumer level, be resolved. In the context of food waste reduction, we therefore suggest referring to the term food value chain rather than to the food supply chain (Feller et al. 2006; Sroufe, Melnyk 2013). The process of supplying food means dealing with a set of values rather than solely with a foodstuff complying with a specification. If food waste reduction initiatives managed to create the added value of "low food waste", this could contribute to solving the goal conflicts existing among the different actors of the value chain.

3.7 Conclusions

With the participatory concept, it becomes possible to identify the reasons for food waste and to develop and implement counteracting measures based on a holistic concept that integrates employees, customers, and other relevant stakeholders into the relevant steps. On an organizational level, however, applying the concept is just the second step after gaining an understanding of the importance of the topic itself. This is where the limitations of the participatory concept lie. It requires that the management of a company is already aware of the problem of food waste and acts as an example. Future research should analyze how management can be convinced to commit to reducing food waste; it should also shed light on how to enhance employee motivation and commitment. Thereby, support of any group involved in a food waste reduction project can best be obtained by using language specific to a target group. Employees who are not used to giving feedback might be afraid of admitting the existence of problems. If employees are intimidated by the presence of superiors, they will not feel comfortable contributing their expertise. In this context, management should seek to establish a level of trust among the participating employees of all hierarchical levels.

Moreover, the study has revealed that there are special burdens of communication at departmental interfaces where employees with different functions, qualifications, and professional backgrounds physically or virtually meet; they need to understand each other and agree on the processes and action to be taken. Future research should, therefore, focus on

analyzing the flows of communication within an organization, especially those at the departmental interfaces having an influence on the occurrence of food waste.

For SMEs, the participatory approach and the Manual for Managers developed in this study facilitate the execution of food waste reduction projects. However, the approach requires that employees and managers take the time to develop measures; it provides no predesigned solutions for counteracting food waste. Especially in SMEs, management and staff have major time constraints outside of their daily work routines. Those companies often do not have job positions exclusively dealing with quality management or sustainability issues. In addition to the above-mentioned manual, there are several other tools available on the internet that support the reduction of food waste. These instruments were often developed in academic research projects. It is crucial that SMEs have easy access to those instruments. Since SMEs in the food industry are the main target group of such instruments, future research should analyze how to best design the transfer of results from science to SME businesses.

The participatory approach does not solve existing goal conflicts within a company or along the food value chain. In this context, it would be useful to create and disseminate the added value of "low food waste", as this would enable companies to benefit economically from the measures, encouraging them to participate in food waste reduction projects. Therefore, future research should analyze how the added value of "low food waste" can be generated and disseminated to all stakeholders in the food industry. Moreover, this would increase the level of appreciation for food, which is necessary to reduce food waste also at the consumer level.

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4 Improving transfer in the food sector by applying a target audience-centered approach – The development of a nonprofit marketing campaign guide based on a case study of the LAV platform

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Strotmann C, Niepagenkemper L, Göbel C, Flügge F, Friedrich S, Ritter G, Kreyenschmidt J. Improving Transfer in the Food Sector by Applying a Target Audience-Centered Approach—The Development of a Nonprofit Marketing Campaign Guide Based on a Case Study of the LAV Platform. *Sustainability* **2017**, 9, 512. doi:10.3390/su9040512

4.1 Introduction and objectives

In Germany, 39% of the 11 million tons of food wasted along the food value chain from the manufacturer to the consumer annually is caused by the food production industry (17%), by large-scale consumers (17%) such as restaurants and public caterers, and by retailers (5%) (Kranert et al. 2012). All food produced has gone through various steps along the supply chain, requiring resources such as energy, water, or other materials before finally reaching the consumer. Therefore, if food is discarded, not only is the final product wasted, but also all the other resources that have been used during production and transportation. With 3.3 gigatons of CO_2 equivalent, worldwide food waste represents the third top emitter after the total emissions of the USA and China (FAO 2013). As a result, the reduction of food waste has gained increased attention internationally, and has been the subject of numerous studies and projects (Beretta et al. 2012; Derqui et al. 2016; Eriksson et al. 2014; Garrone et al. 2014; Garrone et al. 2016; Göbel et al. 2015; Halloran et al. 2014; Hyde. K. et al.; Jepsen et al. 2016; Katajajuuri et al. 2014; Kreyenschmidt et al. 2013; Mena et al. 2011; Parry et al. 2015a; Parry et al. 2015b; Schneider; Sonnino, McWilliam 2011; Teitscheid et al. 2015; Williams et al. 2003) with the goal of identifying the root causes of food waste, or of developing measures, concepts, and tools to counteract it. Besides lowering the environmental impact of food waste, its reduction leaves room for economic savings. Currently, more than 500 tools in the English or German language are available on the Internet free of charge. These include tools that help with collecting or monitoring data; materials such as films or posters to raise awareness and to educate staff; or concepts that focus on recycling and avoiding food waste for use in business. They have largely been developed by nonprofit organizations, such as governmental agencies, or through academic projects (e.g., World Resources Institute[15], United against Waste[16], WRAP[17], EPA Ireland[18]).

Small- and medium-sized companies (SMEs) in the food sector are facing high competition as a large number of food producers supply a small number of retailers and large-scale consumers. This has put these businesses under high competitive pressure to improve efficiency and reduce costs. Therefore, for food producing companies, the reduction of food waste not only makes sense from an ethical point of view, but it also leads to cost savings, which,

[15] www.wri.org/ (accessed on 19 May 2019)
[16] www.united-against-waste.de/ (accessed on 19 May 2019)
[17] www.wrap.org.uk (accessed 19 on May 2019)
[18] www.epa.ie/pubs/reports/waste/stopfoodwaste/ (accessed on 19 May 2019)

considering the highly competitive market, may be critical for the companies' long-term success. As opposed to large enterprises, SMEs of the food sector, including producers, retailers, and the hospitality sector, have fewer financial and human resource capacities to combat food waste. Daily work routines often require the staff's full attention and leave no time to surf the Internet for useful tools to counteract food waste. There are two important premises that contribute to a tool's successful implementation on the market. First, SMEs in the food sector need to actually adopt the tools designed to support efforts in this area, and second, SMEs need to be aware of the tools. To address these two complementary premises, it is necessary to have a marketing strategy that focuses on the target audience, rather than the product or service offered. A clear focus on the target audience is as important for the success of nonprofit organizations as for profit-oriented companies (for-profits) (Andreasen, Kotler 2014). However, nonprofit marketing research has revealed that nonprofits are often organization-centered rather than audience-centered (Dolnicar, Lazarevski 2009). In this study, a guide for a target audience-centered marketing campaign is developed. This marketing campaign guide specifically addresses the needs of auxiliary organizations, such as political institutions, research organizations, or private initiatives not working for profit (nonprofits), and acting in the transdisciplinary field of the food sector. It targets auxiliary organizations that wish to develop and market support tools for SMEs in the food sector. Moreover, the case study of the LAV platform (LAV—Avoiding Food Waste, German: Lebensmittel Abfall Vermeiden) is introduced. The purpose of this project was to develop an online platform focusing on the reduction of food waste in German SMEs, and market it in a process that focuses on the target audience.

The key aim of this study is to provide a marketing guide for nonprofit organizations, such as academic research institutes or government agencies that wish to develop and transfer support tools and services for SMEs in the food sector. The development of this guide proceeds in three phases. First, the concept of target audience-centered marketing is clarified and the specific challenges nonprofits face are outlined. Second, in a case study, participatory methods are applied to develop and transfer a target audience-centered online platform. This online platform targets SMEs in the German food sector, including producers, retailers, and the hospitality sector, that wish to reduce food waste in their organizations. The platform is also meant to serve as a role model for other international projects which have the goal of developing similar tool-gathering platforms. In the last phase, a guide for a marketing campaign is developed based on the theoretical considerations of Phase I and the experiences gained from the case study in Phase II. This guide enables nonprofits to successfully develop and transfer

their services by adopting a target audience-centered mindset. The marketing campaign guide is specifically adapted to the requirements of the food sector.

4.2 Overview of the project design and methodology

4.3 Overview of the project design and methodology

This research project was conducted in a transdisciplinary environment working closely with partners from business (SMEs from the German food sector) as well as with sector-specific guilds, trade associations, or consultants. The project includes three phases and uses multiple methods (see Figure 4.1). Table 4.1 summarizes the project phases, research questions, tasks, and methods applied. In Phase I, the process of adapting a target audience-centered mindset is studied from a marketing perspective. This phase is presented in Section 4.4 of this article. In addition, the section outlines the mutual and the different characteristics of for-profits and nonprofits. The second phase consists of a case study. Section 4.5 presents the online platform, which was developed and transferred in a way that took advantage of target audience-centered marketing. This specific platform serves as a support tool to facilitate the reduction of food waste by SMEs of the German food industry and the hospitality sector. Phase III consists of the development of a guide for a marketing campaign (see Section 4.6) based on the results of Phases I and II. This guide is designed to support (nonprofit) organizations, such as research institutes or governmental institutions, that want to undertake efforts to develop support tools for SMEs of the food sector. It enables such organizations to better understand the needs of their target audience and transfer these needs to features of the product or service and to efficient promotional activities.

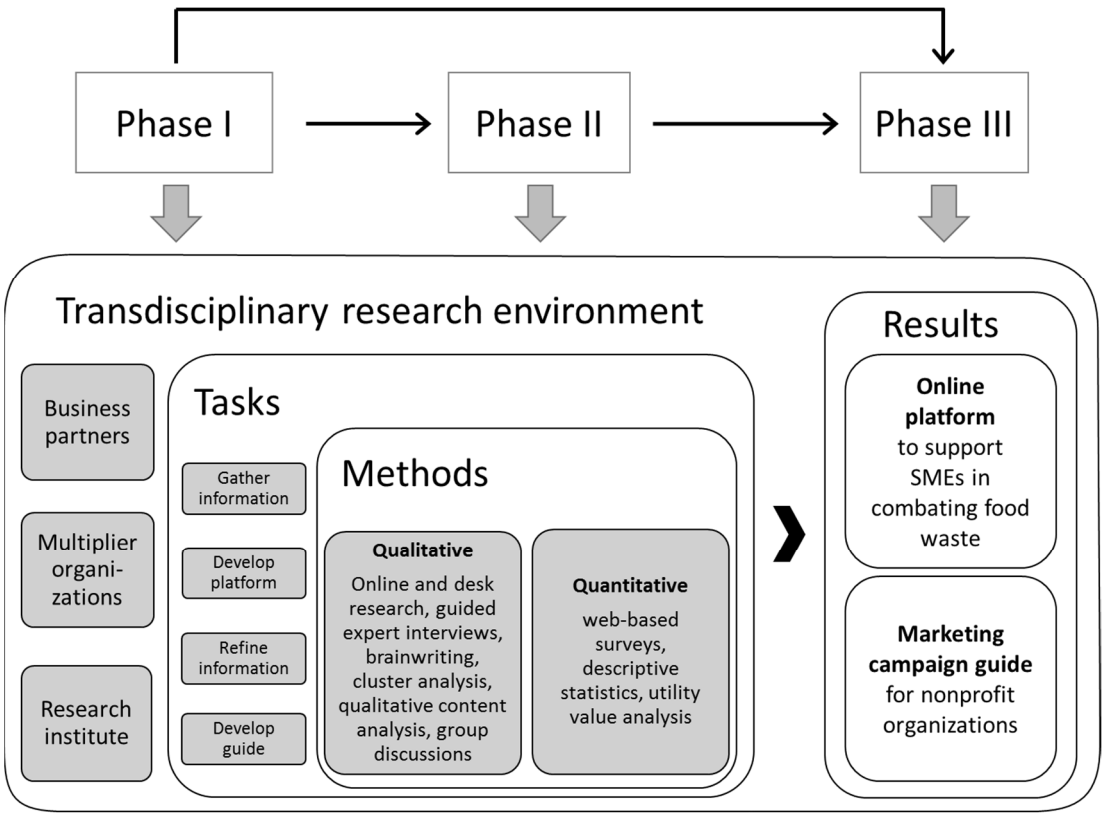

Figure 4.1. Project phases, transdisciplinary research environment, tasks, and methods of developing the marketing campaign guide for nonprofit organizations. SMEs: Small- and medium-sized companies.

