



ARDE'

How to manage
climate change crisis
one meal at a time

THE
**GRADUATE
INSTITUTE
GENEVA**

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Abstract

In recent years, food delivery systems have spread internationally: in particular, because of COVID-19 restrictions their usage has increased greatly. Since these services use disposable materials, a more sustainable solution has to be developed in order to decrease their environmental impact.

Therefore, it has been elaborated ARDE', a sustainable food delivery system that, thanks to reusable food containers, aims at reducing the pollution caused by traditional systems that adopt single-use containers (i.e. Just Eat, Deliveroo, ...).

Firstly, the team has conducted a socio-economic analysis on customer habits by analysing data from previous studies and by collecting others through a google-form created ad hoc.

Subsequently, it is presented a report on the environmental impact of food containers, both reusable and non-reusable: in this paragraph the analysis has been conducted considering different materials and their life-cycles. After having analyzed the health issues connected to the materials researched, it emerged that stainless steel was the best one: therefore, it has been chosen for the ARDE' containers.

Furthermore, the team has presented a SWOT analysis of some existing projects that are similar to ARDE'.

Thereafter, the ARDE' project has been developed. In this phase, the team worked on the brand identity (where the ARDE's logo is presented), the design of an app and containers, and the logistics that are based on a circular system.

In this chapter a risk analysis has been conducted to highlight possible weaknesses and to elaborate mitigation strategies.

Lastly the team has presented its conclusion, stating how systems similar to ARDE' can help *manage the climate change crisis one meal at a time*.

key words: food delivery system; food containers; recycle; reuse; waste management.

Project Proposal

ARDE'

June 2021

OVERVIEW:

The project aims to develop a food delivery app based on a circular system with the implementation of reusable food containers in order to decrease the waste generated by the usage of disposable materials, as done by almost all the delivery food app now on the market. With this app people could order food and receive it in reusable stainless-steel containers that will be then returned during the next food order.

GOALS:

The main goal is to decrease the pollution considerably with an easy and ancient method of reuse, without damaging the delivery system that is fundamental in the post Covid-19 market.

Secondly, the collective consciousness would be impacted and more people would get closer to sustainable solutions for their everyday habits.

SPECIFICATIONS:

The project is based on the creation of an app for the customers where they can order from all the associated restaurants. The system of delivery is similar to the one used by the main delivery platform, with the implementation of reusable containers. Restaurant will be provided with Ardè containers, followed in the organization and distribution of the material.

MILESTONES:

- Creation of the app
- Design of the containers
- Specification of the logistics

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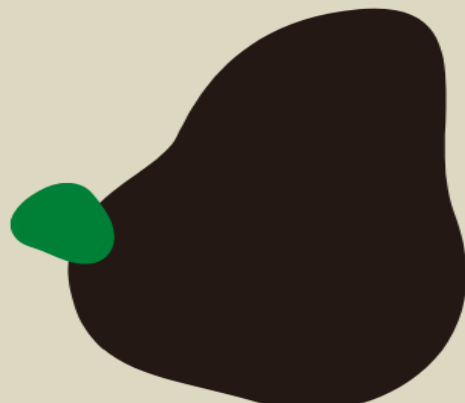
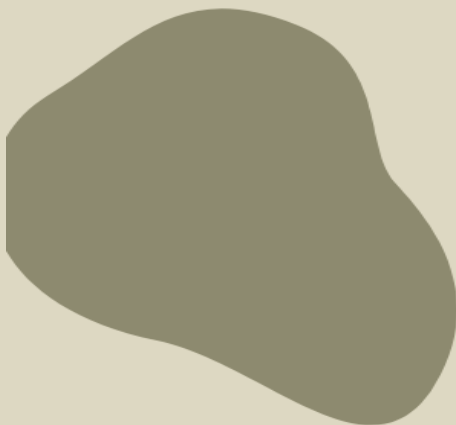


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1. Introduction

In recent years, food delivery has gained popularity by becoming an extensive system to meet the high demands of consumers. Nevertheless, this practice has ancient origins.

During the XIX century, one of the most long-lasting food delivery systems was born in India: the dabbawala system. Dabbawalas still exist nowadays and they are now organized in proper companies, where their employees' shifts start in the morning when they have to collect the lunch boxes from each client's house, then, by train or by bike, the box is handed over to its owner by lunch time. Lastly, the dabbawalas go back to the places where they have deposited the box, collect it and deliver it back to the families of the owners.



Fig. 1: Dabbawala delivery

The first time that a delivery system entered the internet was in 1995 when World Wide Waiter (now waiter.com) was founded. It can be considered as father to the systems that we now used every day. Waiter.com offers various services, addressed to companies and employees particularly. In fact, their core products are office meals and corporate catering services. It is from this system that our projects got its inspiration.

In the last years, the food delivery industry has become bigger, and in particular during the Covid-19 pandemic, since the main part of the population was restrained at home, and restaurants were closed to the public, deliveries were the only system that provided both the survival of a lot of restaurants and the possibility for people to receive a cooked meal. Because of the increasing importance of this industry, we thought that it was time to implement a more sustainable version of delivery, since as today almost every delivery system works with non-reusable (and often non-recyclable) containers, increasing the bad impacts on the environment.



2. Working methodology

To have a clear understanding of the current food delivery systems we have collected papers in the literature, focusing on scientific publications.

First the socio-economic scenario involving the food delivery systems has been drawn, studying who are the main customers interested in these businesses: the team also drew a survey that was submitted as an online form, to collect data from potential targets of the system that has been developed.

Then the environmental impacts of the most used materials have been studied, to understand the benefits of the implementation of reusable food packaging in the delivery food system and to choose the better option for our project, considering both the environmental sustainability and the health safety of our choice.

Some already existing projects, similar to the one we are proposing, have been studied, considering their strengths and their weaknesses: a SWOT analysis has been made.

Then we have worked on all the aspects of our project, from the food container chosen to the delivery system to an accurate description of the logistics and of the app operation.

Last, the risk analysis is presented, followed by the conclusions.

3. Food delivery system: a socio-economic analysis

In the following paragraph there is a report of different analysis to understand the food delivery service from a socio-economic perspective starting with the definition of the sharing economy system and the explanation of data about the increase of that model in recent years, to the study of habitual consumers' attitude and behavior towards food delivery.



3.1. Socio-economic scenario

In today's economy, one of the most innovative ways of doing business is by adopting the *sharing economy business model*: this is a socio-economic system that is built around shared creation, production, distribution, trade and consumption of goods and services by different people and organizations. It is beneficial not only because it reduces the waste of resources but also because it favors environmental sustainability. One of the industries where the sharing economy operates the most is the food delivery sector, which has benefited greatly from Covid-19. Looking back at 2015/2016, many surveys that were conducted on the Italian market showed how this system was present in bigger cities only and the main users were workers or millennials. The Italians that were regularly ordering through food delivery apps were 4,1 million, whereas the ones that would directly call the restaurants to have them deliver food were 11 million (1), (2).

The Pandemic was game changing because it led to the necessity of redesigning the way we eat.

Due to Covid-19 restrictions, restaurants were closed so they had to reach their clients differently. As Daniele Contini, Country Manager of Just Eat Italia stated: *"Never before has food delivery proven to be such an essential service for Italians [...] According to a survey we conducted during the lockdown months, food delivery proved to be an essential service for 90% of respondents."* In fact, as shown by the study conducted by the Just Eat Observatory (3), within the last year, the number of restaurants that have joined food delivery platforms has increased by 30%. 2020 represented a breakthrough year for this sector, with a significant growth that led it to represent 20-25% of the entire delivery industry. During the lockdown's months, a great expansion was registered: 60% of the Italians started ordering at home pizza, hamburger or sushi, whereas 34% (on a sample of 2,000 new users) did so for the first time. Even the users' profiles changed since this industry opened up to older people and to smaller cities. In 2020 the purchases in the food delivery sector grew 19%, compared to 2019, with a value of €706 billion (4).

To investigate the food delivery habits of consumers and their interest in eco-sustainability, we decided to create an anonymous survey in order to understand how hypothetically positive our project could be. The sample of the survey is composed of a total of 327 respondents without any limit of gender, age, working position, educational level. It was created in Italian



to be shared with Italian people. In order to reach as many respondents as possible and to reduce the social desirability bias, we decided to create an anonymous Google form and after sharing the link with our families/friends we shared it through our Instagram profiles. The survey has four parts, each consisting of questions of different content. The last three questions of the survey in fact were created to anonymously profile respondents.

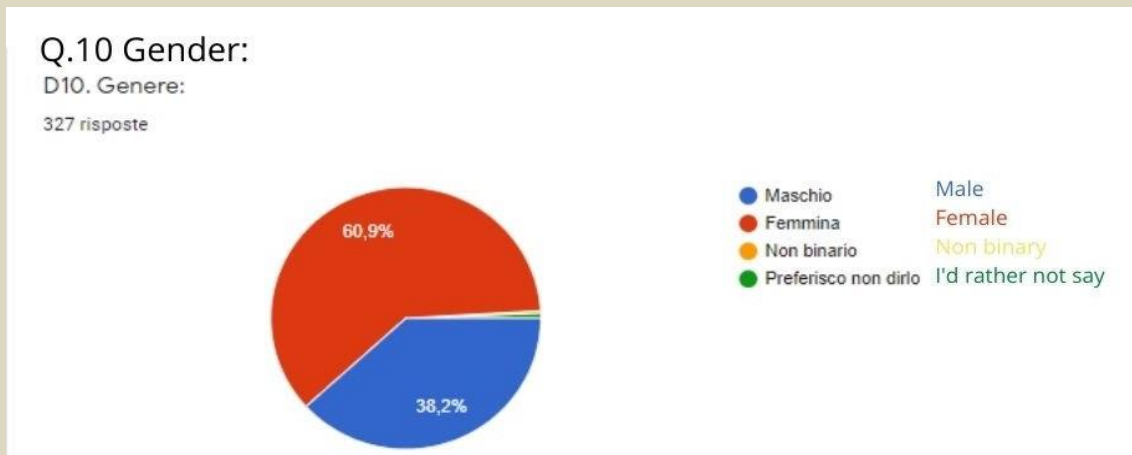


Fig. 2

The majority of the respondents are female (60,9%); male percentage is about 38,2%. This difference is caused by a bias: our Instagram profiles, through which we have collected more answers, are followed by a larger quantity of females than males.

