

A Work Project, presented as part of the requirements for the Award of a Master's degree in Management from the Nova School of Business and Economics.

OPENING THE FOOD RETAILER BLACK BOX,
A PROPOSAL TO REDUCE FOOD WASTE IN SUPERMARKETS

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Abstract

The following work project is a master thesis addressing food waste issues in retailer's supermarkets from an operation management point of view. It provides insights about the current academic knowledge regarding the main causes and solutions of food waste generation and offers a management system based on the PDCA cycle to theoretically identify and reduce food waste level in the food stores thanks to a month long program.

Keywords: Food Waste; Food Retailer; Supermarkets; Operations Management; PDCA; Management System.

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Table of Content

1. Introduction.....	3
2. Literature review.....	3
3. Academic problem.....	6
3.1 Food Waste Cause Analysis.....	7
3.1.1 Cause Analysis Methodology.....	7
3.1.2 Cause Analysis Results.....	8
3.2 Food Waste Solution Analysis.....	8
3.2.1 Solution Analysis Methodology.....	8
3.2.2 Solution Analysis Results.....	9
4. Research question: The Means of Food Waste Reduction.....	9
4.1 Causes and Solutions Connexion.....	10
4.2 Connexion Analysis.....	10
5. Proposal: An In-Store Food Waste Reduction Program.....	12
5.1 Methodological foundations of the proposal and guidelines.....	12
5.2 Stage One: Situation Appraisal, Process analysis and Food Waste data collection	13
5.3 Stage Two: Food Waste Reduction Process Implementation.....	16
5.3.1 Store Operational Improvements.....	16
5.3.2 Communication and redistribution.....	18
5.4 Stage Three: Implementation Impact and Continuous Improvement.....	19
5.4.1 Implementation Impact: data collection and field feedback.....	20
5.4.2 Continuous Improvements.....	20
5.4.3 Further Measures and Next Innovations Benefits.....	21
6. Discussion : Theoretical Evaluation of the Proposal under the PDCA Cycle and as a Management System.....	22
7. Conclusion.....	24
8. Limitations and Future Research.....	25
9. Bibliography.....	26
10. Appendixes.....	31

1. Introduction

Food waste defined by the European Commission as “fractions of food and inedible parts of food removed from the food supply chain (FSC) to be recovered or disposed¹” (Stenmarck et al., 2016), is a major issue threatening the food supply chain. Food waste generation consequences are diverse: environmental, with the waste of resource and the subsequent emission of greenhouse substances; social, considering the edible part of the food could have fed populations suffering from food insecurity; and economical, since the food loses part or full of its value when it becomes a waste, for some stakeholders food waste leads to several costs. Although food waste at retail level acknowledges the lowest amount² in developed economies compared to the other FSC level (5% in the European Union³ (Eriksson et al., 2012; Stenmarck et al., 2016)), food waste reduction still is an operational challenge to tackle and gradually addressed by retailers.

2. Literature review

For the last 15 years, food waste (FW) topic caught the attention of several researchers (see the review made by Corrado and Sala (2018) and Schneider (2013), institutions (the FAO (HLPE, 2014 and FAO, 2019), the European Commission (Antonopoulos et al., 2018), as well as retailers themselves (Tesco in the UK (Tesco, 2014), Intermarché in France (Kulikovskaja and Aschemann-Witzel, 2017)), consulting companies (Olivier Wyman (2014a), McKinsey (2014), Deloitte (Deloitte Netherlands, 2020), KPMG (2020), BCG (Abecasis and Meyer zum Felde, 2020)) and other dedicated organisations (the WRAP in the U.K (Schneider, 2013), FUSION in the European Union (Stenmarck et al., 2016; Canali et al., 2014), ReFED in the United States (2018)).

1 “Including composted, crops ploughed in/not harvested, anaerobic digestion, bioenergy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea.” (Stenmarck et al., 2016)

2 Unless stated otherwise, the amount of food waste refers to the mass of the food waste.

3 With the 28 member states at the date of 2011 unless stated otherwise.

Some of the studies focus on the amount of waste generated among the FSC (Göbel et al., 2015; Hafner et al., 2012; Stenmarck et al., 2016; HLPE, 2014 and FAO, 2019), while others focused on the retail stage. With only 5% of FW (Eriksson et al., 2012; Stenmarck et al., 2016), the retail stage (inside the store) is one of the lowest contributors, but this number hides different realities. In his thesis studying FW in Swedish supermarkets, Eriksson (2015) shows that most of the FW originates from fresh fruit and vegetables (FFV) category, this result has been confirmed by Lebersorger and Schneider (2014) in Austria (highest loss rate of FFV), Bilska et al. (2018) in Poland and by Kliugaite and Kruopiene (2018) in Lithuania (using FW/m² variables). The thesis author relates also the commonality of hotspots in specific departments such as the top five most wasted items contribute between 41% and 34% of the total FW contribution. More in detail research shows specific hotspots among the FFV category account for most of the FW from FFV, for instance in (Mattsson et al., 2018), the top 20 FFV discarded generate 81% of FW while the top 7 generating 47% of FW.

Amount of FW is not only quantified by its mass, articles have been written including FW quantification by its financial value lost, which cost is known to be underestimated by companies (Giuseppe et al., 2014) especially if they do not include the lost profit in addition of the purchased price (Mattsson et al., 2018). €143 billion worth of FW was generated in 2012 along the European Union³ state members' FSC (Stenmarck et al., 2016). At store level, it is between hundreds of euros lost per week in a store (values in pound (Filimonau and Gherbin, 2017)) and up to more than €2,500 in a single supermarket⁴ (Bilska et al., 2018); in an hypermarket⁵ it can add up to €170,000 lost in discarded food in a year (Cicatiello et al., 2017). Eriksson (2015) exposed that hotspots in FW quantified in monetary value are different with FFV still leading in FW cost contribution but with a reduced share whereas meat products triple their cost contribution share while other

4 About 2000m² of sales area.

5 More than 4500m² of sale area

departments kept similar share. Moreover, other studies quantified FW by its environmental impact such as the life-cycle analysis (including a cost and mass analysis) that Brancoli et al. (2017) realised, which shed light on the amount of bread wasted as well as its environmental consequences among the FW in supermarkets. Eriksson (2015) includes this measure and shows the significant impact of meat which accounted for 17% of the FW environmental impact for only 4% of the FW mass. Analysis provided by Mattsson et al. (2018) show that the top 20 FFV account for “78% of FW weight, 77% of economic costs and 85% of [global warming potential]”.