Table 4.1. Overview of the research project: project phases, research questions, tasks, and methods applied.

Project Phase	Research Questions	Tasks/Milestones	Methods Applied
Understanding target audience-centered marketing and the idiosyncrasies of the nonprofit market	What are the characteristics of target audience-centered marketing? What are the specific challenges for a nonprofit's marketing campaign?	Gather information on marketing management and refine relevant information for nonprofits	Online and desk research
Case study: Developing an online platform to support SMEs in the food sector in their effort to reduce food waste	How should the online platform be designed to reach maximum acceptance by the target group? How should the online platform be promoted in order to achieve maximum visibility?	Research (gather information on user needs and on existing tools; determine transfer channels and supporting and inhibiting factors of transfer) Develop (determine product specifications, prioritize tools and information, determine transfer concept)	Online and desk research Telephone interviews (semi-structured with closed and open-ended questions) Web-based surveys (structured with closed and open-ended questions) Guided expert interviews Qualitative content analysis Brainwriting, cluster analysis

		Pretest prototype of platform Implement and monitor (analyze opportunities for optimization after publishing of platform) Transfer platform to public	Group discussion Prioritization based on utility analysis Cost analysis (to compare wants vs. costs) Descriptive analysis of website traffic
Developing a guide for nonprofits that supports them in successfully developing and transferring support tools for the food sector	What are the relevant elements of target audience-centered marketing for the marketing campaign guide? What are the relevant experiences from the case study that should be integrated into the marketing campaign guide?	Determine implications from Phases I and II Develop marketing campaign guide	Group discussion Online and desk research

4.4 Phase I: Target audience-centered marketing in a nonprofit environment

Marketing management deals with the efficient and need-satisfying design of exchange processes (Meffert et al. 2015b). Since the 1950s, when modern concepts of marketing first emerged, marketing has adapted to changing market structures, political and social requirements, and customer needs. The marketing mindset has changed from a product/service mindset and a sales mindset to a target audience mindset. While a product/service mindset focuses on the product and its features (ignoring the needs of the customer), and a sales mindset means the best way of persuading the customer to accept what is on offer, a target audience mindset focuses on the perceptions, needs, and wants of the target market.

A meta-analysis of 11 empirical papers revealed that market orientation is positively related to performance (Andreasen, Kotler 2014). In the study, the correlation was even higher for nonprofits compared to a similar setting with for-profit organizations. Besides market orientation, customer orientation has come to be an important point for management, as growing competition has started to change customer behavior (Meffert et al. 2015a). Several studies have proven a significant positive correlation between company success and a strong customer orientation (Homburg, Becker 2000). Although market orientation (which implies a focus on a target audience) is a crucial aspect for successful marketing strategies for both for-profit and nonprofit enterprises, a study in the UK, the USA, and Australia revealed that nonprofits are still dominated by an organization-centered mindset in which marketing appears to be primarily defined by promotional activities (Andreasen, Kotler 2014; Dolnicar,

Lazarevski 2009). However, what does target audience-centeredness mean for an organization? Andreasen and Kotler (2014) provide the following explanation:

> "*A target audience centered organization is one that makes every effort to sense, serve, and satisfy the needs and wants of its multiple publics within the constraints of its budget*" (Andreasen, Kotler 2014).

In the following paragraphs, this article describes how an organization can become focused on its target audience. The first milestone for nonprofits is to understand what target audience-centeredness means. Andreasen and Kotler (2014) describe the following clues that demonstrate that your organization is organization-centered rather than target audience-centered:

(1) The value proposition of your own enterprise's product or service is seen as extremely desirable: Understand that what you consider the most important values may not satisfy the needs of the target audience. In other words, it might be necessary to adapt what you are offering to the target group by applying typical business terminology rather than using scientific language. Moreover, keep in mind that time usually is rare for businesses in the food sector. Long explanatory texts are likely to be skipped by the audience. Apply methods of market research to understand the target group and its needs. Use incentives that work in business. Contributing to fewer greenhouse gas emissions might not be as persuasive for managers as the opportunity to reduce costs.
(2) You attribute failure to a lack of motivation or ignorance on the part of the target group: Understand that your product or service should fit the target audience rather than the target audience changing to fit the offering. If a tool fails, use market research to understand the reasons. Work with lead users or conduct interviews with potential users. Get them to assess your tool to better understand their needs and how these needs could be integrated into the valuable good you are offering.
(3) You underestimate the importance of target audience research: Understand that target audience research delivers valuable information about attitudes and behavior, which enables you to offer something that provides necessary benefits. Target audience research may also support you in prioritizing information and thus may facilitate decision-making.
(4) You conflate marketing with promotion: Understand that the marketing challenge is not only to improve promotional activities, such as issuing a better brochure, placing more ads or writing more press releases. The challenge is to adapt the whole marketing mix (e.g.,

product features, prices, distribution channels) to the target audience in order to satisfy their needs.

(5) You use a single "best" marketing strategy rather than approaching each market segment with specific strategies: Markets are not monolithic, as the target audience may include different segments that all need to be accounted for in the marketing mix. This may, for example, involve the usage of different languages for diverse segments of the target audience or the need for different levels of comprehensiveness.

(6) You underestimate the effect of generic competition and fail to provide incentives for the target group to its change behavior: Support tools for the food sector have a lot of competition, which is not limited to other tools having similar targets. The largest competitor is the daily work routine of food businesses. Understand that time in companies is often a rare commodity. Hence, managers may not have the opportunity to take the time to learn how a tool works. Find strategies to address this by designing tools that are as easy to use as possible, by providing a support hotline, or by expanding your portfolio with other beneficial goods. For example, instead of just providing an online tool, offer a product service system (PSS) by integrating the optional service of a consultant to your portfolio or by offering webinars.

The second step for an organization to become target audience-centered is understanding its own situation. Analysis is needed to reveal who its clients are, who is providing it with funding, and who its competitors are. The analysis also should show what the competition is offering, and how it differs from what the organization itself has on the market. Answers to these questions are provided by an analysis of the strengths, weaknesses, opportunities, and threats (SWOT) of an organization (Aaker, McLoughlin 2008; Meffert et al. 2015b; Kotler, Keller 2006; Andreasen, Kotler 2014; Vahs, Brem 2015). Figure 4.2 demonstrates the relationship between the external environment, in which the organization is situated; the internal environment, given by organization-specific characteristics; and the marketing strategy, which should be based on an analysis of the given setting. Weaknesses refer to organizational constraints, such as limited spatial capacities to implement a production facility. In contrast, strengths are determined by advantages that an organization holds vis-à-vis others, such as equipment or know-how. Opportunities and threats, however, are given by external factors of the environment, such as legal constraints supporting or hindering the targeted objectives of an organization. Based on the SWOT analysis, the organization can determine its marketing strategy, i.e., the mission, objectives, and goals, substantiating it by a "core" marketing strategy, which specifies market targets and/or the elements of the marketing mix

(Andreasen, Kotler 2014). The traditional marketing mix consists of the "4 Ps", which comprises the elements of Product, Price, Place, and Promotion (Kotler, Keller 2006). For services, the "7 Ps" approach can be used, which additionally includes the elements of People, Processes, and Physical Facilities (Meffert et al. 2015b). Figure 4.2 also highlights the fact that all steps of an innovation process (Cooper 2009) leading to the development of a new product or service need to be coupled with a marketing strategy. In other words, target audience centeredness directly influences the development of a new product or service.

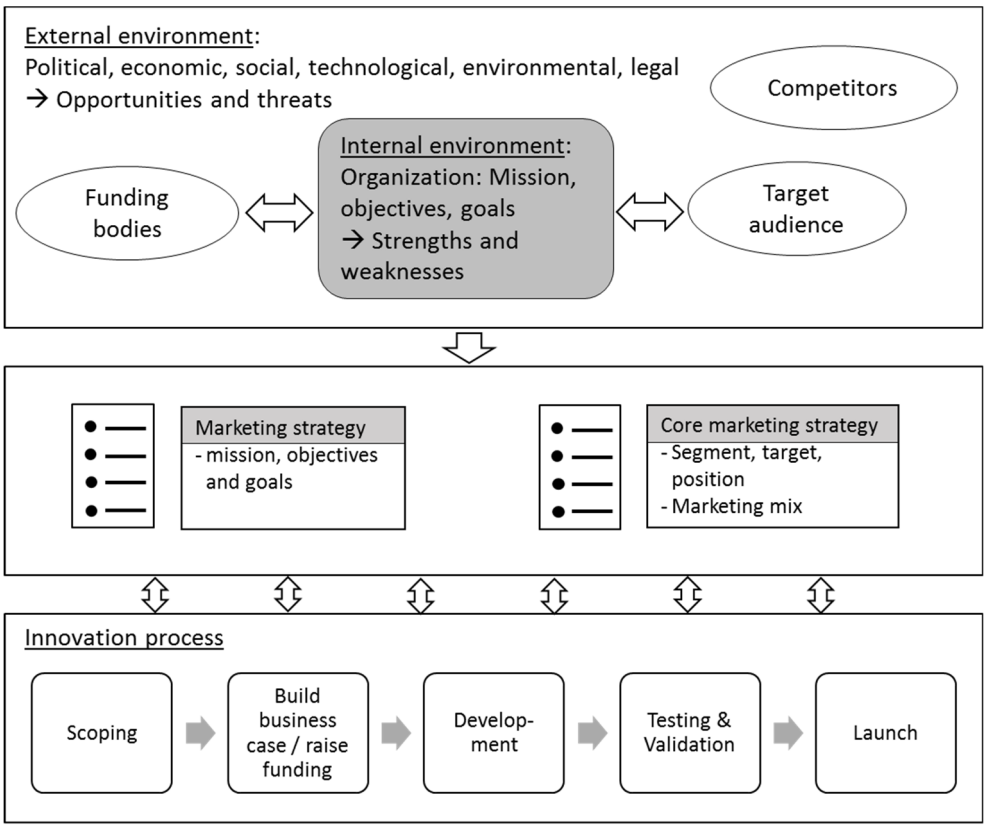

Figure 4.2. Relationships among the market environment, the market structure, and the innovation process (own illustration based on Kotler, Keller 2006, p. 20; Meffert et al. 2015b; Cooper 2009).