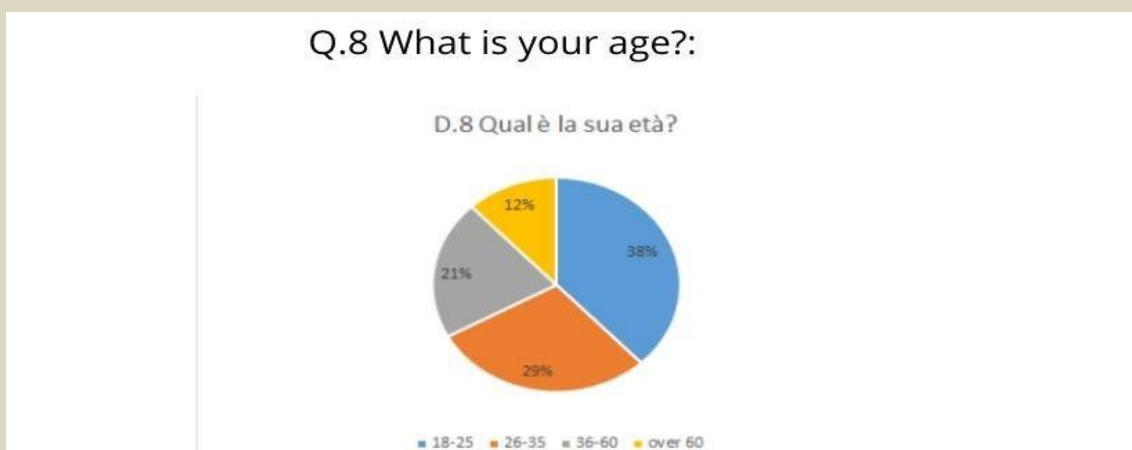


Fig. 3

After collecting the ages of our respondents, we divided them into categories. As we can see, the majority of the respondents belong to the category of 18-25 years old and probably because on Instagram people of that age are more active and available to answer to online



questionnaires. The following category is people that belong to the age range between 26-35 years old. Very significant is the fact that the sum of the last two categories in terms of quantities is 35%, so not too much lower than 50%, in fact is higher than the percentage of the 26-35 years old category.

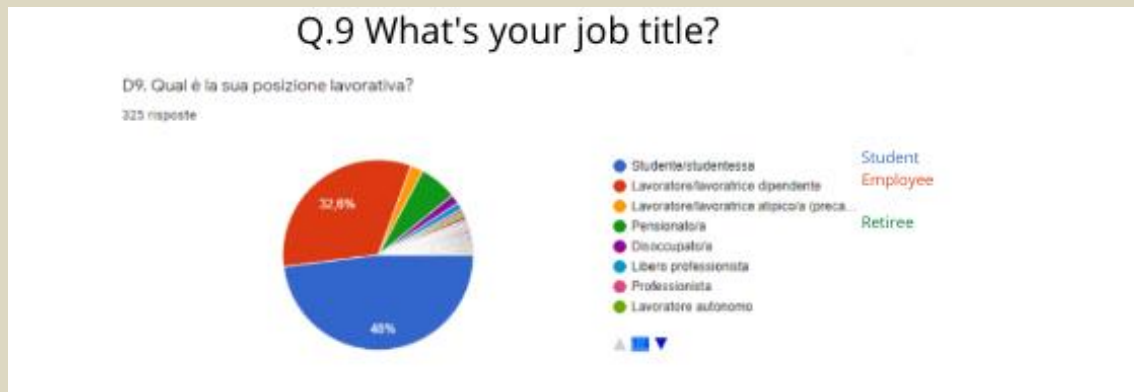


Fig. 4

Regarding the work position the situation is a little bit complicated: a huge quantity of respondents has answered this question with the “other” option specifying their job. By the way we can keep as references the most populous categories: students (48%) and employees (32,6%). These results are very significant because they have confirmed our hypothesis: people that are busy all day studying or working are more likely to order food. On the contrary an unexpected result is the number of retirees (6,5%), that’s not a high percentage, but it means that this category is used to order food.

The second part of the survey is composed of a question about people interest in eco-sustainability habits and behaviours, in order to understand how much people feel like involved into this topic:



Q.1 Do you consider yourself an environmentally conscious person?

D1. Si ritiene una persona attenta alla tematica ambientale e all'ecosostenibilità?

327 risposte



Fig. 5

This is a statistically great result, in fact almost all the respondents define themselves completely interested (48,3%) or more yes than no (42,2%). So that means that people are probably likely to be informed about new solutions to solve environmental problems.

In the third part we investigated about the food delivery practice to understand the respondents' behaviors:

Q.2 Are you used to ordering food through food delivery systems?

D2. Ha l'abitudine di ordinare cibo d'asporto e/o a domicilio?

327 risposte

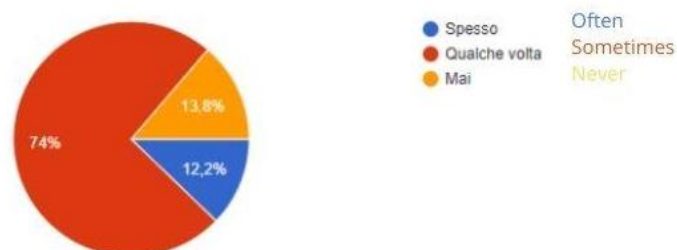


Fig. 6

This result is very useful to support the research we are developing, in fact we can see that the food delivery practice is very common according to the percentages of people that sometimes order food (74%). More than 80% order food sometimes (74%) or often (12,2%).



Q.3 If so, how often?

D3. Se sì, con quale frequenza?

288 risposte

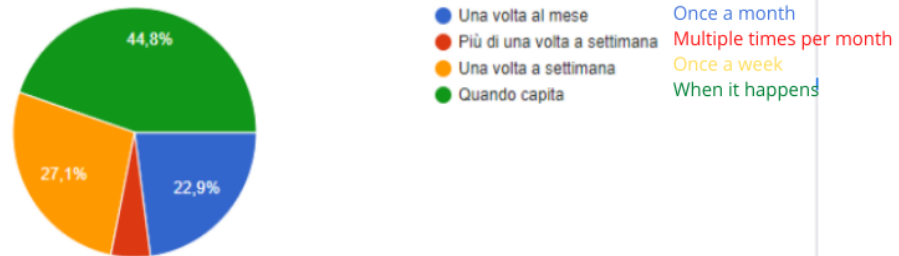


Fig. 7

From this graph we can notice that almost half of the respondents order food when it happens. It means that people are not used to ordering so often, but despite this the practice of food delivery is quite used.

Q.4 During the lockdown did you notice an increased use of food delivery?

D4. Durante il lockdown ha notato una sua maggiore fruizione del servizio a domicilio e/o d'asporto?

325 risposte



Fig. 8



Q.5 After the reopening of the restaurants have you noticed an increased use of the food delivery service?

D5. Successivamente alla riapertura dei ristoranti post lockdown, ha notato una maggiore fruizione del servizio a domicilio e/o d'asporto?

326 risposte



Fig. 9

Comparing these two graphs we can say that during the lockdown, people ordered delivery food more than usual (59,7%). A practice that after the restaurants reopening has been partly abandoned.

Q.6 Have you ever thought about the pollution factor involved in using disposable containers in food delivery service?

D6. Ha mai pensato al fattore inquinante che comporta l'utilizzo di contenitori usa e getta nel servizio a domicilio e/o d'asporto?

326 risposte

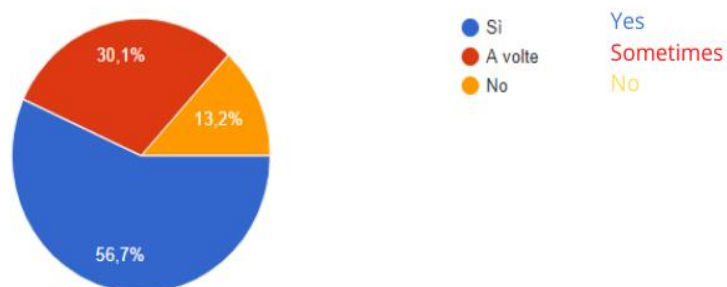


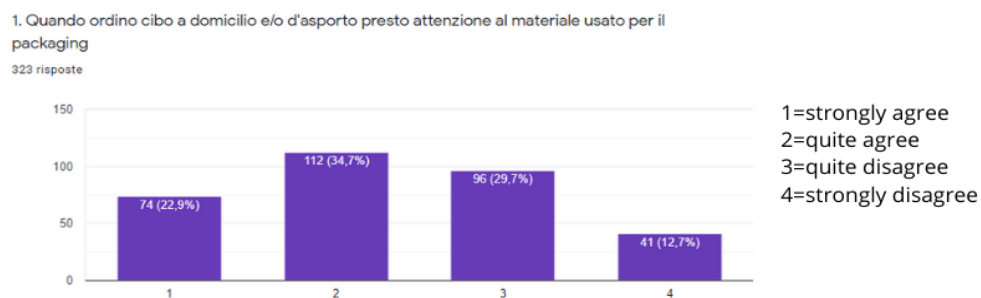
Fig. 10

According to this graph it is very important to notice the quantity of respondents that are involved in the pollution topic related to the use of non-reusable packaging in food delivery (56,7%). It means that more than half are interested in the environmental issue.



The fourth part is composed of Likert-scale questions and we asked respondents how much they agreed with the following sentences:

1. When I order food at home I pay attention to the material used for the packaging



2. Once I have eaten my meal, I pay attention to recycling by throwing the containers in the right bin

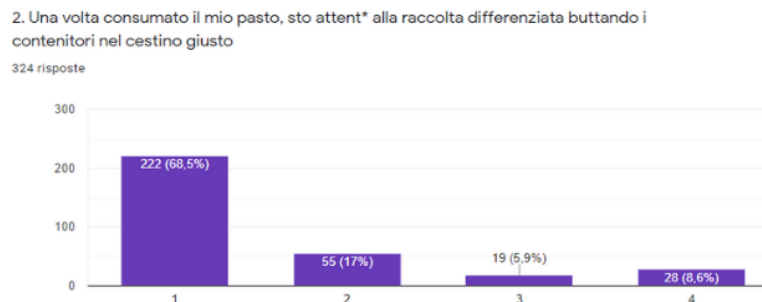


Fig. 11

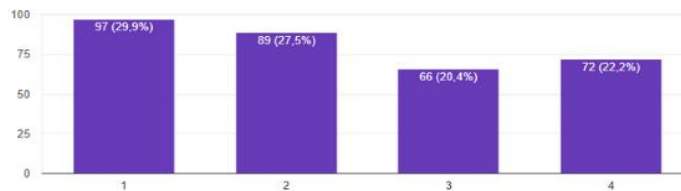
Comparing these two graphs we can notice that in the first sentence the distribution of the respondents is normal and the mode is quite agree (2; 34,75%), on the contrary in the second sentence the distribution is strongly skewed to the right, so it has a positive distribution, in fact the mode of the second sentence is strongly agree (1; 68,5%). We can deduce that respondents are interested in eco-sustainability and in recycling. We were, thus, motivated by this result to develop our project.



