ALTA SCUOLA
POLITECNICA

Multidisciplinarity and innovation
ASP projects

Preface

This book marks the completion of the course of studies for the eighth cycle of students of the Alta Scuola Politecnica.

Created in 2004, the Alta Scuola Politecnica programme draws on the experience of the Politecnico di Milano and the Politecnico di Torino, two universities with different histories, conditions and methods, but sharing the desire to offer a highly-innovative course of studies to selected talented students with an interest on multi-disciplinarity.

From the outset, this ambitious project aimed to create an axis of learning between Turin and Milan. Today, as we witness the growing economic and social bonds between these two cities – both of which are key to the Italian economy – we are increasingly confident that we made the right decision ten years ago, a decision that during this time has come to fruition and has evolved and improved.

The world is witnessing a very fast technological and social development that is leading to the emergence of new paradigms; therefore, technical professionals of the future should not only be specialists in a given discipline, but also capable of building innovative solutions that are most suitable to be transferred to the products and services of the future. At the same time, when dealing with particularly talented students, we believe that universities should do more than simply issue degrees - they should also prepare these students to become future leaders and meet the specific demands that prospective employers cast on this particular segment of graduates. In this sense, the Alta Scuola Politecnica provides an added value with respect to the traditional academic approach. ASP students are given the opportunity to continuously gain insight from one another, from courses offered by both universities, and from projects at the leading edge of technology proposed by companies. Due to this unique learning experience, they develop the managerial skills and the comprehensive training that employers are increasingly seeking from top graduates in technical disciplines. Students have the opportunity to work in teams, managing complex projects which require multi-disciplinary contributions (as illustrated in this book), and follow residential courses, thereby enjoying a stimulating learning experience. The significant presence of industrial sponsors in the ten ASP cycles gives evidence to the fact that industry appreciates the mix of specialized skills, coming from the Master programs, and interdisciplinary skills, coming from ASP.

This important achievement confirms that the path we chose to follow in 2004 is still very timely and promising, and motivates us in continuing and improving this endeavour with the same enthusiasm shown by our ASP students.

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

ASP Sponsors

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 and Fondazione Cariplo. 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.

BCG
THE BOSTON CONSULTING GROUP

The Boston Consulting Group is a global management consulting firm and the world's leading advisor on business strategy.

Founded in 1963, BCG has 78 offices in 43 countries.

We partner with clients in all sectors and regions to identify their highest-value opportunities, address their most critical challenges, and transform their businesses. Our customized approach combines deep insight into the dynamics of companies and markets with close collaboration at all levels of the client organization. This ensures that our clients achieve sustainable competitive advantage, build more capable organizations, and secure lasting results. In our client work, we aspire to make a difference, and we succeed because we are different. We help our clients change the rules of the game, not just play better.

The BCG difference lies in the power of individuals: challenged by mentors, supported in teams, motivated by results. We look for outstanding talents and people who have the curiosity and drive to find innovative solutions. Our consultants work with clients to define the problem and determine the best approach. BCG offers to all its employees to grow further challenging their mind, partnering with leaders, making a difference and ultimately charting a career that fits them.

Our goal is therefore to help ASP students better understand the challenges and opportunities of a consulting career. We are highly committed to develop initiatives to meet, interact and support ASP students in their growth.

BCG. Grow Further! Shaping Your Future. Together.

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CAMERA DI COMMERCIO
INDUSTRIA ARTIGIANATO E AGRICOLTURA
DI TORINO

Along with an ever diversely assorted graduate education offer with 17.738 new degrees or diplomas granted every year, an excellent post graduate training system makes Piedmont and the province of Torino a centre of attraction for young talents.

Moreover, thanks to the presence of more than 200 research centers, today Piemonte Region investment in R&D accounts for 1,8% of GDP. With 2.255 mln Euro invested, Piedmont is the third Italian region as for total investment in research, with 76% of private funded research.

Partnership with public and private institutions, network between territories, support 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, as the new railway connection between Torino and Milan, 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.

Torino Chamber of Commerce: working with businesses to build the future

www.to.camcom.it

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 2013 the Compagnia awarded in its areas of activity 781 grants, amounting to 129.6 million euros, 33.7% 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

McKinsey&Company

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.

www.mckinsey.it

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Maria Grazia Comini

Summary

ASP Alumni
Cultivating ASPers' professional network

The ASP Alumni Association was founded on June 28, 2007, the day of the graduation ceremony of the 1st cycle of the ASP students, 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 aim of growing the professional value of the Alumni and their network, acting in line 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, in the first 7 years, the association has grown rapidly and now boasts a community recognized in the academic and business world, with a network of over 900 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 pro-

Italia 2020

fessionals alumni, offers a broad calendar 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.
An official website and the social networks (as the LinkedIn and Facebook groups) are used to rapidly exchange opinions as well as professional opportunities. The Facebook group is the smart and informal way of communication used by the Association. There are actually more than 600 members and the group is open also to the Aspers that have not already completed their ASP experience. All the Association events and activities are sponsored on the group and each member of the community has the opportunity to post comments, ideas, photos and articles.
In the following paragraphs, a brief review of the main recent activities of the Association will be presented in chronological order.

Marco Magnani and Oscar Farinetti guests of Italia 2020 Event

ASPISSIMA 2013 | CONFERENCE ON SUSTAINABILITY
The traditional Fall Event has come in 2013 to its 6th edition. This year, ASP Alumni dedicated the main event to a particularly important topic for the Alumni DNA: the global sustainability and the limits of growth. On 19th October at Politecnico di Milano, about 200 participants joined the event to listen to and discuss with three outstanding speakers: prof. Jorgen Randers (Oslo Business School), prof. Nicola Persico (Kellogg Business School) and Theresa Kessler (Behnisch Architekten Stuttgart).

SLIDING SESSION 2013 | WINTER LEISURE EVENT
Born the previous year as a collaboration between students and Alumni, in 2013 the sliding session repeated his success among members. The event took place in Courmayeur, one of the most renowned among alpine resorts, hosting over 40 Alumni for a weekend and engaging them with a number of activities including alpine skiing, cross country skiing and trekking in the natural reserve of Val Ferret. The event had the pleasure to host, during the official dinner, the mayor of Courmayeur, Fabrizia Derriard.

CANEVA 2013 | SUMMER LEISURE EVENT
The Summer Event 2013 was organized at Caneva World, the famous water-park on the Garda Lake. During a wonderful sunny day over 40 Alumni enjoyed the amazing water attraction of the park, creating a great ASP group atmosphere which lasted all the day long up to the aperitivo at the sunset and to the dinner in Lazise.

ITALIA 2020 | CONFERENCE ON ITALY'S PERSPECTIVES OUT OF THE CRISIS
On 15th February 2014, the latest ASP Alumni conference took place in Milan. The crowded Aula Rogers hosted an interesting panel discussion on Italy's situation and perspectives out of the crisis. The guests - Marco Magnani (Harvard Business School), Antonio Calabrò (Fondazione Pirelli) and Oscar Farinetti (founder and owner of Eataly)-, starting from problems analysis, underlined the importance of innovation with their personal experience, meritocracy and cultural attitude as main road out of the difficult present situation in the firm opinion (well explained in the Magnani's book "Sette Anni di Vacche Sobrie", UTET), that Italy can

ASPissima 2013

Leisure Events
(Sliding Session
2013)

overcome the crisis and come back to a social, cultural, and economic growth.

**ALUMNI ASP MENTORING
BUILDING THE COOPERATION BRIDGE**
50 Mentors, 50 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. The second edition of the Project was launched in December 2013 and is up and running. Moreover, the Education Team is currently working at the third one. The aim is 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 the job world? Is it worth getting support from the network of ASP Alumni in the steps towards the first job?" After ex-

periencing 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 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. All participants have agreed with signing a code of ethics which 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.

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Twitter **@AlumniASP**
LinkedIn   **www.linkedin.com/groups/Alta-Scuola-Politecnica-4297244**
Facebook **www.facebook.com/groups/AlumniASP/**

Caneva 2013
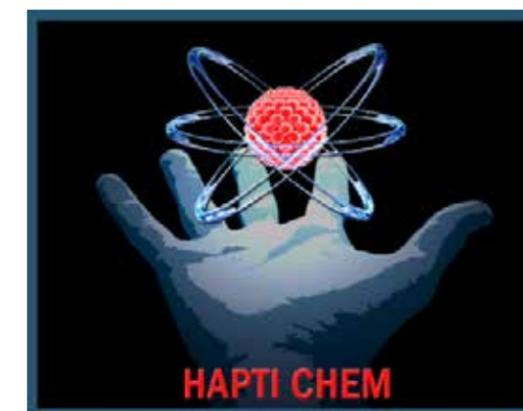
Haptichem

**A HAPTIC-ENHANCED FRAMEWORK
FOR CHEMISTRY TEACHING AND RESEARCH**

Haptichem
A Haptic-Enhanced Framework for Chemistry Teaching and Research

1

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EXTERNAL INSTITUTIONS

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METID - *Metodi e Tecnologie Innovative per la Didattica*
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Giacomo Mazzoletti
Biomedical Engineering, Politecnico di Milano [communication coordinator]

Alessandro Maria Rizzi
Computer Engineering, Politecnico di Milano

PROJECT DESCRIPTION

Haptic technologies provide physical sensations in the interaction with a computing system, by exploiting the human sense of touch and by applying forces, vibrations, or motions to the user's hands or body. These innovative technologies have received important attention in recent years and they have become a common interaction modality in several fields, from simulations, to gaming, as well as in professional training (e.g. surgeons). However, considering their features, they can provide a useful help in training or education as well. Aim of this project is the design and development of a framework equipped with a haptic device for the tactile exploration of molecules and the understanding of intermolecular interactions.

The project started from a 3D virtual environment for molecular exploration interacting with a single charge associated with the haptic device. The tool is able to reproduce the behavior of the electrostatic interaction between an electric charge and a molecule that can be chosen from a set of molecules of different nature and complexity stored in a repository. The user can explore the space around the 3D geometrical model of the selected molecule and feel the electrostatic forces involved in the interaction, i.e., attraction/repulsion forces or stability conditions. The system is also enriched with auxiliary graphical cues that help the exploration and the comprehension of the felt force.