Similar to for-profits, nonprofits must meet the needs of their target audience to be successful (Kotler, Keller 2006). In addition, just like for-profits, their objective is to offer products or services for a certain target audience (or to raise funds for charitable purposes). Meffert et al. (2015b) states that the fundamental principles of marketing are also valid for non-commercial exchange processes. Hence, marketing concepts can also be transferred and applied to exchange processes in the nonprofit market. However, as opposed to for-profits, nonprofits face special challenges. They often attempt to change behaviors or attitudes, which means the benefits accrue to others and may not directly be seen by the individuals involved, or people may be indifferent about the topic (e.g., saving water or recycling). Moreover, the behaviors

nonprofits want to influence often deal with topics that are embarrassing or that are understood controversially, such as obesity or abortion. Therefore, research data might be difficult to obtain or may contain socially desired answers. In other cases, the effects of behaving in the desired way involve intangible social or psychological effects that are hard to present to the target audience (e.g., the effect of listening to a symphony orchestra). Nonprofits also generate no or relatively little net income (Andreasen, Kotler 2014).

Such challenges require nonprofits to adopt appropriate marketing strategies. For example, the non-generation or insufficient generation of revenue requires attracting an additional target audience that provides funding, and second, it requires the utilization of other evaluation mechanisms, which are not profitability-based. In order to be successful, nonprofits seeking to improve the performance of their existing portfolio or seeking to offer new products or services need to adapt their entire innovation process, from generating and gathering ideas to ultimately launching products or services in an audience-centered marketing program. This can be done by effective planning of a marketing campaign that consistently focuses on the target audience (Andreasen, Kotler 2014). A marketing campaign describes how organizational strategies are translated into specific projects. The nonprofit's marketing campaign needs to be adapted to the nonprofit environment. Andreasen and Kotler (2014) describe six steps of a marketing campaign: Conducting formative research to understand the target audience; Planning; Pretesting; Implementation; Routine performance monitoring; and Recycling and Revision. Based on the latter considerations, Section 4.6 outlines a marketing campaign guide for nonprofits, such as academic research institutes and governmental agencies. This guide is designed to support nonprofits in their efforts to develop tools or services for SME companies and to help them successfully transfer these offerings to the food sector.

4.5 Phase II: The "developing and marketing the LAV platform" case study

The LAV platform and the associated transfer concept were developed in a project entitled *Avoiding Losses in the Food Industry: Research Transfer to SME Practice* (German title: "Verluste in der Lebensmittelbranche vermeiden: Forschungstransfer in die KMU-Praxis") funded by the DBU from June 2015 to February 2017. The aim of the case study was to support SMEs in the German food sector, including producers, retailers, and the hospitality sector, in combating food waste with the help of an online platform, which systematizes preselected tools from academia, industry, or other institutions, according to users' needs. Moreover, the LAV platform is intended to serve as a role model internationally for similar tool gathering platforms that also seek to support domestic SMEs in their food waste reduction efforts by gathering,

preselecting, and structuring the tools that are most relevant in their countries. In order to reach this aim, a marketing campaign for the LAV platform was set up and carried out, and the outcomes were used to develop the marketing campaign guide discussed in Phase III. The campaign included both the development of the online platform and the development of the transfer concept, which meant that the platform would reach the widest possible audience within the target group. The campaign was based on the findings of Phase I (see Section 4.4) and made use of a multiple-methods approach, which allowed the target audience to participate as project partners from the food sector (SMEs from the food industry, the hospitality sector and multiplier organizations). Table 4.2 summarizes the steps of the marketing campaign, the project partners, and the reasons for their participation. The limited project budget did not allow the conducting of market research with a large and representative number of SMEs from all segments of the food industry. Therefore, only a smaller number of SMEs was used to obtain qualitative results. In order to deliver such qualitative data, the partners were required to intensely engage in the project (attend meetings, fill in surveys, test the prototype, and act as experts in interviews). To develop the transfer concept, interview partners were obtained via telephone, which made it possible to connect with industry opinion leaders and SMEs from all respective segments. The number of participating SMEs and opinion leaders was not representative of the whole sector. However, the basis of the cooperation guaranteed commitment from the partners, so qualitative in-depth information could nonetheless be obtained in accordance with the project duration and budget.

Table 4.2. Partners involved in the marketing campaign, the reasons for their participation, and results obtained.

Step	Participating Organizations	Reasons for Participation
Conducting research related the needs of the target audience	12 SMEs (project partners from the food sector) 6 multiplier organizations (project partners)	Gaining knowledge about the target group to adapt the LAV platform to their needs and wants related to: The content of tools The design and layout of the platform The structure of the platform The features offered on the platform The usefulness of the platform
Pretesting the platform	12 SMEs (project partners) 68 other SMEs 6 multiplier organizations (project partners)	Gaining knowledge on the application of the LAV platform under real working conditions to identify: Opportunities for further optimization of the platform and individual tools Needs for further research Additional required service improvements

Conducting research related to the transfer concept	24 SMEs (project partners and others) 11 multiplier organizations (project partners and others)	Understanding the process of transfer from the research institute to the SME sector of the food industry and the hospitality sector, specifically: The identification of transfer channels used by the different segments of the target group The identification of reliable intermediaries trusted by the segments The identification of "best-use" transfer instruments

LAV platform: Avoiding Food Waste, from the German "Lebensmittel Abfall Vermeiden"; SMEs: Small and medium sized companies.

4.5.1 Methods applied in the case study

The project was subdivided into four steps: *Research and Development*, *Pretesting*, *Implementation and Transfer*, and *Monitoring*. As illustrated in Figure 4.3, these steps were derived from the general innovation process (Cooper 2009) and the marketing campaign steps introduced in Section 4.4. Table 4.1 (see *case study* row) summarizes the aims of each step and the methods applied. In order to gain a deeper understanding of the needs and wants of the target audience, the case study applied a multiple methods approach, which focused on the participation of the target audience. The approach also integrated key stakeholders, such as sector-specific guilds and trade associations, consultants, and representatives of existing networks (see Table 4.2). Since the project budget did not allow the conduct of market research with a large number of organizations, a limited number of partners was used to intensely work with. These were acquired from the existing partnership network of the iSuN. Although the number of participants in each project step was not representative for the whole food sector, this approach nevertheless delivered valuable information as inputs for the various development and evaluation steps of the case study.

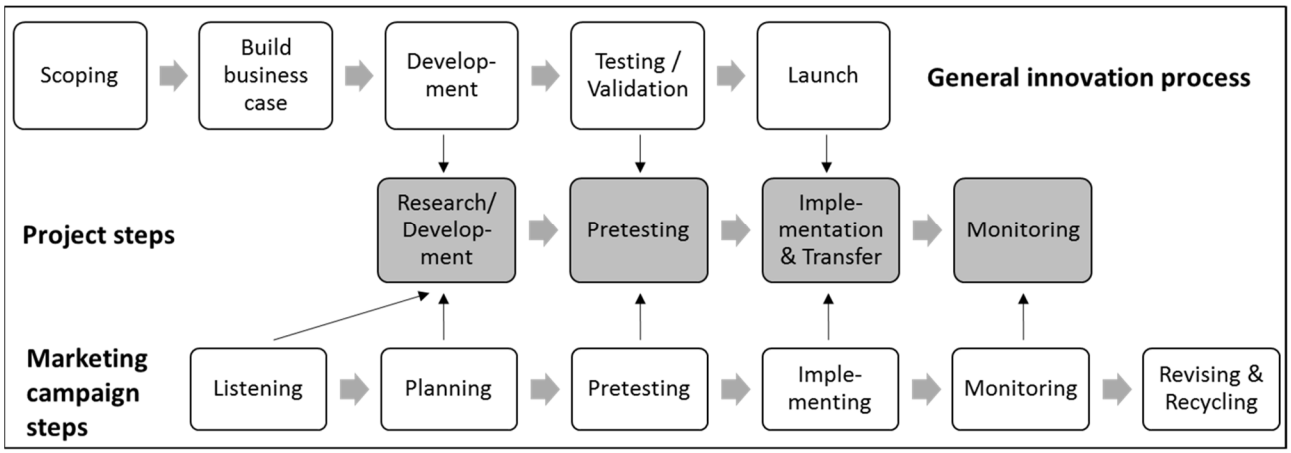

Figure 4.3. Derivation of the project steps based on the general innovation process (Cooper 2009) and the steps of a marketing campaign (Andreasen, Kotler 2014) (context of the case study: steps with gray-colored background).

4.5.2 Implementation of the case study

This section presents the implementation of the four project steps noted above: *Research and Development*, *Pretesting*, *Implementation and Transfer*, and *Monitoring* (see Figure 4.3).

4.5.2.1 Research and Development

The aim of this step was to determine how the online platform should be designed to reach maximum acceptance by the target group and how it should be promoted to achieve maximum visibility. The following paragraphs describe the five tasks/milestones which were set to develop the prototype of the platform and to derive a transfer concept during *Research and Development*.

The first task/milestone of this step to gather all existing tools that support the prevention of food waste and that are freely available on the Internet in the German or English language. Using a combination of online and desk research, a total of 576 tools (iSuN 2016) were found. These included tools such as waste and cost calculators, measuring tools, demand planning tools, training for staff, analysis tools, audit planning aids, best practices, checklists, manuals, guides for food waste reduction, infographics, cost-control systems, and webinars. By using a clustering technique, the tools were categorized by the following goals: *analysis and planning*, *raising awareness*, *measuring and monitoring*, *procedures*, and *benchmarks and best practices*; and by the following sectors: *meat and fish*, *dairy*, *bread and bakery*, *fruits and vegetables*, *other producers*, *retail*, *restaurants*, and *public catering*. Depending on its content, a tool could be assigned to one or more categories or sectors.

The second task/milestone of this step was to finalize specifications of a prototype for the online platform regarding layout, structure, function, and content, and based on the needs of SMEs. These needs were defined and refined in a workshop held with the project partners by applying methods consisting of brainwriting, clustering, and group discussions. Based on the information obtained, the prototype specifications were based on the following needs:

- Customized content for different target groups (producers, which were further classified according to sector *meat and fish*, *dairy*, *bread and bakery*, *fruits and vegetables*, and *other producers*; the *retail sector*; and the *hospitality sector*, divided into *restaurants* and *public catering*).
- Specific target-group language addressing the management and top staff of companies (i.e., avoiding scientific jargon).
- User-friendly navigation with visual aids, which allows for a simple and efficient search for results.

- A clear structure to reduce the complexity of the information provided (categorization of tools according to topic *analysis and planning*, *raising awareness*, *measuring and monitoring*, *measures*, and *benchmarks and best practices* as well as by target group). This allows the platform to specifically offer the target group only those solutions they require from the toolbox. In order to achieve this goal, the main navigation should be structured according to the different stages of the supply chain (producers, retail, and the hospitality sector) and the different sectors for each stage. For example, this ensures that a baker will only be shown tools applicable for bakers and that caterers will find only tools useful for caterers.