3. I'm willing to reuse the containers given to me during food delivery (if possible)

3. Sono propens* a riutilizzare i contenitori che mi vengono dati durante il servizio a domicilio e/o d'asporto (qualora possibile)

324 risposte



1=strongly agree
2=quite agree
3=quite disagree
4=strongly disagree

4. I would like to see more attention paid to the choice of materials in food delivery containers by restaurants

4. Mi piacerebbe vedere maggiore attenzione nella scelta dei materiali per i contenitori del servizio a domicilio e/o d'asporto da parte dei ristoranti

324 risposte

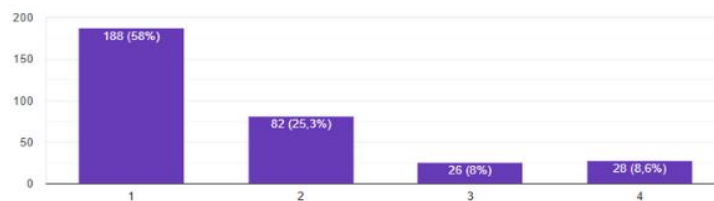


Fig. 12

These results motivated us to continue developing our project, in fact in the first graph we can deduce that more than half of the respondents are inclined to reuse containers whenever possible (strongly agree, 29,9%; quite agree, 27,5%). Probably those who replied not to reuse containers, don't have the opportunity to do it. In the second graph in fact we can see how much people are interested in recycling practice according to the fact that 58% of respondents have answered they would like to see more attention in choosing the most reusable materials for packaging.



5. I would be willing to pay a deposit on the total food delivery order for a system that distributes reusable containers

5. Sarei disposto* a pagare una cauzione sul totale dell'ordine di food delivery per un sistema che distribuisce contenitori riutilizzabili (vuoto a rendere)

324 risposte

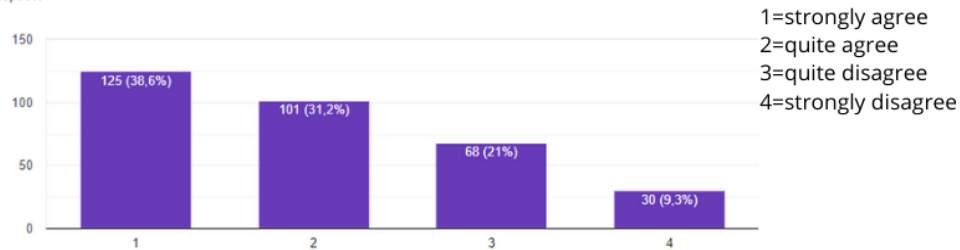


Fig. 13

This last sentence has been fundamental to understanding how much our project would be accepted by consumers. The distribution is strongly skewed to the right and this means that the distribution is positive, in fact the mode is “strongly agree” (1; 36,6%). More than half of the respondents strongly agree and quite agree at the idea of paying a deposit for a system of reusable containers (1, 36,6%; 2, 31,2%). Very significant is to see how much lower the percentage of people who strongly disagree is (4, 9,3%).

After the analysis of the results of each section of the questionnaire, it can be said that the results are largely positive: in fact, the respondents showed that they are very interested in the eco-sustainability discourse, that they are users of food delivery and that they are willing to accept green solutions. These responses gave us the basis to build up our research and our Ardè lunchbox project.

As we can see, delivering food is a social practice: researchers have conducted many studies over the years to analyze consumers’ opinions and behaviors towards this habit. In 2011 Sheryl E. Kimes investigated in the US the practice of online ordering food and in January 2011 she conducted an online survey (5) on people who have ordered food during the previous year for delivery or for takeout. That online survey was composed of questions about individuals’ food ordering behaviors.

According to the outcomes, researchers found a relatively split by gender with a slight majority of women (51.3%) and that the categories of age more likely to order online were 25-34



(18.3%), 35-49 (19.6%), 50-64 (31.1%). Nearly half of the respondents (48.5%) had ordered online food for delivery or for takeout. Moreover, the majority of respondents (75.1%) reported that the most frequent reason for ordering food was for social occasion: hence, delivery or takeaway food represents a social and conventional moment.

Another more recent study was done by H.G. Janssen, I.G. Davies, L. Richardson and L. Stevenson in the UK (6) and its aim was to understand the correlation between lifestyle and takeaway food consumptions in adults. Researchers conducted a cross-sectional observational study of 1724 individuals (18-64 years old) from August 2016 and October 2017. The research was conducted through questionnaires about food frequency, lifestyle factors (physical activity, alcohol consumption, smoke, ...) and socio-demographic factors (age, gender, educational level, ...).

The results were processed using descriptive statistics with a $P\text{-value} < 0,005$ and researchers found out that the majority of respondents (46%) consume takeaway food 1-3 times per month.

Covid-19 had a strong impact on consumers' behaviors changing the way they buy and consume products thanks to technological support. According to the research developed by Jagdish Sheth in September 2020 (7), due to the Covid-19 people changed their perception of reality adopting new practices, but are they supposed to die or to become part of our routine post covid-19? The answer given by Jagdish Sheth is that consumers have adopted and adapted these new habits for a prolonged time period, so it's easy to imagine a different future composed of online practices such as meetings on Zoom instead of meeting friends in presence, and as well online food ordering instead of going to restaurants.

It's clear that many people use delivery services and they usually adopt single-use plastics as food packaging, therefore generating large amounts of disposable food containers to meet demand. Such plastic containers reach the end of their service life after a single meal and are then discarded as plastic waste. Even though the biggest companies operating in food delivery are turning green by adopting recyclable packaging this problem still affects the environment hugely.



4. Reusable containers in food delivery systems

In this paragraph a compared analysis of non-reusable and reusable solutions for food containers will be presented to understand the real impact of the ongoing systems of food delivery. Firstly, we'll be focusing on materials, secondly some projects of reusable food containers will be shown to present the scenario in which we worked on our project.

4.1. Materials

To date, the takeaway industry is predominantly based on single-use containers, and given the increasing consumption of takeaway food, this container choice represents an important source of waste. Therefore, it has a huge environmental impact because the materials usually chosen for the containers are characterized by a low recyclability. Moreover, the material used for take-away containers can also have an impact on human health, due to frequent presence of contaminants that can migrate from the surface of the product into the food.

In this paragraph a comparison of the most used materials for non-reusable containers will be drawn, and after that, these canisters will be compared with some different reusable food containers.

4.1.1. Environmental impacts comparison between the most common non-reusable and reusable food container materials

Regarding single-use solutions, the study presented in (8) draws an exhaustive comparison between aluminium, EPS (Expanded PolyStyrene) and PP (Polypropylene) containers: these are the most common materials used for takeaway food. In this article a comparison of the environmental impacts of these three containers has been done, considering all the aspects from raw materials, to the production and transport, to the use and to their end-of-life impact. The EPS is the best option between them across the impact categories, thus EPS containers, due to their lightness, are easily blown away and dispersed, worsening the riverine littering. In addition to that, EPS remains in the environment for a long time (because of its low degradability) and likely ends up into the sea: EPS is one of the biggest microplastic polluters (cit. (16)). For these reasons, despite its lower life cycle environmental impacts, in comparison



with the other materials, EPS cannot be considered a sustainable option. The transition needed is aimed at promoting the circular economy view, that consists of close loops in industrial systems, minimizing waste and reducing raw material and energy inputs (cit. (9), (17)). The reuse of containers is considered the only way to accomplish the goals of the circular economy, since the usage of recycled materials is not recommended in the food industry. In fact, to assure the safety of recycled materials for food contact needs the recovery of virgin materials, that could not be achieved with low environmental cost using current methodologies (cit. (10), (18), (19)). The reuse emerges as the better solution. To ensure the safety of recycled materials, which is required for them to be used for food, virgin materials must be used.

Still in the study (8) a comparison between non-reusable and reusable solutions has been done by considering, as reusable options, PP containers and Tupperware. It emerged that a Tupperware container should be used 24 times to equal the impacts of EPS, while PP containers should be used 9 times. From these data we can see that reusable options are likely to improve the sustainability of the takeaway industry, since the number of reuses is compatible with the average times these containers are used before being discharged. Glass food containers, as Tupperware, have emerged as an alternative to plastic containers, in particular because of health concerns (cit. (20)): in (12) an analysis about plastic and glass food containers is presented. “The glass food savers have higher impacts than the plastic ones, assuming the same lifespan (50 uses) for both. However, the impacts of the glass containers can be reduced by a longer lifetime, resulting in a greater number of uses (the glass container would need to be used from 1.3 up to 3.5 times longer than the plastic option). [...] The results reveal that the glass container has 12%–64% higher impacts than the plastic and should have 1.3–3.5 times longer lifespan to equal the environmental footprint of the plastic containers, depending on the impact considered. The use stage is the main contributor to all environmental impacts for both types of food saver, mainly due to the use of electricity by the dishwasher and natural gas to heat water for hand washing. Therefore, consumers can help to reduce the impacts of food savers by using efficient dishwashers or following recommendations for improved hand dishwashing. Consumers should aim to prolong the lifetime of food containers, particularly the glass, as they have higher environmental impacts than the plastic”.

