

# The Food & Beverage value chain: How it adapts to 21st century's Macro-trends

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## INTRODUCTION

In the ever evolving economic environment that characterizes global trade nowadays, food security stands out as one of the main issues faced by institutions and individuals worldwide.

The global population is projected to grow by 2 billion by 2030 <sup>1</sup>, and this growth will put a massive strain on the global food supply. This, along with industrialization and urbanization, is increasingly concentrating the population in metropolises, leading to a rapid growth of the middle class.

The growth of the latter is strictly connected to changes in dietary habits, mainly regarding the consumption of goods like meat, fish and derivatives which are a prerogative of this economic status.

The ones affected the most by this change are the emerging markets, mostly driven by resource-intensive goods.

The goal for them is boosting land productivity with an overseas approach, moving to a more capital-intensive production, where, however, the output costs are given by the forces of supply and demand.

A liberalistic approach by governments would leave a wider scope of action to firms and stimulate investments.

Governments, businesses, and consumers all have a role to play in ensuring food security.

Regulators need to create policies that support sustainable agriculture and make food affordable for everyone.

Businesses need to develop innovative solutions to reduce the environmental impact of food production and distribution.

Consumers, on the other hand, need to be mindful about what they buy and its impact on the environment.

Regarding food and beverage, it is not enough for the industry to just grow in order to adapt to the demographic change, in fact, forecasting the needs of consumers in the medium-long term remains a crucial aspect to care about.

- Global meat consumption is projected to grow by 14% by 2030.<sup>2</sup>

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<https://www.un.org/en/global-issues/population#:~:text=The%20global%20human%20population%20reached,and%202%20billion%20since%201998.>

<sup>2</sup> OECD/FAO. (2020). OECD-FAO agricultural outlook 2020–2029. *Oecd*.

- Global dairy consumption is projected to grow by 1.6% by the next decade.<sup>3</sup>
- Global processed food consumption is projected to grow with a CAGR (Compound Annual Growth Rate) of 6.29% in the period 2023-2030. <sup>4</sup>

The data provided explains why many firms on the market are giving priority to R&D as a way to reach production methods which are more efficient and effective.

However, we are living in a timestamp in which climate change poses important constraints on the space of freedom in the research phase.

The economic concept of efficiency and effectiveness, which in the last decades drove the decision-making process, is now naturally including the term sustainability as a key element.

Governments and institutions are delegating ESG responsibilities on corporations, through regulatory and control mechanisms, to enhance and ease the achievement of objectives such as the green transition, gender equality, religious freedom and so on and so forth.

Moreover, factors such as climate change, water scarcity and energy constraints represent a further challenge for the industry.

Modern farming techniques, such as genetic modification, are being debated and are often perceived as negative.

However, their implementation may be necessary to meet the world's growing food needs.

We need an unbiased approach to find innovative and game-changing solutions, allowing the food and beverage industry to overwhelm the obstacles created by modern trends.

For this reason, we will use an objective and unbiased method of analysis to determine and scan the solutions offered by three startups (Vertical Farm, MioMeals, FoodChain), that we will use as food for thought for the thesis.

## THE FOOD & BEVERAGE INDUSTRY

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<sup>3</sup> Outlook, O. F. A. (2021). OECD-FAO Agricultural Outlook 2021–2030. *Outlook, 2030*.

<sup>4</sup>

<https://www.linkedin.com/pulse/processed-food-market-2023-2030-size-share-vbuic/>

## **Value chain**

The Food & Beverage industry value chain is the network of stakeholders involved in growing, processing, and selling the products, that consumers eat and drink, from raw material to table.

Stakeholders are all the actors that actively affect, or are affected by, any phase of the supply chain, and in particular they are: producers, processors, distributors, consumers and governments.

All the latter have the responsibility, while individually adapting to the evolving market, to deal with quality control and food security.

In fact, the actors involved, as a whole, determine the final outcome of the value chain itself.

In particular, recent history taught us how a company's reputation could be ruined because of a food related illness even though they're not at fault, and how the only way to prevent it is collaboration through the whole chain.

We've specified who are the actors in the value chain and the relations linking one to another; we are now going to overview, one by one, the different parts that constitute this network, exposing the main opportunities and threats they're going to face in the coming years.

## **Producers**

Producers deal with research, production and trade of food commodities.

The driver in the industry is agriculture, in which millions of family-owned businesses provide a backdrop for the very few multinational corporations.

Small producers, which struggle with economies of scale, should aim to establish greater collaboration as the key to reach competitive efficiency against better-structured corporations, by enhancing investments in new machinery and infrastructure.

A practical example can be seen in the UK, where grain farmers are now pooling acreages, sharing enhanced profits on an area basis.

Another important challenge faced by producers is market volatility.

Especially in this industry, the long production cycles together with weather and yield uncertainty constitute a further obstacle, coupled with significant volatility of input costs and output prices.

For example, the grain production cycle could last up to 18 months, in which capital is tied up, creating the need for differentiation in harvesting's timing and weather regions.

This shows how risk management assessments are now unavoidable in planting strategies, through the study of price and rate fluctuations.

Other than spreading crops as said, businesses hedge the risks of price movements through entering into future contracts on commodities, to lock the price in a specific period of time.

Even though capital has never been a problem for farming businesses which have operated in the industry for many generations, market volatility and weather-induced effects are now posing considerable strains on their cash cycles.

Another interesting feature of this market, on which we should focus on, is the soaring land prices trend.

Land's appreciation is the main reason why today's market is characterized by a great financial gap between entrants and incumbents.

The above-mentioned appreciation results in the creation of a separate business characterized by limited supply, that makes landowning a safe heaven to stock for both private equity and sovereign wealth funds.

Aware of the threats mentioned in the paragraph, we can now understand why, on the producer's side, it's not that simple to meet demand, and why the research for an innovative game-changer solution could be the key.

We'll later deal with Vertical Farm (chapter 2.3), a start-up that aims to be the new frontier of sustainable production in the industry.

## **Processors**

Processors are involved in the preparation of fresh foods for market, as well as the production of prepared food products.

As key actors in the chain, they need to adapt to the expected demand growth by moving to more efficient production lines and a careful selection of suppliers and distribution channels.