The main extensions proposed within this project aimed to:
- Explore and identify scenarios for the introduction of the framework into didactic and research activities;
- Identify and extend the tool with a set of features to make it usable;
- Extend the functionalities of the tool with the interaction between two different molecules.

In particular, for this last point, the scientific issues met during the design and development of the project were several and not trivial. From a scientific and technical point of view, they included the identification of the models for the simulation of the inter-molecular interaction with real-time constrains, the acquisition and definition of models for haptic data, and the identification of optimal visualization strategies to guarantee a realistic interaction reproduction.
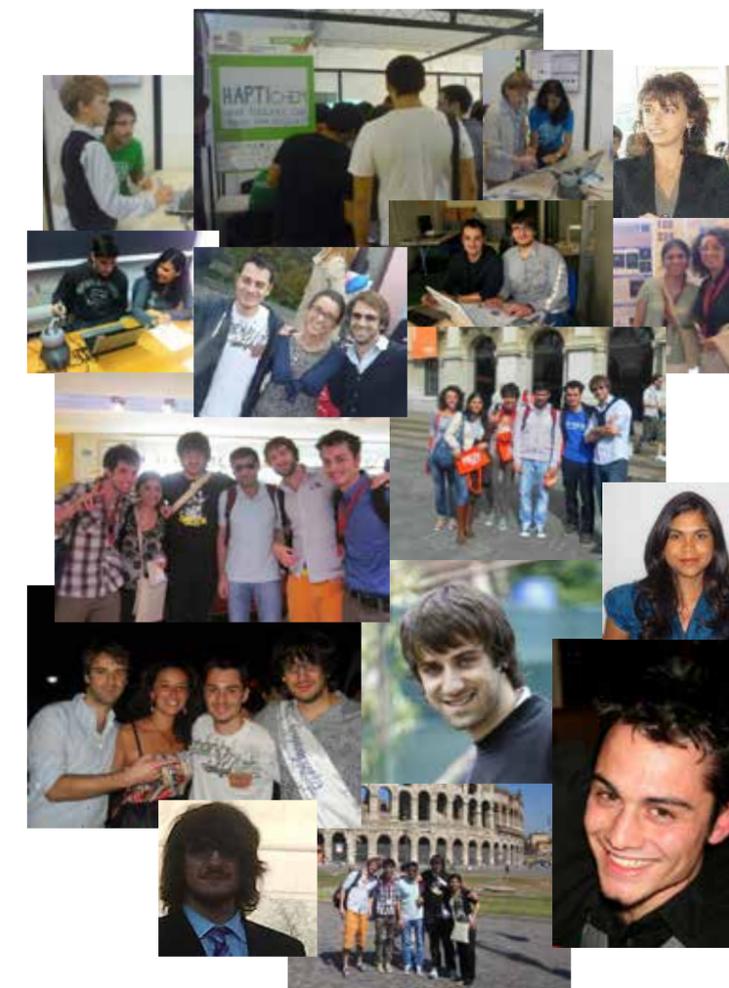
Haptichem
A Haptic-Enhanced Framework for Chemistry Teaching and Research

1. Results of the experimental test session: Have the haptic tool improved student spatial abilities?

2. Results of the experimental test session: Have the haptic tool improved student molecular knowledge?

3. The software graphics: Van der Waals fill representation of molecules.

4. The software graphics: Ball & Stick representation of molecules.

TASKS & SKILLS

Gianluca Brero contributed with mathematical competencies to the research and selection of strategies for implementing the dynamical interaction between molecules;

Rosa Garnier Espinoza carried out preliminary researches on the state of art on the topics related to chemistry; she handled the creation and administration of the project's webpage, managing also social networks' contacts;

Elisa Magnanelli was involved in the analysis of the possible scenarios for the application of the tool; as the team controller, she ensured the consistency and completeness of reports and documents to be submitted, and managed finances;

Giacomo Mazzoletti investigated mathematical models on computational chemistry; he hold a speech to present the project at the international conference ICCE ECRICE in Rome;

Alessandro Rizzi exploited his competences in computer science for the extension of the haptic device, working on the technical implementation of the software.

ABSTRACT

Currently, the approach in life science teaching makes a wide use of visual representations, especially when molecules are involved. Indeed, due to their size they represent an abstract knowledge that sometimes can be difficult for students to grasp. Visual perception is usually superior if compared to touch: first of all it is rapid, while touch involves sensory exploration over time and space. However, visual representation does not provide an immediate mean to improve comprehension of how molecules interact between each other. At this aim haptic technologies enable users to apply and feel forces, that otherwise would not be possible to experience. Haptics can be extremely useful in several education contexts, where forces play a fundamental role, like in the case of molecular interactions. Didactic texts describe them in an abstract way, whereas in the research field they are typically described as huge sequences of data, which is awkward to be interpreted even by experts of the field. Nevertheless, the spreading of haptics in this context has stopped, and the actual use of this technology in chemistry education results really limited.

Given these premises, the goal of HaptiChem project is to extend the features of the existing tool[1], which currently enables the user to explore the surface of molecules with a charged probe, in order to make it exploitable in a didactical context. In particular, the challenge is to highlight the strengths and the weaknesses of the current device under a didactic point of view, to individuate a proper educational framework for the introduction of the tool, and to elaborate a suitable strategy for the spread and diffusion of the new HaptiChem. The path to the final solution followed different stages, starting from the building of a theoretical basis and from the analysis of the requirements, and continuing with the development of a tool with renovated features, to finally conclude with the creation of a on line platform to encourage the diffusion of the device, and at the same time take advantages of feedbacks provided by users to continuously improve the tool.
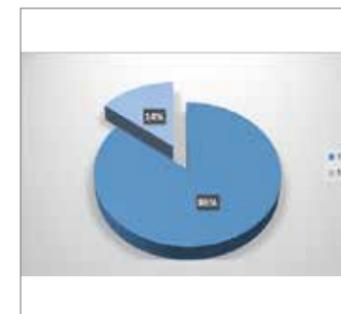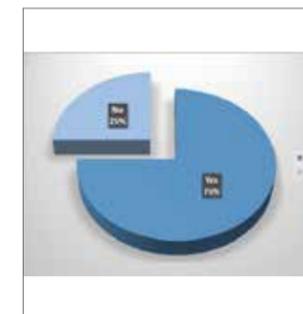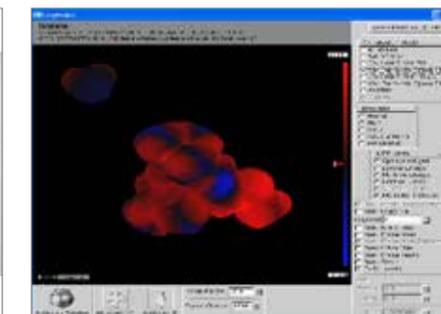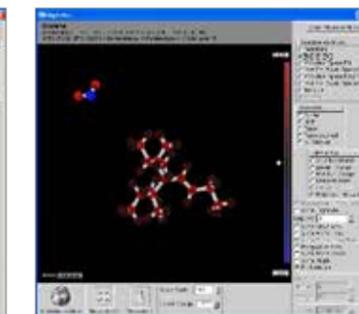
UNDERSTANDING THE PROBLEM

Being haptics a novel technology for all the members of the team, the first phase of the analysis of the problem involved members of the group familiarizing with the haptic device itself, and performing an accurate analysis of the state of the art, in order to deeply understand what its features are, and what an haptic device can add in an innovative way to a chemistry educational context. The first stage of familiarization with the tool was fundamental for the next step. In fact, one of the hardest challenge to be faced regarded the individuation of a proper framework for the diffusion of the haptic device. Concerning the state of the art analysis, due to the complexity of the problem, different areas of investigations had been recognized and addressed: the mathematical methods used in the reproduction of chemical interactions, the various typologies of haptic devices, and the different application of haptics in a chemistry context. The preliminary analysis highlighted the fact that the spread of the haptic technology in chemistry has stopped. Therefore, the choice of the field for the application is crucial to guaranty the success of the project. The field research included a variety of activities, in order to select the most promising context: HaptiChem was first presented [2] at the ICCECRICE 2012 international conference in Rome and advertised during the "Notte dei Ricercatori" in Milan, in order to collect important feedbacks and impressions by researchers and professors on possible applications of the tool in the chemistry context, as well as to stimulate the interest in the haptic technology among a public of non-experts. In this stage, it was really important the direct interactions with all categories of people, that were able to personally use the haptic device, and therefore, helped in the understanding of what set of features was the most suitable for an extension of the tool

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able to meet the requirements of the scenario chosen for the introduction of the renovated haptic device. We have performed this since, as stated in [4], users have a central role in the innovation process and they can actively contribute in the development of new technologies.

EXPLORING THE OPPORTUNITIES

The preliminary activities were the starting point for the delineation of the solution. Thanks to them, it was possible to identify different fields of application of the haptic device. All scenarios were analysed and compared, and the final decision was made considering different criteria. Among these criteria, innovation played a very fundamental role, since according to the preliminary analysis, an important part of the challenge consists in overcoming the current disinterest in the haptic technology applied in chemistry. The selected application sees the use of the haptic device as a teaching

5. Screenshot of HaptiChem on-line platform: team description.

6. Screenshot of HaptiChem on-line platform: downloading of the application.

7. Screenshot of HaptiChem on-line platform: main page.

8. Facebook webpage.

9. Intermolecular interaction.

10. Forceline representation.

11. Molecular representations: Ball & Stick, Van der Waals, Logarithmic scale.

12. Molecular representation: resizing.

13. Charge-Molecule interactions: positive charge and negative charge.

tool in basic chemistry courses at the university, where it is believed to also represent a strong motivational factor in rising the interest of students in the learning process.

A subsequent step consisted in the delineation of the features most needed in the selected context. In order to further investigate the matter, an experimental session with students in Electronic Engineering attending a course of Chemistry at PoliMi was established. The main purpose of the activity was to evaluate the effectiveness of the device for the molecule exploration in a teaching context, as well as to define a possible way of extension of the tool that properly fits the case. Different alternatives were individuated: simulation of molecule-molecule interaction, interactions between proteins, and problems of molecular docking. The extension to the reproduction of molecular interactions was considered to be the most appropriate to the case, not only because it better fits the in the

context of a basic chemistry course, but also because the level of complexity of the simulated phenomena is adequate. Once defined the goal, three main mathematical options were taken into consideration to model the interaction:

- Multipole expansion of the electrostatic potential;
- Classical methods for potential calculations;
- Use of structural factors.