The third task/milestone of this step was determining a viable way to minimize the large number of tools compiled in the system in an effort to reduce complexity and provide only the most practical tools to the partners. The challenge involved in this step was to preselect those tools that could easily be applied in practice, and that would offer a real benefit to companies. Therefore, a tool-selection procedure was developed that every tool had to undergo (Flügge 2015). This procedure is a utility analysis and resulted in a ranking of the tools. The procedure involved three steps. First, the content of each tool was assessed; tools targeting a goal other than those mentioned above were excluded from the list (e.g., tools aiming at the reuse of food waste as an energy substrate rather than at its prevention). Second, a utility value was calculated for each tool. The utility value was based on an evaluation of eight criteria, each of which was assigned a different importance (see Table 4.3). The criteria and their weighting were determined by surveying the project partners (web-based survey with nine closed questions). The criteria were: (1) German language; (2) structure and design; (3) time required to understand the tool; (4) applicability of the tool by management only or also by other staff; (5) cost of the tool; (6) necessity to register to use the tool; (7) usability of the tool in a printed format; and (8) industry specificity of the tool. The importance values total 100%. Table 4.3 provides an overview of the criteria and the importance assigned to each criterion. For each criterion, a rating scale was set up according to which all the tools were assessed. From this assessment, a final utility value was calculated for each tool. Tools that fell below a predetermined cut-off value of 35% were excluded from the toolbox.

Table 4.3. Evaluation criteria for assessment of tools and importance values (%) (modified from Flügge 2015).

Criterion	Importance ∑100%	Rating Scale for Tools
German language	14%	Yes/No
Structure and design	16%	5-point-scale (1 = needs development; 5 = very effective)
Time required to understand tool	16%	5-point-scale (1 = very long; 5 = very short)
Relevance of tool for management only or also other staff	12%	Yes/No
Registration requirement to use tool	9%	Yes/No
Cost of tool	10%	Yes/No
Usability of tool in printed format	11%	Yes/No
Industry specificity of tool	12%	Yes/No

In the third step of the preselection, the remaining tools were ranked in descending order of their utility value for each navigation path, and all tools ranked 16th place or lower were omitted from the toolbox. An exception was made if more than 15 tools were assigned the same utility value. In this case, more than 15 tools per navigation path were kept in the toolbox (see Hospitality Sector in Table 4.6). By applying the tool-selection procedure for all the tools gathered, the number of tools selected was reduced from 576 to 166.

The first result of the research and development step was a prototype of the LAV platform that was developed by an expert web designer based on the aforementioned specifications developed with the project partners. These included information regarding structure, layout, and content, which were obtained using the participation methods during the development step. The toolbox implemented on the prototype platform included the reduced set of tools that remained after the assessment. The fourth task/milestone referred to promoting the platform to the target group. It meant final determination of the transfer channels, as well as the supporting and inhibiting factors of transfer. The process of transfer is presented in Figure 4.4. It shows the LAV platform as the *object* which must be transferred from the *sender* (iSuN) to the *recipient*. The recipient is represented by the target group of the LAV platform, consisting of SMEs from the various industrial sectors. Figure 4.4 demonstrates that the transfer process, i.e., promoting the LAV platform, can either work as direct or *indirect transfer*. The latter makes use of a third actor, *intermediaries*, who may be involved in the transfer process to increase the success of the dissemination process. The *instruments* of transfer describe the specific ways that are used to disseminate the information either directly from the iSuN to the target group or indirectly via intermediaries. As opposed to the specific instruments of transfer, the transfer

channels describe the general method applied to disseminate the information. For example, the Internet is a transfer channel, while setting up a link is an instrument of transfer.

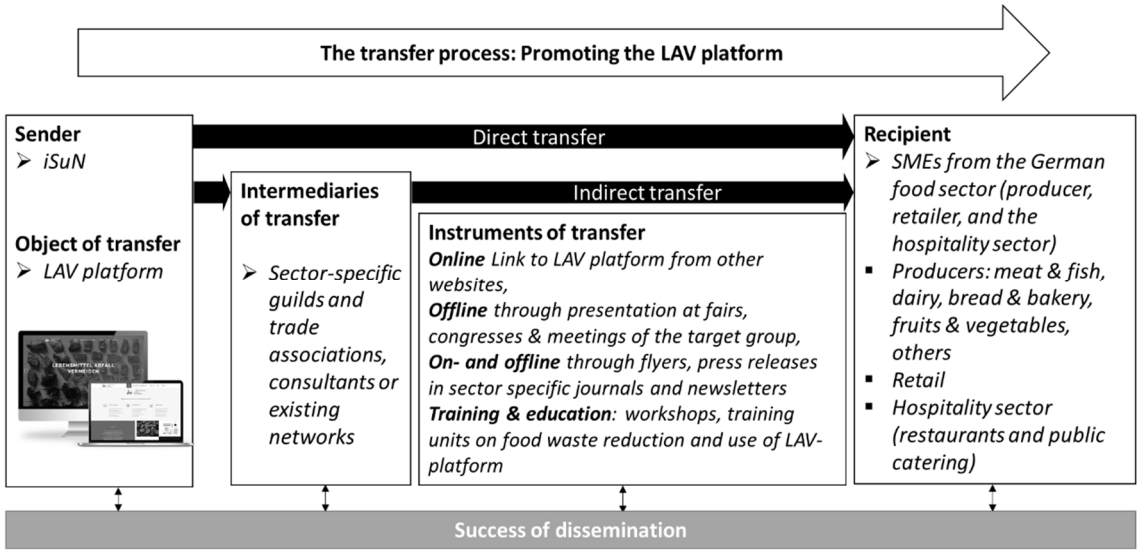

Figure 4.4. Process of knowledge transfer adapted to the case of promoting the LAV platform (own illustration based on Niepagenkemper 2015; Neuber 2016; Korell, Schat 2013). iSuN: Institute of Sustainable Nutrition. LAV: Avoiding Food Waste, from the German "Lebensmittel Abfall Vermeiden".

The transfer channels applied to the target group were analyzed by conducting guided interviews with experts from companies and multiplier organizations. From the interviews, crucial information on transfer channels used in the different sectors were obtained and on key factors that would support or inhibit the transfer of information. This information made it possible to set up the transfer concept.

In order to determine the best transfer channels and instruments to use, 35 guided interviews were conducted with experts from SMEs (24) and from multiplier organizations (11) (Niepagenkemper 2015; Jaensch 2016; Neuber 2016). These interviews resulted in detailed information regarding the transfer channels that should be used for the different sectors. The information should either be disseminated directly through the iSuN or via intermediaries such as the various multiplier organizations that play vital roles in their particular sectors. The interviewees suggested using the following channels to advertise the platform: Multiplier organizations, such as sector-specific guilds and trade associations, as well as consultants and existing networks should be contacted to disseminate general information on the LAV platform through their newsletters and on their website. In order to facilitate access to the platform, they should also provide a link on their own websites. Moreover, the iSuN should offer training classes regarding the platform and the topic of food waste in the training seminars that sector-specific associations provide and in seminars by educational institutions that offer workshops

for different sectors (e.g., vocational schools). The iSuN should also directly advertise the platform by email or phone. The interviewees also suggested that the trade press and magazines should issue a press release about the LAV platform both online and offline, and the iSuN should provide press releases to local newspapers and other local media as well. Moreover, the iSuN should promote the platform at segment-specific exhibitions and directly contact companies in the target group to benefit from word-of-mouth advertising among companies. Furthermore, the iSuN should integrate public institutions that have an interest in the topic of food waste reduction into the concept as multiplier organizations to spread information about the platform via their communication channels.

These potential communication channels were assessed with regard to the key factors supporting and inhibiting the transfer of information, which were also determined from the interviews. These aspects are summarized in Table 4.4.

Table 4.4. Key factors supporting and inhibiting the transfer of information to the target group of SMEs in the food industry and the hospitality sector (Neuber 2016)).

Supporting Factors
• Integration of reliable industry representatives (sector-specific guilds and trade associations), consultants, and existing networks from the various sectors as opinion leaders into the communication process
• Concise, precise information on the LAV platform in newsletters and other media available through multiplier organizations
• Ads in various professional magazines catering to different sectors
• Presentation of the LAV platform at industry-specific events, such as specific exhibitions
• Customization of messaging for each sector by adapting the information provided specifically to each group
• Emphasis on the utility and benefits of the LAV platform
• Provision of easy access to the platform, especially by integrating a link to the LAV platform in online ads
Inhibiting Factors
• Lack of time
• An overflow of information via email
• Too many emails from different and unknown senders
• Email lost in spam folders
• Lack of interest in the topic of food waste reduction/assumption of the topic as irrelevant
• Offline advertising for an online medium
• Target group addressed too generally

The fifth task/milestone was the development of the transfer concept, in which the most promising transfer channels and transfer instruments were utilized. The integration of several sector-specific multiplier organizations as intermediaries of the transfer process turned out to be highly important for the transfer. The multiplier organizations had a key role in disseminating news throughout the sectors, because they are trusted as transmitters of reliable information and knowledge. For this reason, several tools for the transfer were developed which make use of the communication structures opinion makers have, such as using their newsletters for press releases, presenting the LAV platform in meetings, and offering training lessons in seminars given by the different organizations. Due to the central role, these influential actors play, however, it was also important to convince them of the benefits that the LAV platform provides. This task was also integrated into the transfer concept as a major task to fulfill.

4.5.2.2 Pretesting

The project partners assessed the prototype of the LAV platform according to an evaluation concept that was developed. With this concept, the partners were able to assess their satisfaction with the prototype of the platform and to what extent they determined the platform to be effective in providing useful tools to minimize food waste. The evaluation concept was subdivided into three parts. The first two were executed as web-based surveys (including closed-end and open questions). In the introductory part of each survey, the participants had to assign their organization to the respective segment of the food sector, to ensure that the results could be attributed to the correct target segments. In the third part, the partners actually had to use the platform to set up their individual food waste reduction program; they were then subsequently interviewed (guided expert interviews) to evaluate the platform's user-friendliness. Before sending it out to the partners, the research team carried out a pretest with one partner in order to optimize its comprehensibility.

In the first survey, the questionnaire was submitted to 18 project partners (SMEs and multiplier organizations) and 68 other representatives of SMEs, who took part in a workshop related to food waste reduction conducted by the iSuN. The prototype of the LAV platform was presented to the participants and they were requested to fill in the survey. A total of 63 provided feedback on the platform's design, structure, and layout, and made suggestions for further improvements. The respondents evaluated their first impression and the visual appearance of the platform, the effectiveness of the structure and the navigation paths, the comprehensibility of texts and explanations, and the usefulness of the other features integrated into the platform. The second part of the evaluation concept was content-related. It specifically dealt with the content of the tools provided in the toolbox of the platform and with the topics addressed by the

tools, which were *analysis and planning*, *raising awareness*, *measuring and monitoring*, *measures*, and *benchmarks and best practices*. This part was also carried out as a web-based survey submitted to 18 project partners and was completed by 14 respondents.

Based on the results of the first two surveys, opportunities for improvement were derived and implemented into the LAV platform. After improving the platform based on the results of the evaluation, the revised version of the LAV platform was actually put into use by the project partners. This was the third part of the evaluation concept. The participating partners had to set up and execute their own individual food waste reduction programs. They determined their individual goals and chose tools from the platform to apply to their company-specific food waste reduction program. These partners compiled a catalogue, which summarized which measures to implement, the time schedule, and the person(s) in charge. After that, the participating partners provided feedback regarding the effectiveness of the LAV platform and the tools tested. The partners were interviewed (guided expert interviews by phone). Based on the feedback of seven participating companies, the LAV platform was then optimized further. All respondents stated that their specific food waste reduction programs led to an increased awareness of the topic of food waste in their organizations. One caterer decided to reduce portion sizes as their measurement (a tally sheet counting plates with food residues) revealed that a large amount of side dishes were wasted. A bakery revised its ordering system to better adapt its production to actual demand. Table 4.5 presents an example of a food waste reduction program set up by one catering company.