In their partly-based interview study, the most prominent cause of FW in retailers’ stores identified by Stenmarck et al. (2011) is “un-sold” products, while acknowledging this is merely a symptom of a more complex issue (see Moraes et al. (2020)). This complexity has been clearly revealed by the causal maps drawn by Mena et al. (2011) in their attempt to find the root causes of FW in the supplier-retailer interface. The causes found in the articles reviewed (see in Appendix 1 “Causes of Food Waste” sheet for the detailed list of causes) can be categorized in several groups: freshness, issues related to shelf-life or product appearance (for those having not a specific expiration date) ; quality standards, pertaining to product’s aesthetic and visual defects ; management causes, regarding the way companies manage their operations inside and outside the store ; and obstacle to FW minimisation process, including operational hurdles, company objectives, among others. Shop size seems also a factor of FW generation, Filimonau and Gherbin (2017) disclose through the interviews hints for a proportional relationship between the size of the supermarket and its amount of FW, which has been noted by Oliver Wyman (2014). However, Teller et al. (2017) in their qualitative and quantitative study nuance this idea and identify high quality standards to be the major reason why “hypermarkets performs better” regarding FW generation even though they also show the significance of width and depth of product range in FW formation.

Despite the complexity of the FW issue, mitigation process and solutions exist (see in Appendix 1 “Food Waste Reduction Measures” sheet for detailed list of solutions) although they are less examined (Moraes et al., 2020). They can be separated in three categories: prevention, including process and solution to reduce the generation of FW ; donation, means to avoid discarding edible FW ; and recycling, mainly any other solution to avoid FW to go to landfill. The FW matter raises concern among store managers (Gruber et al., 2016), especially considering the medium to high recoverability of FW in the retail-level (Garrone et al., 2014) while generally witnessing few effort from retailers to tackle this complex issue (Eriksson, 2015; Gruber et al., 2016; ReFED, 2018).

Except one article designed as a “Manual for Managers” to reduce FW in the food industry with a PDCA⁶ cycle (Strotmann et al., 2017), no framework or general applied method has been found to tackle FW. This paucity of research on this more operational domain concurs with the results of (Moraes et al., 2020) in which most of the paper written are published in scientific journal unrelated to management. Our review found among more than 40 articles only the contribution of (Gruber et al., 2016), published in a management related journal (*Journal of Public Policy & Marketing* of the American Marketing Association). No articles has been found regarding a framework designed to reduce FW in retailer stores.

3. Academic problem

The conducted literature review showed no previous research aiming to provide a framework applied to supermarkets in order to reduce food waste. Considering the imperatives of the Paris Agreement regarding actions to cut back greenhouse gas emission and the United Nation

6 Plan Do Check Act

Sustainable Development Goal n° 12.3 to “*halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses*” (United Nations, 2020) by 2030 (i.e in less than 10 years); the research paucity, especially in management field, calls for urgent studies about food waste reduction in retailers.

3.1 Food Waste Cause Analysis

3.1.1 Cause Analysis Methodology

Our literature review revealed an important number of FW generation causes that are linked to managerial decision and practices. In the Appendix 1, “Typology of Food Waste Factors” sheet, these causes were grouped by main categories: the “Operational Flaw” that is used to identify the type of dysfunctional practices (“what does the organisation operation is lacking of?”) and the “Organisational Flaw” which are the subsequent negative consequences on the organisation strategy to reduce FW.

In the “Operational Flaw” category, 11 classes were defined encompassing the factors. “Awareness” points out the lack of knowledge resulting in the 12 factors. “Collaboration” identifies the organisation needs of deeper cooperation within the organisation boundaries or with its external stakeholders. “Consumer Education” relates to the impact consumers have in the store regarding FW generation. “Information System” indicate how inadequate information management systems lead to FW. “Collaboration – Information System” refers to the factors relating to both of the aforementioned classes. “Infrastructure” relates to the organisation unfitted infrastructures that are prone to generate FW. “Marketing” identifies the way about how marketing practices can provoke the factor. “Operations” refers to the lack of well defined procedures or unsuitable procedures leading to FW. “Quality” relates to the inadequate monitoring of processes involved with the food,

therefore leading to FW. “ Institutional Incentives” and “Regulation” stand for external factors (i.e not on the direct control of the organisation).

In the “organisational flaw” category, 4 classes have been defined. “Barriers” gathers the elements preventing the implementation of FW minimisation procedures. “Blindness” regroups the factors leading to the organisation inability to apprehend the scale and the stakes of FW generation, it is the class having the highest number of FW generation causes. “Operation Inefficiencies” gathers the factors which are incorrect work processes identified in the literature review. Finally, the “Exogenous” class regroups the external factors related to regulation and public policies the organisation faces.

3.1.2 Cause Analysis Results

The list of cause analysis reveals that the most frequent causes retailers face (see Appendix 1 “Typology of Food Waste Factors” sheet), with 22 out of 44 causes and 48 papers mentions out of 108, is related to a form of blindness preventing them to address FW issues, while with 13 causes and 42 mentions, the operational inefficiencies add up to the blindness to represent 83% of the causes. Regarding the importance of the causes, an equivalent proportion is found in the 10 first most mentioned causes, with the “Standards of appearance and shape” (Blindness), “Incorrect handling” (Operational Inefficiencies) and “Inadequate demand forecasting” (Blindness) on the podium.

3.2 Food Waste Solution Analysis

3.2.1 Solution Analysis Methodology

In the same manner (see Appendix 1 “Food Waste Reduction Solutions” sheet), the processes identified in the literature review to reduce FW were classified in three categories

depending on the FW reduction stage (prevention, redistribution, recycling). We used the processes found in (Moraes et al., 2020) to begin and added the solutions found in other papers. A second filter “Enabler” has been realised to identify the organisation area that will be the transformation vectors to reduce FW: “Information Technology” (IT), “Human Resource” (HR), “Marketing”, and “Operations”.

3.2.2 Solution Analysis Results

The solution analysis result reveals that the overwhelming majority of the FW reduction processes (28 over 31) falls in the prevention category, that 12 out of the 31 procedures identified depends on the operations to be enabled, which confirm the importance of operations in the reduction of FW spotted in the list of the FW causes. Among the preventive practices, 9 belongs to the “Operations” enabler, 8 to the “Marketing” as well as to the “IT” and 3 to the “HR”. The three later enablers only appears in the prevention category, and their processes are respectively mentioned 33, 14 and 7 times out of a number of 94 quotations. The 43% remaining mentions fall into the “Operations” enabler category.

4. Research question: The Means of Food Waste Reduction

In order to address the problem of food waste management by retailers, this thesis aims to research ways to reduce the amount of food waste by focusing on store operations. Our ambitious goal is to provide retailers a framework they can apply in their stores to lower the quantity of food waste and by achieving this, thanks to several measures, maintain and even increase the store profitability.

The list of causes and solutions developed by researchers and analysed in the last part paves the way for a deeper understanding of FW issues in retailers as well as its comprehension by researchers.

4.1 Causes and Solutions Connexion

After the FW causes and solutions mapping, each cause has been linked to its best potential solution, using some of the insights from (ReFED, 2018), see Appendix 2 and in Appendix 1 sheet “Causes & Solutions Table” for more details. The exogenous causes which cannot be directly solved by actions depending on the organisation operations and considering their small number (3 over 44) have been excluded, leaving a remaining of 41 causes.

We observe these causes can be addressed by 18 solutions, with “Measurement Technology” solution appearing the most (8 occurrences). 38 of the 41 solution are to be implemented in the prevention stage and 3 to the redistribution stage. Regarding the enablers, the IT department address the highest number of issues (17 causes) followed by the operations enabler (12), the marketing department (8) and the HR one (4). See Appendix 3 for a global and detailed diagram of the connexions.