As we saw on the producer's side, collaboration is needed to keep up with changing trends, however, in a processor's strategy, vertical integration should be a must to reduce waste and, by that, implementing efficiency and sustainability.

In the last decade, Firms in the industry got that, and Mergers and Acquisitions operations are playing a very important role for many players to reach economies of scale.

M&A, together with joint ventures and other growth strategies are necessary to secure supplies required in the production process, but also to minimize waste and face the issue of on-time sourcing of fresh products.

Miomeal is a perfect example of vertical integration, from processing to delivering; an AI software manages their operations, by organizing the various steps to get as close as possible to a zero-waste process, but we'll see that better in chapter 3.2

## **Retailers**

In the food supply chain, retailers and distributors are crucial players in making sure that consumers receive fresh, high-quality food in a quick and effective way.

Retailers like supermarkets, grocery stores and specialized food markets are the final link in the supply chain by giving customers quick access to a variety of food items.

Retailers and distributors are making changes to accommodate the growing demand from consumers for higher-quality products, shown by the rising demand for biological, organic, regional, and sustainable foods.

As a consequence, retailers are putting strict quality control systems in place to guarantee that the food they sell lives up to their higher standards.

The challenges posed on them are multiple; they have to successfully negotiate intricate retail channels and formats while attending to the diverse demands and tastes of their customers.

While supermarkets and hypermarkets are growing in emerging industries in response to increased middle-class disposable incomes; retailers are heavily investing in e-commerce infrastructure and logistics, as online grocery shopping continues to expand.

Lowering shipping costs, increasing pick-up alternatives, and enhancing the user experience overall, are necessary in order to effectively compete in the online market, but it's not enough!

As we're going to show, R&D must not focus only on the product quality itself but also on his appeal to the consumer, which constitutes a further challenge in this really vast and competitive industry.

Indeed, once the high-quality is guaranteed, marketing comes into play in attracting consumers, through two main instruments: packaging and labeling.

Liquid and odor-absorbing pads are examples of active packaging technologies that are being utilized to boost customer appeal and extend product shelf life, but it's still not enough.

To ease quality control frameworks retailers may track the freshness of their products throughout the supply chain, thanks to smart labels that include temperature and quality sensors, bringing more innovation to packaging.

Smart labeling could be the first step to ensure not only a quality standard, but also total traceability "from farm to fork", as stated in the slogan of the start-up "Foodchain".

We will talk about FoodChain, and their use of blockchain to track and certificate the process in which a specific product is made, in chapter 4.4.

To resume in a nutshell the concepts explicit in the previous paragraph, as the ever evolving environment that rotates around the food supply forces the retailers and distributors to manage a variety of opportunities and problems, being able to adapt to change becomes a crucial feature for every player involved in the industry.

These important players can guarantee a steady and sustainable supply of food to customers worldwide by embracing innovation, adjusting to market trends, and forming strategic alliances.

## **Consumers**

The engine for the evolution in the Food & Wine industry, that we are willing to address in this thesis, are consumers.

Consumers play a crucial role in shaping the food supply chain, driving food demand, influencing food production practices and shaping the food industry as a whole.

Their concerns about food safety, food prices and food security have significant impact on the way food is produced, processed, distributed and consumed.

As a matter of fact, customers around the world are increasingly concerned about the availability and affordability of food in relation to the Growing global population.

This trend, combined with increasing demand for resource-intensive foods, is putting pressure on food supply and driving up prices.

On the one hand, consumers react to these concerns by adopting more frugal buying habits, seeking local and seasonal products, and opting for smaller pack sizes.

Manufacturers and retailers, on the other hand, are adapting to changing consumer preferences by offering value-added products such as functional foods and implementing programs to reduce waste.

By moving our focus to developing countries, we see that the more the spending population grows, the more they adopt dietary patterns similar to those at the apex of their growth path.

Unfortunately, this shift towards meat, dairy and processed foods is contributing to rising rates of obesity and chronic diseases.



If high-income countries, such as the US, are already dealing with these problems, in last years also middle and low-income are facing them, particularly in urban settings, as the World Health Organization (WHO) states: "In Africa, the number of overweight children under 5 has increased by nearly 24% percent since 2000. Almost half of the children under 5 who were overweight or obese in 2019 lived in Asia."<sup>5</sup>

As people are becoming more aware about these data and the impact of food choices on health, the demand is shifting to healthier and more sustainable products, driving the growth of the functional food market and encouraging producers to adopt more sustainable farming and processing methods.

Concerns about possible contamination at any point from farm to dinner table, motivates consumers to demand greater transparency from producers and retailers, asking for more detailed information about the origin and ingredients of what they buy.

Up to this point, data collected clearly shows how food safety remains a primary concern worldwide, posing not only a duty on producers and retailers but also demanding good shopping practices to customers.

## **Regulators**

In the food supply chain regulators face numerous challenges due to the increasingly globalized food market.

Forecasts from the Food and Agriculture Organization Of the United Nations (FAO) estimate a significant increase in demand for agricultural products, rising 50% by 2030 and 70% by 2050. <sup>6</sup>

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<https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight#:~:text=Once%20considered%20a%20high%2Dincome,nearly%2024%25%20percent%20since%202000.>

<sup>6</sup>23. Deloitte. (2013). The food value chain A challenge for the next century.

This increase in demand, along with a growing world population, requires a robust and adaptive regulatory framework.

Lots of new opportunities and challenges are popping up, due to more globalized markets, technological advances and the mass migration of people to urban areas.

It's in the regulator's duties to strictly engage with all stakeholders, to strengthen systems that ensure safe, affordable and sustainable supply in an unprecedented global scale of food production and distribution.

This evolving relationship between public sector institutions and private sector participants in the value chain is evident in several areas:

- Changing trade relations:

International trade in commodities has expanded, with countries sourcing food from a wide range of countries.

This diversity poses new challenges in securing food supplies from both existing and new trading partners, raising up a crucial aspect for regulators to focus on: tariffs.

Last year trends show how the latter have generally fallen, leading to an increase in non-tariff barriers making trade more difficult.

Specifically, small producers in less developed countries may struggle to meet stringent technical requirements and certification standards required for Large importing countries.

