POLITECNICO
MILANO 1863

DESIGN SCHOOL

Master's Degree Course in *Product Design for Innovation*

NEMO 2040

A driverless transportation and delivery system of zero-miles agricultural products for Milan city of 2040: sustainable development and territorial valorization

Supervisor: professor **Stefano Marzano**
Co-supervisor: **Stefano Ivan Scarascia**

Master's degree thesis of:
Francesco Foschi - *873295*

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Academic year: 2017 - 2018

Dedicato a mio nonno Gino e a mia nonna Tina, che mi hanno insegnato ad amare la Natura e la Terra.

Dedicated to my grandfather Gino and my grandmother Tina, who taught me to love Nature and Land.

Index

Part 1: a theoretical model for planning

Part 2: a practical hypothesis

Abstract

What inspired this project has been the seriousness of problems that today's World is exposed to: cities became places hard to live in, due to pollution and population density; rural areas faced a deep depopulation phenomenon that led to a cultural impoverishment and an identity loss; agriculture field will be put increasingly under stress, having to reduce emissions and considerably increase production to feed almost 10 billions of people in 2040.

With these problematics in mind, it's been designed *Nemo2040* system: it's a driverless transportation and delivery system for Milan city of 2040 that allows to transport fresh locally produced food from the rural areas near Milan inside the city, putting directly in connection producer and consumer.

The project conceived aims to rethink the society framework, proposing a more distributed and sustainable one that can draw a path outside this problematic environment.

Starting from the food and its identity value for the people and considering the possibilities offered by new technologies, it's possible to rethink our values and priorities, toward a more sustainable way to live, giving value to territorial identity and giving economical possibilities to the rural communities. Combining the possibilities offered by driverless mobility and precision agriculture it really can be imagined a better future, that is not so far.

Ciò che ha ispirato questo progetto è stata la gravità dei problemi a cui il Mondo di oggi è esposto: le città sono diventate luoghi in cui è difficile vivere, a causa dell'inquinamento e della densità abitativa; le aree rurali hanno subito un fenomeno di spopolamento che ha condotto ad un impoverimento culturale e ad una perdita identitaria; il campo dell'agricoltura sarà posto sempre più sotto stress, dovendo ridurre le emissioni e aumentare considerevolmente la produzione per sfamare quasi 10 miliardi di persone nel 2040.

Con queste problematiche in mente è stato progettato il sistema Nemo2040*: esso è un sistema di trasporto e consegna senza conducente pensato per la città di Milano del 2040, il quale permette di trasportare prodotti agricoli locali freschi dalle aree rurali vicino Milano all'interno della città, mettendo direttamente in contatto il produttore e il consumatore.*

Il progetto concepito vuole ripensare l'assetto della società, proponendone uno più distribuito e sostenibile che disegni un percorso al di fuori di questo contesto problematico.

Partendo dal cibo e dal suo valore identitario per le persone e considerando le possibilità offerte dalle nuove tecnologie, è possibile ripensare i nostri valori e priorità, verso un modo di vivere più sostenibile, valorizzando l'identità territoriale e dando possibilità economiche alle comunità rurali. Combinando le possibilità offerte dalla driverless mobility e dall'agricoltura di precisione, si può veramente immaginare un futuro migliore, che non è poi così lontano.

Prologue

Depopulation as effect of globalization. The case of Trebbiano Nizza (PV).

As will be described in the following chapters, World faced a drastic change during the past decades: the *Second World War* brought massive modifications in Society which transformed from rural to a urban one. The effects of globalization on rural areas have been particularly evident: during the last decades a depopulation phenomenon invested many communities, and this led to a serious loss of cultural features, uses and customs that have been abandoned.

In this prologue, few photographies have been chosen to witness this loss occurred in one of the little towns located on the Appennini mountain chain, that crosses all Italy from North to South, where depopulation had the most serious effects. Trebbiano Nizza (PV) is taken as an example of this process: from the first decades of the 20th Century, where many families used to live and work in crops, until today's World, where very few people keep on working there keeping traditions and memory alive.

But people are not alone: agricultural products, spontaneous plants and wild fruits keep that memory alive, and together with the effort of the people, they wait to be reconsidered and repurposed to become again a foundamental part of Italian Identity and Economy.

1 - Rosina, G. (1994) *Harvest.* Published in *'Ponte Nizza, da casolare a Comune'.*

2 - Maruffi, V. (2014) *Stable work*. Published online at valeriomaruffiphoto.com.

3 - *Trebbiano Nizza school alumns in 1910*. Published in *'Ponte Nizza, da casolare a Comune'*.

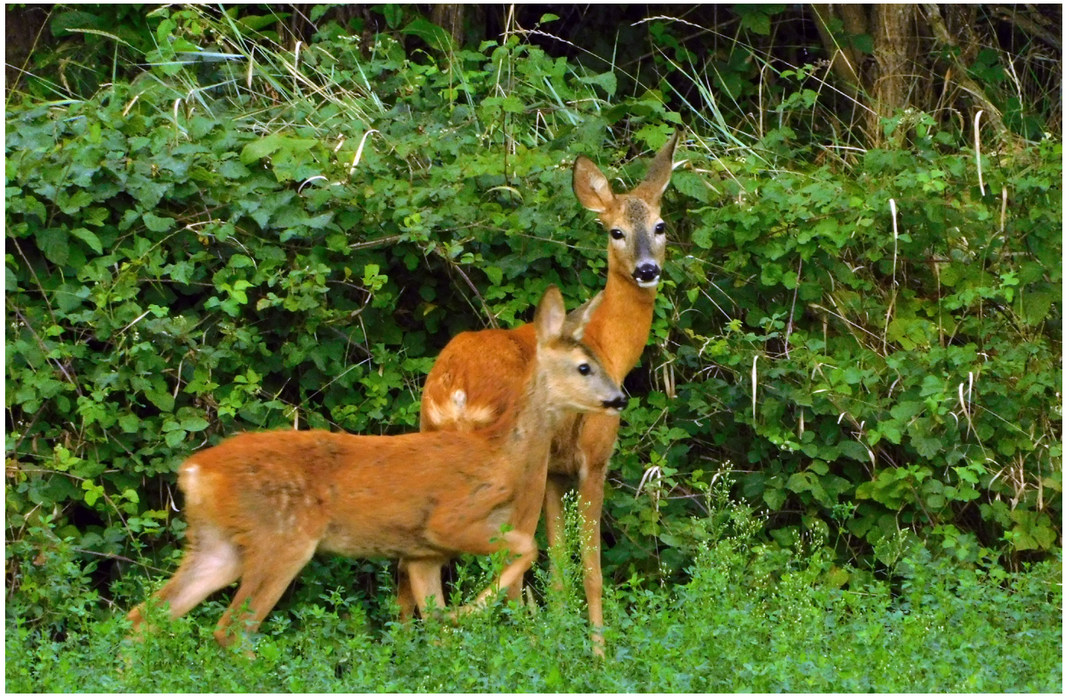
4 - Foschi, F. (2018) *A wild kaki tree.* Personal archive of the author.

5 - Foschi, F. (2017) *A water mill.* Personal archive of the author.

6 - Foschi, F. (2018) *An abandoned tractor.* Personal archive of the author.

7 - Foschi, F. (2018) *A collapsed house invaded by vegetation.* Personal archive of the author.

8 - Foschi, F. (2017) *Trebbiano Nizza in summertime*. Personal archive of the author.



9 - Foschi, N. (2018) *Mother and puppy of roe deer*. Personal archive of the author.

10 - Maruffi, V. (2014) *Wine harvest*. Published online at valeriomaruffiphoto.com.

11 - Foschi, F. (2018) *A wild apple tree, and the local church in the background.* Personal archive of the author.

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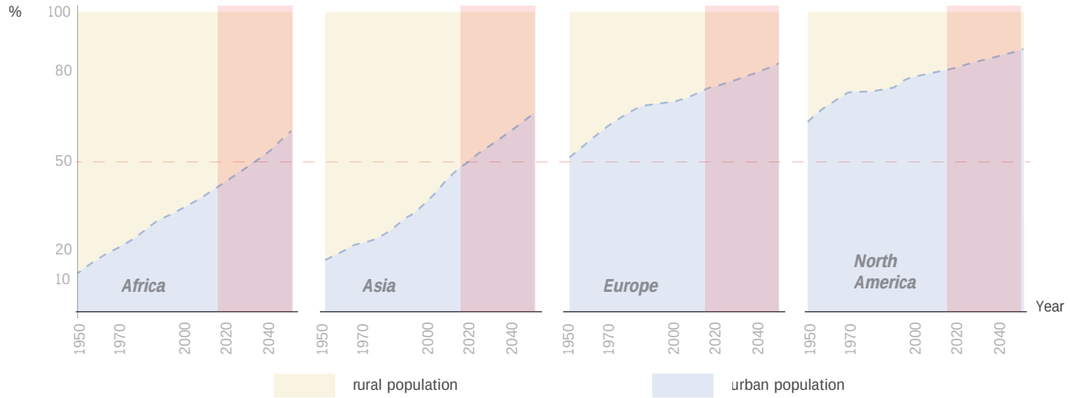
Introduction

Picture 1



The urbanization process that started after the *Second World War* is destined to continue its exponential growth involving, in the next years, a substantial change in human population distribution on Earth. According to a study conducted by *United Nations Department for Social and Economic Affairs*, World population will reach 9.7 billions by 2050, and about 2 inhabitants on 3 (68%) will live in cities[1]. Moreover, still according to this paper, megacities (that are cities with more that 10 millions of people) number will raise: these centers were 10 in 1990, they are 20

Picture 1 - *Graphic that shows the forecasted development of urban and rural population. Published on World Urbanization Prospects 2014 - P. 8.*

1 - *Cf. World's population increasingly urban with more than half living in urban areas, 2014. Published online at un.org*

now and will be 41 by 2030. This radical change will lead to a deep transformation in cities and many problematics in today's urban centers will inevitably worsen, also considering the heavy urban situation caused by environmental pollution and resources supply instability. For these reasons a "passive approach" to future cities development is not feasible, and it's necessary to act firmly to plan and design the next future, a future where urban centers will be critically important, giving it stability, liveability and sustainability. As John Wilmoth, Head of *United Nations Population Department*, suggests:

"Urban area management became one of the most crucial challanges of 21st Century development. Our success or failure in building sustainable cities will be an important factor in success of United Nation post-2015 development program." [2]

Given this topic complexity, it's necessary an holistic approach that considers all the functioning aspects of the "city system" such as mobility, energy, water and food supply, wastes treatment, education, healthcare, emergencies management, studying the potential specific problematics as a base for strategic development.

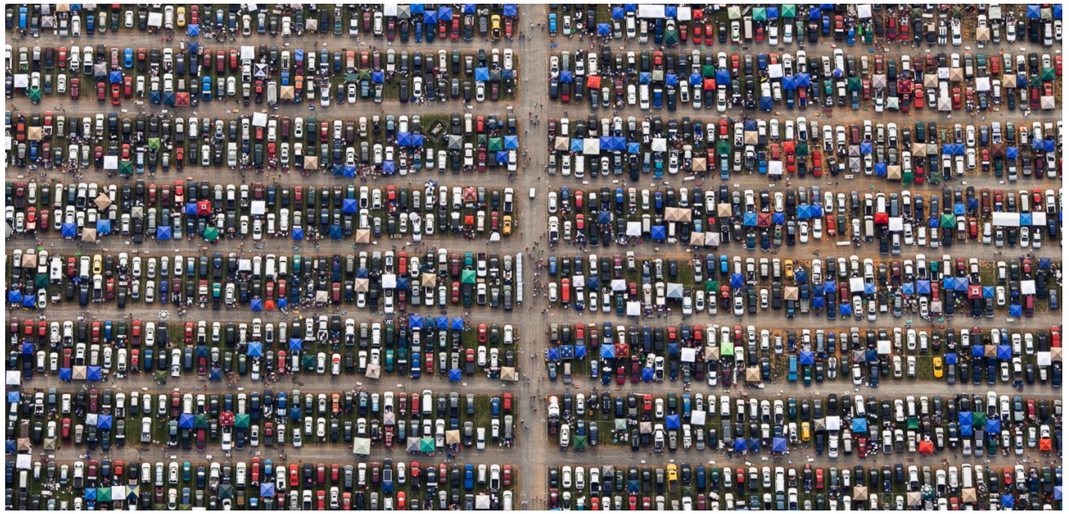
Regarding wastes generation for instance, it's estimated that every year, in Europe, every citizen produces 480 kilos of trash [3], and it's easy to understand the complexity of this issue in a city inhabited by 50 millions of people.

If we think about energy supply, we cannot plan to keep the same system we have been using until today, exploiting not renewable sources of energy obtained by fossil fuel; it's estimated that approximately 70% of global CO2 production happens in cities, that negatively affects life quality.

The area that, seen with a few year perspective in the future, asks for attention for the issues it generates is the one of mobility. This term means both the citizens movement using private or public means of transport and the transportation and delivery of goods and resources. In such a congested context like the future one, a system that follows today's principles it's clearly unsustainable:

"We cannot propose to 7 billions people today and 9 billions in few decades a standard of mobility [...] where every family owns two cars: even if we transform all today's cars in the most advanced hybrid cars, we will still have jams." [4]

2 - *Cf. World's population increasingly urban with more than half living in urban areas, 2014. Published online at un.org*
3 - *Cf. 480 kg of municipal waste generated per person in the EU, 2018. Published online at ec.europa.eu.*



Picture 2

It's clear that there are many issues in the actual mobility system. Besides environmental and acoustic pollution, a poor resources management is obvious. It's estimated that every owned mean of transport lays unused for 90% of the time; this asks for broad spaces to stock used vehicles into, space that is took from certainly healthier uses such as green areas, parks, pedestrian areas or cycle paths.

Mobility importance for present and future cities liveability deserves particular attention: the high density rate asks for an accurate optimization of spaces and resources, and damages caused by pollution pushes toward a deep change. An effective management will be important.

This sector development will happen exploiting systems that are potentially suitable to guarantee a smart mobility management. Car and bike sharing systems (already present in many cities and used

Picture 2 - *Cars parked at a Nascar Event in Richmond, Virginia. Photo: Alex MClean. Published online at alexmclean.com.*
4 - *Cf. Ezio Manzini speech (6:40 min) at The Alfred Deacking Eco-Innovation Lectures, 2009. Published online at youtube.com.*

Picture 3

Picture 3 - *Megacities development for the 2010-2025. Source:* John Vidal, *Here comes the Megacities. Published online at edge.ensia.com.*

by millions of people every day) offer good efficiency signals, allowing to share means of transport among users for resources optimization. Clean energies from renewable sources (sun, wind, water energy) will be fundamental to release pollution dangers.

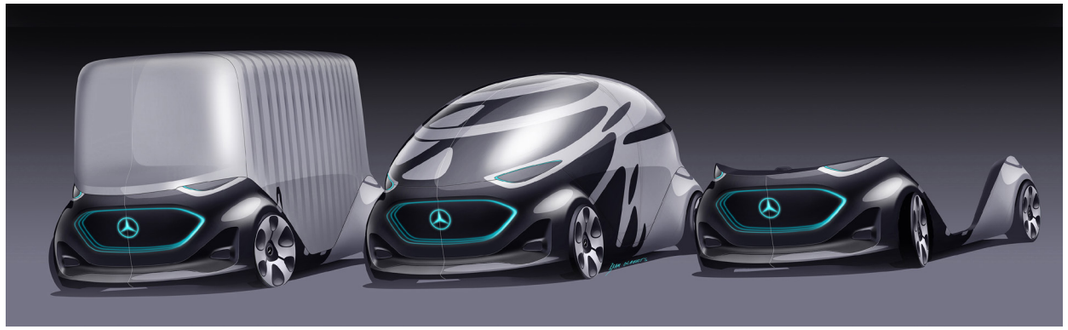
Among all the development possibilities, autonomous driving systems offer the most interesting perspectives. Driving autonomy will allow an incredible use flexibility, leading to release traffic pressure, a drastic reduction in accidents number (about 80% of them happen due to drivers' inattention), and mostly a better management of urban surface.

Many institutions already understood the importance of design future mobility and started to foresee the possibilities offered by new technologies, and some of them started to propose possible solutions. In September 2018, *Mercedes* presented a new mobility vehicle concept called URBANETIC: an autonomous multifunction vehicle that can be used as a people transportation mean or as goods transportation and delivery vehicle; *Postmates* platform, in collaboration with *Ford*, tested a completely autonomous delivery system, that has already been tested in Miami Area; *Amazon* tuned an innovative delivery system run by drones...this list could continue.

The theme of future urban mobility, opportunities and risks offered by electric selfdriving vehicles has been at the core of *Final Synthesis Design Studio* for the academic year 2017/2018, for *Product Design for Innovation* study course at Politecnico di Milano. The laboratory has been a big debate around mobility topic where students tried to make a contribution to during 5 design workshops, everyone focused on a different side of this huge theme.

In particular the Workshop n°2 managed by prof. Stefano Marzano and Stefano Ivan Scarascia developed from a provocative pseudo-announcement made by Milan Municipality: it announced the approval of an urbanistic plan that would have forbidden, from 2040, to get into the city to all the not-autonomous and not-electric vehicles. This huge constrain forced the students to totally rethink the entire mobility and generated many new opportunities for all the sectors that today use means of transport to offer a service. Just to name few of them: private and public citizens mobility, transport of goods, public security, wastes management, that in many cases comprehend the extra-urban and regional area.

From this workshop the project here presented has been developed. From the constrain posed by future mobility in



Picture 4

Milan urban area arose a discussion that, starting from the actual situation in urban environment, enlarged to a global frame, with the aim of studying socio-economic phenomena connected to megacities generation.

The starting point for this project has been the consciousness of the actual situation criticalities: environmental degradation, social and economic inequalities force to imagine a different reality, a better reality. The main problematics regarding the contemporary ecosystem have been studied, proposing a urban and global life scenario based on more conscious and right models supported by more sustainable products, systems and infrastructures.

An attempt has been made to imagine how the future *could be* if we allowed that today's cities would evolve in tomorrow's cities keeping the situation unchanged, trying to propose a vision about how it *should be* describing also an approach to apply for its design and planning, a proposal for a theoretical reference line.

This approach develops on 3 general levels: social, economic-productive and cultural. For each of these fields a theoretical research has been made about the actual condition, analysing the main issues and identifying opportunities on which to build the project of the future global context.

Certainly the design process required to better the current situation and to create such an efficient context requires time and especially a multifaceted approach, to deepen all the the factors that come

Picture 4 - *URBANETIC, a vision project created by Mercedes-Benz. Published online at: quattroruote.it.*

Picture 5

into play in today's and future life and to design it in a more coherent manner. The contribution pursued with this document, apart the definition of theoretical strategic guidelines, it's an application of these principles in a project that could translate the theory in concrete practice, also defining the role of the designer in this changing context.

This case study developed focusing on food world. More precisely it's about a transport and delivery system that exploits a completely autonomous infrastructure (designed on purpose), made up of self-driving and electric vehicles capable of delivering fresh agricultural products from the zones near the city to all the urban area.

It has been a way to think about the possibilities offered by the Workshop constrain, pursuing one of the many aspects that have to be studied and planned for the next decades megacities. Theoretically, this project implies many advantages: an important shortening of food production and supply chain, an economic boost for

Picture 5 - *Antwerp industrial port. Photo: Harry Gruyaert, 1992. Published online at: magnumphotos.com.*

local producers and an exploitation of the territory, decreasing pollution and wastes connected to long transport and protecting both the consumer and the producer, thanks to traceability and the tighter relationship between the two, with the farmer that can sell more easily his products and can work more independently.

Today's crisis concerns (as will be described in the following chapters) different sectors and the deep transformation that will happen in the next few years forces to rethink the approach to resources production and management and to the life model developed in the contemporary globalized world.

The consciousness of problems and knowledge of potentially disruptive technologies create the opportunity to totally rethink the general frame, life models and the main values of our society. The goal is to imagine a better future, more liveable and sustainable, where smart management of resources breakes the vicious circle of environmental and social degradation, drawing a new reassuring scenario for the future generations.

The choice of the food world is a statement of renunciation of all the superfluous, of everything that our society can live without, of all that constitutes a resources waste, going back to what really matters, to the thing that more than anything defines us, socially and culturally. From this we have to go back to rebuild the society on our identity, the one that just the element "food" can tell. As Petrini said:

"Food is the product of a territory and its vicissitudes, of humanity that inhabits it, of its history and of the relationships it built. Every place can be described talking about the food produced and consumed. Telling food stories, agriculture, restaurants, trades, local and global economies, tastes and even hunger stories are told. [...] Food mirrors the complexity of what exists and of the past history, of the interweaving of cultures, the overlapping of different production philosophies." [5]

This project aims to propose to restart from food, and through its trade using the autonomous system designed, rebuild that link between society and territory that has been dramatically broken during the globalization process. From the damages caused, rethink our society and its values starting from food and what it represents as an identity element for men and the territory, drawing a future of liveability in urban context, local economy, territorial exploitation and identity consciousness.

5 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 50-51.*

Part 1

A theoretical model for planning

1.1

*“Posteri, Posteri! Vestra res agitur dies facem praefert diei nudius perendino!”**

Inscription on a tombstone near Vesuvio
that warns to escape at the minum noise of the vulcano.

Social level: for a creative and conscious society

To talk about social innovation can be useful to start from the definition that many scholars of these phenomena share, to describe this principle and its implications. Social innovation is defined as a set of:

“*New ideas (products, services and models) that simultaneously satisfy social needs and create new social relations and collaborations. In other terms, are innovations good for both the society and its capacity to act.*” [1]

From this definition, created by *Nesta* (an international organization that works in social innovation field) and shared, among the others, by Ezio Manzini and the *European Commission*, two important concepts can be isolated. First when we talk about the satisfaction of a need it’s implicit the presence of a problem, a situation that isn’t good in a given context and that it is solved with the creation of new ideas. The second and more important point implies that this problem satisfaction leads to new favourable situations (new social relations and collaborations) inside that context, that can be a neighbourhood, a peripheral zone, an entire city. These situations can create new dynamics in the social fabric and give the citizens new opportunities and new abilities to act.

Some examples of social innovation are two projects developed in places that are very far one from the other, that follow the same guidelines of solving social problems and creation of favourable situations for the community, sign of a generalized

** - Trad: “Posterity, Posterity! It’s in your interest. The experience teaches the life to come”. Cf. Albrecht, Magrin, Il Bel Paese. 1 Progetto x 22.621 Centri Storici, 2017 - P. 14. P. 24.*
1 - Cf. Ivana Pais intervention (min 28) at “Le Mille facce dell’innovazione 2017-2018” conference. Published online at youtube.com.

phenomenon.

Coltivando is a project conceived and realized by a group of students coming from Bovisa Campus of Politecnico di Milano which, supervised by researchers and teachers of the university, designed through co-design sessions a green space inside the campus, a gardening area for the community. In this way they renewed the campus and gave new light to the neighbourhood, creating a space where everyone can grow *zero-miles* and ecological food.

On the other side, by involving about 80 people from the near neighbourhood [2], they also created an important moment of collaboration and social participation that led to revitalize the social fabric, creating a direct link between the campus and the community that lives around it. Going back to social innovation definition, it's clear that this new structure allowed to satisfy the need of Bovisa Campus (considered as a building but also as an agglomeration of people, the students) to get in touch with the district, and the community need to have a cultivable area, and even simply to better the neighbourhood visual impact.

A serious problem in India, the

Picture 1

Picture 2

Picture 1 - *Ankit Agarwal and Karan Rastogi with some women involved in HelpUsGreen project. Published online at helpusgreen.com.*
Picture 2 - *Coltivando garden, with buildings of Politecnico di Milano Campus in the background. Published online at milanoevents.it.*
2 - *Cf. Ezio Manzini, Design, When everybody designs, 2015 - P. 191.*

second most populated country after China, regards the disposal of flowers left in mosques and temples as tributes for deads. Due to religious reasons, they cannot be simply thrown away in landfills, but they can just be left in Gange river water. Being these flowers cultivated with pesticides, they end up polluting Gange waters, that are very polluted already. So Ankit Agarwal and Karan Rastogi created a cooperative called *HelUsGreen* that collects these flowers left in holy places and transform them in incense, soap or eco-packaging, giving many women an employment [3]. It's clear here how problems solved (flowers waste, river pollution and female unemployment) generated new collaborations, economic opportunities and gave new life to social fabric.

From these examples few considerations about social innovation can be made. Firstly, the topic of people collaboration within the same community is very important: intractable problems of the community are solved starting from the will of people to cooperate spontaneously, betting on collaboration to create new results, new faith relationships and in general a society reconstruction.

It can be stated that communities trend to unite and act for a common goal is a phenomenon that always existed. And that it's true: it happens since the remote past that individuals come together to face common difficulties. But if in the past this trend of sharing capacities was a forced choice dictated by survival, the new typologies of these organizations, defined as "collaborative" [4], happens because of the fact that people spontaneously choose to join. And this choice is not dictated by the need to survive, but from the will to act to improve their own situation and the one of the community, to build the life they desire.

In these cases people cannot be defined as passive individuals subordinate to community and its rules, but active elements for which is possible to build their own idea of wellbeing, to redefine the way they live and their future [5].

The relative ease with which these organizations are born is due to digital technology pervasiveness: almost all world population has access to Internet, it's registered to one or more *Social Networks* and can virtually be connected with all the World. At a local level, this means a

3 - *Cf. helpusgreen.com*
4 - *Cf. Jégou, Manzini, Collaborative Services, Social innovation and design for sustainability, 2008.*
5 - *Cf. Ezio Manzini, Design, When everybody designs, 2015 - P. 84.*

new way to approach to near people (of the street, of the neighbourhood) and to reorganize their own life and community. It's a new powerful tool that offers infinite possibilities to cooperate and allows to build better situations, without which they could have been built anyway, but with much more difficulty and time [6].

Every social innovation episode is a collective phenomenon, that starts from a *bottom-up* initiative (that means from common citizens and not from institutions or government authorities). The need for these initiatives comes from the failure to solve social problems that are defined as "intractables", where the "classic tools of government policy on the one hand, and market solutions, on the other, have proved grossly inadequate" [7]. The problems considered in this case are, for instance, the progressive society ageing, the difficulty in cohesion between citizens groups, social equality in multicultural contexts. So critical and complex problems that need a radical intervention outside the inadequate mainstream strategies. The creation of new ideas and life models created through citizens collaboration can efficiently break predefined patterns and treat the problem starting from cooperation and optimization of resources that otherwise could end up wasted (like the flowers of *HelpUsGreen* project or Bovisa inhabitants' will of cohesion). Social innovation episodes start from the communities defined creative and collaborative [8], where people, in a creative way invent, improve and manage innovative situations in order to create new ways of life, and where "the preliminary condition for their existence is the active involvement of directly interested people". [9]

6 - *Cf. Ezio Manzini, Design, When everybody designs, 2015 - P. 80.*
7 - *Ibidem- P. 12.*
8 - *Cf. Anna Meroni, Creative communities, People inventing sustainable ways of living, 2007.*
9 - *Cf. Jégou, Manzini, Collaborative Services, Social innovation and design for sustainability, 2008 - P. 30.*

Social innovation requirements: problems and technology

These episode originate spontaneously in problematic contexts, that have been previously hit by a wave of technological innovation: it's right technology, with all the changes, news and new perspectives that brings in the life of people that can use it that opens new possibilities for these problems solution.

A simple but effective example of this principle is the *Social Streets* phenomenon: they are basically closed *Facebook* groups thought exclusively for the inhabitants of a street, a square or a building where they can exchange informations or simply keep in touch. In this way with a relatively simple technology as the *Social Networks* it's possible to solve problems of poor cohesion among neighbours (an issue that is increasingly more present), but most of all is satisfied the need to create a more joint group of people that can meet physically to share experiences and collective moments (neighbourhood parties), or more trivially find help in cases of need, such as ask to carry out commissions in case of disease, or look after the dog if the owner is in vacation.

Development and diffusion of social innovations

It's useful to study social innovation development process to deeply understand the relationship they have with designers and in which point of their evolution is appropriate a design intervention to amplify its effects and potentialities.

Everything starts spontaneously in small local realities where acquired technology allows to consider problems in a different manner than in the past and gives new tools to face these issues and solve them founding the action on the collaboration of the people involved. As very often happens for these episodes, a spark is needed, one or more elements able to comprehend the community potentialities and to define the common frame where to establish the individual and collective goal to look forward to. Ezio Manzini calls these people "social heroes", that together with the community of people he/she shares the common vision with (a more united neighbourhood, a greener distict) invents a way to solve problems and at the same time satisfies needs and gives new possibilities and stimuli to the community itself. In this case, social innovation is at the very first level of its evolution, defined a 'solution

prototype' [10], that is the first phase of its development: it works, but just relatively to the context where it was born and established.

If these ideas become relevant and can be adopted in other realities outside the original context, they evolve into the second level: they become 'mature solutions'. They are always bottom-up proposals tightly connected to 'social heroes' activity, where local institutions help is often missing, like products and services thought on purpose.

This constitutes a defect since the functioning of these social innovation processes asks for a huge commitment in terms of time and personal dedication that is hard to find in other people than the 'social heroes'. This implies a support required to the system and institutions to sustain and scale these ideas in other contexts.

If there's an effective interest from institutions and organizations, these innovations settle deeply into a given context: they are metabolized by the system and normalized, becoming 'implemented solutions'. Designers', engineers', enterpreneurs' and government institutions' work allows its detachment from a precarious situation joint to the original context, guaranteeing stability and control and allowing its acquisition by other realities. It's the case of car-sharing or bike-sharing systems, that now can be found in all the big cities, that sice few years have been facing a huge demand increase and continue to be implemented.

Designers', engineers' enterpreneurs' intervention in this case is very important: their combined work becomes necessary for the stabilization phase from a precarious situation, dependent on 'heroes', creating systems and products that guarantee a much easier functioning, so that the social innovation dynamics require much less commitment in terms of time and dedication, making it accessible to as many people as possible.

10 - *Cf. Jégou, Manzini, Collaborative Services, Social innovation and design for sustainability, 2008 - P. 35.*

Design for Social Innovation and Sustainability

Social innovations examples that have been described have a strong element in common. They are action that, apart of putting the focus on people collaboration and capabilities share to solve a common problem, they use local resources that would otherwise be wasted or badly used: water, food, human resources and spaces are optimized and exploited to reach the prefixed goal. These are sustainable behavioural and consumption models. The project called *Hosting a student* [11], for instance, an initiative started in Milan in 2004 and promoted by *Meglio Milano*, a no-profit organization, allows to solve two complementary problems: from one side the huge number of elderly people that live alone with at least one empty room, from the other an increasingly high number of university students looking for a low-cost residence. By hosting a student, the elderly person can benefit from the presence of the young person that can help him to take care of the house or simply to have company; at the same time, the student can have access to a cheap stay. The two groups have different characteristics and resources (empty space for elderly people; time energy and low budget for young students), and in this way they can help each other like in a sort of symbiosis, optimizing time, money and space and creating social cohesion and a meaningful experience for both.

"At a first glance we can recognise their coherence with some of the fundamental guidelines for environmental and social sustainability. More precisely, the examples we are referring to here have an unprecedented capacity to bring individual interests into line with social and environmental ones. [...] they reinforce the social fabric and, more in general, they generate and put into practice new and more sustainable ideas of well-being." [12]

Some interesting examples that can be taken in consideration concern the food production and trade, taken by Manzini as virtuous examples of conscious generation and consumption of agricultural products.

In Liuzhou, part of Guangxi

11 - *Cf. Ezio Manzini, Design, When everybody designs, 2015 - P. 111.*
12 - *Ibidem - P. 29.*

Picture 3

province of China, the *Ainonghui* farmers' association was born to produce local food and to deliver it to the local community. In this way, "by selling traditional sourced food to citizens, they also educate them on what traditional/organic agriculture is and introduce a sustainable lifestyle into the city. [...] Farmers' incomes are now better able to sustain traditional farming while allowing them to lead a better and respected life" [13].

Following the same principles of the farmers' markets just described, can be named the *GAS* (*Gruppi di Acquisto Solidale*), where a group of citizens come together to buy fresh agricultural products directly from local farmers, in order to eat more healthy food and to promote local economy and characteristic products.

Social innovations requirements are a densely problematic reality and the acquired capability of the society to use technology, especially the digital one. If we think about the actual situation, with critical social and economic problems and the exponential invasion of digital technology, social innovations can can be considered an important trend for the future and, as underlined by *Young Foundation*, an organization involved in social innovation and development, we are facing a great wave of this phenomenon. It is expected an incremental rise of these situations, that can effectively improve peoples' and communities' life, able to generate new behaviours in line with environmental needs, that is virtuous and more focused on resources optimization.

It's possible to draw a probable future scenario, composed of many creative communities, social inventions and sustainable and conscious use of resources where desigers (together with other professional and institutional figures like engineers, ONGs, etc) are destined to have the task of encourage this change creating new solutions able to stabilize, grow and diffuse these situations in other contexts to shape a right, creative and conscious world.