4.2 Connexion Analysis

By looking at the initial share of each categories of solutions quoted by researchers, the actual importance of the “Operations” solutions decreased by one rank overtaken by the “IT” enabler that moved from the third most mentioned solution to the first category in the number of FW generation cause it potentially address. One of the reason behind this rise is related to the

significant lack of visibility retailers have on the FW issue, as the sizeable number of causes linked to the “Blindness” and “Awareness” factors. The other notable drop of the “Marketing” solutions, from the second most occurring type of solution in the academic literature to the third most found FW cause solver, shows the over-representation of this type of solution in the literature, compared to the actual causes of FW they try to resolve. Regarding the stage in which the solutions are implemented, the absence of recycling solutions highlights its lower desirability and relatively higher costs of implementation (especially if those activities are not outsourced) and low economic value (ReFED, 2018).

The connexion of the causes and solution to tackle the FW issue in retailers shows the retailers need of capabilities to discern clearly the depth of the problem they have to face. Beyond the acknowledgement of this matter, the retailers needs to implement technologies to measure and to analyse the amount of FW generated in the stores at the scale of each store as well as an aggregated level (FW data per type of store, locations, etc.) to define performance indicators for each store in order to assess the FW level amount evolution. As shown by Sakoda et al. (2019), having data on “of each purchase at cash registers, and the daily amount of delivery and disposal for each shop and product” is enough to implement demand forecasts leading to both reducing food waste and increasing profits of the stores.

This measurement implementation has to be done conjointly with specific FW reduction measures that will improve the retailers operations from better food item handling to some store reshaping as well as the optimization of back-office procedures.

5. Proposal: An In-Store Food Waste Reduction Program

The characteristics of FW generation factors and FW reduction solution have been described in the last part as well as the relationship they have to each other, the implementation of these solutions can now be pictured. To validate our assumptions on the best solutions to tackle the FW causes identified, our methodology relies on an experiment in three main steps.

5.1 Methodological foundations of the proposal and guidelines

The PDCA method, defined by W. Edwards Deming (Knop and Mielczarek, 2015) and based on the work of Walter Shewart (Wani et al., 2018) is a continuous improvement cycle made of four successive steps : Plan, Do, Check and Act (Kiran, 2017), see Appendix 4 for more details. This method used by the similar work of Strotmann et al. (2017) that inspired the designed of the proposal, complies with this improvement cycle.

First of all, once a store has been identified, a period of two weeks would begin to collect data regarding the store amount of food waste to provide a witness dataset. The first stage of the proposal, that groups a situation appraisal, an analysis of the store processes and a collection of data including FW amounts, added to the knowledge provided from the theoretical best solutions (see in Appendix 1 “Food Waste Reduction Solutions”) and their practical implementation definition thanks to the workshops of stage two corresponds to the “Plan” step of the PDCA. The “Do” step is the actual implementation of the solutions in the second stage. In the third and last stage of the proposal (the two next weeks), the “Check” part corresponds to the measurement of the FW amount and the investigation of the measure effectiveness in collaboration with the staff thanks to the workshop. The “Act” part is embodied by both this latter workshop, with the feedback given and

the adjustments suggested, and the perpetuation of the effective measures, see Appendix 5 for a global overview. The proposal consequently complies with the PDCA criterions.

Ideally, uncommon periods in which significant sales variation are expected (holidays such as Christmas and other similar period) should be excluded of the experiment. The three aforementioned periods could be extended in the same proportion to improve both the quality of the data and of the measures implementation.

The analysis of this FW matter can use the quality management tools as advised by Janjušić et al. (2012), such as the seven quality tools: flow chart, Pareto diagrams, check sheet, control chart, histogram, scatter plot and cause and effect diagrams; see Soković et al. (2009) for more details about these tools and their application in a PDCA cycle.

The team or individual carrying on the experiment should have a significant experience in quality management and should be an outsider of the store to enhance the objectivity of the experiment, especially since it concerns all the staff involved in the store (not only employees but managers as well considering for instance the significance of their role model in the operations transformation, (Strotmann et al., 2017)). The experimenter should always favours a positive and inclusive approach throughout the experimentation to increase the adoption of the corrective changes.

5.2 Stage One: Situation Appraisal, Process analysis and Food Waste data collection

The first step of our proposal is to evaluate the store current operations thanks to on site observation to analyse the processes in order to identify the FW causes, the missing practices and measures to improve for the store to minimize FW. In order to record data representative of the work procedures usually executed along the year, the site observations should be as discreet as

possible, the use of the security cameras caption inside the store could be an effective way to ensure this criteria.

The objective of the site observations are to understand precisely how the different procedures sustaining the store daily operations are done to detect inappropriate practices regarding FW generation, especially those identified by our literature review (see in Appendix 1 “Typology of Food Waste Factors”), but also good behaviours that will be later set in example to implement the corrective changes. An observation sheet designed to note the behaviours will have to be used (see Appendix 6). The results of the observation will allow to estimate the maturity level of the store operations regarding FW reduction practices as well as to provide practical examples to implement the corrective changes. A quantitative analysis on the most recurrent FW generation factors will guide the experimenter on the most suitable solution to tackle FW.

In addition to the observations, a survey will be made and shared with the staff to assess their awareness on FW issues in general and applied to their daily actions in the store (see Appendix 7 for the survey). The survey should make clear that the name of the personnel member will not appear in the results as it will be replaced by an identification number. The choice of this method is justified to encourage honest answers by setting up a trust environment avoiding peers judgement. The survey will measure the perception of the staff regarding FW generation and FW solutions in their professional life as well as to estimate their potential commitment to the changes. The goal is to adjust and tune the recommendations of the next stage of the experiment thanks to a participatory approach as advised by Strotmann et al. (2017). Moreover, the survey is a good way to collect practical ideas to reduce FW amount in the store. In order to avoid biases in the staff behaviour observation, this survey should be sent at the end of the experimentation first stage.

As part of this evaluation, a quantification process of the FW should be implemented (if not already established to record the FW amount prior to the proposal). The FW quantification will also

allow to measure precisely the cost of FW in the store. Following partly Brancoli et al. (2017) and Strotmann et al. (2017) FW categorisation and quantification method, the registration of the FW can be done by scanning the items having bar codes to collect through the retailer database the product name and weight and price. For loose products (mostly FFV, bakery and in-store kitchens products), their wasted amount should be weighted and recorded with their price (which should be used to compute the FW associated costs). The products should be classify according to their type (FFV, meat, fish, bakeries, preprocessed meal, etc.), and by their waste trigger (“best-before date” or “appearance” for FFV, and “damages”) as well as their edibility at the time they are disposed of (best-before date or appearance for FFV). This categorisation will allow the experimenter to analyse the precise amount of FW and provide the most suitable redistribution solution to manage each type of waste in the next stage of the experimentation.