GENERATING A SOLUTION

In order to overcome the difficulties that are currently present in the spread of the haptic technology, the elaboration of a strategy to renovate the interest in the application converged on the realization of a web platform. The on line platform aims to several objectives. First, it is meant to encourage the spread of the software: in fact, it allows registered users to download the application for the molecular representation. In this way, potential users can

get in touch with our project without the necessity of the haptic equipment, which represents a great expense and a big barrier for HaptiChem diffusion. Together with the software, there is the possibility to download the user guide of the application, which is intended to be constantly updated in order to keep pace with possible improvements.

In the same website section, a well-organized molecule database can be downloaded. Thank to this option, the molecular basis for haptic experiences can be regularly augmented according to users' main interests. In order to collect such interests, we created a section named "Contact Us" and forum for grouping general feedbacks. Through these, it will be also possible to identify eventual software bugs or general improvements that need to be made. In order to inform the users about the new prospects the software offers them, a collection of articles regarding our project is presented in website home page. Among those, we
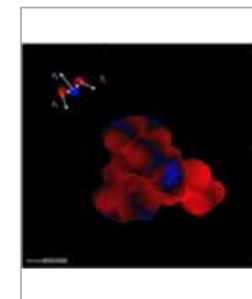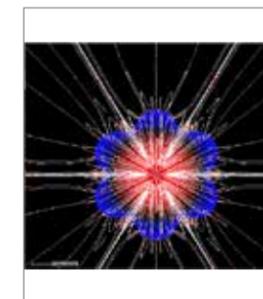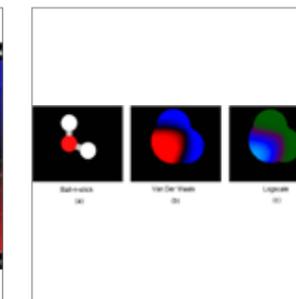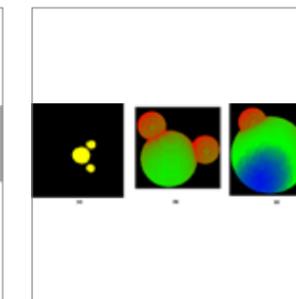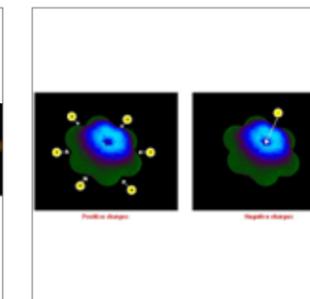
have also inserted papers about software architecture and surveys about didactic experiments that have been carried out. A section for introducing our academic tutors and us has been finally included.

For achieving better visibility, both Facebook and Twitter profiles have been created and linked to our website.

Concerning the software extension, it was fundamental to select a computationally fast approach able to render force perceptions simultaneous to cursor movements but still not too rough in order to produce outcomes coherent with theory. In the model implemented the moving molecule is considered as an aggregated of concentrated charges, each one located in the position occupied by the center of respective constituent atom. The distance between the charges is constant in time since the vibrational effects between the atomic nuclei have been neglected. Each charge establishes an interaction with the fixed mol-

ecule, from which a force rises. The whole force the molecule is subject to will be the sum of these local forces. In order to assign a charge to each atom two different approaches, that of Mulliken[3] and that of Lowdin[3], have been chosen. This methods computes local atomic charges directly from the quantum wave function. The use of either approach can be set by the user interface.

In a second model implemented the total force acting on the haptic-device is not the sum of all the forces as before, but is the highest one. Moreover, the repulsion effect between the atomic nuclei has been added. This extension let the user to experience the equilibrium points in intermolecular interactions.

Considering real time simulation as performances not worst then 1000 frames per second, we estimated that the moving molecule size should not exceed 264 atoms. This result is pretty comfortable since it allows to explore

a wide range of molecule-molecule interactions that includes most of the molecules studied in high school. Haptic application in chemistry contexts is now ready to express all its potentialities.

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SMAPS
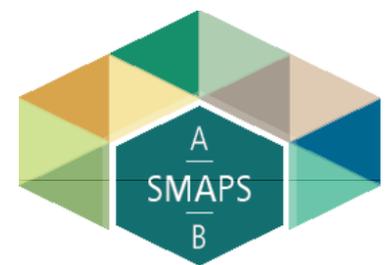
SMART PRODUCTS, PLACES AND SERVICES
FOR SMART CITIES

SMAPS
Smart products, places and services for smart cities

2

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PROJECT DESCRIPTION

The SMAPS project is based on the idea that the smart development of cities should be connected to the design of the interaction between their traditional physical structure and the new digital informational infrastructure. This interaction can be primarily built through the introduction of new "smart" service ideas and solutions for the emerging needs of citizens, whose design is the main goal of the project.

While ubiquitous computing is strengthening the idea that the access to public services will just require digital solutions, such as platforms or e-gates, the SMAPS project aims at exploring the relation between the immaterial nature of services and their material substrate, combining the design of the services together with that of their touch-points. The physical transformation of cities is seen as a result of the introduction of new services, in a continuum where the tangible and the intangible layers influence each other in a dynamic way.

The experimental part of SMAPS is connected to the EU research project *My Neighbourhood*, where a people-centred approach to the development of smart services for urban areas is being experimented. This project involves 4 major European municipalities, as arenas for the experimentation of new participatory practices for the development of urban services. Within this frame, the traditional technology-driven approach to smart cities is integrated with the new idea of "Human Smart City": a livable place characterized by services and infrastructures responding to the needs of individuals and social groups more than by the sheer presence of advanced technologies. This new approach requires the introduction of a systemic perspective, where the role of society and individuals is recognized as integrated with that of technology.

The area of Quarto Oggiaro in Milano, one of the 4 experimentation arenas, is the place where the students' teams were asked to conduct their experimentation. In the frame

of the *My Neighbourhood* research, the development of the new service ideas and solutions is carried on in the perspective of upscaling. The service ideas are thus rooted in a local context, adopting participatory design methods and tools, but include the seeds for their potential adoption, adaptation and diffusion at a larger scale.

At the same time, the SMAPS project aims at integrating the traditional top-down perspective of the municipalities, with the bottom-up perspective bound to the involvement of citizens. This new integrated approach gives the opportunity of interacting and dialoguing with citizens without loosing contact with the real problems (bottom-up trajectory), while at the same time defining priorities and building solutions around meaningful long-term visions beyond the acknowledgement of local needs (top-down approach), thus experimenting new ways of managing urban policies and governance.

project 2A

EVENDA:
Agenda of Events

TASK & SKILLS

Anna Antonova
Dealt with the blue sky analysis and in the project phase worked on the physical interface of the service, designing totems and their functioning

Carlo Andrea Biraghi
Coordinated the group and took part to contextual analysis, focusing directly on Quarto Oggiaro, participated actively to discussing tables with municipality and associations to define the guidelines of the project. He participates to the Aalborg workshop.

Alberto De Antoni
Studied the business model of JCDecaux (partner) and deepened the aspects related to scalability, feasibility and economical sustainability of the service

Alberto Franzoni
Took part to the contextual analysis, deepened the aspects related to scalability and defined the guidelines of the project

Anna Prokudina
Dealt with the blue sky analysis and in the project phase worked on the physical interface of the service, studied the environment to define the best collocation for touch points

Valentina Sardo
Took part to contextual analysis, focusing directly on Quarto Oggiaro, participated actively to discussing tables with municipality and associations, developed the website structure and layout and designed the logo. She participates to the Bologna Smart City Exhibition.

Alessandro Spagnuolo
Dealt with the blue sky analysis, made a research on the state of the art of websites in the field of event management, deepen the constructive process of totems

ABSTRACT
New problems, emerging needs of citizens and new technologies to try to give intelligent solutions to the critical issues of this moment of crisis: the problem that has occurred is very broad and without a definitive way to explore and has required a blue sky analysis on the concept of smart cities and a contextual analysis that has focused on the most critical points of a contemporary city. The problem of the vulnerable suburbs has emerged as critical and urgent and then, becoming aware of the existence of a European project , My Neighbourhood, that deals with the possibility to design a smart service able to enhance the quality of life in suburban areas, our attention focused on the area of Quarto Oggiaro, selected context for the city of Milan.
After an analysis of the problems and opportunities of the area, we decided to work on the social cohesion and the lack of sense of belonging and participation in the life of the neighbourhood. We found out a great number of associations and active people working for the community creating events and opportunities for interaction which actually can't succeed because of a lack of communication among them and with the citizens.
The Evenda service was born from these osservations, as an "Agenda of Events", a set of tools even for citizens and associations based both on physical and digital components to optimize the management of free time and to

1. The logo of the project
2. First table acknowledgment
3. First table discussion
4. First table mapping the conclusions

boost social participation.
The innovative nature of Evenda consists in answering to local needs searching for a wider dimension.   The website is structured as an agenda to show the scheduling of the events around your position, customizable according to each user's preferences, filled in by the activities provided by registered associations. This service is thought to become a global service of local events based on geolocalization.
The physical part, is tought to be applied to specific context that require it, as Quarto Oggiaro. It consists in a certain number of touch points with two different possible layouts studied according to their positioning, dividing between totem for places of transit and for gathering points.