Picture 3 - *A farmer and a customer at the farmers' market in Osseo, Minnesota. Published online at: discoverosseo.com.*
13 - *Cf. Ezio Manzini, Design, When everybody designs, 2015 - P. 10.*

1.2

"When money abundance comes before culture, we have the scene of the gold telephone.
And it's not about culture to say school knowledge, but information, information about everything that happens, about what makes life interesting."

Bruno Munari, *Arte come mestiere.*

Infrastructural level: for a new sustainable economic-productive system

The term *Antropocene* was coined during the 80s by the biologist Eugene Filmore Stoermer, but have been acknowledged just at the beginning of 21th Century. With this word, Stoermer wanted to identify the current geological era where human activity is considered responsible for environmental, territorial and climatic changes. The time interval considered for this Era (that is not acknowledged by the international organization for geological time, the *ICS*) starts with the 18th Century *Industrial Revolution* and comes to today. In this period, thanks to technogical development, a 10 times rise in world population occurred, determining a massive occupation of land, soil and water exploitation used for farming and breeding, with a consequent pollution of these elements.

Despite the efforts made in the past decades to raise awareness about environmental safeguard and to push toward a more balanced relationship between human activity and Nature, it looks like the situation didn't change. Despite the apparent success in reducing the emissions of the single objects, means of transport and appliances, the overall situation continues to get worse [1]. The problem isn't about a single object functioning, but it's about the system that surrounds it: considering the example of cars, is not just about creating sustainable means of transport. What can really solve the problem is to rethink the entire system: not focusing on car itself but on mobility, pushing toward more sustainable mobility systems.

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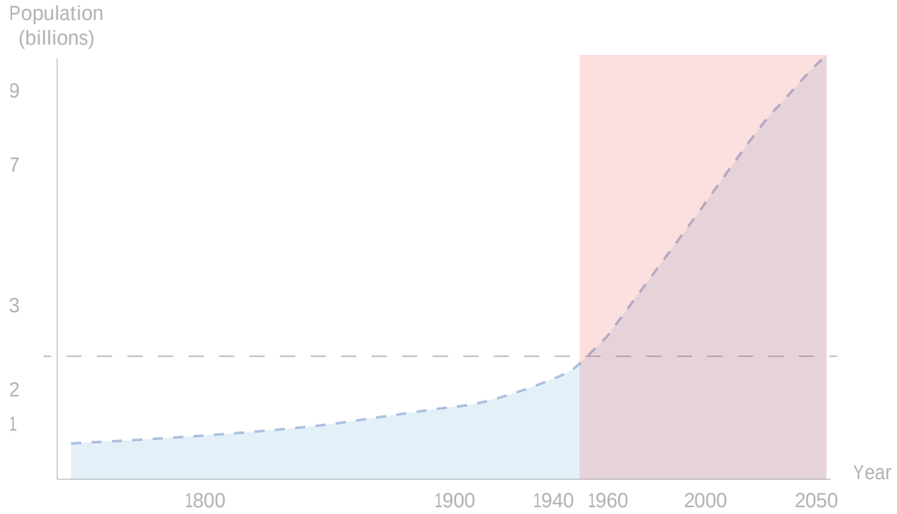
1 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 7.*



Picture 1

The contemporary productive system: centralized

Considering today's mobility, food production, energy and water supply systems is clear their unsustainability and inadequacy to contemporary world problems and needs.

Today's system is heavily centralized, where few centers produce or extract resources in an industrial and standardized manner to trade and deliver it all over the Globe: food, water and energy travel for hundred of kilometres to go from the producer to the consumer. This social and economic framework is the result of decades of technological progress and social changes occurred after the *Second World War*: from that moment a slow but inevitable urbanization process started, due to the greater attractiveness of city compared to the rural areas, being the urban reality the place of progress, safety and future. In this changing context the approach to food, water and energy management had to change: the framework of resources local production shifted toward the centralized and globalized one that has been described.

There are no doubts about its effectiveness in guaranteeing safety during the first years after the *Second World War*: Italy, during the 50s and 60s, faced a great *'Economic Boom'* that was characterized by the pervasive wellbeing in cities, by the availability of work and by the possibility for citizens to spend the salary, gained in big Italian or foreign industries, on consumer goods that bettered their life. Wellbeing at that time existed due to safety in resources supply: fossil fuel, water and food refuelling was constant and abundant. But after decades of resources exploitation,

Picture 2

Picture 1 - *Graphic that shows a World Population projection made by UN Population Division (2015). Published online at OurWorldInData.org.*

Picture 2 - *The picture shows one of the first Esselunga selling points in Italy. Published online at esselunga.it.*

Picture 3

we are not sure anymore that their supply will be stable and continue: since many years we are conscious that Planet oil quantity will finish soon, and in these years more than ever we are getting along how global warming and long drought periods are dangerous for many communities.

Today's resources production and transportation system, globalized, centralized and considered unsustainable by many, ends up worsening the environmental changes and energies scarcity [2]: it's inadequate for the current context characteristics and increases its critical issues. Indeed, how the futurist Jamais Cascio states:

"Centralized, hierarchical control is an effective management technique in a world of slow change and limited information – the world in which Henry Ford built the Model T, say. In such a world, when tomorrow will look pretty much the same as today, that's a reasonable system. In a world where each tomorrow could see fundamental transformation of how we work, communicate, and live, it's a fatal misake". [3]

The reason for the centralized system inadequacy is due to its vastness and complexity, and the implications for this framework regards environmental, economic and social themes and have many negative effects on them.

Firstly, these systems require a huge time gap to be built and ask for a lot of money; their functioning bases on the ability to resist and not to adapt to external changes, assuming that the environmental conditions remain stable or at least controllable. So it develops around outdated assumptions, more suitable to describe the period after the *Second World War* than the actual one, sensible to climatic changes and resourses scarcity.

Picture 3 - *Martin Witte, The Emma Maersk, one of the world's largest container ships. It can transport 11,000 containers. Published online at alamy.it*
2 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 6.*

Picture 4

Picture 4 - *An oil tanker ship in flames in South China Sea, 2018. Published online at tpi.it.*
3 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 67.*

Picture 5

"Very large systems often reduce our ability to detect and respond quickly to changes in the external environment. This lack of "adaptive feedback" caused by distance, time and organisational structures can amplify negative impacts [...]. Because large systems are capital/intensive, involving long pay/back times, they are also slow to change." [4]

The difficulty to adapt to context changes determines their fragility, that implies very often transportation inefficiencies. Besides the economic damages, serious environmental damages occur. A meaningful example is oil transportation with ships: dozens of disasters happened since 1910, with cargo ships that lost part of the oil transported due to damages or failures, causing huge damages to local flora and fauna. But beside this and the significant amount of money required to fix the disaster, these material losses determine a critical dispersion of possible gain, and mostly a missed delivery to the community it was destined to.

The same problem can be found studying the long submarine gas and oil pipelines, exposed to damages and failures, with sustainability issues found during the construction phase as well. It's the case of *TAP* (*Trans Adriatic Pipeline*), a gas pipeline that, according to the plan, should bring natural gas from Azerbaijan through Adriatic Sea to Italy. During its path, this pipeline passes below an old olive field in the Italian Region of Puglia: this requires that all the plants are displaced to allow the pipeline to be mounted, and then replanted once the work is finished. This would determine a landscape alteration and an obstacle to farming activities. It's clear here how this infrastructure creation doesn't take into consideration the adaptation to local conditions for both the resources demand (since an oil pipeline is designed for a regular and constant transportation), and for the morphological and climatic characteristics of the landscape.

The presence of diffused problems and the economic and productive system inadequacy is clear: firstly it's not suitable for a context such instable and sensitive to changes as the contemporary one, that can easily determine failures or collapses for entire parts of the system; moreover, it contributes to worsen the risks for the Planet and the Society, that are already serious and critical. World population is conscious of this, and the risks caused by resources supply uncertainty has been experienced many times in the last few years, but is fundamental to offer an answer to this generalized problem. As Ezio Manzini suggests:

"There is an environmental problem and there's something deeper: there's a systemic problem in the model that has been dominant in the last Century. Unfortunately if the consciousness of this problem increases and you don't offer any consistent alternative, this consciousness can turn in fear. [...] If you don't have the idea that something positive can happen, you can start to think that you have to protect yourself". [5]

Picture 5 - *The TAP in construction. Published online at azernews.az.*
4 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 7.*

5 - *Cf. Ezio Manzini speech (8:25 min) at The Alfred Deacking Eco-Innovation Lectures, 2009. Published online at youtube.com.*

Picture 6

A new economic and productive system: distributed

Now more than ever is required a substantial change in resources production and transportation system so that it's closer to communities needs and more resilient and sustainable from both an environmental and a socio-economic point of view. Many experts agree about the possibilities of sustainable growth offered by 'distributed' models, that have completely different characteristics compared to the globalized system.

This economic and productive framework is not structured in a centralized way but in a distributed way: resources production is not placed just in few industrialized centers, but rather is fragmented in more spots, that can differentiate and customize the offer according to local demand. These centers act independently but being connected with every spot of the net they belong to, have the opportunity to exchange informations and even resources. As observed by Ben Schiller, writer for *Fast Company* magazine:

"In the future, we may buy energy from each other, just as we now rent homes from each other on Airbnb". [6]

This principle is already applied today: it's the case of *Vandebron*, a dutch start-up that works in the energy field. This company created a service that allows the optimization of local and clean energy, giving the possibility to buy some directly from independent producers, like farmers with wind turbines in their properties. According to the informations given by the company, there are currently 12 producers, that supply about 20.000 houses with the energy they produce. [7]

Starting from the Vandebron case studio, it's possible to imagine a new enegetic system where every house or neighbourhood produces by itself the energy it needs (with solar panels, wind implants, etc), with the possibility to sell extra-resources to external customers: for instance, imagining a net of energy production spots, in case of failure of one of these centers, it would be rather easy to fill the energy lack created using the energy produced by the spots close to the damaged one. It's interesting to underline the great efficiency of this system, that allows to customize energy management and to protect the entire system from failures. This thanks to their "flexible interdependence, in which none of the actors or suppliers is vital" [8].

Such a structure can determine benefits not only for local resources optimization, especially because a modular infrastructure could avoid the construction of complex, expensive and unsustainable transportation nets such as the *TAP*, being also much more resistant and capable of self regulation:

"The distributed model can improve the resilience of energy, water and food systems. Its characteristics - diversity, redundancy and modularity – are widely considered critical to the flexibility and robustness of complex systems." [9]

Picture 6 - *This farm in Molkwerum generates electricity for about 575 households. Published online at hollandtradeandinvest.com.*

6 - *Cf. Ben Schiller, The Sharing Economy Takes On Electricity, So You Can Buy Your Power From Neighbors, 2014. Published online at fastcompany.com*
7 - *Ibidem.*
8 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 11.*
9 - *Ibidem - P. 12.*

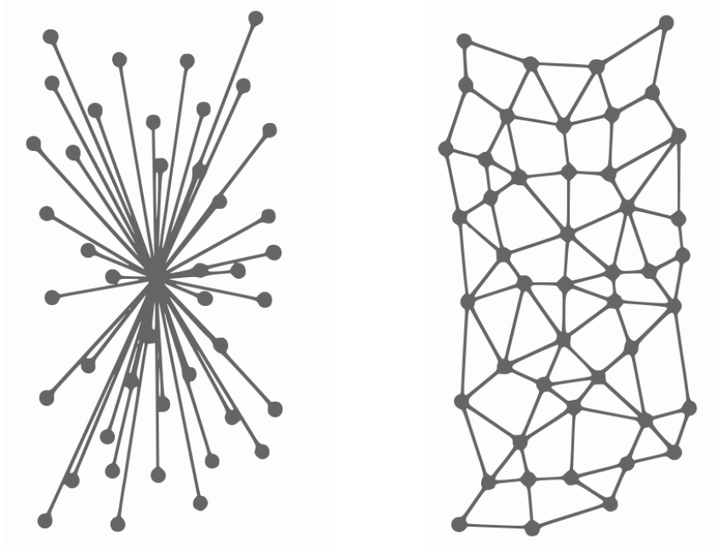
In addition to ensuring increased robustness and resilience for infrasctructures, distributed systems determine other improvements compared to the centralized model. These systems, as underlined in the document *'Distributed System, a Design model for Sustainable and Resilient Infrastructure'* from Biggs, Ryan e Wiseman, engage different topics and it's worth analysing them in detail.

At an economic level, a network of localized production spots implies the possibility to use local resources, optimize and exploit them, promote local economy giving an employment to citizens and creating products and services tailored according to community needs. System flexibility, closeness between producer and customer and speed in informations exchange allows to easily modify and modulate the offer.

"They may help diversify and stabilise a regions' economic base, so that it can better retain financial capital and engage in continued buisness innovation. [...] They can use local resources, employ local people and provide services targeted specifically to local needs." [10]

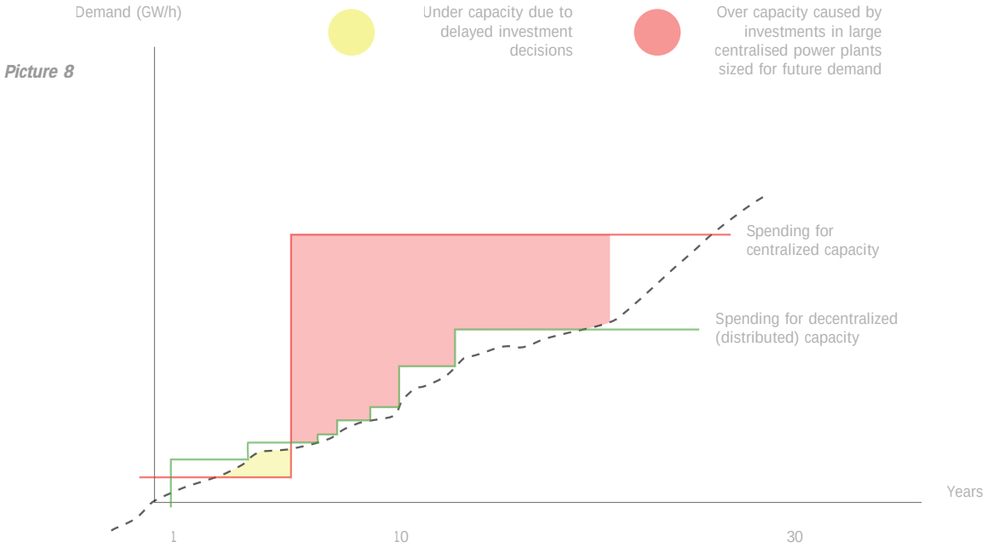
Very interesting in this sense is the case of Krueng Kalla, in Indonesia: to generate new opportunities for poor families or for people whose lifes have been destroyed by the 2004 Tsunami, a microturbines geothermal implant has been built, that can generate locally clean energy. A cooperative administrates the energy production and sells it. The profits created are used to better

Picture 7



Picture 7 - *Skemes of centralized models (left) and distributed models (right). Published online at busy.org.*

Picture 8



Picture 8 - *A graphic that shows comparative costs and resources advantages of distributed modular systems. Published in Biggs, Ryan, Wiseman, Distributed Systems, 2010 - P. 15.*
10 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 17-18.*

village inhabitants life, giving scholarships for children, offering low-interests loans to farmers and local enterpreneurs [11]. In this way the energy supply system works independently from the global and industrialized one, managing resources, production and profits autonomously.

A distributed system is much more efficient compared to centralized systems. Times and costs necessary for planning and installation of centralized systems are bigger, causing a blockage of funds for long periods and requiring high times and costs for its reconfiguration [12]. So the capacity of distributed systems to modulate resources production and offer is an important advantage. This phenomenon is shown in the previous page, with a graphic that explains how a distributed system requires much less time to become operative and even a reduced cost, allowing an effective modulation of resources flow.

From an environmental point of view, there's the possibility to considerably reduce pollution, derived from both human activities and resourses use and waste. Exploiting increasingly more energy from renewable resources, such as wind, hydraulic and geothermal energy, it's possible to fight pollutant energy use coming from not-renewable resources, the ones that characterize contemporary world. A distributed system renounces pollutant energies, exploiting clean energy resources that can be found everywhere: oil, coal or gas are present just in few points of the Globe, and they have to be transported for thousands of kilometres from producer to customer; instead wind, sunrays or geothermal energy are elements that are present everywhere (evidently with different characteristics according to the territory), giving the possibility to localize actually everywhere energy production.

Using a short supply chain (a natural implication of distributed systems, since the shorter the action range of a productive center, the smaller the transport distance will be) it's possible to considerably reduce delivery distance of goods and resources, that determines an important energy (and money) saving, but also a limitation of wastes due to systems failures. In Victoria, one of the states that compose the Commonwealth of Australia, where a centralized system is used, it's estimated that the quantity of energy lost during the transport between production and consumption points is about 7 to 15% [13]. A local resources use can effectively exploit available energies and materials, optimizing them and avoiding wastes.

Closeness of production and consumption points, easiness and speed in informations exchange helps more sustainable behaviours: frequent feedbacks can stimulate new habits and facilitate to adopt them as a norm [14]. To know that we are optimizing electricity use in our apartment constitutes an incentive to better our behaviour for both an environmental and economic reason.

In conclusion it can be stated that change toward a distributed and localized economic system is firstly an environmental need: environmental change induced by anthropic activity caused so much serious damages to endanger energy, water and food supply for our generation and the ones that will follow. It's an ethically correct choice to impose a change toward more resilient infrastructures, more productive systems and more sustainable behaviours.

Moreover, it's a need for the entire society: to avoid that the World fall in the situation made up of resources scarcity, insecurity and fear described by Manzini it's necessary to work to better communities cohesion, their resilience, their economic power and the management of local resources.

11 - *Cf. Berry Kantor, Le développement durable dans le contexte climatique: Le projet southsouthnorth et le mécanisme de développement propre. Published online at un.org.*
12 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 14.*

13 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 20.*
14 - *Ibidem - P. 21.*

Two design guidelines to create a sustainable future

Today's situation offers a problematic scenario from an economic, social and environmental point of view and it's necessary to force a change, acting in two parallel directions: from one side, work at an infrastructural level to create a distributed global system, working in this case on many sides with a *Top-Down* approach, that means on a institutional, government and productive level, satisfying the environment needs (a more responsible resources use) and society needs (giving more power to local economies and a more stable resources supply); from the other side, work to encourage and stabilize social innovation phenomena, in order to push communities and citizens groups to unite and to create the conditions for the life that they want.

It's interesting to note that, acting in this way, a virtuous circle is generated, because a phenomenon ends up encouraging the development of the other: social innovation creates small local spots of resources generation and optimization contrary to centralized configuration, actually drawing distributed systems in line with a sustainable development[15]; distributed systems created allow to strengthen local economy and social cohesion, encouraging social innovation episodes [16]. In this way, at a theoretical al level, a self-sustaining system is created, a system that is socially, economically and environmentally sustainable. In this vision designer's profession can act on both sides (taking into consideration that cannot be the only figure involved in this change): from one side spotting the social innovation phenomena that are considered important and potentially scalable in other contexts and working to strengthen and replicate them; from the other side, answering to environmental and social needs, developing distributed infrastructural systems more in line with local communities, that are more resilient and effective.

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15 - *Cf. Jégou, Manzini, Collaborative Services, Social innovation and design for sustainability, 2008 - P. 29.*
16 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 15.*

1.3

"What mattered to me the most, during these trips, was the kind of city, the urbanistic configuration, the streets, the cancels, the low walls, the small houses born to defend vine plants, normally inhabited by poor people."

Pier Paolo Pasolini,
Conference to the italian-arabian league.

Cultural level: for an historical and ideological continuity with the past

In the previous chapters, talking about digital technology pervasiveness or problems connected to centralized productive system, actually it has been described the concept of globalization. This concept indicates a phenomenon of standardization and integration of economic potentialities and cultural characteristics of different areas of the World, that in the past were limited just to the original national territory. Since the second half of the 19th Century occurred a stabilization of globalized production and consumption models, that led to massive changes in the economic, social and spatial perception fields.

It can be noticed an analogy with the phenomeon of resources production centralization described in the previous chapter: in particular the shift from locality to globality and the consequent possibility to reach every point of the Globe with resources and consumer goods. This new economic and social framework has positive characteristics, which are the great conquests of scientific and technological progress; but it has also negative effects that determine huge damages for society, economy and environment.

From an economic point of view, globalization caused a market unification: every activity is free to export its products abroad, satisfying a demand that potentially comes from all the World that, how it's been noticed [1] it's increasingly less diversified. This substantial change in global market scale and its liberalization has positive implications, including the possibility for every company to transcend the physical

1 - Cf. Hassi, Storti, Globalization and Culture, the three H scenarios, 2012 - P. 8.

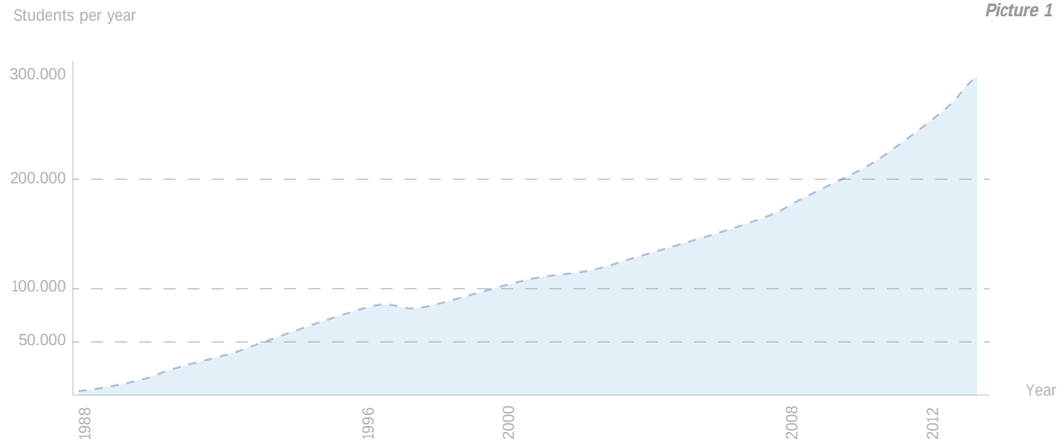
and economic limits of its nation to sell its products abroad, offering infinite growth possibilities. It's thought that market openness helped *Developing Countries* to better their own economy and social conditions [2].

This broad phenomenon brings massive negative effects as well, that negatively affect social equality and culture. It's true that in the global market everyone has the chance to create his own business, but has to be noticed that an increasingly bigger part of the profits belong to big multinational companies: the action of these holdings can be found basically in every country and their capacity to generate needs and subsequently to satisfy them led to always bigger profits for them, an exponential growth that caused the crisis and the fall of the small local realities, that faced a fast economic decline. Moreover these big realities, continuously pursuing a better ratio between costs and profits, tend to delocalize production in localities that are very far from the selling point. The places mentioned are chosen according to social and fiscal characteristics, where is allowed (because of precarious economic conditions or due to a lack of labor unions attention) to pay employees less and where duty to guarantee reasonable work safery conditions is not so restrictive [3]. So from one side occurs a loss of employment in the origin country of the company, and from the other an exploitation of workforce in *Developing Countries*.

Even phenomena connected to spatial globalization should be considered: a progressive elimination of physical and political bareers among different countries occurred, and today is increasingly easier to move around the World for work, study or tourism reasons. An example of the new mobility freedom is the *Erasmus* program: launched in 1987, it allowed to thousands of university students to undertake a study period abroad in a foreign university, allowing to acquire consciousness about cultural richness and heterogeneity of world communities.

In part similar is the process of informatics unification allowed by the growing digitalization of the society and in particular the establishment of the internet during the second half of the 80s: today the ability to communicate immediately shortens distances and the possibility to exchange informations in short time ensures

2 - *Cf. Fairooz Hamdi, The Impact of Globalization in the Developing Countries, 2015.*
3 - *Cf. "Ecco chi produce i nostri vestiti", a report by Ane Irazabal e Cosimo Caridi. Published online at: youtube.com/Rai.*



Picture 1

free access and knowledge democratization, that were once unthinkable.

The most important consideration is the one regarding society and in particular cultural diversity that, with the advent of global market and globalization phenomena, it's inexorably reducing in favour of social, cultural and consumption models that are increasingly more like in different parts of the World.

As stated, globalization implies an important interaction between communities once isolated, and allows goods and services trade and ideas circulation. From one side there's freedom and abundance of opportunities, but from the other side it occurs a loss in terms of uniqueness for cultural products of the single communities.

"In different regions and Countries of the World, increasingly more people watch the same entertainment programs, listen to the same music, consume the same products from famous global brands and dress the same clothes." [4]

According to this vision, globalization phenomenon is weakening the relationship

Picture 1 - *Graphic showing the number of students involved in the Erasmus Project. Published online at europa.eu.*
4 - *Cf. Hassi, Storti, Globalization and Culture, the three H scenarios, 2012 - P. 8.*

Picture 2

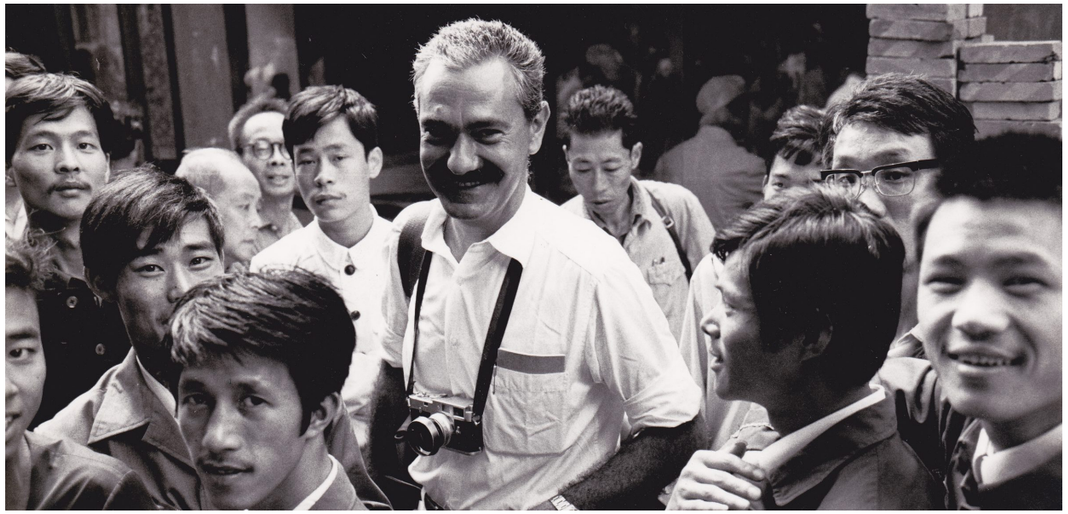
between geographical places and cultural experiences [5]: considering as an example culinary products, Pizza is consumed all over the world, increasingly more eastern restaurants offer sushi and exotic specialities, and still (this is the most evident case) fast food shops like *Burger King* or coffee shops like *Starbucks*, present in almost every state, collect increasingly more customers while traditional restaurants and coffee shops are forced to shut down. It's emblematic the fact that the burger produced by *McDonald's*, the *BigMac*, is taken as a comparison element to measure the purchasing power of the different currencies (the *Big Mac Index*).

It must be said that not everyone has the same thought about these complex phenomena: in the essay *'Globalization and Culture: the Three H scenarios'* is considered exaggerate a scenario of complete homogenisation and standardization, stating that in any case the characteristics of the different Nations are preserved and that interaction with other social and cultural contexts leads to their enrichment.

Since it's a very complex topic with many implications, it's impossible a unique point of view. Anyway it's sure that globalization and urbanization phenomena caused a massive change in demographic, social and economic frameworks, that resulted in some way in a modification, a loss of part of the cultural diversity and identity of places and communities. One of the greatest Italian journalists of the 20th Century, Tiziano Terzani, expresses himself in this way describing the situation in his hometown, Florence, after many years of absence:

"I think about the street I walked through to go to school, and this is a change that occurred everywhere: it was a series of workshops in which there always was a man that was singing while doing something, a chair, stuffing an armchair, polishing furnitures. This was the working-class

Picture 2 - *A restaurant in America 50s style in Bologna. Published online at tripadvisor.ch.*
5 - *Cf. Hassi, Storti, Globalization and Culture, the three H scenarios, 2012 - P. 9.*



Picture 3

Florence where I grew up. Today each one of these shops it's a boutique where there's a seller, a shopkeeper that doesn't anything, he sells something probably produced in Korea, and sells it to Japanese tourists. So there's a progressive impoverishment in material richness and this makes me reason about the future. Because if the change that I saw during my life continues with the acceleration that we all know, where does the man will end up and where this beautiful diversity will end up?". [6]

It seems that the trend for economy, society and culture traced by globalization and industrialization phenomena will end in a progressive, even though not complete, homologation in traditional diversities of populations, territories and (particularly evident) cities. Raffaele Milani, professor of Aesthetic at Bologna University, acknowledges cities as cultural products that respond to cultural, philosophical and psychological characteristics of a community, obeying social and ideal criteria

Picture 3 - *Tiziano Terzani in China. Published online at artspecialday.com.*
6 - *Cf. Tiziano Terzani: "La Pace è da cercare dentro", interviewed by Luciano Minerva in 2002. Published online at teche.rai.it.*

that determine a particular kind of urbanistic and architectural shape. Ancient, Medieval, Reinassance and Baroque cities look profoundly different, reflecting the values diversity of the societies that produced them: being Modern and Contemporary cities very similar from a formal point of view, reflect also a cultural and identitary impoverishment and homologation. [7]

This process of cultural and identitary loss reflects even in other fields, such as the one of agricultural products. It's paradoxical the episode told by Carlo Petrini, founder of *Slow Food* movement: during a visit to one of the many crops in Asti province country, he found out the progressive abandonment of the cultivation of the typical squared pepper of Asti. In that zone, famous for wines and hazelnuts as well, are cultivated and harvested hybrid peppers from Holland, that are "cheaper, great at sight but dramatically tasteless" [8]. In the same fields where it always has been cultivated that local variety of pepper, under nylon towels, they started to cultivate tulip bulbs that will subsequently be exported in Holland.

It could look a bit risky this discussion about cultural impoverishment

Picture 4

connected to globalization phenomena, thanks to which everyone can now move freely in every country of the World: the social and political situation in Italy is, in part, widely against this phenomenon of borders openness and cultural integration, especially with the intensification of migrants crisis in the Mediterranean Sea and the host, for many of them, on Italian soil. Neverthless what is intended here is not the will to limit or deny this cultural mixing: hybridation of different elements it's at the base of natural and even cultural evolution process. A clear example is Terzani himself

Picture 4 - *The countryside near Asti. Published online at theitalianeyemagazine.com.*
7 - *Cf. Raffaele Milani, L'arte del paesaggio, 2001 - P. 57.*
8 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 4.*

who, even though he studied in Italy, spent almost his entire life between India and Far East, Germany and United States, acquiring a precious knowledge and consciousness. Moreover, it has been considered among the benefits of globalization the possibility to travel, work and live different experiences as a reason of personal enrichment.

Picasso stated that the emergence of a new style in Art doesn't mean that the previous styles are obsolete, rather changes our relation to them [9]. The same concept can be considered talking about local identities and culture: transformations in society and cultural mixing are unstoppable and necessary, but there must be consciousness of the thread that links every society to its past. It must be acknowledged the economic, productive and social matrix that molded different nations and communities identities; we have to be conscious that what we are today, what our cities are is a result of a serie of characteristics and variables that determined in the past. Acknowledge this point allows to face future in a way that ensures a deeper knowledge about our society history and mostly about ourselves. Because, as stated by the philosopher Thomas de Koninck:

"The disintegration of culture is the worst disintegration of all, it is the most radical that a society can suffer, the most serious and the most difficult to repair". [10]

9 - *Cf. Agricultura Lusitana: Aldeias do Xisto 2015 - P. 121.*
10 - *Ibidem - P. 23.*

The situation in Italy

If there's a Nation in which globalization effects (mostly cultural) had a considerable weight is Italy: its historical, cultural and territorial diversification always meant a huge heterogeneity that, with urbanization, has been slowly lost. According to a *WWF* study, from 1951 to 2001 demographic increase, that had an exponential growth in the last years and that is destined to still grow, determined the movement of about 2,5 millions of people every 10 years from the rural areas into the cities, overtaking 12 millions people [11].

Italy has always been a very heterogeneous and diversified country: in its history many different polulations and cultures inhabited its territory and contributed to its cultural stratification. This diversification remained alive during the centuries, passing through the *Commons* and *Lordships Era* reaching today's world, made up of regional and provincial identities so defined and characteristic, each one with proper traditions and knowledge result of populations and cultures mixing.

The higher attractiveness of cities, their higher job availability and the wellbeing rate they offer constitute part of the reasons that pushed, push and will push in the next future millions of people to abandon the rural zones where they were born to settle into the cities: it's estimated that in 2050 more than 6 billions people (2/3 of the World population) will live in cities and megacities, exacerbating the urbanization phenomenon started during the 20th Century.

