ALTA SCUOLA
POLITECNICA
POLITECNICO DI MILANO | POLITECNICO DI TORINO

PROJECT / 9TH

Preface

This book marks the completion of the course of studies for the 9th cycle of students of the Alta Scuola Politecnica.
Created in 2004, the Alta Scuola Politecnica programme draws inspiration from the experience of the Politecnico di Milano and the Politecnico di Torino, two universities with different histories, contexts and methods, which both share the common goal to offer a highly-innovative academic curriculum to talented students with an high interest in multi-disciplinarity.
From the beginning, this ambitious project aimed to create a so-called “Learning route” between Turin and Milan. Thanks to the growing economic and social bonds between these two cities, two key realities of the Italian economy, we are even more certain hat ten years ago we took the right decision, a decision that, during this time, has evolved improved and have been put into effect.
The world is experiencing a very fast technological and social development, which is leading to the emergence of new paradigms. As a result, future technical professionals should not only be specialists in a given discipline, but they should be also able to build the most suitable and innovative solutions to be transferred to the products and services of the future. At the same time, considering particularly talented students, we believe that universities should do more than simply issuing degrees but they should also prepare these students to become future leaders and meet the specific demands that prospective employers ascribe to this particular graduates segment. In this regard, the Alta Scuola Politecnica provides an added value with respect to the traditional academic approach. ASP students are given the opportunity to continuously benefit and profit from one another, from the courses offered by both universities, and from projects at the cutting edge of technology proposed by companies. Through this unique learning experience, they develop the managerial skills and the overall training that employers are increasingly seeking from top graduates in technical disciplines. Students have the opportunity to work in teams, to manage complex projects which require multidisciplinary contributions (as illustrated in this book), and attend residential courses, as well as enjoying a stimulating learning experience. The significant presence of industrial sponsors in the eleven ASP cycles gives proof of the fact that the mix of specialized skills, coming from the Master programs, and interdisciplinary skills, coming from ASP are really appreciated by those who operate in this sector.
This important achievement confirms that the path we chose to follow in 2004 proved to be appropriate and still promising, and encourages us to pursue this goal with the same enthusiasm shown by our ASP students.

Prof. Giovanni Azzone, Rector, Politecnico di Milano
Prof. Marco Gilli, Rector, Politecnico di Torino

ALTA SCUOLA
POLITECNICA
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Alta Scuola Politecnica (ASP) is a school for exceptionally talented students who wish to develop their capabilities for leading and promoting innovation in a multi-disciplinary environment.
Founded in 2004 by Politecnico di Milano and Politecnico di Torino, ASP is attended by students who at the same time pursue a Master of Science Program (Laurea Magistrale) in Engineering, Architecture and Design offered by the two Universities. Therefore, ASP is characterised by a multidisciplinary and multicultural community of students, and by an equally diverse Faculty.

The ASP cultural program complements the disciplinary knowledge achieved in the Master of Science course with multidisciplinary knowledge that aims to provide methods and conceptual tools for designing solutions to complex problems and to enhance cognitive capacities, aptitude to learning, and talent for interpersonal relations.

This book presents the results of the multidisciplinary projects of the ninth ASP cycle. These projects are developed by teams of students coming from very different disciplinary backgrounds, in cooperation with professors and with external institutions such as companies and governmental bodies. The book provides a snapshot that illustrates the variety and creativity of ASP contributors, as well as an inside view of the work and life of this unique community.

The illustration of project results is preceded by a short presentation describing the ASP program at its eleventh birthday, complemented by testimonials from ASP Sponsors and Alumni.

ASP Sponsor

ASP is partially financially supported by external institutions which share our vision of educating talented students and promoting interdisciplinary innovation.
Following a three-year initial financial support from the Italian Ministry of University Education and Research, the main supporters of ASP are currently Compagnia di San Paolo, the Torino Chamber of Commerce and McKinsey & Company.
Other institutions, both private and public, have joined in by providing financial support as well as a relation aimed at developing projects and opportunities for the career development of our students.
The logo of each of our sponsors is presented below and their valuable support is hereby gratefully acknowledged.

Compagnia di San Paolo

McKinsey&Company

CAMERA DI COMMERCIO
INDUSTRIA ARTIGIANATO E AGRICOLTURA
DI TORINO

The Compagnia di San Paolo, founded in 1563 as a charitable brotherhood, is today one of the largest private-law foundations in Europe.
It pursues aims of public interest and social use, in order to foster the civil, cultural and economic development of the community in which it operates.
The Compagnia is active in the sectors of Research and higher education, Art, Cultural heritage and activities, Health and Welfare policies.
In 2014 the Compagnia awarded in its areas of activity 812 grants, amounting to 135.3 million euros, 33% of this amount was awarded in the Research and higher education sector.
The Compagnia pays great attention to advanced research and the development of scientific and technological centres of excellence, seen both as catalysts and multipliers of research and higher education initiatives. It supports the strengthening of Torino's university system, especially through the promotion of excellence at the Torino University and Politecnico.
The commitment of the Compagnia in the field of Education is focused on university and postgraduate education, starting from the growth of human capital, internationalization and the provision of infrastructures, with special attention to the conditions that assure equal access for students.
The Compagnia's relations with the universities in Piedmont (Università di Torino, Politecnico di Torino, Università del Piemonte orientale "Amedeo Avogadro") are regulated by strategic agreements covering infrastructures, research and post-graduate education.
In this context, the ASP's focus on excellence and innovation – besides characterizing it as a valuable initiative per se – allows this programme to enhance the global attractiveness of the Universities involved and promote, within the leaders of the future, a specific attention to the interdisciplinary and international dimension of nowadays society. The programme, that is supported by the Compagnia since 2007, also represents an interesting and successful example of cooperation between educational institutions that are based in the north-western region of Italy, such as the Torino and Milano Politecnici.

www.compagniadisanpaolo.it

Founded in 1926, McKinsey & Company is a global leader in management consulting, that helps leading corporations to solve their most complex problems in strategy, organization, marketing and operations. McKinsey also helps a diverse range of government institutions and nonprofit organizations with their management challenges.
McKinsey is proud to be sponsor of Alta Scuola Politecnica (ASP), a prestigious source of excellence within the Italian academic landscape.
We firmly believe that students at Alta Scuola Politecnica have the opportunity to develop a unique mix of skills and experiences that makes them mature and open-minded; furthermore, this distinctive combination strengthens their talent and directs them towards a focused management approach grounded on a "project-based" methodology that entails the development of highly valuable finished products and a real bent for meeting deadlines and experiencing team work.
These attitudes, together with their analytical and problem solving capabilities, fit particularly well with McKinsey's culture and values. These are, moreover, the qualities that McKinsey looks for in its consultants and prospect candidates.
Thanks to these features, all ASP Alumni who had joined McKinsey have proved very successful and have embarked on a career path of excellence and exponential growth.

http://mckinsey.com

CAMERA DI COMMERCIO
INDUSTRIA ARTIGIANATO E AGRICOLTURA
DI TORINO

Partnership with public and private institutions, network between territories, supporting to innovation and research are main objectives for the Torino Chamber of Commerce which promotes the economic development and the local businesses growth.
The Chamber offers a wide range of services to more than 231,000 companies working in the province and listed in the public Register of Enterprises: training, technological innovation, collection and distribution of information, fostering of business relations at home and abroad, creation of services and financing of projects designed to assist new businesses, promotion and organization of events, access to financing, information and consultancy for companies involved in foreign trade.
A particular attention is dedicated to the different levels of education, from professional courses to post-university Masters, with a special focus on high education systems and international training, which represent a significant tool for the attractiveness and worldwide relations, together with the solidity of the industrial fabric, the pro-business mood of the public administration, the quality of life in a creative, cultural and artistic context.
This is the reason why the Torino Chamber of Commerce, years ago, decided to cooperate with the ASP, the advanced international Faculty, founded by Politecnico di Torino and Politecnico di Milano, to enhance links between the two cities.
Italian Chambers of Commerce work to build local area networks between research centers and enterprises, individual enterprises, institutions, territories and cities, as well as technological networks.
Torino, Milan and Genoa Chambers of Commerce support the development of North-western macroeconomic region by means of projects.
Figures are significant: north-western Italy (Piemonte, Lombardia, Val d'Aosta and Liguria) is one of the European biggest areas, with a population that nearly amounts to 16 million people and 1.583,000 enterprises. It is an integrated territory that can proudly compete with the other European polycentric regions.
The North-western region needs economical and infrastructural actions but also stronger cultural relations, focusing in particular on art, education and organization of international events, as Milano Expo 2015.
In addition Torino Chamber of commerce will host the 9° World Chambers Congress in June 2015. The Congress is the only global event gathering Chambers' chief executives and businessmen worldwide to exchange best practice, to widen network and develop projects to support SMEs. A new challenge for the Torino Chamber of commerce and for the city itself.

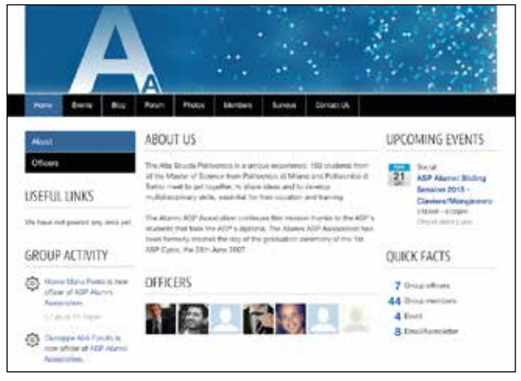
www.to.camcom.it

Summary

ASP Alumni

Association – Overview

The ASP Alumni Association was founded on June 28th, 2007, the day of the 1st-cycle ASP students' graduation ceremony, with the aim of promoting opportunities for personal and professional growth and becoming a frame of reference for all future Alumni.
ASP Alumni operates with the purpose of growing the professional value of the Alumni and their network, acting in accordance with the common values of competence, innovation, and attention to sustainability and social responsibility.
The Association is a global network of highly qualified professionals who wish to share experiences and growth opportunities. Indeed, the association has grown rapidly during its first 8 years, and now boasts a community recognized both in the academic and business worlds, with a network of over 1000 members located across 20 countries and operating in the most widely recognized international companies and research organizations.
The Association, led by the passion of many young professionals alumni, offers a wide-ranging agenda of events. All of them - conferences, workshops, parties or outdoor events – contribute to strengthen the unique community spirit of ASP and foster the professional career of the associates.
A brand new official website has been released at the beginning of February 2015 and is going to be the main internal and external communication channel and organization platform of the Association, jointly with the groups and pages on the main social networks (LinkedIn discussion group and Facebook group, which at present hosts more than 800 members). ASP Alumni members, but also ASPers that have not completed their ASP path yet and followers of the Association can keep themselves updated about all the Association activities and events through these social media. Moreover, interactions and sharing opportunities within the Alumni community are fostered by these communication media, as they their users posting comments, pictures, articles, opinions and professional opportunities.
A brief review of the main recent activities organized by the Association is presented in the following paragraphs.



ASP ALumni Website2015

DISRUPTING ENERGY | Conference on energy business and innovation

On February 7th, 2015 the latest ASP Alumni conference took place at Politecnico di Milano. ASP Alumni hosted a panel discussion about the current situation of the energy market and the paradigm shift that renewables, energy efficiency and innovative technologies or new sources may cause in the next years. The guests – Loris Tealdi (Society of Petroleum Engineers, Italy), Francesco Profumo (Iren Group, Italy), Carlo Zorzoli (ENEL Green Power Spa, Italy), Luca Dal Fabbro (Domotecnica Spa, Italy), Alessandro Ortis (Economic and Social Committee of the Assembly of the Mediterranean) - analyzed the energy business from a wide-range point of view, from the technological trends and innovation in the Oil&Gas industry, as well as in the production from renewable and alternative energy sources, the advances in distribution and energy efficiency and the impact that different policies of Institutions and Companies have on the energy sector.

Disrupting Energy 2014

INNOVAZIONE E KM0 | Conference on km0-based business models

During the year that awaits for EXPO 2015, ASP Alumni devoted the 7th edition of its traditional Fall Event to the topic of innovative km0-based development models. Four outstanding speakers declined the concept of km0 and proximity into development models for different sectors: Silvio Barbero (Slow food, Italy) and Franco Fassio (Università degli Studi di Scienze Gastronomiche, Italy) for the food and agriculture sector, Giulia La Face (Architect and enterpreneur, Italy) for the building and urban restoration sector, Enrico Testi (Yunus Centre, Italy) for microcredit and Social Business Cities. An extraordinary buffet, organized in collaboration with local producers, gave all the attendants the chance to taste km0 products

Innovazione KM0 2014

and wine from Piemonte and directly meet some “Maestri del Gusto” awarded by the Chamber of Commerce of Turin. The buffet was coupled with an exhibition of twelve innovative projects related to the conference topics.

Sliding Session 2014 | winter leisure event

Born in 2012 as a collaboration between students and Alumni, the third edition of ASP Alumni Sliding Session took place in March 2014, with a growing success among ASP Alumni members and ASP students. The event took place in Bardonecchia, one of the most renowned among alpine resorts, hosting over 60 Alumni and students for a weekend and engaging them with a number of activities including alpine skiing and trekking. All participants had the chance to enjoy a great dinner in a high altitude mountain hut, which they could reach by snow cat.

Sliding Session 2014

Carton race 2014 | summer leisure event

As 2014 Summer Event, APS Alumni joined the famous Carton Rapid Race in Cenasa Torinese. The event, usually followed by more than 15000 people, engaged the participants in a crazy rafting race, for which all registered teams had to build their own boat only using some self-retrieved paperboard. All participants enjoyed a sunny weekend in the camping settled by ASP Alumni on the Dora River.

Carton Race

Alumni ASP Mentoring | building the cooperation bridge

60 Mentors, 60 Mentees, the Education Team of our Alumni Association and the desire to create a project of excellence! These were the ingredients of the Mentoring Project has been launched by Alumni ASP in December 2012 and that is up and running for its third edition. Moreover, the Education Team is currently working at the fourth one. The aim is still to build the cooperation bridge between ASP Alumni and Students to help them enter the job market, because talented students deserve promising opportunities.

The Project has started with two simple questions: “Have you completed your time at university without any idea of what comes next? Is it worth getting support from the network of ASP Alumni in the steps towards the first job?” After experiencing these needs as students some years ago, the ASP Alumni has decided to take care of current ASP Students.

The key players are the Mentors, ASP Alumni with several years of working experience in all areas, such as research, marketing, finance, consulting, design, etc. together with the Mentees, selected ASP Students. Mentors and Mentees are paired according to their background and the professional preferences stated by each Mentee.

The enrollment of the Project starts every year in the first ASP Summer School. After that Mentees are entitled to a minimum of five meetings with their Mentor, both face-to-face or by videoconference to address topics such as the choice of the sector or geographical area, how to write a CV and the cover letter, how to get ready for the job interview and much more. From the second meeting onwards the Mentee is able to meet additional Mentors who can offer experience in other job fields.

The Network of Mentors is truly global; widespread in five continents, they can give a live perspective about their own function, business segment and country. Along the way, the Education Team helps Mentors by means of a guideline, to be used as a reference in their encounters with the Mentees. Moreover the Team created a Linked-in group to put together all the Mentors so that they can help each other with some Mentee’s tough questions or special needs. All participants are enrolled in the project only after signing an Ethical Code. The Code seeks to ensure that Mentors will honor their commitment and provide the service free of charge, as a token of gratitude, with the idea that Mentors give back something they had received.

Coming Soon

Sliding Session 2015 | 21-22 March 2015 | Claviere
Carton Race 2015 | June 2015 | Cesana Torinese
Fall Event 2015 | October 2015

ASP Alumni in Internet

Website **aspalumni.campusgroups.com**
Mail **alumni@asp-poli.it**
Twitter **@AlumniASP**
LinkedIn **www.linkedin.com/groups/Alta-Scuola-Politecnica-4297244**
Facebook **www.facebook.com/groups/AlumniASP/**

PIA_A

Playing Architecture,
a prototype of a smart public building

Project

Playing Architecture

PIA_A

Playing Architecture,
a prototype of a smart public building

Principal academic tutor
Alessandro Bianchi
Politecnico di Milano - Architectural building design

Academic tutors
Gian Luca Brunetti
Politecnico di Milano - Sustainable materials and recycling, Photovoltaic Energy production
Cristina Coscia
Politecnico di Torino - Construction costs and building management
Carlo Andrea Castiglioni
Politecnico di Milano - Steel structural engineering, Mechanical and electronic automation
Andrea Pirollo
Politecnico di Milano - Sustainable materials and recycling
Massimiliano Zigoi
Politecnico di Milano - Architectural building design

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IVG Italy Srl
Siemens Spa

External tutors
Maria Vittoria Brigato
Politecnico di Torino
Ildebrande Bevere
Energy Environmental Solution
Marco Grassidonio
IVG Italy S.r.l.

Team members
Marina Canala
Civil Engineering, Politecnico di Milano
Gianluigi Ferrari
Energy Engineering, Politecnico di Milano
Rachel Island
Urban planning and policy design, Politecnico di Milano
Federico Minoli [Team controller and Communication coordinator]
Energy Engineering, Politecnico di Milano
Matteo Novarino
Architecture (Construction and City), Politecnico Di Torino
Claudia Tesei
Civil Engineering, Politecnico di Milano

Project description
Smart buildings are the basic cells of the smart cities, they are the architectures with high technological level that allows cities to evolve with a clever and connected infrastructural grid. This is the concept that moved the ASP team to prototype a small building, a clinic to give basic health care in a quartet, sustainable and energy independent. The idea that guided the insertion of these small buildings in developing countries' slums (the case study is New Delhi) is guarantee a low distance from all the points of the area. In fact having high accessibility in terms of time and space is crucial in a crowded area where people move by foot or by bike and physical obstacles for cars are everywhere. In this way a mother will be able to give birth in adequate conditions, children will be cared for injuries, elder people will receive assistance without moving so much.
The building produces the energy to satisfy its own requirements using rotating photovoltaic panels and thanks to the yearly insolation trend has a surplus for the great part of the year. This energy will be used to provide additional services to the population, as purification of water or small charge access points easily usable by the open porch. Energy is considered as a starting point to improve social conditions, is generated locally by buildings that become small power plants, fully sustainable by using solar energy and eliminating the pollution. In the future this could be a direction to reduce the environmental impact and the pollution of big regional power plants, through a grid of small production unit able to provide energy in capillary way with a low impact also for the esthetic point of view.
Another crucial aspect of the project is the construction process of the building, in fact is quite completely prefabricated in a central place of the studied area to make easier and fast the following assembly phase in the locations of the clinics, inspired by an IKEA logic of macro-object. The packaging project is thought to be adaptable to the transportation constraints of the case study. In New Delhi the elements are produced and packaged in boxes suitable for small jeeps, the biggest way to access the tight and chaotic streets of the slums. The building is made also of local materials and involves local producers in the developing process of the area.
In conclusion the project is thought to answer the innovation challenges to

develop the smart cities, focusing on the extension of this concept to not already developed areas. Smart buildings as our prototype will have a key role in the future evolution of a world ready to face great environmental and energetic issues.

Tasks and skills

Architecture:
Matteo Novarino, the group architect, managed the general organization of the building, merging together the work of the other specialists in the group, harmonizing all the elements in the overall prototype. He worked in tight collaboration with the structural and energetic engineers in order to evaluate all the different alternatives, giving also feedbacks on other members' decisions, evaluating their consequences on the overall system and their integration in the general prototype.
Structure:
As structural engineers, Marina Canala and Claudia Tesei concentrated on the design of the clinic structure, always interacting with the other project aspects(energy and architecture) in order to optimize the structural element sizing. Their most courageous choice has been the adoption of bamboo as structural material, intended to provide a more sustainable and cost effective solution.
Energy Supply:
Federico Minoli and Gianluigi Ferrari are energy engineers and took care of the requirements of the building for what concerns electricity and thermal supply. The implementation of an innovative photovoltaic tracking is their answer, but the integration of the energy system with sustainable architecture and structure is another key element they used to create a smart building.
New Delhi Case Study:
As an Urban Planner and Sociologist, Rachel Izland focused on the case study, applying the project to a real world context and optimizing the social aspects.

Abstract

The challenging goal of the project is designing infrastructures to provide fundamental services in developing countries, in complex situations such as slums or bidonvilles, inserting buildings able to produce energy where it is needed without transportation. The practical idea is to implement several small, prefabricated clinics to have a fast, cheap and sustainable solution but also be able to provide health care for a long period and offer a starting point for local development.
From the structural and architectural point of view, we try to respect local construction tradition, energy issues and structural requirements. To do so we compare different solutions for each building element (envelope, roof, openings, structure etc.) in order to give different possible configurations and features suitable for different situations all over the world. By doing so we give our stakeholders the possibility to choose among different features in order to make the building suitable for different situations all over the world. After the comparison, we have focused our case study in New Delhi, deepening the solutions that are more suitable for our location, according to their availability and respect for the context.
The other main requirement is sustainability, which means satisfying all the energy needs with green energy (considering that slums do not have electricity). To reduce the energy demand we use passive cooling strategies together with high insulation and we implemented an innovative photovoltaic system. It consist in an automatic azimuth tracking of the panels, obtained using turntables originally thought for cars exhibition, because innovation is not only inventing something new, but especially considering and combining technologies from a different and constructive point of view. The continuous interconnections between our disciplines during the design allowed to create a coherent concept, with a global implementation model but also a local approach in the development of the particular solutions for the case study.

Understanding the problem

Our project started with the conception of a sustainable public building, such as a school or a medical clinic, that could provide a stimulus to the surrounding community. The building was intended to provide essential resources to the population, such as technological resources, electricity, special services and also job opportunities related to its realization. In this way, the building could act as a catalyst for the further development of the neighborhood.

Figure 1: Clinics position and walking distance

The specific case study location in New Delhi, India, was selected for a variety of reasons, primarily involving environmental and economic conditions. For instance, India is sufficiently developed in order to provide access to local materials and industries that can be used to develop the essential elements of the project, such as steel, bamboo, and cladding materials. Special consideration was also given to the proposed function of the building. A medical clinic was chosen as opposed to a school because of the high-tech nature of our building makes it is more suitable and cost effective as a clinic. Moreover, the basic health care is a tricky issue and one of the first requirements to achieve a real development of India.

Figure 2: a street in Delhi

The specific slum chosen for the case study is an area in New Delhi of 6 km2 ,located near the center of the city, bordered by the railway tracks. The slums are a primary choice for the location of the clinics because of the high density of the living conditions and the lack of hygiene services, meaning that this population has a need for the kind of basic healthcare that our clinics are designed to provide.
The project stakeholders include local governments, humanitarian aid organizations, environmental organizations, architecture and technology companies.

Exploring the opportunities

A fundamental challenge in the project was the desire to design a geo-

graphically versatile building while at the same time minimizing the transportation of materials. These two desires were in some ways contradictory, since the need for geographical versatility suggested a prefabricated design that would be manufactured off site, while the desire to minimize the transportation of materials suggested the use of a highly customized design using local materials. Although our research into existing solutions found projects that either focused entirely on local materials and construction techniques, or projects that employed a standardized, prefabricated design, we did not find an existing solution that resolved both issues. As regards the structural aspects of the clinic, this contradiction has been faced evaluating the possibility of adopting usual materials, as reinforced concrete or steel, and local ones with a high availability in India as bamboo or a combination of them.
Another important aspect of the project was the development of an energy production system able to combine high output and economical feasibility. The goal of sustainability and the possible absence of grid connection made us opt for solar panels. The process involved optimizing the tracking possibilities in order to maximize the energy output in the most efficient way. In this direction several configurations were investigated using the simulator PVSyst, to understand the gain in energy production and compare it to the additional costs.

Generating a solution

We have attempted to develop a combined solution using a partially standardized and prefabricated design, while at the same time allowing customizable elements for every case study.
In this sense, as regards the disposition of the structural elements, flexibility has been assured by proposing the possibility of choice between different materials. Although the principal structure, composed of 5 portals, is realized entirely with steel profiles, for the secondary structure the opportunity of adopting a traditional material for Delhi like bamboo, arranged in truss beams, is offered as alternative of steel simple beam-sections. Although both the materials are locally available in India, the mixed bamboo-steel solution has been found preferable under several points of view: bamboo adoption not only allows both to cut costs and to satisfy better the environmental sustainability requirement; combined with an high tech way of assembling culms, it is also expected to encourage improvements in the local building culture towards safer construction techniques. In addition, a complete packaging of all the members, divided according to their specific function in the structure, is provided, aiming at both assuring the transportation feasibility in the narrow slum streets (maximum length for a single component of 4m) and making simpler the assembly itself for not specialized manpower.
The possibility to make small changes to the general prototype makes our prototype not only a smart building, but a customizable set, using “ikea” slang, which can be used in very different situations with small changes, cutting costs thanks to pre-cast constructive systems and use of local materials.

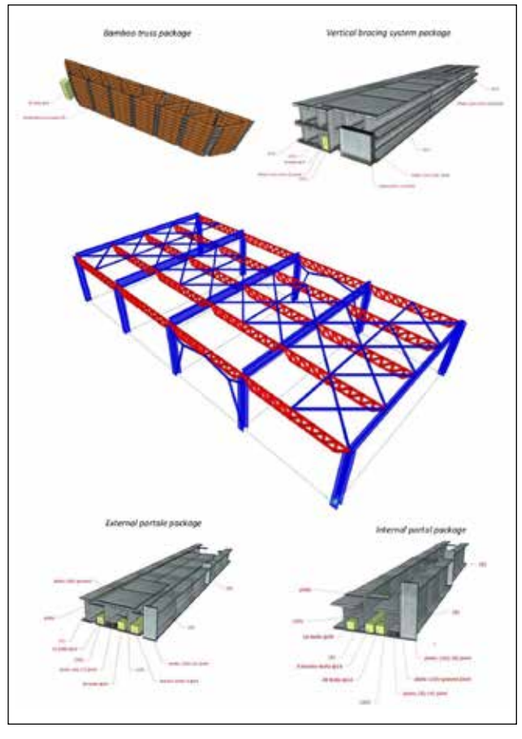


Figure 3: overall structure and details

Figure 4: cross-section of the clinic

We then focused on the New Delhi case study. We did so after a general evaluation which took into account different aspects, from economical and qualitative to energetic and constructive ones. We decided to use coconut fiber for insulation, a locally produced material which is therefore very cheap and easy to find. We then adopted corrugated metal sheets to clad our building, a cheap and easy to substitute material which allows us to face different problems related to durability in difficult areas such as slums.
In order to improve the energetic behavior of our prototype we use natural ventilation strategies, first of all putting windows on the roof, decision which allows us to exploit a better natural air circulation inside the building and, at the same time, overcoming the problem of light in a very crowded area. Of course these strategies are not sufficient to satisfy the energy demand of our building, that’s why we carefully evaluated a series of active strategies to provide enough energy without the need of grid-connection.
Thus the original idea of a public building acting as a social stimulus developed further into the concept of a diffused power plant. The diffused power plant concept involves high-energy producing buildings, keeping energy production inside the city and reducing the need for energy transport, creating in a practical way the concept of smart city.
In this perspective, the energy supply concept is producing an high amount of energy in a small area, to guarantee high reliability and standards of health assistance. The simulations revealed that two interesting configurations to deepen are the seasonal manual tracking, which is simple and involve manpower only twice a year, and the automatic azimuth tracking that has performance (up to +27.8% of yearly energy compared with the fixed solutions) very close to the expensive full tracking. To make the automatic azimuth tracking simple and cheap, we thought to use rotating platform originally intended for cars exhibition. Their features can match our requirements and we hope that more in-depth analysis could be a natural follow-up of the project for stakeholders interested in this cross-industry combination of technologies.

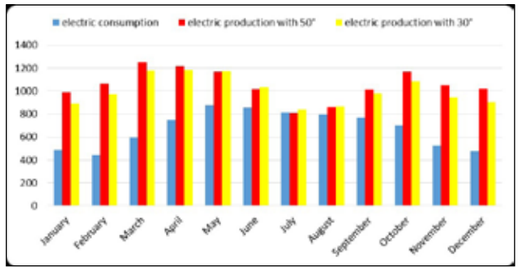


Figure 5: Energy consumption and production with different tilt angles

The idea has been implemented for our case study, considering the electric medical devices and the lighting to understand the consumption of the clinic. Moreover, there’s an heat pump to convert electric energy produced by sun in heating and cooling. This phase has been developed together with the choice of envelope characteristics to find a composition of materials and layer with good thermal properties. The final solution provides considerable energy surplus for the great part of the year; purification of water and free wi-fi are proposed as possible additional services for population.

SCIeNCE

Food and Water Security
in Changing Climate

Project

2

SCIeNCE

Food and Water Security in Changing Climate

Principal academic tutor

Renzo Rosso
Politecnico di Milano - Department of Civil and Environmental Engineering
Maria Cristina Rulli
Politecnico di Milano - Department of Civil and Environmental Engineering

Academic tutor

Pierluigi Claps
Politecnico di Torino - Department of Environment, Land and Infrastructures
Luca Ridolfi
Politecnico di Torino - Department of Environment, Land and Infrastructures
Francesco Laio
Politecnico di Torino - Department of Environment, Land and Infrastructures

External institutions

Enel Foundation
Fondazione Politecnico di Milano
Consorzio Interuniversitario per l'Idrologia (CINID)

External tutor

Paolo D'Odorico
Department of Environmental Science - University of Virginia

Team A members

Elsido Cristina
Energy Engineering, Politecnico di Milano
Pallaro Agnese
Ecodesign, Politecnico di Torino
Pozzi Federico Paolo [Communication coordinator and Team controller]
Management Engineering, Politecnico di Milano
Trabucchi Alessandro
Civil Engineering, Politecnico di Milano

Team B members

Marco Chiesa [Team controller]
Environmental Engineering, Politecnico di Torino
Emanuele Moioli
Chemical Engineering, Politecnico di Milano

Federico Salvati
Chemical Engineering, Politecnico di Milano
Roza Teklehaimanot Siecha
Electronic Engineering, Politecnico di Torino

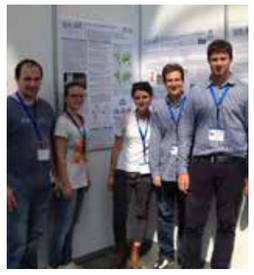
Project description

The increase in global food demand due to population growth, changes in diet and biofuel production is enhancing the human pressure on global land and freshwater resources.
The increase in oil prices, the 2007 changes in the US policy on bioethanol use and the 2009 Renewable Energy Directive adopted by European Union, which predicts that by 2020 the 10% renewable energy must come from biofuels, have increased the global demand for biofuel production thereby further enhancing the need for land and water.
There is some concern that in the next few decades the finite freshwater resources available on Earth might not be sufficient to meet the increasing human demand for food, fibers, and biofuels. Is mankind about to face a severe water crisis?
The last United Nations Conference on Sustainable Development 2012 (Rio+20) states that water is a fundamental resource and one of the main topics in current discussions regarding Sustainable Development and Climate Change. Water is enormously interlinked with other resources like food and energy necessary for the survival of humankind.
In this context the ASP project SCIeNCE studies Food and Water security issues in changing environment. Two teams were formed for addressing the food, energy, water components of the nexus. Team A and Team B were mainly involved in the analysis of the water-food and water energy nexus respectively.
Starting from the definition of the Water Footprint indicator, a new index for a more comprehensive evaluation of the water footprint of a product has been developed by Team A, called Integrated Water Footprint (IWF). The IWF is able to take in account the amount and type (i.e. rainfall, irrigation water) of water needed for the production of a good; the origin of the product (from a water scarce or water abundant country); and the distance travelled by the good (from the place of production to the place of consumption). The IWF was calculated at global scale for three products - maize, beef and rice - using data at the national scale and for two case studies of local productions.
Basing on the IWF a label, linked to a website by a QR-code, has been designed to graphically convey the information of the IWF of selected products to customers.
Team B developed an index, called Nexus Index (NI), able to analyse the efficiency in energy production from biofuel by taking into account both land and land-based resources needed for biofuel crops production and the state of resources and malnourishment in the place of origin. The NI was calculated at global scale for the 9 main crops used for biofuel giving a primer indication on the sustainability of biofuel production on a certain place. Moreover, new plants for energy production from agricultural wastes were analysed and the additional requirement of land and land-based resources calculated for understanding in term of NI the balance between the increase in energy efficiency and use of resources.