- Food Safety And Agricultural bioterrorism:

The responsibility for ensuring the consistent and reliable distribution of safe food is paramount important for regulators.

Despite the existence of a sophisticated regulatory system, problems with foodborne illnesses are widespread, as we've seen in the Salmonella's examples in the last decades in the US.

In addition, the growing threat of agro/bioterrorism poses additional challenges that require a robust and coordinated response by law enforcement agencies.

- Technological advances global trade dynamics:

Advances in storage, transportation and distribution technologies have led to increased global trade, particularly among emerging economies.

This has changed the overall dynamics of food trade, increasing the complexity of trade relations and requiring regulators to adapt accordingly.

- Public-private partnerships and global coordination:

There is a trend towards stronger public-private partnerships within countries and a global approach to food security, which requires greater transparency and coordination between regulators among countries with different economic structures.

Standards such as Hazard Analysis Critical Control Points(HACCP) and global initiatives such as the Global Food Safety Initiative are becoming increasingly more important in this context.

In sum, regulators have a crucial role to play in addressing these complex challenges to ensure the stability, safety and sustainability of the global food supply chain.

Their ability to adapt and respond to changing market dynamics is essential in order to fit in between the fluctuation of supply and demand, trade policy, food safety and international relations in the supply chain.

## SUSTAINABLE AGRICULTURE

### What's new?

In the previous chapter we learned who and how is running the food & Beverage value chain.

We've also addressed the main threats and opportunities this industry must face in the next few years, according to some macro-trends.

These trends, as we've seen, include demographic growth, climate change, globalization, middle-class growth which is directly related to aggressive urbanization and the creation and expansion of megalopolies all around the world.

From now on, we're going to deal with practical solutions in different areas and levels on the chain and, to do that, we are going to start from the very beginning, agriculture.

We can, on the basis of the article published by Bayer Vegetables Italia, define 3 different approaches to agriculture: conventional, biologic and integrated.

The conventional approach aims to exploit as much as possible the soil, maximizing the profits for the firm and it's usually carried out as monoculture. However, as we stated, in the last decades, preferences and standards of consumers shifted to a more healthy and nature-oriented basket of products.

To reach this shift in demand the industry, in particular producers, adopted the biological approach, demanding for an eco-labelling ensuring the application of EU's standards on biological production process.

The Integrated approach, instead, is the combination of both the conventional and biological one.

We can define it as the compromise between the economic and production needs of a firm and the health of consumers and environment, and it is also regulated by EU's guidelines.

However, "The greatest challenge agriculture must face today is undoubtedly that of being able to increase production to feed a continuously growing world, while simultaneously reducing its environmental impact".

None of the stated approaches are able to satisfy growing needs while significantly dealing with economic and environmental sustainability.

It is for this reason that the Sustainable Agriculture Research & Education Program points out another innovative and future-oriented approach: "sustainable agriculture".

**"The goal of sustainable agriculture is to meet society's food and textile needs in the present without compromising the ability of future generations to meet their own needs."**

In the pursuit of sustainable agriculture, practitioners strive to incorporate three basic goals: the development of a healthy environment, economic profitability, and social and economic equality.

Within the intricate web of the food system, which includes growers, food processors, distributors, retailers, consumers, and waste management, each individual plays an important part in the pursuit of a sustainable agricultural ecosystem.

The actors involved in this process and the food systems that support it use a variety of approaches.

Growers, for example, may implement practices targeted at improving soil health, lowering water consumption, and reducing pollution levels on their farms.

On the opposite end of the scale, conscious customers and retailers who care about sustainability might deliberately seek out "values-based" foods.

These items are grown using practices that prioritize farmworker well-being, reduce environmental impact, and strengthen local economies.

Meanwhile, academics working on sustainable agriculture frequently cross disciplinary lines, bringing together insights from biology, economics, engineering, chemistry, community development, and other domains. Nonetheless, sustainable agriculture is more than just a collection of methods; it indeed became a sophisticated negotiating process.

It focuses on the complex process of tackling various issues associated with food and fiber cultivation.

This complicated interplay between environmental health, economic viability, and social equality takes us neatly into the area of vertical farming, a transformative technique that has tremendous potential in addressing these very challenges.

## **Vertical farming**

Vertical farming in theory is “the activity of growing crops in many layers, one above the other, inside a building or under the ground, often in a specially controlled environment”.

Specifically, it is usually carried out in specific buildings or domes made ad hoc, following three different planting strategies : Hydroponics, Aeroponics, Aquaponics.

Hydroponics method consists in growing plants in an aqueous environment or in an inert medium, in which roots receive a nutritive solution.

Aeroponics, instead, leaves the plants suspended in air, the roots are exposed and occasionally misted with nutrient-rich water solutions.

Last but not least, we find probably the most interesting way to grow plants indoor; it's the simultaneous implementation of aquaculture and hydroponics and it's called Aquaponics.

Plants are again grown in an aqueous solution, but nutrients are provided by the waste produced by farmed fish for plants grown hydroponically, which in turn purify the water that goes back to them.

## **Opportunities and threats**

We've seen what is the definition of vertical farming and how advanced and innovative are the growing techniques used to implement it.

Now, we would like to show you the reason why an entire Chapter has been written on this topic.

By doing so we're going to address opportunities and threats rising with the implementation of it.

There are many PROs, but first of all we should point out the most curious and game-changer feature, which is the total absence of the use of soil in the whole process.

Just this, by itself, could solve much of the problems linked with soil contamination and its exploitation for the maximization of production, also reducing pests and diseases risk.

The choice of the essential minerals, both in kind and in quantity, to be misted on the roots allow a faster growth and higher yields of the plant.

For what regard the usage of water, the efficiency is maximized; a drastic reduction in its consumption and waste is possible due to the recirculation system, which also ensures the total absence of chemical fertilizers in the case of aquaponics.

As a matter of fact, when a producer chooses to grow through the aquaponics method, he is aware that only organic products can be used, to not harm fishes who live in the tubs and contribute to the sustainability of the system.

We've now stated a few strengths of vertical farming, but the main opportunity, as the word itself says, is the application of this technique in vertical structures allowing farming in urban areas.