It's clear that part of what Terzani defines as 'beautiful diversity' risks to be seriously lost. All the knowledge, rituals and traditions refined during centuries and generations by small rural communities, in touch with Nature and the characteristics of the territory, are about to be gradually lost due to the missed ability of the present generations to grow in continuitiy with their past, following the ideals of wellbeing and progress, forgetting their own roots. It's rather explanatory the case of the squared Asti's pepperoni, that tells a story of values substitution, such as production locality, identitary characteristics and organoleptic qualities that an indigenous agricultural product holds, with other ephemeral and marginal values such as homogeneity, aesthetic factor and profit (that are all characteristics of the centralized production of food and consumer goods in general).

Considering the development expected, for the future of World society, it's a risky attitude, because it is in danger of cutting the thread that links our existence to the historical richness of our past, determining the cultural disintegration described by de Koninck, that has the potential to be deep and destabilizing.

11 - *Cf. Giornata del suolo, in Italia urbanizzazione più che triplicata in 50 anni, 2017. Published online at adnkronos.com.*

Social Innovation, Distributed Systems and Cultural Identity as matrices for the sustainable development

The premises of this discourse and the gradual process of cultural impoverishment force to report the need to activate a general urban development plan, under an economic and productive level, that in some way opposes to eccessive urbanization and globalization phenomena, that allows to include in the overall development process (at the moment driven by big cities) the local rural realities, that has been a fundamental part of the history of Italian Landscape and in general of human society, before the start of the urbanization/globalization development.

All this is not hoped for trivial nostalgia reasons: the motives that force to reconsider our heritage as a fundamental base for future development imply cultural and personal consciousness reasons, but even economic reasons. As stated in the book '*Il Bel Paese: 1 progetto per 22.621 centri storici*' (translated: '*Il Bel Paese, 1 project for 22.621 historic centers*'), that holds the material of the exhibition that took place in 2017 at La Triennale di Milano

and that tells the work of the architect and urbanist Leonardo Benevolo, it's evident:

"The need to make the best use of a heritage that will be increasingly more important for our economy, but also the one to understand from the renewed knowledge of it those new implications that the past readings coulnd't perceive and that could be useful considered the problems posed by contemporary urban development". [12]

And still:

"The presidium of a fragile territory such as the Italian one it's possible just by performing an action of decentralization and valorization of the tiny and pulverized textile of the historical settlements". [13]

And so once again the concepts of fragmentation, localization and conscious resources use come back, that were used to describe the other two components of this discourse, that are social innovation process and distributed systems generation: once imagined joint in a possible future, these three components appears to come together in a complementary way drawing a context that looks perfectly sustainable, in particular with the idea of sustainability that Carlo Petrini considers the only one possible: it should be, as well as environmental, also economic, social and cultural, "otherwise it's a cripple sustainability" [14]. This possible future reality can be imagined, based on local production exploitation, on conscious use of territory resources, on the revaluation of sociability as an essential element for a desiderable future, on the reaffirmation of identitary and cultural values for a necessary conscious development.

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12 - *Cf. Albrecht, Magrin, Il Bel Paese. 1 Progetto x 22.621 Centri Storici, 2017 - P. 14.*
13 - *Ibidem - P. 75.*
14 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 150.*

Part 2

A practical hypothesis

2.1

“Il sapore della Majella
*è tutto nel nostro cacio pecorino”**

Gabriele D’Annunzio, *Il libro segreto.*

Food production and distribution: criticalities and possible development

Today’s food productive and distributive system generates enough resources to feed about 12 billions of people [1]. Although this huge productive effort, there are still 790 millions of people that live under the limit of a correct nutrition, and are about 2 billions the ones considered overweight[2] (with a Body Mass Index higher than 25). These alarming data highlight how the actual system is highly unbalanced, even considering that about 30% of food, about 1,3 billions of tons, is wasted every year.

Besides being a distribution problem, this system has also a problem of human resources availability do be destined to agriculture: according to a *Capgemini* essay, between 2000 and 2016, Holland lost about 30% of the farms [3]. An another study conducted by *European Commission* discovered that workforce in European agricultural field will decrease from 9.9 millions in 2014, to 7.3 millions in 2025, showing how the farmer job is increasingly less attractive for new generations [4].

As time passes and as population grows (according to *FAO* it will reach 9.3 billions in 2050), it will be necessary to increase food production as well: this rise is estimated in +70% [5]. It’s evident the situation seriousness, further worsened by the need to reduce the environmental impact: it forces to rethink productive

** - Trad: “The taste of Majella is all contained in our pecorino cheese”.*
1 - Cf. Paolo Vurtuani, Lotta agli sprechi alimentari per dare cibo a tutti, 2013. Published online at corriere.it.
2 - Cf. L’obesità, uno dei principali problemi di salute pubblica, 2014. Published online at salute.gov.it.
3 - Cf. Obels, Bulat, Genet, Feeding 10 billion people in 2050, 2017 - P. 4.
4 - Ibidem - P. 9.
5 - Ibidem - P. 3.

and distributive system and asks for a complete reorganization, starting from the consciousness of the generalized problems and of the hard future challenges.

As it can be read in the document published by *Capgemnini* that has been mentioned:

"With the compelling need to produce as much as twice the amount of food in the coming 30 years using half the resources that we currently have, agriculture is facing the biggest challenge of all times." [6]

Almost all the problems in the food production sector is due to the system framework. In the previous chapter have been described damages and problems generated by a centralized productive model and by a capitalistic system and, talking about food, it's clear that it's a perfect example of that.

To tell the contradictions of this system, it can be imagined to follow the path of a common agricultural product along the supply chain, from the place of production until the consumption one.

We are in Mexico, an area that has been historically very important for the domestication of wild plants, that became fundamental for the diet of billions of people: tomato, corn, cocoa, avocado are just few of the many species that have been cultivated first in Mexico area, and in this zone they could develop in many different varieties. More than one thousand of corn varieties are original of this place, and about the 80% of them has been patented by American multinational companies looking for new hybrids. Now, in these territories, instead of these original varieties are cultivated hybrid plants from United States [7].

Right on one of these plants is growing a corncob destined to be sold on the European market. The plant is in a field, together with other thousands of plants of the same variety, in an intensive and monocultural cultivation. Unlike small scale cultivation methods used in the past, not used anymore today for trade but just for self-production, this method is highly fragile, and could lead to a complete loss of the harvest in case of external damages (parasites, bacteria). Being an American hybrid then, it doesn't adapt very well to the climatic conditions like an indigenous plant does: it needs more water, more fertilizers and pesticides, increasing pollution of water and soil. The fruit that this plant generates cannot be as healthy as the one of a plant original of this territory, and will have much less vitamins and minerals richness [8]*. During its growth, the corncob is often treated with insecticides which, besides of polluting soil, seeds and fruits, eliminates also pollinating insects* [9]*.*

As time passes the fruit grows, becoming much bigger than a fruit of the same spiece cultivated just few decades ago, and on every plant are present much more corncobs than in the past. Plants cultivated today has been selected to obtain a higher harvest of bigger and (apparently) better-looking fruits: in this way they will be perfect for the customer who purchases them in supermarkets. Such as dutch peppers described by Petrini.

The harvest occurs earlier than it should: if the product was harvested at a perfect maturation rate, it would rot during the long transportation that waits for them. This practice is used everywhere: for the apples, for example, the time between harvest and consumption varies between 6 and 12 months [10]*, time that the apples pass closed in a controlled environment where their growth is monitored. The final product will not have the taste and the nutrients that a fruit matured on the plant has.*

In few hours the corncob is harvested, together with all the other present in the field. The operation is performed by local people, often underpaid and exploited. The corncob is put on a van: it starts the trip that brings it from Mexico to the United States, where a big cargo ship transports it for thousands of miles until Europe, generating tons of CO2.

Before to reach the selling point in a big supermarket, weeks after the harvest, it has to face a visual selection: if it's big, shiny and has a suitable shape, it can be sold to the consumer, otherwise it's simply thrown away. In this way much of the food produced is wasted in Developed Countries*. The corncob is finally served on the table of the European consumer, holding all its contradictions, damages that it already caused to the environment and the possible damages for whoever will eat it.*

6 - *Cf. Obels, Bulat, Genet, Feeding 10 billion people in 2050, 2015 - P. 4.*
7 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 16.*

8 - *Cf. Sos: i cibi hanno perso le loro proprietà, 2013. Published online at oggi.it*
9 - *Cf. Agnese Codignola, Neonicotinoidi, storia degli insetticidi accusati della scomparsa delle api, 2017. Published online at ilfattoalimentare.it.*
10 - *Cf. Just how old are the 'fresh' fruit & vegetables we eat?, 2003. Published online at theguardian.com.*

Picture 1

From this story it can be understood how unnatural food production and trade system is. In the past, until the half of the 20th Century, food production was profoundly affected by natural processes: climate, territory and available resources posed constraints that man could exploit, creating products and territorial features that were profoundly connected to their unique characteristics. Today the globalized system exploits natural resources over their limit, to produce more than needed in an unsustainable way:

"Modern agricultural and forestry science created a simplification and a homogeneization of Nature to minimize uncertain processes to ensure an effective production of marketable goods." [11]

Since the 40s of the 20th Century developed an innovative approach to agriculture (the one used today) compared to the one used since millenia, based on new cultivation techniques, new artificially synthetized products and few hybrid plants, that allowed to massively increase food production. In few words, an application in the agricultural sector of the industrial production approach, the one introduced in car production by Henry Ford. In this way the world population could have been fed, a hard task due to the fact that, after the *Second World War*, it started to grow exponentially. This new approach was named *Green Revolution*: it has been initially suitable to sustain World food demand after the war. But together with benefits grew risks too:

"The agricultural sector [...] has been profoundly transformed according to the dictates of the technocratic ideology. Agriculture, from source of food for the humanity, had to assume colors, characteristics and measures of the classic industrial sector, transforming in what now is defined commonly agro-industry." [12]

This agro-industrial system, in which is considered production but also distribution and sell of food, has profound implications in different areas. It's useful to analize them considering the consequences on the environmental, the socio-economic and the cultural sphere, described separately but deeply interconnected.

Environmental damages

Environmental damages are the ones that more than anything raised consciousness about how the agro-industrial system is harmful: alterations caused to the environment by the anthropic activity of the last decades has been so evident that, apart few rare cases, now everyone considers a fact the relation between global resources exploitation and ecosystems damages. The accumulation of plastic wastes in oceans is seriously damaging *flora* and *fauna*; global warming is testing many animal species, with many of them very close to extinction; water resources exploitation drained many rivers and lakes, one for all the Colorado river that during the millenia engraved the Grand Canyon.

Agro-industrial activities are also connected to climate changes phenomena: about 40% of the land mass is occupied by agricultural activities, and about 12% of greenhouse gas produced comes from this sector [13].

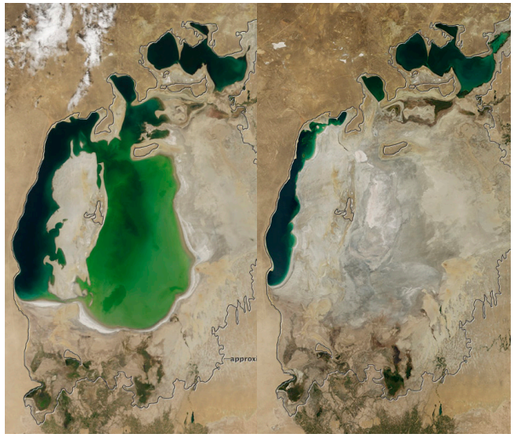
At an agricultural level, a practice used all over the world is the intensive and monocultural one: just few varieties of plants (but the same thing can be said for

Picture 1 - *Yuanyang rice terraces. Photo: John Qu. Published online at nationalgeographic.com.*
11 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 37.*

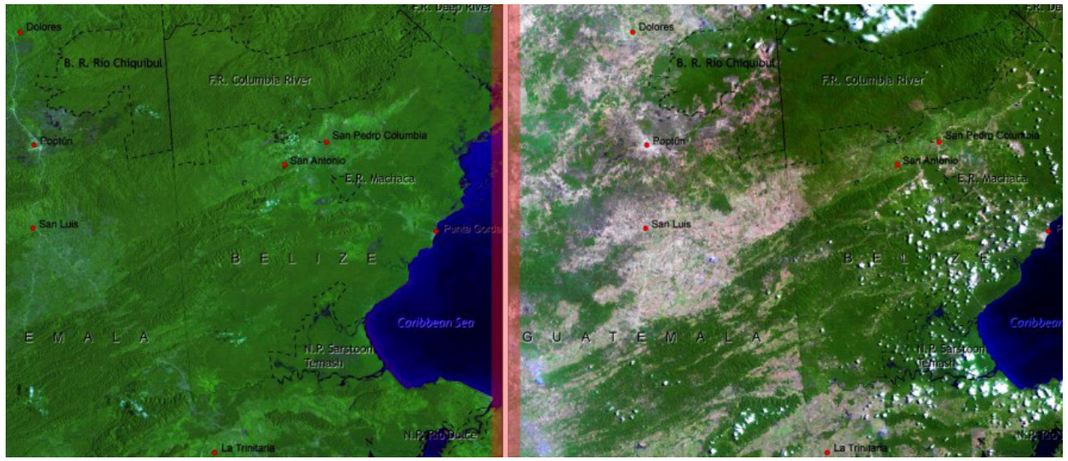
12 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 29.*
13 - *Cf. Bellarby, Foereid, Hastings, Smith, Cool Farming: Climate impacts of agriculture and mitigation potential, 2008 - P. 13.*

Picture 2

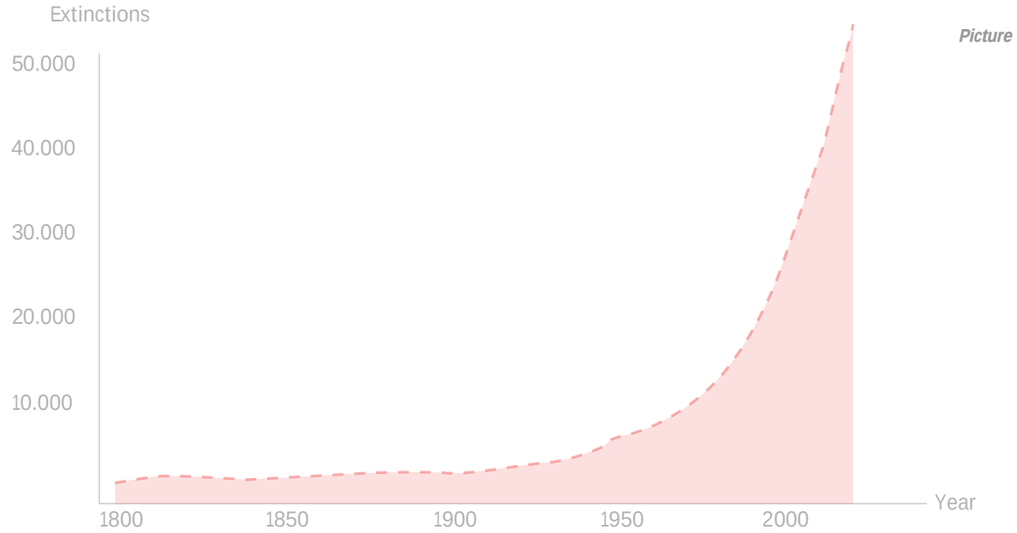
Picture 3



Picture 4



Picture 2 - *A plane sprays fungicides over a monocultural plantation, 2008. Photo: Romeo Gacad. Published online at gettyimages.it.*
Picture 3 - *Drainage of the Aral Lake. Photo comparison: 2000 (left) and 2014 (right). Published online at earthobservatory.nasa.gov.*
Picture 4 - *Deforestation occurred between 1975 and 2007 on the Guatemala-Belize border. Published online at dapa.ciat.cgiar.org.*



Picture 5

breeding in water and land) is cultivated in big fields, that are often obtained by deforestation. It's estimated that about 80% of the deforestation occurs to create space for agricultural activities [14]. In these fields, plants have too little space to grow healthy: for this reason are used big quantities of pesticides, fertilizers and water, that stress the plant and dry nutritives contained into soil, causing desertification[15] and euthrofication phenomena.

An another consequence of these intensive cultivation methods can be understood comparing nutritives of vegetals and fruits cultivated today with the ones produced in the past. According to the study conducted by Donald Davies, of the Austin University, from 1950 to 1999 vegetals and fruits produced lost much of the nutrients they once had. The more substantial decrease is found in calcium, proteins, vitamin C, phosphorus and iron

Picture 5 - *A graphic showing the extionctions occurred in the last 200 years. Published online at biologicaldiversity.org.*
14 - *Cf. Andrea Bertaglio, Agricoltura, prima causa della deforestazione globale e dei gas serra, 2008. Published online at ilfattoquotidiano.it.*
15 - *Cf. L'agricoltura: un ottimo metodo per combattere la desertificazione, 2015. Published online at ccpb.it.*

that decreased by 40% [16]. Lack of essential nutrients in fruit and vegetables means a not-balanced diet and psyco-phisiological imbalances.

At a microscopic level, the agro-industrial system implies serious damages to biodiversity. During the past centuries, farmers made every year a natural selection of their plants: just the seeds of the best plants were kept, the ones that better adapted to that environment. In this way many different varieties were created, everyone with unique characteristics, a result of the features of the territory it was cultivated in.

The selection of few varieties suitable for the global trade (due to size, color, etc) and industrialization of productive processes massively reduced biodiversity with an impressive speed, reducing to few units the varieties produced. Seeds used by farmers are sold by big multinational companies, who sell every year the same seeds, preventing the adaptation process and a new diversification. Just in the United States:

"The 80.6% of totmatoes varieties died out between 1903 and 1982, and so happened for the 92% of salad varieties, the 86% of apples [...] the 90,8% of corn and 96,1% of sweet corn. Among the 5000 varieties of potatoes existing, just four constitute the majority of the ones cultivated to be traded in United States." [17]

Among the environmental damages caused by today's agro-industry system can be considered food wastes, that can be measured in 1,3 billions of tons every year, corresponding to the 30% of the total [18], that entails even a huge waste in resources needed for their cultivation, harvest, transfromation and transportation.

16 - *Cf. Alessandra Farkas, Frutta e verdura «svuotate» di vitamine, 2006. Published online at corriere.it.*
17 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 75.*
18 - *Cf. Gli sprechi alimentari gravano sul clima, sulle risorse idriche, sul suolo e sulla biodiversità, 2013. Published online at fao.org.*

Socio-economic damages

The globalized economic system, as seen in chapter 3, has different contradictory characteristics: a part of the public opinion points out the possibility of progress offered potentially to everyone, while the other part highlights the imbalance that raised during the past few decasdes. If we consider the global context under the lens of food production and distribution, it's clear how:

"The industrial agricultural model has been strongly defended despite it revealed unsustainable, and the Developing Countries *have been forced to pursue unrealistically the same development model, with huge damages to biodiversity and traditional cultures."* [19]

Beside these problematics, it raises even the one linked to social and economic dynamics. The actual agro-industrial system imposes very high quantitative and qualitative standards that producers from all over the World must follow: the quantity has to be abundant, products have to be big and without imperfections (quality is linked to a merely aesthetic issue), otherwise they risk not to be sold.

These standards requested by the system heavily bind farmers in their job: they have necessarily to adapt, organizing production according to the monocultural invasive mode, that allows to reduce time and costs of work and to optimize gain. This last element is highly imbalanced for time and money that farmers spend: zucchini are paid 35 cents every kilogram to the farmer, and are sold at about 2 euros. Peppers raise in price from 70 cents to 2 euros, tomatoes from 25 cents/kilo to 1.50 euros. Even milk follows the same principle, that is paid 37 cents every liter and sold in supermarkets at 2 euros [20].

The dependence of farmers starts at the very first stages of the production chain: the great multinational companies have the power in this market and, exploiting farmers needs to produce more with less and in a way that ensure the harvest, without losses due to parasites attacks, sell their seeds resistant to pesticides, bacteria and long travels. In this way agricultural producers are forced to adapt to these conditions,

19 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 92.*
20 - *Cf. Burocrazia, costi di produzione e prezzi bassi all'origine affossano le aziende, 2018. Published online at cia.it.*

accepting a compromise and abandoning culinary and farming traditions.

The alternative is the one to abandon the agricultural activity, often looking for fortune in highly populated cities, causing both a congestion of urban centers and a lack of farmers in rural areas. Today's situation tells dramatic stories of exploitation and impossibility to adapt to this 'perverse system' [21]. It's the case of India, that in 2016 only witnessed 11.400 suicides of farmers, put under stress by prices that are too low for money and energy they spend [22].

Except few cases, farmers are put in front of a choice: to follow the agro-industrial system rules, or abandon the sector.

"Agri-business transformed farmers in slaves, hopeless poors". [23]

Damages to cultural heritage

From the facts analized, it clearly appears a crisis of the food system. Besides of causing huge damages on a socio-economic and environmental point of view, it is also a cultural catastrophe:

"What we eat is always a cultural product. [...] Food is the result of a series of cultural process that transfom it from a completely natural base (the raw matter) to a product that belongs to a culture (what is eaten)." [24]

Isolating the two components that regard food, the raw matter and the cultural processes that modify it, can be understood even more the scale of this altered state.

Natural products that are traded today have very little in common with the products of the past: it has been told how few nutrients today's vegetables and fruits contain, and how few varieties are sold in the market. The process of standardization of the productive processes transcended, thanks to an improper use of technology, limits and risks posed by Nature. Today's products have very little of natural: apples are all equally big and coloured, shiny, without imperfections.

These products are then modified according to cultural process that are increasingly more globalized and homogeneous. As happens to contemporary cities, very similar from the architecture point of view, also culinary identities of the different countries are getting poorer: cities streets emptied of all the restaurants that offered dishes linked to tradition, substituted by spots of commercial chains (mostly international) that propose dishes that are like in every nation. Just to name few examples can be considered *McDonald's*, *Spizzico*, *Starbucks* or any of the Japanese restaurants that propose raw fish dishes, or hamburger restaurants in the American style.

It must be said that exist also restaurants that propose traditional dishes, but are a niche. There are many other culinary elements linked to the cultural heritage that survived the violent wave of globalization. As in the *Middle Ages*, when thousands of books had been copied and passed on by scribes monks and then discovered by the following generations, so that all the knowledge, the recipes, the rituals, a fundamental part of our heritage, must be reconsidered, reassessed and proposed again to achieve a *New Renaissance*. So that they don't remain a privilege for few, and become the pillars to build the new food system on.

Precision agriculture and new horizons for food production

The american poet Wendell Berry entitled one of his books with this slogan: *'Eating is an agricultural act'*. In this way he pointed out the link between the products that end up on the tables of the consumers, and the process of their creation. How, where and when these goods are generated is contained in them, and we, through the choice we make buying this or that product, somehow approve this or that kind of production, financing it. It's clear that today's system is unsustainable, it doesn't work under many points of view and we, buying products that it produces, promote it.

The new frontiers of agricultural cultivation offer great opportunities to break the vicious circle of the agro-industrial

21 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 177.*
22 - *Cf. In 2016, 11,400 farmers committed suicide in India over debt, 2017. Published online at asianews.it.*
23 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 175.*
24 - *Ibidem - P. 49.*

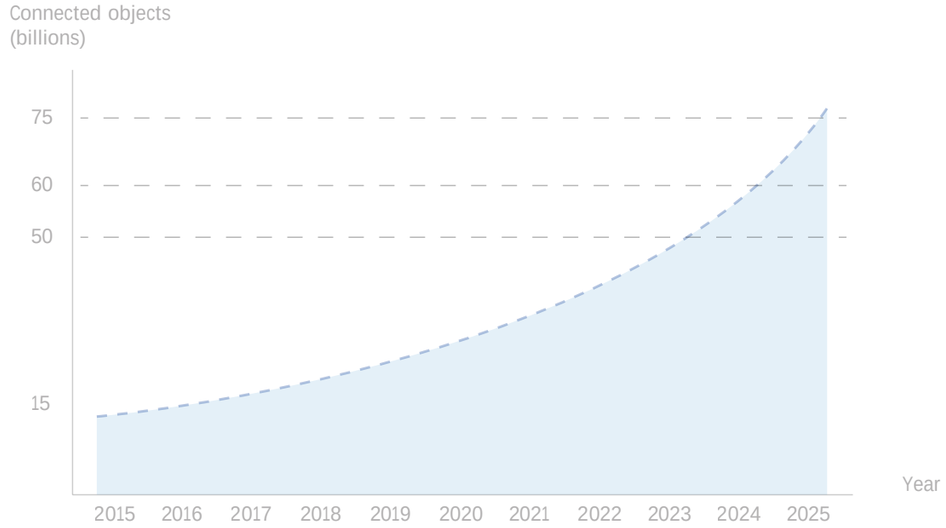
Picture 6

system. It's the case of *precision agriculture*: with this term is intended a method of cultivation management that exploits the combination of digital technology with agricultural science to collect precise scientific data about the conditions of the field, that allow to optimize inputs to be invested and maximize profits.

The union of technologies such as GPS and sensors allow to create maps of the field, through which is possible to read the variations of parameters such as yield, topographical characteristics, moisture, presence of organic matter, nitrogen and potassius, acidity, etc. With this kind of cultivation management it's possible to acquire more informations about the crop conditions, and ensure higher decision-making capacity on the base of scientifically collected informations [25].

Precision agriculture is a practice that is slowly starting to be acquired by farmers, for both the cultivation of fruits and vegetables and breeding. Neverthless is a long adoption process given the scarce digitalization of farms: according to a *ISTAT*

Picture 6 - *A drone used in agriculture to map soil characteristics. Published online at belladati.com.*
25 - *Cf. Dwidvedi, Naresh, Kumar, Yadav, Kumar, Precision Agriculture, 2017 - P. 85.*



Picture 7

agricultural census from 2010, just the 3,76% of Italian farms owns a computer[26].

Benefits connected to precision agriculture touch environmental, economic and social themes. The collection and the analysis of the data allow a much more efficient resources management: plants seeding is tailored according to the morphology and the characteristics of the soil, every plant is watered just when and how it needs, every squared meter of soil is fertilized according to its richness, without over-nutrition. This cultivation management allows to optimize inputs, that translates in a money saving for the farmer, and mostly the use of resources and the environmental damage is limited. Using less fertilizers can be reduced eutrophication episodes, and using less pesticides can be limited damages to beneficial beings that inhabit the ecosystems, such as pollinator insects.

From the economic and social side, precision agriculture allows an harvest increase: a plant that has optimized water

Picture 7 - *A graphic showing the forecasted rise in connected objects. Published online at statista.com*
26 - *Cf. Giorgio Lo Surdo, L'informatizzazione agricola, una sfida non solo tecnologica, 2014. Published in 'L'informatore agrario' of the May 15th 2014 - P. 19.*

and nutrients produces more. Moreover it decreases the prices for every fruit produced and increases its quality [27]. The possibility to know the condition of the soil in every moment allows the farmer to optimize his time: he doesn't have to constantly monitor his field, he doesn't have to do all the routine actions, such as plants maintenance, and in the future he will also be helped by tractors and machines that will manage even very complex tasks. So time that is gained can be used to focus on activities that are more important for the farm, such as management and planning activities. In this way farmers' job could be increasingly further from the fatigue that characterised it in the past, and with the progressive digitalization could even be more appealing for the new generations, filling that lack of farmers foreseen by *European Community*.

An another great advantage that precision agriculture creates is the one of traceability: the collection of data relating to climate, crop and harvest can be transferred from the farmer directly to the consumer. In this way traceability allows to establish a communication between the two extremes of the food chain, producer and consumer, both beneficiaries of this effect: the first has the occasion to let people know his products, his activity and his territory, the second has more informations about the food he purchases and it's more protected.

The exponential development of digital technology is destined to heavily affect many activities. According to a study conducted by *HIS Markit*, objects connected to internet will be 125 billions in 2030 [28], against the current 27 billions [29]. Sensors and devices used in agriculture will augment in the next future, and will even allow to record other parameters, opening the range of possibilities.

Precision agriculture could be a valid alliate in tomorrow's world planning. Neverthless it cannot be the only side to work on: as it's not enough to transform every car in the World in an electric car to solve mobility problems, it's not enough to optimize agricultural approach to solve tomorrow's agricultural problems. An holistic approach is needed, that substitutes the actual globalized and centralized approach to a distributed one that is socially fair, environmentally healthy, economically feasible and culturally sensitive [30]. It's not enough to better agriculture and its products, but it's necessary to rethink the entire distribution system of these production spots, goods trade and the relation among the different actors.

27 - *Cf. Dwidvedi, Naresh, Kumar, Yadav, Kumar, Precision Agriculture, 2017 - P. 85.*
28 - *Cf. Jenalea Howell, Number of Connected IoT Devices Will Surge to 125 Billion by 2030, IHS Markit Says, 2017. Published online attechnology.ihs.com.*
29 - *Cf. Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025 (in billions), 2018. Published online at statista.com.*

30 - *Cf. Carlo Petrini, Buono, Pulito e Giusto, 2016 - P. 170.*

2.2

"There's, in the image of the modern city, a sensation of discomfort, of pain, of offense, of anger that rises from the profound disturbance of form and style."

Pier Paolo Pasolini,
An interview in a television program in 1974.

Urban mobility: criticalities and possible development

Challenges posed by the future developments in the socio-economic context and the damages inflicted on the environment during the past decades regard many sides of the reality. Not just agriculture and resources management: a general commitment is needed focused on effectively planning tomorrow's world in all its aspects. And talking about cities and megaticies of the future a fundamental topic will be the one of mobility.

Urbanized population growth and density rate will complicate people, goods and resources mobility management, that even today pose important problematics to citizens and people responsible of its coordination: public transportation and bike or car sharing systems allow to alleviate the problem in part, decongesting streets by owned means of transport. As far as the results of these mobility typologies are encouraging, problems connected to city movement remain, getting worst as the population and density raise.

Problems connected to traditional mobility framework has different criticalities connected to environmental and economic fields. Atmospheric pollution is one of the most dangerous, having effects both on human health and economy. Traditional mobility bases its vehicles functioning on fossil fuels that release into the air nocive gases and substances. According to a study condtuced in 2017, every year in Italy 91.000 deaths occur caused by atmospheric pollution [1]. Data are still more worrying

1 - Cf. Smog, l'Italia maglia nera in Europa: 90mila morti l'anno, 2017. Published online at repubblica.it.

Picture 1

considering the situation in the two most populated countries in the World: India and China. In these countries, coal is still used to produce energy, and pollution coming from this practice kills about 1,6 millions of people each year [2]. Deaths and diseases caused by pollution imply a huge human and economic effort, that has to be sustained by public funds.

The stereothype that often is associated to the city is the one of a chaotic and polluted environment, where streets are invaded by cars stopped in jams that release in the air toxic smokes, with stressed drivers stuck in the car they drive. Actually the problem of street congestion and traffic jams is a very serious problem, that in cities worsens and generates huge wastes of money and time. The average american commute spends about 40 hours each year in the traffic, causing a rise in psychological stress rate and a waste of

Picture 1 - *Kevin Frayer, Pollution in China. Photo: Kevin Frayer. Published online at newyorker.com.*
2 - *Cf. Cecilia Bergamasco, L'India blocca la costruzione di nuove centrali a carbone, a partire dal 2022, 2016. Published online at lifegate.it.*

Picture 2

Picture 3

money in fuel and working time estimated, for the American reality, in 97,7 billions of dollars [3]. Many queues in cities occur because of car accidents that block viability. Among these accidents, about the 90% are caused by driver's distraction, or more in general by human error [4]. Besides of the waste of money, they cause en economic loss for the country, that is quantified in about 299,5 billions of dollars every year [5]. Thinking about city mobility, an another ctitical point is the one of parking. Owned means of transport implies the use of parkings where to park cars waiting for being used again. The first problem is to look for an empty parking lot. Considering New York City as an example, drivers spend on average 107 hours every year looking for a free parking lot, time that costs about 2243 dollars for each citizen in time, wasted fuel and generated emissions, a total of about 4,3 billions a year considering the

Picture 2 - *Traffic jam in New Delhi, 2015. Photo: Anil Sood. Published online at independent.co.uk.*
Picture 3 - *Umihotaru Parking Area, Tokio. Published online at carbuzz.com.*
3 - *Cf. Study Finds Costs Associated With Traffic Crashes Are More than Three Times Greater than Congestion Costs, 2011. Published online at newsroom.aaa.com.*
4 - *Cf. Bryant Walker Smith, Human error as a cause of vehicle crashes, 2013. Published online at stanfprd.edu.*
5 - *Cf. Study Finds Costs Associated With Traffic Crashes Are More than Three Times Greater than Congestion Costs, 2011. Published online at newsroom.aaa.com.*

entire city [6]. And the same situation can be found in all the biggest cities of the World.

Today's mobility focuses mostly on owned cars, and in extremely populated cities this determines a huge means accumulation: it's estimated that they lie unused for 23 hours on 24 [7], and this implies the use of a lot of space necessary to welcome these cars. Parking became so an increasingly more characteristic element of today's cities:

"In some U.S. cities, parking lots cover more than a third of the land area, becoming the single most salient landscape feature of our built environment." [8]

Opportunities offered by driverless mobility

During the years, awareness about the critical state of mobility and cities liveability grew, and simultaneously it has been tried to offer solutions that could solve these problems. In many cities it has been invested a lot in infrastructures to facilitate and encourage bikes mobility; public transportation means are used now by millions of people everyday, generating a huge challenge for the management of this flow of people; bike and car sharing systems have been installed in many urban areas, finding a widely positive answer, being used by increasingly more people every year.