Wien, May 1 2014, Team A members during their visit to the city

Wien, May 1 2014, Team A members during their attendance to the EGU congress.

Belgirate, May 9, 2014, Team A and B members during the Spring school



Bari, September 9, 2014, Team A and B members presenting their projects at IDRA14

Project 2A

Virtual Water and Food

Tasks and skills

Cristina Elsido carried out preliminary researches on the state of the art and exploited her mathematics and energy skills for the definition of the innovative index we implemented.
Agnese Pallaro made deep researches on the informative tool and developed the new label and the website of the project.
Federico Paolo Pozzi, as team controller, managed the work organization and the relationships with tutors and external institutions.
Alessandro Trabucchi exploited his technical competences for the development of the computational tools used in the project.

Abstract

Water is the most precious although most threatened resource on earth: environmental, economic and social factors are posing serious risks to its availability. Many projects concerning the domestic saving of water have been developed, but the fact that the majority of human water footprint is linked to the consumption of agricultural products is not fully explored. The Water Footprint indicator addresses this issue and conveys a punctual information about the volume of freshwater (blue, green or grey) used to produce a good. However, it does not consider other contextual aspects linked to the concept of virtual water, such as the water conditions of the country of origin of the product, the distance traveled by the good and the effects the withdrawal of water in a certain area can have on local environment. Based on these considerations, a new index for a more comprehensive evaluation of the water footprint of a product has been developed and called Integrated Water Footprint (IWF). The variables considered are: the ratio between Blue Water Footprint and Total Water Footprint of a product; the origin of the product from a water scarce or water abundant country; and the distance travelled by the good. For each variable, an efficiency equation has been developed; the results have then been combined in the formula of the new index. The calculations were made for three products - maize, beef and rice - using data at the national scale.
Then the index was applied to two case studies of local productions. The final user of the project is the end consumer of products: a label for goods, linked to a website by a QR-code, has been designed to graphically convey the information of the IWF to customers. The application of our index and label to products enables customers to make sustainable purchases.

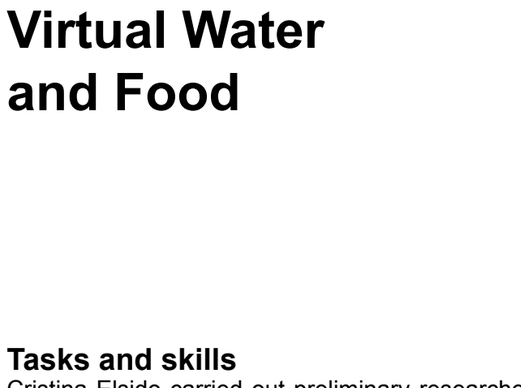


Figure 1: Visual representation of the problems of the Water Footprint indicator and the suggested variables to include in the project.

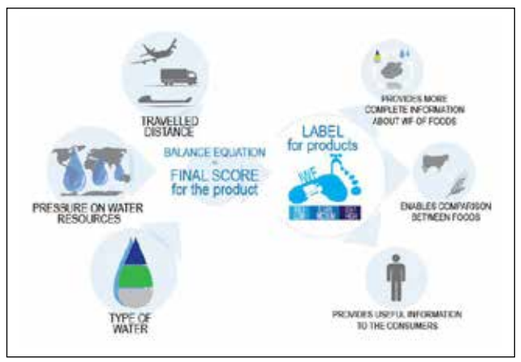


Figure 2: Visual representation of the effects of the application of the label.

Figure 3: Efficiency maize, results at the global scale.

Figure 4: Efficiency meat, results at the global scale.

Figure 5: Efficiency rice, results at the global scale.

Understanding the problem

The main limits of the Water Footprint indicator are:

- it provides merely a quantitative information about the water used to produce a commodity without considering other contextual aspects concerning the appropriation of water in a specific area, such as the water scarcity or water abundance condition of a place;
- it suggests, as a solution to reduce the water footprint of a nation, the import of food from other places where its production requires less water, without considering the environmental impact of the transportation;
- the information about the virtual water content of a product is not properly conveyed to the end customer who has no knowledge about the topic and is not able to operate a wise choice of goods.

The main users of our project are consumers that need to have the correct information about the environmental impacts of products, on the basis of which they can make responsible choices. They also need to easily un-

Figure 6: Final design of the eco-label.

derstand the concept of water footprint. Consumers are also interested in economic costs, in addition to environmental ones: another requirement is thus that the way this information is provided does not significantly increase the price of products.
Other important users are companies that could get advantage from assessing the water footprint of their products as a differentiating factor from competitors. Moreover their personal interests concern the assessment of water-related impact of their production in order to avoid physical, reputational and financial risks for the long-term prosperity of businesses.
Other stakeholders are: producers, NGOs and governments.
Starting from the problems of the water footprint indicator and the needs of users the aims of our project are:

- the development of a new index that could provide a more complete and comprehensive analysis of the impact the production of a certain good has on the environment, with special attention to water resources;
- the design of a label for products that could convey synthetic but meaningful information to consumers in order to rise their awareness about virtual water issues.

Figure 7: Application of the IWF label to beef.

Figure 8: Application of the IWF label to pasta.

Exploring the opportunities

Since international agreed standards do not exist, different methods for assessing the impact on water resources have been created: they mainly differ for the contextual aspects they consider. In order to perform a complete analysis of the topic, many parameters could be included, for example:

- land grabbing, which is the phenomenon of large-scale acquisition of large pieces of land in developing or in undeveloped countries, made by foreign transnational companies;
- land use and suitability, which is the fitness of a given type of land for a defined use;
- yield gap, namely the difference between the yield potential and the average farmers' production over a defined spatial and temporal scale of interest;
- use of fertilizers, related to the grey water footprint component;
- carbon footprint, that is the total amount of greenhouse gas emissions caused directly and indirectly by an individual, product or organization;
- water use efficiency, which is a quantitative measurement of the yield and productivity of the water used in agriculture;
- water scarcity, a situation that occurs when water demand exceeds water supply;
- transportation.

Some of these parameters are included in existing solutions. For example the Environmental Product Declaration (EPD®) is a tool that provides information about the environmental impacts of goods and services. The system takes into account many aspects concerning sustainability, including: the use of renewable and non-renewable resources; energy consumption; the amount and type of waste produced, the feedstock energy embodied in the packaging and the water consumption. The EPD provides also the Ecological, Carbon and Water Footprint values.

Generating a solution

Figure 9: Screenshot of the web page of the project.

Starting from the limits of the water footprint indicator, a new index, called Integrated Water Footprint (IWF), has been developed in order to give more complete information about the environmental impact of product. Some of the parameters previously mentioned have been excluded from the index due to the lack of data; other parameters, instead, were not considered because they are not strictly linked to water issues.
The IWF index includes information about:

- blue water footprint, because it is the component with the highest opportunity cost, in the sense that it has many alternative uses rather than the irrigation of plants. In this sense, the best situation is the one characterized by a small use of blue water;
- water availability. The new index should allow the distinction between conditions of water abundance and water scarcity, rewarding the production of goods in places plentiful of water;
- distance travelled by products. Based on a consumption perspective the IWF should also take into account the provenance of a product consumed by a particular country and the average distance travelled by the commodity between the exporters and the consumers, fostering local productions.

The novelties introduced by our project are: the creation of an easy-to-use tool for a more comprehensive assessment of the impact the production of a good has on water resources that takes also into account the transportation to reward products that travel short distances and especially local products; and the design of a simple though evocative label for products connected to an online website where consumers can enlarge their knowledge about the topic of virtual water.
The main disadvantage of our project is that it considers only three parameters: many other elements could be included but it was not possible due to the lack of data.
The new index is a measure of efficiency expressed as a dimensionless number, ranging between 0 (worst situation) and 1 (best situation). To a low efficiency corresponds a high impact on water resources; to a high efficiency corresponds a low impact on water resources.
The aim of the project is to provide customers with proper information about the sustainability of products: therefore the Integrated Water Footprint index has been applied to two case studies. In order to convey this information to customers, an eco-label was designed: it is meant to be displayed on the product and it is linked, through a QR-code, to a website that provides additional information about the index.

References

- A.J. Hoekstra, A.K. Chapagain, M.M. Aldaya and M.M. Mekonnen, *The water footprint assessment manual: Setting the global standard*, Earthscan, London, UK, 2011.
- A.J. Hoekstra and A.K. Chapagain, *Globalization of Water. Sharing the Planet's Freshwater Resources*, Wiley-Blackwell, Oxford (UK), 2008.
- S. Pfister and B.G. Ridoutt, *A revised approach to water footprinting to make transparent the impacts of consumption and production on global freshwater scarcity*, Global Environmental Change, Volume 20, Issue 1, pages 113-120, 2009.

Project 2B

Virtual Water, Food and Energy

Tasks and skills

Marco Chiesa: analysed existing sustainability assessment tools, worked on the concept of biofuels sustainability and on the definition of the Nexus Index, acted as the team controller.
Emanuele Moioli: used a specific tool to design process alternatives for energy production from agricultural residues and studied the incorporation of Nexus Index in the design phase.
Roza Teklehaimanot: cooperated in the definition of Nexus Index, developed a software for the stakeholders which enables them to assess their feedstock sustainability.
Federico Salvati: applied the Nexus Index to choose the best process alternatives and performed the economic and LCA assessment of the results.

Abstract

Over the last few years, evidences for global climate change have forced governments to establish policies directed towards the decrease of CO_2 emissions. One possible strategy to reduce such emissions is the use of **biofuels** (bioethanol and biodiesel).

Resource used	Global average water footprint [m³/GJ]
Natural Gas	0.11
Coal	0.16
Crude oil	1.06
Uranium	0.09
Wind energy	0
Solar thermal energy	0.27
Hydropower	22
Biomass energy	70

Figure 1: Average water footprint of various energy resource

The production of biofuels leads to a number of problems: for starter, is the fact that biofuels derive mainly from edible crops. The use of **food** for energy is a point of big debate, in that - in a world where there is elevated starving population - it seems unfair to dedicate food to increase energy production. A second main issue is the competition for **water**. Many of the crops used for biofuel production require high quantities of water: a higher production of such crops means an increase in water consumption, which is a crucial problem in countries affected by water scarcity. Moreover, **land** surfaces dedicated to biofuel production may therefore not be exploited for other purposes.
This project started from the existing indicator used to comprehend water consumption in biofuel production (**water footprint**) so as to identify an innovative way to delineate the complex relationship between water, food and energy. The result is the development of a quantitative index - named **Nexus Index** - which allows to quantify the relationship between the resources used and to understand the efficiency in energy production. Such

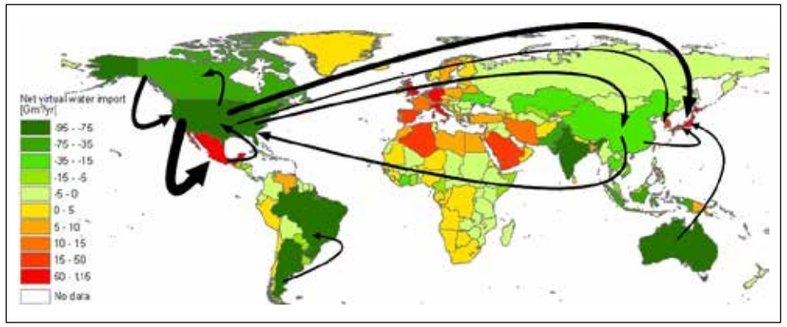


Figure 2: International virtual water flows due to trade in agricultural and industrial products. Source: Mekonnen and Hoekstra, 2001

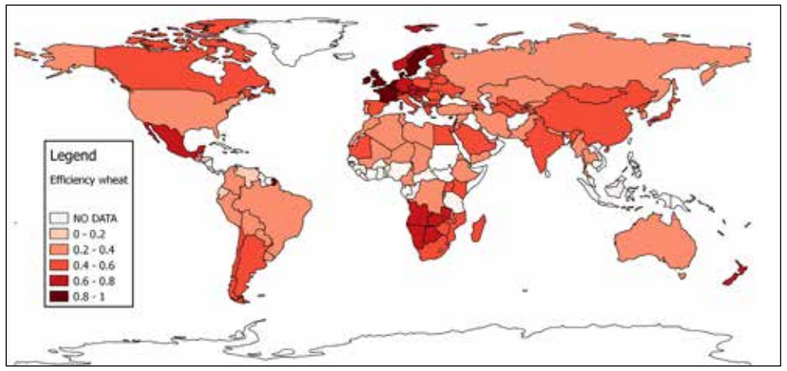


Figure 3: Hydroenergetic efficiency index for wheat

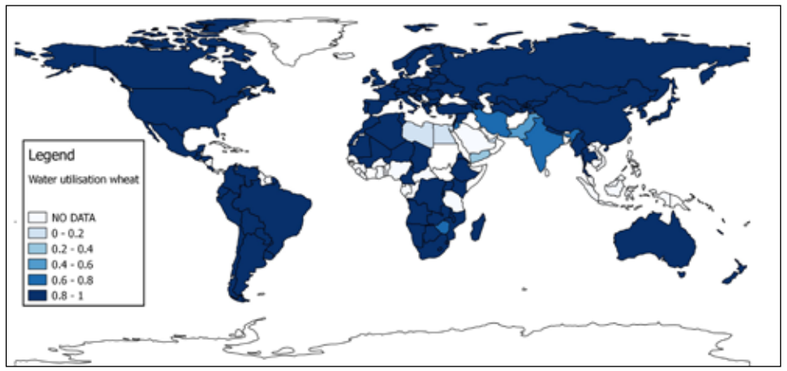


Figure 4: Water utilization index for wheat

new perspective opens the reflection on a possible voluntary **certification scheme** able to guarantee the sustainability of a specific biofuel production.
In order to evaluate the potential of the nexus index, we designed a number of **new plants for energy production**. Thanks to a new conceptual model, it was possible to describe the process of energy production from agricultural wastes, calculating the additional requirement of resources and the increase in energy production. The use of nexus index permitted to frame the **most suitable technical solution** for the specific conditions of country and feedstock used. A technical and economic feasibility study of the chosen solution has been performed in order to validate it.

Understanding the problem

Biofuels use for energy production is rapidly increasing, creating high competition and stress on the resources needed to produce them and posing questions on their real **sustainability**. This last concept is yet very

Figure 5: Malnutrition index

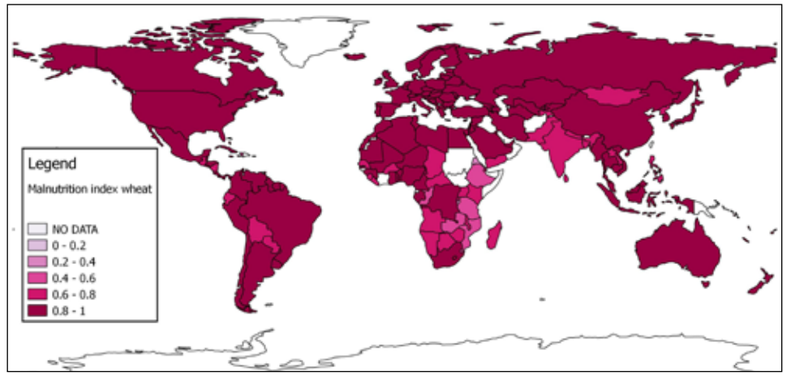


Figure 6: Land use index for wheat

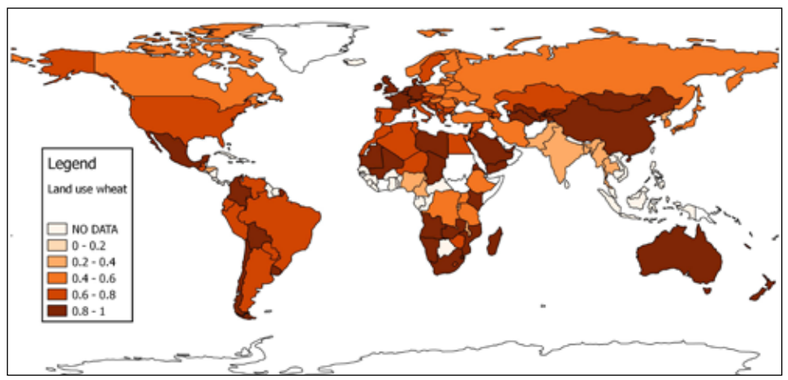
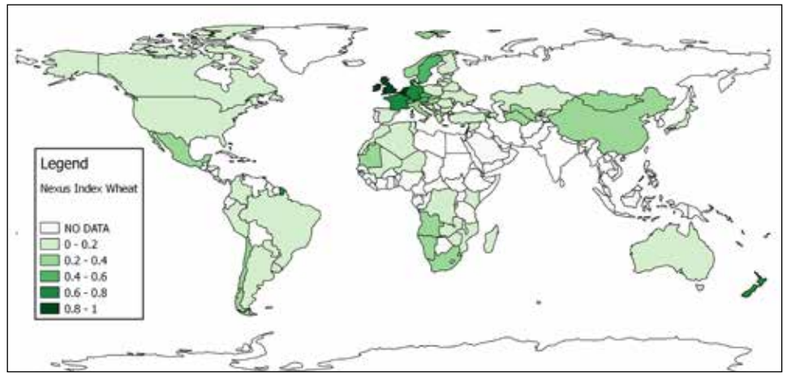


Figure 7: Nexus Index for wheat



broad and could potentially include a variety of aspects to take into consideration. A thorough evaluation should include all critical issues with a sufficient level of depth: an optimal tradeoff must be reached.

Our team focused on the understanding and description of the relationship among the most fundamental resources necessary for biofuels production: water, land and edible goods. Such problematic is generally known as the **"water-food-energy-land nexus"**, as these elements interact and are intertwined with one another. The main request coming from the external institution was to devise a quantitative instrument able to describe these problems, in order to have a new and innovative tool for the sustainability assessment of the existing feedstock used to produce biofuels. The tool can also be used when designing possible plants, considering not only technical and economic issues, but also the plant's **sustainability under the nexus perspective**.

The topics explored in our project comprise several actors, all characterized by many conflicting interests. In order to fulfil the needs of the different actors, effort was put into maintaining our method as general as possible. The key need is the production of a concise and simple tool capable of understanding if one or more aspects considered in the nexus are not optimally managed, and therefore putting the overall process' sustainability into question.

Exploring the opportunities

We first identified **already-existing solutions** for assessing biofuels sustainability, and divided them into two categories:

- environmental indicators that look at quantifying specific impacts (GHG emissions, water consumption, land needed, etc.);
- voluntary schemes based on different criteria, certifying the sustainability of biofuel production.

The most important indicator found in literature is the "**Water Footprint**" of bioenergy [1], which represents the amount of water that is necessary in order to produce one GJ of energy deriving from a specific biofuel obtained from a particular crop. Such indicator takes into account water consumption in all the production chain, from the crop's growth to biofuel's production and conversion. It must be acknowledged, however, that the tool is only a partial, as it does not take into account the quality of water used, the depletion of other environmental resources and social issues. Single indicators may give precious hints, but they are not able to define and express how sustainable biofuel production is in terms of water-food-energy-land nexus. For successful and integrated policy options, as well as a complete biofuels sustainability assessment, the process would thus have to use and integrate other indicators.

Voluntary schemes represent a good example of how to guarantee a transparent and reliable system, which ensures that certain environmental and social standards are respected. Existent schemes are nevertheless not able to synthetize the evaluation in an integrated score and are actually more focused on aspects diverging from the problems the present project aims to assess. Moreover, they can be used only for assessment of existing solutions, but not for design purposes. A tool able to assess in depth the water-food-energy-land nexus in an integrated and methodological approach is to date missing.

Figure 8: NexEn – Voluntary certification scheme developed

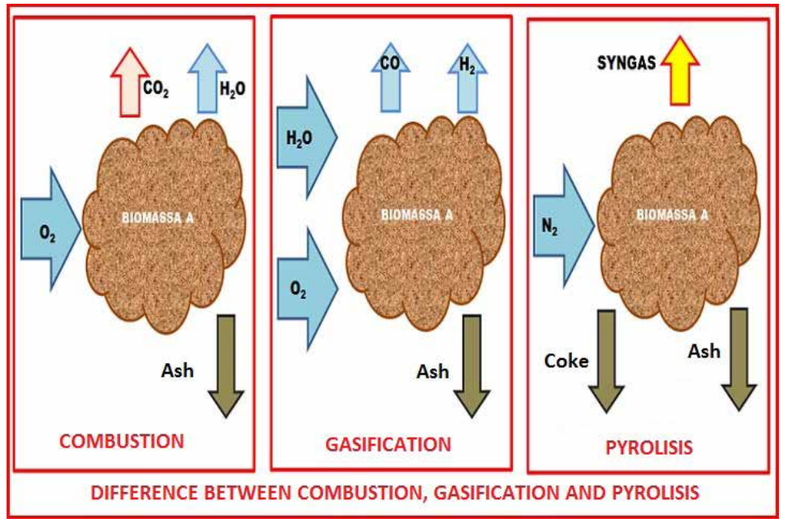


Figure 9: The three main typologies of plant (input-output scheme)

The need to fulfill the stakeholders' requests and the objectives of our project gave birth to the **challenges** we had to face:

- definition of sustainability with a nexus perspective
- data mining (type, quantity and reliability of available data on biofuels production)
- identifying an appropriate mathematical method to merge data in order to get a simple, robust and usable solution, capable to describe biofuels' sustainability

The main source of data was FAOSTAT [2], the Statistics Division of FAO, which contains a large amount of data about agriculture, food production and the related natural resources consumption.

Generating a solution

We first identified which were the **most important parameters** in order to assess biofuels production sustainability. The objective was the development of a single index called **Nexus Index (NI)**, similar to an efficiency, as it assumes values between 0 and 1 and it is the multiplication of single indexes. Such index was used to assess the current situation of biofuels production for the main **9 crops** used in the specific field and **181 countries**. The results were illustrated in maps, helping to understand the geographical differences.

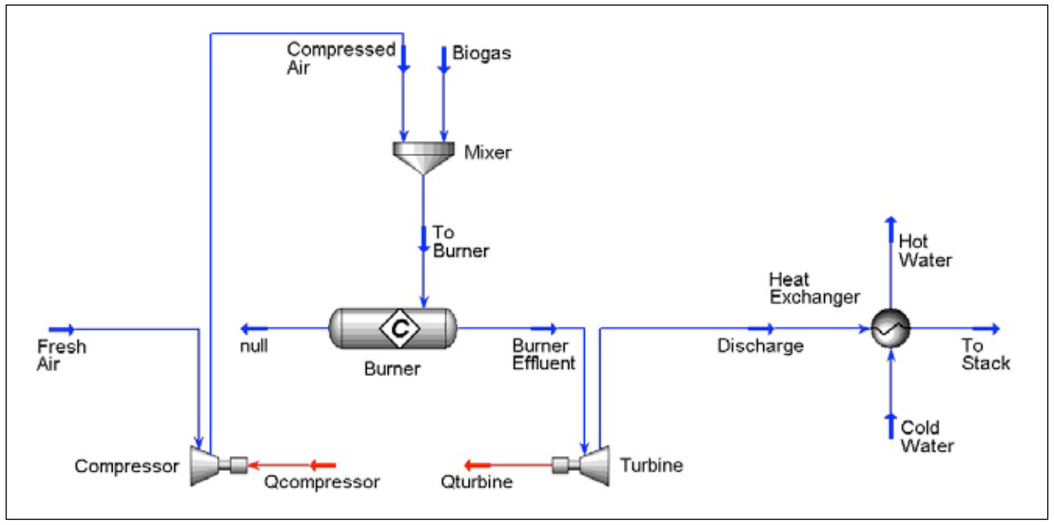


Figure 10: Power generation section of a combined cycle plant

Different aspects of the **water-food-energy-land nexus** were evaluated:

- water efficiency in energy production. To analyse this first element, the water footprint concept was redefined as hydroenergetic efficiency, which is its reverse. Such index enables to understand the quantity of energy obtainable using 1 m^3 of water for a specific crop allocated in a specific country. The values were normalised with the highest value in order to have an index from 0 to 1;
- quality of water. To assess this issue the concept of blue Water Footprint was used: we analysed the percentage of crop water consumption coming from freshwater withdrawal (i.e. surface or groundwater for irrigation). Blue water has a higher environmental value when compared to green water (i.e. rainfall). We built an index having highest score in case of rain fed crop production;
- conflict between biofuel production and food production: the third issue was assessed using available data on prevalence of undernourishment. The highest value of such index is given to countries which do not have problems of undernourishment and thus can dedicate some food for biofuels production;
- conflict for land: both agricultural products and biofuels need land to be grown. An index similar to hydroenergetic efficiency was developed. In this case, the efficiency is defined as the yield reached in relationship with the maximum yield reachable for a particular crop.

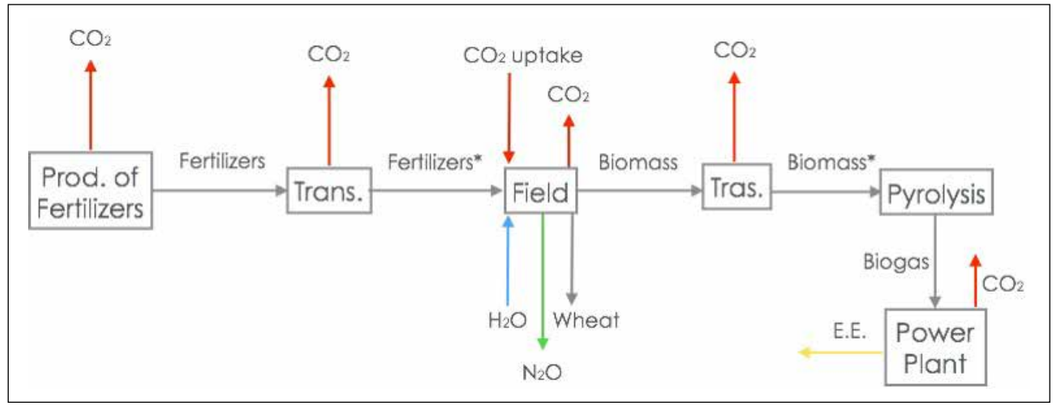


Figure 11: Process scheme used for LCA analysis

An application of the nexus index is a **certification scheme**, awarded only to companies able to produce biofuels fulfilling determined requirements. The appointment of the certification means that the company is producing biofuels respecting high environmental and social standards.

The final part of the project dealt with the use of the nexus index in **conceptual design** of biomass conversion plants. Using a new mechanistic model [3], it was possible to design various types of gasification plants with different scales and operating conditions, considering also water consumption during the conversion process. During this phase, the plants were screened using the nexus index, to understand whether their application can improve the overall efficiency when compared to the current situation. It was this way possible to understand the optimal plants, able to increase the efficiency according to the geographical position and specific crop used. The most optimal technology is dependent from the country, since the water availability is different: in some cases the technology providing the best energetic output could not be the optimal solution.

The final output of the project is an index capable – differing from the existing alternatives - to offer a **complete quantification of the nexus** and to assess the bioenergy production process in an **'ex ante'** manner, instead of the traditional 'ex post' methodology. In our opinion, an effective tool able to guide and allocate the production of biofuels in the most optimal locations is one of the key solutions for facing today's world sustainability challenges.

Bibliography

- [1] W. Gerbens-Leenes, A. Y. Hoekstra, T. H. van der Meer, PNAS 26 (2009), 10219-10223
- [2] FAOSTAT: www.faostat.fao.org
- [3] E. Ranzi, M. Corbetta. F. Manenti, S. Pierucci, *Kinetic modelling of the thermal degradation and combustion of biomass*, Chem. Eng. Sci., 110, 2014, 2-12.

Data4cities

Smart big data for smart cities
in the year 2015

Project

3

DATA FOR CITIES

DATA FOR CITIES

Data4cities

Smart big data for smart cities in the year 2015

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World, 2014, Team B, *Collage*

Project description

The Smart City is stuck in the middle between visionary concepts and implementation problems whose origin often lies in organizational and management problems. Since Information and Communication Technologies (ICT) are often a commodity, what hinders the development of the Smart City is a lack of business and governance models defining how ICT-based initiatives can create economic and social value, how they can be replicated at low cost across cities.
The Data4Cities project tackled these issues in one of the most information intensive fields of city life: infomobility. Two teams analyzed how mobility of cars, public transportation vehicles and tourists could be enhanced by the deployment of established ICT tools.
Both the two teams have developed a state-of-the-art analysis of how ICT is supporting infomobility and the tourist's experience in a city. Then the two teams developed different approaches. A team followed a market-pull perspective, dealing with the requests of Infoblu (i.e. the infomobility player of Autostrade per l'Italia) to propose a concept for a new ICT platform that can help city governments and technical bodies to monitor and manage traffic and mobility in a city. The team addressed this challenge by undertaking a series of case studies with the technical bodies managing traffics in some large cities and regions. This primary market analysis highlighted the need for an open and modular platform inspired on the concepts of re-usability across cities and low costs of implementation. Coherently with this idea, the team developed also a proposal for a governance model for this platform at the country level. The second team analyzed how social networks and communication technologies could enhance the experience and the mobility of tourists in Italian cities and in their world-class historical heritage. The distinguishing feature of the concept developed by the team is using social networking technologies to develop a community-based and bottom-up approach for the recommendation of hidden point-of-Interests (e.g., squares, monuments, palaces, gardens) in cities. The analogy is thus with Tripadvisor. The idea may represent a new and alternative paradigm to the ones of touristic guides. The team developed this concept through a two stage process: 1) a market analysis on how people use mobile technologies and recommendation systems to explore cities; 2) the exploration of a feasible business model, whose revenue sources can be based on location-based advertising. Their effort was thus translated in a quest for a feasible business model and the individuation of alliances with other players of the Smart City.