Another important material that is being more and more appreciated for food containers is stainless steel. Metals can be recycled nearly indefinitely. Unlike wood and plastics, the properties of metals can be restored fully, although not always economically, regardless of



their chemical or physical form. If the metals sector is to contribute to sustainable development it should maximize the percentage of recycling, which can minimize the ecological footprint of the metals industry (cit. (13)). In (15) the comparison of single-use plastic containers and reusable stainless steel has been done. When it comes to the reusable stainless-steel containers, distribution is the most consuming in terms of CO₂ emissions, representing 75% of those emissions. But the reusable stainless-steel containers should be more sustainable when the number of reuses is above 36, that is in agreement with the common use of a container. The reusable stainless-steel containers have turned out to be a better option environmentally speaking, but they are characterized by higher cost associated with them.

From this analysis of the different material options, the stainless-steel containers have been chosen as the better solution.

4.1.2. Health impacts of the contaminants in most used food packaging materials

Most common materials for food delivery contain chemical contaminants that can affect human health. In this study (21) a review of material specific contaminants has been done. We would like to focus on recycled plastic, metal and glass.

Recycled plastic typically contains flavor compounds from previous uses, oligomers formed during plastic synthesis, additives and contaminants derived from non-food grade plastics and consumer misuse ((21), Table 1). Researchers even detected phthalate plasticizers in bottled water (22).



Typical contaminants	Possible origins	Examples	References
Flavor, aroma, odor compounds	Previous use (e.g., sorption from food and non-food applications), cross-contaminations	<p> Limonene (CAS 5989-27-5), y-terpinene (CAS 99-85-4), p-cymene (CAS 99-87-6) and further citrus-based essential oils in conventionally recycled PET Limonene, 3-carene (CAS 13466-78-9), betamyracene (CAS 123-35-3), terpinolene (CAS 586-62-9), 11 esters, 5 alcohols in recycled HDPE </p>	<p> (Bayer, 2002; Franz et al., 2004; Nerin et al., 2003; Triantafyllou et al., 2002) (Camacho and Karlsson, 2000) </p>
Oligomers, monomers and derivatives	Production of virgin materials; degradation of polymers during use and recycling	<p> Linear and cyclic PET oligomers, predominantly dimers and trimers in recycled PET Increased total migration of -presumably- oligomers from recycled low molecular weight PP Acetophenone (CAS 98-86-2) and benzaldehyde (CAS 100-52-7) in PS Increased total migration at elevated temperatures from recycled PS </p>	<p> (Bentayeb et al., 2007; López et al., 2014; Nerin et al., 2003; Triantafyllou et al., 2002) (Incarnato et al., 1998) (Vilaplana et al., 2007) (Kanwal et al., 2007) </p>
Additives and their degradation products	Production of virgin material; (intended) degradation reactions during use and recycling; cross-contaminations	<p> Seven UV absorbers (e.g., UVA-1 (CAS 3864-99-1), UVA-3 (CAS 1843-05-6)), four antioxidants (AOX-24 (CAS 93-43-9), AOX-26 (CAS 96-69-5), AOX-27 (CAS 90-66-4), HALS-3 (CAS 71878-19-8), one plasticizer (diethylene glycol dibenzoate (CAS 120-55-8) in recycled PET Diisononyl adipate (CAS 33703-08-1), diisononyl phthalate (DINP, CAS 28553-12-0), Uvitex OP (CAS 7128-64-5), oleamide (CAS 301-02-0), Tinuvin 328 (CAS 25973-55-1), diethyltoluamide (CAS 13462-3) in recycled PET Bis(2-ethylhexyl) phthalate (DEHP, CAS 117-81-7), diisobutyl phthalate (DiBP, CAS 84-69-5), dibutyl phthalate (DBP, 84-74-2) and benzyl butyl phthalate (BBP, CAS 85-68-7) in recycled PET Adipates and erucamide (CAS 112-84-5) in post-consumer PET Nine phthalates in 20 waste, 8 virgin and 28 recycled plastic samples Irgafos 168 (CAS 31570-04-4), Irganox 1010 (CAS 6683-19-8), Chimasorb 944 (CAS 71878-19-8), and their degradation products in recycled polyolefins Degradation products of additives (e.g., 2,4-di-tert-butylphenol (CAS 128-39-2), and ethylbenzene (CAS 100-41-1) and xylene isomers) in recycled HDPE Brominated flame retardants in different types of black plastic FCMs 2-Methoxynaphthalene (CAS 93-04-9), sulfuric compounds and ethanol with fusel oil </p>	<p> (Bentayeb et al., 2007) (Dutra et al., 2014) (Keresztes et al., 2013) (Franz et al., 2004) (Pivnenko et al., 2016a) (Coulrier et al., 2007) (Camacho and Karlsson, 2000; Dutra et al., 2011; Welle, 2005) (Puype et al., 2015; Samsonek and Puype, 2013) (Widén et al., 2005) </p>
Contaminants from non-food grade plastic and sorted plastics; consumer misuse	Recycling of non-food grade or poorly food grade plastic and sorted plastics; consumer misuse		
Inorganic elements	Catalysts; environmental origin; manufacturing processes		<p> (Dutra et al., 2014; Nerin et al., 2003; Whitt et al., 2013, 2016) </p>

Table 1: Group and examples of typical contaminants in recycled plastic FCMs (21)

For low molecular weight PP (polypropylene) the migration rate of oligomers increases after recycling (21). However, once they are migrated into food, oligomers are absorbed in the gut (23). Internal FDA files have toxicity data concerning 11 oligomeric substances: they've performed 17 genetic toxicity tests and these were all negative, but information is still very limited (23).

The additives found in plastic packaging sometimes can contain harmful compounds: some adjuvants contain significant levels of heavy metals, some lubricant agents such as Methylstearate are tumorigenic, some plasticizers such as Benzyl benzoate are not recommended for pregnant women, phthalates are dangerous to the reproductive system, stabilizers can present carcinogenic effects and can cause abdominal cramps (24). Anyway, packaging manufacturers do not generally exceed the additive authorized levels.



Brominated flame retardants have been found in samples of food contact materials, indicating the recycling of plastic from electric and electronic equipment waste (21). There are differences within each BFR group regarding their toxicity, but generally speaking they can result in neurobehavioral effects, effects on thyroid hormone homeostasis and on the liver. Some BFR such as hexabromobiphenyl can be carcinogenic (25).

Aluminium is a great food packaging material, being relatively non-toxic and having good barrier properties. However sometimes there can be migration from the aluminium packaging to food despite the protective coating (21).

Steel is a permanent material that can be easily recycled without loss of quality yet can be damaged by corrosion. It should be avoided because of the dispersion of iron oxides: they cause oxidative stress with toxic consequences, as a study on land snails shows (26). This is the reason why we would like to use stainless steel in our project: it contains a minimum of 11% chromium that prevents iron from rusting. There aren't any data yet on whether the quality of steel in general has an impact on metal migration. (21)

Glass has been used as a food contact material for years. Migration is usually hindered from the glass bulk, but it can happen due to an ion exchange between cations from glass' inner surface and food. Because of this, "levels ranging up to 0.417mg lead/L in glass bottled drinking water have been found after 6 months storage" (21).

4.2. Already existing projects about reusable food containers

In this paragraph a SWOT analysis will be conducted on the existing scenario to analyze the projects that aim at promoting reusable systems. This analysis methodology consists of identifying strengths and weaknesses, opportunities and threats of businesses: thanks to it, we will be able to design a project that can overcome the weaknesses and threats while being even more competitive.

The most similar idea to the one that we will develop is **Just Salad [1]**, an American company that let people order their own salad in reusable containers by paying a borrowing fee of \$1. When the customers have completed their own meal, they can give back the lunchbox to one of the affiliated restaurants. This business is now present in the USA and Dubai.

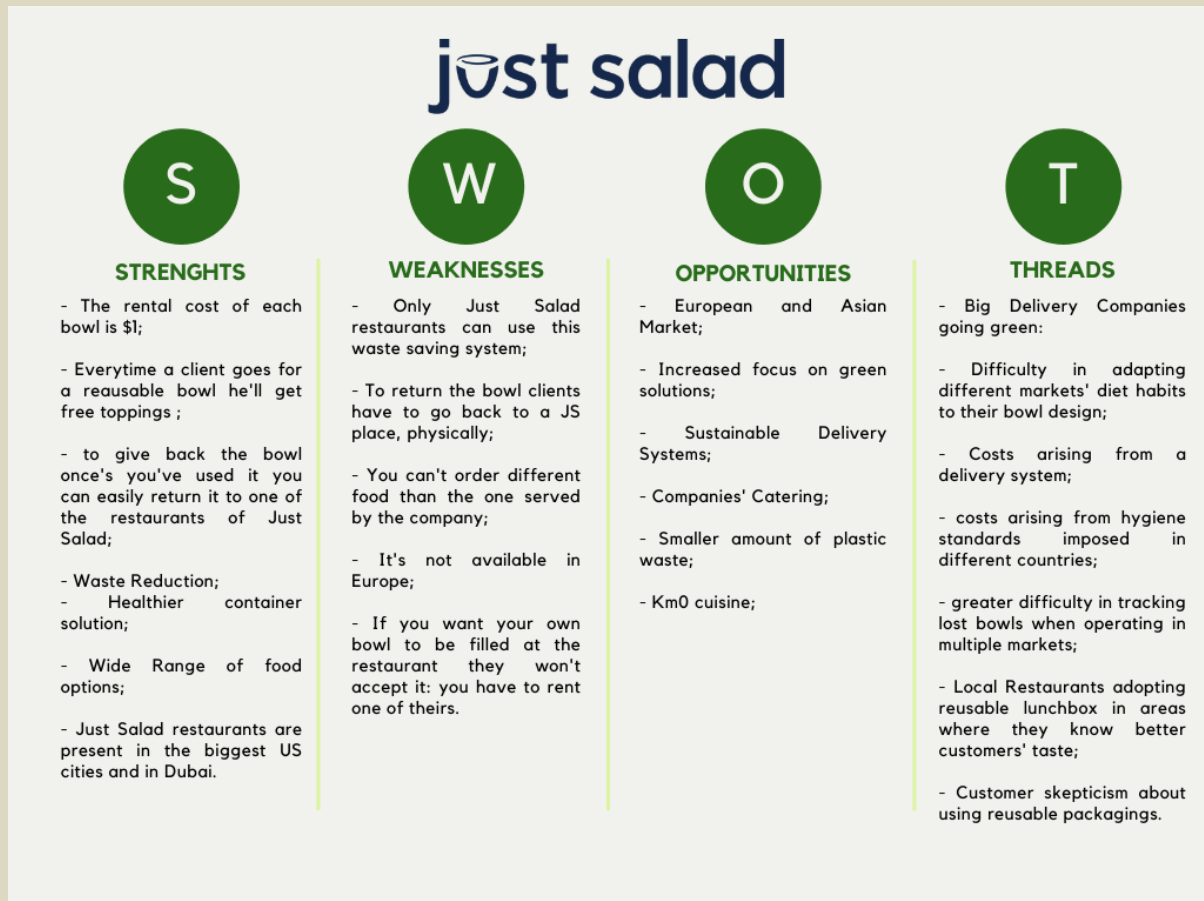


Fig. 14: SWOT analysis of Just Salad, conducted by Anna Rosso in June 2021

Moreover, in the USA, the **NextGen Consortium [2]** operates. It supports projects that want to accelerate the circular future of foodservice packaging financially and professionally. The NextGen Consortium is a multi-year, global consortium that aims to address single-use foodservice packaging waste by advancing the design, commercialization and recovery of packaging alternatives. The Consortium works across the value chain—with brands, municipalities, material recovery facilities and manufacturers—to ensure we provide viable market solutions that scale throughout the supply chain and bring value to recovery systems. It operates the most in the cafeteria industry, by developing reusable cups: research showed that 250 billion single-use cups are sent to landfills each year, contributing to greenhouse gas emissions and wasted energy. Designing new ways of having coffees is a significant opportunity to reduce our waste by tackling this material first.