UNDERSTANDING THE PROBLEM
The analysis try to better clarify the problem and the roads that could be followed to give answers to the new demands of citizens, creating a smart service. We follow two paths: thanks to a blue sky analysis we go deep in exploring the concepts of smart city, while, also, participating to the Bologna Smart City Exhibition in October 2012, which allowed us to have a better idea on the state of the art in this field, and through a contextual research, we had a concrete approach with the most critical parts of the contemporary city, analysing problems and new needs of those who live these spaces. The question of the peripheral degraded areas appears to be a pressing issue and difficult but important to resolve. Working on these topics, we approached the european project "My neighbourhood" for a community of interests: focusing on the creation of interpersonal social interaction to make people live in a more active way in a healthier and happier environment. The solution will be sustainable even from the economical, environmental and social point of view. The pilot cities for My neighbourhood are Milan, Aalborg, Lisbon and Birmingham. According to the decision of the municipality of Milan the project settled in Quarto Oggiaro, a stressed dormitory urban area in the northern part of the city, that present problem of segregation, social degradation and a bad "name", as well demonstrated by the contextual analysis made at the beginning of our work.
The district is constricted by railways and highways on all its sides and present spaces with lack of care and physical degradation, which lead to general perception of insecurity and discomfort. There is an high residential density and a big percentage of elderly people and immigrants; many activities and shops result closed, the spaces are abandoned and this situation reflects a lack of job opportunities inside the area.
This frame has been confirmed in the round tables in May and June with municipality and citizens, to discuss about chances to ensure a better fu-

5. 4th table audience grows

6. Survey on communication channels

7. Training in Aalborg for My Neighbourhood project

8. Team-work in a first phase of the project

9. Mock-up of the web site

10. Functioning of the rapid search of the web site

11. Functioning of the calendar page of the website

12. Totem outside the station - digital side

13. Gathering totem - classic side

14. Mock-up of the Evenda app

ture to the neighbourhood. By the way appeared also many positive aspects to be considered as the real value of the area: the most important element is the presence of high number of people devoted to their environment and helpful in order to improve it. There are a lot of associations and events of different nature, that we have catalogued: there isn't than a lack of possibilities of social interaction, but a weak communication between citizens and organizers and between organizers themselves. Using the personas tool we started an analysis of the actors involved in the life of the neighbourhood. In addition to associations and normal citizens (simple users) there is a good number of active or activable citizens that, thanks to a future better communication policy, could collaborate with the associations and become proactive. Simultaneously we conduced a research on the JCDecaux and on its business model to be sure that our work could meet their interests and

possibilities. We found out that is a company open to many different experiences with the only task of bringing innovation making profit.

EXPLORING THE OPPORTUNITIES
Because of the nature of the context, a top down process could risk to be perceived as something external and negative imposed to the community. So we found necessary starting from the meeting with citizens, and their feedbacks could be the first step of a bottom up project, attempting to overcome a simple solution of the problem, trying to be innovative. We have to consider that the organization of events and the participation to community activities in a neighbourhood as Quarto Oggiaro are important instrument for a social cohesion the development of a sense of belonging. During the tables discussion the associations agreed on the inefficiency of the actual system of organization and communication of events. They have a

website, Quartoweb, that results ineffective because of its confusion, lack of control and user generated contents. Thanks to a survey we discover that due to the unreliability of existing tools, people mainly used the word to mouth system to be informed on leisure activities. Solutions could not be exclusively digital because of the large presence of elderly people. Considering that such situation uses to appear in many other context, both neighbourhood and town, we have to think about a scalable service applicable also from other municipalities. The exportation should not correspond to a segmentation of the service but to an enlargement of its ray of action, remaining under a unique brand. We started to shape our project also thanks to some important meetings. The first appointment in June was the My neighbourhood seminar in Aalborg where some design tools were presented and experienced with a workshop. The common guidelines for every pilot city were

stressed: rebuilding and empowering the neighbourhood and scaling its value, elements that were already in our path.
We also met Peter Gall Krogh, a design professor at the Aarhus School of Architecture, that share with us his experience in similar project, dealing with the involvement of citizens, as Democracity and other still running, giving us useful advises to continue our work.
At the beginning of July we visited the smart city office of the Milan municipality to receive suggestions from people directly involved in the real world, facing everyday problems and contradictions.

GENERATING A SOLUTION
Our solution start from a union between local and global scale: we try to answer the need of a specific community giving a service with a wider breath. The website we designed start from different local dimensions, that linked together could cover an unlimited space trough

the geolocalization system. Analysing the state of the art of our possible competitors, we found many weak aspects in existing websites: dispersion of information, lack of a hierarchy among events with different expiration date. Quartoweb, presents all this problems and is also structured as a blog: the admin load contents as a post, so that they appear with the upload date instead of the event one, and that makes the events consultation impossible.
We decided to create a user-friendly website that in a glance could give all the information needed; first page after localizing you, shows the closest events of the day. From there user can easily access a calendar page completely customizable where is possible to match the events schedule with his personal agenda. After a synthetic overview of the events, the citizen can choose to have further information on the selected one with a simple click. Associations and events' organizers have a preferential access with a log in to a page that allows

to create and manage events having an idea of the existing frame.
At the local scale one of the most important instrument is the totem: it is composed by a digital screen and a traditional notice board to interact with users of every age. Digital interface is directly connected with the web platform so that every data can be updated in real time. After a study of the neighbourhood we identified the possibility of develop two different kind of elements. In those places where people pass, but not stop, we designed a simple totem, while in squares, parks and gathering points in general the totem is enriched by the presence of urban furniture elements. This physical component of the service could be exported in other municipalities: in this way from the local prototype of Quarto Oggiaro it could be possible to approach the global scale with this participation tool, really able to connect people together.

project **2B**

IDEAlize

TASK & SKILLS

Ludovica Cappelletti participated to the preliminary research on Smart City, contributed to the Contextual Analysis, did part of the analysis of the actors, was responsible for mapping the associations in Quarto Oggiaro, maintained the relations with them and gave contribute during the development of the Tool Kit.

Francesca Ditroilo participated to the preliminary research on Smart City, did part of the analysis of the actors, deepened the literature review about participatory design, was the expert for the conceptualization and design of Idealize, was responsible for the development of the Tool Kit, the logo, the video and the website.

Giorgio Doro, the team coordinator, did part of the analysis of the actors, was responsible for the research of the external partner involvment, deepened the literature review about incubators and social innovation and participated to the workshop in Aalborg of My-Neighborhood project.

Maria Glionna participated to the preliminary research on Smart City, developed the Blue Sky Research, did part of the analysis of the actors, deepened the literature review about Smart Cities design, gave contribution during the development of the Tool Kit.

Timur Kadyrov participated to the preliminary research on Smart City, did part of the analysis of the actors, contributed in the contextual analysis, deepened the literature review about incubators, participated to the Smart City Exhibition 2012 in Bologna.

Benedetta Omarchi participated to the preliminary research on Smart City, contributed in the Blue Sky research, did part of the analysis of the actors, performed service design tools analysis and choice, gave contribution during the development of the Tool Kit and the workshop.

Laura Tomasino participated to the preliminary research on Smart City, did part of the analysis of the actors, contributed to the literature review analysis and participated to the workshop in Aalborg of MyNeighborhood project.

ABSTRACT

Many cities are recently developing "Smart" agendas, using a range of ICT infrastructures and equipment offered by the technology industry and/or being discovered by observing other cities. Yet is ICT infrastructure a key condition for smart innovation? Is there any more urgent topic for facing this moment of crisis?

The current recession has highlighted and underlined the various problems existing in our country and not only that; they in particular have hit more consistently the most disadvantaged neighborhoods of the cities.

During our analysis, we've encountered the European project "MyNeighbourhood", with whom we had the opportunity to work together and analyze the territory of Quarto Oggiaro. We've adopted a bottom up strategy, and we took part in some roundtables discussions with the citizens. They've highlighted many problems, but we've decided to focus on one of them, that is the lack of job opportunity and the unemployment.

Instead of thinking of the possible business in this area, we've concentrated more on the process of identifying entrepreneurial opportunities and how to transform them into successful ventures.

The key question for us was if could be possible to help people to realize their own business.

Right now the aspiring entrepreneurs don't have any reliable framing techniques that can help them to build a robust entrepreneurial idea, apart from the business model or business canvas, that focuses more specifically in the business identification phase, rather than the early stages of the process. This can be stimulated applying creative and participatory methods.

In the first phase of our project, we've used some tools, deriving from the service design, that we've found very effective in the development and assessment of our own service idea.

We've then decided that these, could have the potential to be scaled and to be themselves the core of our project, which investigate the possibility of using some service design tools to help the generation of entrepreneurial opportunities.

UNDERSTANDING THE PROBLEM:

The analysis and the understanding of the problem started with a careful study of the concept of Smart City. This first phase was carried out analysing the literature to understand what was this new concept of city, what features should have and how new Smart Services could be implemented in it. We understood the different issues of the present context and the different goals that the United Nations and the European Community have set to achieve this new model. We've scouted already existing ideas and services present in our cities, to understand better the current situation. In addition to the study of the literature and reality, we participated to a fair in Bologna "Smart City Exhibition" where we attended to conferences from different communities and institutions, and we

1. Milano, October 22 2013, The Team is working on SWOT Analysis Canvas
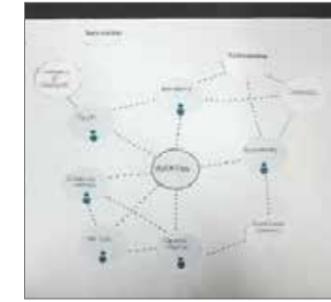
2. Milano, October 22 2013, The Actor Map Canvas completed.
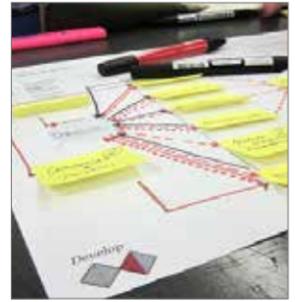
3. Milano, October 22 2013, The Team is working on Sistem Map Canvas

were able to see different realities that are moving to obtain common objective.

Later on, the team began a phase of deeper analysis: a Blue Sky Research was conducted to understand the possible scenarios of future Smart Cities while a Contextual Analysis was carried out on Milan to understand the problems of different places of the city. During this analysis, one of the areas that were studied was Quarto Oggiaro, a troublesome neighbourhood on the outskirts of the city. Through those researches we noted that municipality and in general many companies are gradually decreasing the use of a top-down approaches in favour of bottom-up dynamics. The municipalities have understood the vital role that the public and various stakeholders have, and they are relying much more on the participatory design. This point was crucial also for us: for the way in which our design has been conducted and for the solution itself that we propose, where the participation plays a

key role.