At the end of the evaluation period, when current operations have been duly examined and FW amount recorded, the information gathered will be used to define the way processes will be improved. The data collected will serve to identify the hotspots items causing most of the FW, these products will be the focal elements of the FW minimisation measures. The data collection process should not be interrupted at the end of the first stage but continuously carried out throughout the three stages.

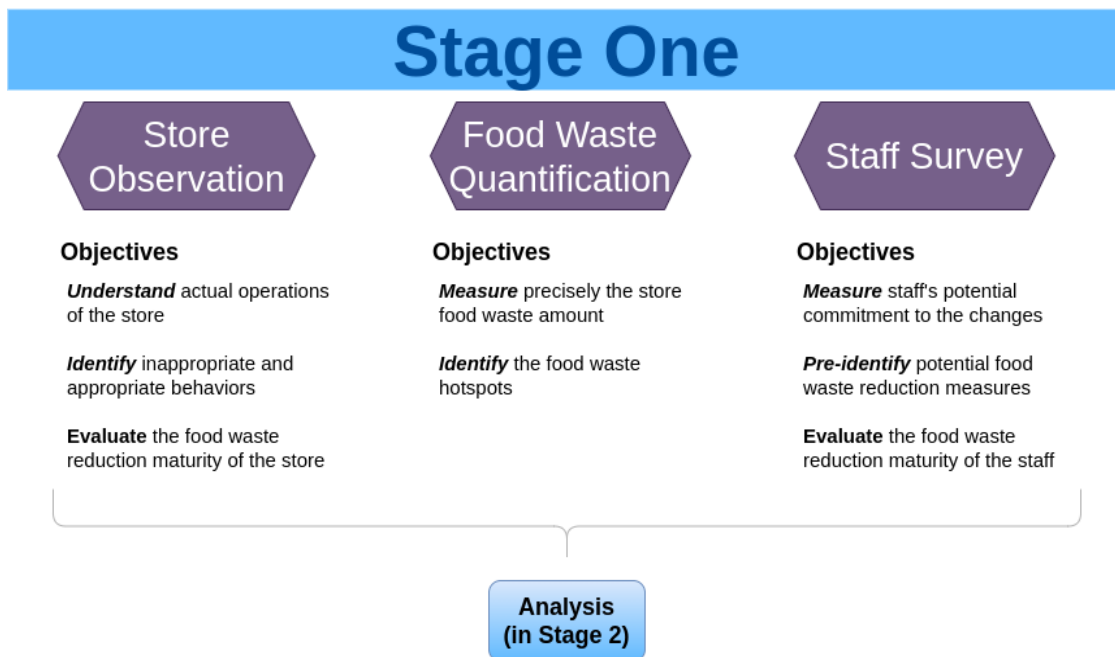


Figure 1: Stage One Summary

5.3 Stage Two: Food Waste Reduction Process Implementation

In this shorter stage, the discrepancies found between the current processes and the best practices identified in the literature review (see in Appendix 1 “Food Waste Reduction Solutions”) and in the store retailer practices are to be corrected by setting up a range of measures including staff training, new processes and improvement of current operational processes.

5.3.1 *Store Operational Improvements*

Using the data and the information collected during the stage one, the experimenter can identify the FW hotspots (the few items accounting for a significant amount of FW (Eriksson, 2015; Lebersorger and Schneider, 2014; Bilska et al., 2018; Kliaugaitė and Kruopiene, 2018; Mattsson et al., 2018)) for each product category and for the total FW generated in the store. The result of this analysis will be used during this period to identify the specific processes involved in this FW

generation and the precise part of it leading to the waste. For this purpose, the analysis of the waste trigger should provide valuable insights to identify the process that comes into play. The hotspots categories should be the one focusing the FW reduction effort.

Once the dysfunctional processes have been all winnowed out and the corrective measures designed in an provisional version by the experimenter, workshops should be set up with the staff (Strotmann et al., 2017). Trails to characterise the correctives measures, as well as new ones, can be found in the list of measures mentioned in the paper (see in Appendix 1 “Food Waste Reduction Solutions”). Considering the importance of the personnel in the store operation as well as in critical processes to reduce FW (product handling, FFV apparent shelf-life, etc.), dedicated training to increase staff awareness is a necessary step towards better FW management (Strotmann et al., 2017). The training workshops need to have two main component: FW issue awareness and corrective measure implementation. The first part will introduce the topic to the personnel in order to convince them about the necessity to tackle this issue by the implementation of the new measures. As spotted by Gruber et al. (2016), employee awareness and commitment, as well as managers leadership and behaviour, play a significant role in FW reduction. This presentation should use the result of the survey sent to the staff and be adjusted by correcting the personnel misconceptions. The second part is a participatory approach involving all the staff, as considered by Strotmann et al. (2017), to define the way the measures should precisely be implemented thanks to the operational knowledge of the employees daily work routines. In these workshops, FW reduction goals on the FW related to direct personnel work (see the FW triggers “appearance” for FFV and “damages”) should be defined. The appropriate and inappropriate behaviours spotted in the first stage should be used as practical examples. The FW amount being known at this time, the workshops are also the place to set conjointly the goal with the staff and the experimenter to reduce the waste generation. Among the staff, “Food Waste Specialist” can be nominated to advise other

employee and oversee the implementation of specific measures. This nomination process should include the candidate survey result.

5.3.2 *Communication and redistribution*

Beyond operational process and internal procedures related solutions, other practices to implement in the store have been identified.

A fundamental feature of the proposal is communication towards consumers (Gruber et al., 2016). Beyond the marketing purposes to showcase this initiative, some changes (mainly regarding store furnitures) may surprise or even disrupt the way consumers used to shop in the store, hence requiring some explanation and advice for them both to understand and accept these changes but also to raise their awareness about the FW topic (ReFED, 2018). Considering the impact of customer on in-store FW, mostly through items handling, this issue is particularly relevant for FFV. Many, if not most, of the FFV are fragile to external impact and their appearance plays a significant role in the purchase decision and consequently to their disposal (Moraes et al., 2020). Promoting soft handling of FFV to customers may show significant FW reduction of this category considering this cause (Eriksson, 2015). A practical idea to raise customer awareness on this topic could be the “egg rule” to generalise the care given when handling eggs to the FFV.

Once the prevention processes implemented, another paramount part of our proposal is the management of the FW that will not be prevented (e.g surplus of FFV still edible but which will undoubtedly be disposed of) or have not been prevented (e.g pastries of the in-store bakery at the end of the day). In that perspective, actions should be implemented such as attractive discount on products that are about to become unsaleable (Stenmarck et al., 2011; Lebersorger and Schneider, 2014), or (perhaps on a long term basis) partnerships with companies (ReFED, 2018) or charities (Gruber et al., 2016) that would accept FW or products which will inescapably become FW

(secondary channels). In some cases, edible FW can be repurposed from direct customer sale to food input for in-store kitchens (Oliver Wyman, 2014): in an original example, bread leftovers were used to make other pastries (Deutsche Welle, 2019).