Here below the swot analysis of two start-ups implemented thanks to NextGen Consortium.

The first one is called **Muuse [3]**, an innovative firm providing restaurants and bars with reusable coffee cups and lunchboxes in various cities located in Asia and in San Francisco.



Differently from Recup, the cups are made of stainless steel and can be tracked down thanks to a QR code. Moreover, to promote this reusable-based system they believe that they have to make this system as accessible as the disposable is: that's why they have located lockers where consumers can drop their empty cups in many spots. Nevertheless, the QR code and the possibility to drop the boxes almost everywhere are two characteristics that are not available for the lunch-boxes service. Furthermore, the lunch boxes are available in Singapore only thanks to the partnerships with Grabfood and Foodpanda.

Since the lunchboxes service is the most similar to our project, here's its SWOT analysis.



Fig. 15: SWOT analysis of Muuse, conducted by Anna Rosso in June 2021

The other company which has benefited from the Consortium's patronage is **Recup [4]**, a startup operating in Germany. Its aim is to reduce disposable cups' waste by creating a virtuous circle where the consumer can rent the cup for €1, have his coffee, return the empty item to one of the company's deposits and have their money back.



Fig. 16: SWOT analysis of Recup, conducted by Anna Rosso in June 2021

5. Project

The idea of our project emerged from the necessity to change the delivery food system because of the quantity of waste it generates. As of today, there are different types of apps to order food, but none of them is based on reusable containers. The project wants to give an alternative to these already existing apps, where a retuning system can be applied.

In the first stage of the project the idea is to produce an app that involves as many restaurants as possible, focusing on a single city, with an average of 200.000 inhabitants: possibly a city with a great number of university students, to include all the main categories of targets. If the project proves to be successful a larger scale system could be implemented, reaching a national coverage level. The targets of this project are the categories of customers that are



coming closer to online ordering, in particular during COVID-19 time. As above mentioned, the online delivery food market is likely to grow thanks to the continuous technological development and thanks to the COVID-19 restrictions that are making staying in more and more common.

5.1. Brand identity: name, logo and font

Before developing the brand identity, firstly we started figuring out the general features of our solution: the project is based on the idea of box reuse after ordering food at home, in order to limit waste of disposable materials. From that concept we started building the actual brand identity defining the name, that in our plans should have been a name linked to the purpose of our solution: reuse and local eco-sustainability. For this reason we decided to identify our brand with the Piedmontese dialect word “Ardé”, whose english translation literally means “to give back”. It is also the acronym of: Accessible and Reusable Devices for the Environment. The next step was to create the logo for the app to use the services of Ardè: first we thought about the colour and our decision was green, then we thought about the design inside the logo and we decided to represent the act of sharing the food.

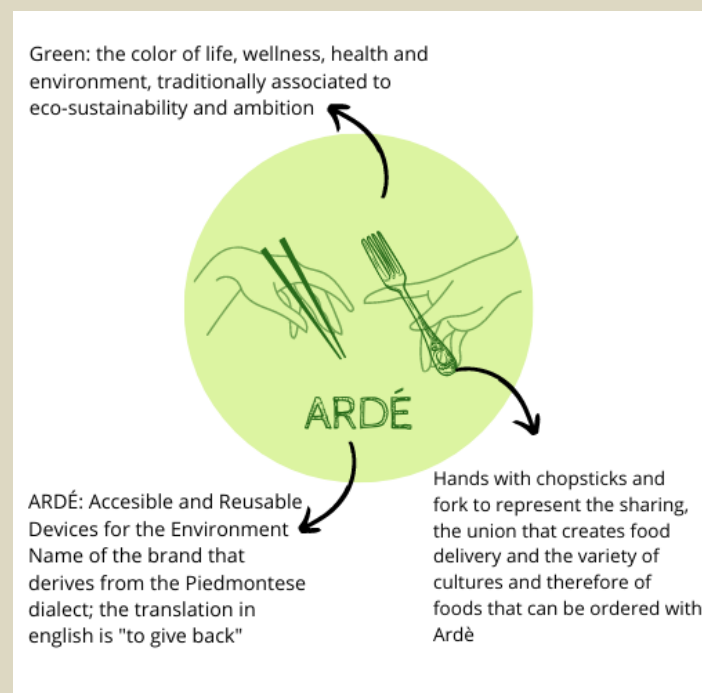


Fig. 17: Logo description and name explanation



The design is very simple and essential to recall the ease of use of the app, while the circular shape and the soft lines are used to recall dynamism. The font we used for the word “ARDÉ” is called Cabin Sketch and it incorporates modern proportions, some geometrical aspects and optical settings.

5.2. Logistics

About logistics, the idea is to work with the same transport systems of the existing methods of delivery, since they are for a major part based on transport by bike or electric motorcycle that are the best option under an environmental impact point of view.

Below, we have described the logistics for both the customer and the restaurants.

For the customers

- Order

The customer can choose from the app the restaurant he is interested in and order from it. During the order the customer will find a section where he can choose if he wants to receive for the first time the food container: he will have to choose this option if he does not have in his possession a used container. When this option is checked an additional payment of €6 is requested, as a deposit for the possession of the container.

- Delivery

At the moment of the delivery the customer that was already in possession of a container will give back the empty one to the delivery man, whilst receiving his order in another container. If the customer does not have the container, he will just receive the food in a new one.

- After

After the order the customer can keep the container for a total of 30 days: after that time he will be charged €7 more, to cover the price of the container. If he does not want to buy the container he can either make a new order and thus receive a new container, and have 30 days more, or can go to one of the restaurants that are present in the app and give the container back, receiving a refund for the container of €6 (that was the rental fee).



The containers have been provided with a QR code, to trace each one of them and know if they have been returned already or not.

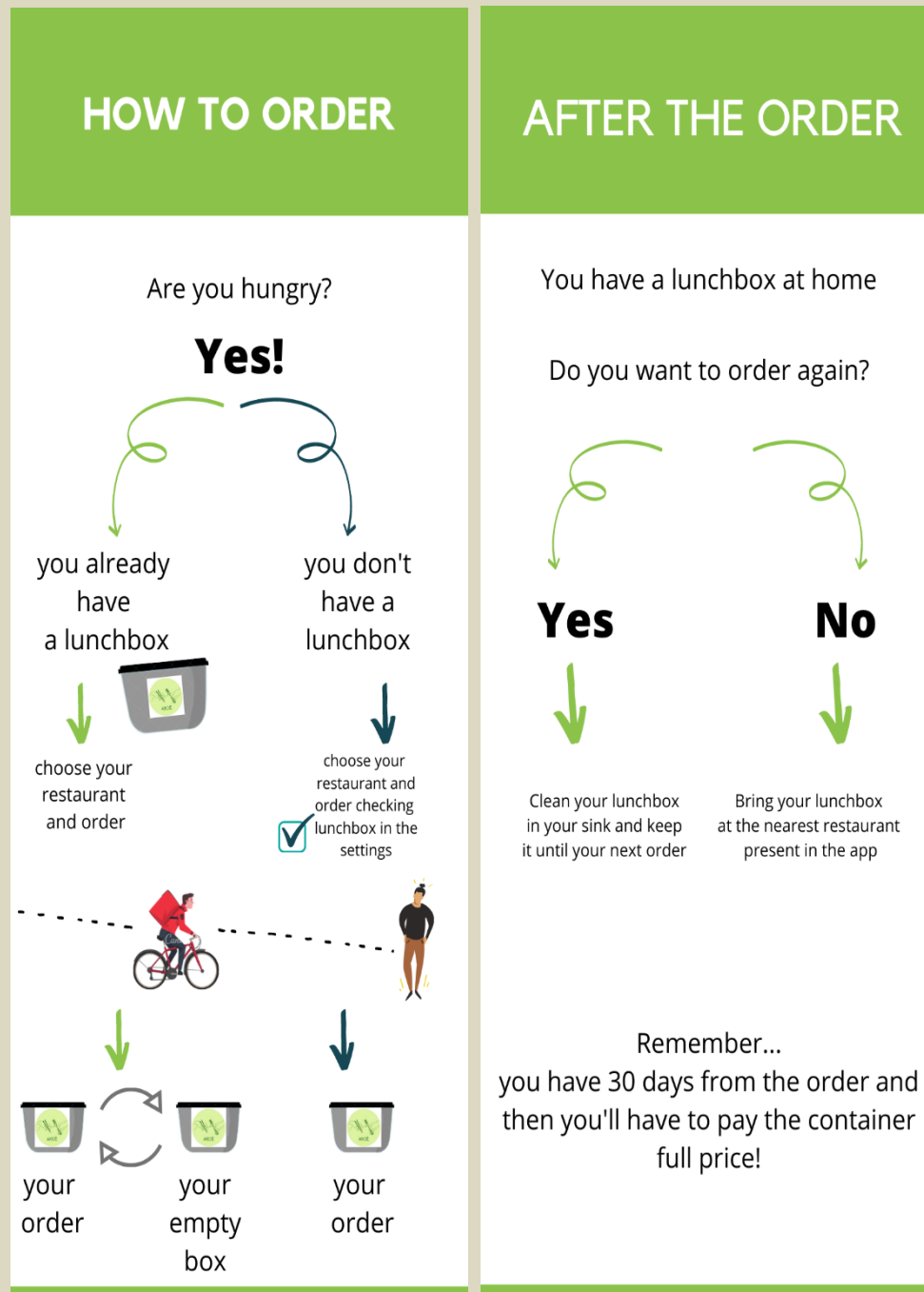


Fig. 18: Scheme of the order phase and what to do after the order



For the restaurants

After a first period of calibration of the number of containers that are used by the restaurant and the number of the ones returned, the restaurant will be checked weekly about the number of boxes in its possession, so that if there are some disparities there is a system of transports that redistributes the containers. The expenses of the boxes are managed by the ARDE' system, and not by the restaurants: nevertheless, the Restaurants will be charged with a fee equal to 10% of the Total of the order. This is the fee to be affiliated within the ARDE'S network.