These new models of mobility offer encouraging data, but the change that could seriously determine a substantial shift in urban mobility is the passage to the driverless mobility. As can be read in the essay *'Self driving cars, the next revolution'*, this kind of mobility could determine "profoundly disruptive implications for almost every stakeholder" [9]. And still, it has the:

"Potential to dramatically reshape not just the competitive landscape but also the way we interact with vehicles and, indeed, the future design of our roads and cities." [10]

Driverless mobility bases its functioning on highly advanced systems from a technological point of view, that provide means of transport of numerous "senses" that allow to collect data about the environment around, and to adapt vehicle's functioning and behaviour according to the inputs collected. These data can be informations about means or people around, weather conditions or street conditions, traffic situation, etc.

In particular, there are two macro-areas that, if combined, allow driverless vehicles to move autonomously. The autonomous mean of transport is provided of sensors that allow it to constantly monitor the part of space closer to it and to collect informations to be used for its movement. It's the case of proximity sensors or stereo-cameras, that can map the zones near the vehicle, and the connections with actuators allow to use the informations to accelerate, break, turn or park.

Simultaneously to the sensors work, the vehicle collects other data about the external environment: its connection with the internet allows it to directly dialogue with the other vehicles in real time, and even with the infrastructures the car will move on. This system allows to store much broader informations about the environment and the city. From this comes the possibility to know in real time traffic conditions in the areas where the vehicle is and even the zone where the vehicle will be in few minutes along the established path.

Crossing the two data coming from sensors and the communication with other vehicles and infrastructures, the autonomous vehicle can move freely, being conscious of close and far space: this allows it to move and organize the path to follow, reaching the destination in the shortest time possible.

By doing so, urban mobility system functioning reminds of a living being functioning: it's composed of many different parts (cells, organs, bones, blood, etc). These parts act independently from the others, but interact with them for the survival of the entire organism. It's capable of self-regulation and of adaptation to the external environment conditions: this is a fundamental issue for individual survival and the reproduction of the species. A

6 - *Cf. Pamela Oldfield, Searching for Parking Costs Americans $73 Billion a Year, 2017. Published online at inrix.com*
7 - *Cf. Car sharing, ecco perché usarlo, 2017. Published online at repubblica.it.*
8 - *Cf. Silber, Wallace, Self-driving cars: The next revolution, 2012 - P. 8.*
9 - *Cf. Silber, Wallace, Self-driving cars: The next revolution, 2012 - P. 3.*

10 - *Cf. Silber, Wallace, Self-driving cars: The next revolution, 2012 - P. 4.*

driverless mobility system follows the same principle and can be said capable of a swarm intelligence: with the digital connection that permeates every corner of reality, autonomous vehicles can exchange informations with the external space and the immediacy with which they exchange informations, leads to consider them as part of a unique big organism, that can lead and organize its conformation according to external conditions. The swarm can self-regulate and distribute itself uniformly in the streets not to congest them, planning a path for every unity that is as short as possible and that is less affective as possible on mobility fluidity.

Issues generated by driverless mobility

The advent of driverless mobility poses issues that are broad and complex and that concern firstly the ethical level. During the debate about this topic, a question that often is posed regards a situation that occurs many times on the streets, and it's a situation that could occur even in an autonomous mobility context, that asks for a forced choice. Many variants of this question exist, but this one can be considered as a base model:

"Consider the ethical dilemma that an autonomously driven car would need to resolve in an instant when a child jumps suddenly into the car's path from the curb. There's no time to brake. What then? Veer left into oncoming traffic, possibly causing an accident that would injure the driver and passengers? Veer right onto the sidewalk, possibly injuring pedestrians? Continue straight, possibly colliding with the child?".[11]

In this case, which is the right choice? And in case of injured people or, worst, victims, who would the responsible be?

A try to solve this dilemma has been made considering just the number of human victims as a unique parameter, without considering the life of a child more important than the one of a senior, or again not considering properties or animals damages [12]. The theme is undoubtedly important and far from being solved [13].

An another important question that autonomous mobility poses is the one of the acceptance by the society. From one side there's the problem of faith in this new technological world: they are very advanced systems and, according to the data of the tests made, also sure and efficient. But the psychological limit could lead to mistrust toward a vehicle that 'drives itself', with anyone at the steering wheel (and even *without* steering wheel). It's a cultural bareer that with time will be overcome. It probably happened something similar at the beginning of the 20th Century, when the first planes appeared: people were used to move on the ground, and the idea to move in the air at kilometres of height scared many.

The other side of the issue is connected to the values that the car evoqued since its invention, since it was a vehicle that just rich people could afford, desired by poorer social classes being a wellbeing icon. As time passed the iconographic meaning of the car changed, but didn't its importance: in mass society car always meant the conquest of autonomy and independence, it's always been considered as a rite of passage toward the adult age.

But generations change and so the values of the society and its conception of car:

"Younger generations, the ones who grew up with game consoles and smart phones, are not so in love with cars. They live perpetually connected lifes, and while they may have the same desire for mobility on demand, some see the act of driving as a distraction from texting, not the other way around." [14]

New generations are not so attracted by driving: in United States, in 1978 about the half of sixteen years old and the 75% fo seventeen years old had the driving license; in 2008 numbers decreased to respectively 31% and 49% [15].

These data offer a sign that time and cultural shift will pose the bases for a complete adoption of driverless mobility.

11 - *Cf. Peter Novak, The ethical dilemmas of self-driving cars, 2018. Published online at theglobeandmail.com.*

12 - *Cf. Peter Novak, The ethical dilemmas of self-driving cars, 2018. Published online at theglobeandmail.com.*
13 - *Cf. Besti, Samorè, Responsibility driven design for the future self-driving society, 2017.*
14 - *Cf. Silber, Wallace, Self-driving cars: The next revolution, 2012 - P. 7.*
15 - *Ibidem.*

Picture 4

Implications of driverless mobility

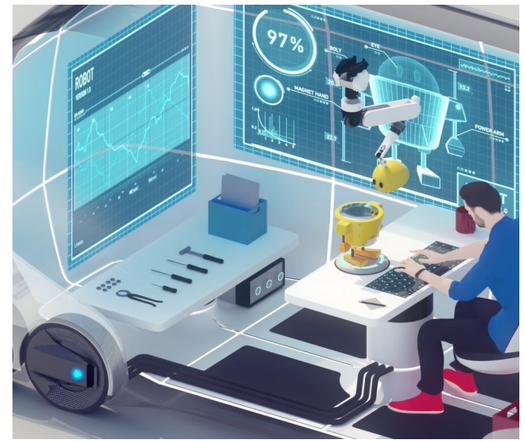
What looks clear here is that there are many problems that negatively characterise life and mobility in cities: pollution, traffic jams, lack of green, pedestrian or cycle zones due to the huge space used to accept all the owned vehicles. And it's also clear that the sector of mobility will change city set-up and even people's life.

To base the functioning of vehicles on data collected on the environment will make movement a lot more efficient. Data are processed by softwares that calculate in real time movements that the vehicle will perform: calculus capacity of today's computers transcend even the most optimistic expectancies had 20 years ago concerning future technology, and given the exponential development occurred in the last few years it just can be imagined the performance level that can be reached in the next 20 years. This will signify more effective, precise and safe movements.

A direct effect of this will be a drastic decrease in accident number, of which about the 90% is caused by human error[16]. Consequently cars cockpits will not need anymore all those structural and protection components that are fundamental today: chassis and bodies are constituted by steell, a very hard material, to resist impacts, airbags and roll-bars are put in strategic points to increase safety. Without these components, autonomous vehicles will be much lighter than today's cars, and will have a lot more space available inside the cockpit: without steering wheel, gear stick and dashboard the space gained is considerable, and it's even more adding the one obtained by the engine bonnet. In the past it contained the engine and mechanical connectors needed for the vehicle propulsion, but with the shift to electric engines its dimensions wil reduce, and will generate more space to be destined to the vehicle abitability.

The new spacious internal configuration of the vehicles will permit to detach from the traditional way to live the car space: cockpits can be transformed to allow more productive activities,

Picture 5



Picture 6

Picture 4 - *A frame of the movie 'American Graffiti', 1973. Published online at whichcar.com.*

Picture 5 - *A frame from the video of e-Palette Concept Vehicle project by Toyota. Published online at youtube.com (min 1.00).*
Picture 6 - *Ibidem (min 1.30).*
16 - *Cf. Bryant Walker Smith, Human error as a cause of vehicle crashes, 2013. Published online at stanford.edu.*

transforming car space into a changeable space, an extension of the home or working environment. In autonomous vehicles will be possible to work, relax in a place studied on purpose, to have a dinner to a real dining table: it will be possible to do things unthinkable in today's cars. In this way, time inside vehicles can be used in a more productive way, for example bettering working productivity. With this new range of possibilities that opens:

"Consumers will expect the latest gadgets in their driverless cars—and that means a new landscape and new business pressures for current players in the automotive ecosystem." [17]

Self-driving vehicles offer the possibility to optimize their use: if traditional mobility means of transport are mainly owned and estimated to be unused for 23 hours on 24, with the new autonomous mobility systems vehicles can be used 24 hours a day, even exploiting the fact to share them through sharing systems. This implies the chance for the citizen to save money on the purchase of a new owned car, and to benefit of a city with less means of transport and more space for green, pedestrial or cycle areas.

Decrease in accident number implies effects on the healthcare system, beside of the governative and insurance ones. Eliminating the possibility of accidents along the streets involves a dramatic reduction of victims and injuries that have to be cured in hospitals, determining a remarkable save of public funds. At an insurance level, a lot will change: the car sector constitutes a big slice of insurance business, and in a World without crashes and even without owned cars, this will determine a huge loss. Even for local municipalities will occur a dramatic gain loss. Automatic pilot plays by the rules, and this will mean no more penalties and no more money cashed by municipalities.

The elimination of technical features will happen both inside the vehicles and outside, at an infrastructure level. Today's streets are designed for means of transport driven by human drivers, but:

"With extra-wide lanes, guardrails, stop signs, wide shoulders, rumble strips and other features [are] not required for self-driving, crashless vehicles." [18]

Future infrastructures will host much more

17 - *Cf. Silber, Wallace, Self-driving cars: The next revolution, 2012 - P. 31.*
18 - *Ibidem - P. 26.*

Picture 7

Picture 8

vehicles than the present one, without the need to build new roads or extend the existing ones. Research state that it will be possible to augment street capacity by 500%, and the efficiency of intersections can be bettered by 200 or 300 times [19].

Finally it have to be considered the energy theme: traffic costs to americans 4,8 billions of hours every year, 7 billions of fuel liters, 101 billions of dollars in total considering fuel costs and delays. Efficiency and route optimization allows to reduce movements, and vehicle weight decrease contributes to optimize and minimize energy use.

Driverless mobility promises to solve many of the issues of today's and tomorrow's cities. But it's important to keep a critical approach and a vision focused on the long period, considering all the aspects that come into play, planning everything at the best. It's particularly interesting to consider the transition period that witnessed the rise of cars in the mass market, that substituted the horse as main mean of transport for the citizens. Problems connected to a mobility

Picture 7 - *Children playing near a dead horse, 1905. Published online at sutori.com.*
Picture 8 - *Streets of New York covered with manure, 1893. Published online at huffingtonpost.com.*
19 - *Cf. Silber, Wallace, Self-driving cars: The next revolution, 2012 - P. 26.*

system based on horse were many: animals' manure were spread for the entire city [20] (a horse produces on average between 10 to 20 kilos of manure and 4 liters of hurine), and their carcasses often accumulated along the streets. At the beginning of the 20th Century, automotive propaganda preached the advent of a 'horseless era', promising a considerable saving and gain in terms of life quality [21]. The advent of cars mobility actually eliminated all the problems coming from horse mobility, but posed many other critical issues, hard to see at a first impact but with damages that are now threatening the entire human population and the entire Planet.

Possibilities for transport and delivery

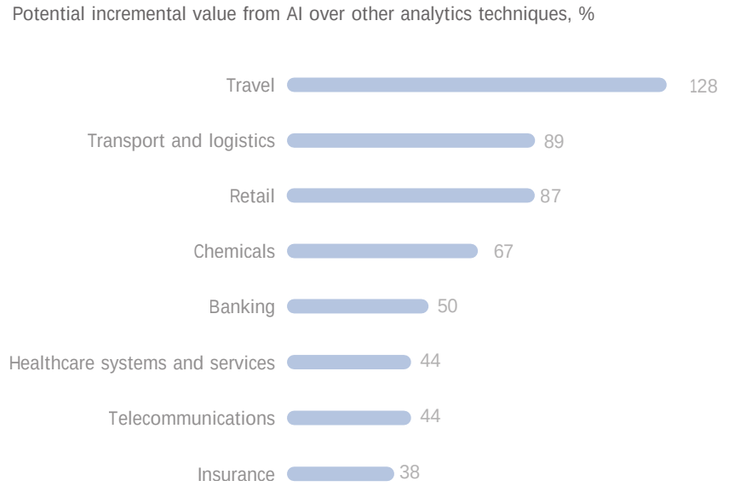
Autonomous mobility will bring massive changes in both citizens mobility and goods movement, transport and delivery. Self-driving vehicles are used today in logistics, mostly at the level of warehouse management and in general in the first phases of the distribution chain. Case studies analized show how self-driving vehicles have the ability to transport goods, but also to combine other processe such as loading and unloading, that permit to considerably increase the overall processes efficiency, even increasing safety [22].

The system of warehouse automatization called *Kiva* can autonomously organize warehouse shelves, and in 2012 has been purchased by *Amazon*[23]. Also more advanced systems exist: the company called *Jungheinrich* created a forklift that, thanks to a laser navigation technology can move autonomously into warehouse spaces, moving and organizing stored goods.

The advantages of autonomous vehicles used in logistics open new perspectives, in particular for the 'last

20 - *Cf. Andrew Nikiforuk, The Big Shift Last Time: From Horse Dung to Car Smog, 2013. Published online at thetyee.ca.*
21 - *Ibidem.*
22 - *Cf. Heutger, Kückelhaus, Self-Driving vehicles in logistics, 2014 - P. 21.*
23 - *Ibidem - P. 24.*

Picture 9

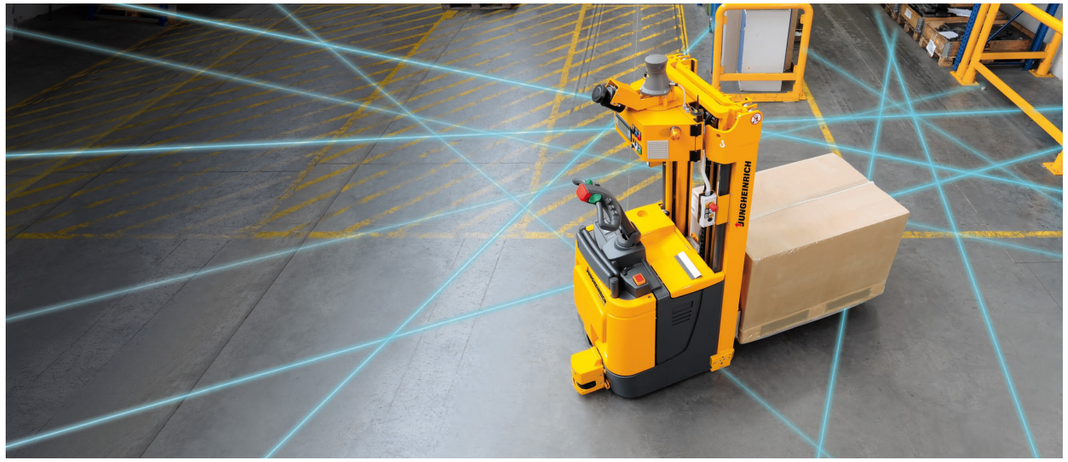


mile delivery' sector: in today's context, deliveries to customers' homes are performed by humans employees that, driving a van, transport the parcel until the door of the customer's house to deliver it directly into his/her hands. This phase is the shortest, considering the length of the transport, but it's the one that has the most critical issues. A big transport van has to charge all the goods to be delivered in a delimited area, follow the predetermined path, stop to the house of each customer, often running into problems for parking or customer availability.

According to a study conducted by *McKinsey&Company*, autonomous transport and delivery systems will totally replace today's ones that, if compared to the possible future ones, look poorly digitalized and optimized: it's estimated a decrease in functioning cost of about 40%[24], also allowing to optimize and make more efficient the overall system functioning. The advantages acquired by autonomous vehicles will be also present in the driverless delivery phase. This translates in

Picture 9 - *McKinsey&Company chart that shows the possibilities offered by AI for sector. Published online at Linkedin.com.*
24 - *Cf. Joerss, Schröder, Neuhaus, Klink, Mann, Parcel delivery: The future of last mile, 2016 - P. 15.*

Picture 10



Picture 11

Picture 10 - *Kiva warehouse robots at Amazon's center in Tracy, California. Published online at wired.com.*
Picture 11 - *Jungheinrich robot and its laser navigation technology. Published online at texpotrade.com.*

an important chance to better the service for the clients: containers, infrastructures and structures digitalization will allow a complete traceability, and thanks to their autonomous functioning, means of transport could delivery goods even at night or during the weekends.

The increased effectiveness in managing goods flow will allow deliveries accurate to the second: knowing precisely the path that the container and the vehicle will have to follow, it will be possible to estimate exactly the arrival time of the parcel, creating a more reliable service that can be tailored according to customer's needs.

A variable that is considered very important in the process of adoption by the society will be the consumers' choices: still according to this study, about 25% of the clients are willing to pay an extra for immediate deliveries or same-day deliveries, that can be considered a sign that customers are adapting to home delivery sector and are becoming comfortable with it. Moreover, talking about driverless vehicles, about 40% of the consumers are favourable to get their parcel delivered by one of them. The number raises at over 50% for young between 18 and 34 years. Considering drone delivery then, 25% of the interviewed stated indifferently, while 35% stated that would prefer to get parcels delivered by these [25].

25 - *Cf. Joerss, Schröder, Neuhaus, Klink, Mann, Parcel delivery: The future of last mile, 2016 - P. 24.*

2.3

"If you don't want a man unhappy politically, don't give him two sides to a question to worry him; give him one. Better yet, give him none."

Ray Bradbury, *Fahrenheit 451.*

The *vision*: conscious production, trade and consumption

The analysis made about urban mobility and food production and distribution highlighted many criticalities and, together, has been described many possibilities of sustainable development offered by the application of new digital technologies to traditional vehicles or cultivation methods.

Problems and opportunities push toward an approach of choral planning, that gathers actors with different capabilities to be destined to a common design goal. Ezio Manzini emphasizes the importance of this last concept:

"Design-orienting scenarios are a set of motivated, structured visions that aim to catalyse the energy of the various actors involved in the design process, generate a common vision, and hopefully cause their actions to converge in the same direction."[1]

So it's necessary to make clear the shared scenario, as a common goal to aim for. The concept of scenario is composed of three parts, that constitute its architecture.

The first component is the *motivation*, and has to gather all the reasons that tell why that scenario is meaningful. Starting from the premises, it's necessary to rationally explain why is important to undertake that path instead of another.

The second one of these components is the *vision*, that has to answer the question *'What would the world be like if...?'* [2]. The answer can be expressed using sketches, stories, images: everything that

1 - *Cf. Ezio Manzini, Design, When everybody designs, 2015 - P. 130.*
2 - *Ibidem.*

could describe how the World *could* and *should* be. It's the most important part of the scenario and aims to define the overall characteristics of it.

Finally is the *strategy*. It's the component that adds consistency to the scenario and defines which are the steps required to realize it.

The previous chapters described the problems that push toward a radical change of today's urban mobility and food supply system, pointing out that it's a generalized problem in all the Planet, telling even the implications. The part of *motivation* of this project has been defined, and in this chapter it will be clarified the *vision* component, that allows to imagine and define the boarders of the future scenario. The *strategy* part of this project will be described in depth in the last chapter.

The *vision*, analized and described according to social, economic and cultural parameters, comprehends a new infrastructural model that re-conceives the way food is produced and distributed today, that pushes toward a products and local resources optimization, that encourages social cohesion and that raises citizens awareness toward food importance in our society. Not only considering health benefits coming from a healthy diet, but also thinking about how many social and economic benefits follow a local products consumption: less exploitment of workers, more biodiversity and an enhancement of the territory that citizens live every day.

The overall functioning is the one of a *zero-miles* products trade, that is products cultivated near the place where they will be consumed. It's for sure the most ancient method of products trade: during past centuries it was a normal condition that the farmer transported his products to the closest city to sell them. The element that differentiates this new system by the ones of the past centuries is the fact that is based on digital technology: digitalization of cultivation, transportation and delivery processes will allow to maximize service efficiency and increase the possibility to transfer informations from the producer until the consumer (the *traceability*).

Digital services that will be used in cultivation and urban mobility can be combined to create an efficient system of production, transportation and delivery of fresh agricultural products, that can be distributed efficiently from the rural areas around the city inside the urban area itself.

Picture 1

Picture 2

Picture 1 - *A farmers' market from the 17th Century. Hendrick Martensz Sorgh (1611-1670), A vegetable market, Private collection.*
Picture 2 - *A farmer using digital devices to monitor the field. Published online at videoblocks.com.*

The chapter about social innovation allowed to define its main base requirements: the presence of problems and the pervasivity of digital technology that allows to face these problems differently. These new dynamics permit to create “new social relations and collaborations”, transformations favourable to the society and to its evolution, starting from community cohesion.

With these concepts in mind it’s possible to consider the new system of autonomous transportation and delivery of fresh agricultural products theorized as a social innovation. Its functioning is anabled by the presence of autonomous vehicles and systems equipped with digital technology, and this allows to solve (in part) the problems present in the agri-food chain and opens new possibilities for the actors involved. Considering just the social issues, it can be mentioned the exaggerate length of the food supply chain, that implies huge transportation costs, underpaid workforce exploitment and a lack of relationship between producer and consumer. The last two actors, respectively the first and the last of the supply chain, are heavily damaged by the mainstream agri-food system: producer is forced to accept laws of the global trade, while the consumer buys and consumes products optimized to make a profit, and not to feed him properly. This determines an imbalanced diet for billions of people, physical damages and a lack of agronomic consciousness: it’s very difficult that consumer knows where, when and how an agricultural product is cultivated and harvested.

The new system theorized allows to reconfigure the supply chain functioning and shorten the process, renouncing to the vertical framework between urban and rural areas established during the past few decades. The goal is to create an equal relationship between city and countryside, and so even between producer and consumer: if the agro-industrial system alienate the two extremes of the supply chain, the new system aims to bring them closer allowing a product and informations exchange that is more effective and fast. The consequences of these dynamics make the famers’ work easier: for instance, while he is in its farm working, studying new ways to better harvest quality, a drone can deliver his products directly to his customers. A huge convenience for the customer and a great increase in selling capacity and time for the farmer.

Today’s farmers’ markets are a reality, and are acquiring increasingly more consensus: Milan, since more that ten years, has been hosting different farmers’ markets all around the city, and the same happens in cities like Los Angeles, Pechino, San Francisco. As stated, it’s an ancient phenomenon that is as old as the cities themselves, but the dynamics of the agro-industrial system imposed all over the World, and big supermarket chains can be found everywhere. This reduced the field of action of these markets, that reduced to isolated cases. Moreover the majority of these markets takes place just in established days of the week (normally 1-2 times a week), and are able to focus on a restricted number of users.

The goal of the new system designed is to expand the selling possibilities of these products. Now just few people can interact with this service, being many citizens at work, while an autonomous delivery system could allow to better trade efficiency, and consequently sell more products. The final aim is to create a transport and delivery system that transforms and evolves the concept of farmers’ market, proposing it as the main food supply method for citizens,

Picture 3

Picture 4

Picture 3 - *Customer and farmer at a farmers’ market in Rome. Published online at mercatocircomassimo.it.*
Picture 4 - *A farmer growing vegetables on a rooftop. Published online at nationmultimedia.com.*

scaling and spreading its benefits.

It must be said that it is not thought to be *the only* system for food supply: many other interesting trends are emerging today, that can effectively contribute to shape a more equal and sustainable food system: self-production and urban-gardening are two of the most interesting trends that, together with Nemo2040, can reshape the way agricultural products are produced and traded.

Considering the actual phenomenon of farmers' markets as a social innovation, it can be said that, with the design of a new autonomous system of transport and delivery, it can be boosted to the level that Manzini named *'implemented solution'*: applying products and technological systems to support its functioning, social innovation detaches from the insecurity and fragility of the first phase, acquiring more authonomy, safety and efficiency contributing to broaden the possibilities for the people involved in it.

Productive and economic perspective

Social innovation, to survive in time and proliferate, needs the combined work of many actors: just in this way is possible to build a valid system that can effectively sustain and amplify its effects. Beside of supporting this phenomenon, the system theorized, focused on the autonomous transport and delivery of fresh products, can do much more than that.

Rethink the economic-productive system, currently centralized and globalized, implies benefits for the environment and local economies, and allows even to rethink city and countryside relationship.

Distributed systems logic aims to create a net of production knots deeply interleaved to the social context, local know-how and traditions, but globally connected. In this new ecosystem every local reality can act more freely than in a globalized system and has the chance to exploit and give value to its resources and knowledge. Talking about production and trade of food, this implies a new relation between city and rural areas that are placed near it: during the past decades, after the establishment of the centralized system, these realities were intended to be at the antipodes, two contexts seen as divided compartments. The progressive urbanization is a symptom of this contrast: people leave rural areas to establish in cities and pursue the opportunities offered by technological progress.

The goal is to establish a new relation between these two ecosystems that is not vertical, where city is considered at the top of the pyramide, and rural areas that serve intensively its food demand, but rather a symbiothic relation, a tighter relationship to facilitate the exchange of resources, food and workforce. In this way, everyone's capabilities are exploited: "those at the margins have what those at the center can never have – a knowledge of detail, the specificity of time, of place, of particular events" [3], on the other hand city inhabitants need food and are increasingly more willing to have it consciously and in a sustainable way.

In a modular system of food production and distribution, every knot of the net has a reduced action range, making its action more flexible and customizable according to the needs and opportunities of local communities. Short chain allows to get producer and consumer closer, and even to eliminate intermediaries: in this way the farmer can recover part of the gain lost now along the long supply chain, obtaining a more honest profit for his job and generating fairer prices for the consumer.

The design goal is the one to conceive and draw a distributed productive system, starting from the idea of a more united society, that can exploit its resources to encourage a progress that is environmentally healthy, socially fair and economically valid.

3 - *Cf. Ezio Manzini, Design, When everybody designs, 2015 - P. 20.*

Picture 5

Picture 6

Picture 5 - *Windy Hill Wind Farm, Queensland, Australia. Published online at trendintech.com.*
Picture 6 - *Solar panels mounted on hill tops, Qinhuangdao, Northern China. Published online at videoblocks.com.*

Cultural perspective

Cultural implications of the current global centralized paradigm has been described previously. Both the cultivation of alimentary resources and their transformation through 'cultural processes' lost the identity component that characterised them.

Technological processes offer hartening perspectives, but what is needed is a broad approach, that comprehends those factors that are often underestimated. The cultural factor is often considered superfluous given the severity of today's issues: with the aim to generate clean energy, huge wind turbines are installed in the middle of wonderful mountain valleys, and legions of solar panels are mounted on hills sides, horribly ruining the landscape, witness of culture and identity. So it's fundamental not to forget this essential component.

In this polluted, inequal and paradoxical system, it's necessary to act and design to create a system that brings possibility of growth and economic power even in rural areas, in those points where identity of communities, populations and countries was born, during a tight relationship with Nature and where, in few points, it still holds that value. The goal is to create a contrary movement to globalization, that doesn't focus on tackling the change occurring, inevitable and in some cases necessary, but rather that offers a new point of view on progress, that comprehends in its path also the rural areas and a revaluation of territory and historical identity as a fundamental value where to build the future on, that makes good use of the "scandalous revolutionary force of the past" [4].

In this sense it must be emphasised the importance of the real actors of this change: citizens. Every citizen, when buys food that will eat, expresses a kind of vote for the system that supports the production of that fruit. To know the consequences that our choices imply opens up a new universe that citizens should know. And this is an essential parameter for change: knowledge of the system that turns around food and citizens' consciousness about the power they have being actors of this change. Because designers and organizations can create all the most advanced systems or products to support them and their lifes, but everything is about the use they make of them.

4 - *Cf. Albrecht, Magrin, Il Bel Paese: 1 Progetto x 22.621 Centri Storici, 2017 - P. 68.*

2.4

- "What's the point of your building? - he asks - Which is the aim of a city in construction if not a city? Where's the plan that you follow, the project?
- We will show you as soon as the day ends (...).
The work finishes at the sunset. The night falls on the yard. It's a starry night.
- Here's the project - they say."

Italo Calvino, *Le città invisibili.*

Milan city: a model of sustainable development

Every *scenario* needs a tangible component: it's not enough to imagine how future *should* be, there's the need to realise the principles fixed into a project that gives all this a shape, that translates the collective vision into a design action.

The vision drawn for this project (as will be shown) comprehends numerous factors, with many of them acting on a very broad slice of territory: this makes the realization of an hypothetical design arduous. Resuming the example of the living being, every part that composes it has a precise function, and the perfection of its shape is given by the adaptation to a precise function occurred during a long period of natural selection. It's been needed time to create it, but it's perfectly efficient. In the same way, during the planning of the future cities, it's necessary to know dynamics involved into planning, and design change as a sort of adaptation to external characteristics, planning resources reorganization and technological adoption by the society.

The integration of such a pervasive system will inevitably be a gradual process, that will occur in different points in different times, starting necessarily by the ones that has the most favourable characteristics for system introduction.

In the Italian reality, the city that is showing more propensity to acquire the most advanced mobility systems and that shows more attention toward social innovation phenomena is Milan. During the last few years many initiatives have been created to promote a sustainable development: everything leaded to the choice of the *Design Capital* as the perfect context where to assume the creation of this system, a first step to subsequently spread the same concept in other realities, following the concept expressed by Manzini of scalability of social innovations. [1]

1 - Cf. Ezio Manzini, Design, When everybody designs, 2015 - P. 180.

Piano Urbano della Mobilità Sostenibile (PUMS)

'Piano Urbano della Mobilità Sostenibile' has been deliberated on June the 8th 2017 by Milan Municipality and states the choice to evolve the city mobility system toward a more sustainable one. It's the result of 5 years of work by the city council, that clearly expresses which will the urban development be during the next years, that is to pursue:

"An effective balance between mobility demand, life quality, environment and health protection." [2]

From this sentence can be noticed that the four components are equated: the need of mobility doesn't take precedence on the others, but are all considered into the urban planning, focused on:

"Achieve the goal posed by European Union *about resources efficiency through eco-mobility and sharing."* [3].

More in concrete, *PUMS* aims to implement public transport to make it more efficient and convenient compared to owned means of transport that are much more pollutant and congest city streets. Connected to this point is the one to decrease gradually spaces destined to parking, in particular in the areas around the historical center, to obtain more space to be converted in green or pedestrian areas.

Through the *PUMS*, the city council aims to create a more inclusive and accessible city: a smart environment that offers to future citizens, connected and digitalized, all the possibilities and services needed to create a customized experience according to different needs, with a constant focus on technical, economic and social sustainability.

2 - *Cf. Piano Urbano per la Mobilità Sostenibile, 2017 - P. 11.*
3 - *Ibidem - P. 12.*

Farmers' markets

Farmers' market trade is a traditional way of selling agricultural products, as old as the cities are. It's a sort of analogical traceability: the customer has the chance to know all the informations that food contains directly by the person that cultivated and harvested it. This model has many innovative features that define it clearly as sustainable, and that's why it's been taken as a model during the design process.

Farmers' markets have been introduced in Milan urban area in 2008, when the first market opened. Since then, many others markets have been inaugurated through city streets, to reach the 20 we find today. Their growth is a symptom of the fact that, during the years, they collected increasingly more consensus and requests, highlighting even the increased attention of Milan municipality toward *zero-miles* products.

For sure, a feature connected to farmers' markets rise in Milan city is the particular landscape conformation of the area around the urban borders: the Region Lombardia is very rich of breedings and farms and has a very differentiated geography. This implies a huge diversity of agricultural products and even a reduced distance to reach the urban area. These characteristics make Milan a suitable city for this kind of trade, through which it's possible to give value to the territory and its products: both encouraging local economy and autonomous cultivations, and even selling local typical products to customers and restaurants of the city, enhancing the quality level and gastronomic characterization.

Sharing services

Sharing systems of vehicles included in the *PUMS* are mobility services made available by the city council that allow the citizens to instantly rent a mean of transport for a limited time (usually from few minutes to about 1 hour). A fleet of vehicles (bikes, cars, scooters) are shared by all the clients of the service.