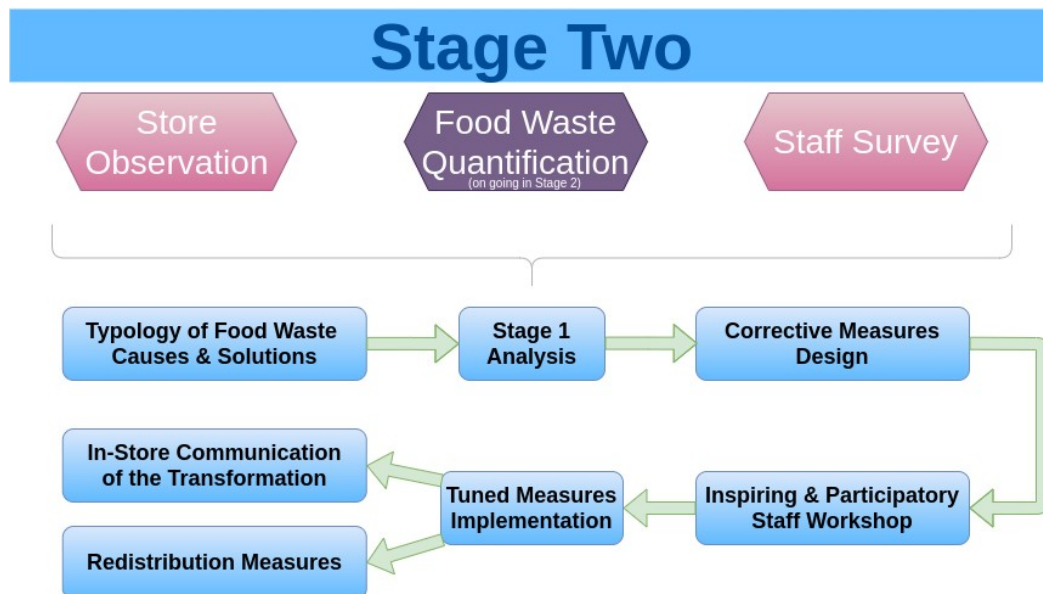


Figure 2: Stage Two Summary

5.4 Stage Three: Implementation Impact and Continuous Improvement

Once the second stage is complete (i.e when the measures are fully implemented), the last stage of our proposal consists in the measure of the FW during the same period length of the first stage in order to evaluate the impact of the proposal as well as to pave the way for further improvements.

5.4.1 Implementation Impact: data collection and field feedback

To evaluate the effectiveness of the measures implemented, the FW data collection that has been carried out since the first stage should be used. The data of the current FW levels should be analysed, in involving the statistical significance of the reduction (Strotmann et al., 2017), at the second week of stage three implementation in order to make the necessary adjustment to the organisation operations within the time-frame of the third stage. Using the different features of the FW data (type of product, waste trigger and edibility at the time of disposal), the data analysis paired up with the operations observations (following a similar protocol used in the first stage) should reveal the areas where the measures were the least and most effective as well as their most probable causes.

Once the first week of FW data has been analysed, a short workshop with the staff should be organized in order for them to share their feedbacks on the first week of the measures complete implementation (contrary to the stage two period where only few measures were put into practice after their implementation, the stage three is the time where all measures are implemented, see Appendix 5 for more details). This meeting gives the opportunity to reflect on the actual execution of the measures and fine tune the operations according to the staff feedbacks as well as serving as a basis to select the measures taken on.

5.4.2 Continuous Improvements

The other component of the third stage are the perpetuation of the effective measures and the design of regular actions to monitor the FW levels and reduction efforts in order to sustain the benefits of the proposal.

A paramount aspect is the continuation of the FW measurement to apprehend the scale and the importance of FW in the store . Therefore, this procedure should be completely integrated to the daily store operations. The FW data will allow to set FW reduction goals to the store and deepen the understanding of the causes. Moreover, if the FW data collection is generalized to other stores (if not all of them), these information would help to define the reduction objective by comparing the FW amount among stores sharing similar attributes (mainly location, type of the location area and sales area (Kliaugaite and Kruopiene, 2018), or turn-over (Bilska et al., 2018)).

Besides ensuring measures that will avoid the organisation lack of awareness, maintaining the dynamic of FW reduction among the staff is as well a matter of prime importance, considering the fact that the staff is on the front-line of the store FW generation. In order to do so, the “Food Waste Specialist” role, as defined in the precedent stage, should be extended beyond the proposal to monitor the operational effort continuation of FW reductions. As specified by (Strotmann et al., 2017), regular meeting to follow the FW specialist with the store management should be scheduled to monitor the specialist progress. This role should also be useful to train the new employees to the FW practices which, considering the relatively high turn-over rate of these employees (Harrison and Gordon, 2014), would otherwise threat the reduced FW amount reached at the end of the proposal.

5.4.3 Further Measures and Next Innovations Benefits

At the end of the operational transformation implemented by the proposal which provides guidelines to lower in-store FW based on the best practices identified in our literature review, complementary measures (other solutions still relevant to FW reduction though not the best as identified in Appendix 1 sheet “Food Waste Reduction Solutions”) such as recycling the inedible part of FW (Moraes et al., 2020; ReFED, 2018) could be enacted the same way as specified in the proposal. The proposal is also fitted to test the adoption and effects of innovative new ideas to

reduce in-store FW. An example of innovative idea could be to leverage the retailers mobile application customers used to shop in contactless and cashless stores to support FW reduction initiatives such as notification of discounts related to food basket still edible but at the end of their shelf-life.

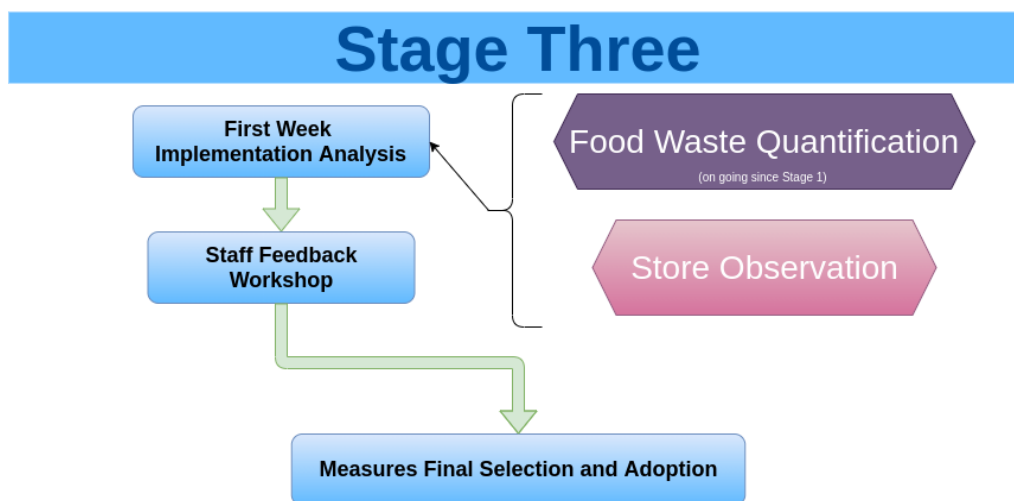


Figure 3: Stage Three Summary

6. Discussion : Theoretical Evaluation of the Proposal under the PDCA Cycle and as a Management System

The PDCA cycle is known for its simplicity compared to other quality methodologies (RADAR, DMAIC, DFSS) (Soković et al., 2010) and has also been chosen for its ability to be flexible enough for combination with other methods, such as within the Kaizen framework (*ibid*). This method is also the one ISO (2003) recommended to be used when carrying process improvements and corrective actions in management systems regarding quality (ISO 9000 family), environment (ISO 14000 family) or corporate social responsibility. Moreover, the most frequent and with highest impact mistakes when executing a PDCA project are avoided (Wani et al., 2018) thanks to the experience of the experimenter, the standardisation guaranteed by the Food Waste

Specialist after the proposal implementation, and the careful and joint preparation to avoid obstacles during the proposal.