But, why is it so important to bring production to urban areas?

We've seen, in the very start of this paper, that in the last decades one of the main trends is the massive urbanization, moving millions of people from the countryside to cities which are getting bigger and bigger.

According to the World Urbanization Prospect by the United Nations, by 2030, urban areas are projected to house 60 percent of people globally and one third is going to live in a city with at least half-million population's city.

By doing so, there is a growing need for fruits and vegetables in cities, leading the industry to exploit as much as possible the production's area in a non-healthy and neither sustainable way.

Vertical farming, if well-implemented, could bring the KM 0 in cities by enabling both firms and individuals to grow in narrow spaces.

Unfortunately these products still cannot be considered biologic because of EU's regulations, which put as a prerogative the cultivation on soil, however regulators are currently studying to overcome this definition of biologic.

Other limitations of these technologies are the high initial and operating costs; the need for skilled labor and the dependency from complementary technologies to let it work such as illumination, climate control, irrigation, and other factors which can lead to vulnerabilities in case of technical failures or power outages.

All said, a future in which everybody could grow their own plants for nutritional-purposes, Lacking even the simplest of gardens, might seem like something only possible in the distant future.

However, we've already seen the first autosufficient vertical farm, made by the homonymous start-up "Vertical Farm Italia"; it was made in tuscan, more precisely in Siena and it shapes up as something definitely present in everyone's future.

### **"Vertical farm" an entrepreneurial example**

"We design, develop, and coordinate projects for the creation of self-sufficient Vertical Gardens for individuals, businesses, and cities, operating in the agricultural, hospitality, educational, urban planning, and social sectors. Our goal is to promote these new productive structures at both national and international levels to create a network that integrates with and supports the current agricultural system, and to ensure greater self-sufficiency and sustainability of communities."

Vertical farm's mission states how their will is not only to implement these innovative and technological structures, but also its use for communities and society in general.

But, how can a farming technique be a positive and inclusive tool for collectives?



Well, as they also state, one can see the examples in “Vertical Harvest” and “Jackson Hole” in the U.S, where people with disabilities run the vertical farming activity for the respective communities.

Due to the importance of the topic and the curiosity we had on it, we insisted to obtain, through the company’s mail and the owner’s LinkedIn accounts, directly from the founder and director Ing. Matteo Benvenuti, a really interesting analysis on how cultural limitations and pandemic-related issues slowed down their growth, imposing a change in their projects’ direction.

He said:

“The biggest obstacle we encounter in Italy when proposing this new way of farming is a cultural one.

In Italy, people are deeply attached to the idea of traditional soil cultivation, considering it the only “healthy and genuine” way, which is actually a distorted view of farming.

Our primary commitment is to help people understand that vertical farming is not something “strange” at all; in fact, it often yields higher-quality products than those considered “genuine.”

Furthermore, we explain that we are not doing anything different from what a traditional farmer does.

From a technical standpoint, we must create projects that strike a balance between costs and benefits.

The changes brought about by COVID-19 and the post-COVID evolution of the global situation (increased energy costs, raw material prices, and inflation) have slowed down the industry, requiring a change in how we approach projects.

However, these situations have made people more aware of the need to be more self-sufficient while still being open to collaboration with others.”

This statement gives us an idea on how, to run a business, great ideas and products are not enough.

There will always be some negative exogenous factors, demanding for flexible strategies and an open-mind to change trajectory at any point in time, without trapping start-ups in their own plans.

We now want to focus on what exactly their business strategy is now and the value they bring to the industry.

This Italian pride has already differentiated their activity in three different segments, by the purpose of use: projects for privates, for firms and for cities.

The case history of the firm led us to show one for each target, which is not only an idea or a prototype, but already available and feasible projects.

The first one is the so-called “Microgreens vertical farm”: Microgreens are young vegetable greens that are approximately 1–3 inches tall, which are harvested just after the first true leaves have developed.

This system, in just 3 square meters, with production cycles of 10 days can produce the equivalent of 20 restaurant’s supply, with the only prerequisites of water, power and drainage connection.

For what regards firms, they can adopt the “Vegetarian Indoor Farm”, which refers to the creation of an indoor vertical farming system for the production of leafy vegetables, aromatic herbs, and small fruits intended for the production of vegetarian food for human and animal consumption.

It is shown how, within an area of about 40 square meters and 2 persons’ occupation, this system can reach an average production of 20 to 40 KG per week with 27 days production cycles.

The last project we want to show is probably the most interesting one: “The Agroalimentar Neighborhood”, a food and agriculture district in an abandoned urban area, establishing an hub for production, distribution, sale, and consumption of locally sourced agricultural products with the primary objectives of making the neighborhood self-sufficient and generating new economic activity in an otherwise deteriorating area.

A 30.000 square meters space will host a 2500 square meters cultivation leading to an average production of 2500 Tons.<sup>7</sup>

The financial engine of the project becomes the vertical farm.

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<sup>7</sup> [https://www.verticalfarmitalia.cloud/conoscere-le-vertical-farm/#dica\\_divi\\_carouselitem\\_0](https://www.verticalfarmitalia.cloud/conoscere-le-vertical-farm/#dica_divi_carouselitem_0)

While Vertical Farm projects and builds these systems, there are many other start-ups dealing with the production of prepared foods using ingredients from this kind of cultivation; various examples can be seen with Plenty, Agrofresh and Brightfarms.

## **DELIVERY 2.0**

In the early 2010's, many app-based food delivery services such as Instacart, Doordash, Uber Eats and so on emerged in the U.S..

However, it is only in the current decade that these platforms shifted from convenience to indispensable services.

The pivotal moment was, of course, the COVID-19 pandemic, which helped the delivery apps to get familiar to the most.

As the lock down persisted, platforms increasingly grew expanding its domain from restaurants to every kind of good related to the grocery, to the house and even, speaking about quarantine, the COVID-19 tests.

By giving a look at data, revenues in the Online Food Delivery market are forecasted to reach US\$1.22tn in 2024, which is, to get a sense of this data, the market cap projected to reach in 2031 by the "generative A.I." industry.<sup>8</sup>

However, the delivery explosion was not just the effect of pandemic, but is also the technological evolution which led to increasingly sophisticated and efficient ordering methods.