Project 3A

MuniciPanel

Govern the data

municipanel
GOVERN THE DATA

Figure 1: MuniciPanel logo

Tasks and skills

Michelle Jung Boehm: ProductServiceSystem Design – Team Controller - Concept development & Visualization
Mattia Cantono: Telecommunications Eng. - Platform Technology
Andrea Colagrossi: Space Eng. – Platform definition
Alice Mora: Management Eng. – Market Analysis
Ario Sadafi: Computer Eng. – Big Data overview

Abstract

Every day in a city a lot of data that can be processed in order to extract useful pieces of information are continuously generated. However, one of the main issues is that this data is often wasted, because there is no unified and systematic way to process them. For sure, some services that exploit particular groups of data do exist, like those that provide traffic information, but private companies, which have their own interests, manage them accordingly. For this reason the concept proposed by this project tries to provide a solution for the public administrations, helping them having a smart tool to manage better the areas they supervise. The main idea is to implement a unified information technology platform that facilitates the acquisition, aggregation, processing and usage of data coming from different sources. Then, through the use of standardized APIs, there is the possibility to build different elaboration and processing tools giving different information but starting from a homogeneous and trusted pool of aggregated data. The APIs will help the externalization of development and usage of this service in order to build up a real **open service**. This could be a good asset helping the public administrations to implement this service with lower costs and with the possibility to create value out of this raw data, through the whole processing chain and the management of the APIs access. Moreover, in this way several governance issues that the public administrations deal with can be solved, mainly because nowadays they suffer from a lack of coordination between the several bureaus, while the way in which this platform is built tries to enhance the cooperation and unification between the several actors that actually work for the benefit of the city and its citizens.

Figure 2: In the very beginning, so excited to start the journey

Figure 3: One funny night hitch hicking to Stresa

Understanding the problem

Every day in the city, large amounts of data are continuously produced by various sources: traffic, pollution, weather sensors and so on. This kind of data is of little use if not refined into information. In order to create a better environment and improve the urban quality of life, Big Data should be exploited and converted into a tool able to support the smart management of a city, a major challenge worldwide. Especially in the Italian scenario, the technological innovation required by Big Data clashes with the skepticism of the administrations in financing innovative projects when in a period of resources shrinkage.
This project particularly dedicated to mobility is driven by a request from our partner Infoblu, an Italian company dedicated to infomobility, seeking a way to expand its operations to the Business to Governance sector. The purpose is to create a tool able to help the public administration (PA) of municipalities to reach the objective of smart mobility in the urban scenario. To better shape the concept proposal on the stakeholders' requirements and fulfill their needs, interviews were conducted among different municipalities (Torino, Milano, Emilia Romagna, Autovie Venete). The performed analysis helped in shaping the current scenario of the urban mobility, underlining its structure and problems, defining the ground floor from which the project's final proposal takes place.

Figure 4: Last summer school workshop, in the making of the video Andrea Colagrossi is the star

Figure 5: Michelle and Andrea working on the logo for one project

Exploring the opportunities

The need of the PA is to monitor in an efficient way all the events occurring in the urban area, to be able to take decisions based on the generated information. PA needs to control the *as is* situation of the city to plan maintenance, monitor the effectiveness of some interventions (such as traffic restricted area) and checking the public services for further improvements. Moreover monitoring is essential for the city planning and the wise evolution of the urban territory.
The general scenario, however, is defined by a lack of proper technologies to adequately map the city traffic, especially point to point and real time, with high costs of ownership and maintenance. Other problems arise from

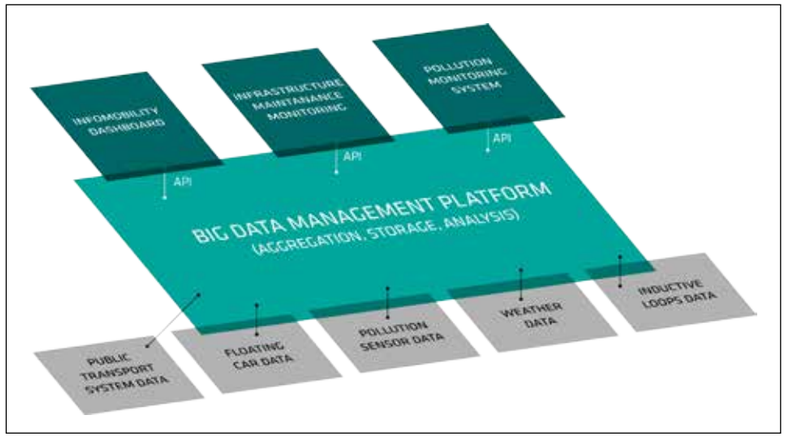
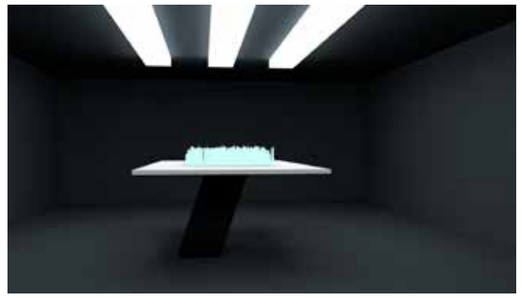


Figure 6: Platform Concept



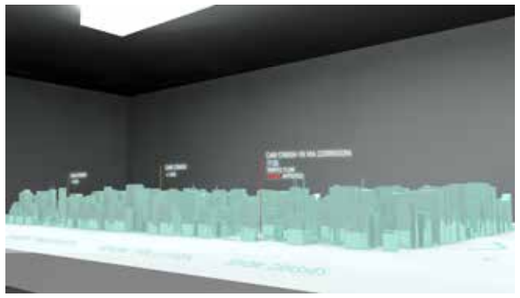


Figure 7: dashboard General

Figure 8: dashboard GUI

the architecture of the systems that manage the data. In particular, the lack of standardization inhibits the global vision of the city, increasing both timings and cost of obtaining information. However, a smart city depends on *smart governance* to be successfully implemented, but from the analyses emerged that this is one of the major issues, since each office works separately, with its own IT systems. By definition, this is against the holistic vision needed to have full control of the city and to make correlations with different events.

Generating a solution

The proposed solution is to create a platform for Big Data management and analysis that can be a support for the decision-making process of the PA. The main idea is to aggregate different types of data (traffic, GPS, weather, pollution, public services, demography, events) from different sources to produce complete pieces of information able to give a global vision on the city. The difficulties in creating such tool is that the PA want to keep the control over the data aggregation and processing, so outsourcing is not considered as a possible option. That is why commercially available platforms (e.g. IBM IOC) do not find room among Italian municipalities. Our proposal instead tries to fulfil the necessities and constraints in the *as is* situation.

The proposed platform is thought to be an IT system based on open sources Hadoop technologies able to aggregate, store and analyse PA's Big Data in a unified way, in order to break verticality of PA's existing IT systems. The architecture of the platform is modular, meaning that several different software components can be build on top of it to use its functionalities and pool of data in order to perform specific analysis and adapt the current structure of the administration. The modularity of the platform will allow different department of the same PA to still work autonomously on specific types of analysis, that can also be linked to a global perspective of the problems of interest.

The use of Application Programming Interfaces (APIs) is key for such platform, to access its data and analytic functionalities. For this, the platform can be considered an enabler for future products and services that can be built on top of it and use its data and functionalities, in a freemium logic: the number of accesses on an API per day are counted and if they exceed a certain amount, it needs to be pay a premium. The revenue is then divided between the developer of the API (who gains the major part) and the PA who published it on its systems, to recover partial of the hardware/maintenance costs. The logic also allows the creation of a network among which the different municipalities can share the API in their platforms. In this way there is a marketplace for the API, ruled by a public entity like ANCI (Associazione Nazionale Comuni Italiani), to promote the reusability and harmonization of IT systems and data standards among the Italian territory. ANCI must play the role of IT architect, encouraging the development of common

Figure 9: dashboard HI2

Figure 10: dashboard welcome

IT governance. The platform's logic also allows to fully develop the concept of open services: while open data is realized by simple data dumping on public repositories, open services allow exposing the functionalities of PA's IT systems outwards, so that the final output is information. This allows third parties to make use of these latter systems to enrich the smart city experience through products/services.

Exploiting the platform functionalities, innovative dashboards for infomobility data can be built; the main feature being the use of an innovative user interface shown on an interactive table that displays a holographic view of the city, showing the different layers of information as a stack of digital layers possible to interact with. Such zenithal vision of the city can help the decision-making process with the visual understanding of events in real time or the simulation of future events to forecast the possible outcomes.

The platform is thus shaped upon the needs of the main stakeholder providing a horizontal vision that grants the possibility of executing complete investigations and correlation among the events taking place in the municipality, still keeping the control on the generated information. The modularity of the tool is also of easy implementation, from a governance and technical point of view.

The vision of the platform as an enabling technology thanks to the use of API to enable open services is an innovative element not seen until now in the European scenario. In period of resources shrinkage, the exploitation of technologies in an innovative way represents a chance to reach urban development. In order to increase the common welfare, the changes must involve all actors in the city network. That is why we think that open source architecture for public administration is the best solution to the problem of valuing big data for smarter cities.

Bibliography

[1] Fuggetta - *Open Services nell'agenda digitale* – Feb. 12 – lavoce.info

Project 3B

CIAO!CITY

Can social and local features generate a sustainable business model in digital tourism?

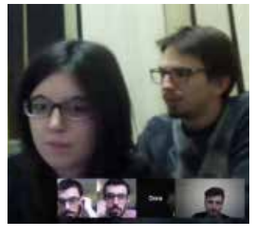


Figure 1: World, Team B, *Brainstorming videoconferences*

Tasks and skills

Mario Aricò: carried out the context analysis of the competitors touristic apps, the literature review about gamification mechanisms and Mobile Recommendation Systems, he helped in the definition of the App features. He took part to Bologna Smart City Exhibition 2013.
Dora Coccorullo: was involved in the definition of the business model, she managed the market analysis, made the competitors' location based services comparison and defined the commercial offer of the app, the strategy and the financial sustainability of the project. She participated to Bologna SCE 2013 and SMAU Torino 2014.
Alessandro Conti: defined the business model and carried out the swot analysis and the financial plan of the project. He was involved in the definition of partnerships with stakeholders and deepened the analysis in big data field. He held the relationships with institutional partners, participated to Torino Digital Festival 2013 and European Innovation Academy 2014 in Nice.
Anita Fontana: was involved in the state of the art of competitors touristic apps and social guidebooks, she designed the logo of Ciao!City and created the App mockup, defining the features and the social engagement of the platform. She took care of all the design aspects of the project (presentations, report, images).
Davide Ivaldi: exploited his competencies to define the technological features of the App, evaluating the geo-localization techniques and the database structures. He was involved in the data management and in the context analysis of the competitors' touristic app. He participated to SCE 2013.
Federico Pavan: contributed with his mathematical competencies to the data analysis from survey results and created the bass model for estimating the market of the App, he deepened the aspects of smart cities and helped in the definition of the Ciao!City commercial offer. He took part into European Innovation Academy 2014 in Nice.

Understanding the problem

Since the very beginning, it was clear how our project focused on two main key concepts: "smart cities" and "big data". Combining these two ideas together means to exploit "big data" and their hidden information to provide a service or product that is helpful to someone and make his/her experience within the city smarter. We tried to answer the basic questions to frame properly the problem(s) and thus provide our innovative solution:

- What are big data? To get a deep understanding we carried out a state-of-the-art analysis: at first we focused on the three biggest data providers, namely Google, Nokia and Tom-Tom, pointing out how they gather and manage data, their data sources, what services they provide and who are the target customers. Secondly, we focused on our main project partner: "Infoblu". We studied their current business model, their market share, even in comparison to the previous providers, their partnerships with "Autostrade per l'Italia" and "CCISS", trying to identify possible future services which it might be interested in.
- What is a smart city? From a further state-of-the-art analysis emerged how "a smart city is one that has digital technology embedded across all city functions" (Smart Cities Council) and characterized by "eight key aspects: smart governance, smart energy, smart building, smart mobility, smart infrastructure, smart technology, smart healthcare and smart citizen". (Frost & Sullivan)

After deep brainstorming, we decided to focus on "smart mobility" field and came up with three different concepts for project:

- A platform providing infomobility services, regarding public and private transport systems, targeted to both B2G and B2C. We ruled out this idea due to the inherent difficulties in focusing on a precise need.
- An additional service attached to "E015 – digital ecosystem", the "Infoblu" platform. The idea was related to "people mobility" and focused on a service providing information about the different pavilions across the site and their level of crowd, to guarantee a more enjoyable visit. Unfortunately, along with technological issues, we found out that no real needs were left uncovered.
- A "Tourist platform". We analyzed services available in stores and drafted the main features that our app should embed to be competitive on the market: Social (share your experience with the community), Local (customized recommendations), Mobile (integrated and easy-to-use information): SoLoMo.

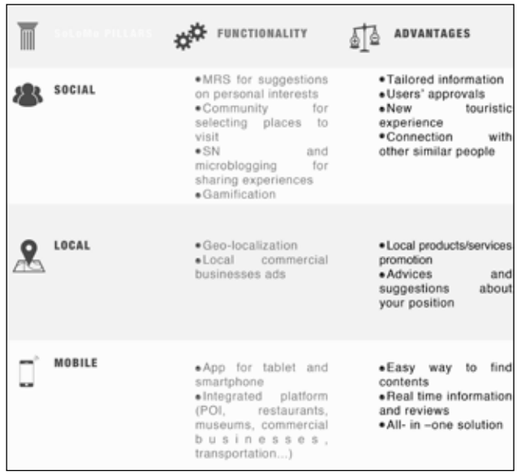


Figure 2: Torino, 21st June 2014, Davide Ivaldi, *SoLoMo pillars*

Exploring the opportunities

Ciao!City has to face multiple difficulties. First of all, Ciao!City plans to enter the app market, that is notoriously a *winner-takes-all* market, currently dominated by famous IT giants. Then, the app needs differentiating contents to attract a critical mass of users, but the generation and maintenance of such contents are obviously costly. Moreover, engaging commercial venues requires an old-fashioned approach, which nonetheless should be blended seamlessly with the app ecosystem.

However, a closer look reveals the existence of many opportunities the competitors currently find not profitable to exploit. First of all, the particularization of the service offered. While many IT giants focus on providing a global standard localization, pointing out the most common touristic hotspots, Ciao!City focuses on local traditions, products, and characteristic points of view. The tourist can live a 360° experience of the city, delving into a world for mostly hidden for mass tourism.
Moreover, most of the time, competitor apps can provide high-quality services restricted to a specific field, without providing a complete touristic experience because of the lack of a multisectorial approach. Ciao!City wants to overcome this issue

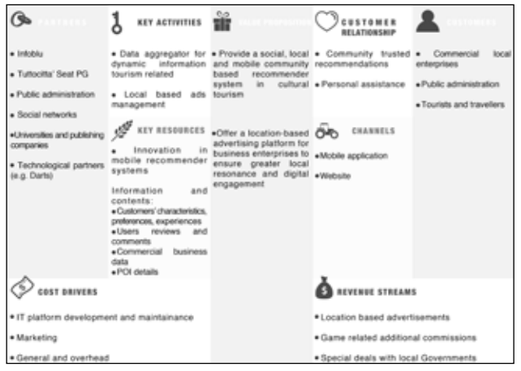


Figure 3: Sestriere, September 2014, Team B, *Business model canvas*

Figure 4: Torino, September 2014, Anita Fontana, *Ciao!City logo*

by gathering previously disjointed offers from many competitor in just one App, bundling them into a single package and making it convenient both for users and for businesses.
Eventually, a common problem for many apps is stimulating the active behavior of users and raising interest in the community. This problem is tackled by Ciao!City with the exploitation of the gamification concept. Even though this is not a new solution, Ciao!City exploits the opportunity to modernize this idea. The app provides a stimulating gaming experience (quiz games, check-ins), which becomes the basis for a fresh point of view of the touristic experience, achieved through engagement, entertainment, and fun.

The main challenge for Ciao!City is to be sustainable also from an economic point of view. Therefore, a lot of effort has been put to show that this is possible, and social and local features can generate a sustainable business model in digital tourism.

Generating a solution

From the analysis of the competitors' offer in the field of social tourism and the market analysis to potential customers a lack of integrated solutions has arisen, which are strictly local and little developed, with inaccurate and not up-to-date information.

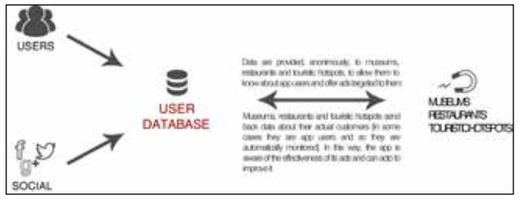


Figure 5: Ann Arbor, October 2014, Davide Ivaldi, *User Database*

Ciao!City wants to overcome these issues, by providing a complete, social and tailored touristic service.
Ciao!City is a mobile platform for smartphone and tablet, which provides a personalized local and social touristic experience: starting as a prototype in the city of Turin, in Italy, it will be used in the other most important cities of the country.
Through the mobile recommendation system, the app is can take into account the spots where the users go and their impressions about places, events and attractions, like advices for other users and generate highly personalized contents and itineraries, according to their preferences.
To increase the sense of community and the social sharing, contents are proposed in an interactive and gamified form, microblogging and social networking have a primary role: the platform will give users the possibility to recollect and record the special moments of the travel experience by means of classical tweets and media resources (photo, video etc.).
The contents are provided from partnerships with museums, points of interests, public administration, universities, publishing companies, websites, and, obviously, the users.
The aim is to provide high quality contents and real time information, in the first phase coming from institutional agreements, in the future generated

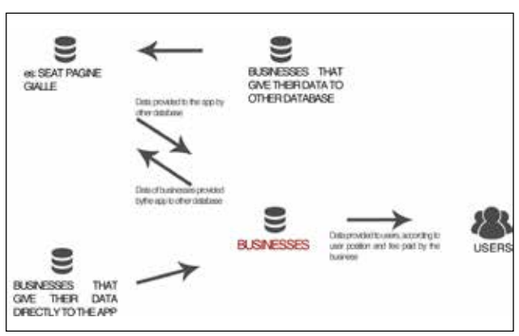


Figure 6: Milano, October 2014, Alessandro Conti, *Businesses database*

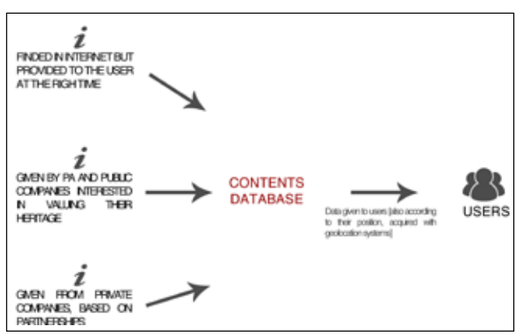


Figure 7: Milano, October 2014, Alessandro Conti, *Contents database*

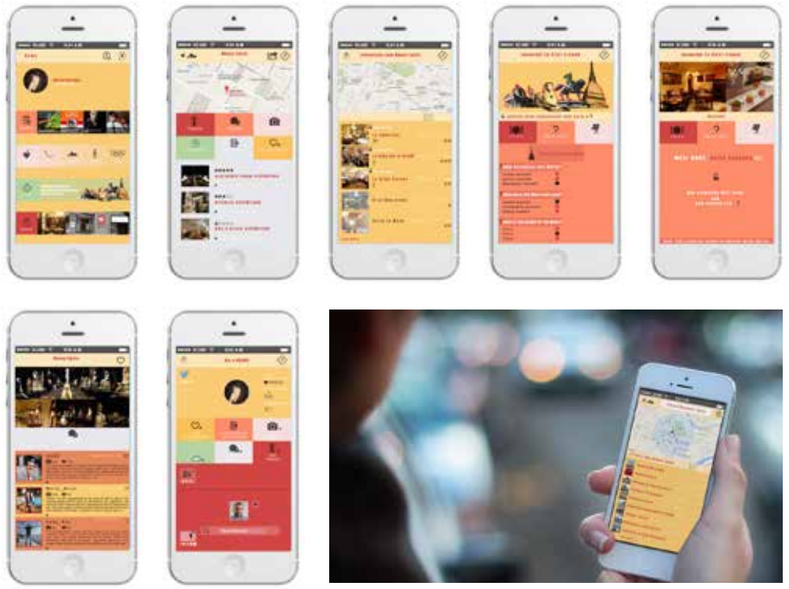


Figure 8: Torino, September 2014, Anita Fontana, *Ciao!City Homepage*

Figure 9: Torino, September 2014, Anita Fontana, *Evaluation section for points of interests*

Figure 10: Torino, September 2014, Anita Fontana, *Restaurants and commercial businesses nearest to POI*

Figure 11: Torino, September 2014, Anita Fontana, *Game features: quiz to unlock levels*

Figure 12: Torino, September 2014, Anita Fontana, *Game features: how to get bonus*

Figure 13: Torino, *September* 2014, Anita Fontana, *Reviews from the community*

Figure 14: Torino, September 2014, Anita Fontana, *User profile: how to invite new friends*

Figure 15: Torino, September 2014, Anita Fontana, *Ciao!City App for smartphone: POI in the area*

by customers themselves (UGC) that will enrich the databases with their reviews and recommendations.
A considerable number of customers can attract the second side of the Ciao!City offer on the platform: commercial businesses, which are the core of the revenues.
Taking advantage from location based services, the platform will be able to canalize tourists in the local and traditional businesses of the city, which can display on the app their offers and discounts under specified rules and fares.
Clearly, there is no competitive advantage coming from the technology. The app uses existing positioning techniques to detect users' locations (GPS and and Wi-fi signals), standard database management systems, combining them in an established software architecture.
What is crucial is the implementation strategy of Ciao!City business model is linked to stakeholders. It relies upon a strong relationship with local authorities and obliges company to deal with red tape issues that have little scalability in moving from a country to another.
The result is that what really matters is being the first to offer users the services the app provides and being extremely fast and efficient in getting in touch with customers, in order to be the first mover.

Figure 16: Torino, September 2014, Anita Fontana, *Ciao!City App for tablet: page of the events*

Bibliography

[1] A. Osterwalder and Y. Pigner, *Business model generation: a handbook for visionaries, game changers, and challengers*, John Wiley and Sons, 1st edition, 2010.
[2] G. Tim, D. Jumping, S. Zengqi, J. Yingmin, *"Digital tourism integrated service system realization"*, IEEE, 2010.
[3] G. Zicherman, J. Linder, *"Game-based marking"*, 2010.

ACED-IoT

Safe Cities through Cloud
and the Internet of Things

Project

4

ACED-IoT

Safe Cities through Cloud and the Internet of Things

Figure 1: The ACED-IoT team at work.

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Figure 2-3: Reviewing the solution concept.

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GoCloud, Italy
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Project description

Continuous urbanisation is a growing trend worldwide. Cities are home to more than half of people in the world today, and will be home to nearly 70% of our population by 2050. This growing concentration of people creates interesting opportunities, but also many challenges. An important one is flooding of urban areas. This phenomenon is becoming more and more frequent and critical due to both urbanisation and climate change. Thus, flooding should be carefully studied and analysed in order to (i) timely foresee its occurrence, (ii) keep under control both the flooding itself and the status of important infrastructures, (iii) timely help involved citizens, (iv) assess and count damages, (v) improve prevention and control mechanisms for the future.
Clearly, the problem is very complex and its solution requires the interplay of domain-specific competences on flooding, emergency management, civil protection, and ICT.
ACED-IoT blends together all the above competences and focuses on providing tools suitable to help civil protection during the occurrence of floods. More specifically, it supports exchange and availability of real time information among emergency coordinators and agents, so that they can react timely to any issue.
The work has been conducted rigorously and included the following steps:

- *Analysis of the problem:* This phase has been started with an in depth analysis of the state of the art for what concerns both the study of pre-

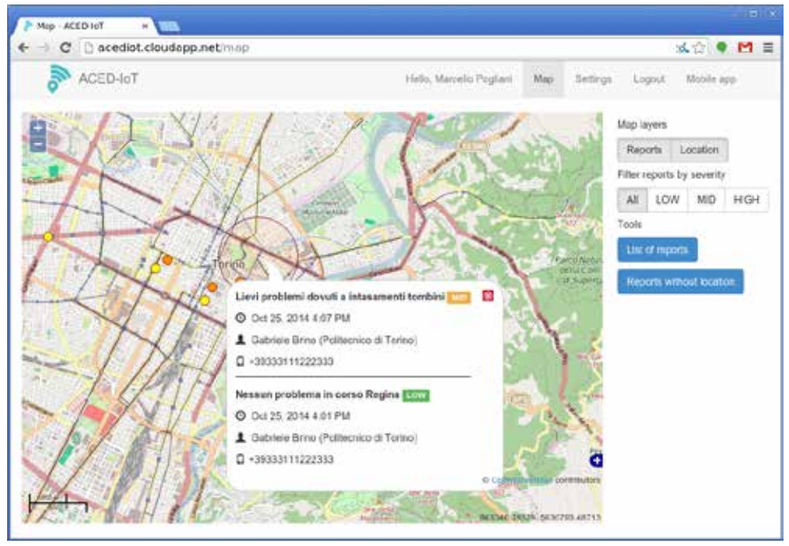


Figure 4: The web application: selecting a report on the map.

vious crises (not only floods but also earthquakes) and the analysis of the literature concerning crisis management. Moreover, it has included the development of a survey that has been conducted with representatives of twelve relevant organisations (Civil Protection, ARPA, and others). The result of this survey has allowed the team to identify two high priority issues: to gather information from other organisations and to be able to geolocate rescue teams.

- *Development of a prototype:* This prototype includes an Android application to be used by the rescue team members and a server-side system to be used by coordinating organisations to visualise the position of rescue teams and the information they provide through their terminals. The prototype is open source and is available on a public repository.
- *Collection of feedback:* In order to validate the project idea and the prototype, various relevant stakeholders have been asked to use the system and to provide feedback through a questionnaire. The answers have been analysed and the improvements for the future have been identified.

Tasks and skills

Gabriele Brino: studied the state of the art about emergency management. He designed, performed, and analysed the interviews to stakeholders, in order to determine users' requirements.
Niccolò Dal Santo: dealt with the technological part of the project. He designed the solution concept, helped with the implementation of the web map, and modelled the system using space4cloud.
Paolo Fantini: studied the state of the art about emergency management, focusing on the city of Turin. He identified the actors to involve and interviewed them, collecting users' requirements.
Stanislava Georgieva: studied the state of the art about best practices and techniques in flood management and communication. She also designed the project logotype.
Eugenio Gianniti: dealt with technological aspects of the prototype. He studied the basics of Android development and implemented the mobile application prototype.
Nicolò Macera: studied the state of the art about ICT in emergency management, focusing on the basics of geo-information. He performed the feasibility analysis of the system.
Marcello Pogliani: focused on the state of the art in cloud computing and with technological aspects. He designed and implemented the web application and helped with some parts of the mobile application.

Abstract

Figure 5: The ACED-IoT team (Sestriere, September 2014).

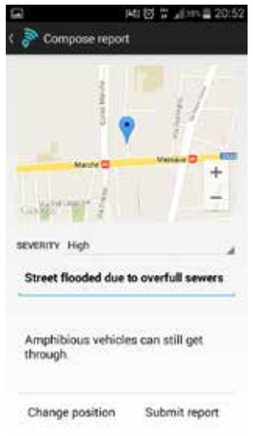


Figure 6: The mobile application: login screen.

Figure 7: The mobile application: main menu.

Figure 8: The mobile application: composing a new report.

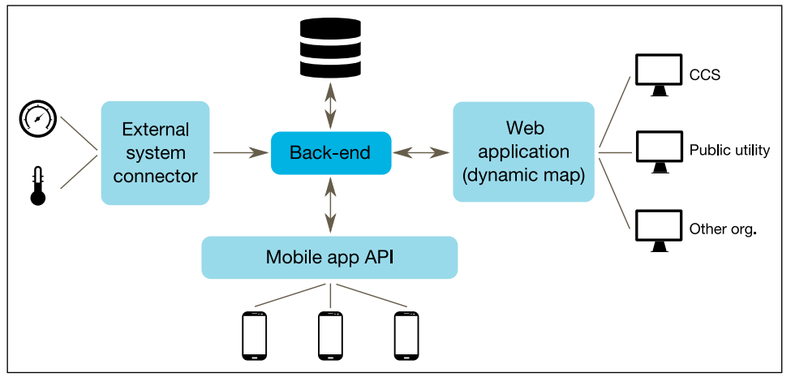
Figure 9: The mobile application: manual location selection.

The ongoing growth of urban population coupled with the frequency of extreme weather phenomena all over the world is causing an increase in the exposure of people and goods to natural hazards. This implies a general rise of the risk level. The culture of risk prevention and management is increasingly widespread – also due to the huge media coverage of such phenomena – but cities are complex systems where strict planning is ineffective. Despite the efforts to minimise the risk, emergencies happen all the time: in order to have a good disaster response capacity, the need of an adequate awareness of the present and upcoming situation is clear. Current trends in emergency management are going in the direction of structured data collection as a tool to improve reaction time and to allow analyses through geoinformation and geostatistics. Such a problem emerged worldwide in huge events (e.g. the Haiti Earthquake in 2010), but the state of the art lacks solutions focused on communication and designed with the aim of satisfying these requirements. The ACED-IoT project tackles this problem. Although we propose a rather general solution, we consider as a reference case study flood emergencies in an urban setting, focusing on the city of Turin. We target the scenario of floods as they are fairly frequent in Italian cities, whilst at the same time being difficult to manage.
Our project is concerned with exchange and availability of real time information among emergency coordinators: our solution is able to help them in analysing data retrieved from various sources and identifying problems in order to react in a timely manner. We focus on both integration and visualisation: we integrate real time data from different sources (e.g. a mobile app handed out to rescuers) and visualise them in a clear and coherent map developed with web technologies, so that it is possible to immediately answer questions such as "which are the most critical areas?" or "where are the rescue teams?".

Understanding the problem

During the first work phases we framed the scope of the project and studied the relevant state of the art on risk and emergency management, mainly focusing on the procedures and laws currently in place in Italy [1]. With this knowledge, we started the requirement analysis phase. To collect requirements, we contacted twelve different organisations involved in various aspects of emergency management in the area of Turin, ranging from the Civil Protection to ARPA, the regional environmental agency. We were able to schedule a face to face interview with representatives from each of them. We presented them a schematic overview of the project aim and go-

Figure 10: Conceptual architecture of our solution.



als and asked questions that could help us to understand how they currently manage an emergency, what are the problems of the current approach, as well as to know which data can be made available to use with innovative ICT tools also in the context of partnerships with other organisations. The results of these interviews were fundamental to understand the real needs of the stakeholders: it was clear that the main problem to solve is improving the communication with and inside the Centro di Coordinamento Soccorsi of the Civil Protection during an emergency, while organisations are not interested at all in investigating ways to automate the decision making process. Other two high priority needs, as resulted from the interviews, are to gather information from other organisations and to be able to geolocate rescue teams: we decided to tackle them both in our project.