The restaurants will be in charge of the cleaning of the containers: following there is a paragraph about hygiene certificates.

When our containers get to the restaurant, they must be washed and sanitized. Nowadays, every restaurant uses dishwashers to wash their crockery. They are practical and, in many ways, better than hand washing. First of all, a study conducted in six European countries shows that consumers could reduce primary energy use, GHG emissions and costs, by switching from manual to automatic dishwashing (table below) (28). In addition, dishwashers can totally remove bacteria from the plates, while hand washing can't: the number of bacteria which can be found on the plates increases seven-fold (29).

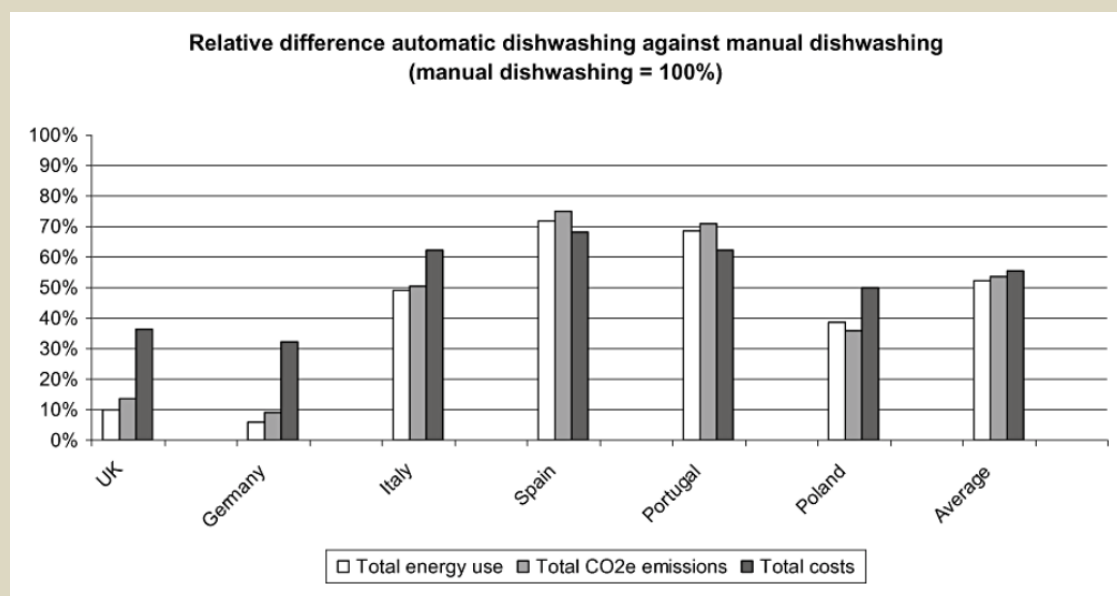


Table 2: Automatic and manual dishwashing related CO2 emissions

To ensure proper hygiene to our customers, when restaurants sign up in our app, they will have to show their HACCP (Hazard Analysis and Critical Control point) certification.



Procedures based on HACCP principles are mandatory for most food companies on the European market.¹ In Italy, the country where we would like to test our app at an early stage, HACCP system is mandatory for every restaurant, coffee bar and pizzeria.²

We would also like to add a short explanation for the customers on how to handle and wash our container properly (Fig. 19).



Fig. 19: Short guide on how to return Ardè lunchbox

¹ European Commission for Food Safety, Overview Report on the state of Implementation of HACCP in the EU and Areas for Improvement

² Italian Ministry of Health



5.3. App design

In order to adopt this system, we believe that the easiest way is to design an App that can allow customers to use it easily. We have created a step by step guide, given below.



Fig. 20

Home screen once the app is downloaded.

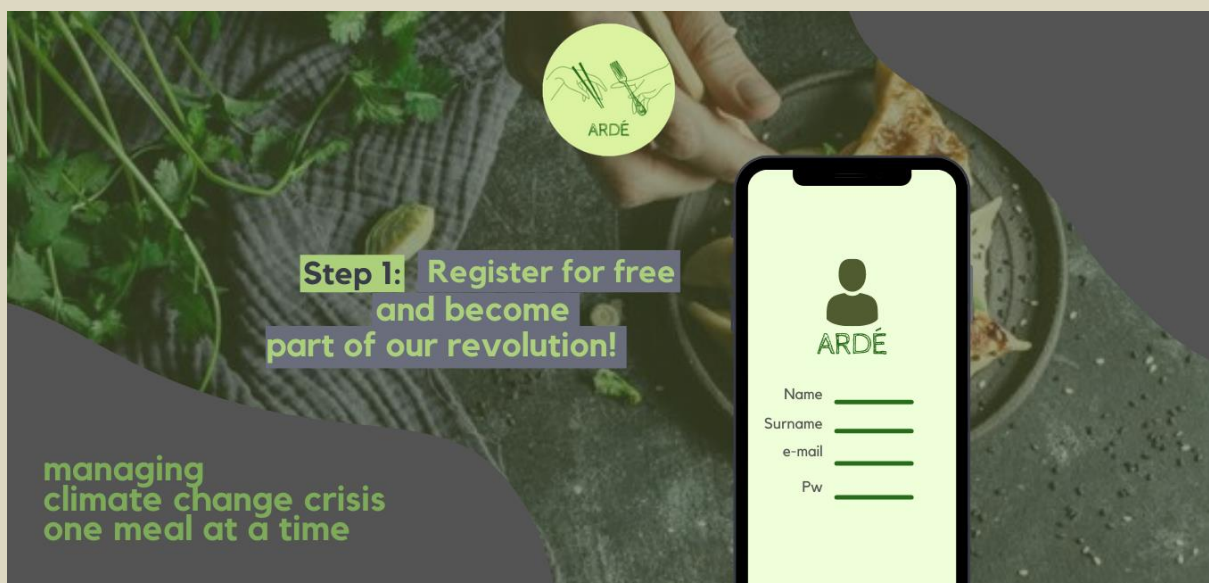


Fig. 21



Once the customer has downloaded the app, he has to register to be able to use the ARDE's delivery service.

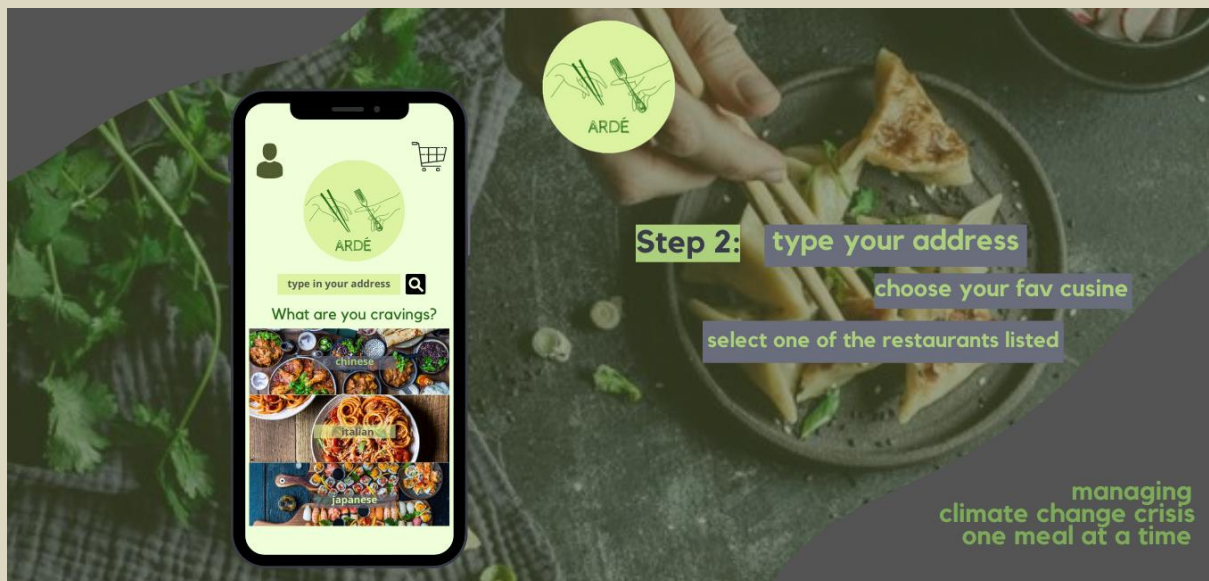


Fig. 22

Once the customer has logged in, he has to type his address and choose among the cuisines that are available in his geographical area. Next step is to select the restaurant he wants to order from.