Table 4.5. Example of a catalogue of measures applied in a catering company.

	What? Field of Action	**How? Instrument/ Procedure**	**Where? Process**	**Who? Person in Charge**	**Who? Person Involved**	**When? Frequency/ Schedule**	**Remarks**
1	Raising Awareness	Video clip	Store	Store manager	Other employees of store	Once by July 2016	Can directly be started
2	Measurement	Measurement of plate waste	Dishwashing area	Store manager	Other employees of store	One week measurement by July 2016	Requires planning and instruction of employees
3	Procedures	Use food waste calculator for analysis of results	Management	CEO	Store-manager	By August 2016	Requires results of measurement

While the individual goals of the implementation phase varied among the partners, most companies stated that they wished to raise awareness about the topic of food waste. None of the companies announced any objective to reduce food waste by a fixed percentage.

The additional feedback given by the partners revealed that minor layout changes were necessary. Moreover, some of the companies wished to have German translations of tools that had been only provided in English. As a result, 13 tools were translated into German.

4.5.2.3 Implementation and Transfer

After optimizing the LAV platform, it was finally published[19]. The user navigates through the platform by choosing a sector (producer, retail, or hospitality sector) first. Second, the user selects the requested tool category (*analysis and planning*, *raising awareness*, *measuring and monitoring*, *procedures*, and *benchmarks and best practices*) by clicking on the respective tabs of the toolbox, and third, the user chooses among the tools offered. The numbers in Table 4.6 represent the number of tools available in the toolbox of the LAV platform. Each number also stands for one navigation path on the platform. For example, there are nine analysis and planning tools available for a producer in the fruits and vegetable sector.

Table 4.6. Final number of tools per navigation path implemented on the LAV platform.

Sector	Analysis and Planning	Raising Awareness	Measuring and Monitoring	Measures	Benchmarks and Best Practices
Producer					
Meat and Fish	13	4	4	8	5
Dairy	9	6	2	4	2
Fruits and Vegetables	9	4	2	4	5
Bread and Bakery	9	4	6	10	6
Others	8	4	2	6	3
Retail					
Retail	9	4	2	4	8
Hospitality sector					
Restaurants	8	10	12	21	12
Public Catering	9	11	17	26	9

At the same time, when the platform was published, the transfer concept was put into practice. Segment-specific press releases were sent to multiplier organizations to disseminate this information via their newsletters. Further, the LAV platform was presented at scientific conferences, at symposia of the target audience, and to political organizations (in roundtable discussions, workshops, etc.).

4.5.2.4 Monitoring

The aim of this step was to determine if the LAV platform was successful and if the transfer concept raised awareness among members of the target audience. Due to the limited project

[19] www.lebensmittel-abfall-vermeiden.de/ (accessed on 19 May 2019)

time, monitoring actions were reduced to a limited set of activities. First, website traffic was monitored once the LAV platform went online, on 1 October 2016 (see Figure 4.5). As the graph shows, in October and November 2016, the first two months after its publication, when the transfer activities were started, the number of viewers rose to 6110. By 13 February 2017, the number had risen further to a total of 9016 views. The bounce rate, which determines how many visitors leave a website directly from the entrance page, was 7.6%, which means 92.4% of the visitors clicked further on the site. On average, they visited 2.9 pages.

Due to the limited time of the project, surveying a large number of SMEs from the target group in order to assess whether the LAV platform was successful was not possible. Instead, the 18 project partners (six multiplier organizations and 12 SMEs) were ultimately requested to assess the performance of the LAV platform and the cooperation of the project. This final evaluation was answered by nine participants who assessed three categories. First, they rated the overall performance of the platform as a 1.6 (on a six-point scale with 1 being best, in analogy to German school grades). In the second category, they had to assess to what extent they considered the platform to be a useful tool for preventing food waste in their own organization. Their average rating on a nine-point scale (with 9 being best) was 7.2. In the last category, they evaluated their cooperation with the iSuN in the project. The average rating achieved was 7.3 on a nine-point scale (with 9 being best).

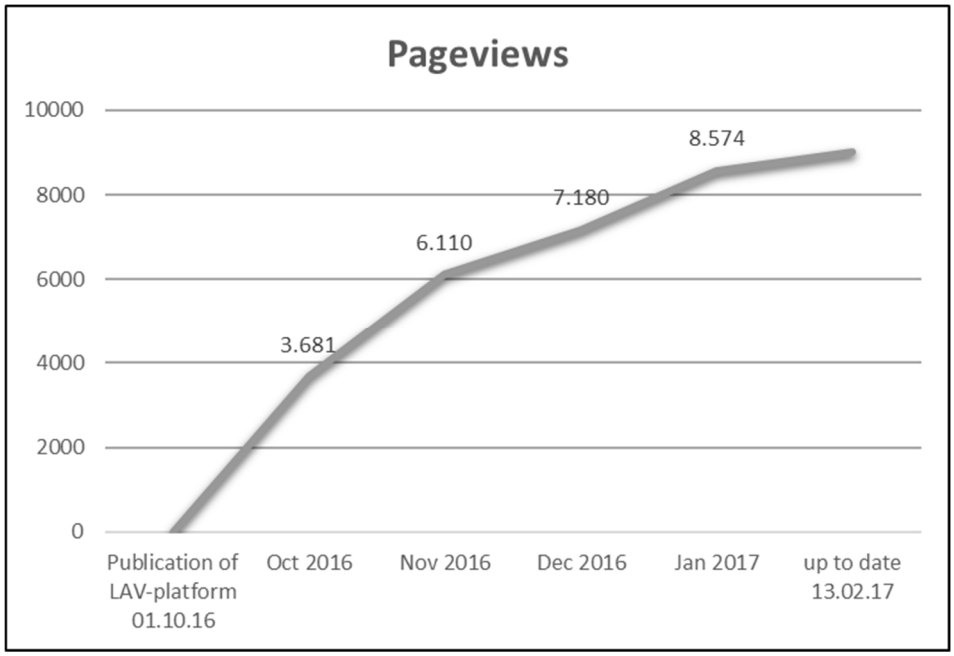

Figure 4.5. Pageviews of the LAV platform from 1 October 2016 to 13 February 2017.

4.5.3 Conclusions drawn from the case study

The case study to develop and disseminate the LAV platform provided valuable experience from the transdisciplinary working environment, which included iSuN as the project leader, as well as up to 11 multiplier organizations, 12 SME project partners, and up to 68 other SMEs (who took part in online surveys or who were involved as experts in guided expert interviews) from different segments of the food sector. The SMEs and the multiplier organizations were integrated in various participatory methods applied during the project to help understand the needs and wants of the target group and better adapt the LAV platform to their requirements. In addition, SMEs delivered information regarding the transfer of the platform to the food sector. The following conclusions were drawn from the case study:

- SMEs are interested in fighting food waste. Their motivation is based on economic considerations.
- SME project partners have the will to participate. However, they have few time resources. Surveys were often only filled in by the contact person after sending a reminder or after personal communication via telephone. Moreover, guided expert interviews revealed more detailed information on opportunities for improvement than structured surveys.
- Personal communication with the contact person via telephone is important to establish a level of trust and to increase the commitment of partners.
- SMEs have limited time resources and consider additional consulting services useful to counteract food waste.
- Participatory methods are useful for gaining information on the needs of the target group. The research uncovered information on: (a) the functionality, layout and design of the platform; (b) the required content of the toolbox; (c) the required segmentation of the food sector; and (d) the transfer channels applied by the segments.
- Each segment of the target group wants to be addressed separately. General solutions are perceived as providing less benefit than segment-specific solutions.
- Pretesting of the platform is useful for receiving feedback on further opportunities for optimization (e.g., SMEs wished to have more tools in the German language).
- The promotional activities determined in the transfer concept lead to an increased awareness of the platform.
- Evaluating web traffic results in valuable information on the success of the transfer concept.

- The integration of multiplier organizations in the transfer process is useful, as they are perceived by the target group as a reliable provider of information.

4.6 Phase III: A marketing campaign guide for nonprofits targeting the development and promotion of support tools for the food sector

This section takes the results of the research project and uses them to develop a marketing campaign guide that enables nonprofits (e.g., research institutes or governmental agencies) to successfully develop and transfer their offerings, e.g., support tools, to SMEs in the food sector. This guide is based on the marketing considerations summarized in Section 4.4 and the conclusions drawn from the case study in Section 4.5. A marketing campaign plan describes how organizational strategies are translated into specific projects (Andreasen, Kotler 2014). An effective marketing campaign consistently maintains its focus on the target audience. Andreasen and Kotler (2014) describe six steps of a marketing campaign: Conducting formative research to understand the target audience, planning, pretesting, implementing, routine performance monitoring, and recycling and revision. Based on the experiences gained from the case study, Andreasen and Kotler's (2014) campaign was used for the specific purpose of developing and transferring support tools for the food sector as is illustrated in Figure 4.6. This procedure specifically emphasizes the importance of the *transfer* step and includes the additional step of *raising follow-up financing*. Transfer follows *development*, in which not only the offering itself is developed, but also the transfer concept (including the appropriate transfer activities). This development is based on the information (transfer channels, supporting and inhibiting factors of transfer) provided by the target audience in the research step. Moreover, the step of raising follow-up financing differentiates between for-profits' and nonprofits' campaigns. If nonprofits do not generate a financial surplus that ensures the continuation of their product beyond the project scope, it means they have to start sufficiently early in raising follow-up funding, as part of the marketing campaign itself.

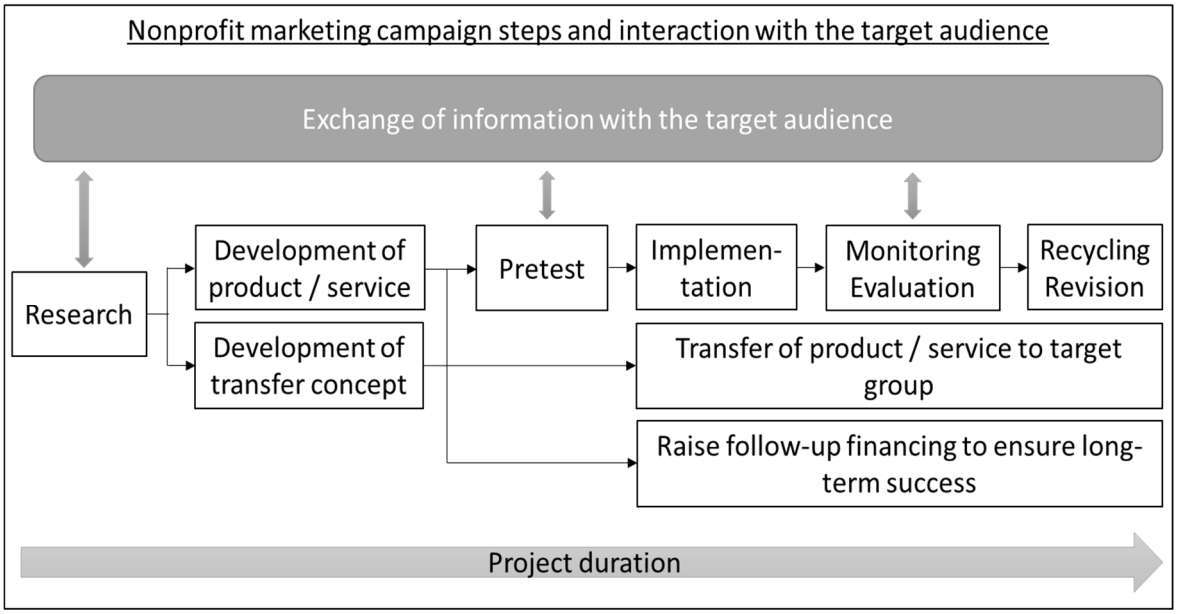

Figure 4.6. Nonprofit marketing campaign steps and interaction with the target audience (own illustration based on experiences from the case study (Section 4.5) and (Andreasen, Kotler 2014)).