Exploring the opportunities

While the focus of the project was clear after the interviews – to focus on improving communication between organisations involved in an emergency using ICT tools – the design space to be explored was huge. For example, an important decision has been whether to work on low level data collection, dealing more with issues related to sensors and to the Internet of Things, or to focus directly on the interaction with operators and emergency coordinators. Since the most urgent needs are related to communication between on field rescue teams and managers in the operative room, we chose the second path.

Another relevant point to address has been whether to spread our tools to the public, or to make them available only to rescuers and emergency managers. Although the first alternative seemed appealing at a first look, it carries several issues. First of all, the population is not trained in providing valuable information to emergency managers: data collected in this way would require a careful analysis to extract relevant information. Furthermore, it is difficult to persuade citizens to install on their smartphones an application useful only in case of natural disaster: to reach a critical mass among the population requires the integration of emergency-related features in a broader system offering services also in ordinary circumstances. Due to these concerns, we chose a narrower target: people directly involved in crisis management.

Generating a solution

The outcome of our project is an ICT platform able to retrieve data from various sources and visualise them in a coherent map. Data are different in nature, both static (e.g. population density) and dynamic (e.g. rainfall and river level), collected by sensors deployed throughout the territory or provided by third parties such as environmental agencies and public utilities.

The most important feature of ACED-IoT is the ability to collect data from on field operators through a mobile application. Operators are continuously tracked by the GPS devices installed on their smartphones; they can feed the system with geolocated reports and pictures and keep track of the tasks they are assigned to.

In order to aggregate and visualise data in a timely manner under all load conditions, the complete system according to the ACED-IoT concept requires a fairly high amount of computational resources. As a system designed for critical applications, it has also strict availability and reliability requirements, even if its use is concentrated in a short and unpredictable time frame. The exploitation of cloud computing features [2], like the ability to quickly scale up and down, is a promising solution to the problem of allocating the right amount of resources for the system.

To show the feasibility of our design, we implemented a prototype that showcases some of the most important features. It is composed by a mobile application that runs on the Android operating system (the most widespread one, especially on low cost devices), a REST API to allow the mobile application to send data to the server, and a web application, implemented in Python using the Flask framework, as an interface for emergency coordinators. The main part of the web application is an interactive map implemented using the OpenLayers Javascript library and OpenStreetMap maps. The prototype has been publicly released under an open source license and made available at https://bitbucket.org/acediot. In order to assess the benefits of cloud computing to our project and to develop a complete cost analysis, we evaluated the resources needed by our system using the *space4cloud* tool [3]. With the aid of this tool, we built a model of our system, fed with performance data obtained profiling the prototype, and we ran a set of simulations considering a realistic case study (the flood that hit Turin in 2000) to estimate the workload pattern and the number of active users in the different phases of the crisis.

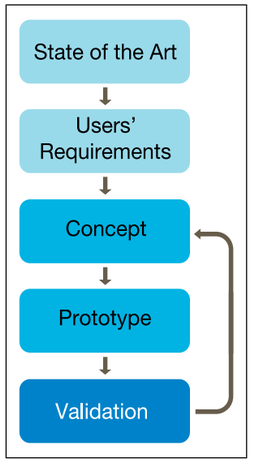


Figure 11: The project workflow.

We validated our idea actively involving final users: we sent to all the organisations and companies involved in the initial requirement analysis process a description of our work with instructions on how to access the prototype, and we collected their opinions. In general, organisations agreed with us that our approach can be profitably used in the real world and that it can bring a benefit, increasing the timeliness of the emergency response due to a better awareness of the situation.

Bibliography

[1] A. K. Jha et al., *Cities and flooding: A guide to integrated urban flood risk management for the 21st century*. The World Bank, 2012.

[2] M. Armbrust et al., *Above the clouds: A Berkeley view of cloud computing.* Technical Report UCB/EECS-2009-28, University of California, Berkeley, 2009.

[3] D. Franceschelli et al., *SPACE4CLOUD: a tool for system performance and cost evaluation of cloud systems*. In Proceedings of the 2013 international workshop on Multi-cloud applications and federated clouds (MultiCloud '13).

FFD

Future Food District

Project

5

FUTURE
FOOD
DISTRICT

FFD

Future Food District

Team A

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Team B

Project description

Food is key for the whole humanity. Worldwide policies and organizations should aim at a better and more equal redistribution of food all around the world; we can only foster "local" solutions to educate people, improve the quality of what they eat, and give them better means to address the food problem in our society. Future food districts cannot be global, pervasive entities, but they must work with the environment and obtain the best out of it. The problem is multi-faceted and can be tackled from different angles: for example, new supply chains, new supermarkets, new cuisines, more sustainable packaging and distribution, healthier recipes and new cooking machines. It is not only a matter of using smart tags or mobile technologies to let the customer leave a better, social experience while buying goods at supermarkets. Food distribution, purchasing, and processing must be thoroughly rethought and repositioned in our lives. As for distribution, we need sustainable solutions and customers must be re-educated to eat what is close to them and when the environment produces it. There is not need for strawberries in January if they need to travel from one continent to another, they must be treated with too many chemicals, and the costs of packaging and transport are prohibitive. It is also a pity that every time we return home after buying food at supermarket, we immediately waste a conceivable amount of money, time, and resources in un-rapping and un-packaging the food. Smarter, cheaper, and more sustainable solutions must be devised to preserve the freshness and integrity of food without exaggerating with too many boxes, wrappers, and containers.
Purchasing cannot simply become a quick task where people buy packaged food and try to save as much time as they can by exploiting web-based solutions and by buying pre-cooked food. The persons, in the different phases of their lives, must be the center of the supermarket, which must become a place people can enjoy, a place where customers can share experiences on products and recipes, and a place that provides the right means for helping/assisting the customer select products, move them around the supermarket, consume them together with other customers, or deliver them at home.
Finally, food processing must find a compromise between gourmands and junk food addicted. The era of standardized pre-cooked food is over: people want fresh, healthy raw materials and the capabilities of preparing customized recipes. New processing tools, conceptually similar to 3D printers, are needed to process raw materials and produce individual solutions. This idea also implies that there is no need for the supermarket to store many different similar products, just to accommodate as many needs and tastes as possible, but they only need a limited number of raw ingredients ---even molecules--- and proper processing devices to server all possible requests.
A Future Food District can thus be many different things at the same time. A single viewpoint is not enough to cover its different angles, but many different (alternative) pieces must be integrated and work together to provide the user with a complete, sustainable, and enjoyable experience.

Project
5A

Mix, share, buy

Tasks and skills

Gianluca Bergami
Involved in the research phase, he deepened technical aspects of the projects. He attended several meetings, focused on the state of art analysis and helped to contact the sponsors.
Stanislava Bivolarevic
Focused on the economical and social issues of the projects and coordinated the team. She analysed the market trends and made a research on the target groups. She took part to EIA course.
Laura Cavelli
Coordinated the team and dealt with design issues. She attended many courses in the innovation field abroad (i.e. the EIA course). She actively participated to several conferences and focused on the interaction with the consumers.
Ilaria Maltoni
Coordinated the group work, actively participated to several meetings about the food topic. She dealt with issues' analysis and the definition of the solution. She improved her competences in innovative design and deepened the architectural design of the supermarket.
Sara Morettin
Analysed and focused on the feasibility and economical issues of the project. She constantly gave concreteness to our work and developed the code of the app. She also studied a wide range of examples and defined future implementations of the project. She took part to EIA course.
Valentina Porceddu
Dealt with issues analysis and the definition of the solution. Focusing on the graphic design of the app and the bracelet she focused on the interaction with users. She constantly took part of the team meetings and helped to tackle sustainability issues.

Abstract

Main issues
The Future Food District is an ASP project integrated into the one developed by Carlo Ratti Associati and Coop for EXPO 2015. The FFD team A conceives a reunification of the food district inside the supermarket of the future.
MIX SHARE BUY aims at optimising grocery management according to specific customer needs in a dynamic way. The customisation, the social experience and the food quality are the basic pillars of the proposal.

Proposed solution
- **Mix**
  The project takes inspiration from the neighbourhood market, using technology to solve the disadvantages of the supermarket.
  The space will be divided into "islands" that distribute products according to their categories and preservation methods. Providing customers with such a layout will satisfy their sense of discovery, typical of grocery shopping as a free process. Moreover, carts and checkout lines will be replaced by an automatic payment system.
  The products, limited to organic and locally sourced, will be offered in a raw state, avoiding pre-packaging; the ingredients will be exposed in dispensers or arranged around their islands.
  Although the offer will be seasonally limited, the combinations will be infinite and the supply chain will be shortened.
- **Share**
  The shopping will be extended to a social dimension, based on intergenerational cooperation.
  A common kitchen will be provided inside the supermarket, enabling customers to prepare and eat the food just bought. A chef will help them, while volunteers and experts of traditional cooking will occasionally organise cooking classes. The common tables will be casually disposed, composing a more conscious experience of the whole "food district".
- **Buy**
  Information results from a better customer engagement. The project, thanks to technological devices, revolutionises the dynamics of shopping that focuses around consumers' awareness about the products and their backgrounds. Data related to traceability and nutritional value will be displayed on the screens above the islands, which will also provide suggestions by the community, in order to allow conscious decision.

Figure 1: The image refers to the two main aspects of the supermarket on which Team A was focused: Quantity (seasonality of products, selection) and Quality.

Understanding the problem

The complexity of the contemporary economies, caused by a diffusion of new technologies, globalisation, as well as insufficiently sustainable actions, asks for creative and innovative measures that can improve current food issues. Actors operating across different business sectors and geographical areas are asked not only to find ideas that would improve and solve emerging problems caused by the implementation of unsustainable practices, but also to engage currently uninvolved players across the marketplace.

Exploring the opportunities

Food itself is considered as a commodity in many countries, whose production is managed through an industrial approach that does not take into account the seasonal cycles of the nature. Consequently, the current equilibrium is flawed: knowing that food is produced for over 12 billion people, while world's population is now around 7 billion, it can be easily concluded that a large part of produced food is wasted or lost. If the conditions remain as such, the food production will inevitably be constantly higher than the demand. By altering this emerging issue, we can guarantee a sustainable future for ourselves and the next generations.

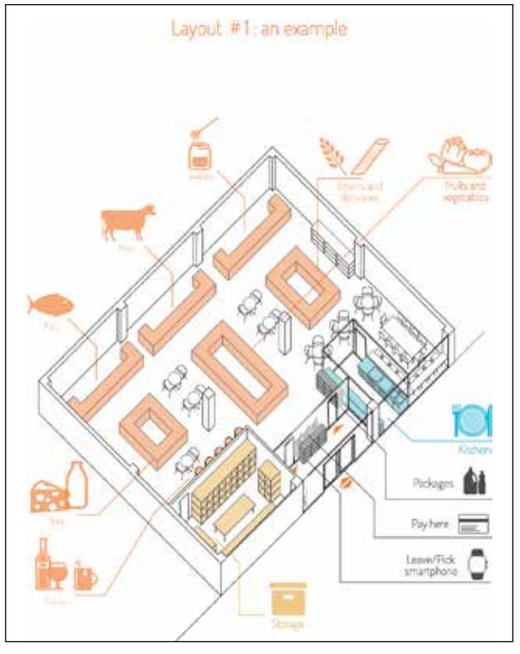


Figure 2: A possible configuration of the supermarket: subdivision of the space into islands of categories of products, the common kitchen and the tables.

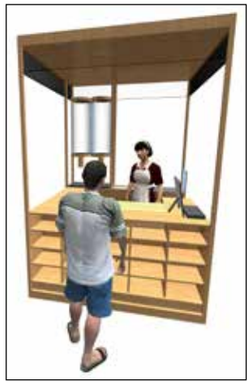


Figure 3: Layout of the island of dairy: example of disposition of the elements of the island to expose the products and allow the interaction between the employer and the customer.

Figure 4: Development of the App for smartphones

Figure 5: The bracelet is the device that will allow the customers of the supermarket to scan the products they are buying time by time. This will avoid them long cues also thanks to the automatic payment system.

Why would sharing be a key point to improve the actual grocery shopping experience? People already share the environment, infrastructures, and communities, satisfying two important needs: convenience and congregation. Thanks to the modern innovations, a greater scope in fostering a collective sentiment can be achieved, especially by a more responsible use of the shrinking resources, resulting in the avoidance of overproduction and excessive food waste.

Generating a solution

The FFD project tackles the ambitious goal of combining tradition and modernity; it revives and expands the idea of a farmer's market into a technological supermarket whose innovations are conceived. As such, the supermarket of the future represents an improvement of the current setting, rather than a cumbersome obstacle in the customers' shopping experience.

The respect for food from many points of view has been the cornerstone of our project from the very beginning; yet, the solution has been changing and improving in time. Our personal and academic backgrounds (architecture and engineering), together with the knowledge obtained during each and every ASP school, were the drivers of new ideas and hints for deeper digging into the project.

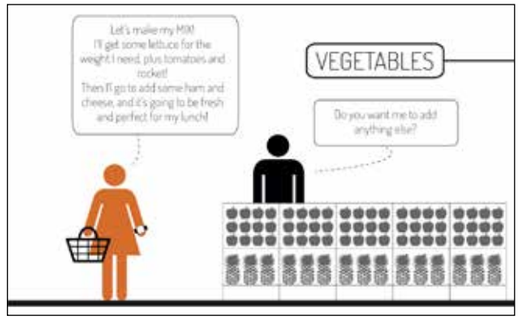
The solution named "MIX SHARE BUY" stresses the main principles guiding the project: high customisability of the products, development of a sense of community, and introduction of devices that can make grocery shopping experience simpler, faster and less stressful. The name of the solution itself is quick, strong and straightforward, mirroring the ideas wished to be deployed.

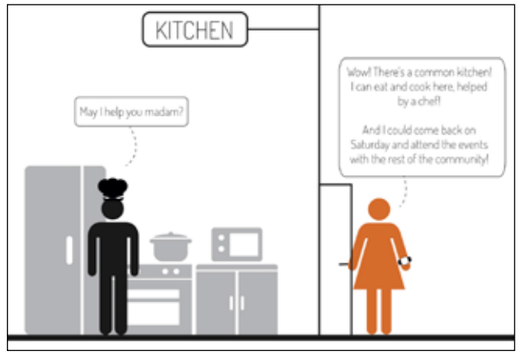
The new paradigm based on an enhancement of the shopping experience in all its aspects without distortion, relies on technology and community creation. A thorough use of creativity, modernity and reliance on people can enhance existing opportunities, local products and cultural heritage to bolster new shopping models, while assuring sustainable economy growth. Hence, the key point is a change of perspective and introduction of a new way of thinking. Technology is not an end in itself anymore, but rather a means to improve the shopping management and to foster the sharing of expertise, recipes, and time.

It is worth mentioning that our project was among the selected Politecnico projects for the events organised around Expo 2015. Unfortunately, due to incompatibilities in the scope of the two projects and the lack of financial resources, we decided not to proceed with further developments of this opportunity. In addition, we had the chance to exchange our ideas with Carlo Ratti and his collaborators Matthew Claudel and Marco Maria Pedrazzo, working respectively at the MIT Senseable Lab and at the Carlo Ratti Associati. Their feedback was extremely positive, suggesting that we further proceed with seeking sponsorships and actually implementing the concept we developed. Our commitment and interest into the project as a team will not prevent us from finding alternative solutions. The innovative approach acquired during the past two years of studies provided us with tools and means to identify, appreciate, and utilise valuable innovations.

Bibliography

- Ratti C. Claudel M., *Open Source Architecture*, Thames and Hudson, 2014
- Johannes S.C. Wiskerke, Jorge Mario Jauregui, Vandana Shiva and others, *Food for the City, A future for the Metropolis*, NAi Publishers – Stroom Den Haag, Rotterdam, 2012
- Cockrall-King J, *Food and the city, Urban agricolture and the new food revolution*, Prometheus Books, 2012
- Raisson V, 2033, *Atlante dei futuri del mondo, migrazioni, agricoltura, acqua, clima*, Slow food editore, 2012
- PSFK, *The Future of Retail*, Report, 11-2012
- Forum of the future, *Consumers' Future 2020, scenario for tomorrow's consumers*, 10-2011
- Tns, *New Future In Store, How will shopping change between now and 2015?*, Research Report, 05-2008
- OECD, *The future of Food, Long term prospects for agro-food sectors*, organization for economic co-operation and development, 1998
- Petrini, Carlo, *Terra Madre. Come non farci mangiare dal cibo*, Giunti Editore, 2009
- Bistagnino, Luigi, Petrini, *Design sistemico. Progettare la sostenibilità produttiva e ambientale*, Slow Food Editore, 2009
- Perullo N., *Il gusto come esperienza. Saggio di filosofia e estetica del cibo*, Slow Food Editore, 2009
- The Week staff, Walmart's 'Scan & Go' iPhone app: The future of shopping?, 09-2012
- Gaskins, Kim, The interactive Future of Food, in Latitude 42°, January 2010 http://latd.com/2010/01/25/latitude-42-food-connected/
- Mergiani, Despoina, New technology in the super-market: a whole new way of shopping, a whole new way of marketing [http://www.wbiconpro.com/6.Despoina.pdf]
- Next-gen retail: mobile and beyond, in Latitude 42°, December 2012 [http://latd.com/2012/10/24/coming-soon-next-gen-shopping-mobile-beyond/]
- Ross, John, Retail technology and the evolving shopper [http://www.visualise.ie/wp-content/uploads/2011/11/Retail-Technology-and-The-Evolving- Shopper_v4_SHS.pdf]





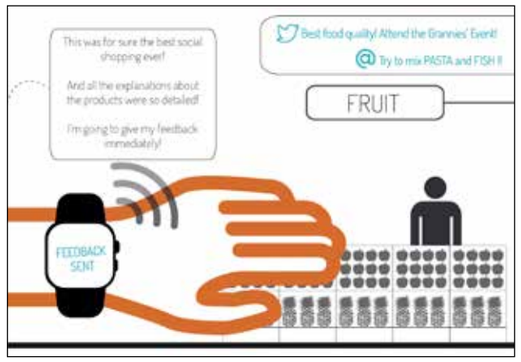


Figure 6 - 7 - 8: The three images show the steps for the correct use of the new tools provided by the supermarket.
The first one explains how the customer could make his/her own mix of the food he/she chose, asking help also to the employer in the island and completely customising the final purchase.
The second one shows how to use the common kitchen, learning from the chef or attending some particular events based on the sharing of cooking knowledge.
The third one shows the social aspect of the supermarket, in which all the users can share their opinion and give feedbacks on the food or in general on the experience they had.

Project
5B

Over Oven

Figure 1: Shopping cart with costumers' consideration

Tasks and skills

Anna Dalla Valle took part to the realization of the state of the art and of the solution concepts. She was responsible for the graphic design in the project and she also realized advertisements for the final product.
Deva D'Angelo put her expertise to the service of the analysis of the environmental impact of the solution in terms of wastes and transportation. She also contacted experts to discuss the feasibility of the project.
Stefano Ricci took part to the realization of the state of the art and used his skills of computer engineer while elaborating a web platform for team working.
Henri Valancogne developed the design methods as well as the solution concepts. He also contacted experts in order to discuss the validity of the final solution.
Maja Urosevic worked on the actors' analysis. She was chosen to be the team controller and therefore was responsible for deadlines and appointments setting.

Abstract

FFD tries to explore new levels of interaction with food, by providing more transparent food chain by the use of new technologies. Prior to coming up with an innovative solution for the supermarket of the future, a survey related to shopping habits was conducted. As a result, quality and sustainability of products proved to be the main concerns of customers. Furthermore, customers claimed to use automatic cashers and avoid queues as these were considered to be the major negative points of the buying experience.

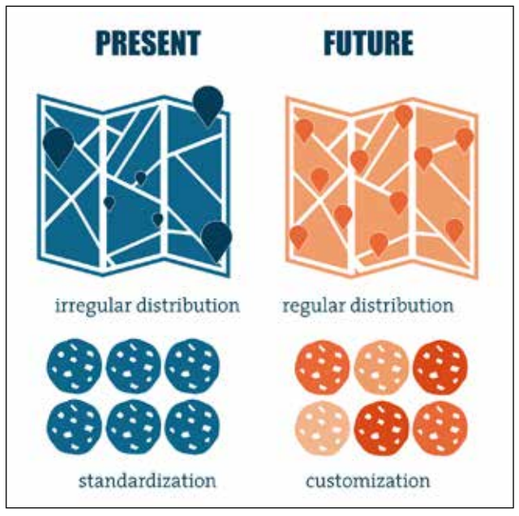


Figure 2: Distribution in the city

Given that IT has become inevitable part of the business world, the physical and the digital intersect more than ever in retail. Supply chain has transformed enormously reflecting ever-changing human needs. Thus, a systematic approach was used towards innovation in order to efficiently improve all aspects of the identified phases of the supply chain: production, elaboration, distribution, consumption and waste disposal. Specific design methods for problem solving were used in order to reach an out-of-the-box solution for the two aspects, namely the supermarkets and the customization of products in order to satisfy unique customer needs.
The new supermarkets will be close to city centers, where customers will feel welcome and easily find products on low shelves using touch screens, smartphones and scanning devices. Customers will buy intermediate products and the recipes at the supermarkets for their preparation at home. A special cooking machine is designed to make their favorite food customized especially to their tastes. Therefore, the "Over Oven" will have many benefits for customers, including its connectivity to the internet and to users' smartphones. Nevertheless, it will solve the issues of energy and space efficiency as well as of waste reduction. Finally, an environmental analysis assessed the solution from sustainable production and consumption perspectives. Further validations for the model were achieved through interviews with experts in the related field.

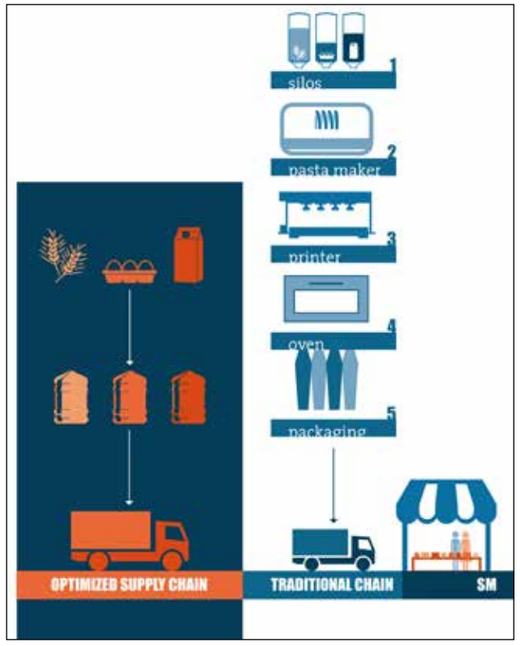


Figure 3: Production step inside the supply chain

Understanding the problem

We were invited to imagine the future of the supermarket in the framework of the Expo 2015. Thus, our starting point has been to understand the issues that the Expo planned to tackle and study the problematic of food in a broader perspective.
At the global scale, by 2050, the planet will have to feed an additional 3 billion of inhabitant while struggling to maintain an energy production that meets new environmental standards. In the meantime, today's food chain is wasting more than 30% of the food between the field and the plate of the consumers.
On the local scale, the Expo plans also to be a field of experimentation for pleasures and traditions related to food, which is at the base of our culture, especially in Europe. The team being composed of two architects we also had the consciousness that the future of the planet would very likely be urban. Food retail in history had a significant evolution that became more dramatic in the last century. Our mission was to discuss the future of the supermarket in this context.
The supermarket is a service retailing for customers: we directly understood that we had to have a user-centered approach. For that matter, we decided to start by organizing a survey aimed at understanding the behavior of customer, as well as their expectations. We conducted an online survey on a broad sample of customers from various countries and resorting to various scale of food retailing. It made us understand that customers preoccupation were centered on time, price and buying experience.
We then conducted a first research to establish a state of the art in the food supply chain to create a starting point for our developments. It permitted us to understand better the trends that were driving innovations in the field: user experience, connectivity, simplification of the purchasing process, efficiency and waste management.
Moreover, many hypermarket brands opened new branches of local market realizing that a new demand for local retailing was emerging: partly because of the morphology of our cities that do not allow anymore the customers to reach easily far away supermarket

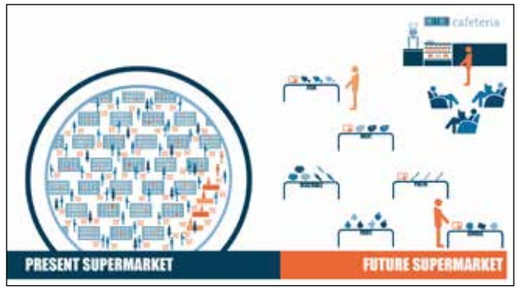


Figure 4: Traditional and future supermarket

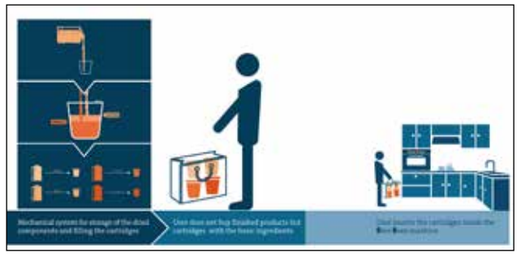


Figure 5: Mechanical system inside the supermarket

Figure 6: Advertisement of the Over Oven machine

and partly because of a new movement in favor of human scaled services. The aging population is also a key factor for delocalizing food retail points in the city. Finally, we understood that customization was the key driver of innovation.
However, analyzing the results, we realized that we would need another strategy. Most of the just introduced innovations were aimed only at embedding information technologies in the process of purchasing experience. A meeting with a representative of Telecom Italia, a partner for the project, directed us toward a more creative approach in order to bring out of the box concepts.

Exploring the opportunities

In this second phase, we therefore decided to change our approach and resort to design methods. We used two techniques in parallel to benefit from both approaches and have richer results: the “Algorithm of Innovative Problem Solving” and the “Concept Knowledge Theory”.
To implement these methods we had first to extract key ideas; we obtained them from our previous researches: customization, human scale, waste reduction and social interaction. The application of these techniques showed a possible solution capable to maintain the choice offered in a hypermarket in a small local market by selling not finite products anymore but decomposed food. That way food could be reduced to a selection of basic components rather than the whole range of industrialized products that were space consuming and waste producing.
We obtained in this way some innovative ideas, but we needed to go through another state of the art analysis, with a broader outlook: this time it lead us through a great variety of fields from cuisine to biotechnologies, from agriculture to 3D printing.

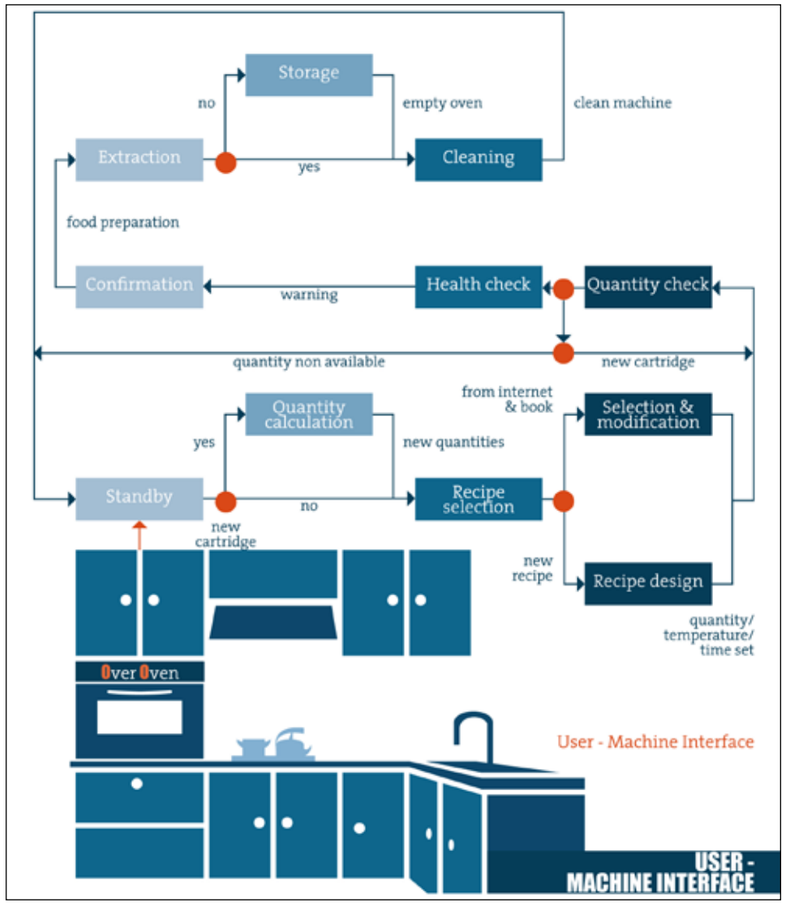


Figure 7: User-machine interface

Strengthened by this new knowledge, we could switch from targeting a product to a system design approach. Indeed, we understood that an efficient transformation on supermarket would have impacts on the whole food supply chain. We found out that chemist and chef were already studying the decomposition of food in basic elements in order to recompose it to discover new flavors, smells and textures.
To learn more about the concept we interviewed Hervé This, chemist at the French National Institute of Research in Agriculture, father of the Molecular Cuisine and, recently, of the Note à Note cuisine. In addition, many kitchen appliance companies developed programs to build food printers capable to bring automation the preparation of food. An analysis of food-related waste showed us that not only packaging, but also preparation and transportation were important factors of increase.

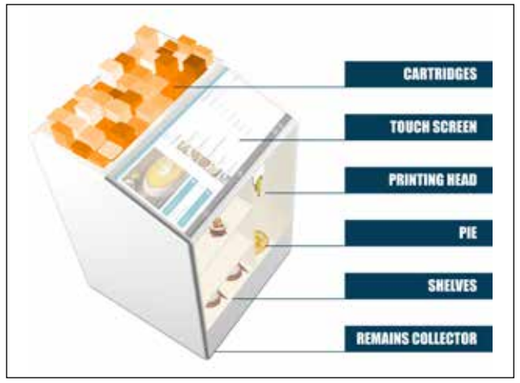


Figure 8: Over Oven machine

Generating a solution

The main concept behind the supermarket that we are proposing is that it would not be storing huge quantities of finished products but rather the basic components used to cook them. The components would be in a dried form, in big batches in order to facilitate storage and extent significantly their lifetime. Customers would directly receive the cartridges containing the ingredient for the products they chose when they are done with their shopping in the supermarket.
The space in the supermarket would be therefore dramatically modified to become more airy: since only few finished products would be exhibited, the gained space could be dedicated to education provided by experts (chefs, chemists, nutritionists). This information would be broadcasted in local retail points thanks to information technology. To improve user experience a particular care would be given to allow customers to taste and experiment cuisine in the supermarket.
Packaging would be drastically reduced since reusable cartridges would replace wrapping. At home, users would plug their cartridges of ingredients on a machine that could store the recipes of the products they bought. The interface would allow them to customize the composition of each dish according to their health requirements and tastes.
The machine, that we called Over Oven, would after “print” the food automatically. It could be remotely controlled or simply manipulated at home.
Such food production system would have important impact of the food chain, starting from the production phase: we found out that farmers could get the equipment necessary for the decomposition of food at good price. Powdered food imply also efficiency in transportation since water is a large percentage of food weight: our environmental analysis, focused on a cookie, showed that we could more than halve the CO2 emissions in this way. The fact that we decompose the food and automatically cook the dishes ensures also a reduction in the waste of ingredients.
Conscious that the solution was challenging, while developing it we discussed the project with important personality and experts in the related fields, as Renato Marchi (CEO at PAM) and the already mentioned Hervé This.