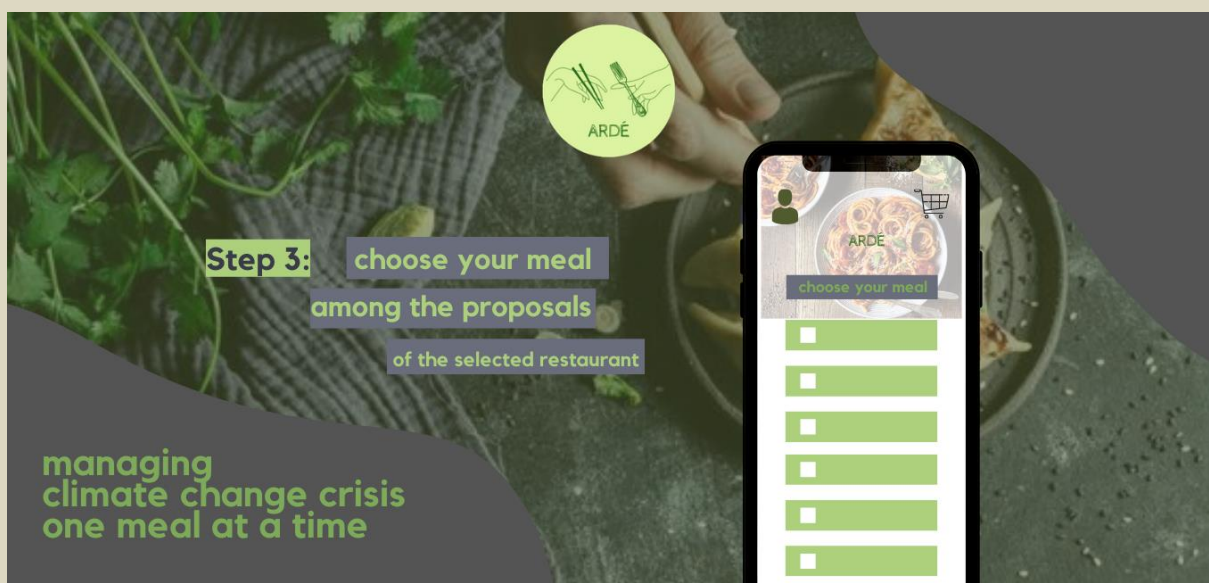


Fig. 23

In this phase, he can choose among the different proposals of the restaurant.



Fig. 24

In step 4, the customer is asked if he already has an ARDE' lunchbox or not:

- If yes, there will be no adding costs to his order, since he has already paid the rental cost once;
- If not, he will be asked to pay an additional fee to rent the lunchbox. This fee has been esteemed having regard of various element, listed below:

1. The customer can buy its own stainless-steel lunchbox starting from a price of €15.
2. our business model does not provide for the internal production of lunchboxes: we have therefore consulted online wholesale sites that sell them at an average price of €13,50 per unit.
3. Competitors rent the lunchbox for free if the customer pays a monthly subscription fee or they rent it for 5€ (this service is available in other countries but Italy. The box provided is not made of stainless steel).
4. it has to include the ARDE'S service cost: similar companies charge the restaurant with a fee equal to 15%-20% of the total amount of the order (i.e. Just Eat, Deliveroo, Uber Eats, ... [5]. Instead of imposing a service fee on the restaurant only, we decided to split it in two:



- ◆ On the one hand, the customer will pay to the ARDE' system an amount equal to 10% of the cost of the box (equal, on average, to 13,50€): this sum is different than the rental fee and will not be refunded once the box is returned.
- ◆ The restaurant, on the other hand, will pay a fee equal to 10% of the total amount of the order: this is the rate for the service provided by ARDE'.

This way, the fee paid by the restaurant will be significantly lower than the one charged by competitors (equal to 15/20% of the total order). This choice has been made in light of the latest trends recorded: due to too high fees, restaurants have preferred to organize themselves with independent delivery systems. It follows that, imposing on the restaurant a payment which - in total - is only equal to 10% of the order is a strategy to incentive to join ARDE' and embrace a green philosophy.

As far as customers are concerned, we have said that they will pay a fee equal to 10% of the cost of the box (13,50€) for the service: this amount is not refundable. However, since ARDE' is a returnable vacuum system, the customer is expected to pay a deposit for the rental of the ARDE' box. Regarding the deposit, keeping in mind that - usually - it amounts to 30-35% of the price paid for a service, we have set a deposit - to be paid at the time of the order - equal to 35% of €13.50: €4.70. This amount will be returned to the customer if he returns the box within the set time (30 days), without placing a new order.

At the time of check-out, therefore, the amount of money charged to the customer is equal to (approximating) €6

10% of the cost of the box	1.35€
+ 35% of the cost of the box:	4.73€
Total	6,00€

Table 3: amount charged to the customer at check out

If the box is returned within the limits provided, the customer will be re-credited the €4.70 spent as rental fee. If, on the other hand, the box is not returned within the limits provided and a new



order is not placed on the platform, the customer will be further charged 65% (100-35) of €13.50 = €8.77. Once this amount is charged, the box will become the customer's property. This way, we are trying to stimulate the green philosophy in clients: in fact, for a total amount of €15 (which in reality is also inclusive of the service fee), competitive with respect to the market, the customer is able to buy a lunchbox. So, even if he no longer wants to order from the ARDE' system, having a personal lunchbox at his disposal could stimulate him to order less take-away (for example when he is in the office), avoiding the waste of wrappers that are often not easily disposable.

	€/Unit
Average price of the lunchbox in bulk paid by ARDE' company	€13,50
Cost of the ARDE'S service: Nevertheless, it will be divided in:	10% of the average price of the lunchbox in bulk (paid by the customers) + 10% of the total of the order (paid by the restaurants)
Cost for renting the box	35% of 13,50€ (paid by the customers)
Total Price paid at check-out	€6
After 30 if the box isn't returned, the company will collect the remaining 70% of the lunchbox cost	65% of 13,50€
Total price paid if the box is not returned (including service charge)	€15

Table 4: summary of how the total amount to be paid has been determined, including the hypothesis that the box is not returned and the service charge.

N.B: the above calculations are a mere hypothesis, at an initial stage which, in order to be thorough, requires accounting documents that are not easily available.

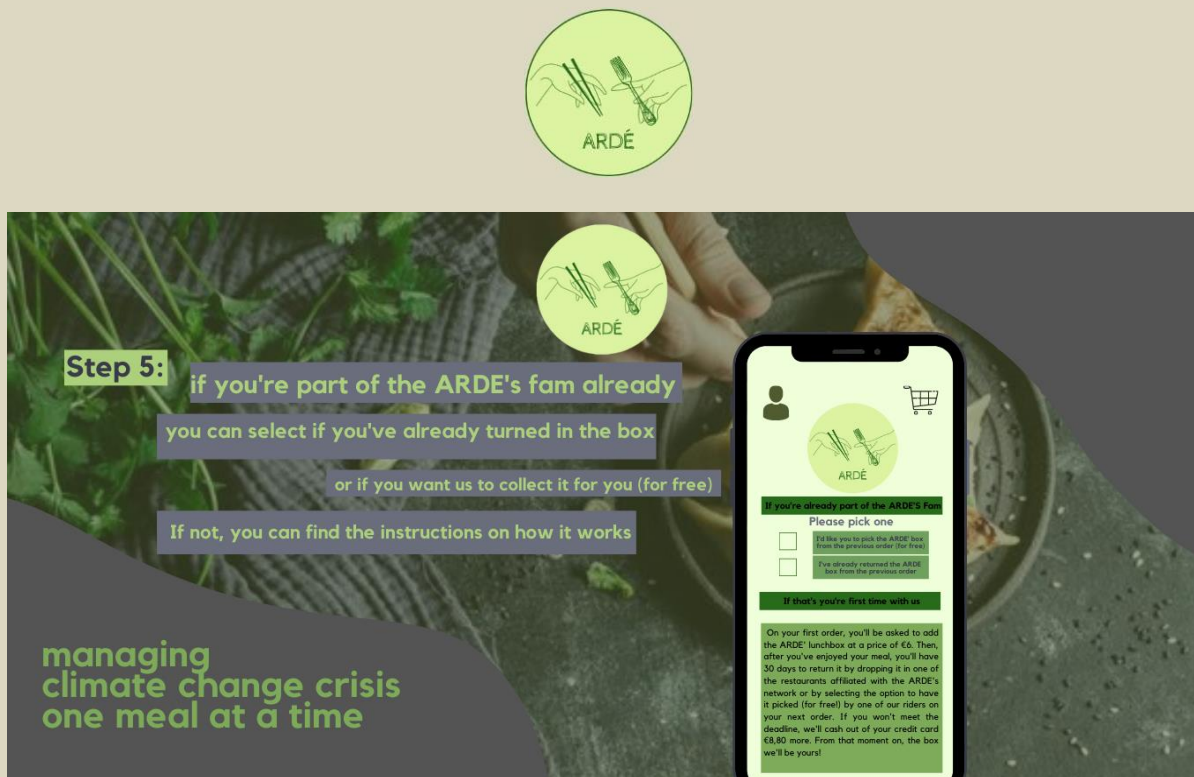


Fig. 25

Here, the customer is given with two options:

- if he's ordered already from ARDE's app, he will have to select if he's turned in the box already or if he wants it picked by one of the riders during his next order (this service is provided for free). He will not pay additional fees for the lunchbox rental.
- if it is his first order, he'll be explained the policy of the company: in short, as above mentioned - he will have 30 days to return the box to one of the affiliated restaurants or during his next order. If he won't meet the deadline, he'll be charged €8,33 more: then, the lunchbox will be his property.

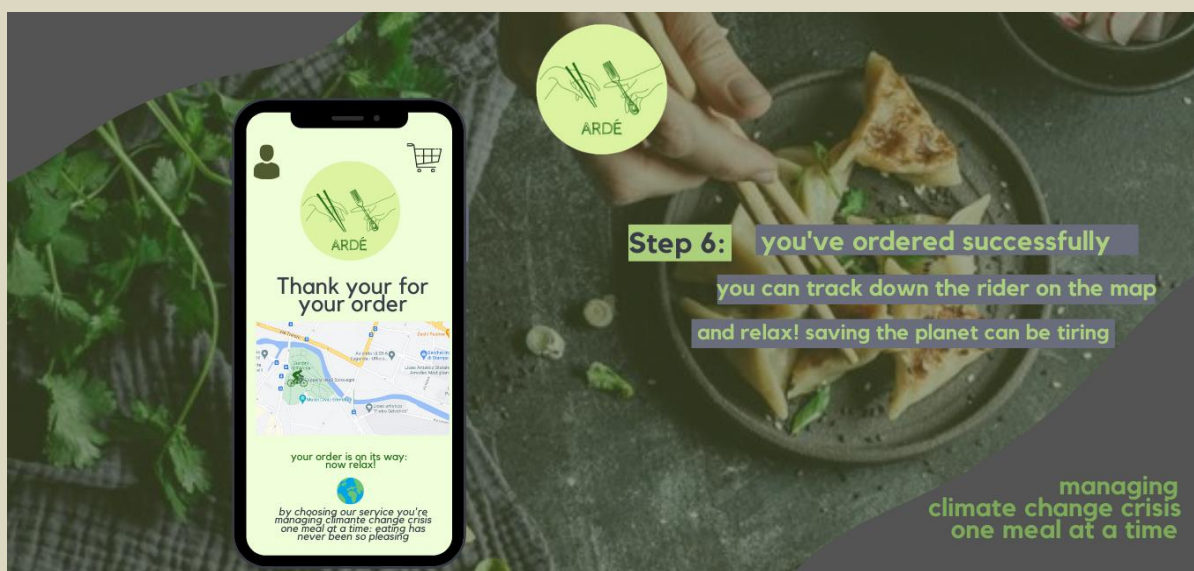


Fig. 26 The order is completed: the customer can track it down through the app.