The latter gradually evolved from the introduction of telephone ordering in the 20th century, which at the time was limited by inaccurate orders, slow deliveries and a restricted choice for customers due to the lack of a well-done management system.

In the early stages, restaurants used to receive calls from clients to place the orders, requiring a dedicated phone line and additional staff to manage orders, leading to a very inefficient organization.

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<https://www.guidaviaggi.it/2024/01/12/ai-generativa-un-mercato-da-1-trilione-di-dollar-i-entro-il-2031/>

However, as we said, in the last decade the delivery landscape has significantly shifted towards online ordering platforms.

Customers are now able to give a look at menus, customize their orders and pay electronically on websites and mobile apps; this led to more convenience for restaurants which, however, still relied on traditional delivery methods.

It was only in the very last years that technological advancements revolutionized not only the ordering process, but mainly the delivering one with the integration of tools like GPS tracking of your order.

Customers are now able to place an order in a few taps on the smartphone, providing the information to the restaurant and delivery riders in real-time, giving birth to the so-called Delivery 2.0.

These third-party platforms work as intermediaries, connecting customers with a lot of diverse restaurants, and by doing so, expanding the consumer's choice and at the same time boosting business's visibility.

On the other side, they also manage an insanely huge delivery riders network, democratizing these working assets between the various activities, to let the delivery be much more efficient and to relieve the restaurant's burden.

The new logistic framework in Food delivery 2.0 is drastically innovated by the employment of cutting-edge algorithms, driver optimization techniques, reducing time waste on transits and minimization of environmental impacts through the introduction of electric or, in general, eco-friendly delivery vehicles.

On the industry side, many adaptations of the supply chain are asked by the transition to Food Delivery 2.0.

First of all, real-time orders need a rapid and well-organized inventory management, to ensure the availability of products at any time and minimization of waste through precise control while processing all the orders. However, adaptation is needed not only on the organization but, as we are going to see, also on the product itself.

As a matter of fact, menu adaptation is required on the restaurant's side, because not every product or prepared food is able to maintain their freshness during the delivery.

A careful selection of dishes is asked and, along with it, also innovation on packaging becomes crucial to preserve the integrity of the meal.

However, the rise of delivery 2.0 also gave birth to specialized delivery-only concepts and “ghost kitchens” also known as virtual or cloud kitchens.

This new concept is really effective in this new delivery landscape; these kitchens do not have an open-to-public space, they just operate online gaining an advantage on competitors due to the absence of costs associated with physical traditional restaurant spaces.

A single location is able to host a variety of restaurants and brands to operate more efficiently by sharing equipment and staff and to aim for economy of scale.

Experimentation becomes easier, and the risks associated with introducing new culinary concepts are minimized, as the need for significant equipment investments during the testing phase is bypassed.

Obviously, as in any other industry at this time, sustainability concerns may rise; in this case, single-use packaging, along with energy consumption and food waste, required vast research and development on eco-friendly solutions.

## **Opportunities and threats**

We’ve analyzed why and how the delivery industry evolved from restaurants' direct calling to the creation of a vast framework of businesses, people and algorithms managing the apparently simple food delivering process.

We now want to list, and delve into, what will be the success factors and the limiting ones for the actors operating in the Food Delivery 2.0 industry.

First, we would point out the tremendous market expansion opportunities.

New markets have been opened up, reaching approximately 2.7 billion<sup>9</sup> customers worldwide this year, due to the enormous pool of users in the

specific area constituting the 60% of total users, generating meaningful revenue streams for restaurant, fast food and grocery stores.

Because of this, an abundance of data is generated enabling businesses to inspect customer preferences and effectively customize the offers accordingly to that.

The amount of data generated and collected by delivery platforms may be a secondary business for them, by selling the big data to other corporations as many online businesses, such as social networks and browsing systems, already do as their core.

On the operational side, the overall efficiency may be enhanced by the most recent cutting-edge delivery solutions which, through the optimization of the supply chain operations, enable a drastic reduction in costs.

Something that many players in the industry should think about, and are probably already developing, is the horizontal expansion to the delivery of a wide range of shopping needs beyond meals.

These platforms may gradually become universal storefronts, in the same way as Amazon did in its process from being a book-selling business to what we know now.

Last but not least, many opportunities may be seen in the eco-friendly initiatives.

A greener-packaging, through the use of re-usable, recyclable, biodegradable, compostable or even edible materials may not only have a positive effect on the environment, but also on the firm itself.

As a matter of fact, by adopting these practices, firms may communicate the efforts, together with the positive outcome on the environment, aligning themselves with the growing consumer demand for sustainable practices.

By doing so, they spread a very good brand image and potentially attract a more environmentally conscious customer base.

We've listed the main opportunities the delivery industry may exploit in the next few years, however since it can not be all sunshine and rainbows we are now going to expose the main threats this market is going to face.

In the face of an increasingly crowded marketplace, a very intense competition between the hundreds of restaurants available in the surrounding area of every customer is understandable.

In this landscape it becomes very challenging to sustain the business in a profitable way while trying to ensure loyalty from customers.

Additionally, not only restaurants have to deal with loyalty issues; Consumers too often hop from one platform to another to search for the best-deals, bringing down Customer Retention Rates at only 21%.<sup>10</sup>

Even multinational corporations such as Amazon struggled in reaching an effective food delivery venture and had to shut it down in 2019.

In addition to that, we have to understand that they're operating in a market in which a 1% margin fluctuation may lead to a 50% profitability variation, both in positive or in negative, meaningfully rising the associated risk.

A practical example may be seen in Doordash, which in the Q2 2020 reached a \$23 millions pandemic-driven profit while reporting loss in Q3.

The same happened to Grubhub and to Uber eats, registering a \$183 million loss in Q3 2020.<sup>10</sup>

To balance the low-margin risks, delivery intermediaries were obliged to gradually increase commissions reaching a 20% or plus fee.

The high commission fees charged by the third-party platforms have a significant weight on consumers wallets and restaurant profits making it harder for both to balance the supply and demand prices in an economically sustainable way.