The marketing campaign guide is presented in Table 4.7. It summarizes the general intention of each step (*Intention*); with the *Meaning* paragraphs, the guide specifically describes the meaning of the step for nonprofits that targets market options for SMEs in the food sector. In the *Methods* part, useful approaches which can be used by nonprofits are suggested.

Table 4.7. Marketing campaign steps (adapted from Andreasen, Kotler (2014), general *intention* of each step, *meaning* for the development of support tools for SMEs in the food sector, and suggested *methods* for application (based on experiences gained from the case study).

Marketing Campaign Steps
Research
Intention: Conducting formative research means listening to the target audience in order to understand audience needs, wants, values or motivations. Moreover, information on market segmentation is gathered. The most common reason for failure is not properly listening to the target group. **Meaning:** The target group of SMEs in the food sector is quite diverse, as it covers a whole range of companies along the food value chain. Producers have needs and wants that are different from those of retailers or companies from the hospitality sector. Market research is a method to obtain the information required. If expert interviews are used, pretests should first ensure that the interviewer knows how to ask the questions and that they are easy to understand. The same applies to web-based surveys. **Suggested methods:** • Desk and online research (to deliver initial qualitative information on market segments) • Descriptive statistics (to deliver facts and figures about the market) • Expert interviews (to deliver more detailed information on required sub-segmentation of target market and on transfer channels and important intermediaries used for promotion activities) • A web-based survey with a sample of the target group (to identify needs and wants of the target group)

Development of product /service and transfer concept

Intention: This step is intended to translate the information gathered in the preceding step into concrete characteristics of the marketing mix. This means identifying the benefits of the proposed offering, and defining goals, timelines, and responsibilities. Moreover, the information concerning transfer channels is analyzed, and activities related to the transfer concept are defined.

Meaning: Segmenting SMEs of the food sector may result in groups such as bread and bakery, dairy, meat and fish, confectionary, or fruits and vegetables. The hospitality sector may be split into restaurants and public catering. Moreover, it is necessary to further define which group of employees should be addressed. Blue-collar workers may have different needs and wants than white-collar workers do. Any products or services offered need to be tailored to the specific target segment. A support tool might be web-based or a printed brochure or checklist, which addresses the fact that blue-collar workers might not have the same regular access to computers that white-collar workers do. For this reason, the tools for each group need to be designed accordingly. The challenge of this step is therefore to develop a tool which can be made for the whole target group but also specifically addresses the needs of each member of the segments. Just as different segments of a target audience request different value propositions of the product or service, the transfer concept must require different transfer activities. In the food sector, there are several different transfer channels: intermediaries, such as segment-specific guilds and trade associations, consultants, and existing networks, or different professional magazines and the trade press. In the research phase, it is also important to identify the transfer channels used by various segments of the target audience.

Methods:

- Cost analysis (to compare costs with the available budget)
- Qualitative analysis of open-ended questions in a web-based survey (to detect the benefits the target audience desires)
- Quantitative analysis of closed questions (to determine the relevance of the proposed benefits)
- Calculation of utility value (to prioritize the benefits)
- Establishment of technical specifications (to transform the desired benefits into technical requirements)
- Analysis of transfer channels (to identify the transfer channels used by the target audience and to assess their importance)

Pretesting

Intention: Pretesting key elements of the product or service is necessary to assure the target group reacts in the desired way. By pretesting, marketers gain valuable insights into how the product or service is used and judged by the target group. Pretesting assesses whether the marketers have been capable of transforming the information gained through market research into the proposed benefit. It serves as an initial evaluation of the success of the planning process and detects the discrepancies between that what the marketer intended to develop and what has actually been carried out.

Meaning: A prototype of the support tools should to be tested by the targeted segments. Do the users feel the tool addresses their needs, or do they perceive it as “not made for me”? The pretesting step shows if the users understand how to apply the supporting tool. Further, it reveals if the user likes the content and the way it is designed and if it leads to the desired result. Pretesting should be related to the layout as well as to the content of the tool. Since evaluating the content may require more time than evaluating the layout, it is useful to separate the assessment into two parts. If the tester only has limited time, he might be deterred by a long testing process. Splitting the test allows him to do the testing step-by-step, which will increase the chance that the testing is actually completed. Moreover, it is important to do a pretest of the pretesting procedure with a

selected member of the target group. This helps in designing the pretest, including its introductory text, to be efficient and clearly understood.

Methods:

- Pretesting of pretest with a selected member of target group (to check appropriateness/ comprehensibility of test)
- Guided expert interviews (two parts: one related to content and other related to structural aspects and design)
- Qualitative content analysis (to analyze interviews conducted with experts)

Implementation

Intention: In the implementation step, the campaign is launched after the product or service has been improved according to the results of the pretesting step. The product/service is distributed to the target group.

Meaning: This is the point in time when the support tool is actually published and available for the target group. Therefore, it is important that the pretesting (and refining) step is finished. Once the promotion campaign, i.e., the transfer activities, has been started, the target group is going to access the tool. Therefore, the product should include all the intended benefits. If the tool includes a service hotline, there must be sufficient personnel to staff it. Brochures need to be printed, and online tools must be ready to use. In addition, monitoring activities should be initiated in order to assess the campaign's success.

Methods:

- Use of a checklist for the implementation of the transfer concept (to optimize promotional activities)
- Maintaining the schedule (to ensure subcontractors such as web designers or print shops keep their deadlines, and to ensure that promotional activities and publishing go hand in hand)

Monitoring and Evaluation

Intention: This step is designed to monitor if the campaign works in the desired way. It reveals whether there is anything unexpected happening on the market, such as the launch of a competing product/service or a new political trend. Moreover, this step verifies if the tool satisfies the needs of the target audience, i.e., if its benefits are perceived in the desired way and if the promotion campaign reaches the target audience.

Meaning: Nonprofit organizations offering support tools for SMEs from the food sector rely on feedback from businesses. Since the tools are often developed by non-practitioners, receiving feedback is essential to evaluate the success of the tool and its usefulness in daily work routines. Since nonprofits often cannot evaluate the success of their product/service in terms of sales figures or generated revenues (as what they are offering is provided free of charge), they need to establish other measures of oversight. This means relying on non-financial indicators, such as measuring the performance of the target audience or stakeholders. Target audience performance may be assessed by such indicators as the percentage of users who would reuse the product/service, who would recommend the tool to others, or who fall into the categories of very dissatisfied, dissatisfied, neutral, satisfied, and very satisfied (Kotler, Keller 2006). The food sector is highly competitive for and among SMEs. The practicality of the tools offered should be evaluated under real working conditions, when time and staff resources are low. As opposed to for-profits, nonprofits that are providing something free of charge do not have a customer database. It is not clear who exactly is the person in the SME who ultimately uses the tool. There is no contact person to address to gather feedback. Therefore, it is useful to acquire business partners in all targeted segments who are willing to use and assess the tools. The evaluation can be separated into two parts: The first concerns layout, design, and content of the tool; and the second is related to the transfer concept. This means analyzing if the target audience could be (or has already been) reached by transfer activities.

Methods:

- A web-based survey (to evaluate the value proposition of the tool, e.g., layout, structure, design, content)
- A web-based survey (to evaluate the efficiency of transfer activities)
- Transfer oversight (to check if transfer activities were actually implemented by the intermediaries, e.g., to check if press releases were actually published in a newspaper or magazine)

Revision and Recycling

Intention: The revision of the product/service is a consequence of following the monitoring and evaluation step. This step is designed to reveal whether the target audience did not understand the benefits provided by the tool, or it was unable to be reached at all. If this is the case, the marketing campaign needs to start again at the research step to improve the situation. It might also be that one segment of the target group could be reached, while others were not. In this case, it might be necessary to adapt the product/service to the special needs of this segment (including a new pretest) or to revise and improve transfer activities.

Meaning: It is important that project managers integrate the revision and recycling step into their project schedule. This is especially true if funding has only been granted for a limited time; project managers need to realize that they should have the financial and personnel resources to react to the results of the revision phase. In other words, if the product/service launched by the nonprofit organization is a website, the task of improving it after the evaluation should be integrated into the web designer's contract, or a budget for improvements must be considered in the financial plan of the project.

Methods:

- Comparison of cost and utility of improvement procedures
- Prioritization of results of the evaluation
- Return to the appropriate step (e.g., transfer or planning)

Transfer of Product / Service to the Target Group

Intention: Transfer activities are put in place according to a transfer concept. This is set up during the development phase, based on analyzing the target group during the research phase. It integrates the supporting factors of transfer and works to mitigate or avoid inhibiting factors. Transfer attempts to promote the product/service to the target group.

Meaning: There are several support tools available on the Internet for free. Moreover, it is not clear for every SME what the advantages of any given support tool may be. Therefore, it is important to grab the target audience's attention regarding the new product/service and to convince potential users to test it. As a result, transfer activities have a major influence on the success of a tool. Nonprofits need to identify any and all actors on the market who could support their promotional activities. This "indirect transfer," which uses intermediaries, has the advantage that SMEs know these intermediaries and they trust them to provide reliable and relevant information. For the food sector in Germany, sector-specific guilds and trade associations, well-known industry-specific consultants, and existing professional and social networks were all identified as relevant intermediaries.

Methods:

- Direct transfer (to get in direct contact to the target audience; e.g., by presenting the product/service at fairs, or at annual meetings of associations)
- Indirect transfer (leveraging the integration of intermediaries, such as sector-specific guilds and trade associations, consultants, or existing networks, which were found to be relevant in the research step)
- Execution of the transfer concept (defining transfer channels and transfer activities to better reach the different segments of the target audience)

Raising Follow-Up Financing
Intention: Raising follow-up financing is important to ensure the long-term success of the product/service. **Meaning:** Follow-up financing ensures updating of tool content, or technical maintenance of web-based tools. It allows permanent adaption to changing markets (e.g., new political decisions related to prevention of food waste) and the continuing of transfer activities. **Methods:** • Creativity techniques (e.g., brainstorming) • Research (to identify new funding sources)

4.7 Discussion

At 283,000, the number of SMEs in the food and beverage industry in Europe is enormous. They account for 99.1% of the food and beverage companies in Europe (FoodDrinkEurope 2015). Competition on the market is high (in Germany, the five biggest food retailers have a market share of more than 70% (BVE 2016)). Considering this strong competition on the market, SMEs face a situation of high cost pressures, often leading to low staff capacities and time constraints. For this reason, it is important to offer support to such SMEs in their efforts to reduce food waste and to guide them through the jungle of tools freely available on the Internet designed to counteract food waste—currently numbering more than 500 in English or German. Viewed from a marketing perspective, these tools need to take into account the user's needs and wants in order to be successfully utilized. Moreover, a transfer concept needs to ensure that the user becomes aware of the tools. While in profit-oriented businesses it is common sense that a market and customer orientation are necessary for commercial success, nonprofits still need to work on adopting an audience-centered mindset (Meffert et al. 2015b; Kotler, Keller 2006; Vahs, Brem 2015; Homburg, Becker 2000; Meffert et al. 2015a). The experiences gained from the case study are in accordance with Andreasen and Kotler (2014), Dolnicar, Lazarevski (2009), and Kwak (2011) who stress, that a clear focus on an organization's target audience is also crucial for nonprofit projects. In the case study, the LAV platform's layout and navigation structure as well as the transfer concept were developed in a participatory way and thus they reflect the needs and wants of the target audience. By using this approach, a rating of 1.6 (on a six-point scale, with 1 being best) for overall performance could be obtained. Moreover, the transfer of the platform to the various segments of the target group led to more than 8000 views within the first three months of the platform's publication. The marketing campaign guide presented is specifically targeted to nonprofits that wish to develop and market support tools for the food sector. It suggests appropriate methods for each of the marketing campaign steps and explains why these steps are necessary to understand the needs

and wants of the target audience. This is especially relevant since nonprofits still often have an organization-centered mindset and managers equate marketing activities to promotional activities (Andreasen, Kotler 2014; Dolnicar, Lazarevski 2009).