These mobility methods constitute an alternative to owned vehicles and faced a huge use increase during the last few years: systems such as *BikeMi* or *Enjoy* had such a great success to generate always more request. And so other more advanced systems has been installed in Milan city, such as the new free-floating bike sharing

Picture 1

systems that, contrary to *BikeMi*, don't need stations where to park bikes that can be left anywhere on the streets. Consensus received by these services pushed Milan city to such strongly believe in these sharing technologies that they have been included into the *PUMS* as an essential point to build the future urban development on. Together with the self-driving and electric cars and public urban transport, they will determine a substantial change in mobility and will contribute to reduce pollution and street congestion. Moreover, their use could allow to reduce surface use, and increase the space destined to green areas or cycle paths.

Sistema Città di Milano

The thesis project here presented was born during the *Final Synthesis Design Studio* during the academic year 2017/2018, of the study course *Product Design for Innovation*, and in particular during the workshop n°2 managed by professor Stefano Marzano and Stefano Ivan Scarascia.

The workshop opened with a pseudo-document coming from Milan municipality that declared the prohibition to circulate to all the not-autonomous and not-electric vehicles. All this starting from the year 2040. It's not a real document: it has been conceived as a constrain we would have had to face with to imagine the new mobility in a new hypothetical Milan city with autonomous vehicles.

It's important to highlight the point of this document that refers to the collaboration among all the actors involved into the city system: institutions, companies, commercial activities and mostly citizens that, as stated, are the main actors of change. Social innovation phenomenon is a perfect example.

Picture 1 - *A free-floating bike sharing system, called Mobike, in Milan streets. Published online at radiolombardia.it.*

SELF DRIVING SOCIETY@2030 | New unexpected relations among domesticity and mobility

Milano decide il proprio futuro

Dal 2040 circoleranno solo automezzi autoguidanti elettrici

I cambiamenti radicali in una metropoli avvengono solo attraverso la concordata collaborazione di tutte le istituzioni, aziende, attivita'commerciali e privati cittadini che costituiscono il "***sistema città***".

L'accordo fra il Comune di Milano, l'Azienda di Trasporti Pubblici, l'Associazione Commercianti , la Confindustra Milano, la Pubblica Salute e Pubblica Sicurezza è raggiunto e consolidato con la formazione dell'esecutivo "***Sistema Citta di Milano***"

Ogni parte del sistema ha un ruolo attivo nella realizzazione di questo grande progetto che definirà:

1 *le tipologie di mezzi autoguidanti che costituiranno il sistema del trasporto urbano pubblico e privato.*

2 *le infrastrutture necessarie a supportare il nuovo sistema di trasporti: viabilita' e controllo, parcheggi, stazioni ricariche e manutenzione mezzi.*

Il progetto definira' inoltre l'interfaccia fra il "***sistema di trasporto autoguidante urbano***" con il sistema di trasporti extraurbani publici e privati.

Una ipotesi-studio preliminare del progetto sara' realizzata dal "***Sistema Citta di Milano***" in collaborazione con Polidesign Milano.

POLITECNICO
MILANO 1863

Picture 2

Picture 2 - *The document 'Sistema Città di Milano', the starting point of the Workshop managed by Professor Stefano Marzano.*

2.5

"Each part of a system isn't important in itself, it's relevant just for the way it is used in the intrinsic logic of the whole".

Dan Flavin

A new system to realize the vision: *Nemo2040*

Nemo2040: *nomen omen*

Project name could look a little simple and even trivial. But the name Nemo2040 can have many meanings into the context drawn, and they help to better express the vision that the project is built on. The word *nemo* has latin origins and literally means nobody. Infact the peculiar characteristic of this project is the one of being composed of vehicles that are actually driven by no one in a direct way (even though it can be said that they are indirectly driven by man, through sensors, algorythms and GPS connection programming) allowing to save money, time and space. However the complete name is not simply *Nemo*, but *Nemo2040*. The number *2040* infact means the year in which the project could start. It's about in that period that some favourable situations concerning electric autonomous mobility and delivery systems will materialize. From one side the ever growing urbanization will almost reach the pique forecasted in 2050, in which 2 people on 3 will live in cities, that will entail an unprecedented soil use and population density, making transport with traditional means increasingly more problematic. On the other side, we will witness the establishment of the faith increase toward driverless systems: a new technology always requires time to be metabolized by society, and especially this happens if the innovation field is such disruptive as the autonomous mobility one.

So in 2040, use and live together with this kind of vehicles will be normal, and at the same time will constitute a new main need for every big city and for its own

Picture 1

Picture 2

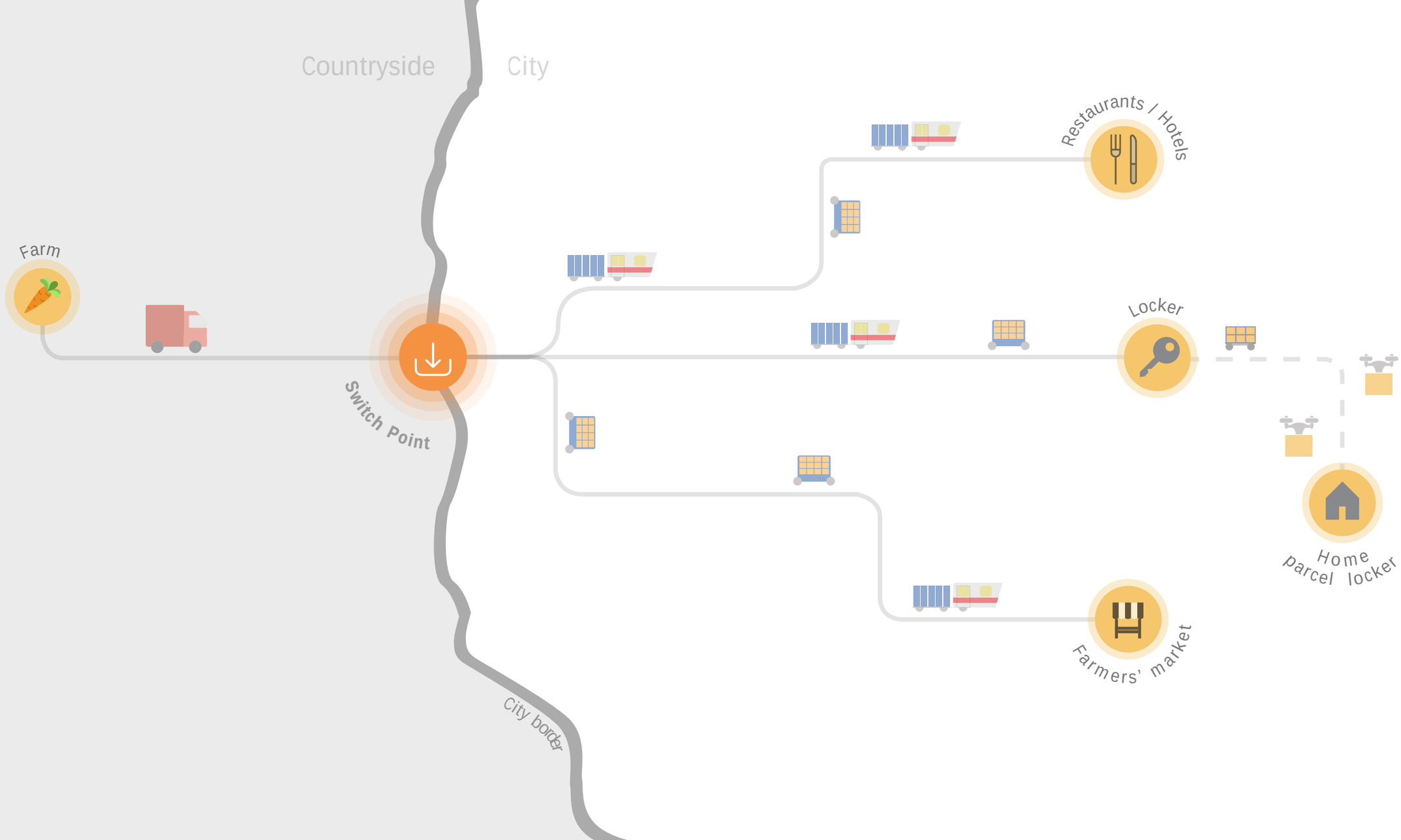
liveability.

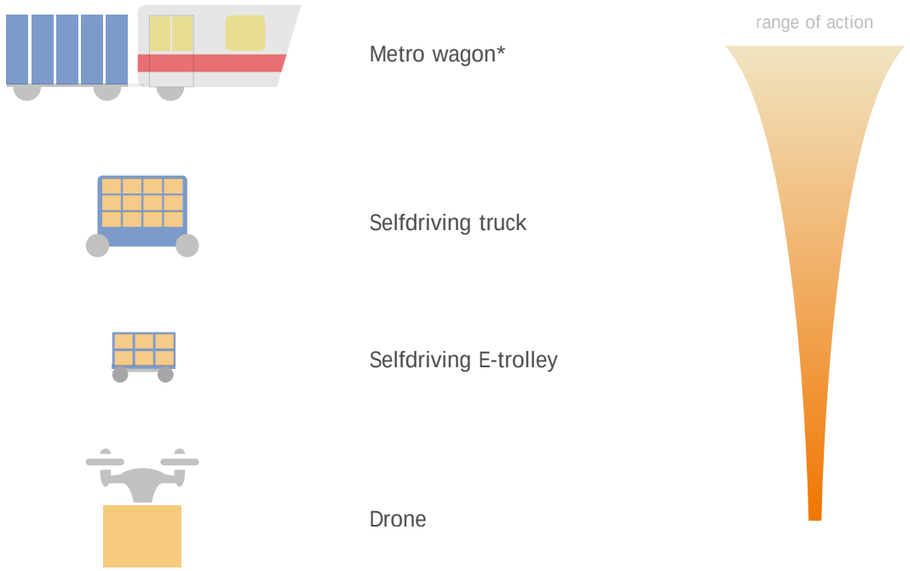
For sure, it is not a name that can be defined 'new' or something never heard before. Often it has been heard in design field: it is well known the armchair that Fabio Novembre designed for *Driade* in 2010, and it is also known in cinematography, with the famous animation movie *Finding Nemo* produced by *Pixar* in 2003. But right this famous architect and designer's words who talks about this film, offers another point of view to consider the project and the society it will set in:

"The Market is like a shark which shares the same space with consumers. We are goldfishes whose memory resets every three seconds creating a state of oblivion that repeats endlessly. [...] Goldfishes freedom is a tank perimeter in which we believe to have the priviledges of an evolved society. Today more than ever, individual happiness must produce collective effects, without whom society is just a predators dream. Recently I was watching Finding Nemo *with my daughter, a cartoon where a vegetarian shark helps a little fish to find his son. Is there a better metaphor to escape from tank oblivion? The vegetarian shark is a kind of Market that must find in self-regulation new reasons to exist. Our time urgencies are evaluated in terms of sustainability more than utility. To realize that the tank is just one should lead us to a new consciousness about herd and community life."* [1]

Picture 1 - *Nemo armchair, designed by Fabio Novembre for Driade. Published online at driade.com*
Picture 2 - *Clownfishes between Anemone tentacles. Photo: Tim Laman. Published online at nationalgeographic.com.*
1 - *Cf. Fabio Novembre, Il Design spiegato a mia madre, 2010 - P 47-48.*

Moreover, the protagonist belongs to a particular fish spieces: they are called *Clownfishes* and their main characteristic is about the symbiosis relationship they establish with the *Sea Anemone*. This plant has poisonous appendices to whom the *Clownfish* is immune: in this way it can defend itself from predators and, in return, it keeps plant tentacles clean. This symbiotic relationship is one of the main concepts which the project is based on: it's a strict contact between city and countryside that would be recreated, with a mutual resources exchange that allows to optimize them and to give value to territory culture through food trade.


Countryside
City
Farm
Switch Point
Restaurants / Hotels
Locker
Home parcel locker
Farmers' market
City border



** An extra Metropolitana wagon can accepts the containers.*

Vehicles are different and have various ranges of action: they act differently according to functions and tasks, from transportation to *"last mile"* delivery.

Overall functioning of the system

The infrastructural project designed aims to put in relation the two big technological innovations analyzed: precision agriculture and driverless mobility, exploting the possibilities offered by them and their combined action. The result is a service that can potentially better food supply chain, make it more fair, more sustainable and respectful for the identity of the territory. Last but not least, it's potentially convenient for all the actors of this ecosystem, first of all citizens and farmers.

In the future foreseen consequent to the establishment of the document *'Sistema città di Milano'* a circulation of not-autonomous and not-electric vehicles will be impossible inside city borders. So this means that even what happens today with the farmers' markets will be unfeasible: farmers will not be able to transport their products inside the city to sell them, as have been happening for centuries. Nemo2040 system aims to solve this future problem, also exploring the new possible scenarios with the rise of the new digital technologies analized.

On a practical level, Nemo2040 creates that link that will become impossible, the phisical link between the producer and the consumer, a direct connection between rural and urban areas. A foundamental element in this relationship is what has been called the *Switch Point*: it's a sort of station located on the border of the city, in which happens a switch of vehicles. The parcel containing fresh food is unloaded from the farmer's vehicle, that cannot enter into the city, and loaded on one of the vehicles that compose the system.

From that point starts the route of the parcel. The first vehicle that transports it isn't the last one that delivers it to the final customer: from that point it's passed 'from hand to hand' among the different vehicles, until the most suitable one performs the delivery. In this case the most suitable vehicle to conduct this task is calculated by an algorythm: it has already been said the huge potential that tomorrow's machines calculation ability have to improve the efficiency in transportation and delivery, allowing to calculate the path of every vehicle and to estimate precisely an arrival date. So, since this sort of 'big brain' knows exactly where all the vehicles will be at every second, it will be possible to calculate the perfect path and all the passages from a vehicle to another, studying the fastest and less resource-expensive path until the delivery in customer's hands.

An important element of this system is the base element: the parcel. Since all the system functioning will be automatic, the goods flow has to be fluid and efficient. So great attention is focused on the container that holds goods: it has been studied just one shape and dimension of it, in order to eliminate the shape variable that otherwise would have complicated Nemo2040 functioning. Its modularity improves efficiency in goods management and the relationship with the vehicles.

Logistics elements

A vital part of Nemo2040 systems are the logistic elements, for which is intended vehicles and even particular typologies of storage elements. As far as vehicles are concerned, it has been chosen not to focus on them during the design phase, for the reason that there are so many 'giants' of automotive sectors that since few years have been exploring their possibilities, that it would have been pretty little interestig to define them. It's the case of *IDEO*, that created a concept van for transportation and delivery.

Switch Point - As said, this element is the spot where parcels are transferred from the farmer's vehicle to the autonomous vehicle of the system. In this point of the chain there could be the presence of humans: since it's the point of the system that relates to an external (and not-autonomous) element, the presence of humans could be needed. Not for loading and uploading operations, but rather at a supervision level, to manage the overall process.

Metro wagon - Milan city has a broad infrastructure that is composed of many different vehicles typologies. A part of them can be exploited to transport goods:

Picture 3

by doing so it's possible to avoid the construction of an extra line, and it's also possible to not overcrowd streets.

Metro wagons are particularly suitable for this operation, especially the driverless ones. Driverless metros have the same benefits of driverless cars, so people flow is more efficient with this kind of vehicle, and potentially goods flow too. Moreover the fact of being autonomous makes them perfect to loading and unloading operations: driverless metros stop always in the same point, and this can permit to automatize the process, using the stop times, normally around 30 seconds, to perform logistics tasks.

For this particular vehicle, infrastructural modifications are required: in strategically chosen metro stations, logistics centers have to be created to perform the operations required and to exchange parcels with the other vehicles.

Van - This vehicle is the biggest to move on streets, and it's thought for transportation operations. This vehicle typology has already been explored by many car producers, and has the potential to link

Picture 3 - *IDEO's concept of a delivery van, Cody. Published online at automobility.ideo.com.*

wide transportation capacity to the agility of a tire-wheeled vehicle.

Their range of action is rather broad, and can potentially move through all the city. The elements they relate to are: the structure that manages goods flow in metro stations and the lockers.

E-trolley - It's a rather small typology of vehicle, and has a restricted load capacity compared to vans. For this reason, is thought for delivery operations or for transport of few parcels at time.

Given its small dimensions and its slow movements, it moves on cycle paths: the surface of these infrastructures will be broader as streets surface decreases, and so this kind of vehicle can act with a considerable efficience.

The only element it relates with is the locker: from that point it performs deliveries. Its range of action is limited, smaller than the vans' one but can relate with different lockers.

Drone - This vehicle has the most interestic characteristics concerning logistics and delivery: the fact of flying allows to sensibly reduce variables related to traffic and also to reduce delivery distance. Its potential has already been explored by many companies, including *Amazon*.

It's single-slot space allows delivery operations only: this feature implies a range action that is considerably reduced.

The only element it relates with is the locker: it supplies the drone with energy and with the parcels it has to deliver. In case of a particularly high density of parcels of one locker, more drones can be temporarely moved to perform urgent deliveries on that locker.

Locker - This feature is has been studied to increase system flexibility and modularity: infact it provides Nemo2040 of a fixed point where goods can be temporarely stored waiting for being delivered. It's a similar concept of the aircraft carrier ships, used for military operations: they offer a phisical point of support, where the movable elements (aircrafts in case of ships, parcels in case of Nemo2040) can be stored to be activated one at time.

This element is capable to produce energy through surface that can absorb solar energy. The energy produced is foundamental for its functioning and to reload even the vehicles of the systems it relates with, that are van, e-trolley and drone: in this way, every time a vehicle gets in touch with it, together with the parcel can receive the energy it needs to work, avoiding recharge time. This makes Nemo2040 a self-sufficient system from an energetic point of view, exploiting clean energy from renewable resources.

Home parcel box - Digital technology pervasiveness involves many sides of reality, and it could even affect houses configuration. Letters, poscards, bills, documents in the past were all phisical and delivered to the adressee in a box by a postman. Digitalization of these processes and the consequent dematerialization leads to a possible future where mailboxes can become useless. Instead of these features, it can be imagined to equip homes and buildings of a *parcel box*, also considering the high increase of home deliveries and the always higher number of on-line purchases. Parcel boxes can hold the goods that customers acquired, waiting for being picked up. In this way it could be solved a big problem in last mile delivery, that is the one of the customer's availability.

Delivery possibilities

Nemo2040 is thought to be modular, adaptive and efficient, and the possibilities opened are many. Few of the possible alternatives that can be exploited concern the points of delivery. During the project development, the choice has been the one to focus just on one of these, but it worths to mention them to clarify better the system potential.

The first of the delivery possibilities are restaurants or hotels, and even all the commercial activities that have food as a fundamental part of their buisness. One of the goals of this project is to facilitate territory enhancement, that has to be pursued even by all those commercial activities that have the possibility to be ambassadors of the territory they belong to. Restaurants or hotels can enhance the quality of their service exploiting territory products, and can directly contribute to better local economy.

This part of the system could be potentially explored, requiring a different approach for delivery: commercial activities have a higher food need than the average family, so even the parcels have to be modified according to the specificities of this sector.

The second of these possibilities

is the one to deliver products to farmers' market. It has been said that this project has the aim to evolve farmers' markets concept and to broaden the possibility to sell these products. The reason to maintain a farmers' market approach is to keep alive their tradition and the phisical relationship possible with a farmer. Because traceability is foundamental for the trade world, but the informations and the experience that can be lived talking directly with the farmer are precious and cannot be replaced by a totally technological system.

For this part of the system is required a new vehicle, different from the others mentioned, that can allow to transport goods and also to show and sell them to the market.

The third possibility is the one that has been chosen to be better developed, and concerns the last-mile delivery to the customer's house. This part of the system involves all the vehicles described before and even the locker. The reason why this part has been chosen is due to the problematics related to last-mile delivery that raised more curiosity about the possible solutions offered by driverless technologies. Moreover it's the part that directly involves the customer in first person: this allowed to think more about his experience of the service and to experiment more with delivery possibilities.

2.6

"I searched new shapes in a kind procedure similar to the one of Nature growth. I tried to make the shapes grow. I put my faith in the example of seeds, stars, clouds, plants, animals, men and at the end in the more intimate part of myself".

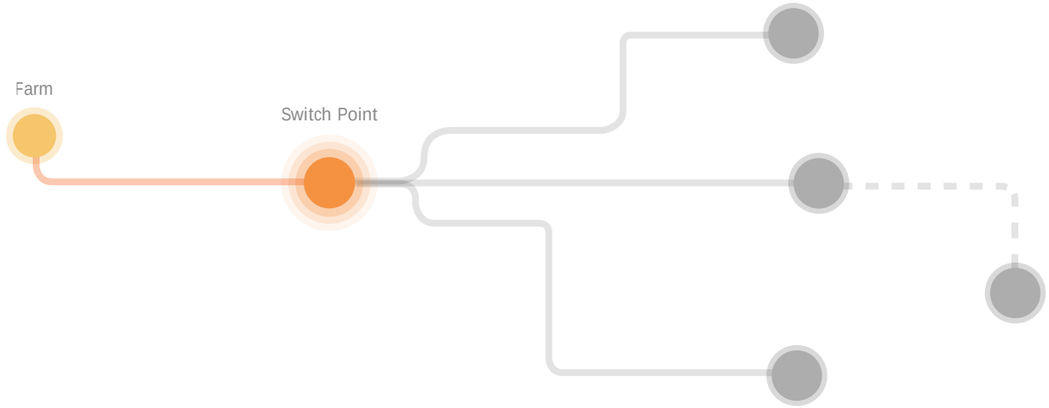
Jean Arp

System functioning

First step: from farm to the Switch Point

The first phase of the transportation is not selfdriving but it's still manual: the adoption of selfdriving systems requires a lot of time more in rural areas, since the electronic infrastructure is poorer compared to the city one, and the digital development will be slower.

The farmer driving his truck goes to the closer *Switch Point* to unload all the goods he has to deliver, that will be loaded on an automatic vehicle. During this phase, it is needed the presence of logistic employees who manage and organize all the logistic process. To link the 'manual' transport (of the farmer) and the selfdriving one (of Nemo2040), human work will be important, due to its the capacity to overcome specific issues that could emerge.



Vehicles used:

Traditional fuel-engined truck

Stakeholders:

Farmer

Logistic employee

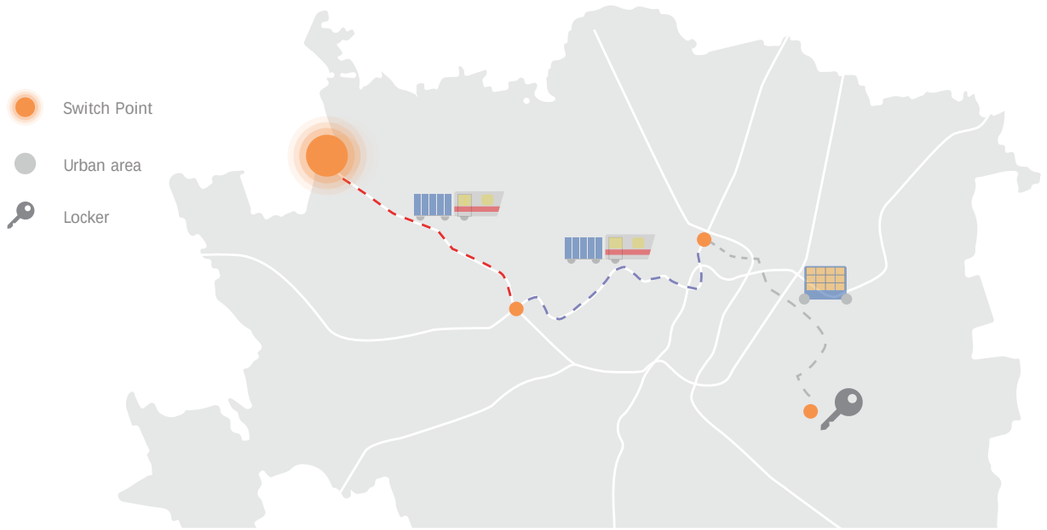
Coldiretti

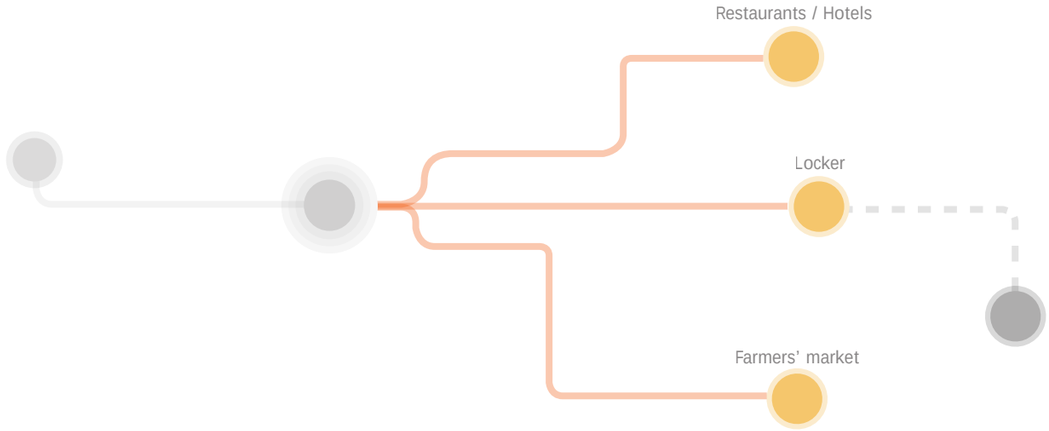
Second step: selfdriving transportation

From the *Switch Point* goods are automatically transported by the two selfdriving vehicles of the system (the driverless truck and a Metropolitana wagon) to one of the three possible delivery points: restaurant or hotels, lockers and farmers' markets.

According to the point where the parcel has to be delivered, the system can calculate autonomously the fastest path and even all the exchanges that the different vehicles have to perform. The shift from a vehicle to the other is performed by robotic arms and other autonomous structures and items, such as forklifts or conveyor belts.

As stakeholders for this part of the system, *Coldiretti* manages the part connected to the farmers' work, ensuring conformity of his products, while *ATM* (*Azienda Trasporti Milanesi*) deals with the part related to vehicles management, infrastructures maintenance and goods flow. In this case, the logistic employee's work is rather a supervision one, to control the overall functioning.





Vehicles used:

Metropolitana wagon

Selfdriving truck

Stakeholders:

ATM S.p.A.

Coldiretti

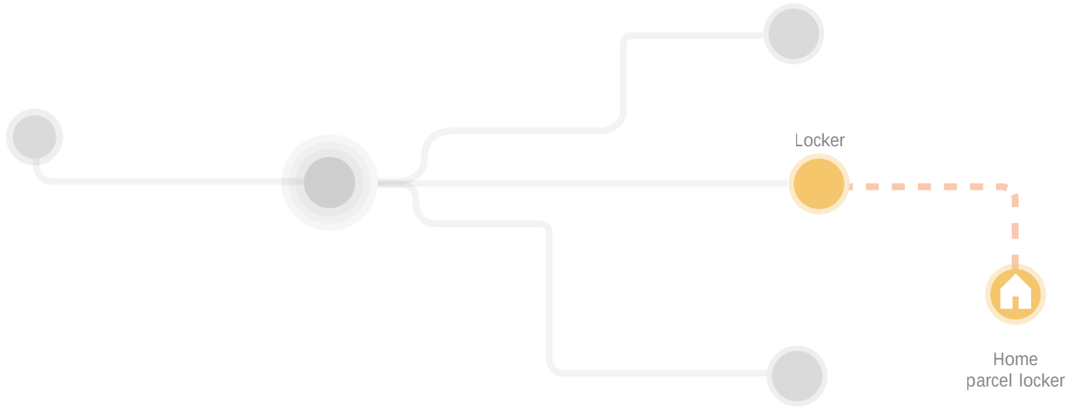
Logistic employee

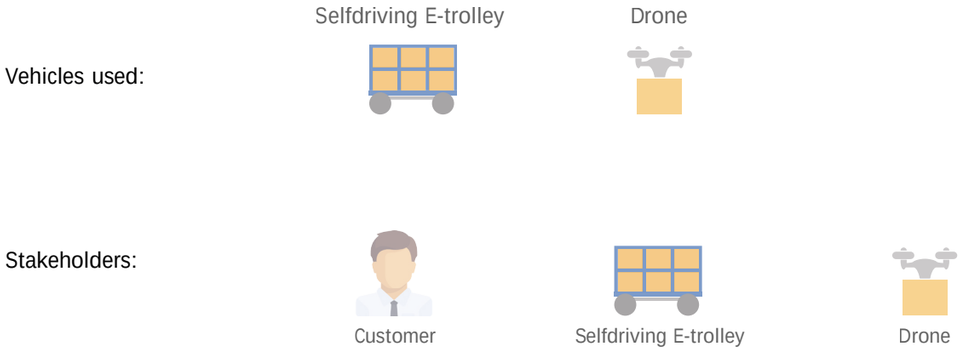
Third step: customers' home delivery

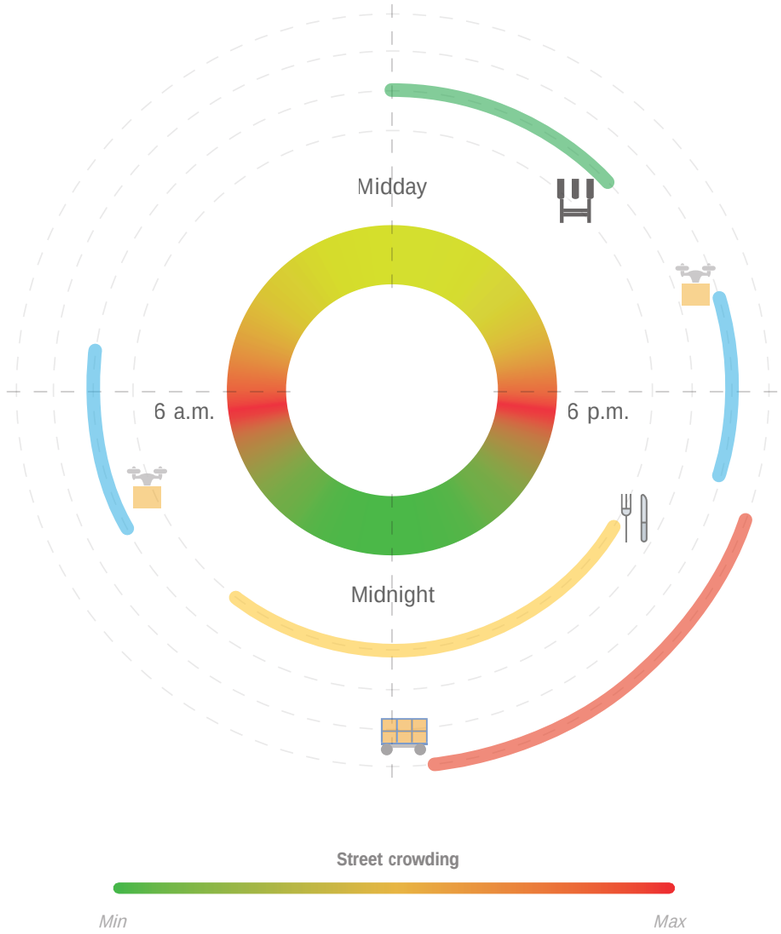
Among the three possible delivery options, the one that has been decided to design better is the one that, through the locker, comes directly to the final customer.

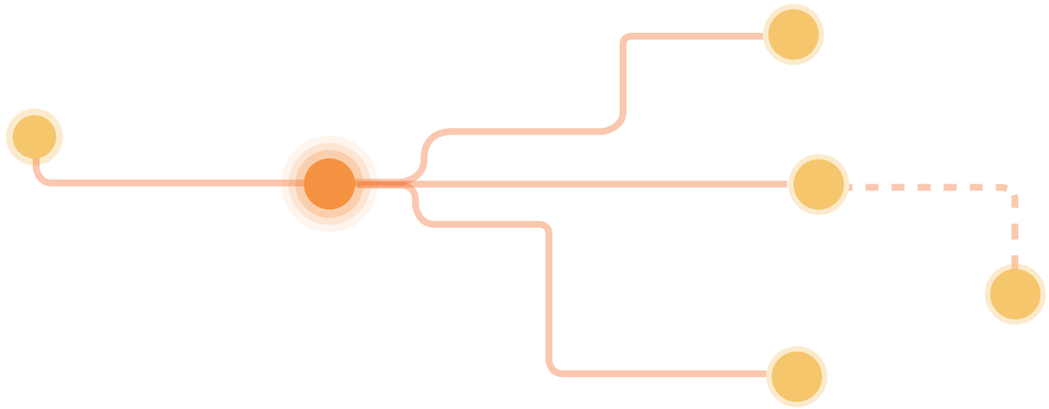
The locker, a sort of mini logistic center, allows to increase the system efficiency and flexibility, offering a fixed storage point inside the city. The main activity that this feature performs is the one of delivery base for drones and e-trolleys. But it is exploited even for other tasks. It is used as a collecting point for empty parcels, that will be then transported to the *Switch Points* waiting for being reused. It is used even as a parcel withdrawal point, giving the customer the possibility to pick it up directly there, maybe paying less for it, since the drone isn't used in this case.