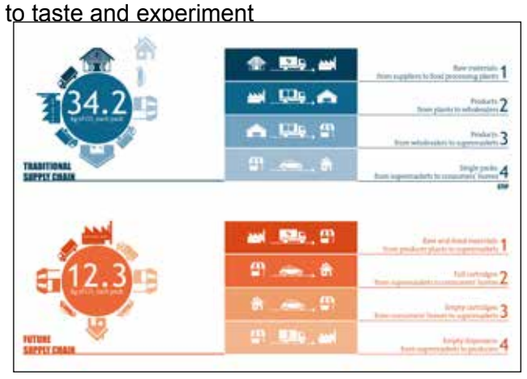


Figure 9: Environmental analysis

Smart-k

The app that will make
small knitwear companies bigger

Project

6

Smart K

Smart-k

The app that will make small knitwear companies bigger

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Project description

Smart K project focus on knitwear manufacturing, a strategic manufacturing field for Italy that crossed a deep crisis but still own a distinctive know how and heritage with notable competitive assets in the high end global market.
It aims to address the challenges faced by fashion companies in entering the digital economy, therefore underlining new business opportunities offered by 2.0 economy both to traditional brands and NewCo.
In fact, the project offers to a fundamental field of expertise in Italian manufacturing a bridge to 2.0 technologies for overcoming criticalities and market barriers characterizing contemporary global competition and affecting especially Italian SMEs. Moreover it exploits the chances of implementing a new possible organizational paradigm based on a networked and hybrid model, integrating technological resources already available in a more effective way.

The partners

The two partners for the project are a small knitwear company and TXT Solution a software Italian group.
Sartoria Vico is a brand of knitted clothing and accessories founded in 2005 in Milan by a group of designers, with a specific training in industrial design. It is a very innovative company both in product concepts but also in approaching the on-line retail channel, which is the main source of their business. In growing up and being based in out-sourcing production, Sartoria Vico is presently facing a big challenge in managing effectively the supply chain in its connection with the e-commerce platform.
TXT Solution is a software house specialized in systems for the management of information flows and planning, product development and retail processes. Precisely in this area, major international players like SAP are often inadequate to respond with sufficiently flexible and customized solutions to the management of a cycle that, for its seasonality and streams, is entirely specific. Taking advantage of this inflexibility, TXT, a small software-house boutique, is now a recognized leader in IT systems for Product Lifecycle Management and Retail Management, with offices in seven countries, and has clients like Adidas, Luis Vuitton, Bottega Veneta, Tod's.

The solution

The smart K App aims to bring Italian knitwear SMEs, such as Sartoria Vico, into a new scenario where fashion independent brands can find in digital technologies alternative solutions in terms of supply chain management, communication and retailing for their growing and internationalization. The App designed integrates into an easy and usable tool all processes today managed with heavy data entry and time spending activities. It merges already implemented technologies, such as TXT ones, into a new platform that can be easily shared and used by their present network and suppliers working in different product development and retail phases.

Tasks and skills

Giorgia Cammi - she has been the coordinator of the team for the entire project. Since the beginning she took the lead, and managed logistics and accountings too.
Jimeng Li - approaching the textile industry has been easy for the whole team thanks to his deep experience. His passion guided the definition of the concept.
Alberto Viarengo - he has been the reference point for the presentations since the starting point. During the project he developed a strong interest in the business side of the analysis.

Abstract

In Italy, small and medium knitwear companies are the ones suffering more the ongoing economic crisis. While International fashion brands have kept on exploiting economy of scales and delocalization strategies, small players have not been able to defend their share of market. Even if they own extraordinary skills and expertise, often they are not able to take any advantage from that. Their traditional way of thinking prevents them to adapt to new trends.
Smart-K is an app specifically developed on their needs; it is thought to enhance their ability to face the increased competition. The application brings several benefits. First, it increases the internal efficiency of the company. It enables faster and more reliable internal communication. Second, it makes easier to do networking among companies, bringing many small players to a critic dimension. This kind of improvements refers to all members, or potential members, of the supply chain. Third, it discloses new opportunities and profitable segments to serve.
Basically, everyone knows that social media have been the force that shaped a new way of doing business in the last years. Smart-K is going to make small and medium knitwear companies part of that revolution. The report describes the functions of the Smart-K community and its ability to

keep each user in contact with the others. The project has a strong scalability and it does not require heavy investment to be developed since it is fully based on a web application. Moreover, rather than developing a new architecture starting from scratch, Smart-K collects functions similar to the ones implemented by famous software suites, modifying the specifications to perfectly fit the needs of small and medium enterprises. The result is a light and easy web-based application with great potential.

Understanding the problem

Italian fashion sector is one of the most famous in the world. Italian luxury brands are worldwide appreciated. The success began in the sixties thanks to the abilities of local artisans. These abilities have kept growing and today are a peculiarity of many small-medium factories. Most of them are part of fashion districts, which are networks that do not just come from the willingness to compete, but also from the willingness to cooperate. The small size of the companies building districts gave to Italian brands the **flexibility** to deal with a very unstable sector as fashion, leading the global market for years.
Unfortunately in the last years flexibility has not been enough; Italian

Workshop in Berlin

fashion sector started suffering a structural crisis. Considering the fragmentation, small and medium companies will have hard times in competing against big foreign players. SMEs could achieve a strong position by serving specific segments of the market, however customer's tastes are in constant evolution and reliable long-term sales forecasts are impossible. Consider that the fashion industry was characterized by two productive phases, Spring-Autumn collection and Fall-Winter collection; now has deeply changed. The introduction of fast fashion model, and the delocalization of the production to low labor cost countries, really changed the boundaries of the competition.
The massive introduction of Information and Communication Technologies (ICT) has been a second big breakthrough in the management of the value chain and of the retail system of big players. Fast fashion companies are extremely interested in having short time-to-market and updated sales data. Thanks to ICTs the flow of information from the retail to the management, bottom to top, is faster than before; the integration of tools like PLM or ERP makes possible to shorten the time-to-market and handle several collections per year.
Smart-K project aim is to give a real help to Italian knitwear companies in

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facing this new global market competition. Small and medium factories need to speed up the value chain and reduce costs immediately, avoiding outsourcing and quality reduction. The target is to be more effective on the market by offering to the customer the products with the right quality-price ratio as soon as a new trend appears. A higher level of integration into the knitwear value chain, introducing advanced ICTs tools, is paramount.

Exploring the opportunities

The typical value chain of a knitwear company is complex. Moreover the several player of the chain are usually geographically dispersed.
Smart retailers want to be focus on selling knitwear, and transferring as much as possible of the rest of the supply chain activities onto its suppliers. So the **"lean retailer"** was born, which calls upon the supplier to offer a full package service. Upstream, this means taking responsibility for sourcing yarn and knitting fabric. Downstream, it means organizing the logistics and transportation, and delivering the items to the retailer's warehouse or even stores in a "ready-for-sale" packaging. Retailers are increasingly cutting out agents and doing business direct with manufacturers, who are expected to provide a much wider range of support services and facilities. A supplier must be able to co-ordinate and run several stages along that chain, instead of being responsible for only one part of the value chain. This demands a high level of integration, and **suitable management systems and information technologies** to make it possible. This trend offers an opportunity to move into higher margin activities, improve profits, and establish niche services too.

Moreover, products are no longer ordered 10 months in advance. Retailers now use electronic point-of-sale barcode technology to collect and process huge quantities of data. They know exactly what the customers are buying and how each product is performing. In a business where speed-to-market is paramount, the supply chain must be highly integrated to overcome geographical dispersion.
A proper **flow of information** must be ensured to bind together the knitwear supply chain. ICTs tools are the ones that provide efficient information sharing process taking advantage of Electronic Data Interchange (EDI) systems or more flexible web-based platforms. Thanks to ICT tools, as the Enterprise Resource Planning (ERP) system, bottlenecks are easily solved too, enabling higher efficiencies.
The introduction of ICTs allows a firm to offer an integrated full package service, but it also provides new opportunities to capture emerging niches in a disaggregated value chain. The wide range of ICTs applications already in use within the knitwear industry goes from advanced Computer Aided Design (CAD), virtual prototyping packages, to the online handling of routine customs such as PLM application.
In conclusion, a real shift to “just in time” is possible only with the appropriate set of ICTs. At the same time, ICTs can help companies in cutting costs in the sourcing and manufacturing process

The solution

Smart-K solution is a web-based application able to enhance the information flow in the knitwear value chain. We understood that real time information exchange is a key point in speeding up the knitwear value chain, and a web-based application is the best way implement it, avoiding heavy investments.
The main characteristics of Smart-K app are:

- **Enhanced collection management**: Smart-K application allows Fashion Houses to build a versatile on-line catalogue. The catalogue can be used in the designing phase to store projects, in the production phase to check in real time manufacturing progress and in the selling phase;
- **Creation of a community** of knitwear factories, fashion houses, retailers and customers: each user manages a profile with specific functionalities to stay in contact with its present and future partners, or customers;
- **Improved orders management**: When a new collection is ready to be sold, it can be made available online through to the catalogue. Retailers can be informed in real time, check new collections, directly order new items from the application, or ask for an appointment to see the garments;
- **Real time sales data**: To apply RFID labels on the garments is simple and cheap. Smart-K application can be in communication with RFID readers so that, when an item is sold, the application will automatically update the information;
- **Enhanced communication** between designers and craftsmen: The online catalogue can be used to share projects and ideas for the upcoming collection between designers and craftsmen;
- Simple and effective **product lifecycle and inventory management**: Smart-K app catalogue is a simple and effective way to take under control every aspect related to the designing, production and selling phase of an item.

Bibliography

- S. Saviolo and S. Testa, *Le Imprese del Sistema Moda*, Rizzoli, 2005.
- S. Felicioni and C. Bonora, *The textile-clothing industry in Italy*, Fondazione Istituto per il Lavoro, 2006.
- G. Calcagnini and I. Favaretto, *The Italian Small na Medium Sized Firms in the Aftermath of the Crisis,* Conributions to Economics, pp 87-111, 2012
- A. Ricciardi, *I distretti industriali italiani: recenti tendenze evolutive*, Sinergie, Vol 91, pp 21-58, 2013.
- D. Alampi, L. Conti, G. Iuzzolino and D. Mele, *Le agglomerazioni industriali italiane: peculiarità strutturali nel confronto internazionale”*, Atti del convegno Banca d’Italia “Le trasformazioni dei sistemi produttivi locali”, Università di Bologna, 2012.
- A. Osterwalder and Y. Pigneur, *Business Model Generation*, John Wiley & Sons, USA, 2010.
- A. P. Palladino, *Zara and Benetton: Comparison of two business models*, MSc Thesis, 2010.
- Bertola, P.; Colombi, C. (Guest Editors), *Fashion Practice - Fashion Made in Italy Special Issue*, 6(2), Bloomsbury Publishing Plc, London (UK), November 2014.

D-VERSE

The Space Park

Project

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D-VERSE

The Space Park

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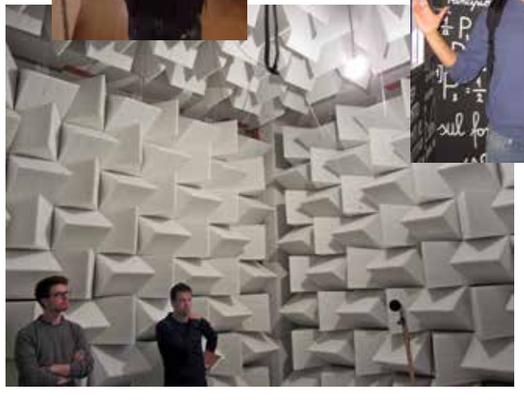

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Project description
The twentieth century has been a period marked by many important historic events but undoubtedly one of the biggest steps for humankind has been the start of the space exploration and the numerous achievements of the astronomy and aerospace engineering worldwide. Through the work of thousands of scientists and researchers, we came to understand some of the biggest mysteries of the Universe and at the same time to push the limits of innovation and technological development. However, for the general opinion, this field of studies is very distant from everyday life and often shares its boundaries with science fiction. Even though today we live in a highly automated world, only few of us know how many objects and technologies surrounding us have come as a result of the aerospace research and development.
The aim of the project *D-Verse (Dive into the uniVerse)* is the creation of a *bridge* between everyday life and the complex sphere of space science and innovations. The best way to achieve this connection is the development of a technology park that can help people: **understand** the world of the space environment; **learn** about astronomy, astrophysics, space engineering; **be conscious** about Italian and European space programs; **discover** how largely space technology supports and enhances daily life; **make enterprises meet** and cooperate to rise potential new businesses; and **host** special events and conferences in the field. The project looks at visitors from all ages and fields of expertise: students, families, professionals, multidisciplinary enterprises as well as the scientific and civilian community. The main objectives for the experience inside the technology park are: **flexibility** in the method of exploring contents and exhibitions, **interaction** and various ways of understanding the showcased technologies and objects and **simplicity** of the presented complex scientific materials, adaptable for different levels of expertise.
The physical space selected for the development of the technology park is

Figure 1: Corporate Identity (Edited by team D-Verse; *Mockup photo by Cristian Rivas*)

Villa Confalonieri and the adjacent public garden, located in the city of Merate (Lecco, Italy), close to one seat of the *Astronomical Observatory of Brera*. To both activate the city life and revitalize the historic building, the project *D-Verse* proposes also a new culture centre for Merate that can be beneficial for the whole community. Finally, the project attempts to create a meeting point for the entire aerospace sector in Lombardy, able to unite the various actors and connect them through series of events, conferences and workshops held in the premises of the technology park.

Tasks and skills

Chris David Bucciarelli visited *Smithsonian Air and Space Museum*, worked on SD2 drill research and set-up, worked on the contents for the *Dive into the Universe* section.
Paolo Colbertaldo maintained relations with tutors and partners, defined and created the surveys, worked on SD2 drill set-up. He designed the *Sound of Space* module, was in charge of the economic feasibility and participated to a workshop on Interactive Art and Augmented Reality.
Niccolò Ludovico Coscia was responsible for the actor analysis, helped defining the online survey, worked on SD2 drill set-up. He worked on the permanent exhibition contents and quantified sustainability-enhancing solutions for the buildings.
Giuseppe De Nittis studied augmented reality and its feasibility, testing different applications and learning the software *vvvv.* He contributed to the IT aspects of the spin-off module and drafted the *Rosetta's journey* app.

Figure 2: Website, Twitter, Pinterest and Instagram pages (Photo Edited by Team D-Verse, *original photo http://www.messinasportiva.it/wp-content/uploads/2014/01/Messinadi-corsa-responsive-showcase-mockup.jpg*)

Martina Deneva defined the exhibition design, interior spaces and visitor experience and realized their visual presentation through 3D models and renderings. She collaborated in developing the *Sound of Space* module and the branding strategy and identity.
Alberto Stracuzzi analysed *Infini.To astronomy and space museum*, worked on the mechanical design of the microgravity simulator, worked on SD2 drill research, set-up concept and module design.
Lorenzo Trucato worked on the territorial and historical analysis, defined the philosophy of the architecture intervention and designed its formal and technical aspects.
Ilaria Vitali defined the interaction scenario, worked on mood definition, branding and graphical elements. She fully designed and prototyped the spin-off module, helped with visual materials and with the SD2 module. She learnt the software *vvvv* during a workshop on Interactive Art and AR.
Andrea Vivani was responsible for the microgravity simulator design, worked on SD2 drill set-up, designed the *Sound of Space* module, contributed in sustainability-enhancing solutions for the buildings.

Figure 3: Permanent exhibition - Introduction Area - Render

Figure 4: Permanent exhibition - Section *Space around us* - Render

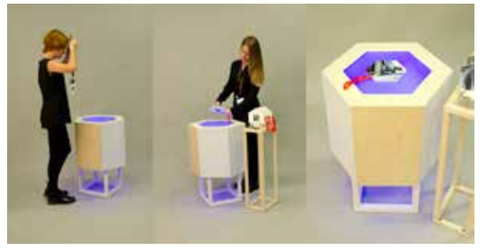

Figure 5: *Space around us* - Interactive module *Spin-off* - Prototype Photos (Team D-Verse; Photos by Stefano Mattiocco)

Figure 6: Permanent exhibition - Section *Dive into the Universe* - Render

Abstract

Space has always captured human imagination ever since the most ancient civilizations, but it was only in the last century that science evolved to the point where the actual space exploration could start.
Nowadays astronomy and aerospace studies are among the most advanced fields of research and development in the world. The extreme conditions in the space environment require innovative solutions that often find a secondary application on Earth. This is how spin-offs were born: technologies initially developed for use in space have been transferred to assist our daily activities. The pacemaker, the memory foam and the fire extinguisher are only few examples of the thousands of spin-offs present in our life, but not known by people.
Historically Italy can be considered one of the most important cradles for astronomy where the constant work in this field gave birth to a large number of companies in the last century. Their contribution to Italian and international space projects is very important but not effectively presented and to the general public and widely unknown.
Having that as a starting point, the D-Verse team was asked to develop a technology park dedicated to astronomy, space exploration and science in the city of Merate, Lombardy. The project, called Orbita, is characterized by different levels of complexity, requiring multidisciplinary competences: architecture, interior and product design, computer engineering, mechanical and energy engineering, economics and management. The developed solution attempts to answer the needs of all actors, innovating the experience of each of them and providing feasible solutions.
Orbita Space Park is a threefold soul entity:

- a meeting point for all actors in the aerospace field in Lombardy, promoting coordination and development of new projects;
- an astronomy and space museum, proposing an engaging and innovative way of learning the story of space exploration and technology;
- a new culture centre for the city of Merate, reviving the economy and attracting tourists.

Understanding the problem

The aim of the *D-Verse* project is to fill the gap between common mind-set and actual space-related activities, making people conscious about the importance of space research. The project was supported by three partners: *Municipality of Merate*, provider of the building and interested in the opportunity of creating an important cultural centre attracting new visitors and funds; *Astronomical Observatory of Brera*, willing to promote their activities in space science and observation; and *Selex ES*, supplier of scientific know-how and interested in highlighting the Italian role in the international space exploration.
To understand all problems related to the project, the team had to identify its various levels of complexity.
The first challenge was to research how the topics of astronomy and space exploration are presented in existing institutions worldwide by using them

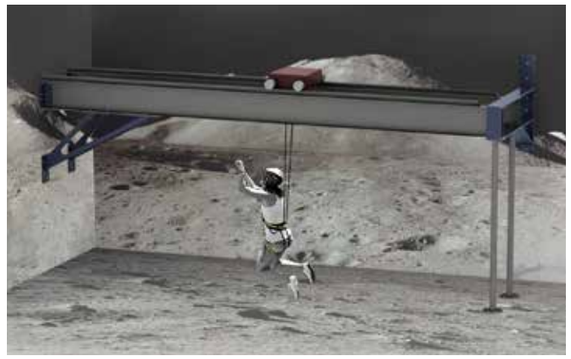

Figure 7: *Dive into the Universe* - Module *Discover the Comet* - Render

Figure 8: *Dive into the Universe* - Microgravity simulator - Render

as case studies. Then the team had to analyse the characteristics of the territory of intervention – Merate, Lombardy – including the connection with existing astronomy institutions in the region. Following was the problem of the missing exhibition collection and the need to select and curate possible museum contents. Next was the request for complex architectural and restoration work in the Villa in order to adapt it to the chosen contents as well as the exhibition design and study of possible interactive technologies that can be integrated in the concept. The team then went into further details by developing specific solutions such as interactive modules and simulators. Finally, the concept had to be made feasible in an economic, environmental and social way, considering both the requirements and the ideas provided by the partners.

Exploring the opportunities

Starting from the numerous and different requirements of the project, the team investigated the problem from different levels and multiple points of view.

Other museums, spin-offs and the Italian contribution. International and local institutions have been analysed. On one side, the *Smithsonian Air and Space Museum* in Washington DC, the *Cité de l'espace* in Toulouse and the *National Space Centre* in Leicester. On the other, the *National Museum of Science and Technology* in Milan, *Volandia* in Varese and *Infini.to* in Turin. Specifically, we considered their position, contents and interacting modes. The final proposal wants to avoid competition with other institutions of the region and to promote a collaborative network. Main objective is to show the bridge between space-related technologies and everyday life, through the spreading of knowledge about the Italian contribution to space development and the utility of space spin-offs for the quality of life.

The opinion of potential visitors. An online questionnaire was the first key to understand users' ideas. Students, teachers and common people explained their interests and expectations. The results show that people are curious about space topics even though they know just a little about them. To better understand how to harmonically insert the park in Merate, a specific questionnaire was submitted to citizens. The outcome is that there is low awareness about activities and public events of the close *Astronomical Observatory of Brera*, but there is a vivid interest.

Interactive and edutaining solutions. The relationship between visitors and exhibits have been deeply examined through examples and case studies and several different applications designed for augmented reality experience have been tested. This has led to the introduction of the *fiducial markers* (FM), special codes able to create personalized effects in specific installations.

Generating a solution "Technology for space, development for Earth."

The proposed final solution is *Orbita*, a three-soul technology park. A renovated garden and temporary shows to revitalize the town life; an interactive permanent exhibition to diffuse space culture focusing on spin-off technologies; a place for meetings and events to create a network among companies and research centres, allowing the encounter between people and experts. According to the vision, the main purpose is to spread knowledge and support development. The key features are interactivity and customization: the park offers an experience that is personalized at various levels. A detailed design of the permanent exhibition has been performed. A wide presentation of space physics and exploration follows a section showing the benefits of space research for daily life. Both the past and the current use of the most interesting spin-offs are presented in the *Space around us* section within interactive modules that offer dedicated contents depending on the visitor, who has been given a classified FM at the entrance. Space environment and space missions are illustrated with interaction too: the *Dive into the Universe* section ranges from the fascination of astronomy to the most recent discoveries like Rosetta, passing through the physical experience of microgravity with a simulator and of silence in the *Sound of Space* anechoic chamber.

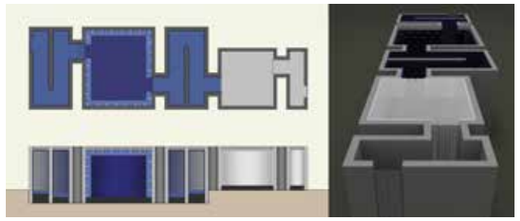

Figure 9: *Dive into the Universe* - Module *Sound of Space* - Plan, Section, Render

To match the technology park with the available location, an enlargement and a renovation of the villa are needed. The enlargement creates a huge elliptic hypogeal structure covered by a water mirror, reminding the shape of planet orbits. A non-invasive intervention combines the historical identity of the building with the new contemporary and technological contents. The choice is to preserve and create a dialogue between old and new, exploiting the underground spaces to host the permanent exhibitions and keeping the atmosphere of the noble parts of the villa.

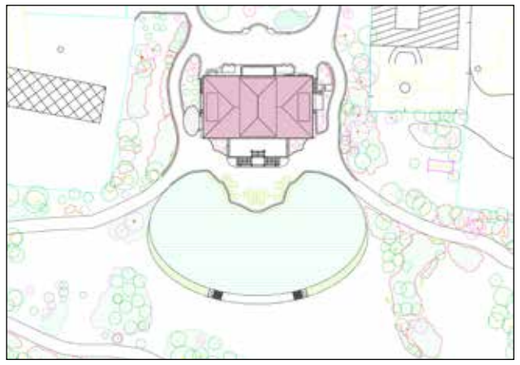

Figure 10: Architecture Intervention - Plan

The design has not been just theoretical: exploiting simple but effective technologies, the team developed a working prototype of the spin-off modules, which is the first step towards an actual realization of the technology park.

With an edutaining approach, *Orbita Space Park* wants to attract curious people and make them feel the Universe, because *"The impact of space activities is nothing less than the galvanizing of hope and imagination for human life continuum into a future of infinite possibility."* (V. Bonta).

Bibliography

[1] *Spinoff: an annual publication*, National Aeronautic and Space Administration, 1976-2011

[2] M. Fiala, *ARTag Revision 1. A Fiducial Marker System Using Digital Techniques*, National Research Council Canada, 2004

[3] S. Karaman, A. D. Bagdanov, G. D'Amico, L. Landucci, A. Ferracani, D. Pezzatini and A. Del Bimbo, *Passive Profiling and Natural Interaction Metaphors for Personalized Multimedia Museum Experiences*, ICIAP workshop, 2013

WATT

Waterways for Territory Transformation,
a methodological approach
to urban and landscape design

Project

8

WATT

Waterways for Territory Transformation, a methodological approach to urban and landscape design

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Figure 1: Team WATT members.

Project description

Expo 2015 and the related Waterways and Park Plan (Le Vie d'Acqua e Il Parco dell'Expo) entail major landscape regeneration outcomes in the north-western territory of Milan metropolitan area for the future years to follow the end of the event. The new waterway project, in fact, was conceived also to connect the Expo site to a larger infrastructural network of existing rivers and canals with a high potential to enhance the environmental qualities of the territories and to drive a new social and economic development of the area.
Triggered by the needs of the "Patto per il Nord Ovest" Authority - 16 neighbouring municipalities crossed by the new waterway - and on their common concerns towards the Expo 2015 transformations, and with the aid of Centro Studi PIM (Programmazione Intercomunale dell'area Metropolitana) consultancy, the WATT Project offers a double contribution: on the local scale, a masterplan proposal for the area affected by the planned Via d'Acqua canal, in order to enhance its economic, social and environmental sustainability through participation; on a wider scale, the on-field development of a possible methodological approach to understand and recover the forgotten role of waterways as manifold resources to drive and lead change in urban planning.
The meta-design project, albeit on an urban scale, aims to connect, in a larger programmatic framework, existing potentials and features to the regional scale of the Milan Waterways in order to enhance quality of space ad define new fruition opportunities. The work is based on the hypothesis, validated through the historical analysis of the territory, that waterways have, since ancient times, defined the character of the landscape, a role which should be thus rediscovered and improved in order to attribute a renovated identity and significance to the place.
Therefore, a multi-scalar multidisciplinary approach is applied to explore the diverse meanings of water as a resource to produce and store renewable energy and to be recycled according to Water Sensitive Urban Design solutions, as well as for its symbolical and ornamental properties in the design of public spaces. Moreover, the possible upcycle of the Expo 2015 pavilions through three strategies is experimented in order to tackle with both environmental and economic issues. In addition, the proposal is completed with a thorough investigation of a varied range of policies and practices to involve people's participation in the feasibility of the project over time.
Finally, the WATT Project approach, even though developed for the specific case study, offers the possibility for the scaling up of the experience. The proposal should be therefore intended as a first step for the definition of guidelines and methodologies aimed at recognizing an important role, in urban and large scale planning, to water bodies, whether canalized or natural, and to advance a programmatic and technical thinking on the destiny of watercourses as a resource to envisage eco-compatible and sustainable horizons for managing change in contemporary landscapes.

Team description and skills

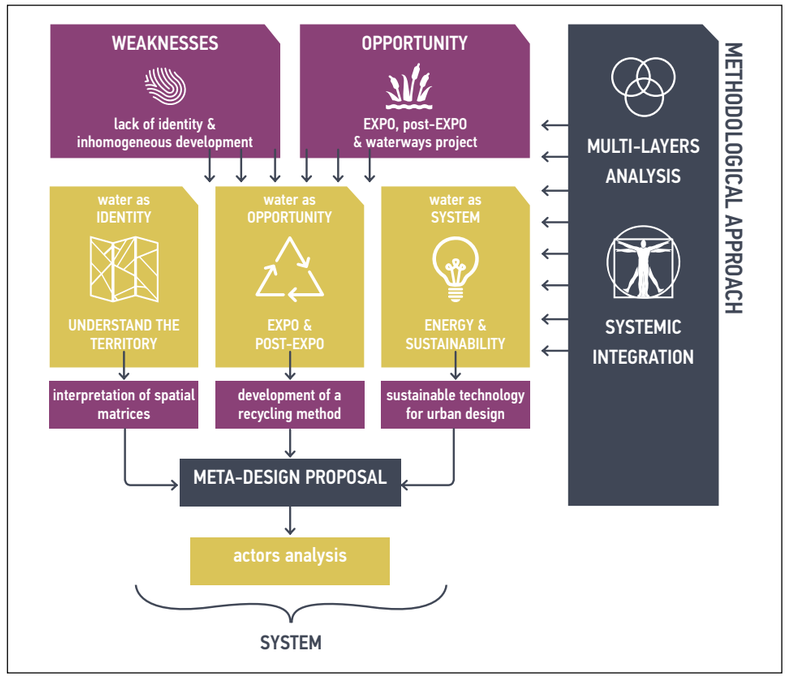
Sara Borchiero supported the other teammates in the definition of the methodological scheme, in the study of territory layers and in the definition of the master plan. She analysed the user participation methods to be applied

in the master plan and the referring case study.
Antri Pantelide took part in the identification of the different layers for *Reading the Territory* section and in the tracing of the analysis maps. She also contributed in the definition and description of the six nodes that are part of the final master plan of the project.
Anna Pichetto Fratin dealt with the definition of the methodological scheme adopted in the project and with the study of the territory layers. She also helped in organizing the background information and in drawing the final maps of the project.
Ivaylo Vladimirov Nachev took part in the identification of the different layers for *Reading the Territory* section, studied the background of the territory and the six points along the waterway drawing a matrix of state of art, problems and opportunities throughout the defined methodology.
Alberto Re took part in the first studies of the territory; he analysed the upcycling of Expo pavilions, envisioning and examining consequences on the WATT Project.
Davide Resnati worked in the analysis of the territory layers and, later, in the investigation and the development of feasible solutions for the energy production along the waterway.
Francesca Sorli worked as coordinator between different team mates' work, taking into account the general organization. She analyzed the different stakeholders acting in the territory and she helped to complete maps' drawing up.