In a third stage, the group had the opportunity to take part to a project in the borough of Quarto Oggiaro, MyNeighbourhood. It is a European Union research project, involving four municipalities (Milan, Lisbon, Aalborg and Birmingham), aiming at creating Smart Sevice using new technologies to retrieve the sense of neighborhood, which is long lost. This project has pushed us to make an overview of the actors who live and work in the neighbourhood, and gave us the opportunity to do a preliminary analysis of the territory and the problems it presents.

The problems encountered were mainly three. At first it was reported the lack of social cohesion, sense of belonging and participation. This has become the topic of the group A. Secondly, was highlighted the presence of problems within the different ethnic groups; citizens have very different backgrounds, culture and skills, making it difficult for them to live together. The third, that has become the sub-
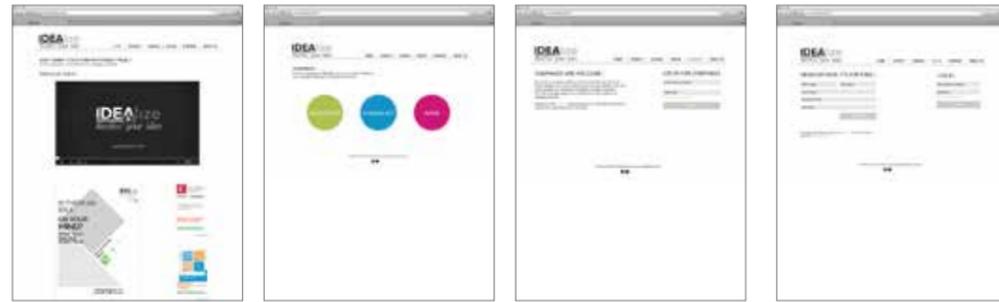
4. Homepage of the website www.idealize.com

5. Login user of the website www.idealize.com

6. Page for companies of the website www.idealize.com

7. Page for the users of the website www.idealize.com

ject of our project, is closely related with the presence on the territory of a very high rate of unemployment. There is no reference point for the business environment of the district; in addition the activities of this kind and the people who want to start a business on their own have no support.

EXPLORING THE OPPORTUNITIES
According to the problem definition, project challenges came up thus, to face and solve them, we had to better explore the local environment to study opportunities and possible problems. Knowing already the context of Quarto Oggiaro (from the previously described Contextual Analysis) we started to analyze the local community processes and to better understand profiles of people living there. My Neighbourhood project gave us a possibility to meet together with different actors of local processes during a series of "round tables" that helped us to understand the difficult situation of the community from the bottom. We did research about different types of

activities in Quarto Oggiaro (dividing into scholar, offices, religious and cultural types), developing a mapping of the main actors' activities. Opportunities were found out in the presence of different activities and possible places for their development.
Due to the lack of data about the borough, local social associations, local administration, institutional representatives and actively interested residents gave us an idea about real problems related to the real people, with imagination of possible solutions and suggestions. As one of the goals of My Neighborhood project for Milan Municipality was to improve local life conditions through supporting or creating work opportunities, we focalized on the entrepreneurial aspect of social innovation. Moreover the implementation of Smart Services in Quarto Oggiaro has been further explored with reference to their entrepreneurial potentialities, due to the initially identified relevance of the topic.
Participations to Denmark meeting

of "My Neighbourhood" project (Aalborg, 18-19 June 2013), the meeting with Professor Peter Krogh of Aarhus School of Architecture and Smart City Exhibition and Conference (Bologna, 29-31 October 2012) helped to link local problems and needs with innovations opportunities and incubators actors. Later on we analyzed literature of social innovation, business improvement and service design.
Next step was to understand the incubating and co-working actors' process for small entrepreneurs and innovative startups either by studying literature review about them or by acquiring information from local entities ("The HUB Milano" and a future-coming co-working space in Villapizzone).
From those analysis we've decided that could have been more interesting to innovate in the methods for the generation of entrepreneurial opportunities, rather than on the incubator itself. For doing so, we've decided to concentrate on the service design tools, which we've been using for the mid-term review for our Asp project. Those methods were really effective in the development and assessment of our own service idea.
To be sure that our idea was an innovation, we've also studied co-working, workshops, incubators, tutoring and specialization workshop programs, to understand whether they make use of service design tools. In addition their working logics were studied to take inspiration and to better understand how and where to implement our solution.

GENERATING A SOLUTION
Based on the identified opportunities, the development of the service became the target for our project. We focused on the definition of a Smart Service, based on active support to entrepreneurial activities and on a precise set of service design tools, applied on entrepreneurial ideas not yet formed: this is how the service, "IDEAlize" has been shaped. We tried to understand how IDEAlize could work at its best: we chose to structure it as a direct and active communication of know-how. The service consists in a Service Design Toolkit offered by professionals to local people through said workshops: it aims to help local people to design better and to develop more clearly and effectively their business idea, during the first stages of the entrepreneurial idea definition itself. In fact, while we were analyzing the current situation, we understood that local associations in Quarto Oggiaro were unable to face this issue on their own, and incubators or co-working organizations were either too detached from local realities or require an already structured business idea, in order to actively engage in it.
After scouting service design tools to understand which to apply, we imagined and outlined precisely how a workshop would work, organizing it by pointing out steps and phases in which service design tools would be used, with a twofold purpose: to test the applicability of the tools and to shape the service itself. After understanding the specifics about how the

service would be delivered, we concentrated on means of communication useful to inform people about the service and its organization. According to identified problems and needs of the citizens, we recognized a series of promotion channels: Evenda, the service elaborated by team A, web services for youth (Web site, Facebook event page, neighborhood's web-portal, Promo video) local information points for elderly and unemployed (bulletin boards, places of social associations, verbal communication to generate curiosity) and direct promotion using bulletin and flyers distributed by informed personnel.
The next step is the registration to the workshop itself, in which citizens describe their profiles and ideas. Registration could be done through website or directly in the office desk in local association's place. After that, all the requests are evaluated, workshops for different targets are planned and confirmation letters are sent.
Before the beginning of the workshop, participants receive an introductive lecture, where the workshop is explained. Later on, during the workshop, tools are taught and used on the task-projects selected as case study, so that people attending the workshop learn how to apply the tools. The final aim is to make it possible for them to apply the tools on their own ideas in order to implement and structure them as an entrepreneurial proposal. Institutional actors, such as students of Politecnico of Milano, could support workshop and tutoring activities, pro-

viding their knowledge, as a research phase in their own field of expertise. Furthermore, private entrepreneurships could be involved submitting their project as explanatory task-projects, and performing a market research and/or promoting their activity (e.g. incubators or financial organizations for future business ideas).
The overall service provided by "IDEAlize" answers to My Neighborhood's purposes and objectives to foster local entrepreneurial activities (thus improving unemployment condition) and to consequently enhance social innovation and cohesion, finally impacting on the quality of life of the community. Moreover, "IDEAlize" could be easily scaled up and extended to other boroughs or cities, implementing Smart Services for its inhabitants.

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GreenSpace

SPACE AND GREEN TECHNOLOGIES

GreenSpace
Space and Green Technologies

3

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PROJECT DESCRIPTION

The pursuit towards eco-friendliness is radically transforming the way we think, design and work, as private companies and public organizations approach the concept of sustainability as a new frontier and a powerful trigger for innovation.

Up to now, the space industry is not implementing any analysis or quantification of the environmental impact of its activities, even though one of the main objectives of satellites is Earth observation for environmental monitoring purposes. The causes of this shortcoming reside in the fact that production rates of satellites are extremely low, that the launch phase is perceived as a singular event in terms of emissions of pollutants in the atmosphere, and that mission specifications and constraints are demanding and leave poor margins to alternative designs. It must however be noted that the environmental impact of a satellite is not concentrated in a single point in space and time - the launch event - but it must be evaluated considering its whole life cycle.

The GreenSpace challenge is framed within the European Space Agency development of an environmental outlook, which aims not only at the full compliance with the legislation and at the assessment of the impact of its activities, but also at laying the foundation for future evolution through innovation, ensuring a competitive advantage for European industry. ESA commits to become an exemplary space agency by promoting the sustainable use of space as a necessity and a duty for Europe. Action is necessary to turn a threat into an opportunity.

Keeping in mind the peculiarities of space operations - the only anthropogenic activities which cross all layers of the atmosphere – GreenSpace concentrates on the definition and implementation of design procedures suitable to minimize the environmental impact of space assets, both in space and on ground.

An initial phase of research underlines the lack of tools and methodologies that allow for the specificities of space materials, processes and technologies, and points out the iso-

lation of the space industry with respect to other productive sectors.

In order to enhance its innovative potential, the project fosters a contamination between the space sector and other industrial areas as a starting point for the design activity. The two teams have different design targets - outer space assets and on-ground activities - but a common goal: the development of resource efficient processes and technologies which might reduce raw material inputs, energy consumption, wastes and costs.

Team A, AENEAS, is characterized by a strong technical background and focuses on both methodological and engineering solutions related to launchers' life cycle issues: on one hand, the definition of innovative tools of analysis and, on the other hand, the adaptation of technologies used in different industrial sectors to this segment, in order to reduce its environmental impact. Team B, EAC, had a diametrically opposite perspective: the development of environmentally, economically and socially sustainable concepts for on-ground building design, inspired by space-specific technologies; moreover, the definition of a multi-criteria tool for a mathematically rigorous evaluation of the concepts which considers both requirements and goals of the project.

AENEAS
Assessment on the ENvironmental Effects of Activities in Space

TASK & SKILLS

Beatrice Buffa focused on the development of the social branch of the project, making proposals to convey through various channels information on the environmental solution.

Francesco Consonni took care of the elaboration of the alternatives for the reduction of the environmental impact of hydrogen production.

David Dianda worked on the identification of the stakeholders and on the definition of their needs and acted as the Team Controller.

Filippo Manelli performed the feasibility evaluation of the alternatives for the environmental solution, conducting a multi-criteria analysis.

Massimo Molinelli analyzed the state of the art on Sustainability Assessment Tools and worked on the economic aspects of the sustainability problem.

Davide Pizzocri worked on the criticality analysis of space subsystems, adapting the eMergy approach and successively developing the innovative FLECA method.