Analysing the ISO 9000 standards Bauer et al. (2006) defines a management system as “a set of interrelated or interacting elements of an organization to establish policies and objectives” and “a set of interrelated or interacting activities that use inputs to deliver an intended result”. In order to ensure the “goal-seeking” characteristic of the management system, the author specifies the system needs to possess 5 properties: resilience, the ability to overcome uncertain events; self-maintenance, the “ability to correct, repair and maintain itself”; self-organisation, “the capacity to change its own structure in response to risks and opportunities”; hierarchy, understood as “subsystems having the same properties as the system” with an emphasis on the latter two properties; and emergence, “the essential properties of a system taken as a whole derive from the interactions of its parts” or expressed in a simpler way “the whole is greater than the sum of its parts”. The three former properties require feedbacks defined by the author as “a situation in which [...] each [connected] system or system element influences the other and their dynamics are thus strongly coupled”.

By reducing FW amount in retailer store as final objective by implementing a set of measures and policies involving the retailer organisation, the store staff and customers, the proposal fits the definition of a management system. Moreover, the proposal has the properties sustaining a goal-seeking management system. Indeed, the proposal incorporates discretionary elements (for instance the workshops to define how the measures will be implemented) that allow ongoing adjustments depending of the situation faced by the experimenter (such as various levels of staff engagement measured). The presence of an experimenter to supervise the proposal application fits both the “self-maintenance” and “self-organisation” properties of a management system. The information flow provided by the FW quantification process and the field workshops correspond to

the feedback characteristic of the proposal. The proposal (the system), being made of three main successive steps each one including several processes (the subsystems), maintains its properties in each of its part thanks to the experimenter guidance. Finally, the interactions between the stakeholders (employee and management staff, the experimenter and to a lesser extent the customers) all coordinated and engaged toward the FW reduction objective fill the emergence property requirement for the proposal to be a goal-seeking management system.

Considering, the fact that the proposal can be seen as a management system respecting the PDCA principle of continuous improvement, it can therefore be regarded as a theoretically viable and effective model.

7. Conclusion

The literature review conducted showed a paucity of research regarding food waste reduction in the food retailer stores, although both food waste generation factors and solutions were identified, no methods nor frameworks has been introduced to address this particular issue. Using the causes of food waste generation and their respective countermeasures, a matrix has been realised to link each cause to its best potential solution (see Appendix 1). The result of these connections (see Appendix 2 and 3a) served as the foundation of our proposal that would implement the solutions to address the FW generation factors identified in a store in a three step program (see Appendix 5). The proposal is not only fitted to tackle the issue of FW generation at the current state of knowledge but is suitable to test new solutions thanks to the progress of the academic research or of the technologies providing new tools to face this problem. Moreover, the theoretical effectiveness of the proposal has been verified considering it fulfils the requirement of a goal-seeking

management system while respecting the qualities of the PDCA cycle. Consequently, the proposal if applied to a retailer store is likely to result in a significant drop in food waste level.

8. Limitations and Future Research

The first and foremost limitation of the proposal is the lack of experimentation on the field. Although it is based on the results of academic research using field experiment (Strotmann et al., 2017; Cicatiello et al., 2017; Sakoda et al., 2019; among others) and the fact that the analysis made in the discussion indicates the theoretical effectiveness of the proposal, the actual benefits of it still needs to be confirmed by the implementation of the proposed program.

A second limit is identified in the literature review collection of academic papers. Despite the fact that more than 40 articles have been read covering a period from 2008 to 2020 regarding the topic of food waste generation and reduction with an emphasis on food retailers, no methodology for a systematic literature review such as the one used by Corrado and Sala (2018) has been followed. Using a dedicated software would reveal more precise insights regarding the state of the art for food waste generation and reduction.

A third limit is found in the connection of the food waste generation factors and the food waste reduction solution identified. This linkage have been realised based on the limited knowledge of this thesis author. However, the list of factors and solutions provided in the Appendix 1 allows anyone with more knowledge of the subject (researchers, store managers, CSR managers) to develop a better combination of factors and solutions. Besides, Multiple-Criteria Decision Analysis (MCDA) method can also be used to choose the the right connection between a food waste generation factor and their potential solution.

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10. Appendixes

Appendix 1 – Typology of Food Waste Causes & Solutions

See the Microsoft Excel file “Typology of Food Waste Causes & Solutions.xlsx” [attached to this link](#)⁷.

This file is made of five different sheets in this order:

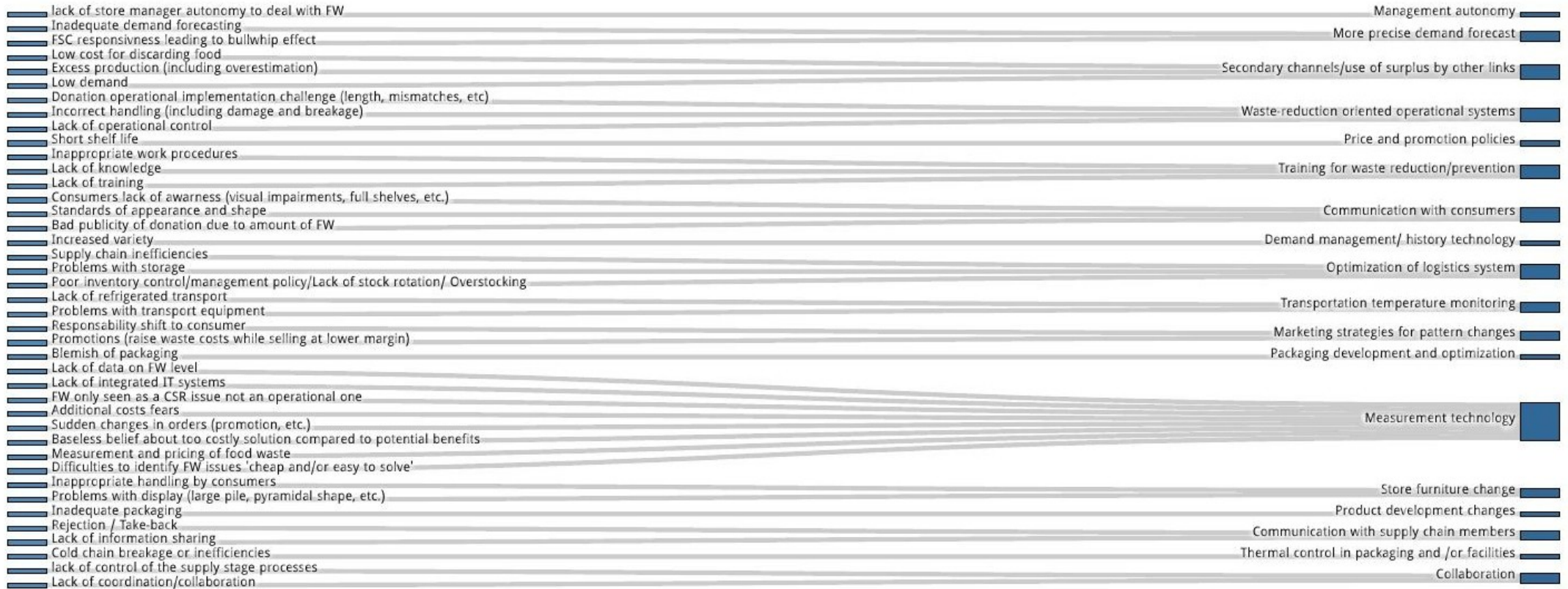
- “Causes of Food Waste” gathering the causes identified during the literature review;
- “Typology of Food Waste Factors” which provides a classification of the food waste causes;
- “Food Waste Reduction Measures” collecting the solutions to food waste generation from the literature review;
- “Food Waste Reduction Solutions” categorising the solutions;
- and finally, “Causes & Solutions Table” establishing the connexion between the causes and their respecting solutions