This system feature is rather strategically important, even because it is used as a energy generation point: since it relates with all the movable vehicles, they get charged during the loading/unloading operations.









In the chapter about selfdriving delivery has been said that it could allow to expand enormously delivery services possibilities: sundays delivery will be normal, just like night time deliveries. During daytime, when streets are more congested, few delivery operations are performed, keeping streets capacity for people transport vehicles. Deliveries and other logistics operations, such as transport of the empty parcels to the *Switch Points*, can be made during night time.

Moreover, the fact that during the night electricity is cheaper, allows to improve the efficiency in energy use and even to permit clients to customize their service: they can choose night time delivery to spend less, or daytime delivery, spending more.

In this case, drones are very useful to perform day time deliveries: flying, they can bypass streets and can be very useful during the most crowded hours of the day.

2.7

“It’s living into the factory that technical and aesthetic issues are solved. Designer has to get intimately into the factory life (...) he has to know production better than plant directors”.

Osvaldo Borsani

Definition of the system’s main features

Nemo2040 project wants to imagine a new sustainable socio-economic framework, that causes a new interdependence relationship between rural areas and the city. This new system acts as a net, with every spot involved in production and consumption of fresh local products. Trade of locally produced goods implies a short supply chain that simplifies and eliminates processes and intermediaries. Despite the fact that it’s much more contained than a centralized and industrialized framework, it involves a substantial amount of structures and features that should be defined and realized to create it: vehicles, new structures and infrastructures that move and manage goods flow have to be designed through a choral work that involves different actors from different fields. Architects, urban planners, engineers, agronomists and agricultural enterpreneurs, institutions and government organizations, etc. Designers too will deal with Nemo2040 and its development: in a World that is increasingly more complex and fluid, and designers’ work is increasingly more fragmented, they become a foundmental figure to fill the gap between technogical and social dynamics through artifacts (that can be products, systems, services, spaces, experiences, interfaces, etc), to allow people to use that technology to create the life that they desire and, in this case, to allow them to become aware consumers of local food and promoters of local economy. To make this happen everything, from the *Switch Point* until the drone has to be conceived and realized at best.

This project has been conceived and defined with a product designer’s approach: an architect would perhaps have developed more the structure of the *Switch Point*, an agronomist would have studied more the varieties of vegetables and fruits produced in the territory outside the city, and maybe a telecommunications engineer would have defined the technology that allows such a massive exchange of informations. For

a product designer, the choices regarding the elements to phisically develop were many. Vehicles have been immediately excluded: there are so many companies of the automotive sector that developed their own project or vision about vans, vehicles, drones, delivery trolley, etc. that it would have been a very little interesting and relevant topic to focus on.

The two features that has been developed more in detail are particularly interesting due to their implications on the usability experience of the service by the final customer. The level of definition of these products is not so deep: since the evolution in materials science, production techniques and digital technology, and since the project is thought to be operative in 2040, it didn't look interesting to develop in detail the parts, knowing that they will probably end up being obsolete soon. So the overall definition of the objects arrived at a concept level: all the dimensions, the parts, the visual identity and the general functioning have been defined, leaving freedom for the technological and scientific development to improve the project.

The first element is the container that holds fresh products. This is for sure the key element of the system: it's the item the customer comes in touch with the most, so its shape, visual elements, usability and interface has to be well conceived. Moreover, it's an element that covers a high distance moving, and comes in touch with many different features and vehicles: its shape had to be defined so that it can be easily carried and handled by humans and autonomous items.

The second and last element that has been developed is the locker. It has a rather big dimension, and the kind of parameters taken into consideration during its development overlap with the architecture field. Infact, its big dimensions give it a potential considerable weight into the city landscape: it had to be designed considering the overall framework of the city and its visual identity, to adjust its elements and to integrate it into Milan streets without alter the balance. Moreover, the locker, as the box, gets in touch with many driverless vehicles and even with the user: all these elements made it a very interesting object to better study and develop.

With the definition of these two elements it has been possible also to express better a visual identity of the overall system, starting from the logo until the colors and some characteristic visual elements.

Pantone 2010 C	R: 255 G: 173 B: 0
Pantone 663 XGC	R: 232 G: 231 B: 234
Pantone 423 C	R: 137 G: 141 B: 141

The Box

The key element of Nemo 2040 system is the box: inside it, fresh local products travel many kilometers to be delivered to the final customer who purchased hem. The reason why it has been chosen to create a new box instead of using single-use ones is because the direct implication of all the theoretical discourse made, focused on sustainability, have been the one to avoid single-use packagings, creating a more resistant and durable one. It's known that single use-packagings (and items in general) pollute the environment, and exploit multiple-use and durable boxes is a way to fight that side of pollution. So the main goal has been to make it last as long as possible maintaining its functionality and that, at the end of its life cycle, can be recycled or repurposed, to contribute to the establishment of a circular economy.

The importance of this feature is related to the fact that it's the only phisical element (beside the products it holds) that goes from the farmer directly to the customer: it's the element that phisically puts in relation the countryside with the city, the producer with the consumer, the first with the last point of the supply chain. So the task that the container has is to put both phisically and digitally in connection these two points, carrying the informations regarding the goods it transports until the final customer.

The main characteristics identified for the box are:

Picture 1

Picture 1 - *Sewage surfer, 2017. Photo: Justin Hofman. Published online at nationalgeographic.com.*

the possibility to interact and be handled by all the elements of the system that may do it, such as drones, robots, vehicles and humans;

be collapsable: this allows a much more efficient and fast transportation of empty boxes;

the capacity to store informations regarding fresh food it holds, that are then transferred to the consumer. In few words: to allow product traceability.

Use and dimensions

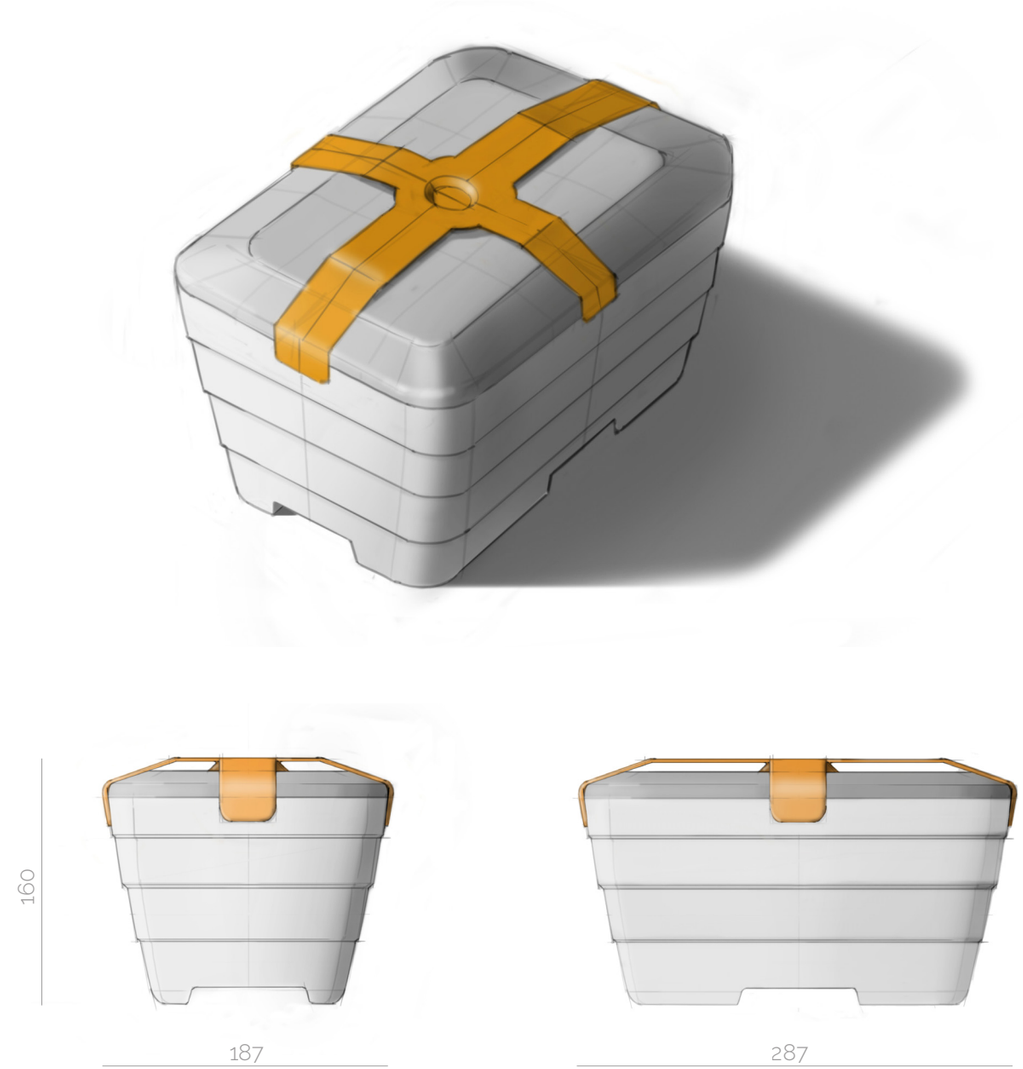
One of the many problems that characterise today's food system are food wastes. Of all the aliments that are wasted each year, a big part occurs inside homes, mostly in the so called *Developed Countries*. A waste that constitutes also an economic loss, that is quantifiable in 470 euros each year, according to *BBC* [1]. One of the reasons of this loss is customers' purchase habits: due to short time available, the average customer goes to the supermarket about once a week: that day he buys food for the entire week, also included more fragile products, such as fruits or meat, that have few days to be consumed. He is forced to buy many products, part of which will end up thrown away.

Nemo2040 can help in this issue: thanks to the automatized functioning of vehicles and structures, the delivery process can be more efficient and the goods flow more regular, tailoring deliveries according to customer's food consumption habits and rate. Instead of having the products delivered once a week all in the same time, they can be divided in more parts, and sent separately during more days. Doing so, staggered deliveries allows to store and consume food much more efficiently, customers have fresher food and wastes generated are minor.

This particular has been taken into consideration during the development of the box: its dimensions are quite contained, because are thought to hold a limited quantity of food delivered more frequently during the week. For instance, instead of deliverying 2 kilos of apple for a week all in one delivery, can be delivered 500 grams every two days, to cover an apple week supply.

The system functioning is though for a high supply rate of products, even allowed by the short lenght of the production chain. With the reduced length of the transportation phase, and the consequent short time of it, products are not exposed to the risk of decline, that could require cooling parts: it takes few hours to be delivered, according to the transportation schedule, that can avoid need of a refrigerating system. In this way, the box is much lighter and less pollutant.

1 - Cf. Household food waste level 'unacceptable', 2017. Published online at bbc.com.



Materials

As stated, the definition depth of the objects designed arrived at a concept level: the use, shape, visual identity and the relationship with the other elements have been described and defined. Other elements of these features haven't been studied, such as materials: they are not defined, but are expressed the necessary requirements to perfect fit into the project.

Beside the digital technology progress that is one of the key elements of this project, the contemporary World is on the threshold of a big revolution in material science. This process is the direct implication of two facts. The first is the pollution side connected to garbage production, mostly made of plastic: since the 60s, when plastic mass production started, it have been generated 8.3 billion metric tons of that material, that takes more than 400 years to degrade [2]. Not considering all the garbage made up of other materials, this constitutes a dramatic damage for the environment. This critical situation generated a new research for alternative materials that can replace plastic. *Lego* [3] has stated that its goal for 2030 is to identify a material to produce its iconic pieces with, eliminating plastic from its production, and *Ikea* [4] already banned single-use plastics from the stores.

An interesting trend identified is the exploitation of bio-based materials, that are materials synthetized using organic substances produced by living beings. It's the case of *chitin*, a bio-polymer produced in huge quantities by shrimps, crabs, scorpions and butterflies. It has been used for projects developed by Neri Oxman and the *MIT Lab* she is in charge of, creating 3D printed objects with that material.

Another trend that can express the degree of progress reached now, and that can give an idea of the possibilities that can be achieved by 2040, is the technology called 4D printing: it's an evolution of 3D printing technology that, thanks to thermo or magnetic-reactive materials, allows the printed artifact to change shape, in order to self-assembly or to change configuration according to the external conditions.

This side of the product development has been left open, to allow the future research of the more suitable material.

As for the overall requirements of

2 - Cf. Laura Parker, Here's how much plastic trash is littering the Earth, 2017. Published online at nationalgeographic.com.
3 - Cf. Lego, la svolta green: addio alla plastica entro il 2030, 2018. Published online at repubblica.it.
4 - Cf. Ivana Kottasovà, Ikea bans all single-use plastic from its stores and restaurants, 2018. Published online at cnn.com.

Picture 2

Picture 3

Picture 2 - *Neri Oxman's project with 3D printed chitin (a biopolymer). Published online at: engineering.com.*
Picture 3 - *Self-assembly Lab MIT, 4D printing technology exploits materials that can change shape according to stimuli. Published online at wired.com.*

the box, also for the materials the main characteristics have been defined, to pave the path for the material research.

The overall goal of Nemo2040 is the optimization of local resources as model for sustainable development and local economy enhancement. Even the choice of the materials will follow this principle, and will have to be completely organic and 100% compostable. Exploiting the wave of research for bio-based materials, Nemo2040 will base it functioning on materials that can be reused and repurposed at the end of the box life cycle: this for an environmental pollution reason and even for an economic reason. Because re-use present resources allows to decrease costs. So particular focus will have to be put on this phase of disposal and reuse.

The box will be travelling most of the time, going through many kilometers each day and coming in touch with many vehicles. The autonomous structures and vehicles will have very precise movements, and the box will be handled with care, but it's necessary to equip it with high mechanical properties: it will be resistant to plastic deformation and to breakups, to avoid failures and to extend its life cycle as much as possible. It even has to be scratch resistant, to maintain its original aspect as much as possible.

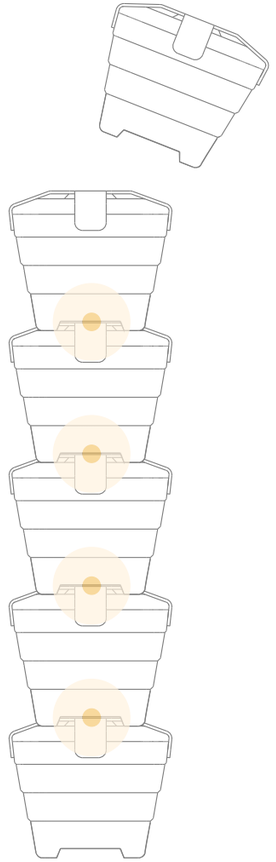
Moreover, the materials will have to be as light as possible. In transportation, high weight corresponds to high energy consumption. The goal is to optimize the resources available, reducing as much as possible boxes weight, even for a transportation efficiency reason: ligher parcels are much easier and faster to deliver, and can improve the service functionality.

The box will come in touch with many organic products that will be eaten by someone, and this will have to happen without affect the products integrity and health. This means that the materials will have to be bacteria repellent and easy to clean.

Re-use

Following Nemo2040 path toward resources optimization, it has been imagined box use as a great swarm of parcels that continuously flows through city streets. Boxes are used and reused, with no break in continuity. To do so, they have to be resistant and easily manageable to be efficiently carried in and out the city, with a shape that is conceived to create the most practical container possible for this kind of system. A first essential feature to equip the container with is be stackable. The shape had to allow this, and it has been studied so that the upper part finds its position inside the hollow made in the bottom part of the box, that can be used even as handle for the human user (as will be shown in the next pages). Further elements that contribute to keep the parts in position are some elements, integrated into the box, that create a magnetic field between the two parts and keep the two stacked boxes joint.

The main issue of reusable containers is the fact that, after the delivery, they have to be transported back to the logistic center empty. This particular can cause huge extra costs that the logistic company have to sustain: imagining a van transporting containers full of vegetables, on the way back after the delivery, being empty, parcels



‘transport a lot of air’, becasue actually they are transporting nothing profitable. Furthermore, beside of being a delivery extra-cost, it’s also an extra-use of energy needed to move the vehicle, increasing company extra-costs and even pollution.

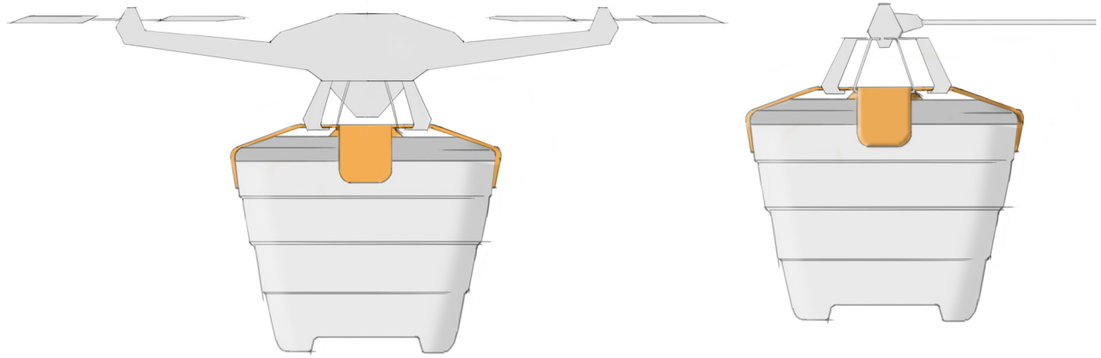
A collapsable parcel can help to make re-use more efficient, allowing to ‘transport less air’ and to optimize vehicle volume and energy. The box body has been designed made of different movable parts that, once empty, can be collapsed pushing them inside the upper part. In this way its volume can considerably decrease of almost 1/3, allowing to transport three collapsed boxes instead of one non-collapsable.

Interaction with humans and machines

The container is the system feature that travels all the system, going from the *Switch Point* until the final customer. During this path it has to be moved, transported, handled by many different actors, going from the drone to the structures machines and the final user. Regarding all the robotic devices, they will be designed to adapt to the box shape and to be able to handle it safely.

To allow this, the box has been equipped with a sort of handle on the upper part to allow all the trasnportation and delivery features to come in touch with it: it is a rigid cross that is suspended from the top surface of the lid. In this way are created some holes that function as catch point for drones, robotic arms, robots, etc. This will allow a firm grip and a safe delivery.

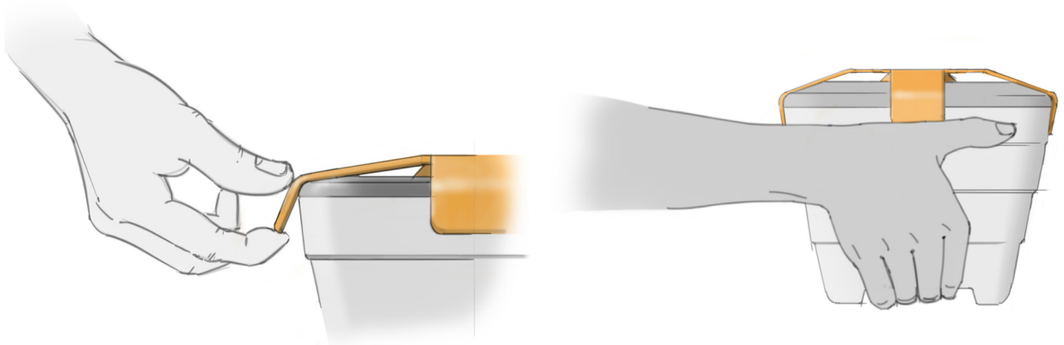
This rigid part that works as a handle for machines is connected to another important part of the box, that is the closure part at the sides of the box. These elements

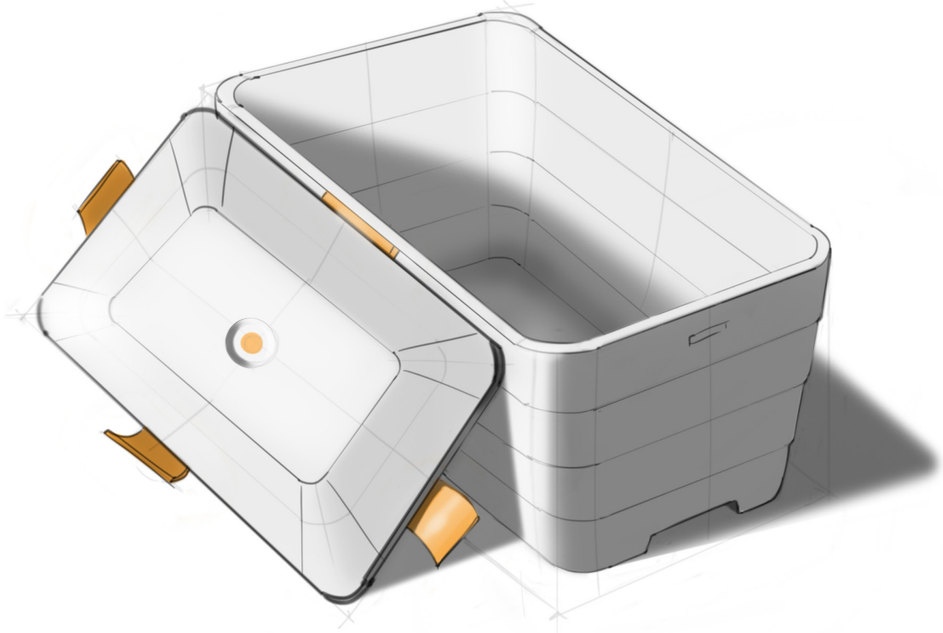


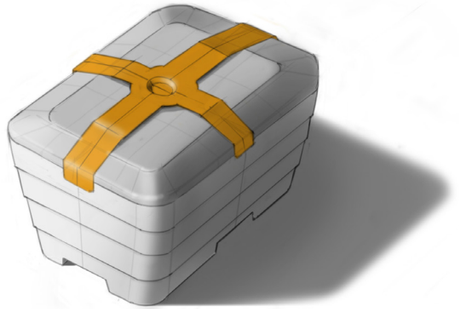
are four, one for each side of the box and have the function to keep closed the box during the delivery phase, and to allow the final customer to open it easily. These two parts, that is the machines handle and the closure elements, are connected: this choice was made to create the visual element that characterises this box the most. This graphic feature has a strong presence on the overall image of the box, and constibutes to make it recognisable as an element of Nemo2040, even recalling the orange of the logo.

The orange part on the top connects on one side the lid of the box to its body: in this way the components compose a single object, without detachable parts that could be lost during the transport operations.

Finally, in the bottom part, are derived the handles for the human user: given the small dimensions of this container, it could have been possible to engrave the handles directly on the box body in the bottom part, allowing a natural and fluid gesture to grab and handle it. Furthermore, the handles hole allows the boxes stackability: it fits with the upper part, the machines handle, creating a sort of conceptual match between human and digital entities through their signs on the box.







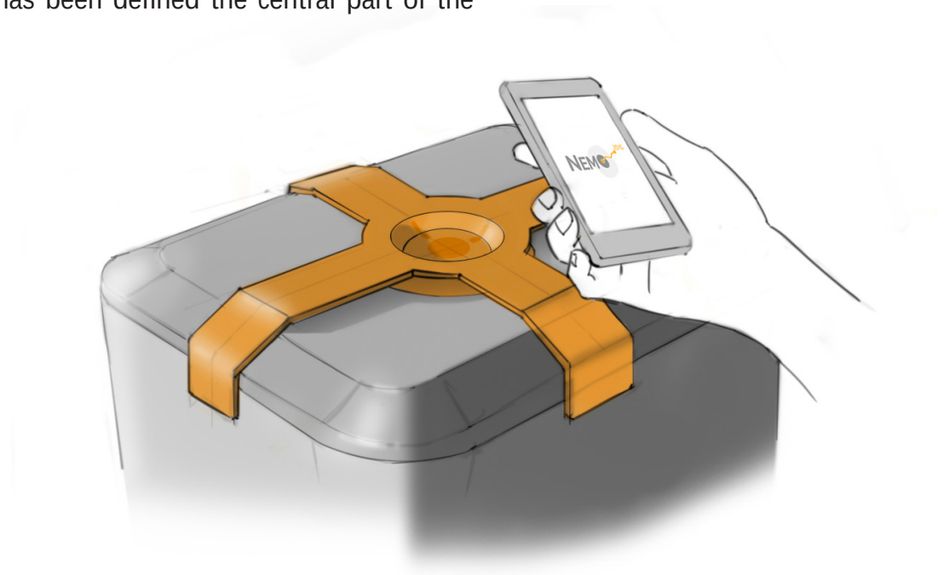
NEMO 2040

User interface

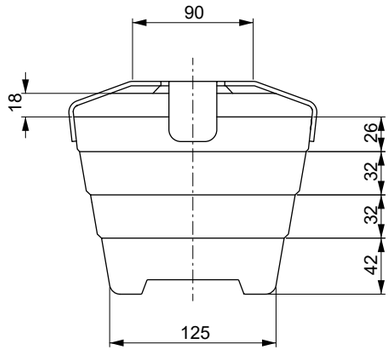
Container holds food, creates the bridge between producer and consumer, phisically and digitally: it even holds the informations regarding agricultural products transported until the customer, allowing an efficient traceability, even keeping under control the conditions of the products. It contains the digital components that allow to carry informations that the user will read, and even the sensors and GPS hardwares needed to monitor the goods conditions.

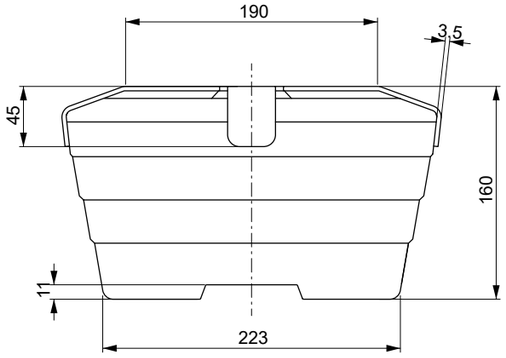
As a digital spot of the container, it has been defined the central part of the orange element on the top: it's positioned on the point of union of the four arms of the cross, and this creates a strong visual element that enhances the product identity. Moreover the position in the middle of the cross helps to create a more precise and immediate understanding of the use modality.

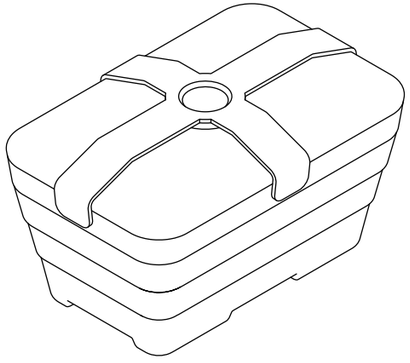
To read the informations about the products received, the customer can use his/her personal digital device.

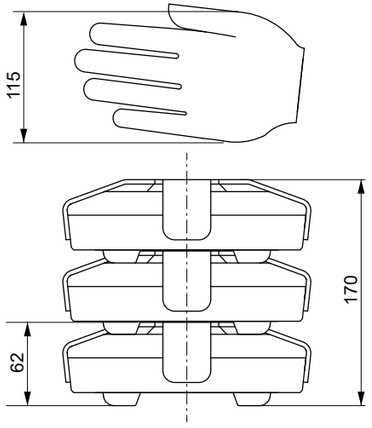


Technical drawings

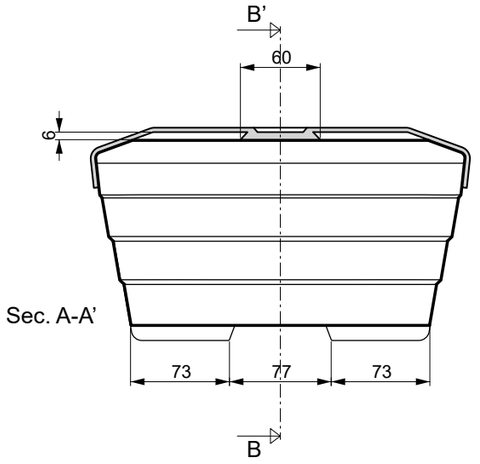


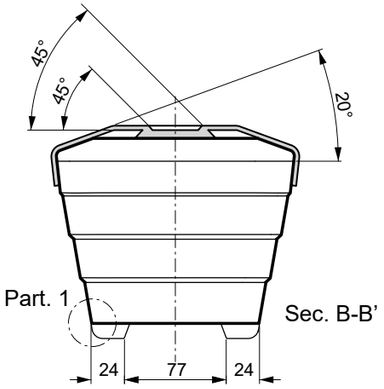


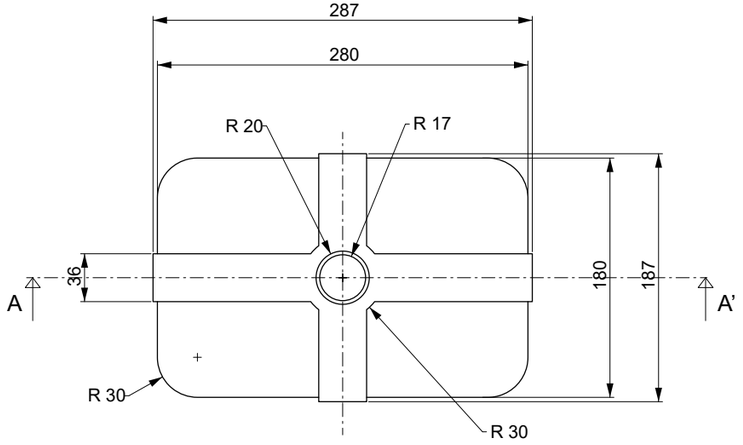


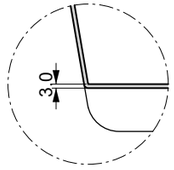


Nemo2040	Box - 01	Overall dimensions	Scale 1/20









Part. 1 (Scale 3:1)

Nemo2040	Box - 02	Section	Scale 1/20

The Locker

Nemo 2040 has been conceived to become operative in the Milan city first, because of its commitment in sustainable urban development. It's planned to come into operation in 2040, and to define the single elements it's first necessary to try to think about how the city will be then, firstly from a street configuration point of view. And talking about the lockers, it should be defined all the elements that move around it to better conceive it.

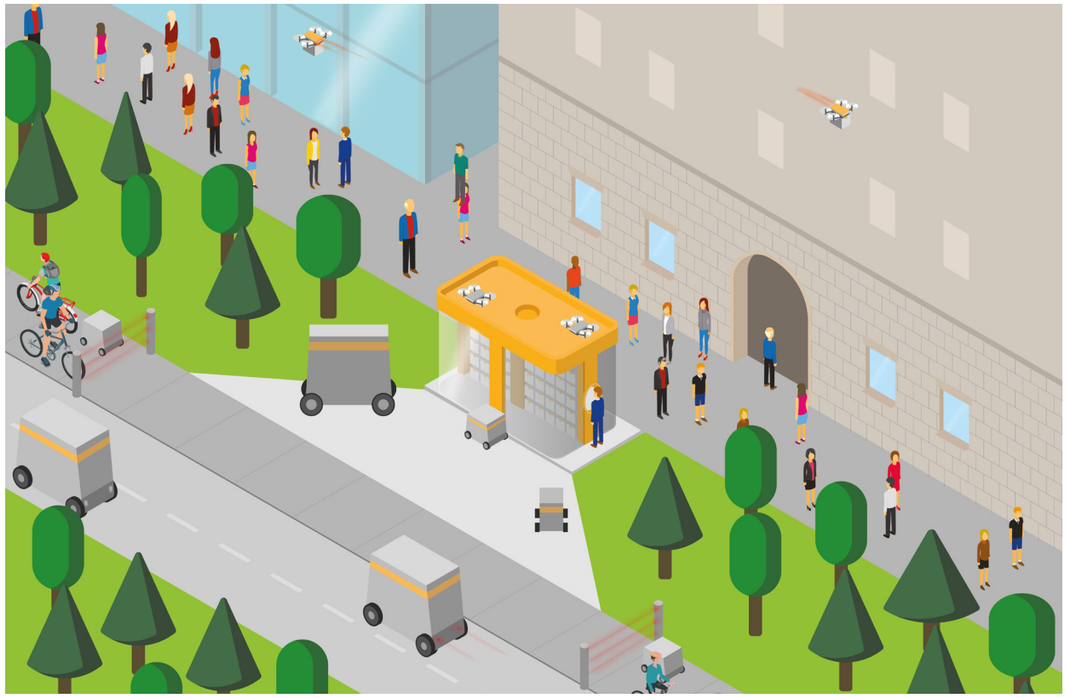
Milan city of 2040 has been imagined with a much minor surface dedicated to streets and cars mobility. The strategical development of Milan points toward more sustainable mobility systems, such as bike mobility or public transport. Much of the space of the city will be dedicated to trees and green spaces. It will be a much more fragmented street environment, not monopolised by cars but with many parallel infrastructures.

The locker will be positioned in a place that allows to interact with all the vehicles and elements of the system in an efficient way. In particular, the locker will dialogue with the vans, e-trolleys and drones. Vans will move on the streets, that will occupy a limied surface of the urban area, sharing the same infrastructure with cars and public transport vehicles. E-trolleys, since are slower and smaller than vans, can move on cycle paths, that will increase in lenght and surface in the upcoming years, sharing the same infrastructure with cyclists. Drones will fly, and will have a facilitated path. Moreover, the pedestrian paths will have an increased space dedicated next to green areas. In this area will move the potential customer who will use the locker.