ABSTRACT

The European Space Agency has recently decided to systematically assess the environmental impact of its activities, both because of the increasing environmental awareness and because of the emanation of new regulations on industrial processes. GreenSpace Team A was assigned the task of examining the space-segment of ESA's activities, defining the idea of sustainability in this frame, developing an innovative method to evaluate their impact and proposing a more environmentally-friendly design solution. The first task was carried out by adapting the definition of sustainability given by Gro Brundtland, one of the pioneers of environmental studies. Then, the eMergy approach, holistic and simpler than LCA methods, was adapted from ecology and was used in order to identify the critical subsystem of a space launcher. The criticality analysis shifted the focus on the propellants, which were further analyzed through a specifically tailored qualitative method, Fuel Life Environmental Cycle Assessment (FLECA). The use of this method led to the identification of the hydrogen production for Ariane launchers as one of the most significant environmental hotspots. Six alternatives for the mitigation of the carbon dioxide emissions caused by the plant were proposed. After a preliminary evaluation of their effectiveness, an MCDA method, TOPSIS, was applied in order to find the best solution, considering also the criteria of adaptability to the plant, maturity of the technology and cost. The production of hydrogen from biomass-derived methanol, paired with carbon capture, turned out to be the best option, mainly because of the significant reduction in specific CO2 emissions it generates. Carbon dioxide savings for a single launch event were converted to units used in the Wedge Game, developed by Princeton University professors Stephen W. Pacala and Robert H. Socolow. The results from the previous phase were used in the social promotion of ESA's environmental awareness through both physical and digital channels.
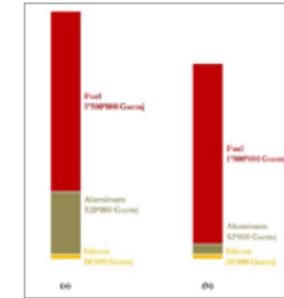
1. Energy Amounts Competing to Each Subsytem in a Typical Satellite Launch
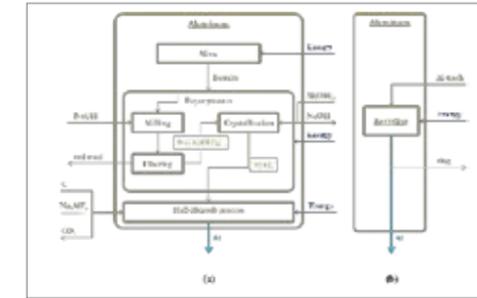
2. Energy Diagrams with Materials and Energy Fluxes for Aluminum Production from Mine and from Recycling
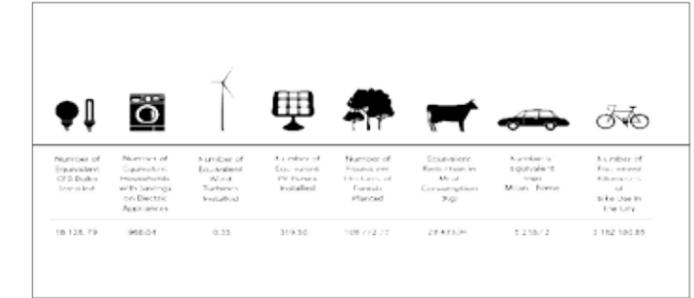
3. Equivalents of Emissions Savings in Wedge Game Units

UNDERSTANDING THE PROBLEM

Following the breakdown of the GreenSpace teams' objectives, we were assigned the task of focusing on the space segment. Team A thus focused on the following goals:

- giving a definition of sustainability for space activities, as nobody had ever taken in consideration the problem in this industrial sector;
- developing an innovative tool for the analysis and evaluation of the environmental impact of space activities;
- proposing an innovative design solution to reduce the environmental impact of space launching activities during one of the many stages of their life cycle, possibly borrowing it from other industrial sectors.

Since the GreenSpace project is framed in the Clean Space initiative promoted by the European Space Agency, our work has ESA itself as its principal stakeholder and inherits the Agency's ones. There are several actors who carry an interest in the results of our researches, both in a direct and indirect way. The main contacts have been kept with ESA's staff and scientists working on the Clean Space initiative through phone calls and emails. On the other hand, the awareness of citizens on the problem has been investigated through a survey conducted with the help of social networks. Information on the suppliers has been conveyed to the GreenSpace Team through ESA's staff, due to the peculiar privacy policies that characterize this sector. European Space Agency asked us to develop a method to assess the environmental friendliness of space activities and a solution to minimize their environmental impact. To evaluate the solutions we proposed, we have defined a short set of final requirements. Considering the assessing method, we defined two criteria:

- effectiveness, i.e., the capability of the solution to provide the desired result;
- efficiency, inversely proportional to the consumption of resources to get to the desired result.

When we switched to the evaluation of the technological solution to reduce the environmental impact of space activities, additional criteria had to be taken in consideration, due to the different needs that industrial activities must satisfy. These further criteria have been discussed with the main stakeholder and are validated by current use in industrial practices and by experts' opinions. Thus, we have considered also the following aspects:

- adaptability, related to the number and the size of the plant's modifications to be implemented to adopt the solution;
- maturity, related to the industrial state of development of the examined solution and to its capillarity of diffusion in present-day plants.
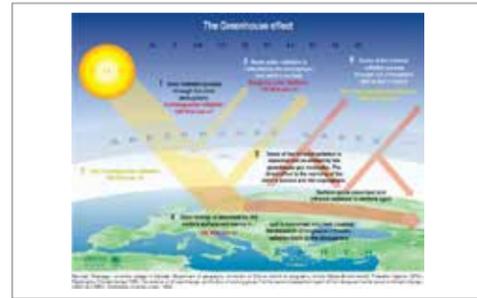
4. Greenhouse Effect Mechanism
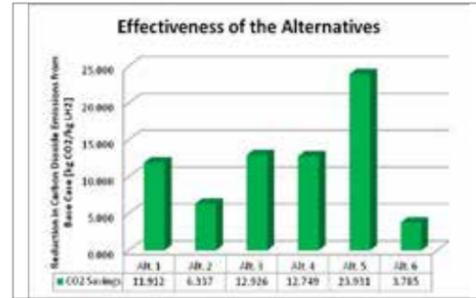
5. Histogram Showing the Effectiveness of the Different Examined Alternatives

6. Map of Sustainability Assessment Tools
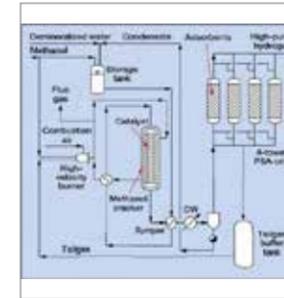
7. Plant Scheme of ESA's Hydrogen Production Plant in Kourou

8. Promotion of Converted Quantities through Oshi Application
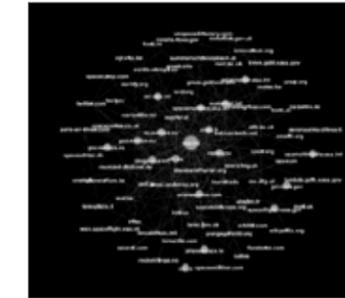
9. Stakeholders' Websites Network Charted with Issue Crawler and Gephi
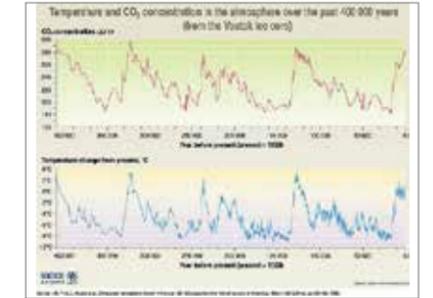
10. Temperature and CO2 Concentration in the Atmosphere in the Past 400,000 Years

EXPLORING THE OPPORTUNITIES

The need to fulfill the objectives of our project, respecting the requirements we have identified, gave birth to the challenges we had to face. First, since a definition of sustainability in the field of space activities had never been given, an effort of restricting a broad idea into narrower boundaries was required. Then, the second and even tougher challenge was to develop a holistic, efficient and effective method to obtain an estimate of the environmental impact of the main subsystems of a space launcher. The present solutions, among which those belonging to the family of Life Cycle Assessment are dominant, did not suit our needs for various reasons:

- Industrial databases are not sufficiently enhanced to deal with the specificities of space systems manufacturing;
- LCA-related evaluations require huge amounts of data as input and specific knowledge of the processes involved and, as a consequence of this, they are often subcontracted to companies that have special expertise in the field;
- An adequate modeling of the impacts peculiar to space activities is not carried out.

Finally, following the results obtained in the first phases, the proposal of a design solution to reduce carbon dioxide emissions linked to the hydrogen production for Ariane launchers was set as the objective of the last phase of the project. The present production, using methanol derived from a methane-reforming process, is characterized by significant values of greenhouse gases specific emissions. The main results of these phases, which make up the environmental solution, must then be conveyed through suitable means to the general public.

GENERATING A SOLUTION

The challenges that were posed by the objectives of the project have all been overcome through the proposal of solutions that either have been created ex novo or that have been adapted to contexts different from those that originated them. The definition of sustainability for space activities was given developing ideas that had been elaborated by one of the pioneers of environmental literature: Gro Brundtland. As for the method of analysis of the various subsytems, the eMergy approach, borrowed from ecology, was implemented in order to conduct a criticality analysis. Once the critical subsystem, the propellant, had been identified, a qualitative method for the selection of the environmental hotspots in a propellant's life cycle, was developed. Fuel Life Environmental Cycle Analysis, FLECA, specifically tailored for the study of the different processes undergone by a space fuel, allowed the identification of several hotspots for different propellants used by ESA. Among these hotspots, we chose to focus on the hydrogen production for Ariane launchers for the following reasons:

- Hydrogen is a commonly used chemical and improvements in its production for space applications could have beneficial impacts also on other industrial activities, eventually fulfilling one of ESA's goals;
- Current hydrogen production is characterized by significant carbon dioxide emissions and environmental problems related to greenhouse gases are among the most relevant ones in contemporary society;
- The problem of the evaluation of feasible alternatives to mitigate the carbon dioxide emissions from hydrogen production perfectly fit the competencies of our team, whereas the focus on other environmental hotspots would need specific space knowledge and peculiar information from the industry.