⁷ If for some reason the hyperlink is not working, please copy and paste the following link in your web browser :

<https://www.dropbox.com/sh/tm9hmiydbb1af4e/AADM3em7pAH5BVatWrBIX7wba?dl=0&preview=MIM+Food+Waste+Thesis+Appendix+1+-+Charles+Montama+CC+BY-NC-SA+4-0.xlsx>

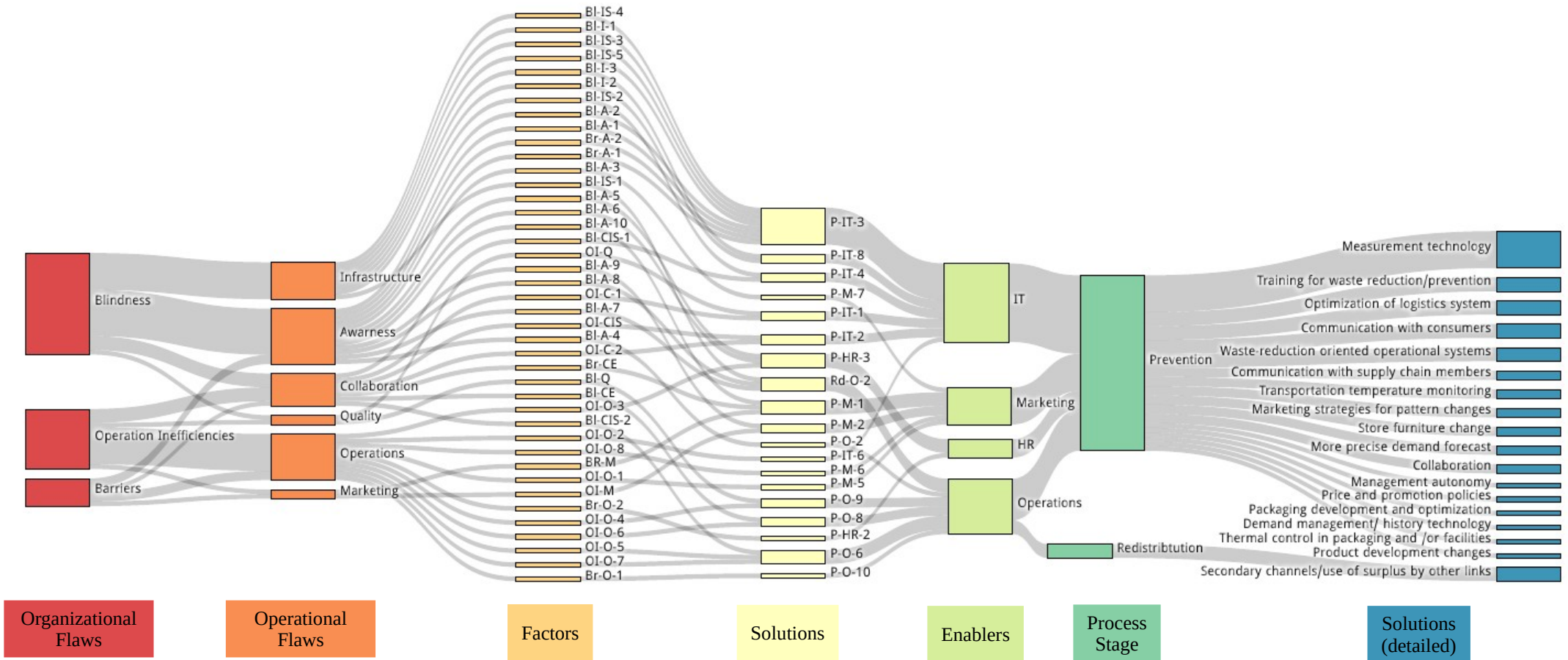
Feel free to reach out on LinkedIn (in/charles-montama) in case of further inquiries.

Appendix 2 – Causes and Solutions Connexions



Causes (on the left side) link to their respective solutions (on the other side).

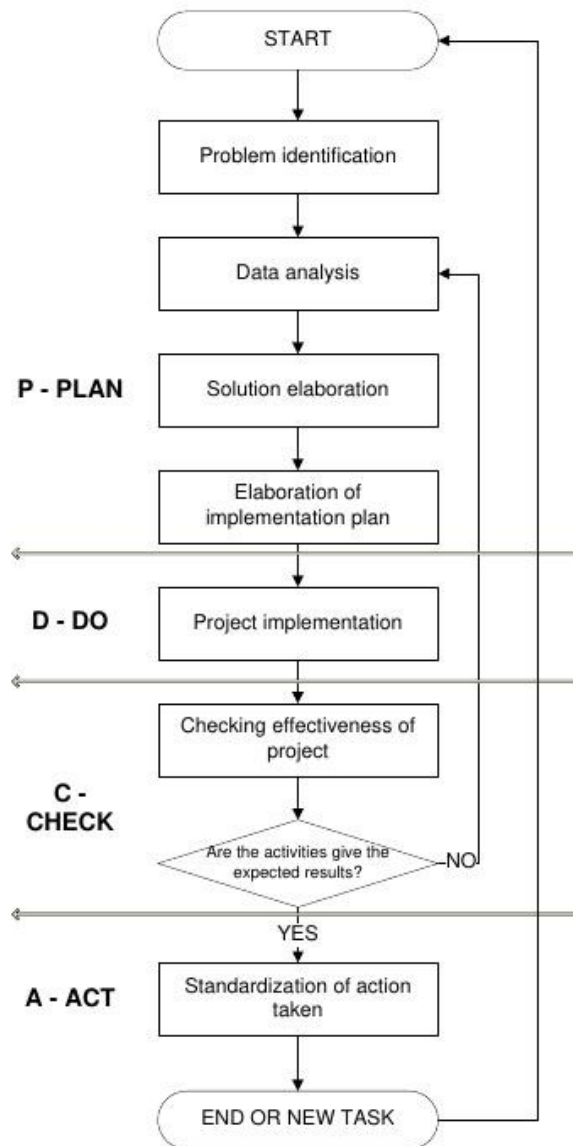
Appendix 3a – The Detailed Relationships between the FW Factors and the FW Reduction Solutions