Another important strain in profitability is given by the growing consumer expectations, following the accustomization to the convenience of Delivery 2.0.

Faster delivery times, competitive price and higher quality are expected by customers posing lots of delivery challenges.

Merchants also have to ensure the maintenance of the quality during the transportation, raising the R&D costs on packaging and product selection.

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<https://www.fastcompany.com/90604082/future-of-on-demand-meal-delivery-ghost-kitchens-postmates-doordash-uber-eats>

To conclude, the regulations surrounding delivery apps, labor practices, food safety and frameworks like HACCP are always evolving; This regulation uncertainty may have a negative impact on business operations.

At this point, we have explored the evolution from the traditional Food Delivery to what we know now as Food delivery 2.0.

However, the evolving process has not finished yet.

We mentioned, speaking about opportunities, the possibility to expand horizontally to different products and shopping needs, but the real evolution in the industry is the vertical integration of every phase of the process.

We are going to use the proudly italian start-up “MioMeal”, which we selected between many, to explore this whole new delivering strategy focused on a zero-waste objective and the delivering of customized dietary programs.

### **“Miomeal”**

Miomeal is an Italian start-up, founded in Rome in 2019 from the idea of Marco Coscarella, a management engineer who, at the time, was an employee of a big firm in the consulting industry.

While studying about this start-up, we were so fascinated about the idea that we had to know much more than what is available online and so we asked through a presentation of how we were going to conduct it, an interview to the founder that was, fortunately, accepted.

We will use his answers to explore how Miomeal reached the recognition of being one of the 50 most innovative start-ups in Italy.

The idea was born out of the founder’s personal need to have healthy and ready to eat meals, while working as an analyst in the consulting industry.

Because of the very long shifts, he was willing to eat healthy without spending neither time to cook it at home every morning nor a lot of money for restaurant meals.

At that moment, just one firm was trying to fulfill this need, but after trying it he realized that even though they were beneficial, the taste was not as satisfying as he thought.



A market research had been made and he noticed that there were a very lot of people with the same demand, not only from his industry but from many others such as employees in healthcare.

It started with some partners with the idea of making a firm with the sole objective of delivering healthy meals at home.

However, they decided to pivot, which in terms of start up means to change the direction of a business, many times during the first years.

The new business model includes a self-catering installed by them in the client-firms offices to provide their employees with a dietary wealthfare formula.

Another pivot they decided to do was not on the strategy but on the product itself.

If, at first, they were used to delivering fresh products, they have now moved to a frozen oriented direction to ensure longer life to the high quality level they want to offer and push down the waste level.

Waste, indeed, is something that Miomeal really cares about and, in time, became the driver of their innovation.

As a matter of fact, an algorithm has been developed to reduce the waste and the inventory stock.

By linking the algorithm to their e-commerce, they, on the basis of some drivers, are able to autonomously propose offers and discounts or targeted advertising to those who are potentially more interested in that product.

These drivers are sales, stock levels, analysis of keywords in the reviews, which gives them a panoramic about what they more or less like, and the production and expiration dates.

What really works in this business model is how user-friendly it's the set-up installed by Miomeal in the client's office.

The employee is able from his smartphone to buy a meal, with all the possible payment methods such as paypal, google pay, apple pay, meal vouchers and so on.

When the payment occurs, the door of the fridge unlocks and it's possible to withdraw the 350 grams meal, and in case the worker also takes another meal the fridge is going to recognize it and accredit the cost on your account.

Unlike restaurants, The service is available 24 h and gives the possibility to all the employees, if needed, to take the meal at any time, without waiting time and with the possibility to bring it home.

With just a small monthly investment the client-firm obtain the fridge and microwaves, to heat the meals up, in loan for use.

Cost of a box ranges from 4.99 to 5.99 euros in the B2B case, while for the B2C model, it is around 9 euros for the single meal, with a minimum order requirement.

They became, in just a couple of years, the reference point for many health eating and vending machine's company, giving the possibility to expand Miomeal's branded refreshment points.

Furthermore, their way to scale up is focused on three pillars.

The first, is the expansion in the cities with more potential clients for their product and it is, in fact, for this reason that they started their business in Rome, then moved also to Milan and now they aim to the European capitals.

The second way to reach the economy of scale is the creation of a process, service and brand's standard with a white-label approach.

White-label refers to the production by a brand of a product that is rebranded and sold by another firm, which usually are restaurants willing to innovate themselves, paying a fee to the start-up.

To conclude, the most important R&D project they're working on is the placement in the HACCP, of a patent for a way to freeze products having the possibility to eat it in up to 15 days after defrosting it.

A great thank you to Marco Coscarella that allowed us to conduct this interview in an engaging manner, also providing us with helpful advice beyond the topic covered for the thesis.

## **THE 4TH INDUSTRIAL REVOLUTION**

In the preceding chapters, we've explored the global macro-trends and their measurable effects on the Food industry.

We've also examined how the supply chain is adapting to these trends through the adoption of numerous new technologies that are fundamentally altering the paradigms of production, driving the industry towards more efficient, sustainable, and responsive operations.

However, there are so many other game-changing innovations from the 4th industrial revolution that deserve to be analyzed.

The 4th industrial revolution or Industry 4.0 is a term coined at the “Hannover messe” in 2011, and refers to the industrial approach based on interconnections and automation in production processes.

Practical examples we have observed include the application of Vertical Farming techniques and the deployment of AI algorithms to optimize operations at Miomeal, enhancing efficiency while substantially reducing food waste.

We will next delve into identifying the hallmark technologies shaping the future of the Food & Beverage sector within the context of Industry 4.0.

## **Precision agriculture**

We could say that precision agriculture is the brother of Vertical Farming.

They share the same objectives and the same values but the way they operate and the technologies used are not actually the same.

The term "precision" encapsulates the strategy of targeted interventions, addressing issues in the fields with exactitude at the precise location and moment they arise.

To do that, many tools have been developed that are actually being used in this farming technique.

First of all, we have what we refer to as "Ground Technology" consisting of real-time monitoring, through the use of GPS-equipped machinery, the operations of the farm by planting, fertilizing and pest controlling the crops with stringent precision.

Monitoring on the fields, however, is not only operated from the ground.