Abstract
EXPO 2015 propose itself as a strong agent of change for the north-western Milanese area, giving a wonderful occasion for the transformation of the territory but, on the other hand, forcing to deal with various issues which characterise the area. Marco Biraghi and Silvia Micheli in *"Storia dell'architettura italiana 1985-2015"* [1] already expressed potentialities and problems related to Expo 2015. The site, *"in the black heart of the post-industrial Brianza"*, according to them is one of the most industrialized, environmentally downgraded and polluted area of the Milan suburbs [2]. This, from one side, represents a big problem of integration between the Universal Exposition planned for the year 2015, the site itself, the whole area and the society, but from the other it gives a big chance of change. In this difficult territory a new channel, the Via d'Acqua, has been planned – but not realized yet. The new channel itself represents an environmental, architectural and social opportunity of change of a land which is now lacking of a common identity and of a common systemic project of development.
WATT – Waterways for a territory transformation aims to that. Starting from an analysis of the different layers that compose the territory, bound together by water as a unifying element, together with an analysis of the actors involved, the WATT project tries to give an answer to the needs of the territory and the society.
The multidisciplinary approach is here fundamental, given the manifold nature of the context in which the project has to be conceived. As Giancarlo de Carlo in 1969 said, *"Architecture is too important to be left to architects"*; different suggestions should come from every stakeholder and they should be integrated in a project which should not involve only architectural and urban planning experimentations but also social and technical skills. In a society that gets more complex every day, equally complex solutions coming from the integration of different fields are needed.
The project developed along the Via d'Acqua by the team takes into account and tries to integrate in a common outcome problems of green energy production, urban and landscape design, lack of common identity, dismantling of Expo pavilions, social involvement, using "water" as core element in order to re-establish the ancient connection which it had with the territory.
In the area along the new channel some focus points have been identified and analysed in order to define potentialities, unified in a programmatic framework and a masterplan of a new urban public area.

Understanding the problem
WATT project focuses on the territory transformation of the area interested by the Vie D'Acqua project; looking at the suburban Milanese territory as it is today, it is possible to recognize an irregular urban development that created a need to reconnect the different parts of the territory, in order to restore its lost identity. The development of this proposal with the aim of finding the optimal way to shape the territory exploiting the water element has been carried out with a specific methodological approach which allowed to correctly consider the manifold nature of Vie D'Acqua project, which is set in a complex territory like the north-western Milan area.
The starting point has been a weaknesses/opportunities analysis, which helped us to identify the needs of the area and the framework for which the project has been conceived. In particular, the Milan suburbs along the Via d'Acqua is characterized by a strong non homogeneous disorganized urban development, which is also the main cause of the lack of identity that has been pinpointed and which will become one of the main purposes of the research. On the other hand, the EXPO and the area in Rho municipality assigned for the universal exposition represent a big opportunity for changing and renovating the territory itself: the needs for an integrated action and for the reconstruction of the area's identity, based on the matrices which defined this territory in the past, are two of the core points which drive the design stage of the project. Especially, water has been recognized as one of the most important layers featuring the area. As historical maps show, most of the settlements developed along rivers and canals, widely present in Milan and its suburbs, being also the main means of transportations and source of life for agricultural activities. Water has been the driver of urban economic development.

Figure 2: Scheme of methodological approach.



Exploring the opportunities
As a conclusion of the analysis part; three different keys to interpretation have been provided to the "water element". First, water has been declined

as element of *identity* in order to understand the development and organization rationales of the territory and then as interpretation, of the morphological layers which structure the area and give a clear image of the matrices at the basis of the territory design. Secondly, water has been identified as element of *opportunity*, especially related to the year 2015, when the EXPO will take place. This important event will create the chance to develop some projects aimed to enhance the identity of the area, now partially lost, and water can also be considered as a solution to tackle with some EXPO-related issues. In the EXPO guidelines, though no instructions are defined, a special request to indicate the management and the dismantling of the pavilions and the possible reuse of the materials is expressed. As third and final key to interpretation, water has also been identified as a *system* which can provide green energy. Since the final proposal is an integrated project for the area, water could be envisaged not only as a natural and artistic element but also as a source of renewable, clean and reliable energy.

Generating a solution

In the final part of the project, all these separated aspects of this fundamental element, which is water, are unified and integrated again into a meta-design proposal for the area. In particular, the project concept faced the problem of the lack of identity of the Milan suburbs, with the aim of reconnecting a fragmented territory, rebuilding its relationship with the water element, which has been lost through the modern urbanization process. Hence, EXPO 2015 offers the opportunity to enhance the image and identity of the area, strongly connected with the water element which is the

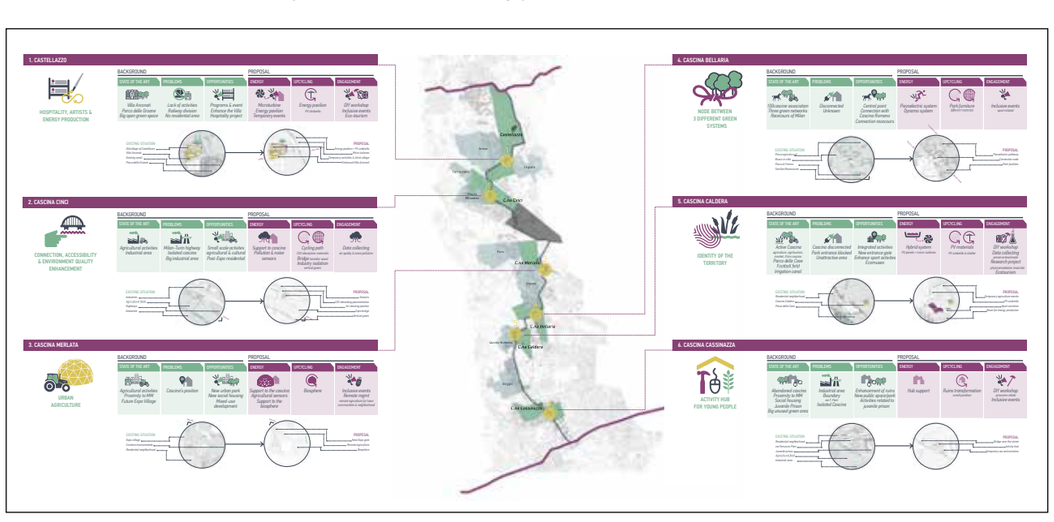


Figure 3: Scheme of Meta-design proposal.

morphological layer that since the beginning of urbanization connects land and people.

Specifically, the meta-proposal matrix resulted by the the synthesis of the different composing elements of the Milanese territory is translated into a master-plan for the new waterway. The main effort is to provide a framework and some particular guidelines for the possible activities that the waterway can accommodate along its course through the landscape. This master-plan is focusing on six points that are proposed to function as nodes in the Via D'Acqua system. The six nodes (Castellazzo, Cascina Cinci, Cascina Merlata, Cascina Bellaria, Cascina Caldera and Cascina Cassinazza) are selected due to common homogeneous criteria and to their more specific and unique features. Most importantly all of the six nodes are parts of other physical and service systems and networks, and work as intersections/ interactions between the different networks with the new system of Via D'Acqua. An investigation was carried out for each of the points to explore the current situation, the main problems and possible needs - opportunities that characterize each specific point. This analysis led to the shaping of a complete and integrated proposal for each point involving almost all of the topics developed in the project: ***functional enhancement, energy production, energy usage, upcycling and user engagement***. The main concept is to develop all the topics whenever it is possible in the Via D'Acqua *macro*-scale and in each node *micro*-scale. All the nodes will become part of one new system: Via D'Acqua, with various functional objectives but with a persistent and systematic proposal corresponding to the four developing topics of the project. The systematic approach suggests to foster energy production whenever possible in the system of Via D'Acqua and to provide energy to the various parts of the project. Upcycling is applied in each node in a different way but the concept is to apply it also in the macro scale of the project shaping for example the cycling and pedestrians paths with various elements. Finally through a systematic effort we reinforce the user engagement concept with the promotion of co-design, social networking, data collecting and eco-tourism.

Conclusions

The multi-layered analysis method applied for describing the Milan area was rather new and applicable not only in this particular context, but similar studies could be undertaken for any other city. The bid made was to develop a methodology able to analyse critically an incoherent territory in order to set the framework for a development project strictly related to the territory where it is requested.

Together with that, an analysis of the different stakeholders, of their needs and their problems, have been conducted for planning a new public space which would eventually fulfil these requirements.

In this complex context, Expo 2015 comes to the fore as an opportunity of change, and the WATT project tried to deal specifically with the construction of the new channel Via d'Acqua, using the element water to start a deep territory transformation and, at the same time, transforming in opportunities the problems related to the dismantling of the Expo pavilions.

However, the WATT project does not aim to be only architectural. Problems of green energy production were also considered and suggestions of possible assets to experiment in the new channel were explored, as well as, the problem of users involvement was tried to be solved particularly looking to some virtuous examples such as the IBA project for Hamburg.

All the aspects analysed in the research phase were then unified in a programmatic master-plan, which considered some core-points arose from the previous territorial investigations. The final output attempts to be not only an architectural project, but the definition of a linear public space which unifies together all the aspects examined in the first chapters of the research.

Bibliography

[1] Marco Biraghi, Silvia Micheli, *Storia dell'architettura italiana 1985-201*, Einaudi ed, Torino 2013
[2] Ibidem, p.325

SYN DYAG

Development of a system for 3D face comparison
aimed at medically diagnosing rare diseases
and syndromes involving face dysmorphisms

Project

9

YNDROME IAGNOSIS

SYN DYAG

Development of a system for 3D face comparison aimed at medically diagnosing rare diseases and syndromes involving face dysmorphisms

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Turin, 20/10/2014. Antonino and Daniele working on the project at PoliTo. Autore: Rosario Sicari

Milan, 19/11/2014. Cristina and Marina working on the poster at PoliMi. Autore: Antonio Froio.

Project description
SYN DYAG, SYNdromes DIAGnosis, is a project devoted to the development of a system for 3D face comparison aimed at medically diagnosing rare diseases and syndromes involving face dysmorphisms in a prebirth phase.
The concrete problems we had to face since the beginning, and that made of this project a hard challenge were: the necessity to think to a very valid proposal in order to gain the confidence of doctors and obtain the ultrasound-scans of fetuses; the need to properly process the points cloud generated by the scans; the need to identify the most significant landmarks for the syndrome we wanted to study; the necessity to think to a method to do a reliable diagnosis.
In a context in which the research activity in medical and diagnostic field is still largely opened, and a standard procedure to elaborate the points cloud, extract the landmarks, and allow a reliable clustering operation, does not exist, our system allows a completely automated procedure that links all the just listed operations in a unique software easily usable by doctors in their diagnosis operations, thanks to a very user friendly interface, studied on the basis of their own necessities.

Milano, 22/11/2014. All the team members. Autore: Francesca Gasperoni.

Milan, 19/11/2014. Antonio and Luca working on the final presentation at PoliMI. Autore: Cristina Vicini

Milano, 19/11/2014. Luca and Rosario working on the final presentation. Autore: Marina Rinaldi.

Tasks and skills
Luca Bonacina, sound engineer, used his competencies in digital image processing developing the algorithm for the creation of the threedimensional image starting from a stack of 2D sonographies;
Daniele Conti, postgraduate in physics of complex systems, made the clustering algorithm used to assign, with a certain degree of confidence, a scanned face to a disease. He also realized the website;

Figure 1: An example of smiling baby affected by Cleft-Lip.

Emanuele Del Sozzo, computer science engineer, provided useful tips for the creation of the algorithms, in which a deep knowledge in computer science was required;
Antonio Froio, nuclear engineer, shared with the team his methodological approach in solving problem, offering also a useful help in the design of the algorithms;
Francesca Gasperoni, mathematical engineer, tackled the main issues of this project providing her deep knowledge in mathematics. She took part in the creation of the general algorithm;
Antonino Nava, aerospace engineer, collected information about the state of the art technology searching in a wide literature and suggested the proper way to implement our idea;
Marina Rinaldi, mathematical engineer, offered her help in all the phases of the work, adapting her skills in mathematics and managing throughout these two years;
Juan Sandoval Rojas, aerospace engineer, helped the team with punctual researches about technologies to acquire digital images in medical field.
He also made the revision of the poster and the report;
Rosario Sicari, civil engineer, shared his managerial skills dealing all the bureaucratic aspects of the work: contacts with tutors and stakeholders, organization of meetings, managing of work's activities and time;
Cristina Vicini, computer science engineer, was the person in office to keep contacts with doctors, providing them a questionnaire. She also offered a great help in analyzing the problem and structuring the solution.

Understanding the problem

The number of children affected by diseases involving facial dysmorphisms is still considerably high: labioschisis (cleft-lip), craniosthenosis, labiopalatoschisis are only some examples. These children have typically an hard life, often being target of social exclusion and having the need to be constantly followed by their parents for medical treatments or for a help in their every day life. The majority of them develops the disease during the gestation while the fetus is growing up: this is a crucial aspect because programming a therapy in advance may reduce the further development of the disease, decreasing the risk for negative consequences. A powerful tool for a preventive complete diagnosis is still missing: first of all a market survey was required to better understand if there was market demand for such a tool. Therefore, to get in touch with the problem, the team created a questionnaire to be sent to doctors, ultrasound technicians and other professionals in the health care sector. Firstly we asked which is the current methodology followed to diagnose diseases involving facial dysmorphisms and the most repeated answer was "sonography and practice", clearly suggesting the lack of an innovative tool for diagnosis. We then asked their opinion about which of these diseases could take the greatest advantages from the development of such a tool and the answers, confirmed by further

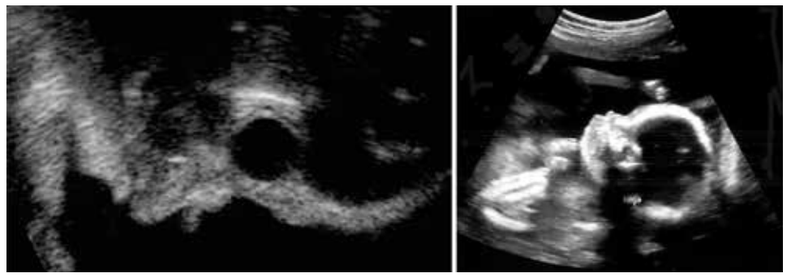


Figure 2: Examples of 2D sonography scan.

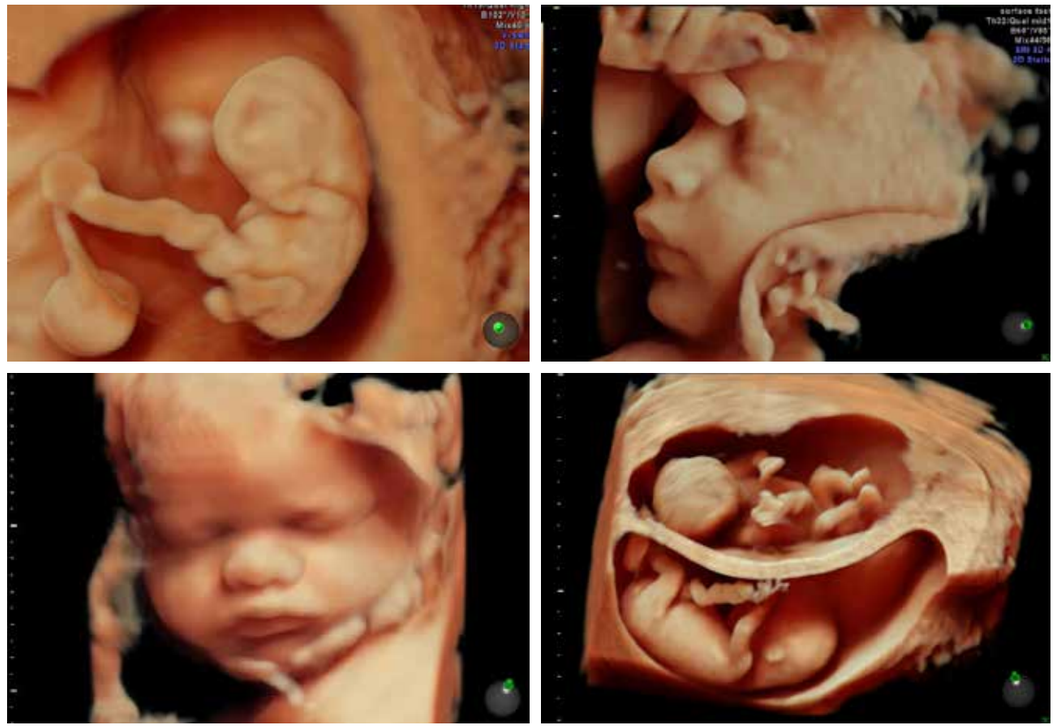


Figure 3: 3D ultrasound scans. The visual result is the best achievable today but the 3D model is not accessible.

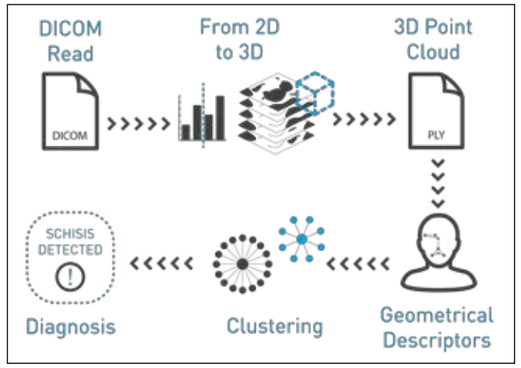
researches, focused on labiopalatoschisis or palatoschisis (because of the difficulty to get a limpid image of the palate from a sonography) and craniosthenosis. At the beginning, academic tutors proposed to focus on the feto alcoholic syndrome (FAS) and the labioschisis; but the former seems to be easily diagnosable with other investigations, while for the latter an expert ultrasound technician is able enough to diagnose the disease thanks to the current standard methodology. What stimulated the team a lot was the vivid interest manifested by the interviewed physicians in providing all the necessary information that could help the development of an innovative software to help them in performing faster and more precise diagnosis.

Generating a solution

Ultrasound scans are the most diffused machines for monitoring the fetus evolution during pregnancy; then naturally they are chosen as the preferential technology to which our software should be interfaced in order to be widespread and become the new standard as diagnosis support. The design of the software conceived to extrapolate a 3D model accounts for four different elaboration phases:
1. Preprocessing
2. 3D histogram processing
3. Data fusion
4. Post processing

The first and the last one are a refining of the 2D images and of the cloud point respectively and adopt filtering techniques to clean the fetus image from blurred details, noise and other unrelated information like the mother's tissues. The innovative core of this algorithm is the 3D histogram processing, where the image edges are detected analyzing with a cubic kernel the ultra sound scans. Thanks to a statistical analysis of the pixel intensity distribution,the stack is thresholded, binarized and the point cloud is extracted.

Figure 4: An overview of the SynDiag algorithm.



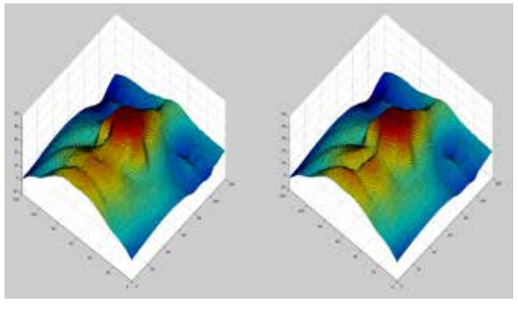
Once the cloud is available, it is very easy to obtain a mesh describing the face surface and compute at any of its point the value of mathematical descriptors useful to quantify the surface shape. In such a way one has available an objective description of the different face areas that can be used to highlight the so called face landmarks: fundamental points, common to any face, like the nose tip or the “labrum superior”. They carry the important information discriminating between healthy and affected by a pathology individuals. Thus, for further analysis, any face is parametrized by values assumed by the geometrical descriptors in those points. This new way of reading faces throughout their landmarks allows a direct comparison performed by an unsupervised clustering algorithm. The innovative methodology here developed adopts the so called D-MST algorithm [3] and allows to keep track of the individuals classification naturally encoded in their data, introducing a quantitative approach new to the standard diagnosis procedure. The statistical probability of being assigned to any class and the robustness of this choice are computed and, in such a way, the clustering algorithm already performs a former diagnosis. Moreover, a statistics of the geometrical descriptors expressed by individuals assigned to different classes can be obtained and used to define the typical distributions observed for the studied pathologies. This allows to define the normotype of the disease, filling a lack present both in scientific literature and in daily medical activity. Finally, comparing the geometrical descriptors values observed for a new individual with those obtained during the clustering allows to express even a more confident diagnosis.

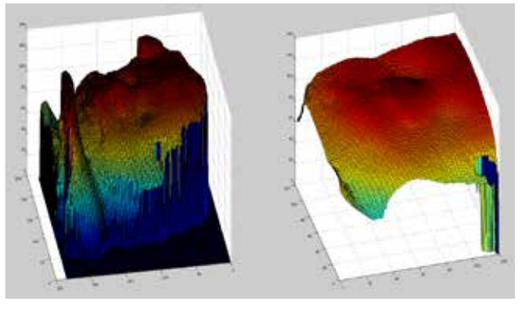
Exploring the opportunities

Keeping in mind the preliminary work, the team performed an analysis of the state of the art; the main result was that, although the technology for threedimensional ultrasound fetal scans is quite common nowadays, it is not used as a tool to help the physician in pre-birth diagnosis. In order to exploit the work already carried on by the project’s tutors [1], we focused on the development of an algorithm to extract the 3D information (i.e. a point cloud) of the face from a set of two-dimensional ultrasound slices, as there was no such software already available to perform this task. Since the most important information needed for our purposes was related to landmarks

Figure 5: Comparison of two faces from the Bosphorus Database [2].

Figure 6: Analysis of a face of a fetus extracted with the SynDiag algorithm.





located on the face’s outer surface, we discarded the option to develop a complete 3D model of the head and focused on the extraction of the point cloud of the surface only, in order to improve the simplicity and the speed of our algorithm. Simultaneously, the team members started exploring the possibilities for the diagnosis. In this framework, the two main problems were how to use the geometrical information in order to perform the diagnosis and how to perform the actual classification of the individuals.

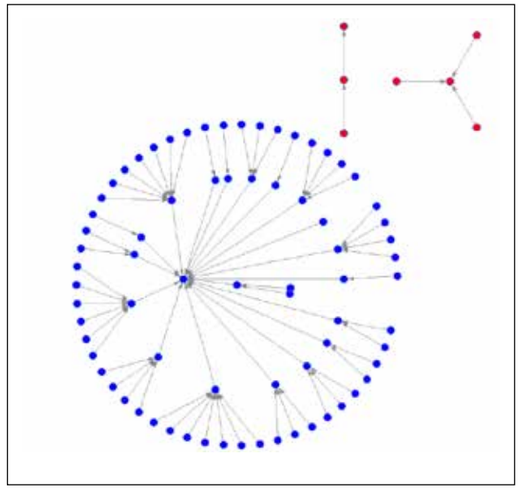


Figure 7: Diagnoisis clusters.

For the first point, the study has been carried on searching through the literature, as we did not have enough scans to perform a direct analysis. For the latter, first of all we decided to focus on a single disease (i.e. cleft lip) rather than two or more, in order to produce a more robust algorithm. Then, several data mining models were considered for the classification, both supervised and unsupervised; we ended up choosing an unsupervised clustering algorithm for a first stage, followed by a supervised technique to perform the actual diagnosis. Because of the lack of a big dataset of both healthy and dysmorphic fetuses, the algorithm has been developed using 3D scans of healthy adult people, coming from the Bosphorus database [2].

Website

www.syndiag.com

Bibliography

[1] Vezzetti, E. and Marcolin, F., *Geometrical descriptors for human face morphological analysis and recognition*, Robotics and Autonomous Systems 60(6):928-939, 2012.

[2] Savran, N. Alyüz, H. Dibeklioğlu, O. Çeliktutan, B. Gökberk, B. Sankur, and L. Akarun, *Bosphorus Database for 3D Face Analysis*, The First COST 2101 Workshop on Biometrics and Identity Management (BIOID 2008), Roskilde University, Denmark, 7-9 May 2008.

[3] Bailly-Bechet M. et al., *Clustering with shallows trees*, Journal of statistical mechanics, 2009.

GoAAL

NEA Going towards solutions
for Ambient Assisted Living

Project

GoAAL

NEA Going towards solutions for Ambient Assisted Living

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Gianmarco Ciorra
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Giacomo Cuspidi *[Communication coordinator]*
Biomedical Engineering, Politecnico di Milano
Federica Giraudi

Figure 1: Monza, november 11th, 2014. A photo with Alessio Tavecchio, founder of the omonym Onlus Foundation.
From left to right. Second row: Riccardo Musetti, Lidia Palladino, Ludovica Zengiaro, Giacomo Cuspidi, Juan Camilo Avendano Diaz, friend of Alessio Tavecchio. First row: friend of Alessio Tavecchio, Alessio Tavecchio. Author: unknown.

Figure 2: Bologna, november 30th, 2014. A group photo at Handimatica, the fair held in Bologna for the presentation of technologies to help disabled subjects.
From Left to right: Juan Camilo Avendano Diaz, Andrea Mortera, Federica Giraudi, Gianmarco Ciorra, Ludovica Zengiaro, Giacomo Cuspidi. Author: unknown.

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Gelila Seifu
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Ludovica Zengiaro
Product Design, Politecnico di Milano

Tasks and skills

Juan Camilo Avendano Diaz: Biomedical Engineer - Contributed to the design of the project activity diagram and to the set up of the physical prototype. Developed the software for Lift Me App and the firmware for Arduino.
Gianmarco Ciorra: Mechanical Engineer - Attended visits and fairs; reviewed laws on accessibility and studied the feasibility of the app both from a software and hardware perspective.
Giacomo Cuspidi: Biomedical Engineer - Attended visits and fairs; contributed to the creation of the activity diagram for establishing the logic of Lift Me App.
Federica Giraudi: Management Engineer - Attended seminars and visited the facility “La Nostra famiglia”; developed several parts of the scenario analysis of existing solutions and helped to produce the activity diagram.
Andrea Mortera: Biomedical Engineer - Attended the visits to Niguarda, seminars and fair; developed the application for the transmission of the alarm signal at a long distance scale using the Wi-Fi.
Riccardo Musetti: Management, Economic and Production engineer - Structured the project into a GANTT diagram. Studied the economic feasibility for the implementation of our solutions inside Niguarda and the economic future paths.
Gelila Negash: Electronic engineer - Participated to the visit to “La Nostra famiglia”; made an analysis on currently existing technologies of elevators.
Lidia Palladino: Management, Economic and Production engineer - Structured the project into a GANTT diagram. Studied the economic feasibility for the implementation of our solutions inside Niguarda and the economic future paths.
Ludovica Zengiaro: Product designer for innovation - Redesigned the indications and the elevators interface of Hospital Niguarda Spinal Unit;

Figure 3: Screenshots of Lift Me App: the logo, the button panel, the number of the floor or the symbol of the called function, such as the alarm or door opening.

designed the interface of Lift Me App and contributed to the realization of the prototype.

Project description

The main goal of the GoAAL project (Going towards solutions for Ambient Assisted Living) is to increase the degree of independent living for disabled and frail people with particular attention to the needs of people with motor impairments. The activity has been divided into three parts: the analysis of the needs (people centered), the design of a possible assistive technology solution (a satisfaction of a specific need), and the implementation of a prototype.

The first part of the activity has been based on the study of some real-case scenarios. During this initial phase (Phase 1), and throughout the whole project, the GoAAL team took advantage of the collaboration with some external foundations:

- ASPHI Onlus, that works in the field of ICT (Information and Communication Technologies) applied to improve the social inclusion of disabled people;
- AUS Niguarda, an entity internal to the Unità Spinale of the Niguarda hospital. The team visited the structure several times and have established a close collaboration with the medical and technical personnel of the structure.
- CRAIS and SO.LA.RE., two institutions whose aim is to promote the autonomy of people with special needs.

Among the needs at AUS Niguarda, the team analyzed the need of quadriplegic people to be supported by caregivers in their movements inside the Unità Spinale. In particular, the team has faced with the problem of interfacing the lift with quadriplegic: the solution of this problem would greatly improve the autonomous displacements of the quadriplegic patients inside Niguarda (but also in other hospitals and residences in general) and can also be attractive for privates. The project proposal was deeply discussed with the Niguarda staff, with quadriplegic people (a focus group was organized) and tutors to extract and to define the functional and non-functional requirements of the application (Phase 2). After a phase of market survey and technology scouting, necessary to delineate the boundaries of the state of art of the sector, the team has developed a prototype for the vocal control of the elevators (Phase 3).

The system consists of a mobile application, called **Lift me App**, that accepts, interprets, and transfers to a microcontroller platform the voice command. **Lift Me App** is wireless connected to a microcontroller platform (an Arduino board) that, in turn, is connected with an elevator button panel, whose prototype has been built by the GoAAL team. Through the demo platform it is possible to simulate both the request of a specific floor and the call for help. Next to this solution, the team also redesigned signs and

Figure 4: Lift me App controlling the button panel of the prototype.

Figure 5: The inside of the button panel: Arduino connected to the PCB.

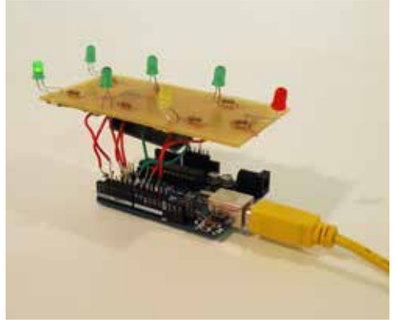
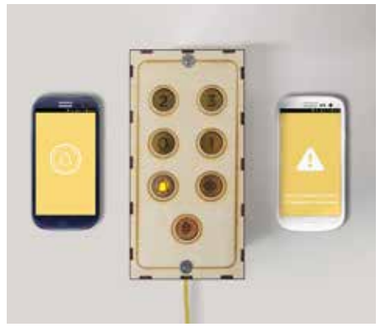


Figure 6: Lift Me App sending the alarm both to the button panel and to an external smartphone.



indications present inside the Unità Spinale in order to make them clearer and more easily understandable. The work continued with a study of the economical feasibility of the implementation of such a system at Niguarda and was concluded by an analysis of the possible future steps that the team should take to carry on to extend the current prototype.

Abstract

The aim of the GoAAL project is to increase the degree of independent living of disabled persons, in particular with motor impairments. The concept of Ambient Assisted Living (AAL) implies the use of innovative ICT-based products, services and systems for disabled people to increase the quality of life and the social inclusion, with the advantage of reducing the costs of health and social care.

From the cooperation with Niguarda Spinal Unit and the observation of patients while interacting with the environment, we realized that the elevators accessibility was a critical issue in this facility. Therefore, we decided to propose a solution in order to improve the access to lifts even for quadriplegics, who face the hardest physical limitations. The most suitable solution consisted of a vocal-controlled elevator system, implemented through a smartphone/tablet application we named **Lift Me App**.

Lift me app is meant to receive vocal commands regarding each of the functions incorporated in a normal elevator, while working in parallel with the usual button-panel, and to send them via Bluetooth. In the physical prototype, data are sent to an Arduino board, which is connected to a reproduction of an elevator-button panel, where some icons are enlightened according to the vocal command. Moreover, special security considerations are included in order to guarantee the safety of the patient inside the elevator.

Other than the APP, we focused on improving the indications inside the structure of Niguarda Spinal Unit in terms of intuitiveness and readability for users on wheelchairs and also their visitors. The result was a color and symbol legenda to map spaces and further renderings of the possible future elevators for Niguarda Spinal Unit.

Finally, we also carried out a cost analysis for the implementation of all the previous solutions inside the building of Spinal Unit, with the hope that it will be considered by the hospital for a potential future realization.