Appendix 3b – Factors and Solutions Codes Reminder

Code	Meaning
A	Awareness
Bl	Blindness
Br	Barriers
C	Collaboration
CE	Consumer Education
CIS	Collaboration - Information System
HR	Human Ressources
I	Infrastructure
IS	Information System
IT	Information Technology
M	Marketing
O	Operations
OI	Operation Inefficiencies
P	Prevention
Q	Quality
Rd	Redistribution

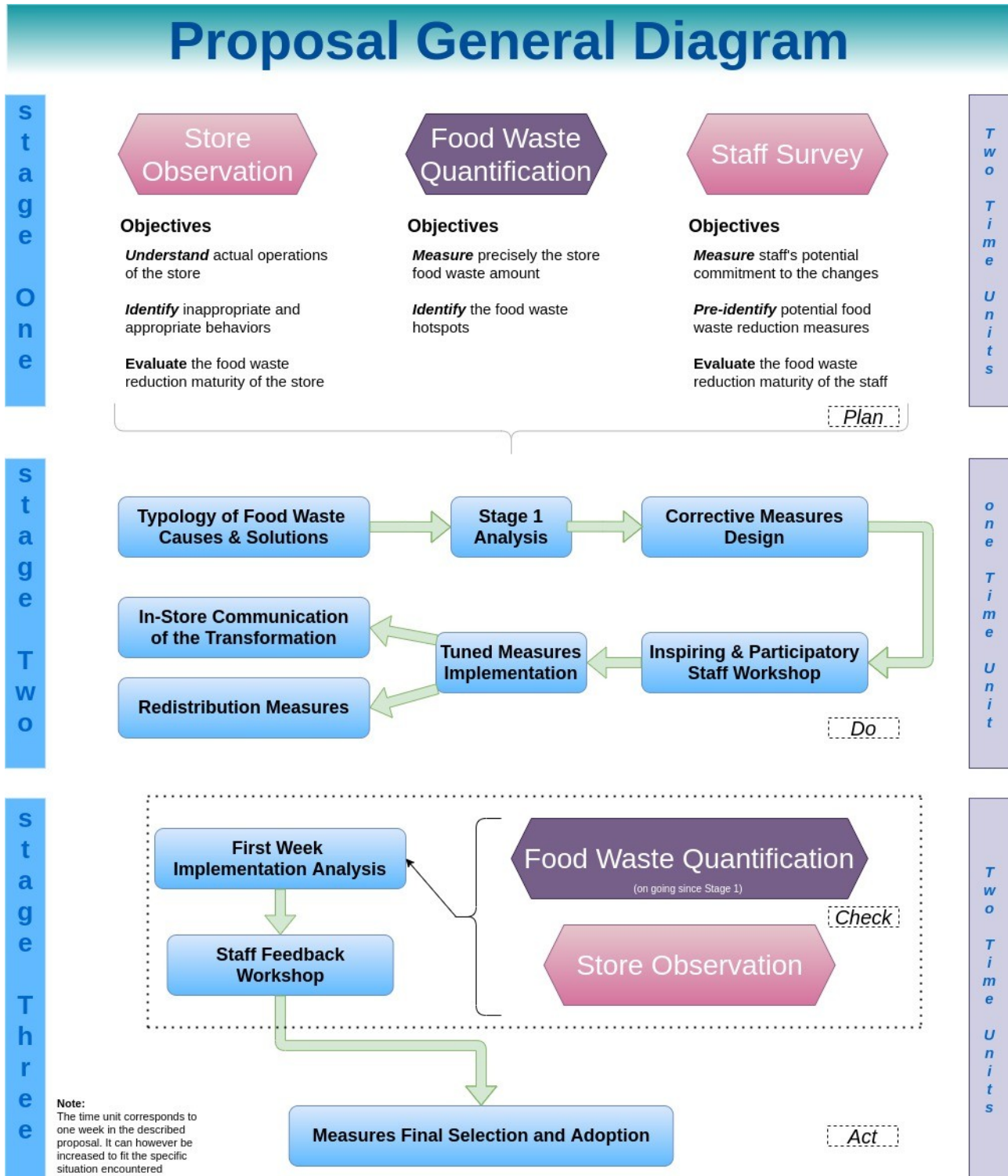
Appendix 4 – The PDCA Cycle



Algorithm of the PDCA cycle for solving a problem with steps in individual phases.

Source : Łazicki et al. (2014) available in Knop and Mielczarek (2015)

Appendix 5 – Proposal General Diagram



Appendix 6 – Observation Sheet Template

The objective of this template to provide an account of the staff behaviours impacting the food waste amount of the store. An example is made on the two first rows.

Employee Name	Behaviour		Behaviour in detail
	Food Waste Generation	Food Waste Reduction	
João	X		Incorrect Handling (OI-O-4) : Careless handling of fruits (bananas) when put in the displays
Raquel		X	Closed the fridge door after a customer left it open
...			

Appendix 7 – Food Waste Awareness Survey

1) Regarding environmental topics (climate change, pollution, biodiversity, etc.), I consider myself:

- knowing nothing or few things about the topics
- knowing some things about it but nothing more
- knowing a good deal about at least one of the topic

2) Do you feel concerned by these topic?

- Yes
- No

3) Regarding environmental topics (climate change, pollution, biodiversity, etc.):

- I believe these topics do not have a big importance.
- I believe it is important but these topics are mentioned more than they should be
- I believe it is important and these topics are mentioned less than they should be

4) Regarding food waste, I consider myself:

- knowing nothing or few things about this topic
- knowing some things about it but nothing more
- knowing a good deal about the topic

5) Regarding food waste:

- I believe this does not have a big importance.
- I believe it is important but this topic is mentioned more than it should be
- I believe it is important and this topic is mentioned less than it should be

6) Do you think you can have a positive impact on environmental issues in your daily work?

- Yes
- No

6) During my time spend working,

- I am not aware of the consequences my daily actions can have on food waste level
- I know my action have consequences on food waste level but I do not know precisely how
- I am aware of the consequences my daily actions can have on food waste level

7) According to you what is the value (price displayed) of the food wasted in the store?

- Less than 100€ per week
- Between 100€ and 500€ per week
- More than 500€ per week

8) In order to reduce food waste amount in the store, what could be implemented?