Detailed observation and issue detection, such as nutrient deficiencies, are possible through the use of Drones equipped with multispectral cameras.

Not only from the sky, but also from space! In the industry 4.0 we use satellites also for agriculture purposes.

Whether patterns, vegetation indices and broader land-scape data are very important to manage the long-term activities and all the risks linked to them.

These technologies play a crucial role in displaying the future of this industry, where the supply chain suffers the changing dynamics of the demand due to the demographic growth and the evolution of dietary habits.

These needs, in precision agriculture, are addressed by the maximization of crop efficiency.

The panoramics about soil composition and crop data allows us to do tailored dosages of resources like water, pesticides and fertilizers to reduce environmental impact and waste.

Food availability and overall quality are important outcomes of data analytics and predictive modeling.

They both contribute in more precise forecasts which have a direct positive impact on the supply chain's planning and management leading, in turn, to increase in the overall efficiency of the production, storage and distribution. What mostly benefits from these techniques is Waste management, whose efficiency is crucial in addressing, in the context of growing food demand and environmental concerns, a sustainable supply chain.

## **Robotics**

As in all the other industries, in the food production the most part of the effort in Research & Development are oriented in the automation of processes.

Leaving apart the ethical, ideological and political concerns about the substitution of robots at the expense of human labor, we are going to see how this objective is pursued in all the phases of the enogastronomic value chain.

The starting point was assisted robotics, which refers to the use of advanced technologies depending on human presence.

This could be the case of modern heavy vehicles, driven by human workers, helping the latter to fulfill a task like seeding, planting or harvesting in a more efficient and accurate way, while reducing labor costs.

Today, many corporations in the industry, already adopted fully automated robots.

Examples can be in the automated harvesting through robotic arms, endowed with sensor and vision capabilities, harvesting crops when they are perfectly ripe and reducing wastage.

Others are the GPS guided vehicles and machinery which, with the help of Artificial Intelligence, performs tasks with a high precision level.

By automating harvesting streamlines processes, one may cut expenses and secure a sustainable and productive future.

Doing a step forward in the supply chain, we see how the processors are the one that the most already rely on automation.

As a matter of fact, every industrial revolution started the development and innovation process inside the factory.

In the Industry 4.0, the automation in processing food products by big corporations is almost done; we can see production lines forming thousands products a day, using the employment of just a very few individuals.

Other than the reasons expressed before, these “Robots” are excelling in screening and organizing in a fast and very precise way, drastically cutting down human errors.

The probably most sensible part of processing foods is packaging; at this point food safety becomes a primary concern.

Today’s machines are able to identify defects and contaminations occurring during the whole process ensuring high-quality product and maintaining hygiene standards.

The extension of the shelf life too is possible by handling to robots the accomplishment of repetitive tasks involving filling, sealing, labeling, and palletizing in a rapid and precise way.

These processes ensure a decrease in product damages and risks of contamination, packaging consistency and quality control, contributing to a reliable and sustainable supply chain.

On the other hand, however, only large corporations can afford this kind of machinery, expanding even more the competitive strategy they have on small family-owned businesses.

### **3D printing**

As we did in the last chapter, we are going to ignore the ideological and political concerns about this topic, but we will discuss it in an objective way showing how this particular industry may benefit from it.

“Much like how Lego blocks can be used to build structures of nearly any shape, 3D printing foods allows manufacturers to have greater control over the final shape, nutrition and taste characteristics of the product,” food scientist Bryan Quoc Le.

This statement from an authority in the field gives us the perception on how vast the range of use can be for this technology.

3D printing, indeed, consists in the additive printing, layer by layer, in intricate shapes made of an edible material.

The vastness of production opportunities arise from the possibility to model and customize the shape, the flavor and most importantly the nutritional values.

A very lot of studies, researches and experiments are being made to better combinations of these factors.

At the beginning 3D printing was made on products like chocolate, cheese and cookie dough by maintaining them in a liquid form and letting them solidify as soon as the layer was made.

Today it is possible to print with a much wider range of products such as sugar, cake icing to achieve complex designs with minimal efforts, coloured food ink using an inkjet style printing technology, mashed potatoes and so on. However, the most interesting applications of this technology are the hydrocolloid systems and cultured meat.

The former refers to those materials that have the ability to form a gel-like structure when they come into contact with water.

In this case they're gelatin-based ingredients mixed with any kind of flavor; the reason why it's so important is the possibility to work with it while cold.

The second one gain importance in terms of alternatives for vegans.

As a matter of fact, it consists in an inkjet style printing of meat cells composed of both meat and fat cells which appear and taste like real meat, excluding the potential moral implications.

Other meat substitutes may be done with protein extracted from peas and other legumes to create look-a-like burgers and steaks.

Even though we decided to discuss separately about this technology and robotics, we cannot ignore how the most important feature is the automation of very complex design processes.

Other strengths may be the precise ingredient control and maintenance of an incredible accuracy in dosing, meaning in a very effective waste minimization. Creativity plays a very crucial role in the creation of complex 3D food products with very particular and unseen geometries, which would not be possible in a handcrafted product.

Additionally, if customization is possible in modeling and shaping the product, it is even more important in meeting people's preferences by changing the ratio of ingredients used by just changing the settings on the machine, or swapping pods to choose completely different ingredient combinations.

Even though this may look as a practical solution to most of the issues we highlighted in this thesis, the purchase cost of the printer and the time necessary to print products it's still too high to become a profitable business.

## **IoT & AI**

Many of the innovations we've discussed, however, could not function without relying on two fundamental technologies: IoT and AI.

The former refers to the possibility of connecting all the electronic devices to form a network between them, and for this reason is called the Internet Of Things.

The application in this industry occurs when the link is made between sensors tracking different parameters, such as temperature, humidity, air quality and so on, while, at the same time, automatically moving this data to the systems directly operating on the plants.

An example may be a sensor detecting a non-sufficient humidity level, sending a signal to a sprinkler which identifies and rearranges humidity to its ideal level.



It also may ease traceability of inventory in the production process, through the use of interconnected RFID tags, barcodes and others providing sensible data to all the devices operating on that product in the factory.