The position chosen for the locker is between the two vehicles path and the pedestrian path, so that the customer interaction is prioritised and easy. In this case, it will have to be well managed the intersection between the street and the cycle path: even though sensors and cameras will avoid crashes, bikes will not be driverless, and so it will be needed a way to settle that point, so that system functioning is as efficient as possible without affecting cyclists route experience.

Picture 4

Picture 4 - *'La biblioteca degli alberi' (trad. Trees library), the new park that has been inaugurated in Milan, next to "Bosco Verticale", the building designed by Stefano Boeri. Published online at milanolife.it.*



The locker is a foundamental element for Nemo2040 goods management, and this due to the many functions that can perform. It's a storage point for goods waiting for being delivered; it can be used as a withdrawal point for the customer; it is the collecting point where empty containers are stored, waiting to be brought back to the *Switch Point*. But the possibilities can be much broader: for example, if a delivery isn't succesful due to customer's change of mind, that place can become a potential purchase point for another customer, who can take advantage of the missed delviery.

Visual characterisation

Milan has a very old history: it goes back to the Roman era when it was called *Mediolanum*, and since its foundation has been an important urban center for its position in the middle of *Pianura Padana*. During the centuries, many populations settled in this area, and many different cultures left a fragment of themselves. All these cultures can be seen today in Milan heterogeneous identity: Romans, Reinassance, Baroque, Neoclassicist, Rationalist buildings can be found all over the city. Its fragmented visual identity makes locker design complicated: it has to relate with the overall identity of Milan, that is such sfaceted, in a coherent way without altering its aequilibrium and continuity.

To create a coherent feature to be put into the city, it has been analized the urbanistic identity and the most important and iconic buildings of Milan city, in order to isolate some common elements to be exploited to build the locker image. Shapes, materials, and visual signs have been observed to identify and abstract some features: these had to be proper of the different architectonic styles, but characteristic of none of them. An important source of inspiration has been the graphic project developed by Bob Noorda for M1

Picture 5

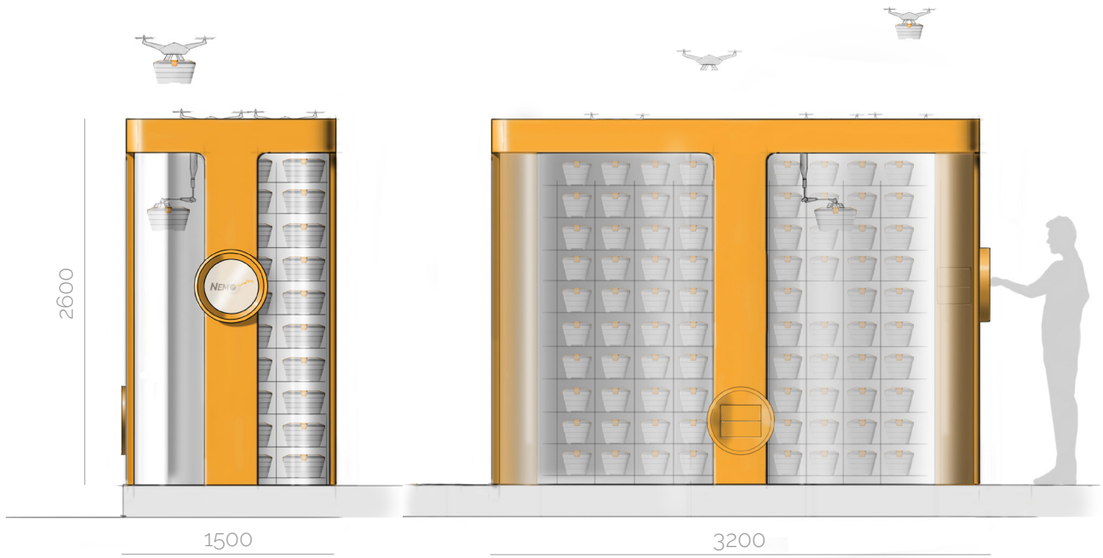
Picture 5 - *Moodboard.*

Metro line, in collaboration with Franco Albini, that became famous worldwide and took as inspiration by many.

The part that characterises the locker the most is the orange part that, seen from the front or the side, recalls the image of a T. It has been identified this elementar shape because it's composed of the two most simple, yet important, construction elements, that constitute the base of the architectonic discipline and can be found as a common point in all the styles that compose the urban identity of Milan: the pillar (or column) and the trabeation. Two elements, one vertical and the other horizontal, that intersect creating the base module of the architecture. This shape even recalls the shape of the orange element of the box designed: this choice was made to create a visual unity between these two elements: since the customer will come in touch with both of them, he must have a coherent experience considering the two elements.

Even materials contribute to characterise the image of the locker, mainly evoking modern or contemporary styles: glass and metal (that the orange part is composed of) are characteristic of the architecture of the last 160 years: for instance, can be mentioned Galleria Vittorio Emanuele, one of the most famous and important buildings of the *'Iron Architecture'*, or Piazza Gae Aulenti, that became the symbol of the new city growth where glass of the skyscrapers is one of the main visual characteristics.

Dimensions



During the design phase, particular attention has been put on the definition of dimensions. Being a feature that has to integrate with the road overall image, it shouldn't have been too big or disproportionate. The goal has been to create the most capacious locker with the less volume, in order to be less visually impactful.

Its dimensions have been adjusted considering two parameters: the first is the load capacity and the second is the visual impact. It has been tried to find a compromise that allowed the maximum load capacity and that lead to a visual alteration as minumum and balanced as possible, that enriched the identity of Milan without distorting it.

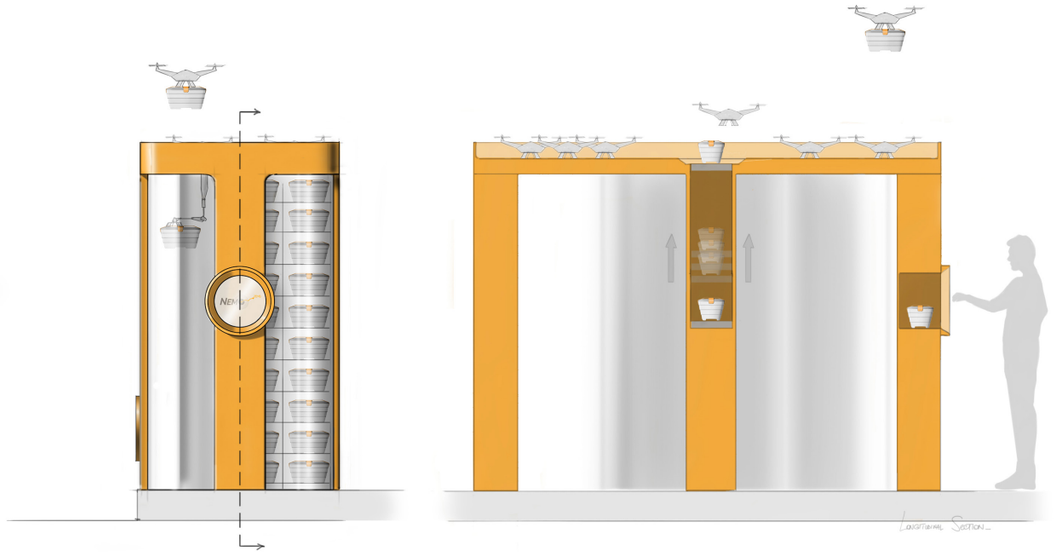
Each locker can contain 160 containers, and it is spread on the city streets according to the number of people

to be served. In the more densely populated zones will be more, and fewer in less populated areas of the city.

The number of boxes it can hold doesn't corresponds to the actual number of people to serve. It's a temporary storage point where to deposit goods to be delivered, and the products stay time is content: it can last potentially few minutes due to the system ability to work 24/7. Goods flow will be constant and allows to serve much more customers than the boxes it can hold.

Interface with delivery vehicles

The fact that the locker comes in touch with many different elements of the system, means that it has to perform different and precise tasks. It has to relate with the customer, who will bring the empty box or to withdraw the full one; it will come in touch with vans and e-trolleys, with which it'll exchance parcels; and drones will wait on its roof for the container to deliver. It's been thought to separate the points of interaction with the three system elements (drones, vans and e-trolleys,



Trasnportation and delivery vehicles

Customer

Drones

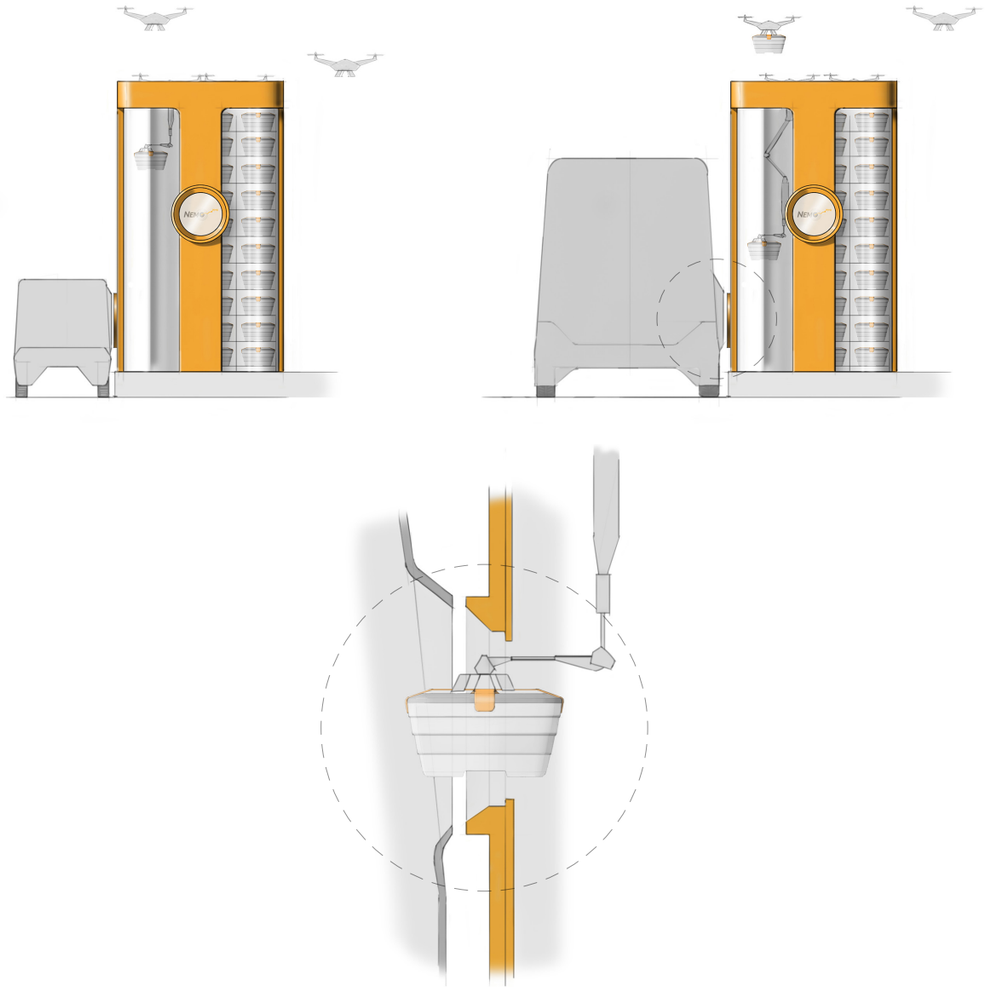
customers), keeping a surface for each one of them: each one of these elements implies a different task that the locker has to perform and divide them has been a way to make its functioning more rational, and this also has an impact on the overall shape configuration. The surface that faces the street and the cycle path is dedicated to the relation with vans and e-trolleys; one of the two short sides is dedicated to the relation with the customer that, in this way, can come in touch with the locker outside of the pedestrian area, that will be crowded of people; finally the top surface will be used as a drones platform, where they can take-off and land.

Inside the locker, all the tasks of handling parcels will be performed by a robotic arm that, exploiting the handles that the box is equipped with, can move and put them where required.

To allow the locker to efficiently supply the drones platform with parcels to deliver, the central pillar is equipped with a platform that takes the parcels up to the take-off point. At this point, drones can grab the parcel using the handle on the top of it and transport it to customer's home.

To supply vans and e-trolleys with parcels, the surface facing the street has an interface point through which they can exchange boxes with the locker. Both the locker and the vehicles have two access points with sliding elements normally closed. When one of the vehicles aligns to the locker, they open and allow the robotic arm to move boxes inside or outside the vehicles.

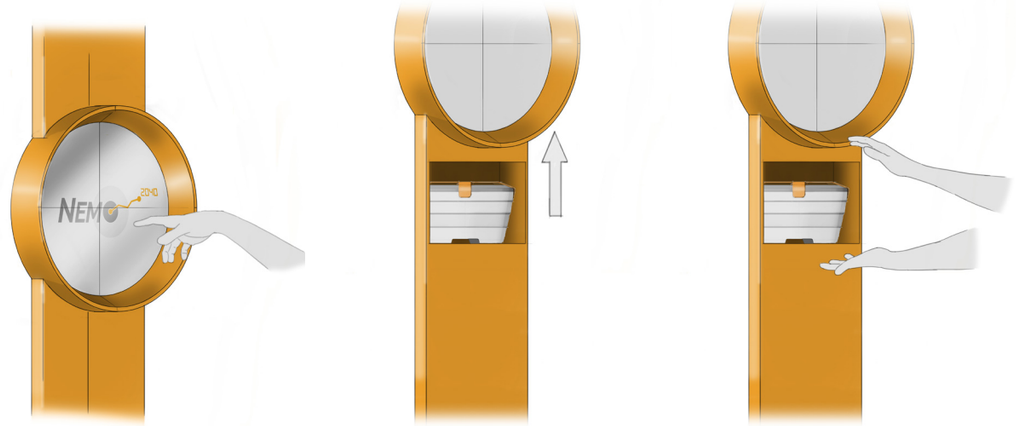
This operation is allowed by the precision of self-driving vehicles: they are driven by very sensitive sensors that can calculate precisely the routes and even the stop points.



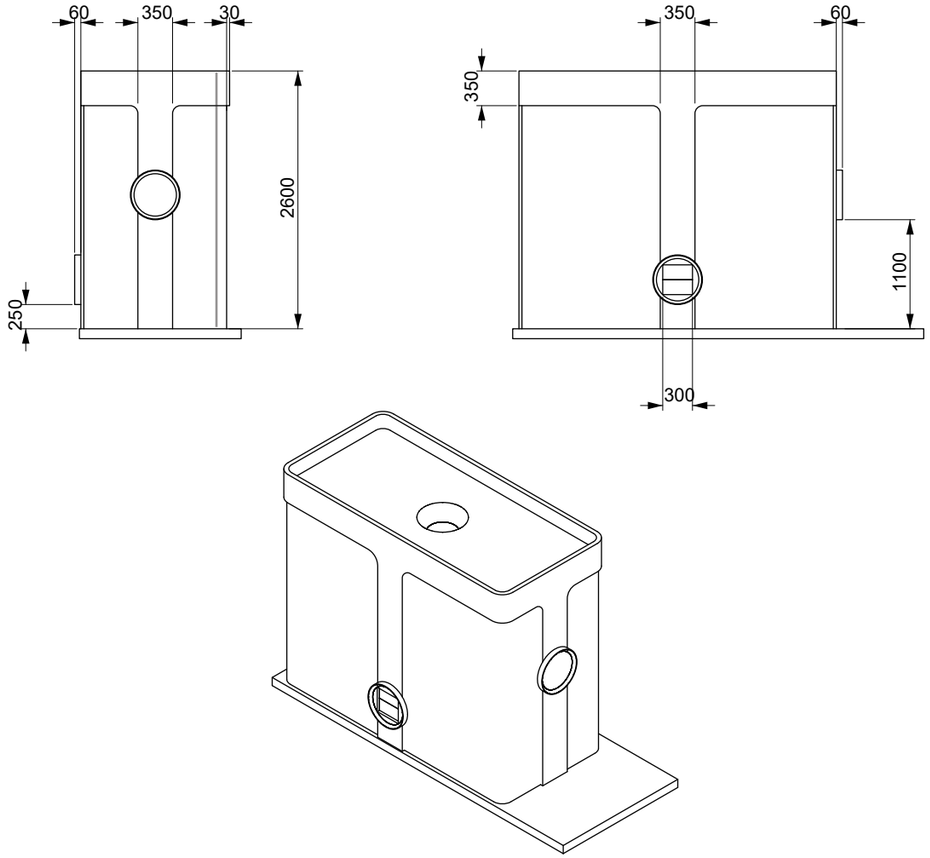
Interface with humans

The interface point shown below is the feature that allows the customer to come in touch with the locker, pick his parcel up or to perform other tasks. For example it can be used as a digital point where to subscribe to Nemo2040 service, so becomes a point where to collect new customers; it can be the point where to take advantage of the day's specials: if a deliver hasn't been successful, a customer that comes across that locker can take a look at it and see if there's any interesting offer. So it constitutes an interesting point to extend the service possibilities.

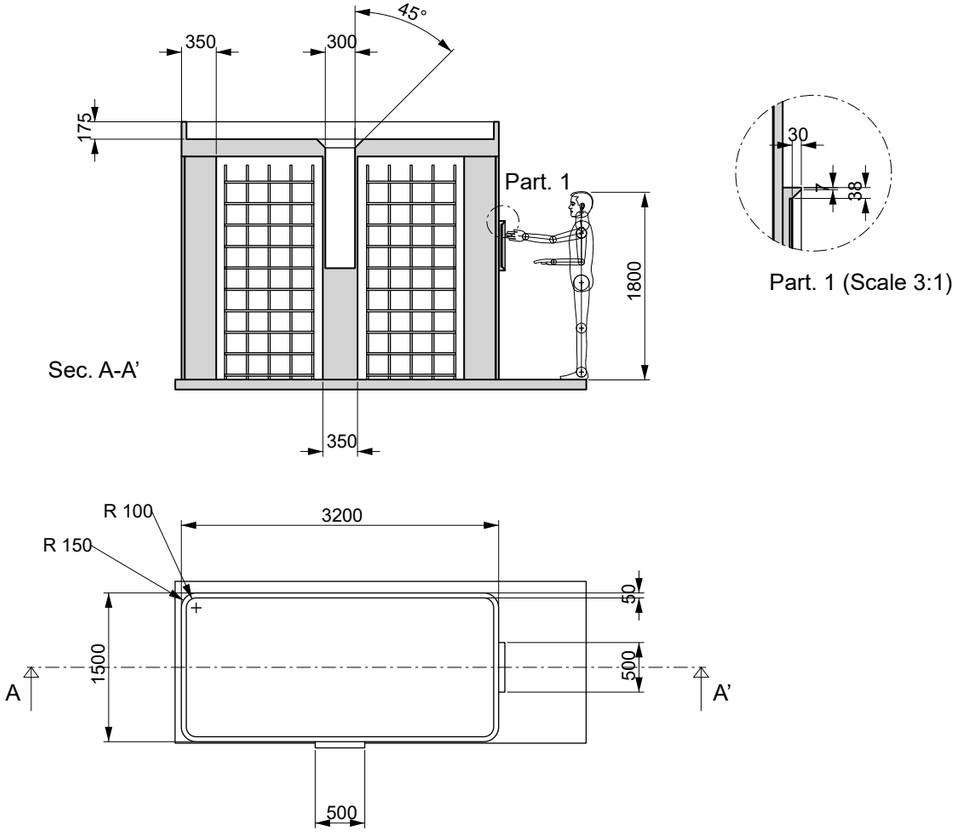
Beside this interface role through its screen, in this feature is integrated even another role: it becomes the sliding element that allows the customer to pick his parcel up. It has been decided this to simplify the overall morphology, integrating objects and their functions to create a more immediate understanding of the locker use. It's shape visually recalls the central element of the box used as an interface point: doing so, the two objects have similar interaction modalities and contribute to create a more coherent experience of the service, even making its identity stronger. This also thanks to its shape, that becomes narrower as it gets closer to the screen, emphasising it.



Technical drawings



Nemo2040	Locker - 01	Overall dimensions	Scale n/a



Nemo2040	Locker - 02	Section	Scale n/a

2.8

“Perhaps when you look at me I wish you’d say: ‘Damn! How did he do?’. And then I show you how I did. I want you to surprise twice. The first time because it looks impossible and the second one because it’s easy. That’s how I like it”.

Damien Hirst

The strategy: steps required to create the system

Nemo2040 proposes a new configuration of the actual food production market: technological innovation in self-driving field added to a strong change in habits (home delivery, digitalization, self driving vehicles use,...) and choices (local food products, alimentary consciousness) paves the way to a deep change in socio-economic framework for Milan city, and this innovation involves important benefits on a economic, cultural and environmental level.

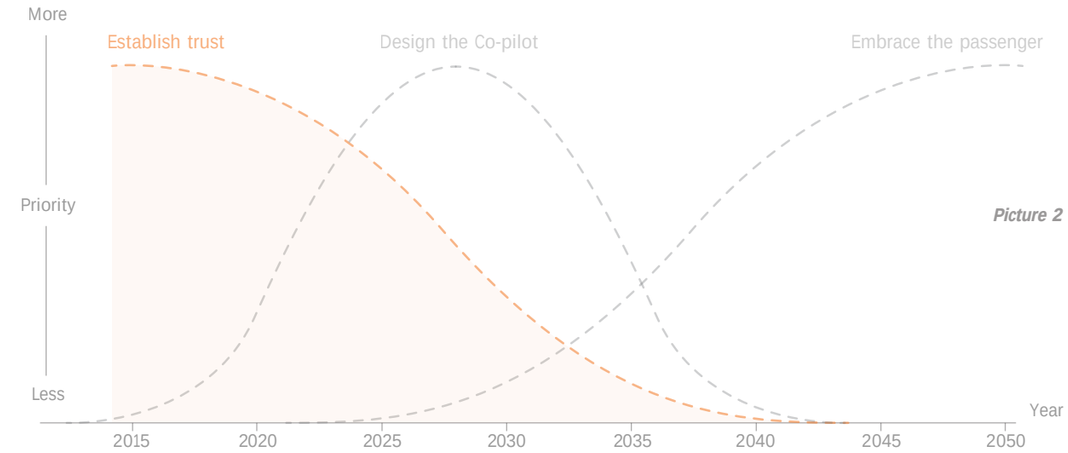
Although on a embryonic stage, this transformation process is already taking place: evidences of this phenomenon are the increasing demand for sharing systems, attention to fresh and local f00d, fervent research in self driving field, or drone delivery experiments.

So a potentially interesting field that is developing, to whom this project aims to give shape and purpose. If starting point (today) offers many perspectives, arrive point (2040) that is drawn looks possible. But many substantial changes are necessary to build *that 2040*: only by studying all the steps required this scenario becomes a possible future.

Autonomous vehicles

An importnat area that has to be studied concerns driverless means of transport. As stated, the project will not focus on designing them, but it’s extremely important to know their actual development and a future evolution. These vehicles are at an early stage of evolution: at the moment not all of them have the reliability and safety

Picture 1



Picture 2

Picture 1 - *Amazon Prime Air drone. Published online at time.com.*
Picture 2 - *A chart showing the expected development of autonomous vehicles. Published online at artefactgroup.com*

Picture 3

Picture 4

Picture 3 - *A convoy of the Metro Line 5, in Milan. Published online at metro-5.com.*
Picture 4 - *A convoy of Dubai Metro line. Published online at dubaitaly.com.*
1 - *Cf. Wavestone, World's best metro lines, 2017 - P. 22.*

required to establish themself as a valid option, so they are often combated by government laws, especially vehicles with bigger critical issues.

Autonomous metros are for sure the most realiable ones at the moment because of the low number of critical issues: this vehicle has defined infrastructers that are also separate from city traffic, limiting the variables linked to its movement. They are safe and precise and also contribute to keep people flow much more fluid. Like with autonomous cars, metros eliminate human error creating a safer and more reliable service. Moreover according to studies carried out by *Waveston* company, it can reduce waiting time on platforms leading to a more vehicle frequency, a quicker mobility and consequently an increased punctuality. According to the same essay, a driverless metro service could require 33% less vehicles than a traditional system [1]. For all these reasons, many cities all over the world adopted an autonomous metro system: Lille city has a functioning one since 1983 (the second completely autonomous one ever built); Dubai has the broader one (52,1 km); Milano, one of the last cities to build one, completed it in 2013. According

to *Wavestone*, autonomous metros total extension will reach 2300 km in 2025 counter the actual 800 km [2].

Another vehicles category that is shifting toward automation are trucks. That is a good thing, since there are some limits for human use. Monotony is a deleterious fact, because could lead the pilot to distract and consequently to cause accidents, which could become very serious because of the dangerous load they often transport (gas, fuel, gasoline, etc.). There is also an hour limit for continuous driving that a person can do, forcing the driver to stop and rest: obviously in case of autonomous drive such a problem wouldn't exist. Moreover according to *American Truck Association* [3] there is an availability problem for truck drivers: despite the fact that America bases 70% of goods transport on trucks, it's short of 50'000 truck drivers, that could become 175'000 in 2024. Like for metros, these vehicles don't have many critical issues for automation as well: they travel most of the time along straight highways, rarely changing lane and keeping a constant speed. There are many companies that are launching autonomous trucks projects and started to test and even use them: *Mercedes*

Picture 5

Picture 5 - *Otto self-driving prototype truck on a highway. Published online at thedrive.com.*
2 - *Cf. Wavestone, World's best metro lines, 2017 - P. 27.*
3 - *Cf. Alex Davies, Self-driving trucks are now delivering refrigerators, 2017. Published online at wired.com.*

Picture 6

Picture 7

tested the Future Truck 2025 project, *Uber* created a spinoff called Otto to explore this field and a startup called *Embark* have been transporting refrigerators since october 2017 in Southern California [4].

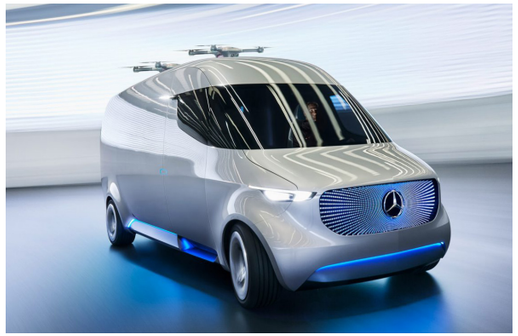
Many companies are focusing on creating driverless transport and delivery vehicles for the city. This kind of vehicles has much more problems compared to metros or trucks because they move in a urban context where variables such as traffic or pedestrians could make the functioning problematic. Is the case of *Domino's* pizza, which in collaboration with *Ford* tested a last mile delivery vehicle: a car modified to be driverless transports cooked food to the customer who, using a code, can pick his pizza up.

Neverthless more advanced and smarter delivery projects from space optimization point of view has been created by *Toyota*, in partnership with *Pizza Hut*, and *Mercedes*. The german company conceived an hybrid vehicle that matches vans loading capacity to drones capillarity, that can take off and land from the platform on the top of the van. This hybrid vehicle has some analogies and similarities with actual *Mercedes* vans, since it's planned the operator presence inside the vehicle who can intervene in case of problems. This fact shows the gradual shift from a manual system to an automatic one: it requires intermediate steps, where man presence is foundamental.

About last mile delivery, many

Picture 6 - *Yape, the delivery robot tested in Cremona. Published online at corriere.it.*
Picture 7 - *A truck blocked on an african road. Published online at cnn.com.*
4 - *Cf. Alex Davies, Self-driving trucks are now delivering refrigerators, 2017. Published online at wired.com.*

Picture 8



Picture 9

projects are raising and could soon substitute delivery boys speeding under the rain with *Deliveroo* backpack. Electric and autonomous trolleys have been tested already and are ready to be launched into cities: they have restrained measures and speed and a considerable autonomy of about 80 km on average. These vehicles can travel along pedestrian areas, at a speed of 6 km/h, and cycle paths as well, with a full speed of 20 km/h [5]. So they have a considerable practicality: a gradual car disappearance on urban surface means an increase of pedestrian and cycle areas, that can be used by these vehicles to deliver goods, creating a more efficient service.

An interesting project, that is already active in Redwood city in Silicon Valley, is the robot created by *Starship Technologies* which is based in London [6]. This trolley is capable to delivery packages within a 2 miles radius in about 15-30 minutes. In Italy instead, more precisely in the city of Cremona, the delivery-robot *Yape* has already been tested and is planned a future introduction. It is a totally italian project developed by Politecnico di Milano and recently received 6 million euros as a financing by *Eldor Corporation* [7].

Finally drone is surely the most fascinating and for some aspects the most problematicic vehicle to be automatized. Its main chacacteristic, flight, allows for sure a great mobility freedom in three dimensions, but it also involves a critical issues increase: weather conditions could be a serious challenge for it, or again if it did't work properly or fell down it would for sure be a danger.

Neverthless many companies are testing drone delivery to exploit potentials that it offers: *Amazon* already tested the *Prime Air* project, but it has many difficulties to impose it as a valid delivery method because of law limits. The fact remains that drone would be an efficient vehicle in crowded cities, because it could guarantee a punctual delivery without overcrowding streets. In particular, drone delivery can be a very important tool for resources supply in tough zones of the Planet: in Africa for example, where poor infrastructures don't allow a regular delivery, drones can be used to ship medicines.

In addition to projects and companied mentioned, there are many others that is possible to find online, some of them very far from the ones we are used to see today. It's the case of a project created by *Ideo* called Cody: a mobile logistic mean of transport and delivery, more resemblance to a small high-tech warehouse than to a vehicle. And also the project conceived by the young isreaeli designer Ayelet Fishman called Link: she thought to a modular container and autonomous platforms system that can exchange freely; this separation between container and platform reduces at minimum platforms and optimize them, using less resouces as well.

During the last years many prjects came out, and it's a symptom of an increasing attention for this slice of the market, consequent to an always greater necessity to optimize and automatize transport and delivery process.

Picture 8 - *Link, a last mile delivery solution designed by Ayelet Fishman. Published online at yankodesign.com.*
Picture 9 - *A delivery van concept designed by Mercedes. Published online at lastampa.it.*
5 - *Cf. Yape, il sistema di consegne a domicilio a guida autonoma. Published online at e-novia.it.*
6 - *Cf. Melia Robinson, Tiny self-driving robots have started delivering food on-demand in Silicon Valley, 2018. Published online at buisnessinsider.com.*
7 - *Cf. Luca Tremolada, Yape, il pony express robot riceve 6 milioni di finanziamento da Eldor Corp, 2017. Published online at ilsole24ore.com*

Selfdriving city

As we saw, autonomous vehicles are a reality, although a niche one, that has the possibility to establish itself now, even though not completely autonomously in some cases, but with an increasing autonomy degree.

An autonomous transport or delivery system that is private or public needs a favorable context in which to set in. Firstly trust it's foundamental: to entrust ourselves to a driverless vehicle or, in this case, our goods without having control on it, needs a lot of work and time. According to this forecast, time required to create trust to selfdriving vehicles will expire in 2040, as shown in the graphic at page 182.

Secondly, it's obvious to project city so that it's able to embrace this changing to the best. Its configuration could radically change: no more traffic lights, parkings and streets predominance on city fabric. It follows an increased focus on cycle paths, pedestrian areas, green spaces and public transport infrastructures.

As far as food transportation system is concerned, it's necessary to implement metropolitan net, creating more link spots between it and the street surface: this allows a more flexible service (creating more intersections) and a completely automatized goods management system.

So an important work has to be made, first from a safety point of view, from which derives an increased trust toward these vehicles, and even from an infrastructure point of view, necessary to make the system work at the best.

Home delivery

E-commerce sector is acquiring incresing consensus: in Europe, 65% of european internet users shopped online in 2015 [8], with a trend that is destined to grow. Ever-growing digitalization and possibility of a capillar transportation made possible to shift trade buisness from phisical reality to the virtual one, just like communication (mail) or postcards. These has been displaced by the infinite possibilities that

8 - *Cf. E-commerce statistics for individuals - 2015 edition. Published online at europa.eu.*

Picture 10

Picture 11

Internet offers and by apps like *Instagram* and *Facebook* that allows to share images and pictures instantly.

If we consider that adults in 2040 will be today's teenagers, it's clear that this trend aims to a complete dematerialization of visual and textual informations and, on the other hand, to a increasingly substantial growth of e-commerce and home delivery. As happened to telephone cabins, the scenario forecasted is: less mailboxes and more parcel boxes. Structures that can hold parcels will be present in every building, with a dedicated slot for every inhabitant that collects goods ordered online, waiting for the customer to pick it up.

Food delivery cases and containers

Modular boxes and lockers are the core parts of Nemo2040, and have to be designed with particular attention. Moroever is foundamental to study projects that focused on last mile delivery and tried to facilitate the process, because allows to understand the direction the market is going toward.

The first of these is present basically everywhere: the insulating backpack used by delivery boys, exploited mainly for ready-to-eat food. It keeps warm the food inside for the short trip, in a smart way: it uses insulating material layers, without hot plates or else that could make it more complex and pollutant.