On the LAV platform, a large number of efficient tools have been gathered, preselected, and categorized and thus the platform offers valuable support for SMEs in Germany. While platforms presenting tools against food waste for single segments of the food sector or the consumer already exist (see the FoodSave website[20], with its food waste reduction tips for the restaurant sector, LeanPath's food waste prevention website for commercial kitchens[21], and the consumer-focused campaigns of Love Food Hate Waste campaign by WRAP[22] and "Zu gut für die Tonne," a German campaign[23]), the LAV platform is the first Internet site internationally that covers the whole food supply chain, from the production of food to its utilization by large-scale consumers, such as restaurants and public caterers. Other food waste reduction initiatives have developed useful tools for special segments of the food sector. For example, WRAP has published more than 100 instruments (e.g., Toolkit for fresh produce[24], Tool: diagnostics spreadsheet template[25], Tip Sheets: Forming Teams and Champions[26], Secondary Packaging Optimisation[27], Food Waste Prevention – Digest Series: e.g. Reducing waste in the fresh meat sector[28], Food Waste Tracking Sheet[29], Self-assessment Review for Food and Drink Manufacturers[30]) that help companies to reduce the waste of food. Although, the tools are useful, potential users need to search the Internet to find the specific solutions they are looking for. The search time required is an obstacle, especially for SMEs that are often focused on daily work routines. The LAV platform is specific and unique, as it connects supply and demand of food waste reduction tools. Thus far, there has not been a platform that gathers the existing tools to make them available in a structured manner according to the requirements of the different segments of the food sector. Three main advantages differentiate the LAV platform from the

[20] www.foodsave.org/ (accessed on 19 May 2019)
[21] www.leanpath.com/ (accessed on 19 May 2019)
[22] www.lovefoodhatewaste.com/ (accessed on 19 May 2019)
[23] www.zugutfuerdietonne.de/ (accessed on 19 May 2019)
[24] www.wrap.org.uk/sites/files/wrap/WCRE%20Toolkit%20V2.pdf (accessed on 19 May 2019)
[25] www.wrap.org.uk/content/problem-definition-spreadsheet-template-v1 (accessed on 19 May 2019)
[26] www.wrap.org.uk/sites/files/wrap/Tip%20Sheet%20-%20Forming%20Teams%20and%20Champions.pdf (accessed on 19 May 2019)
[27] www.wrap.org.uk/content/food-waste-prevention-digests-secondary-packaging (accessed on 19 May 2019)
[28] www.wrap.org.uk/sites/files/wrap/Meat_Sector_supply_chain_sheet.pdf (accessed on 19 May 2019)
[29] www.wrap.org.uk/sites/files/wrap/Food_Waste_Tracking_Sheet_v1.1_0_050115.pdf (accessed on 19 May 2019)
[30] www.wrap.org.uk/sites/files/wrap/EN864_final.pdf.pdf (accessed on 19 May 2019)

platforms published by other initiatives. The LAV platform provides the benefit that: (a) it gathers and preselects those tools which are most efficient for the SMEs, greatly reducing their time required to assess the utility of each individual tool; (b) it addresses all segments of the food sector individually (e.g., bakers can directly find special tools for bakeries; restaurant manager can select those tools specific for restaurants); and (c) the toolbox provided on the platform is structured according to the different goals of the tools (*analysis and planning*, *raising awareness*, *measuring and monitoring*, *procedures*, and *benchmarks and best practices*), which further facilitates the search process for SMEs.

The LAV platform can also serve as an example for new tool-gathering platforms in other countries as well. Initiatives that wish to set up their own platform for SMEs can use the marketing campaign guide (see Section 4.6). The guide specifically focuses on the special requirements of the food sector and describes how nonprofits, such as governmental initiatives or academic projects, can develop and transfer tools by adopting a target audience-centered mindset. The research on existing tools and the tools-selection process that was carried out during the research and development phase of the LAV platform could also deliver valuable inputs for other national or international food waste reduction projects (e.g., the European project REFRESH (see Section 1.2).

From an organizational perspective, SMEs also need to have an economic incentive to deal with the topic of food waste. Betz et al. 2015 (Betz et al. 2015) calculated costs for wasted food in two food-service institutions to amount to CHF 170,216 (EUR 156,303, September 2016) annually; moreover, examples such as four Swedish restaurants which saved EUR 657 (SEK 6030, July 2003) daily (Engström, Carlsson-Kanyama 2004) and a German hospital whose costs of wasted food accounted for EUR 318,000 annually (Teitscheid et al. 2015) reveal that reducing food waste also makes sense from a monetary perspective. In the future, the financial impact of food waste should be further emphasized on the LAV platform (either in a category of its own or in the benchmarks and best practices category) in order to stimulate managers to commit to food waste-prevention activities.

Although the LAV platform is directed at single SME companies, it supports the development of comprehensive food waste reduction programs, as it gathers tools for all actors of the food supply chain. This is important, as the implementation of inter-organizational measures should not lead to a shifting of food waste further up or down the food supply chain (Göbel et al. 2015). The platform covers the skilled-labor (such as butchering and baking) and industrial production part of the supply chain, as well as the retail and consumption part with measures for the restaurant and public catering sector. For this reason, it supports a holistic way

of thinking in the fight against food waste along the whole food supply chain. This holistic view should also be supported by legal and political authorities. They need to ensure that legal and hygiene requirements become more transparent to lower the barriers for companies to donate excess food. In addition, they should provide further funding for food waste reduction programs in order to facilitate the implementation of food waste reduction concepts for SMEs, which is often hindered by a lack of staffing and time capacities.

The transfer of the platform from its scientific background to the daily work of SMEs in the food industry and hospitality sector contributes to an increased awareness of the topic of food waste. By allowing straightforward access to preselected tools against food waste, the LAV platform can support companies in their food waste reduction activities. The marketing campaign guide provides useful assistance to project managers who wish to develop and transfer support tools for the food sector. As such, both results of this study, the marketing campaign guide and the LAV platform, contribute to achieving United Nations Sustainable Development Goal 12.3, which calls for halving food waste at the retail and consumer levels and reducing food losses along the production and supply chains, which the European Commission has committed to.

4.8 Conclusions, limitations and the need for further research

Nonprofits (such as academic research institutes, or governmental initiatives) should apply a systematic marketing approach, such as the one presented by the marketing campaign guide (see Table 4.7), if they wish to develop and promote a support tool for the food sector. Market research provides valuable information on the needs and wants of a target group. Therefore, it is important to integrate this target audience into the research and pretesting phase to gain insights. It is also important to integrate a pretesting step into the campaign, to raise the tool's acceptance of the target group and to detect any potential for optimization at an early stage before the tool is transferred to the market. In projects in which limited funding opportunities do not allow large market research campaigns, nonprofits should intensify cooperation with a few key SMEs to receive adequate qualitative information. Guided expert interviews are useful to gather information concerning the requirements of the target group. Monitoring the success of a tool offered and of the promotional activities is also a required step of a marketing campaign. Therefore, appropriate funding for monitoring activities should be raised and sufficient time in the project should be scheduled. For example, for online tools, a monitoring concept for web traffic can be used to analyze if all targeted segments were reached using

promotional activities. The requirements of SMEs from different segments of the food sector differ. For example, the skilled-labor sector needs to be addressed differently than retailers, and butchers in a different way than bakers. Hence, it is important to provide target segment-specific solutions rather than generalizing information. This relates to the value proposition of the proposed tool itself, but also to promotional activities. For the latter, transfer channels and transfer instruments applied by each segment of the target group need to be determined. In the food sector, multiplier organizations often play an important role in disseminating information. Therefore, relevant multipliers (e.g., sector-specific guilds and trade associations, consultants, or segment-specific networks) should be integrated into the transfer activities of each segment. The food sector is highly competitive, exerting tremendous cost pressures on SMEs. Therefore, the economic benefits generated by a support tool should be emphasized as an incentive to apply the tool. Moreover, SMEs are confronted with few extra personnel capacities to conduct new projects, such as starting a food waste reduction initiative. Organizations that wish to market a tool to the food sector should consider offering product-service systems that integrate consulting services (with costs) to provide support SMEs in utilizing such tools.

The limitations of this study include the number of SMEs participating in the development and transfer of the LAV platform. Defining the value proposition of the LAV platform and the transfer channels and instruments was only based on a limited number of participants, since the project budget did not allow market research with a more representative number of SMEs. Although the information gained had a qualitative rather than a quantitative character, it nonetheless delivered valuable input for the marketing campaign steps. Another limitation of this study was the limited time to monitor the LAV platform's success. Success was determined by surveying the limited number of project partners and by analyzing the number of pageviews of the platform. Both the analysis of the platform's success and the efficiency of the transfer concept could have been more thoroughly developed if there had been more time or funding respectively.

Future research should analyze how the marketing capabilities of nonprofits can be improved further, since an understanding of all actors on the market is crucial for the successful development and transfer of support tools. Future research should also further analyze the potential cost savings applicable for each target segment in order to deliver convincing evidence for management that efforts made to combat food waste pay off. Research should also be conducted on evaluating the effectiveness of tools in respect to their actual food waste reduction potential. This can only be done if standardized methods for the measurement of food waste exist. Therefore, future research should elaborate such methods. Moreover, companies showed

great interest in the field of best practices and benchmarks. Future research should therefore also determine key figures specific to each sector to evaluate the occurrence of food waste, which could then be used as the basis for segment-specific benchmarks. This would enable SMEs to evaluate their own position and to reveal further optimization opportunities.