Figure 7 / 8: Billboards for Niguarda Spinal Unit re-disigned with new colors and symbols, not misleading for color-blind or dyslexic people.

Understanding the problem

The first phase coincided with the observation of disabled people in order to understand their needs. The specific objectives of the project addressed both disabled children as our target, and an ICT device as the possible solution.

The field was wide open at the beginning, considering the variety of existing disabilities. However, once we started our most precious collaboration with Spinal Unit of Hospital Niguarda in Milan we focused our attention on people on a wheelchair. Both our cooperators from this hospital and our academic tutors warned us to be careful in interacting with patients, not to hurt their feelings, and to empathize with them to understand their needs and perspectives. Thus, entering the world of disabilities meant for us an increased awareness of the current limits in the daily life of physically and/or mentally impaired subjects.

Niguarda Spinal Unit hosts paraplegics, quadriplegics or people suffering from Spina Bifida. During the preliminary visits to this structure we received lectures from the medical personnel regarding the aetiology and the possible accidents leading to spinal cord injuries. They also explained us the medical and psychological effects experienced by people with this condi-

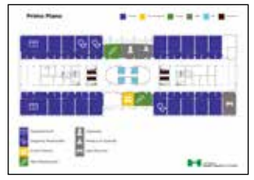


Figure 9 / 10 / 11: Planimetry of the three floors of Niguarda Spinal Unit with new color and symbol legenda.

tion, who often suffer from depression or anxiety after the accident that forced them on the wheelchair. Finally, we visited the structure and we understood why Niguarda is one of the leading Italian centers for the rehabilitation: it does not only focus on the medical treatments of patients, but it gives them the opportunity to train and to interact with the environment. Spinal Unit contains, in fact, a pool, a gym and apartments with *home automation systems*, where patients could experience technological solutions to possibly adopt in their private houses. Patients are also involved in painting and cooking courses, allowing them to interact with each other as well.
The main limit we observed in this precious structure consisted of its elevators, which are uncomfortable for users on a wheelchair, who can't use properly the button-panels and move inside and outside them. For this reason we decided to make lifts accessible even for the most impaired category of patients: quadriplegics. In addition, we worked to improve the independence of all Spinal Unit patients and familiars by re-designing the indications inside this facility.

Exploring the opportunities

At the early stage of the design process, we even thought of designing an innovative wheelchair or a playground suited for motor impaired subjects. However, once we identified the elevators of Spinal Unit as the problem to solve, we focused on an ICT solution to improve the lifting systems. Our tutors helped us in addressing the problem and also in the path of finding the solution, according to their knowledge in the ICT field. Considering we wanted to guarantee the accessibility also to patients who may not control their body below the neck, we explored some existing solutions to control an external device:

- Brain Control Interface (BCI): an interface that interprets the brain electrical signals;
- Sip and Puff (SNP): an interface controlled by the air pressure created when inhaling or exhaling on a straw or tube;
- Voice Control Interface (VCI): an interface interpreting speech.

Among these options, we chose the most feasible one: Voice Control Interface. Modern smartphones and tablet are in fact already equipped with speech recognition and everyone has or can easily get one.
Moreover, during our preliminary visits to seminars and fairs, we were impressed by the use of smartphone applications created ad hoc for disabled subjects. For example, we attended a seminar from a member of ASPHI, one of our project partner which aims at diffusing ICT solutions to assist impaired persons, where the APP Touch for Autism was presented. This APP teaches autistic subjects basic tasks by illustrating the necessary steps with images and brief descriptions.
To simulate the control of an external device, we evaluated electronic boards such as Arduino, BeagleBone and RaspBerry PI. From a PROs and CONs evaluation, it emerged that Arduino was the most suitable to our needs and competencies.
Finally, we also explored several commercialized elevators systems with easy access. We found out that many efficient solutions already existed and for this reason we decided to make our solution open-source, customizable and low cost.

Generating a solution

Therefore, we started to develop a mobile application we named **Lift Me App**, which we implemented through MIT App Inventor. **Lift Me App** allows to request the floor, to open the elevator doors or to send the alarm, acting as a parallel vocal-controlled-button-panel. The command is then sent to the elevator through Bluetooth, which is a common feature on smartphones and with MIT APP Inventor is possible to send the command to a specific MAC address of an external Bluetooth Module, i.e. the potential one installed on the lift.
To create our prototype, we installed a Bluetooth module on Arduino to let it communicate with **Lift Me App**. Arduino was then connected to different LEDs placed inside a reproduction of an elevator button-panel created by us: we managed to enlighten the button corresponding to a specific command given by the user.
However, since Bluetooth acts within a short spatial range, we also thought of realizing a system to communicate on a wider scale through WiFi. This decision was pushed by security issues: granting patients more freedom also implies that they might find themselves alone in potentially dangerous situations. This is why **Lift Me App** contemplates a Security Timer which starts when the user enters the elevator. If the Timer expires and **Lift Me App** has not received any vocal feedback, both the traditional alert and an additional message to Niguarda personnel are sent, the latter through WiFi. This could be the starting point for the future development of an internal WiFi based network to monitor patients' location inside the building.
In addition to the smartphone application, we also decided to smarten up Unità Spinale facility by redesigning its billboards and its elevators from an aesthetic point of view. In particular we identified a symbol legenda to map rooms based on their usage, using colors discernible also from dichromatic and colorblind subjects. Moreover, their positioning was evaluated according to the height of people on a wheelchair. Instead, the elevators button-panels were designed according to legislative norms.
Finally, we carried out a cost analysis to make Unità Spinale elevators compliant to **Lift Me App** and it emerged it would request less than 2'000 €. Instead, to implement the control of patients' positioning through WiFi, the cost is almost 4 times higher, making it not suitable to the budget of a public institution, while the costs of changing the signs are almost negligible.
Regarding future perspectives, we plan to insert **Lift Me App** inside those spread by ASPHI, in order to find as many users as possible, not only Niguarda patients.

Figure 12: Rendering of the new button panel inside elevators of Niguarda Spinal Unit.

Figure 13: Rendering of the new interface for calling the elevator.

Bibliography

- Marcel W. M., Van Dijk, A.,J., Van Asbeck, F.,W,.A. (1998). *Life Satisfaction of persons with spianlcordinjury compared to a population group*, Scandinavian journal of rehabilitation medicine, vol. 30, pp. 23-30, 1998.
- Tyler, J. (2011). *App Inventor for Android: Build Your Own Apps - No Experience Required!* (John Wiley & Sons).
- Timmis, H. (2011). *Controlling Your Project: Bluetooth Arduino*. In Practical Arduino Engineering, (Apress), pp. 277–297.

Virtual Museum

Virtual Museum for the XXI century

Project

Virtual Museum

Virtual Museum for the XXI century

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Project description

The profound and rapid shifts in contemporary city are nowadays coming with a strenuous recollecting of memories. Museums of architecture, with their valuable collections, and urban museums play a complex role – not only for their documentary and public value, but also for being involved in a wide debate on urban and cultural politics for cities' change. The main aim of the project is to elaborate a **model** for a virtual museum (and in particular for a urban museum), that will be tested in the selected urban realms, and should be capable of bringing up a crucial contribute on specific issues: fruition and audience within the new museum typology; worth and use of primary sources for history of architecture and for the knowledge of the city in a close and constant confrontation with the new digital media; involving urban citizens in setting up the contents and the stories of the virtual museum, as a practice to highlight innovative features related to the preservation of the architectonical and urban heritage through useful means to enhance the knowledge need in the contemporary transformations; exploring new working fields for new figures both professionals and academics bounded to curatorial aspects into a virtual museum. In this frame, the ASP project set to start out from both potential use and hybridization of new languages given by digital technologies, with the aim of identify a new museum concept, in which the virtual aspects join a new account, including and going over archives and real museums, enlarging the potential of traditional ideas of fruition and access. To build the virtual museum model, the experimentation filed proposed by the students has been to investigate the small and medium size ex industrial cities of the XX century. Within these cities, the industrial production has been determined by the scientific management of work and city evolution, which has led in different phases of the history to interesting experimentations in architectural and urban field. Nowadays these realities are facing a transformation process that is strictly related to their ex-industrial past (both in positive and negative, in a ideological process of memory acquisition and removal), and it's devoted to their future. The two case study cities are Ivrea (Italy) and Hunedoara (Romania), two small industrial cities grown in different geographical and political contests, but in the same mainstream of the industrial European history within the second half of Twentieth Century, with a consistent architectural heritage for their national realities. Ivrea and Hunedoara are now going through urban and cultural changes, favored also by EU cultural politics that stress the importance of collections in the archives and the real city as a deposit of essential information to understand the shifts of our cities and to define new grounds of use and reflections about them. Due to the open process of experimentation that characterized the project, and to the team composition (mainly composed by students within the architectural and urban filed of studies), it has been followed a work methodology in which the frequent exchanges between students and tutors led to the realization of a *concept* for a future practical application. Indeed, it has been asked to the team's members to conduct the researches by studying and analyzing the heterogeneous materials that would compose the virtual museum (from the bibliography on the general and specific themes, to the direct analysis of the case studies, using all the means that were available, from the perceptive to the archivist analyses). This open process has been always conducted by involving the students in numerous brainstorming activities and important seminars within the group and together with external figures and tutors. In this way, the students have been able to follow the steps in the overall process of work and to open new perspectives and fields of research around which they have been able to manage their model of virtual museum.

Figure 1: Hunedoara

Figure 2: Ivrea

Tasks and skills

Martina Alterini
Thanks to her capacity in understanding the cause and effect relations, she was essential in the definition of the problem and in the control of the coherence of the entire project. She focused then on the inputs and outputs of the Virtual Museum Model.

Chiara Fauda
She challenged herself focusing specially in the definition of the layers, the conceptual categories that define the ex-industrial cities. Furthermore, due to her graphic skills she coordinated the graphical layout of the project.

Chiara Fraticelli
Exploiting her background in urban planning, she worked a lot on the comprehension of the dynamics that tie the industrialization process and the development of the cities in the XX century. She tried then to explore the field of informatics to specify the implementation of our web platform.

Eloisa Gattiglio
As the only engineer of the group, she was really helpful in reaching a synthesis. Systematic and careful on the details she focused especially on the methodology and the users requirements. Moreover, she enjoyed to dedicate herself to some graphical aspects.

Camilla Guadalupi
She focused on the analysis of the case studies and on the definition of the framework of the project. In the introduction of the work, she tried to give an overview on the main issues faced by our project that are extremely complex.

Francesco Savoini
He is characterized by a pragmatic attitude, which came out especially in the analysis of the feasibility of the project and in the definition of the further steps to eventually develop the projects afterwards. He had an important role in the research phase, deeply investigating the history of museums and archives.

Abstract

Right now ex-industrial cities, that were developed around important factories, are facing the big issue of new identity reshaping. A huge heritage is conserved in this realities and it is not always profitably managed in order to preserve and communicate the memories related to it. On the other hand, traditional museums and archives are nowadays facing renovation processes, which include the attempt to expand their boundaries in the through digital and virtual means, maintaining the same physical structures. The Virtual Museum wants to give a practical support to solve these problems, enhancing the development processes of cities, archives and museums. An open, flexible, dynamic web platform was designed. The Virtual Museum allows one to surf in the data flow of urban statements, uploaded in the server not only by formal institutions, but also by normal users. This bottom-up approach is an useful instrument not only to increase traditional archive boundaries, but also to create a strongly interconnected community within the users. Even if the input is a chaotic memories tangle, the output is a structured collection of documents, which are organized in layers and geolocalized in the shared city. In this way, the memories leave signs in the city, which can be discovered by the people taking advantage of a serendipity process. The platform was conceived to respond to the necessities of the city of Ivrea (Italy) and Huneodoara (Romania), taken as case study cities for the project. This two cities share the same ex-industrial essence, but for historical, social and economical causes they are deeply different. This is the reason why the model was set on these two realities, its structure is adaptable and it could be extended, with the possible future collaboration of external institutions such as the UNESCO, to all the post-industrial realities of the world.

Keywords

Contemporary, Ex-industrial, Heritage, Memories, Virtual, Cities, Archives, Museum, Open, Flexible, Dynamic, Bottom-up, Community, Collection, Layers, Model

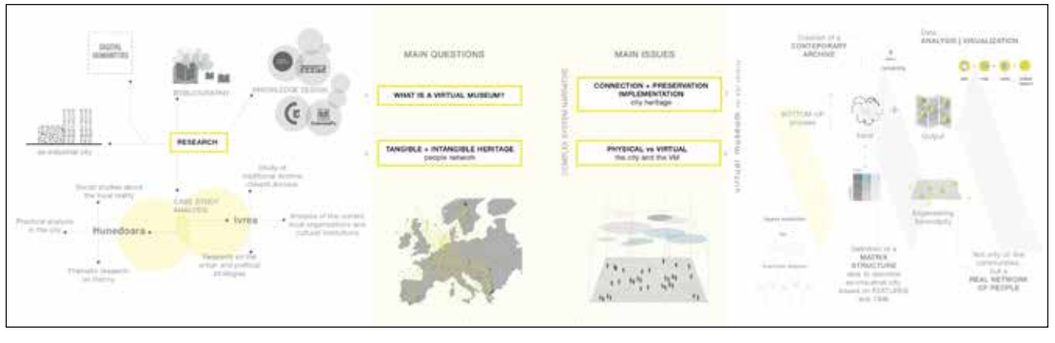
Understanding the problem

The framework of our proposal is constituted by the challenging situation of ex-industrial cities. After the crisis of the ‘70s and the phenomenon of the de-industrialization, those cities, which in the past were strongly interested by the industry experience, had to face a demanding challenge: how to recognize the consistency and the concrete value of what is defined as industrial heritage? We reflected on this issue observing closely two different case studies: Ivrea, well-known for the Olivetti company experience, and Hunedoara, Romanian city intensely shaped by one of the biggest steel mill industry of the soviet bloc, on the way of abandonment after its closure. Regarding these complex realities, traditional archives have to face the lack of suitable structures to be effective in the collection, preservation, implementation and transmission of memories, including the complex system of contemporary memories. The need of an archive able to make materials accessible and to contain even the contemporary memories is clear in deeply changing cities, such as the ex-industrial ones. We developed a Virtual Museum with the attempt to give a positive contribution to all those situations involved in these challenging processes of definition of an identity.

Exploring the opportunities

The project is based on a deepened research activity. This approach has

Figure 3: the process



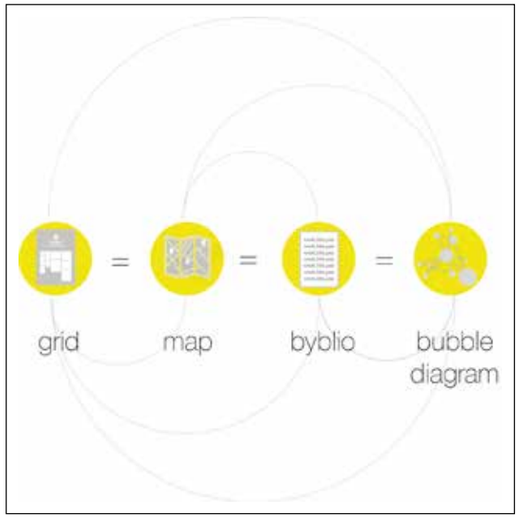


Figure 4: data visualization

permitted us to get to a complete, as much as possible, comprehension of the problem. What significantly emerge from the research activities is that all the topics detected were object of study for many cultural and internationally recognized organizations, ICOMOS and Harvard MetaLab as examples. This demonstrates the importance and modernity of our work. This task led us to think to a Virtual Museum model that could be diffused globally involving potentially all the ex industrial cities. Therefore, we had to work intensively on this task, trying to solve all the issues related with the main feature definition. During the process of the project's definition, we had to make some important decisions, which stongly influenced the final proposal. For this reason, we analyzed many other projects in order to have a clear view of the state of the art we were dealing with. Reflecting on the relevance of our choices, we have manly focused on some issues. One of the first stance was on the content of our archive. We had to understand which kind of memory we wanted to preserve and then implement. We reflect on the crucial importance of having an open and contemporary archive and on the role played by the users in order to get this purpose. Therefore, for us the promotion of an academic knowledge wasn't enough, but we have the need of extend the audience. In our Virtual Museum each one is considered a knowledge producer. This first statement had substantial implications, in primis, in relation to the reliability of the data. Considering that the data wouldn't come exclusively from the institutionalized sources, but also from not certified knowledge suppliers, we had to deal with a problem related to the quality of our museum's content. How to supervise what each user could upload on the website? This was a really problematic issue. Firstly, we thought to establish a scientific committee. In the end, in order also to face contingent problems of copyrights, we decided that the best solution was to appoint all the responsibility of the material uploaded to the individual user, and to ensure the quality of the documents through a process of evaluation between users. Another important question was about the criteria for the selection of which cities would take part in our Virtual Museum. In order to create a model that could potentially describe not just the single cases of Ivrea or Hunedoara, but all the ex industrial cities, first we had to reflect and discuss on the industrial city's definition. We couldn't find a proper and fixed explanation. So, starting from the analysis of the two case studies, we integrated the observations done with what arose from the bibliographical research: we arrived to a personal and interpretative definition. The description of what we considered as an ex industrial city is showed by the constitution of a series of layers. Each layer is the representation of an industrial city's feature and each data must be referred to a specific layer. A city should fit six main layers in order to be approved and considered part of our archive. This methodology is close to the one promoted by the UNESCO for the evaluation of the candidate sites. In closing, a further discussion was about the choice between the development of a connection between the Virtual Museum and the physical world of the cities. Our decision was to give the possibility to the users to discover through the tool also the setting of the ex-industrial memory: the city itself. Obviously, firstly we considered the arrangements of some tracks, informative totem or screens characterizing some specific places; however, we established those solutions were not suitable for a flexible archive, based on the people. This solution was too much related to a top-down imposition. Instead, we chose to support with the Virtual Museum an engineering serendipity process. This stance leaves to the user the freedom to disclose places. Through the layers and the collections output map, visitors have the opportunity to meet in the spots of the city related to the archive and the collections. In this way, the creation of a human community permits our project to overcome the boundaries of the virtual, and allows it to become real.

Generating a solution

The Virtual Museum is a new tool, a web based platform useful for the collection and the production of both the past and the contemporary memories, in an ongoing process devoted to the future. It is a bottom-up archive model in which are stored different type (formaL and informal) and format (images, text, audio and video file) of data. The involvement and the centrality of the user in the process of collecting data is an important innovation because it implies the diffusion of particular kind of data, private pictures and stories, not accessible before. This decision promotes a specific position on the role of the museum in the contemporary debate in contrast with the typical communication model conceived, the linear-information transfer process from an authoritive source to an uniformed receiver. However, the active role of the user is not just in the process of collection, but also in the curatorship activity. Each user could be the curator of his own collection. A web platform is the ideal support because it fosters the interaction between the user and the comparison between the data. It is flexible and dynamic. It permits to overcome the problem of the limited space and the physical distance. The challenge for us was the creation of an appropriate and easy interface and the management of an increasingly huge amount of data. The outputs of the curatorship activity are differentiated: a mosaic of the selected items, a bibliography of the collected data, a map of the city with the localization of the sources and, finally, a bubble diagram, which shows the connections between the files.

More generally, the proposal reflects on the museum's concept and its evolution. Our intention is to define an idea of an increasingly personalized museum. The user is at the core of the museum's experience, not just a visitor. The enhanced interaction of the user is one of the biggest innovation of our proposal. The concept of virtual museum is not new, but it never got off the ground because of its scarce actractivity for the user. Our project overturns the perspective, re-thinking the museum and in particular the virtual museum conceptualization.

Figure 5: Layers matrix Ivrea

Inteface Design

Definition of a User-Friendly System
for Data Mining

Project

12

mercure
SHARE YOUR DATA

dialogue

Inteface Design

Definition of a User-Friendly System for Data Mining

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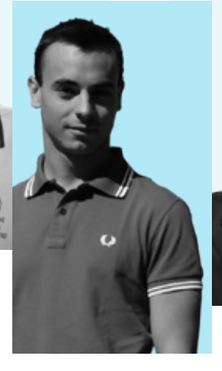
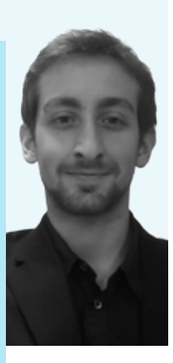
Team A





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Project description
Complex environments, such as organizations, are characterized by the potential availability of a constantly increasing amount of data. This data are often unstructured and organized in separated blocks stored within different company units, often without a clear strategy for their management and exploitation. Thus, the potential largely remains unexpressed.
One of the most critical concerns reveals to be data integration for accessibility: that's where methods and technologies that allow us to establish connections and shape data are of primary importance.
The possibility for users to have direct and immediate access to information yields a competitive advantage for the company, in terms of efficiency and effectiveness of the processes both at individual and department level. Information technology and communication design skills – data and information visualization especially - can offer innovative and productive ways to approach the problem, structuring organizational processes, ensuring data accessibility and engagement in the most effective way to achieve company goals.
The project aims at exploring the possibilities offered by Information and Communication technologies for data mining and information visualization, starting from the recent investments Barilla made in the implementation of 3D Laser Scanners for a complete map of all the industrial plants and their asset.
The goal of the project is to design user interfaces capable of integrating data and information (such as maintenance and financial information) from different areas of the Company into dedicated touch-point serving specific user targets.
Two different projects have been developed, addressing respectively the need of data and information that could emerge a) when operating close to the machines in the production line and b) with a remote access, far from the context of the data.
Both projects faced all the stages required for the development of an effective data interface. In the first project the focus is on the robustness and the efficiency of the interface (speed and simplicity) and the possibility to serve different users with a customized layout; the second project focuses especially on the usability of the user interface, as many data information where already available but not integrated and with a fragmented user experience. A social network approach has been also incorporated, in order to foster participation and sharing in the information process.

Project 12A

Mercure

Tasks and skills

Paolo Aymerito: Paolo carried out state of the art studies on user friendly human-machine interaction and developed the prototype software for the Mercure interface.
Beatrice Borsetti: Beatrice designed the interface on the graphical point of view, has analyzed the user friendly aspect on the project and developed the tools for data interaction
Manuel Cuomo: Manuel developed the concept of the tool, reaserching on ranking algorithms and business intelligence and the integration between them.
Alessandro Daga: Alessandro extrapolated information from ISDOC 2014 conference, analyzed data and users needs and performed a feasibility study.
Davide Ignazio Indovina: Research on the state of the art on database systems technology in industrial field, analysis and classification of needs and interactions amongst users.

Understanding the problem

Nowadays the development of information technology allows to collect exponentially increasing quantity of raw data, the challenge is to aggregate them in order to extract useful information that comes from detailed analysis but is synthetic enough to be meaningful and easily manageable. Moreover in the last year also the visualization of data is gaining much more importance: companies are understanding that having the right information is not enough, it is also crucial to present it to the user in a way that enables him to understand it easily and use it in the most effective way.
In this trend through the modification of interaction and communication within a company, also Barilla needs to start thinking about a powerful way to internally share information, and the design of such a user friendly software is the goal of this project.

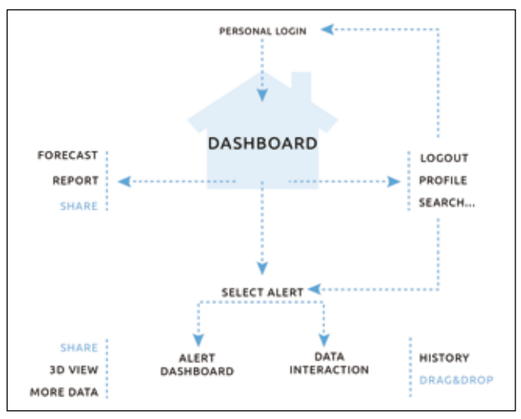

Figure 1: The diagram shows how the software works, from the main dashboard to each side option and interaction.

In the first phase of the development of the project we worked to build a common knowledge base on the main topics related to this field and to get updated on the latest developments and trends performing a wide range state of the art study.
We understood that we had to put the user at the center of our project. We had interviews with Barilla employees and we visited a plant to be able to understand the needs of the user: what they were looking for in our software, what were the main problems our solution could face and how we could innovate the way they work.
The two teams focused on different groups of users. We, as Team 1, developed a solution for "remote users" that are those who usually access to the data from an office and are not working directly on the line.
In this situation we discovered that workers already had access to nearly all the data they needed but in a very unstructured and difficult to access way, because data were managed using a lot of different tools (excel files, SAP, pdf files, images), and with great difficulties to communicate them to colleagues. So the main challenges were to find a way to allow easier access and communication of important information building a common platform able to collect all this different types of data, to extract useful information from them and provide a mean for sharing knowledge in an effective way.
The most important features we find our tool needed where:

- Guarantee user-friendly access to all the information available.
- Provide personalized information according to different user profiles.
- Allow customization of the interface according to personal preferences.
- Foster sharing of information between workers.

A strong connection between data and physical place through 3D visualization.

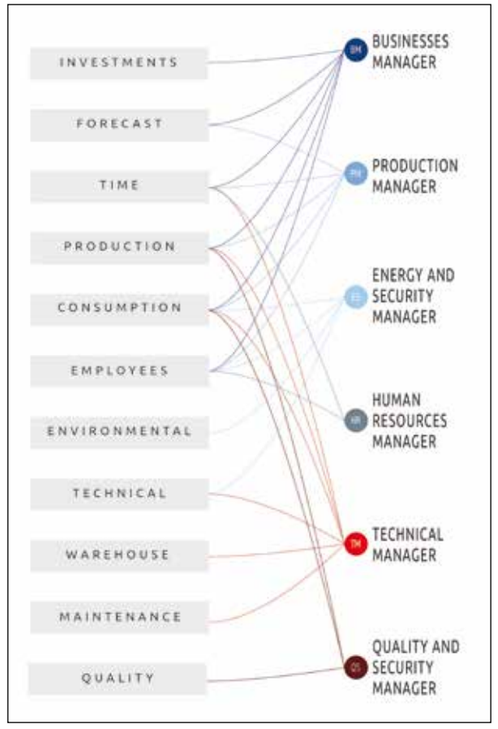

Figure 2: The matrix of interaction between data and firm's profiles has been defined to understand how each worker can visualize relevant information.

Exploring the opportunities

As starting point we decided to focus on a specific line to limit the complexity and the amount of data initially involved; we used the Pan Bauletto production line in the Cremona plants as test bench.
The research phase was very useful in order to have a clean overview on what current technology and solutions offer to solve our problem and to give us structured knowledge base to face the upcoming phases.
In June 2013 we had the possibility to visit the Barilla plant in Cremona and to meet both the administrative staff and the line workers. We interviewed them to understand the present situation, their needs, the additional information that would facilitate their tasks and the main problems. We combined this needs with the ones Barilla showed us in the first meetings.
In order to deepen the research about the state of the art and focus on more modern studies, some information from the Lisbon 2014 Information System & Design of Communication (ISDOC) conference has been taken. In particular the most interesting presentations, considering Barilla requirements, helped us about the state of the art on Web-based communities and internal social networks.
As a preliminary phase we classified workers, in different profiles according to their role, and created interaction tables to better separate the different contexts. The profiles we identified are: Business manager, Production manager, Energy and Security manager, Human Resources manager, Technical manager and Q&S manager.
We developed a first prototype structured in a traditional way where the user is the only active agent and has to inquire the interface to get the information he needs. We understood that this solution was not enough user-friendly, especially on critical situations.
Thus we developed a second prototype able to actively choose a set of

information that could be interesting for the specific user logged in at the moment and able to highlight critical situations. This prototype was shown to Barilla and approved.
We noticed that this system was fitting requirements on critical situations but it was still not so user-friendly on accessibility of generic data. So we developed a third release improving data accessibility through graphical representation.
The key characteristics of this last release are:

- Active selection of data shown.
- Easy sharing with colleagues.
- Graphic presentation to make data accessible.
- Cross-searching of data from different areas of the company.

Generating a solution

In order to fulfill Barilla requirements of a system able to gather all the data present in the company, widening the accessibility to information from any point in the plants through a user-friendly interface, Web-based communities and internal social networks have been considered.
These Enterprise Social Networks (ESN) are becoming an important fact in big companies, in order to link employees, improving communication and fostering knowledge sharing and collaboration in virtual teams.
A kind of “Facebook” for the workers in fact, can combine the user friendliness to the usefulness of a common work space able to guarantee communication, coordination and control in a smart and quick way.
In particular the integration of the user-friendly system to access information together with a form of communication between different users, different departments and even different plants has been approved by Barilla, which especially liked the idea, and helped us generating a matrix of interests for hypothetical users (six profiles, that are employed as manager or responsible at different positions).
This data matrix is useful also to define the ranking algorithms typical of social networks, since it would define clearly which interest are proper of a group of users.
Once the matrix and the concept were both clear, we begun to make hypothesis on the graphical point of view.
The main idea was to use a social media template based on a dashboard concept as we wanted to display as many data as possible at a first glance. Information is ordered according to each user interest, so that he does not need to browse endlessly to find what he is looking for. Anyway a search tool has been introduced in the home page, together with a section for live feed.
To keep user friendliness, we decided to adopt a “less is more” design of the page, ensuring a pleasant user experience and fostering quick interaction and communication among users.
This has been done focusing on the usage details, for example introducing interactive graphs with automatic magnification at mouse leaning and easy scrolling to show the entire time history, with different time scales. Furthermore an automatic system of alerts, based on historical data, will drive the focus on critical events, classified according to a seriousness color scale (from green to red).
Furthermore clicking on an alert or a graph it will be possible to perform a fast research of related information and the sharing experience will be enhanced thanks to a drag and drop system thought for an easy share of information with preferred contacts, sending official reports and private chat messages.
A relevant section of the software, required by Barilla, was the 3D tool, which allows a 3D visualization of a plant, enabling geo-localization of machines and fostering a better understanding of eventual problems on the lines.
As last, an important step to set the image of our design was also the study on the branding of the software. We chose the name Mercure according to the friendliness of the communication process proposed by our system, referring to the homonymous God Messenger, called Hermes among the Greeks and Mercure among the Romans. This set the connection between the role of the software among Barilla’s workers and the one of an invisible messenger living on the data cloud.

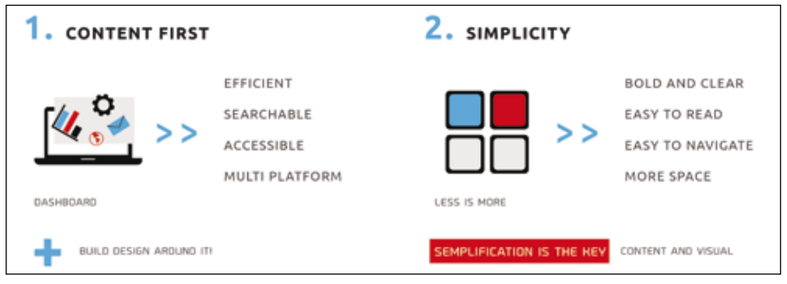

Figure 3 / 4: Main consideration regarding the look and operation of the software

Figure 5: Main dashboard: it is possible to visualize information concerning alerts and relevant graphs.