5.4. Food containers design

The container that has been designed is made of stainless steel: as explained in the “*materials*” paragraph, this is considered the best choice from a health security and environmental impact point of view. Indeed, it is impervious to corrosive attack by animal fats, acids and salts. It’s also very easy to keep it clean simply by wiping and washing it with water, because it doesn’t have any pores or cracks to harbour dirt or bacteria. Stainless steel is chemically and biologically neutral in food contact applications and is inert to most of the compounds released by cooked foods.

It should also be noted that stainless steel is tolerant to a wide range of temperatures, from cooking to freezing, and can resist thermal shock (27). This is an essential feature for Ardè containers because they can be filled with hot food without their spoilage.

Moreover, stainless steel has a low thermal conductivity $\lambda = 17 \text{ W m}^{-1} \text{ K}^{-1}$. This means that Ardè container’s material is not efficient at conducting heat, while it is the best among metals in insulating. That is the reason why the container can keep the food warm until it gets to the customer.

About its design, a 1000ml container was chosen, so that it can be divided into two parts: there is a bigger outside container and a smaller inside basket with a handle that can be folded to the side to allow an efficient locking of the Ardè box. This way the container will also work for restaurants that serve multiple dishes.

It is a very simple but effective design, even though it is at an early stage of development.



Fig. 27: Ardè container external appearance

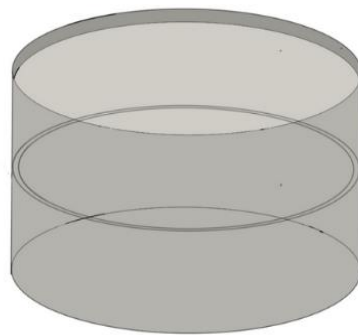


Lunchbox lid



Basket

It has a handle that helps to pull it out and can be folded to the side when the lunchbox is closed



Food container

It is designed to be a two level container: the basket should be leaning on the inside notch



Locking system

Fig. 28: Ardè container description



5.5. SWOT analysis

In order to analyse ARDE's potential, we have decided to develop a SWOT analysis of this project. In fact, by doing so it will be easier to determine how our business idea is placed on the market and which risks it is expected to face in the future.



Fig. 29: SWOT Analysis of the ARDE' Project conducted by Anna Rosso in July 2021



5.6. Risks analysis and mitigation strategies

A particular focus has been made on the risks, in order to think about possible mitigation strategies that could be implemented in a second phase of the project. Here a tabular with some of the identified risks is presented.

Risks	Mitigation measures	Severity
The restaurants is left out of containers	After a first phase of assessment the needs of the restaurants will be studied and a system of electric transport is implemented to redistribute the containers weekly: in special cases, extra transports will be provided	High
The container is not sufficiently big for the order	A section in the order would be implemented, where you can choose the number of containers you need and the number of containers you have at home, so that you can both order as much as you want and give back all the containers you have	High
People not adopting the system because there aren't enough places where to drop it	In a subsequent phase, the ARDE' system will be equipped with a system of lockers to be placed in the most frequented areas in order to facilitate the return of the box. In fact, we believe that to make this system pervasive it is necessary to make it as easy to get rid of the box, once used, as it is to throw away disposable containers.	Medium
Usury of the container (breaking and damaging)	A quality check will be made periodically to be sure that the containers are in optimal conditions to be used	Low
The loss of containers	The full price, that the customers pay after 30 days, would be increased	Low
Skepticism about using the system due to lunchbox sanitation issues	<p>OPTION A) In a second phase of the project, ARDE' will be in charge of the sanitation of the lunchboxes. Therefore, the company will pick up dirty boxes and return them clean.</p> <p>OPTION B) In a second phase of the project, the ARDE' company will set a stricter hygiene standard. In fact, the restaurants that will be able to access this program will be the ones that be accartered with higher standards (i.e. ISO).</p>	Low

Table 5: Risks analysis and mitigation measures



In conclusion, the SWOT analysis conducted on the ARDE' system and the risk analysis accompanied by the mitigation strategies that would intervene at an early or later stage of the project, **demonstrate the feasibility of a system such as this**. We believe that, if properly implemented and transposed into a business plan, it could be a full-fledged business idea that would contribute to creating a philosophy of reuse and minimization of the environmental impact of our actions.

6. Conclusions

Climate change crisis is a wicked problem that is linked to many different issues that make it incredibly hard to manage. The waste increment and the use of disposable materials are one of the main concerns: nevertheless, due to the nature of those problems the choices of the single individual, if properly addressed, can be the solution.

This project aims to reduce the pollution related to food delivery systems which is caused, mainly, by the usage of non-reusable containers. Since these ones are the most used, switching to reusable containers and to a circular system could have a great impact on the environment.

By adopting a disruptive strategy, the ARDE' project has great potential in becoming one of the most effective approaches in the climate change crisis management. It could provide a new concept of food delivery, since as today in Italy there are no sustainable options. Moreover, since delivery food systems are becoming part of our lifestyle, having a sustainable choice could also help with raising awareness on the importance that our daily choices have in limiting climate change.

Since we believe that the climate change crisis can be managed and fought by everyday actions, we chose to create a project that was actually feasible and that could become part of people's culture. Therefore, the question that is at the heart of this project was: *is it possible to have a more sustainable version of food delivery?* In this paper we have demonstrated that it is and that, by redesigning our daily habits, **we could fight climate change one meal at a time**.



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Sitography

- [1] <https://justsalad.com/our-story>, last visit on 15/05/2021
- [2] <https://www.closedlooppartners.com/nextgen/>, last visit on 15/05/2021
- [3] <https://muuse.io/how-it-works>, last visit on 15/05/2021
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- [5] [https://riccardobinaco.it/ristoratori-ecco-4-food-delivery-app-a-confronto/#Quanto costa il servizio Justeat per i ristoranti](https://riccardobinaco.it/ristoratori-ecco-4-food-delivery-app-a-confronto/#Quanto%20costa%20il%20servizio%20Justeat%20per%20i%20ristoratori), last visit on 05/07/ 2021

Pictures

Cover page: Pag. 1: <https://bit.ly/3y9Sh70>

Fig. 1: Dabbawala Delivery, Pag. 5: <https://bit.ly/3AuYz35>

Image Brochure Background: [https://blogs.webmd.com/public-health/20200826/can-i-get-covid-from-sharing-food-or-drinks?ecd=soc tw 200922 cons blog SharingFoodAndDrink&linkId=100000015391003](https://blogs.webmd.com/public-health/20200826/can-i-get-covid-from-sharing-food-or-drinks?ecd=soc%20tw%200922%20cons%20blog%20SharingFoodAndDrink&linkId=100000015391003)

Appendix A: survey that has been given, in the original language (italian)



FOOD DELIVERY E SOSTENIBILITÀ

Buongiorno. Siamo un gruppo di studentesse universitarie e stiamo effettuando una ricerca sulle abitudini

D1. Si ritiene una persona attenta alla tematica ambientale e all'ecosostenibilità?

- ☐ Sì
- ☐ Più sì che no
- ☐ Più no che sì
- ☐ No

D2. Ha l'abitudine di ordinare cibo d'asporto e/o a domicilio?

- ☐ Spesso
- ☐ Qualche volta
- ☐ Mai

D3. Se sì, con quale frequenza?

- ☐ Una volta al mese
- ☐ Più di una volta a settimana
- ☐ Una volta a settimana
- ☐ Quando capita

D4. Durante il lockdown ha notato una sua maggiore fruizione del servizio a domicilio e/o d'asporto?

- ☐ Sì
- ☐ Non ci ho fatto caso
- ☐ No

D5. Successivamente alla riapertura dei ristoranti post lockdown, ha notato una maggiore fruizione del servizio a domicilio e/o d'asporto?

- ☐ Sì
- ☐ Non ci ho fatto caso
- ☐ No



D6. Ha mai pensato al fattore inquinante che comporta l'utilizzo di contenitori usa e getta nel servizio a domicilio e/o d'asporto?

- ☐ Sì
- ☐ A volte
- ☐ No

D7. Mi può dire quanto è d'accordo con le seguenti frasi?

Descrizione (facoltativa)

1. Quando ordino cibo a domicilio e/o d'asporto presto attenzione al materiale usato per il packaging

	1	2	3	4	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Molto					Per niente

2. Una volta consumato il mio pasto, sto attent* alla raccolta differenziata buttando i contenitori nel cestino giusto

	1	2	3	4	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Molto					Per niente

3. Sono propens* a riutilizzare i contenitori che mi vengono dati durante il servizio a domicilio e/o d'asporto (qualora possibile)

	1	2	3	4	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Molto					Per niente

4. Mi piacerebbe vedere maggiore attenzione nella scelta dei materiali per i contenitori del servizio a domicilio e/o d'asporto da parte dei ristoranti

	1	2	3	4	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Molto					Per niente

5. Sarei dispost* a pagare una cauzione sul totale dell'ordine di food delivery per un sistema che distribuisce contenitori riutilizzabili (vuoto a rendere)

	1	2	3	4	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Molto					Per niente

D8. Qual è la sua età?

Testo risposta breve



D9. Qual è la sua posizione lavorativa?

- ☐ Studente/studentessa
- ☐ Lavoratore/lavoratrice dipendente
- ☐ Lavoratore/lavoratrice atipico/a (precario/a)
- ☐ Pensionato/a
- ☐ Disoccupato/a
- ☐ Altro...

D10. Genere:

- ☐ Maschio
- ☐ Femmina
- ☐ Non binario
- ☐ Preferisco non dirlo

Grazie per aver risposto alle nostre domande!

Descrizione (facoltativa)