Through the Technique for Order Preference by Similarity Ideal Solution (TOPSIS) method, which is a Multi-Criteria Decision Analysis tool, after setting a system of weights and taking in consideration the previously listed requirements for the technical solution, we found the optimal alternative for the problem. The best one among the proposed solutions was the production of hydrogen from biomass-derived methanol, paired with carbon capture at the outlet of the plant.

The savings in carbon dioxide emissions obtained with this solution were converted in equivalent units of practical interest exploiting the categories proposed by the Stabilization Wedge Game, invented by Princeton University professors Stephen W. Pacala and Robert H. Socolow. The results will be conveyed both through physical and digital channels to promote ESA's efforts towards a stronger environmental sustainability of its activities.

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project 3B

Spaceship EAC
European Astronaut Centre & Environmental Advancement Centre

TASK & SKILLS

Masoud Bozorg Bigdeli focused on the development, definition and AHP evaluation of sustainable standard and space-driven concepts for water management in the European Astronaut Centre.

Alberto Castiglioni concentrated on standard and space-driven energy solutions to improve the EAC sustainability and defined criteria and processes for the AHP assessment.

Ludovica Frezza performed the analysis of the EAC district, the environmental impact evaluation of the proposed solutions and studied the integration between existing buildings and new structures.

Diego Martinoia worked on the design and engineering of an online platform for concepts showcase and collaborative decision-making between ESA and the local community which surrounds the EAC.

Beatrice Matassini concentrated on the economic feasibility evaluation of the proposed concepts.

Cristina Palamini focused on the definition and AHP evaluation of waste management standard and space-driven solutions, worked on the concept generation and design of the online platform and acted as Team Controller.

ABSTRACT

The GreenSpace project aims at filling the gap between the lack of commitment shown in the past by the space sector in the monitoring of its impact on environment and the current perspective towards sustainability. As awareness towards the problem is growing, eco-friendliness is today an essential requirement for all industrial activities, both from a corporate social responsibility and from a European regulatory compliance point of view.

Within the GreenSpace framework, team B focuses on the assessment and the sustainable development enhancement of **ground-based space facilities**. The name **Spaceship EAC** covers both cardinal aspects of our design activity: the definition of **space-driven concepts** for the **European Astronaut Centre** redesign and the environmental advancement goal of the project.

As history teaches us, technical knowledge emerged within the space sector serves as innovation driver in other industrial branches: this project aims at consciously managing this generally spontaneous process by fostering the contamination between the space sector and the architecture and civil engineering fields, in an **eco-design** perspective. Indeed, space technologies, developed for an extreme environment, deal with resources scarcity and need to be highly efficient, representing a valid source of inspiration for the generation of innovative concepts for sustainability improvement on ground.

1. The European Astronaut Centre building (source: European Space Agency)

2. Layout of the territory around the EAC v

3. Solar irradiation map of Germany (source: A.G. Aberle, "Thin-film solar cells", Thin Solid Films Journal, 517, pp 4706-4710, 2009)

4. Wind farms distribution in Germany (source: European Environment Agency)

In any case, when dealing with complex and uncertain scenarios, decision among the possible solutions is not straightforward and needs to be supported by appropriate methodologies: the final goal of Spaceship EAC is to provide a multi-criteria and quantitative **decision-making tool**, able to focus on the main goal while considering all other relevant aspects – environmental, economical and social sustainability. Furthermore, the project promotes local community participation in the decisional process, as a way to enhance knowledge, generate understanding and promote consensus towards the EAC redesign, space activities and their potential innovative impact on sustainability.

UNDERSTANDING THE PROBLEM

Eco-friendliness is nowadays a paramount requirement for any space facility, especially if we consider the **ground segment**, which is fully comparable to other industrial sectors and,

due to its key role in respect to sustainability, represents the core of Team B's project. Our case study, the EAC building, provides training facilities to the European astronauts and includes offices, meeting rooms, training areas and a swimming pool, which result in high energy and water demand and in large amounts of waste production: their management acquires high importance from an environmental perspective, and becomes the key for sustainability improvement. The building, unlike many ground-based space sites, is not located in a deserted area but near a city: we identified the integration with the pre-existing compound and the attenuation of the impact on landscape and local community as additional fundamental requirements. Indeed, our design activity began with the broadening of the environmental advancement objective in order to fully embrace the concept of **sustainability**, which considers not only eco-friendliness but also its bal-

ance with economical and social aspects.

In collaboration with ESA partners we structured our tasks as follows:
- the **assessment of the sustainability**, in ecological terms, of the EAC building, based in Köln, Germany;
- the undertaking of a **design process** within a technical context, as required by the project goals, namely the exploration of the potential of space technologies applied in the architecture and civil engineering fields. The human resources of the team have been selected accordingly and do not include aerospace expertise, in order to foster the exploration of innovative paths;
- the generation of **space-driven innovative concepts** which may turn the EAC in an Environmental Advancement Centre, a first attempt to enhance sustainability through space technologies, processes and systems. The extreme performances, limited resources and strong
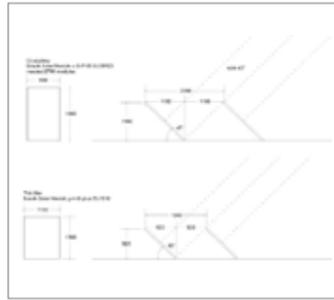
5. Thin film and crystalline modules orientation
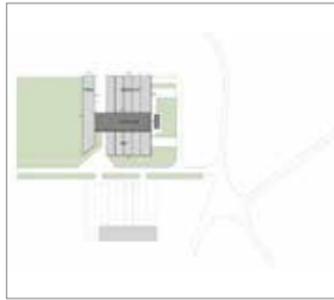
6. Map of EAC buildings roofs' surfaces

7. Estimation of EAC water consumption for the different equipments

8. "Overall Preference Matrix" and relative RVV vector for the ranking of the selective criteria within the AHP decision-making process (S=degree of sustainability, M=maturity of the technology, E= economic feasibility)

9. Matrixes and eigenvectors for the energy solutions' selection (left: criterion "S"; center: "M"; right: "E")
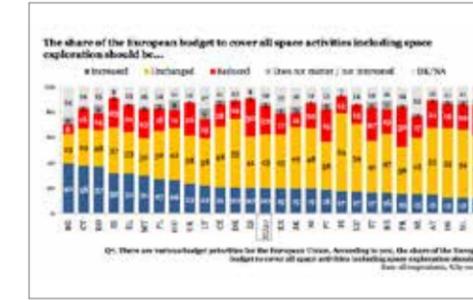
10. European citizens' opinion on space activities funding (source: Space Activity of the European Union Survey, conducted by The Gallup Organisation, Hungary, upon the request of Directorate General Enterprise and Industry, 2009)

constraints that characterize the outer space environment are regarded as design opportunities, inspiration and sources of innovation for the ground segment;

- the definition of a **decision-making process** for the evaluation and comparison of the concepts. The tool requires flexibility in the criteria definition and needs to consider technological, economical and social aspects.

EXPLORING THE OPPORTUNITIES
Design methods suggest the understanding of limitation and **constraints** in the early phases of the project as a way to identify innovation **opportunities**. Taking on this perspective, we pinpointed the most relevant ones for our project:

- the EAC building compound, far for being space-specific, supports the development and testing of concepts that are potentially applicable to the standard construction industry;

- surveys highlight EU citizens' lack of interest and knowledge towards the space sector. The EAC location enables the experimentation of the integration between its facilities and the local community, as an opportunity to enhance the perception of space activities, their role in innovation and their potential positive impact on sustainability;
- the complex decision-making process, which requires an *ad-hoc* tool and includes sustainability as a crucial criteria, may foster a paradigm shift in assessments procedures. In addition, experimenting openness and community involvement may enhance consensus towards space activities, a critical resource for ESA;
- the partnership with ESA allows a potential implementation of the concepts, thanks to the agency's ownership of technologies, expertise in the field and spending power, which may support the high costs of such an investment and drive the compet-

itiveness of Europe through sustainability;
- multidisciplinarity and lack of aerospace background within the team allow a fresh and holistic perspective, which goes beyond the current state of art and is more likely to engage in new paths.

A preliminary research on LCA and LEED rating systems, together with the analysis of the available EAC data, served as guidance in the identification of five relevant **areas of intervention**, in accordance with project requirements and team expertise:

- **energy** solutions;
- **water** management;
- **waste** management;
- preservation of **local area**;
- involvement of local **community**.

An in-depth analysis of the above-mentioned areas considered the technology state of the art, its current application in the EAC and an overview of the German situation, as well as the related space technologies, as groundwork for

the generation of innovative concepts. Two main drivers influenced our design activity: a certain **urgency for action** on sustainability, which leaves little space for research and experimentation, and a **call for groundbreaking solutions** that may revolutionize the European scenario in a longer term perspective. Taking advantage of these conflicting requirements we performed a comparison between standard technologies and innovative space-related concepts.

GENERATING A SOLUTION
The project focused on the development of a range of concepts: there is no evidently dominant solution and the decisional process is not straightforward. We consequently thought important to define an *ad-hoc* assessment tool for our design proposals: we relied on the Analytical Hierarchy Process developed by Thomas Saaty in 1980, a method emerged during the "*Design Methods*" ASP School. The peculiari-

ties of our project fulfil the AHP application requirements:
- the **availability of alternatives**;
- the **absence of a clear criterion** for their evaluation.

As for the selective criteria, we decided for a compromise between complexity and completeness, and we identified as relevant:

- the **degree of sustainability** (S), which refers to the technology overall contribution to sustainability and represents a necessary but not sufficient index in relation to requirements;
- the **maturity of the technology** (M), a parameter in open contrast with "S" if we consider that innovative solutions are often experimental and yet not suitable for large scale applications. The importance of balancing the oppositions through the AHP method is evident;
- the **economic feasibility** (E), in opposition to "S" but concordant with "M", since mature technologies are

likely to be economically competitive. The AHP process outcome is a **quantitative assessment** and a **mathematical rigorous ranking** of our design alternatives; it received positive feedbacks from ESA as considered a valuable tool for decision making practices in complex and uncertain contexts.