IoT reduces the need for manual inspections, it enhances transparency and enables efficient decision-making improving waste management, food safety and ensuring high-quality products to the consumers.

However, the real potential of the Internet of Things is exploited when the data collected are used for advanced analytics and predictive modeling through machine learning.

It is for this reason that we chose to put together, in the same paragraph, the IoT with AI.

Even Though Artificial Intelligence is already in our daily life, not everybody understands the real use you can make with it, at the industrial level, if connected to the IoT.

Imagine how an AI, analyzing and making real-time decisions autonomously on the basis of the data collected from all the electrical devices monitoring the air parameters, the color of the leaves of a plant and the presence or not of bacterias, would improve risk and waste management, while increasing the overall efficiency.

The detection of contaminants through pattern recognition may be used to maintain safety standards and ensure consistent quality.

To conclude this analysis, we are sure that we will see, In the very close future, very interesting advancements in AI that will further improve the food production industry.

## **“Foodchain”**

Until now, we have examined technologies that enhance the product quality, in terms of deliciousness and food security.

Presently we’re going to show you a start-up dealing with transparency and legitimation, through recognized decentered certifications, on the life of the product “From farm to fork”.

The name of the start-up “FoodChain” explicits the content of their operations, which is based on the Blockchain technology to track any transaction, made with that good and with the parts of which is composed.

The term Blockchain, at this point, is already globally known but maybe not all the readers know what exactly is and how it works.

It, in fact, refers to a Digital Ledger Technology (DLT), providing decentralized storage of information which, once registered in it, will not be able to be modified or deleted.

In practice, a set of data called “Block” is linked to a previous one, and will be later linked to the next one, forming a metaforic chain; From this, the name!

The most important aspect is the decentralization, which allows not to have a central authority managing it, but it’s daily implemented and filled by individuals, sharing, in real time, all the data embedded in it.

Now that we’ve seen how this technology works by itself, we have to focus on its exploitation in daily life.

Among many, the most known way to use it are cryptocurrencies, such as bitcoin, however it’s the FoodChain’s application, what we are really interested in.

As said, the core objective is to ensure food security and transparency through the whole Food & Beverage supply chain, but let’s see, one by one, all the steps.

- Producers will be able to show authenticity, by entering all the information about the product, from the origin of raw materials and cultivation or breeding methods, to packaging and labeling.
- Large-scale retail distribution (GDO in Italy) will let the consumers see and compare the intrinsic quality of the products by accessing registered information at any point of the supply chain.
- Public administration will be helped by a blockchain-based tracking model to drastically reduce counterfeiting and the fake “made in” phenomenon.
- Transparency on logistics will increase in terms of providing reliable data on stocking-centers quality, product conservation timeline and the organization of delivery periods.

- Furthermore, for what regards delivery, it will be possible to track at any single moment the location of your product, its status and the guarantee that it will be delivered in the pre-arranged terms.
- To conclude, it will ease and speed up the certification bodies work, by the utilization of a tool providing added value to an information's certification.

The vision of the firm, which we see as the most important step this industry has to take in his evolution to the 4.0, is having every single product on a supermarket's shelf equipped with a qr code providing certified and very detailed information about its life.

By doing so, we're going to benefit from it in terms of food safety and the risk connected to it, but more important, as a country, ensuring that the "made in italy" brand is not misused in the world's market.

## **CONCLUSION**

In this thesis, we have detected and argued all the challenges that the food & beverage industry is going to face in the next years.

This challenge, as seen, refers to the change in dietary habits given by the main trend the world is facing such as demographic growth, climate change, massive urbanization and the rise of the middle-class.

Precisely, we've seen how this translates, on the consumer's side, in a more aware consumption, with a rise in the demand for sustainable, transparent and innovative processes for the production of food related goods.

On the other hand, however, the same trends may be seen, by open-to-innovate firms and start-ups, as opportunities to be exploited, which in many cases, as we've shown, result in the fortune of the business itself.

We then analyzed the structure of the supply chain in the industry, focusing on the actors to understand why and how they've been affected by the concerns above mentioned.

In this sense, producers and processors need to constantly adapt their business models and processes to the very fast adjustments, occurring in the industry, to remain competitive against competitors.

Regulators should be, as well, ready to move their focus on latest trends to intercept them and provide a policy framework providing the supply side with clear guidelines to operate safely and sustainably, while reassuring the consumers about the high standards operated in the context of food security.

The practical application of what we've seen in the first chapter, has been further shown in the following chapters.

Sustainable agriculture, in response to climate change and urbanization, gave the possibility to research and develop many innovations and technologies aimed at moving the production to a zero-impact direction.

This is the case of "Vertical Farm", which not only aligned his mission to that objective, but also aimed at furnishing cities with KMO fruits and vegetables.

Furthermore the founder provided us with an analysis on how cultural limitations and pandemic-related issues slowed down their growth, imposing a change in their projects' direction.

We've focused on how the delivery industry evolved itself, providing us with a vast choice of alternatives in what, how, when and where we want to order our meals and groceries.

We delved into the details by showing the world of "Miomeal", through a very interesting and stimulating interview kindly granted by the founder itself, showing how they manage to provide healthy and complete meals, to employees in work environments requiring very long shifts, at any moment and with really contained costs.

To finish we illustrated all the 4th industrial revolution inventions and their applications in this sector.

Clarifications have been made on the most interesting ones, providing the readers with insights about precision agriculture tools, application of robots on the field, in the factory and in logistics and the very interesting way to link the network made by the internet of things with the use of A.I. to allow autonomous working of machineries.

We concluded by showing the very interesting world of the blockchain which, within its endless applications, provides us with a transparent, detailed and

undoubtable decentralized certification about “ins and outs” of food related products.

To do so, we analyzed the first mover in this market “Foodchain”, whose objective, indeed, has always been the possibility to track “from farm to fork” every single product on the shelves of our favorite supermarket.

We hope that, during the reading of this paper, you were able to gradually obtain awareness of the inputs, and how they change in time, in the food value chain.

To conclude, we want to thank you for reading and repeat how during the writing of this thesis we excluded any kind of ideological and political opinions, so that you’ll be able to form your own, on the basis of a very neutral and objective approach.

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