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5 Summary and concluding remarks

SDG 12.3 of the United Nations calls for halving food waste at the retail and consumer level and reducing food losses along the entire food value chain. Moreover, food waste reduction contributes to achieving SDG 2, "Zero Hunger" and SDG 13, "Climate Action." The goal of food waste reduction has consequently been adopted by the German federal government. Over the last few years, it has become a crucial part of four government programs (the National Program for Sustainable Consumption, the Waste Prevention Program, the Climate Action Plan 2050, and the German Sustainable Development Strategy) and has recently been included in Germany's National Strategy to Reduce Food Waste. There already exists a large number of tools against food waste (Section 1.1). However, it is unclear if those tools provide a significant benefit for the SMEs of the food sector, as the tools are only distributed on the Internet. A crucial aspect of successfully employing such tools is that they need to be set up and marketed according to the needs of their target audiences (Section 1.4). Therefore, auxiliary organizations that provide such food waste reduction tools need to focus on the specific target audience (e.g. bakeries, butchers, or the hospitality and catering sector). Such organizations often lack a market orientation (Section 1.4), and therefore any approach must help these organizations to correct this. Moreover, companies in the food sector, especially SMEs, are exposed to high competition and cost pressures. They often lack extra capacities to initiate additional projects. For this reason, it is especially SMEs that need support in implementing initiatives to counteract food waste. The shifting of food waste from one stage to the next must be avoided if the total amount of food waste along the whole food supply chain is to be reduced. Therefore, a holistic approach is required that is capable of both supporting SMEs in their food waste reduction initiatives as well as contributing to food waste reduction outside a given individual company.

Thus, the main objective of this thesis was to develop concepts to support the reduction of food waste in the food sector, particularly for SMEs in manufacturing, retail, and large-scale consumption (i.e. the hospitality and catering sector). Another objective was to develop guidelines for the application of such concepts for their intended users.

The first research question focused on determining the status quo of organizations from the food sector with respect to the occurrence of food waste and to reduce it. That meant determining the initial quantities of food waste and the organization-specific challenges that led to it, as well as developing and implementing measures to reduce these problems. This in turn called for selecting case studies; this study looked at three: a hospital, a cafeteria, and a residential home. Five problematic fields leading to food waste were identified: *information on*

food waste, communication, *product presentation*, *food ordering and supply*, and *customer needs*. The first aspect, *information on food waste*, required sensitizing all actors involved in the food supply about the topic of food waste, because they need to understand its relevance. For the field of *communication*, it is important to analyze the flow of communication along the supply chain from the kitchen to the customer, and improve such communication especially at departmental interfaces, as well as establish feedback loops concerning food waste. In the category *product presentation*, menus or food catalogues need to be adjusted to the specific serving context, so that customers clearly understand what they get (e.g. adjusting the visual and descriptive presentation of products in menus, or training order assistants in presenting the products). The field of *food ordering and supply* means optimizing processes related to the delivery of the food to the customers (e.g. providing reserve meals in hospitals or individualizing food service in residential homes to better meet needs). Finally*, customer needs* have to be taken into account, e.g. children have different needs and preferences than elderly or sick people have. In other words, suppliers delivering food to different organizations need to adapt their menus accordingly. In order to reduce food waste in the three organizations under study, it was necessary to bring together the relevant actors to develop and consequently implement site-specific measures to identify food waste and reduce it. This lead to a reduction of the total quantity of food wasted in all three organizations. However, the degree of reduction differed. While the average waste rates in the residential home and in the cafeteria fell significantly, from 21.4% to 13.4% and from 19.8% to 12.8% respectively, the average waste rate in hospital remained at a constant level of 25.6% and 26.3%. However, in the hospital, both the quantities of daily average food provided and food wasted per person declined. A comparison of the three organizations revealed that less food waste was generated in the residential home, where demand, i.e. the number of meals required, could be planned relatively precisely. It was not possible to precisely predict demand for meals needed for inpatients due to unplanned new admissions or discharges, or demand for meals sold in the cafeteria; this led to untouched reserve meals in the hospital and serving losses in the cafeteria.

Conclusion #1

The degree to which food waste can be reduced in organizations from the food sector varies. It depends on the individual initial quantities of food wasted as well as on situational factors, such as the organizational structure, the design of the food system, and the profile of customers present in a given organization. SMEs in particular are subject to time constraints and/or limited financial resources, and need assistance in reducing food waste.

Based on the conclusions drawn from the cases studied, the second research question aimed to provide sufficient support for SMEs in their food waste reduction efforts. Furthermore, it attempted to include all relevant stakeholders in the food supply chain in order to ensure that food waste was not simply shifted from one step to another. To answer this question, it was necessary to develop a participatory food waste reduction concept. This meant targeting managers of SMEs from the food sector, such as from manufacturing companies, retail, or large-scale consumers (Concept #1). The concept consisted of five phases adapted to the PDCA (Plan–Do–Check–Act) cycle applied in Total Quality Management. The phases *analyze the status quo*, *develop measures*, *implement measures*, *review results*, and *determine corrective actions* include a total of eleven consecutive steps. Concept #1 responds to the need for a holistic approach that contributes to food waste reduction beyond the boundaries of a single company. This was accomplished by incorporating participatory elements into the concept. Participants and users of the concept themselves were included in the phases of developing and implementing the measures, as well as in the phase of determining corrective actions. During the development process of the concept, it also became clear how important it was to harness the expertise and knowledge of all stakeholders along the supply chain to identify root causes, develop measures, and successfully carry out food waste reduction initiatives. At the end, a "Manual for Managers" described and summarized the concept as a whole. This manual will continue to serve as a guideline for managers who wish to reduce food waste in their respective organizations.

Conclusion #2

Concept #1, which is summarized in the "Manual for Managers", targets the reduction of food waste by SMEs in the food sector. The concept directly contributes to fulfilling the demands of the National Strategy to Reduce Food Waste in different ways: The concept can be directly applied in efforts to fulfill the demands presented in the *business* field of action of the National Strategy: Concept #1 is a tool to analyze the production processes of companies in the food sector in an effort to identify their sources of food waste and accordingly develop and implement measures. Moreover, it can be applied to implement food waste reducing actions into the daily business routines of companies, and integrate the different stakeholders of the food supply chain in their food waste reduction efforts.

The third research question provided an answer to how auxiliary organizations, mostly consisting of organizations such as research organizations, political institutions, or private initiatives, can be supported in developing tools and transferring them to their target

demographic. This entailed developing a marketing concept (Concept #2) that would help auxiliary organizations in becoming more market-oriented. The concept demonstrates what auxiliary organization needs to do in order to identify what attributes a support tool requires for it to be appealing for users. Furthermore, the concept illustrates how it would be possible to optimize the transfer of these tools to the different target groups. Concept #2 uses market research to determine the needs and wants of the potential target demographic for the support tools, and to obtain information on the transfer channels their potential clients use. By doing so, the concept takes into account the different needs of each actor of the food value chain (e.g. butchers vs. bakeries, or manufacturers vs. retailers). Moreover, it ensures that the tools can successfully be transferred to the desired target group. Finally, the concept was summarized in the "Marketing Campaign Guide", which presents a systematic and target-audience-centered approach. This guide leads organizations through the various steps of a marketing campaign, from defining the required benefits of a new product or service to ultimately launching it. The marketing guide starts out with a *research* step, which is essential to identifying the target group's needs and to providing something that benefits the target group. This is followed by steps comprising *planning*, *pretesting*, *implementing*, *monitoring*, *recycling and revision*, *transfer*, and *raising follow-up financing*. The concept explicitly emphasizes how important the *transfer* step is to ensuring the tool's successful dissemination to the target group.

Conclusion #3

Concept #2, summarized in the "Marketing Campaign Guide", supports auxiliary organizations in developing target-group-oriented measures to counteract food waste, and to successfully disseminate these measures to the desired target audience. In this way, the concept contributes to implementing the necessary activities called for in the National Strategy to Reduce Food Waste; one point of the Strategy includes a demand for the "greater appreciation of food," e.g. by awareness-raising campaigns, under its *changing behavior of all actors involved* field of action.

Concept #2 was put into practice and tested using the LAV platform (LAV – Avoiding Food Waste, from the German "Lebensmittel Abfall Vermeiden") as a case study. This case demonstrated how an auxiliary organization, in this case a research institute, was systematically guided through the process of developing the LAV platform and transferring it to its desired target group. The LAV platform was specifically set up and targeted to SMEs in the German food sector that wish to reduce food waste in their operations. The LAV platform compiled various applicable tools from academia as well as from industry, and the most suitable tools

were made available in a toolbox. The tools were structured by topic and market segment. The effectiveness of Concept #2 was assessed by looking at two different aspects. First, SMEs and industry organizations evaluated the platform's user-friendliness, and second, the transfer of the platform to the target group was assessed by monitoring the platform's website traffic after its launch. The user-friendliness was rated according to two categories. In one category, the overall performance of the platform was rated 1.6 (on a six-point scale where 1 is the best, analogous to German school grades). The second category assessed the extent to which the platform was considered to be a useful tool for preventing food waste. The average rating on a nine-point scale (where 9 was the best) was 7.2. The platform's content was integrated into the national platform for food waste reduction run by the BMEL.[31]

Conclusion #4

The two concepts developed in this thesis support all relevant actors that need to be involved if a holistic food waste reduction approach in Germany is to come to fruition. As such, they contribute to reaching the stated goal (SDG 12.3) of halving food waste at the retail and consumption level as well as of reducing food waste during production and manufacturing.

As this thesis has illustrated, the challenge of fighting food waste requires a holistic approach, as reducing food waste on one level of the food value chain should not simply lead to shifting food waste to other parts of it. This challenge involves different players from the realms of politics, academia, and especially the actors along the food value chain themselves, who all contribute with their own expertise and motivation. All in all, the two concepts developed in this thesis contribute to addressing the holistic challenge of fighting food waste, because these concepts support all relevant players (auxiliary organizations as well as the actors of the food supply chain) who need to be involved in food waste reduction efforts.

[31] www.lebensmittelwertschaetzen.de/instrumente/instrumente/ (accessed on 19 May 2019)

Abbreviations

The following abbreviations are used in this manuscript:

BMEL	Federal Ministry of Food and Agriculture
BMELV	Federal Ministry of Food, Agriculture and Consumer Protection, now BMEL
BMJV	Federal Ministry of Justice and Consumer Protection
BMUB	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, now BMU
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CO2	Carbon dioxide
CPK	Central processing kitchen
DGE	Deutsche Gesellschaft für Ernährung (German Association for Nutrition)
EPA Ireland	Environmental Protection Agency
ERP	Enterprise Resource Planning
et al.	Et alii (und andere)
FAO	Food and Agriculture Organization
FEFO	First expired first out
FPpP	Food provided per meal per person per day
FUSIONS	Food Use for Social Innovation by Optimising Waste Prevention Strategies
GfK	Gesellschaft für Konsumforschung (a German consumer research association)
i.e.	id est (that is)
IGD	Institute of Grocery Distribution
iSuN	Institute of Sustainable Nutrition
ISWA	Institute for Sanitary Engineering, Water, Quality and Solid Waste Management
KNB	Competence Center for Sustainable Procurement
KRWG	Circular Economy Act
LAV	Lebensmittel Abfall Vermeiden (Avoiding Food Waste)
LMA	Lebensmittelabfall (food waste)
N/A	Not applicable
n.d.	Not defined
PDCA	Plan–Do–Check–Act
PW	Plate waste
PWpP	Plate waste per meal per person per day
REFRESH	Resource Efficient Food and dRink for the Entire Supply cHain
SDG	Sustainable Development Goals
SL	Serving losses
SLpP	Serving losses per meal per person per day
SME	Small and medium-sized enterprises
STREFOWA	Strategies to Reduce Food Waste in Central Europe
TQM	Total Quality Management
UK	United Kingdom
UN	United Nations
UBA	Federal Environmental Agency
USA	United States of America
WR	Waste rate
WRAP	Waste and Resources Action Programme
WRI	World Resource Institute
WWF	World Wide Fund for Nature

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