Figure 6: Interactive data: by leaning the mouse on a specific piece of information, it is possible o magnify it and interact with the related history by scrolling and zooming.

Figure 7: Sharing option: the software contains a social-media-oriented channel of interaction between users, with the possibility to share graphs, create working groups and so on.

Figure 8: Interactive data: by clicking on an alert a dedicated dashboard opens up, giving to the user the whole picture of the situation.

Bibliography

[1] Keim, D.A.; *Information visualization and visual data mining, IEEE transactions on visualization and computer graphics*, vol. 7, no. 1, January-March 2002.
[2] Kent, P.; *Data visualization: making big data approachable and valuable*, SAS.
[3] Pursche, A.; *Exploring collaboration requirements of heterogeneous teams on the example of a critical sales process*, SAP Research & Innovation.

Project 12B

Dialogue: connect, visualise, inform

An interactive platform to access, visualise and modify back-end data in real time and on-the-spot inside Barilla production plants

Tasks and skills

Matteo Cunial, he is the team leader of the group.
Alice Casiraghi, the creative of the group, developed the interface structure and design.
Marco Alessio, involved in the definition of the state of art of the project.
Eleonora Piersanti, analysed the state of the art of human machine interaction in industry and technological world.
Matteo Mautino, developed analysis related to the customer journey and touchpoints between the interface and the employees.

Abstract

The variety and quantity of information a global company needs to handle nowadays imposes to generate intelligent data mining systems for acquisition and exploitation of data, for the creation of useful patterns of behaviour and trends. This is what pushed Barilla Group invest in data visualization.
In our specific case, Barilla asked for the mock-up of a tool that should be used inside the company as an interface connecting big data and workers in the production plants.
Barilla is requiring, for its plants, a tool to enable all the different actors and areas of expertise to connect, confront, share information. A platform that should be user-friendly, dedicated to different grades of user experience and containing a huge amount of structured data accessible on site and in real time.
In order to ensure Barilla workers a quick and effective usability of complex data regarding the supply chain, we developed an interface system called Dialogue. It is based on a platform that visually connects Barilla plants machinery with company databases back-end data, enabling seamless information share among offices and production line and simple data visualisation in loco and in real time for the workers of the plant, in order to better understand machinery requirements and promptly act in case of emergency.
Dialogue can be visualised on screens scattered in plants, along production line, by workers, or on company smartphones by supervisors and managers, connecting the two roles and allowing communication among different professional roles and plants all over the world. Swift interaction and communication is enabled among diverse actors of the same system, guaranteeing a more reassuring working experience on both sides and a comforting work environment.

Understanding the problem

Barilla is a huge company with more than 13.000 employees, 25 production sites in 9 different countries all over the world and needs to handle the production of more than 2.300.000 tons of products per year. The problem with this big reality is that information can't be shared, since data are usually promptly recorded and stored on SAP 2000 Database, but not accessible for physical, linguistic and expertise barriers. These's no system, at the state-of-art, which enables the plants to communicate with each other, data from different places to be compared and analysed, employees to access sensitive information they would need to simplify and make their job seamless.
The only available technology is a High-Definition Surveying ScanStation that measures plants and generates interactive 3D models of plants from point clouds, for office based employees to explore, take measures, add labels, notes, markups, links. Problem is, there's no equivalent tool allowing production site workers to gather information from company offices.

Figure 1: Barilla plant workers' badge to access Dialogue screen interface

Exploring opportunities

With the passing of time human-computer interaction, HCI, are evolving towards human-machine interactions, HMI, in order to account for the dynamism of the industrial environment. Many models have been created to simulate the flow of information during the interaction.
The complexity of the study is mainly due to the difficulty in understanding the connections between the affective, the cognitive and the sensormonitor sphere in the human user. Despite any difficulties, machines are anyway undergoing a humanization process, aimed to put the man in the center of the machine evolution.
Thus the HMI changes shape according to the user, to its role inside the company, to the task he's been assigned. Particular attention is dedicated to the interaction component aimed at dialogue and information processing. In this context an important role is played by augmented reality which allows enhancing the perception of the reality itself by displaying useful hidden information.

Figure 2: Dialogue interface quality section in control area with details

Figure 3: Dialogue interface maintenance section in control area with details

Generating a solution

Dialogue, our platform mock up, visually connects Barilla plants machinery with company databases back-end data (SAP 2000), Leica 3d Scanner data (plant images and 3D maps with digital measurements and other details) and all the documentation around machinery history and functions. Data from company databases is collected through cloud server, reshaped, interpreted by the platform system and inserted in the interface in form of text, images or infographics, according to the different needs, so that it can be as readable as possible.

Plant workers are able to read all this database layered information through Dialogue interface from machinery screens while they supervise normal operation and access each machine history and specifications, control if everything is working according to the guidelines, inform who's concerned of any anomaly with due proficiency. They just need to pass their personal badge close to the screen, contactless, which acts as a filter (read only/ read and edit) enabling them to enter their area of interest, depending on their qualifications.

Managers, other supervisors and maintenance workers, which are to be contacted in case of emergency or extraordinary matters and work seldom around plants, receive information about machinery issues directly on their company smartphones. They can hence promptly answer the needs of plant workers, solve problems or inform about their position and the time of intervention required, drastically cutting down the delay in operations.

Dialogue interface displays four Control areas (Quality, Maintenance, Productivity, Technology) that workers around plant can access accordingly with their badge allowances and one Emergency area, to notify problems, anyone can reach anytime on-the-spot in the quickest possible way.

The control areas are mainly: Quality, pointing out all preparation handbooks and mixture parameters related to each piece of machinery, both visually and by schemes; Maintenance, gathering breakdown history and programmed maintenance, both structured chronologically by calendar

Figure 4: Dialogue interface emergency section with details

Figure 5: Dialogue interface trailer and tutorial sections with details

Figure 6: Emergency mobile notification for managers and supervisors

Figure 7: Answer to emergency mobile notification for managers and supervisors

Figure 8: Answer to emergency mobile notification for managers and supervisors

and spatially along the plant map; Productivity, showcasing production volumes and correspondence with expectations and trimestrial plans; lastly, Technology, illustrating machinery mode of operation and typology of communication. All these four areas have a further dedicated analysis section with gathered data history reorganised in trend graphs.

Two optional Dialogue software tasks we decided to take care of during our concept development for resource optimisation and which were not required by Barilla, are New Hires Training and Tutorials For Visitors. Both the sections contain mainly videos which are informative, educational or promotional, depending on the purpose and occasion of use. New Hires Training is a section where experienced workers can show to new hires educational videos and pieces of information about the machinery they'll need to deal with which are difficult to explain by mouth but are visually usable; Tutorials For Visitors concern all the advertising and instructive material managers can illustrate to their guests or to visiting school children when showing them around the plant.

Along with a screen interface, we developed the mobile application for managers and supervisors to get notification from plant workers in case of urgent matter, usually problems with the machinery functionality. In this case workers in the plant notify the problem trough Emergency section on screen interface and this is sent to selected managers or supervisors depending on the kind of problem.

The actor in question instantly gets the notification of the problem on his company smartphone, thanks to compulsory Dialogue app. The note is accompanied by vibration or ringing tone, it shows on a single screen, with information on plant, machinery type and number, localization, problem description and gravity. He can choose wether to answer by message, call, or ignore the notification if he believes it is not pertinent with his expertise. On the app settings he can also authorize or not his geolocalisation so that the software can process times of intervention. Managing center gets notified too of the communication between the two actors and records it into the system.

Bibliography

[1] *Arvika - Augmented Reality for Development*, Production and Service Dipl.-Ing. Wolfgang Friedrich Siemens AG, Automation and Drives Advanced Technologies and Stan- dards Gleiwitzerstr. 555, 90475 Nuremberg, Germany

[2] Stybliğska, Maria, *LongTerm Preservation of Digital Assets – Some Specific Aspects*, Faculty of Informatics and Materials Sciences, Institut of Infor- matics, University of Silesia

[3] Johannsen, Gunnar, *Human Machine Interaction*, Dept. of Mechanical Engineering, University of Kassel, Germany

EXPeeRIA

Experiencing a Network
of Places for Expo

Project

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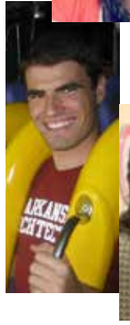
expeeria

EXPeeRIA

Experiencing a Network of Places for Expo



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Project description

The project takes into account the outcomes of the works carried on by Telecom Italia with the same academic tutors and other external partners during the previous ASP cycles. We assume that it is a relevant opportunity to accumulate specific, multidisciplinary knowledge concerning a territorial context (the region between Milan and Turin) and a broad set of topics, oriented to the understanding and evaluation of the complex effects of the preparation, realization and legacy of Expo 2015. The project will mainly rely on two different areas of knowledge: on one side urban planning in order to model the representation of spaces. On the other side ICT to understand how this representation could be retrieved and shown on user terminals, both fixed and mobile.
The addressed issues are essential for the event of Expo but, more generally, for innovative approaches in the uses of territories, especially of those that don’t directly benefit of the Event, also considering how important it is to consider that the Expo event should be based on physical (and not virtual) experience of places and that such an approach is not always obvious in the contemporary world.
The area of interest is that of the metropolitan and regional scale, taking into specific account the so-called in-between places: between city and countryside, between the main centers of the Region, between the site in Milano and the hinterland. These are places where some of the Expo the-

Figure 1: Exploring the territory around Santhia

mes are more clearly evident and where, at the same time, the need of an economic, social and physical reorganization is more pressing.
To provide information, the concepts of “mapping” and that of “interface” are essential, as it is not yet theoretically and practically clear how to fit regional scale information into user mobile terminals of limited dimension, defined by ergonomic criteria, especially when we consider that mobile terminals have to incorporate information that refer to two different kinds of approaches:

- top-down, that correspond to design intentions of authorized actors and that need to refer to “from above” wide scale, abstract visions of collective interest;
- bottom-up, that correspond to specific services provided to single final users, and that must be supported by “site specific” information, meaning that they are related to the near, concrete context and that they must be defined according to inclusive, socially participated processes.

Referring to scopes defined for EXPO in the ASP context, the project may refer to “Digital Smart City” and “Cyber Expo”.

Tasks and skills

Gergana Marks (Architecture) dealt with narrative map generation and digital place-making, understanding how this could be integrated with the final solution contributing to the final storyboard visualizations and diagrams. [Team controller]
Agnese Trotta (Sustainability Design) spearheaded community outreach initiatives including the focus group and worked closely with Scuola Holden to develop stories for the platform.
Francesco Isaia (Building Engineering) helped to developed preliminary website logic concepts and administration hierarchy as well as contributing to the users requirements.
Giorgia Chinazzo (Building Engineering) carried out the online survey and eventually analysed its results to contribute in determining users’ requirements. She also worked on the stories and video making.
Martina Cairati (Management Engineering) developed the business plan of the project, understanding how it could affect local people and future visitors.
Francesca Modica (Architecture) participated in the focus group and helped to develop stories for the platform in partnership with Scuola Holden.
Teodor Hristov (Architecture) explored the technical possibilities of virtual maps, understanding how the interface with future users could be fitted to the project’s needs, as well as developing final prototype visualizations and storyboards.
Aidan Carruthers (Architecture) contributed to the problem set-up phase and carried out the final solution development including the application of game-design, diagrams and visuals. She also helped the group in its organization and management.

Abstract

Globalization and its associated patterns of urbanization and high speed mobility have created a scenario where cities are disconnected from their hinterland despite the fact that they are reliant on them for energy and food. These in-between landscapes are now experienced in the blink of an eye from your car or a seat on a train via infrastructural systems that segregate and marginalize the intermediate territory found between the urban centres. The result is that the inhabitants of these territories are left with dwindling local economies and feelings of disconnection. While this is a trend found everywhere the focus of this particular project is on the landscape between Milan and Turin, home of the upcoming world EXPO 2015. Made up of a highly complex system of people, places and products this landscape helps to sustain the urban centres of northern Italy with a vast system of waterways and rivers, which irrigate the extensive agricultural landscape that helps to feed the surrounding cities and towns.
Recognizing that there is little in the way of recourses to develop this region physically, we look instead to the potentials of new digital and social media to attract visitors and connect existing inhabitants. This is done in two parts; first by building a local knowledge base and online community that can help establish a narrative for the region. The second is the development of an online platform by which these stories can be communicated as well as a gateway for visitors to the territory. The website combines digital mapping with social media as a way to organize content spatially rather than topically. By focusing on visualizing the context where these narratives are established we hope to map not just the individual nodes or Points of Interest (POIs) but the physical and virtual networks that link these sites of interaction.

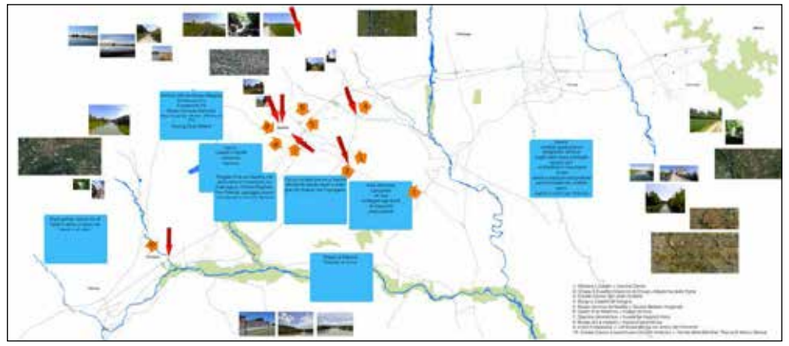
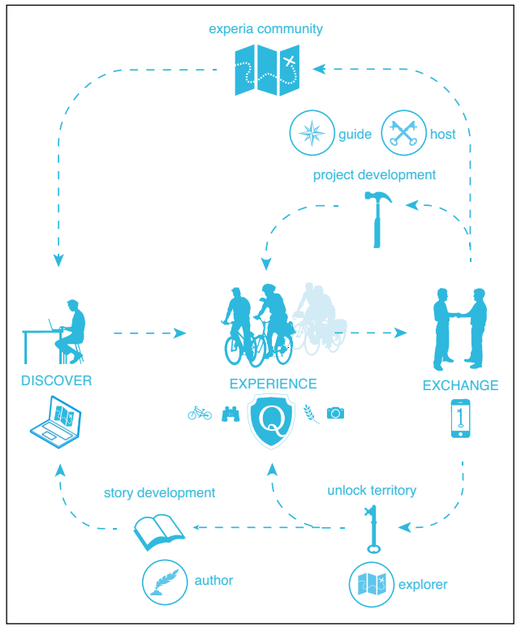


Figure 2: Focus Group Outcomes - Mental Map of the Territory

Understanding the problem

This landscape between Milan and Turin is connected by a high speed transportation artery segregating the intermediate territory found on the short and slow networks. Thus despite the regions unique characteristics the high speed connections prioritize the urban and contribute to a lack of interest in the rural. Consequently, potential visitors fail to see the value of visiting the in-between both because of the lack of narrative for the territory as well as issues concerning accessibility. The effort required to enter the territory is far greater than the inherent draw due to barriers to movement and a lack of information concerning what there is to see and do.
Disconnect is exacerbated by virtual connections that allow inhabitants to communicate with a network of people outside the immediate physical community. While the internet allows for people to keep in touch no matter where they are in the world it can also contribute to feelings of loneliness, where virtual connections precede physical ones. This can lead to conditions where proximity between neighbours is the only thing they have in common. Furthermore, residents often commute to the urban centres for the extensive amenities and attractions leading to a dwindling quality of life in the smaller towns. This contributes to a lack of a shared vision or sense of purpose for the community. The question, is then, not just how people will experience the territory, but how to spark interest, both for visitors and in-

Figure 3: Expeeria User Interaction and Feedback



habitants, enough interest so that they decide to access these in-between landscapes. What could generate this interest? How can we create these connections that are missing, both peer to peer and person to place? How can we leverage ICTs to bring about this change? And finally how can we transform this interest into an experience?

Exploring the opportunities

When first considering the problem question of how to enhance the territory through ICTs, we began researching the potential of data mining and geocoding whereby we would use existing data sets to develop a map for users to navigate the territory. However, due to the fact that we were considering what is the territorial space between major cities there is a large deficit of information relative to urban centres. Cities contain much higher densities both of people and the systems and tools necessary to create these datasets, whereas territories are largely mapped as open spaces with little to define them besides roads and occasional POIs. As one of the major goals of the project was to promote the physical experience of the territory we needed to develop means to elaborate on what was actually there. User generated content and social media provided the opportunity for more collaborative, qualitative data which could allow for a place based, situated interaction that was able to express an identity for the region.

As we shifted from a primarily navigation based solution to a more collaborative narrative, we switched from a purely app based platform to developing a website that would allow for a point of discovery or gateway to the territory. As it is not an urban situated place but rather outside the boundaries of potential visitor's day to day activities we can leverage ICTs to introduce the user to the territory. A website also allows for better browsing and editing capabilities which are necessary for both the locals who curate the content and future users who wish to pursue or contribute. This does not mean that a mobile app is not necessary, in fact it is quite the opposite, but rather that they both provide different types of services which can be overlaid to allow for a better user experience.

As the concept of community collaboration and participation became a key component of the project the necessity to define who contributes and how, became a primary sub-problem. The desire to create a platform that allowed for top-down curation of content so as to be able to provide a cohesive narrative was at odds with the desire to allow for visitors and "outsiders" to participate as well. Furthermore, the ability to contribute and interact at a social level can act as an intrinsic motivation for potential users of the platform. One of the primary design problems was how to motivate a user from interacting on the virtual platform to physically experience the territory. Based on our research on narratives, storytelling, social media and mapping we arrived at the potentials of gamification. From here we applied the concepts and elements of game design in order to generate both the necessary

Figure 4: Expeeria Web Platform Territorial Map

Figure 5: Expeeria Web Platform Local Curated Map

Figure 6: Expeeria Web Platform User page

contextual frame as well as delineating the ways different users could interact and derive motivation.

Generating a solution

Based on these findings Expeeria builds a community by encouraging interaction and participation, acting as a social arena, providing places of dialogue, negotiation and value articulation. The dynamic and interactive capabilities of ICTs and Web 2.0 inherently generate networks by allowing different sites or actions to be linked and thus reference one another. Taking advantage of these new digital potentials, storytelling became a central theme of the project in order both to generate meanings and narratives to attract visitors and to help give a sense of shared purpose to the territory. Working with Scuola Holden and different inhabitants from these territories, we curated a series of stories including photos, writing and videos that constitute the first contents of the website that would be geolocated and associated to stylized territorial and local maps. Expeeria acts as a gateway through which the gameworld projects the potential "experience" to the outsiders encouraging them to actually visit the in-between territories. When users interact with the platform they are participating in game-play which is based on the different rules associated to the user roles: Hosts, Guides, Explorers, and Authors.

Figure 7: Expeeria Mobile App StoryBoard Sollution

Expeeria allows a user to "discover" the territory through the digital platform, thus encouraging the Explorer to "experience" it in the real world, which allows for an "exchange" between the Host/Guide and the Explorer. This interaction generates two different feedback loops. One allows for the Explorer to contribute to the platform with a story and hence becoming an Author. The other involves the Host leveraging the "experience" as a service in order to further develop a project dealing with the restoration of an old castle that has fallen into disrepair or the addition of sign posts and fountains along a territorial path. These interactions leverage the potential of the "collaborative economy" enabling different transaction models. In so doing virtuous cycles between the virtual platform and physical spaces will occur. The innovation is the realization of an emergent virtual platform which instigates territorial transformation and development. By designing for interaction and collaboration between locals and visitors the platform allows for negotiation, agency, change and the sustainable development of the territory.

Bibliography

- Goodchild, M., 2007, *Citizens as Sensors: The World of Volunteered Geography, http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.165.9241*
- Deterding, S.; Sicar, M.; Nacke, L.; O'Hara, K., *Gamification: using game-design elements in non-gaming contexts*, Proceeding CHI'11 Extended Abstracts on Human Factors in Computing Systems, 2011, pp. 2425-2428
- Page, R., and B. Thomas, *New Narratives: Stories and Storytelling in the Digital Age*, Lincoln, NE: University of Nebraska Press, 2011.

sMAIN

Innovative Small
Appliances & Accessories

Project

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SMAIN
SMALL KITCHEN APPLIANCES AND ACCESSORIES

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Innovative Small Appliances & Accessories

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Project description
The SMAIN project was focused on the development of innovative kitchen and fabric care small appliances and/or accessories to complement and enhance the performances of Electrolux major appliances, and to provide consumers with innovative functionalities. The project investigated the possibility of opening a new market for Electrolux, introducing new a range of offering to be commercialized in new distribution channels.
The overall objectives of the project are:
1. To explore the front end of innovation within a multidisciplinary framework, to generate innovative ideas and to perform their screening integrating different perspectives;
2. To experiment the new product development process with a cross-functional team simulating real industrial practices;
3. To exploit industry and academia partnership to the advantage of students, who will be guided by a team of professors, managers and technicians from the company.

Figure 1: Sestriere, September 2014. The team at work

A preliminary project briefing introduced the expected objectives of the new products, as follows:
1. To allow the appliances to be installed and run at their best (any new accessory that improves the installation set up and/or the discovery of the product functionalities);
2. To allow the professional care and maintenance of appliances over time (any new accessory that improves the aspect and the efficiency in the use of the appliances);
3. To enhance the product performance in daily use;
4. To allow the refresh/repair of appliances before their life cycles end (any new accessory that can renovate bringing new vibes to the appliance).

The NPD process was based on Electrolux Innovation Triangle, integrating R&D, Marketing and Design with the aim of exploiting a multidisciplinary approach to innovation, along the following phases:
- Market research and identification of opportunities;
- Idea generation and screening;
- Conceptual design of the chosen ideas;
- Advanced concept development of the chosen product;
- Preliminary prototyping;
- Business analysis and case.

At the kick-off of the project Electrolux provided market and consumer insights to the ASP team, and performed an idea generation workshop in cooperation with the academic tutors.
The conceptual design of the new products started after the screening of the ideas.
Two ideas were initially selected and developed at a conceptual level, to perform a further selection of the project to be carried on to the next steps. Consumer insights gave the possibility of understanding consumer needs to finalize the expected consumer benefits for the identified solution. The insights were partly based on Electrolux consumer profiling and partly based on a research on secondary sources, with a particular focus on user-generated contents (blogs, consumer reviews etc.).
The team also developed a benchmark of the existing solutions (products similar in aspect and performance to the one developed in the frame of the project), to properly capture the novelty element of the proposed solution.
Preliminary prototypes were used to prove the design concept and to give feedbacks on the ergonomic aspects and the functional features of the product.

Tasks and skills
Marialuisa Grizzuti gave a fundamental contribution to the idea generation work and the design of the chosen ideas and collaborated with the whole team for the general world market research. Later, she focused on the user requirements for the glove idea and on a more specific market

research.
Miroslav Kis worked with the whole team in the first phase dedicated to idea generation, preliminary world market research and conception of the chosen products. At a later stage, he focused on materials and environmental issues for the oven glove.
Ksenija Perovic participated in the preliminary work of idea generation, world market research and design choices for the two designed products, the stirrer and the oven glove. She also took care of the graphics for the several presentations we made and the final report.
Elena Pugliese worked with the other teammates in order to generate the first ideas, produce a preliminary market research and conceive the chosen ideas. Later, she focused on the choice of the materials and on environmental issues. She acted as Communication Coordinator.
Sanja Savic always took care of the communication with tutors and of the management of the whole project, since she was the Team Leader. At the beginning, she worked for the idea generation, the preliminary market research and the design of the chosen ideas. Later, she focused on the study of the market competitors.
Teodora Tasic actively worked for the generation of the first ideas, the world market research and the design choices for the selected products. Later, she took care of 3D rendering and of the graphical representation of the oven glove kit. She also created a first prototype of the glove.
Elisa Zocca collaborated with the whole team in the first phase of idea generation, world market research and design of the chosen products. At a later stage, she focused on the economic aspects of the idea and on marketing strategies for the distribution of the product. She also worked as Team Controller.

Abstract
sMAIN is a project completely focused on innovation and product development. It originates from a collaboration between Alta Scuola Politecnica and Electrolux Company and the main goal was to conceive a completely new product to be used in households, in particular in the kitchen area.
During the two years of our group work on this project, we went through

Figure 2: Idea generation result example

Figure 3: The Stirrer

various phases in order to reach an innovative solution in the multinational and multidisciplinary environment that characterized our team. In order to achieve the best solution for the company we used our knowledge and competences from the wide range of areas that are related to the topic of kitchen appliances and accessories.
At the beginning, there was no problem to be solved and since we wanted a solution, we had to find the problem ourselves. This means we did a preliminary market research and tried to gather information about the needs and the opinions of normal people that use their kitchens.

Figure 4: Idea generation result example

After having realized that oven cleaning is one of the most disliked kitchen activities of the users, we have decided to create a more professional solution in order to make this task easier and safer.
The main idea was to develop a glove, equipped with some sponges and different for its dimensions and materials from any other normal glove, that could make easier the task of cleaning the oven. We thought about all the details of our product, from shape to materials, from costs to distribution strategies.
Finally, we came up with the Oven Cleaning Kit, as a single solution, that figures the glove and other useful tools, that will not only make cleaning an oven simpler, but which takes, as well, into consideration the safety of users while they are performing this task – complying with the most sustainable and ecologically conscious way.

Understanding the problem
As every project development, this one also started with a research in the area of kitchen accessories. The most important part before the idea generation process is exploring all that is out there, existing solutions, potential target, and, most importantly, what is the main issue our potential users are experiencing. Understanding the needs and unmet problems that our target has is what should come out of this first and very important phase.
In this part, we tried to have a more profound insight into what is our target facing every day or occasionally, as well as if it could be in our interest do develop a solution in one of discovered directions.
The analysis started by exploring the worldwide existing product as a first step. It was necessary to become greatly familiar with all the possibilities that were already introduced and would be conflicting with our own innovation. It was a deep and thorough research that gave us many useful results and that would, later on, be of major help in the idea generation process.
After exploring the solutions that are already existing we have set some foundation for our future project by making some limits and excluding some potential ideas we could have developed. This knowledge was of great value and gaining it helped us understand existing technologies, innovative materials and many other details we were not familiar with in the past.
After the research, we found ourselves in the vast sea of issues that could be addressed. What we further did was to go closer to our target, to have more knowledge of their personal experiences and setbacks. We talked to our target in person, but we were also aware that we might have limited ourselves to one particular area of the world. Therefore, we expanded our canvas again and restarted with a new research: the target. We went deep into understanding the target through reading numerous comments, customer complaints, discussions, forums, blogs, etc. After acquiring all this important information, we were finally able to understand the possible area in which we could work and take it to the level of an idea generation process, and then further on, to the project development.

Exploring the opportunities

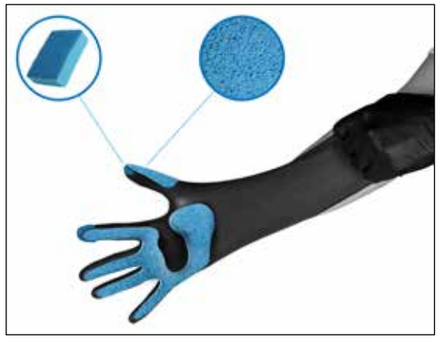

Figure 5: Original single glove idea

Figure 6: New Oven Glove (1): long chemical resistant glove

Figure 7: New Oven Glove (2): short disposable sponge glove

After defining areas of work, we decided it was time to go even deeper with the exploration. We did another research on the topics and discovered even more cases that could be helpful in broadening our horizons and downsizing the area of work.
The areas we chose generally were the oven cleaning process and the cooking. Now it was time to have a clear insight into these specific areas and to define all the constraints, limitations, setbacks and frustrations of these processes.
Again, we turned to our target and their desires, forum discussions and complaints in detail. As we soon discovered, there were many problems related to these specific areas of our interest and they were mostly related to time and quality of their performance. Dealing with these two issues is not an easy task, since many companies are trying to accomplish the same and apparently failing in the process of doing so. There are many unsatisfied customers out there, and we realized that the challenge will be great. Continuing, we finally had a clear problem in our mind that we wanted to face and develop something that can be more than appropriate as a solution.
At this point of our project, exploring opportunities and idea generation process started to overlap due to the fact that we all got inspired by the research and numerous case studies that we found. We started coming up with many possible solutions and we kept analyzing the existing situation in order to able to filter ideas and discard the less innovative ones. The market research at this point was a very good support, as well was talking to our target. It gave us necessary insights in connoting our project and developing our ideas more and more as we were progressing.

Generating a solution

After defining the opportunities, by analyzing basic user needs and the general kitchen accessory framework, we decided to focus our efforts in the development of a product for the oven care.
The starting point of our solution was that of a specially designed glove that allowed users to clean their oven using less effort possible: we called it

Figure 8: OvenGlove Kit elements

OvenGlove. The main innovation consisted in sponge elements attached to specific areas of the glove. Combining the glove with the sponge, in opposition to using both of them separately, proves an effective choice, increasing the user control on the task to complete.

Figure 9: OvenGlove Kit packaging proposal

After further and more complete market analysis, we defined our main competitors and improved the user profile of the product's expected customers. It turned out that people concerned with oven care wish for ease of use of accessories, visible results in terms of cleaning, and safety, especially when chemicals are involved. Furthermore, we noticed that many people feel confused when they notice that their oven urgently needs to be cleaned: they often do not know exactly which is the best way to do it and seek out for help, e.g. inside web communities.
Thanks to the results obtained by this analysis, we developed the evolution of our starting idea: the OvenGlove Kit. This kit would include the OvenGlove, an oven care chemical spray, a microfiber cloth and an oven care manual.
We redesigned the OvenGlove focusing on the safety user criteria. We decided to have two gloves instead of one. The first glove will be long and made of a material highly resistant to chemicals. The second glove, that needs to be worn on top of the first one, is where the sponges are attached. This second glove is shorter and it is made of a more common material (e.g. latex). Furthermore, it will be disposable: after many uses, it can be thrown away and substituted with a copy.
The oven care chemical spray would exploit co-branding, and this means choosing an already known, successful and trusted oven detergent.
The kit and the oven care manual are the most important result of user analysis. By giving the user everything they need and graphically describing how to use the elements inside the kit, it allows everyone to dedicate himself or herself to oven care without feeling lost.
This product answer the question: "how can I improve oven cleaning in an innovative way?" The concept of the OvenGlove kit can be extended to other fields, as well. We propose as a future business opportunity the creation of a line of different cleaning kits, with the objective of helping to improve general kitchen care.

Figure 10: OvenGlove first prototype

Bibliography

All of this led to a strong idea generation that gave us two solutions as possibilities for further developement.
References:

- Hans Kjellberg, Frank Azimont, Emma Reid: *"Market Innovation Processes: Balancing stability and change"*, 2014.
- Karl T. Ulrich and Steven D. Eppinger, *Product Design and Development*, 5 edition (2011), McGraw-Hill.

For further information on ASP:
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