Picture 10 - *An Amazon Locker that can hold stuff for few days. Published online at sicilianews24.it.*
Picture 11 - *A not-digitalized home locker, Published online at killswitch.me.*

Other projects are not about boxes or portbale containers, but explore new ways to make delivery easier, to keep the parcel safe from thiefs or damages. Some lockable containers have been designed, in which delivery boy inserts the pack, which is protected until the client picks it up. In this case the box doesn't have a centralized connection, that involves access problems for the operator and makes the process too elaborate. A similar project that is much more efficient and systematized is an *Amazon* project recently launched, called *Amazon Lockers*: these temporary stock points are located in city strategic points and constitute an alternative to home delivery, for instance in case the client is not at home during the planned delivery. When the *Locker* receives the pack, customer receives an e-mail with the code necessary to pick it up. Compared to self driving vehicles sector, this one (delivery boxes and stocking stations) offers much more possibilities for Nemo2040: the project is composed of autonomous vehicles, but its core part is focused on these components that allow a smooth interaction between vehicles and permit to establish a more direct interaction between client and the system itself, generating an easier and more engaging service. For a possible further development of this project, this topic is for sure particularly interesting to develop.

3.

Conclusions

The project presented was born from the *'Sistema città di Milano'* pseudo-document, conceived for the *Final Synthesis Design Studio 2017/2018* course. Despite of being an invented document, it's something that will probably happen in future cities: pollution and streets congestion due to traditional car-based mobility will force cities municipalities to ban or heavily restrict owned cars to enter into the city, determining huge changes in how this ecosystem will work. Willing or not, the globalization effects are particularly serious in big cities, and it has to be acknowledged the duty to plan a more sustainable World, to ensure a safer future for the Planet and the Society because, as stated, the risks connected to the actual anthropic activity determined a deep crisis and, if the action will not be firm and collective, they will end up worsen.

From the focus on Milan city, a fertile soil to conceive this project for its sustainable sensitivity, the base concept is to scale Nemo2040 project in other contexts that have similar characteristics and, in a future of demographic rise and megacities development, it could be a possible need for these urban centers the one to have a constant supply of organic, fresh and local food, even considering the implication on territory identity and economy. Of course it's unthinkable to transpose the system as it is: every city and territory has its own morphology and identity, and they must be taken into consideration to adapt this system at best. The overall concept will have to be concretized according to the specific characteristics of the city, such as its *configuration*, that will imply a different approach with the territory around it, the *pre-existent infrastructure*, that can be kept as a part of the transportation and delivery phase, and even the overall *urban identity*, given by the city visual features that could imply a totally different visual identity of the system and its characteristics. Taking Shanghai as an example, the river that crosses the city can be considered a possible transport route to exploit and make the service more efficient without congesting the streets. Or considering London, that has a very characteristic visual identity, it asks for a complete change in the overall

visual image of Nemo2040 and its features. And again, considering Lisbon, has a very rich fish supply, and in this case a particular attention should be put on the connection between the city and the Port.

The solution designed for the future cities and megacities food supply is not thought as the only way to satisfy the demand: other interesting and sustainable ways to generate and trade food are used even today (at a very small scale), such as self-production and urban gardening methods that allow to produce food from within the city allowing to further reduce supply lenght and to make supply more efficient. So it's unthinkable to just rely on this system to satisfy cities demand, and it's also unthinkable to imagine that this distributed framework will totally replace the centralized one: if we consider how important are the exports of local products for many companies and nations, how many people are employed in this sector and the amount of gain generated, it can be understood how important is for local and national economy. Considering the *Parmigiano Reggiano* cheese, every year about 3.6 millions of pieces are produced, with a value that worths 2.2 billions of euros[1]. It's impossible to imagine to consume *Parmigiano Reggiano* only in the areas near the production points. A more realistic scenario is the one where distributed and centralized frameworks co-exist, being even able to supplement each other, if cleverly designed [2].

Finally, it's right to express a overall consideration about this work. It's really a broad and complex project, that involves many different actors, structures, infrastructures, vehicles, features and elements and has many implications on many sides of the reality. On a theoretical level it has the potential to better the situation inside the city, solving one side of the mobility issue for tomorrow's cities, and even outside the city, creating a link with the countryside and the communities living there, allowing development possibilities even in rural areas. The theoretical reasoning tries to express the importance to plan and design life in the future cities, and Nemo2040 aims to give a possible answer to this need. But the truth is that it's impossible to say if it's something feasible or not: the project here presented is a 1 year work of a single designer who tried to answer to the possible future problems of the world with a project, and it must be acknowledged that just a deep further work, faced on more sides involving more people with different capabilities, focused on the assessment of the project can actually say if it's something feasible or not and if, once created and materialized, it has realistically the potential to actually better the overall situation or not. So it's necessary a combined approach to evaluate the project potential in reality, to state if what can become is just a theoretical *Utopia* or something real and concrete.

Picture 1

1 - *Cf. Food Insider (2018) Why Parmesan Cheese Is So Expensive. Published online at: youtube.com.*
2 - *Cf. Biggs, Ryan, Wiseman, Distributed Systems: A design model for sustainable and resilient infrastructure, 2010 - P. 3.*

Picture 1 - *Foschi, F. (2018) Nemo2040 preview.*

4.

References

Iconography

Prologue

1 - Rosina, G. (1994) *Harvest*. Published in *'Ponte Nizza, da casolare a Comune'. P. 143*.

2 - Maruffi, V. (2014) *Stable work*. Available from: http://valeriomaruffiphoto.com/gallery/gente-dappennino/.

3 - *Trebbiano Nizza school alumns* (1910) Published in *'Ponte Nizza, da casolare a Comune' P. 126*.

4 - Foschi, F. (2018) *A wild kaki tree*. Personal archive of the author.

5 - Foschi, F. (2017) *A water mill*. Personal archive of the author.

6 - Foschi, F. (2018) *An abandoned tractor*. Personal archive of the author.

7 - Foschi, F. (2018) *A collapsed house invaded by vegetation*. Personal archive of the author.

8 - Foschi, F. (2017) *Trebbiano Nizza in summertime*. Personal archive of the author.

9 - Foschi, N. (2018) *Mother and puppy of roe deer*. Personal archive of the author.

10 - Maruffi, V. (2014) *Wine harvest*. Available from: Available from: http://valeriomaruffiphoto.com/gallery/gente-dappennino/.

11 - Foschi, F. (2018) *A wild apple tree and the local church in the background*. Personal archive of the author.

0. Introduction

Picture 1 - United Nations, Department of Economic and Social Affairs, Population Division (2014) *Rural and urban population forecast*. Published in *World Urbanization Prospects 2014 - P. 8.*

Picture 2 - Alex McLean (2011) *Cars parked at a Nascar Event in Richmond, Virginia*. Available from http://www.alexmaclean.com/portfolio/transportation/110430-0792.

Picture 3 - Ensia Edge, *Megacities development for the 2010-2025*, Ensia Edge. Available from http://edge.ensia.com/here-come-the-megacities/.

Picture 4 - Urbanetic mobility vision. Available from https://www.quattroruote.it/news/concept/2018/09/10/mercedes_benz_con_vision_urbanetic_uno_sguardo_sul_futuro_delle_citta.html.

Picture 5 - Gruyaert, H. (1992) *Antwerp industrial port*. Available at https://pro.magnumphotos.com/CS.aspx?VP3=SearchResult&VBID=2K1HZO4OAJNEJA.

1.1 Social level: for a creative and conscious society

Picture 1 - *Ankit Agarwal and Karan Rastogi with some women involved in HelpUsGreen project*. Available from https://www.helpusgreen.com/pages/our-team.

Picture 2 - *Coltivando garden at Politecnico di Milano Bovisa*. Available from https://www.milanoevents.it/2018/04/18/coltivando-apertura-straordinaria-bovisa/.

Picture 3 - *A farmers' market in Osseo, Minnesota* (2015). Available from https://www.discoverosseo.com/blog/2015-farmers-market-in-downtown-osseo/.

1.2 Infrastructural level: for a new sustainable economic-productive system

Picture 1 - Our world in Data (2018) *World Population projection for 2050*. Available from: https://ourworldindata.org/world-population-growth.

Picutre 2 - *One of the first Esselunga selling points in Italy*. Available from: https://www.esselunga.it/cms/info/area-stampa/cartella-stampa/la-storia.html.

Picture 3 - Witte, M. (2017) *The Emma Maersk. Available from: https://www.alamy.it/foto-immagine-emma-maersk-163393455.html.*

Picture 4 - *An oil tanker ship in flames in South China Sea* (2018). Available from: https://www.tpi.it/2018/01/08/una-petroliera-ha-preso-fuoco-nel-mar-cinese-meridionale-si-teme-lesplosione/.

Picture 5 - *TAP in construction* (2018). Available from: https://www.azernews.az/oil_and_gas/136088.html.

Picture 6 - *Windmill in a farm*. Available from: https://www.hollandtradeandinvest.com/dutch-solutions/clean-energy/energy-marketplace-locally-generated-energy-security.

Picture 7 - Skemes of centralized and distributed systems. Available from: https://busy.org/@ethfinex/the-significance-of-decentralisation.

Picture 8 - *Costs comparison between centralized and distributed systems*. Published in Biggs C., Ryan C. Wiseman J. (2010) *Distributed Systems: A design model for sustainable and resilient infrastructure*. P. 15.

1.3 Cultural level: for an historical and ideological continuity with the past

Picture 1 - *Students involved in the Erasmus project*. Available from: http://europa.eu/rapid/press-release_MEMO-13-647_en.htm

Picture 2 - *American Graffiti restaurant in Bologna* (2016) Tripadvisor. Available from: https://it.tripadvisor.ch/Restaurant_Review-g187801-d10039286-Reviews-America_Graffiti_Diner_Restaurant_Bologna-Bologna_Province_of_Bologna_Emilia_Rom.html#photos;aggregationId=101&albumid=101&filter=7&ff=196440017

Picture 3 - *Tiziano Terzani in China*. Available from: http://www.artspecialday.com/9art/2018/07/28/tiziano-terzani-oriana-fallaci/.

Picture 4 - *Asti's countryside* (2018) The Italian Eye Magazine. Available from: https://www.theitalianeyemagazine.com/food-tour-di-asti/6/.

2.1 Food production and distribution: criticalities and possible development

Picture 1 - Qu, J. (2014) *Fields of Old*. National Geographic. Available from: https://www.nationalgeographic.com/photography/photo-of-the-day/2014/5/rice-terrace-landscape-china/.

Picture 2 - Romeo Gacad (2008) *A aircraft sprays fungicide over a plantation*. Getty Images. Available from: https://www.gettyimages.it/detail/fotografie-di-cronaca/picture-taken-on-april-22-2008-of-a-crop-duster-fotografie-di-cronaca/127867838.

Picture 3 - NASA Terra Satellite (2000-2014) *The Aral Sea Loses Its Eastern Lobe*. Earth Observatory, NASA. Available from: https://earthobservatory.nasa.gov/images/84437/the-aral-sea-loses-its-eastern-lobe.

Picture 4 - NASA Terra Satellite (1975-2007) *Deforestation in Guatemala-Belize border*. CIAT (International Center for Tropical Agriculture). Available from: http://dapa.ciat.cgiar.org/tracking-forest-loss-on-the-guatemala-belize-border/.

Picture 5 - Biological Diversity. *Extinctions occurred in the last 200 years*. Available from: https://www.biologicaldiversity.org/programs/population_and_sustainability/extinction/index.html.

Picture 6 - BellaDati. *Drone for Precision Agriculture*. Available from: http://www.belladati.com/iot/.

Picture 7 - Statista (2018) *Internet connected objects forecast*. Statista. Available at: https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/.

2.2 Urban mobility: criticalities and possible development

Picture 1 - Frayer, K. (2015) *Pollution in China*. The New Yorker. Available from: https://www.newyorker.com/news/news-desk/china-tries-new-tactic-combat-pollution-transparency.

Picture 2 - Sood, A. (2015) *Traffic jam in New Delhi*. Independent. Available from: https://www.independent.co.uk/news/world/asia/is-this-the-biggest-traffic-jam-ever-extraordinary-26-lane-gridlock-photographed-10495111.html.

Picture 3 - *Umihotaru Parking Area, Tokio.* Available from: https://carbuzz.com/features/10-of-the-coolest-car-parks-in-the-world.

Picture 4 - *American Graffiti* (1973). Available from: https://www.whichcar.com.au/features/american-graffiti-1973-ripper-car-movies.

Picture 5 - *Toyota e-Palette Concept vehicle video presentation* (2018) Toyota Motor Company. (min. 1:00). Available from: https://www.youtube.com/watch?time_continue=62&v=bniK9Eqgnw4.

Picture 6 - Ibidem. (min 1:30)

Picture 7 - Anonymous author (1905) *Children playing near a dead horse*. Sutori. Available from: https://www.sutori.com/story/immigration-and-urbanization-during-the-gilded-age-f8bd.

Picture 8 - Anonymous author (1893) *Streets of New York covered with horse manure*. Huffington Post. Available from: https://www.huffingtonpost.com/entry/government-wont-save-us-but-dumb-government-could_us_57a906dce4b08f5371f1db63?guccounter=1.

Picture 9 - McKinsey&Company (2018) *The sectors with the biggest potential value from AI*. Linkedin. Available from: https://www.linkedin.com/feed/update/urn:li:activity:6458029204159234048/.

Picture 10 - Kelly, D. (2014) *Kiva warehouse robots*. Wired. Available from: https://www.wired.com/2014/12/amazon-reveals-robots-heart-epic-cyber-monday-operation/.

Picture 11 - TexpoTrade. *Autonomous pallet mover*. TexpoTrade. Available from: http://www.texpotrade.com/?page_id=352.

2.3 The vision : conscious production, trade and consumption

Picture 1 - Hendrick Martensz Sorgh (1611-1670) *A vegetable market*. Oil on canvas, private collection. Available from: http://artpaintingartist.org/a-vegetable-market-by-hendrick-martensz-sorgh/.

Picture 2 - *A digital farmer*. Available from: https://www.videoblocks.com/video/female-farmer-using-tablet-computer-in-wheat-crop-field-concept-of-modern-smart-farming-by-using-electronics-technology-and-mobile-apps-in-agricultural-production-rquyqprz-j35khixg.

Picture 3 - *Farmers' market in Rome*. Available from: http://www.mercatocircomassimo.it/i-gruppi-di-acquisto/#!prettyPhoto/20/.

Picture 4 - *A rooftop garden*. Available from: http://www.nationmultimedia.com/business/Urban-farming-takes-on-more-important-role-worldwi-30278361.html.

Picture 5 - *Windy Hill Wind Farm, Queensland, Australia*. Available from: http://trendintech.com/2016/06/19/australias-clean-energy-future-gets-brighter/.

Picture 6 - *Solar panels mounted on hill tops, Qinhuangdao, Northern China*. Available from: https://www.videoblocks.com/video/aerial-flight-over-a-massive-solar-panel-power-project-in-the-mountains-near-qinhuangdao-in-northern-china-h6p_go3pitqds643.

2.4 Milan city: a model of sustainable development

Picture 1 - *MoBike bikes in Milan* (2018). Available from: http://www.radiolombardia.it/2018/04/16/bike-sharing-in-arrivo-le-nuove-mobike/.

Picture 2 - *The document 'Sistema città di Milano'.*

2.5 A new system to realize the vision: Nemo2040

Picture 1 - Novembre, F., *Nemo armchair*. Driade. Available from: http://www.driade.com/divani-e-poltrone-nemo-metalliche.

Picture 2 - Laman, T., *Clownfishes with Sea Anemone*. National Geographic. Available from: http://www.nationalgeographic.it/wallpaper/2015/08/02/foto/tim_laman_e_il_suo_mare_nelle_grandi_foto_della_settimana-2665390/4/.

Picture 3 - IDEO (2017) *Cody, a driverless delivery vehicle*. IDEO. Available from: https://automobility.ideo.com/moving-together/intro.

2.7 Definition of the system's main features

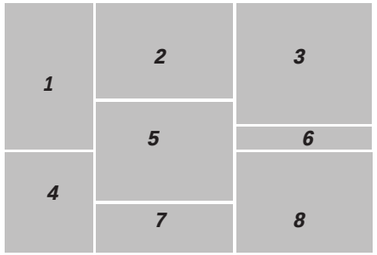
Picture 1 - Hofman, J. (2017) *Sewage Surfer*. National Geographic. Available from: https://www.nationalgeographic.com.au/planet-or-plastic/.

Picture 2 - *Chitin-based 3D printed artifact* (2015). Engineering. Available from: https://www.engineering.com/PLMERP/ArticleID/10818/MIT-Demonstrates-Structures-that-Combine-Biology-and-Tech.aspx.

Picture 3 - Wired (2014) *4D printed elephant*. Wired. Available from: https://www.wired.com/2014/11/skylar-tibbits/.

Picture 4 - *'La biblioteca degli alberi'* (2018). Available from: https://www.milanolife.it/milano-sempre-piu-verde/.

Picture 5 Moodboard -



1 - Foschi, F. (2016) *Tribunale di Milano*. Personal archive of the author.

2 - Foschi, F. (2016) *San't Ambrogio Cathedral* Personal archive of the author.

3 - Foschi, F. (2016) *Palazzo della Regione Lombardia*. Personal archive of the author.

4 - Falciola, F., *Piazza Gae Aulenti*, Milan. Available from: https://www.francescofalciola.com/en/my-product/piazza-gae-aulenti-milano-en/.

5 - Oddo, F. (2015) *Stazione Centrale di Milano*. Available from: https://www.fabryphoto.it/milano-street-photo/.

6 - *Bob Norda in the M1 Line at San Babila Station*. Available from: https://www.citylab.com/design/2016/05/the-undervalued-simplicity-of-bob-noordas-vision-for-milans-metro/483782/.

7 - *Philosphy closter in Università Statale di Milano*. Available from: http://www.dipafilo.unimi.it/ecm/home?p_p_id=TOWERMOD_2_WAR_calendarportlet_INSTANCE_V8th&p_p_lifecycle=0&p_p_col_id=column-4&p_p_col_count=1&_TOWERMOD_2_WAR_calendarportlet_INSTANCE_V8th_calType=-month&_TOWERMOD_2_WAR_calendarportlet_INSTANCE_V8th_curDate=20010617&_TOWERMOD_2_WAR_calendarportlet_INSTANCE_V8th_calNext=%2B1&noindex=true.

8 - Foschi, F. (2016) *Galleria Vittorio Emanuele*. Personal archive of the author.

2.8 The strategy: steps required to create the system

Picture 1 - Amazon (2016) *Prime Air drone*. Time. Available from: http://time.com/4185117/amazon-prime-air-drone-delivery/.

Picture 2 - Artefact Group (2015) *Expected development of autonomous vehicles*. Available from: https://archive.artefactgroup.com/articles/the-human-transition-to-autonomous-vehicles/.

Picture 3 - *Milan Metro Line 5*. Available from: http://www.metro-5.com/.

Picture 4 - *Dubai Metro convoy*. Available from: https://www.dubaitaly.com/2018/07/24/rta-unapp-per-guidare-i-non-vedenti-in-metropolitana/?locale=it.

Picture 5 - *Prototype of Otto truck*. Available from: http://www.thedrive.com/news/3516/former-google-geniuses-are-now-building-self-driving-trucks.

Picture 6 - Corriere Innovazione (2017) *Yape delivery trolley*. Available from: http://corriereinnovazione.corriere.it/2017/07/07/nuova-frontiera-consegne-milano-arriva-drone-robot-yape-a1eb2a32-630b-11e7-8724-0d53d361406e.shtml.

Picture 7 - CNN (2016) *African streets*. CNN. Available from: https://edition.cnn.com/2016/03/25/politics/drones-federal-aviation-administration/index.html.

Picture 8 - Fishman, A. (2014) *Link, the last mile delivery solution*. Tanko Design. Available from: http://www.yankodesign.com/2014/12/18/link-the-last-mile-delivery-solution/.

Picture 9 - La Stampa (2016) *Mercedes-Benz vision van*. La Stampa. Available from: https://www.lastampa.it/2016/09/10/motori/mercedesbenz-vision-van-le-consegne-del-futuro-saranno-automatizzate-e-a-emissioni-zero-flqqSDmTlLKa8MgoR0LAjO/pagina.html.

Picture 10 - SiciliaNews (2018) *Amazon Locker*. SiciliaNews. Available from: https://sicilianews24.it/armadietto-amazon-a-palermo-535871.html.

Picture 11 - Kill Switch. *Home parcel locker*. Available from: http://killswitch.me/parcel-box-for-home-delivery/home-delivery-box-parcel-for-drop-small-improvement-wilson-meme/.

Picture 1 - Foschi, F. (2018) *Nemo2040 preview*.

Bibliography

AAA News Room (2011) *Study Finds Costs Associated With Traffic Crashes Are More than Three Times Greater than Congestion Costs*. AAA News Room. Available from: https://newsroom.aaa.com/2011/11/aaa-study-finds-costs-associated-with-traffic-crashes-are-more-than-three-times-greater-than-congestion-costs/.

AdnKronos (2017) *Giornata del suolo, in Italia urbanizzazione più che triplicata in 50 anni*. AdnKronos. Available from: https://www.adnkronos.com/sostenibilita/risorse/2017/12/04/giornata-del-suolo-italia-urbanizzazione-piu-che-triplicata-anni_5dj9iMPUBUPrW3bHvPgzGJ.html.

ADXTUR (Agência para o Desenvolvimento Turístico das Aldeias do Xisto) (2015) *Agricultura Lusitana 2015*.

Albrecht, B., Magrin, A. (2017) *Il Bel Paese, 1 progetto x 22.621 Centri Storici*. Soveria Mannelli, Rubbettino Editore.

AsiaNews (2017) I*n 2016, 11,400 farmers committed suicide in India over debt*. AsiaNews. Available from:http://www.asianews.it/news-en/In-2016,-11,400-farmers-committed-suicide-in-India-over-debt-41350.html.

BBC (2017) *Household food waste level 'unacceptable'*. BBC. Available from: https://www.bbc.com/news/science-environment-39747327.

Bellarby, J., Foereid, B., Hastings, A., Smith, P. (2008) *Cool Farming: Climate impacts of agriculture and mitigation potential*. Amsterdam, Greenpeace International.

Bergamasco, C. (2016) *L'India blocca la costruzione di nuove centrali a carbone, a partire dal 2022*. Lifegate. Available from: https://www.lifegate.it/persone/stile-di-vita/lindia-blocca-la-costruzione-di-nuove-centrali-carbone-partire-dal-2022.

Bertaglio, A. (2008) *Agricoltura, prima causa della deforestazione globale e dei gas serra*. Il Fatto Quotidiano. Available from: https://www.ilfattoquotidiano.it/2012/10/03/agricoltura-prima-causa-della-deforestazione-globale-e-dellemissione-di-gas-serra/371131/.

Besti, F., Samorè, F. (2018) *Responsibility driven design for the future self-driving society*. Milan, Fondazione Giannino Bassetti.

Biggs C., Ryan C. Wiseman J. (2010) *Distributed Systems: A design model for sustainable and resilient infrastructure*. Melbourne, Victorian Eco-Innovation Lab.

ccpb (2015) *L'agricoltura: un ottimo metodo per combattere la desertificazione*. ccpb. Available from: http://www.ccpb.it/blog/2015/09/09/agricoltura-ottimo-metodo-combattere-desertificazione/.

CIA (Confederazione Italiana Agricoltori) (2018) *Burocrazia, costi di produzione e prezzi bassi all'origine affossano aziende*. CIA. Available from: https://www.cia.it/news/notizie/burocrazia-alti-costi-di-produzione-e-prezzi-bassi-allorigine-affossano-aziende-agricole/.

Codignola, A. (2017) *Neonicotinoidi, storia degli insetticidi accusati della scomparsa delle api*. Il Fatto Alimentare. Available from: https://ilfattoalimentare.it/neonicotinoidi-insetticidi-scomparsa-api.html.

Comune di Milano (2017) *PUMS (Piano Urbano per la Mobilità Sostenibile)*.

Davies, A. (2017) *Self-driving trucks are now delivering refrigerators*. Wired. Available from: https://www.wired.com/story/embark-self-driving-truck-deliveries/.

Dwivedi, A., Naresh, R. K., Kuman, R., Yadav, S. R., Kuman, R. (2017) *Precision Agriculture*. Jharkhand, PARMAR PUBLISHERS & DISTRIBUTORS.

E-novia. *Yape, il sistema di consegne a domicilio a guida autonoma*. E-novia. Available from: http://www.e-novia.it/it/yape/.

Eurostat (2018) *480 kg of municipal waste generated per person in the EU*. Eurostat. Available from: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20180123-1.

Eurostat (2018) *E-commerce statistics for individuals*. Eurostat. Available from: https://ec.europa.eu/eurostat/statistics-explained/index.php/E-commerce_statistics_for_individuals.

FAO (2013) *Gli sprechi alimentari gravano sul clima, sulle risorse idriche, sul suolo e sulla biodiversità*. FAO. Available from: http://www.fao.org/news/story/it/item/196458/icode/.

Farkas, A. (2006) *Frutta e verdura «svuotate» di vitamine*. Corriere della Sera. Available from: https://www.corriere.it/Rubriche/Salute/Alimentazione/2006/03_Marzo/01/farkas_verdure.shtml.

Food Insider (2018) *Why Parmesan Cheese Is So Expensive*. Available from: https://www.youtube.com/watch?v=ZgjWOo7IqQY.

Hamdi, F. (2015) *The Impact of Globalization in the Developing Countries*. Available from: https://www.linkedin.com/pulse/impact-globalization-developing-countries-fairooz-hamdi/.

Hassi, A., Storti, G. (2012) *Globalization and Culture: The Three H Scenarios.* InTech. Available from: https://www.researchgate.net/publication/300386582_Globalization_and_Culture_The_Three_H_Scenarios.

Howell, J. (2017) *Number of Connected IoT Devices Will Surge to 125 Billion by 2030, IHS Markit Says*. IHS Markit. Available from: https://technology.ihs.com/596542/number-of-connected-iot-devices-will-surge-to-125-billion-by-2030-ihs-markit-says.

Hutger, M., Kuckelhaus, M. (2014) *Self-driving vehicles in logistics, A DHL perspective on implications and use cases for the logistics industry*. Troisdorf (Germany), DHL Customer Solutions & Innovation.

Irazabal, A., Caridi, C. (2017) *'Ecco chi produce i nostri vestiti'*. RAI (Radio Televisione Italiana). Available from: https://www.youtube.com/watch?v=IJrn2QVmtko&t=3s.

Jégou F., Manzini E. (2008) *Collaborative Services, Social innovation and design for sustainability*. Milan, Edizioni POLI.design.

Joerss, M., Schroder, J., Neuhaus, F., Klink, C., Mann, F. (2016) *Parcel delivery, The future of last mile.* McKinsey&Company.

Kantor, B., *Le développement durable dans le contexte climatique: Le projet southsouthnorth et le mécanisme de développement propre*. United Nations. Available from: http://www.un.org/french/pubs/chronique/2007/numero2/0207p68.html.

Kottasovà, I. (2018) *Ikea bans all single-use plastic from its stores and restaurants*. CNN. Available from: https://money.cnn.com/2018/06/07/news/ikea-bans-single-use-plastic/index.html.

La Repubblica (2017) *Car sharing, ecco perché usarlo*. La Repubblica. Available from: https://www.repubblica.it/motori/sezioni/attualita/2017/10/31/news/carsharing_ecco_perche_usarlo-179857929/.

La Repubblica (2018) *Lego, la svolta green: addio alla plastica entro il 2030*. La Repubblica. Available from: https://www.repubblica.it/ambiente/2018/09/05/news/lego_la_svolta_anti-inquinamento_addio_alla_plastica_entro_il_2030-205662646/.

La Repubblica (2017) *Smog, l'Italia maglia nera in Europa: 90mila morti l'anno*. Repubblica. Available from: https://www.repubblica.it/ambiente/2017/09/29/news/smog_l_italia_maglia_nera_in_europa_90mila_morti_l_anno-176866776/.

Lo Surdo, G. (2014) *L'informatizzazione agricola, una sfida non solo tecnologica*. Published in L'informatore Agrario of May the 15th, 2014.

Manzini, E. (2009) *Design for Social Innovation and Sustainability* [Presentation] The Alfred Deacking Eco-Innovation Lectures. October 2009 (min 6:40). Available from https://www.youtube.com/watch?v=B2luPJ4hTN0&t=514s.

Manzini, E. (2015) *Design, When Everybody Designs, An Introduction to Design for Social Innovation*. London, The MIT Press.

Meroni, A. (2007) *Creative communities, People inventing sustainable ways of living*. Milan, Edizioni POLI.Design.

Milani, R. (2001) *L'arte del paesaggio*. Bologna, Società editrice Il Mulino.

Ministero della Salute Italiano (2014) *L'obesità, uno dei principali problemi di salute pubblica*. Ministero della Salute. Available from: http://www.salute.gov.it/portale/salute/p1_5.jsp?lingua=italiano&id=175&area=Malattie_endocrine_e_metaboliche.

Nikiforuk, A. (2013) *The Big Shift Last Time: From Horse Dung to Car Smog*. The Tyee. Available from: https://thetyee.ca/News/2013/03/06/Horse-Dung-Big-Shift/.

Novak, P. (2018) *The ethical dilemmas of self-driving cars*. The Globe and Mail. Available from: https://www.theglobeandmail.com/globe-drive/culture/technology/the-ethical-dilemmas-of-self-drivingcars/article37803470/.

Novembre, F. (2010) *Il Design spiegato a mia madre*. Milano, Rizzoli.

Obels, J., Bulat, A., Genet, P. (2017) *Feeding 10 billion people in 2050, Debunking the digital myths in agriculture*. Capgemini. Available from: https://www.capgemini.com/nl-nl/bronnen/feeding-10-billion-people-in-2050/.

Oggi (2013) *Sos: i cibi hanno perso le loro proprietà*. Available from: http://www.oggi.it/cucina/news-cucina/2013/06/26/sos-cibi-ricchi-di-nutrienti/.

Oldfield, P. (2017) *Searching for Parking Costs Americans $73 Billion a Year*. Inrix. Available from: http://inrix.com/press-releases/parking-pain-us/.

Pais, I. (2018) *Innovazione Sociale* [Lecture] Casa della Cultura di Milano, April 9th 2018. Available from https://www.youtube.com/watch?v=aHmJVCXK2h0&t=2878s.

Parker, L. (2017) *Here's how much plastic trash is littering the Earth*. National Geographic. Available from:https://news.nationalgeographic.com/2017/07/plastic-produced-recycling-waste-ocean-trash-debris-environment/?_ga=2.137615670.743342342.1542905442-1717861390.1542905441.

Petrini, C. (2016) *Buono, Pulito e Giusto*. Bra (Italy), Slow Food Editore Srl.

Robinson, M. (2018) *Tiny self-driving robots have started delivering food on-demand in Silicon Valley*. Buisness Insider. Available from: https://www.businessinsider.com/doordash-delivery-robots-starship-technologies-2017-3?IR=T.

Schiller, B. (2014) *The Sharing Economy Takes On Electricity, So You Can Buy Your Power From Neighbors*. Fast Company. Available from: https://www.fastcompany.com/3036271/the-sharing-economy-takes-on-electricity-so-you-can-buy-your-power-from-neighbors.

Silberg, G., Wallace, R. (2012) *Self-driving cars: The next revolution.*

Smith, B. W. (2013) *Human error as a cause of vehicle crashes*. CIS (Center for Internet and Society). Available from: http://cyberlaw.stanford.edu/blog/2013/12/human-error-cause-vehicle-crashes.

Statista (2018) *Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025 (in billions)*. Statista. Available from: https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/.

Terzani, T. (2002) *Tiziano Terzani: La Pace è da cercare dentro*, Interview by Luciano Minerva. RAI (Radio Televisione Italiana). Available from http://www.teche.rai.it/2017/06/tiziano-terzani-2/.

The Guardian (2003) *Just how old are the 'fresh' fruit & vegetables we eat?*. The Guardian. Available from: https://www.theguardian.com/lifeandstyle/2003/jul/13/foodanddrink.features18.

Tremolada, L. (2017) *Yape, il pony express robot riceve 6 milioni di finanziamento da Eldor Corp*. Il Sole 24 Ore. Available from: https://www.ilsole24ore.com/art/tecnologie/2017-11-23/yape-pony-express-robot-riceve-6-milioni-finanziamento-eldor-corp-152707.shtml?uuid=AEjcj1GD.

United Nations (2014) *World's population increasingly urban with more than half living in urban areas*. United Nations. Available from: http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html.

Virtuani, P. (2013) *Lotta agli sprechi alimentari per dare cibo a tutti*. Corriere della Sera. Available from: https://www.corriere.it/ambiente/13_ottobre_15/lotta-sprechi-alimentari-dare-cibo-tutti-320961f2-359c-11e3-9c0c-20e16e3a15ed.shtml.

Wavestone (2017) *WORLD'S BEST DRIVERLESS: METRO LINES 2017, Market study on driverless metro lines and benchmark of network performance*.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