The final solution implementation may affect the local community and the landscape surrounding the EAC; disruptive sustainability innovations, despite their benefits, may rise controversies and opposition as they represent an alteration of the status quo: a more **open decision-making process** may be advantageous in order to improve understanding and consensus, as underlined in the ASP Schools "*Innovation and Society*" and "*Complex Decision-Making*". Consequently, our project was concluded with the development of an online tool, based on gamification principles, that allows EAC district's employees and common citizens to get in touch with the Spaceship EAC project, discovering the different concepts, following their testing and expressing a preference, always keeping in mind their cost and their environmental benefits.

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WISE-SOS

WIRELESS SECURITY SOLUTION FOR SCUBA-DIVING

WISE-SOS
Wireless Security Solution for Scuba-diving

4

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The WISE SOS Project, developed in collaboration with Istituto Superiore Mario Boella, aims to develop a wireless system to help divers communicate in case of danger.

INTRODUCTION
From the '60, when professional associations for instructors were established, scuba diving has increased more and more, reaching the nowadays figure of 950.000 new diving certification per year worldwide. Even if safe to be performed under ideal conditions, the impossibility to efficiently communicate during the activity, but only by mean of hand gestures, could compromise both the environment and divers safeness. In fact, according to a Japanese study from 2000, every hour of recreational diving is 36 to 62 times riskier than automobile driving, rising to about 96 times according to an historical data set analysis over 10 years of activity in USA. Moreover, several studies confirm how leisure costal activity, such as scuba diving, if performed with a poor training may alter fauna and flora safeguard, exhausting natural resources (e.g. coral barrier in Red Sea). All these evidences lead to the desire to give a technological solution, able to answer to the open questions about diving safeness and providing a useful tool to improve scuba training all throughout the activity.

THE CHALLENGE
The project wishes to push new optimized ICT solutions and state of the art technologies throughout innovation design solutions in the underwater communication field, considering all the related challenging aspects this represents: the propagation, the integration of the sensor node and of the radiating structure into the diving suit, the use of adequate materials, the investigation of energy efficient solutions and green harvesting mechanisms through experimental and innovative lines of developments.

THE TEAM
All member of the team were engineers, with different scientific background. Most of the efforts were given on the study of electromagnetic underwater propagation and hardware solutions to develop the network between hosts, thanks to the majority presence of telecommunication and electronic engineers in the team. However, thanks to the presence of material science and bioengineering knowledge inside the group, it was possible to face the issue

from other point of view, designing for the first time a new coating material for underwater application.

THE RESULTS
With only few data about underwater propagation published in literature and patents pending on principal application for underwater communication, one of the main result was to define a legal frequency of work, collecting moreover data about principal variable to parameterize the electromagnetic communication and study its feasibility in theoretically, in fresh water and in salty water. Experimental test, given the complex state of art analysis and theoretical modeling, were carried out only in fresh water (Belgirate, March 2013) with a simplify model. Air and underwater wireless propagation were then compared, demonstrating the possibility to communicate underwater and defining technology limitation of the process. Results of theoretical analysis, antenna modeling and fresh water test were then presented to ASP-URSI 2013 Conference in Orlando, Florida. Simultaneously, material analysis and selection for underwater application was carried on, defining advantages and drawbacks of metallic and polymeric materials. Moreover, existing commercial solutions were examined, discussing the possibility to tailor them for our purpose. However, a total innovative approach was chosen, leading a nine-month long laboratory research to synthetize a new class of materials, able to act as a coating on electronic devices while protecting them from water and corrosion. Results led to the definition of a M.Sc's thesis project.

WISE-SOS
Wireless Security Solution
for Scuba-diving

1. Antenna design: analysis of electromagnetic field.

2. Salinity and pH variation in the world [Nasa data]

3. Experimental test on underwater propagation in fresh water: set up scheme [Belgirate 03.2013]

TASK & SKILLS

Andrea Manzoni studied the propagation of electromagnetic waves at low frequency in both fresh and salted water, designing solutions to achieve underwater communications among scubas.

Matteo Gregorio Modesto Marascio in his role of Team Controller and Communication Coordinator was in charge of group management, work organization, constant communication between stakeholders and external relations.

Simone Merlo brought his scientific experience into material analysis for underwater applications, focusing on material selection and R&D for a waterproof coating solution.

Nicola Peserico designed and simulated innovative antennas for underwater communications, aiming to wearable solutions for scuba divers.

Francesco Silvestri analyzed state of art of IP for underwater communication, leading the experimental investigations

ABSTRACT

Diving is an activity in continuous development, firstly as an exciting and relaxing sport, secondly because of the increasing attention to the underwater environment requiring continuous and in-situ observation. In this contest, the underwater safety represents a vital requirement. Beside the regular maintenance of the equipment it would be expected that single divers have a further security level represented by the possibility to communicate each others in case of danger. This project aims to develop a wireless system allowing such a possibility. Starting from the analyses of the state-of-the-art of existing underwater communication solutions and brainstorming on innovative solution that could be put in act to solve current limitations, including conceptual and/or technological ones, two short-term key macro goals where identified to be applied to a first prototype: (i) modeling of underwater propagation to collect inputs for the design of a new antenna and (ii) researching on the possibility to design a new class of material able to protect the device, without introducing artifact among the communication between users. In the first case, the analysis led to the definition of narrow working band for radio communication, under the right of Italian legislation. Moreover, simulations with commercial tools provided an insight into the propagation pathways and antenna design. Research on feasible material started from analyses of commercial solution and ended with the notable result of designing an innovative polymeric coating able to protect electronic devices without interfering with remote-host communication.

Future prospective after proposed results would led then to the creation of a first prototype and assess its expected behavior both in simulated and real environments.

UNDERSTANDING THE PROBLEM

Main challenge all along the project duration was to drag innovative solutions into a complex topic such as scuba diving, keeping a good degree of simplicity without compromising divers' safeness. Moreover, a green approach to the issue was required, to avoid short and long-term impact on the environment and possibly reduce underwater pollution, introduced by human improper activity. All of these goals could be achieved by the development of a user-friendly wireless communication system, which could allow a better communication between scuba divers (e.g. instructor and students), leading to a reduction of both self-risk and environment hazard. Since only one of five team members had previous scuba diving experiences, enforced the necessity to discuss with real stakeholders the feasibility of our solutions, in a field where, even from the state-of-the-art, the knowledge about many processes was not still fully disclosed (e.g. few study are available for any kind of underwater communication, followed with an even poorer commercial scenario in this sense).
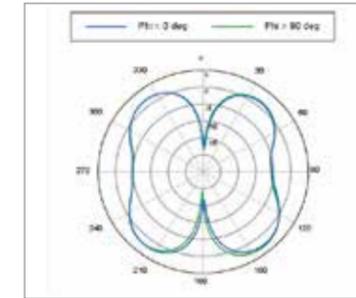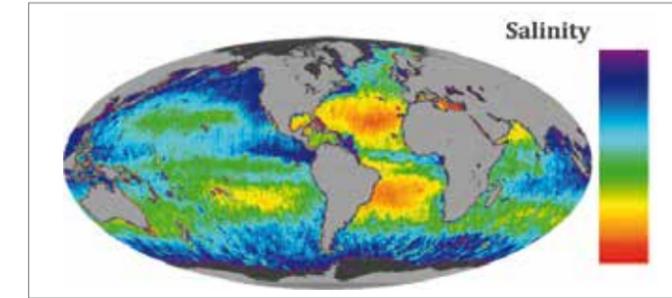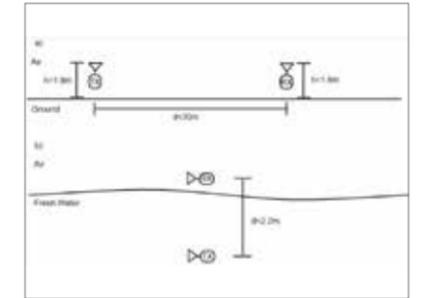
EXPLORING THE OPPORTUNITIES

The complexity of the topic was clear from the very first phase of analyses. The overall framework set up by the group to led the preliminary investigation on technical feasibility and existing solutions covered two synergic topics: study of underwater propagation and critical issue on material selection.

One of the main innovative ideas enclosed into the project consists of considering the use of electromagnetic instead of acoustic waves, reducing environment impact over marine fauna. Analyses of the state of the art shown a lack of understanding on underwater electromagnetic propagation, requiring an experimental campaign ad hoc to answer questions about feasibility and settle of working variables (e.g. dielectric constant, conductivity, propagation constant, phase velocity and wavelength and group velocity).

A dedicated study on the "Liverpool experience" on a similar test case was performed, critically analyzing methods and results. The antenna was modeled by mean of a numerical simulation tool, investigating the effect of design over electromagnetic field. Theoretical feasibility studies about best frequency of work were coupled with definition of allowed working bands for radio communication, set by the Italian department of environment. Commercial solutions in the same field were investigated, with analysis of existing patents and a focus on microchip hardware. In particular, visits at Istituto Superiore Mario Boella were useful to determine the state of the art of a working hardware solution for wireless communication and discuss the possibility to tailor some new ideas in the field to our purpose.

A side issue coupled with the devise of an innovative propagation system was how to make it reliable in an electronic-hostile environment like the underwater, without damaging neither the performance nor the easiness of use for the final user.

A self-critical thinking process was then required to design the circuit packaging with materials with both favorable mechanical and electromagnetic properties. Metallic and polymeric material were studied, starting from existing solutions

for underwater application.

After the definition of advantages and drawbacks of each class of material, analyses moved then towards intensive laboratory research to avoid principal weaknesses, while improving claimed best features. To realize the cover of the device, an innovative coating was developed based on a composite material made of a high hydrophobic polymer reinforced with ceramic particles to achieve water impermeability and scratch resistance.

GENERATING A SOLUTION

Theoretical analysis of underwater propagation identified a putative communication frequency, coherent with the Italian law for radio propagation (10-10KHz). Experimental analysis of underwater communication in fresh water by mean of a 27MHz radio-controlled system. Measurements were conducted both in water and in air: the maximum distance where estimated, comparing the two systems (air/water). From this preliminary analysis, it was proved that a simple communication in fresh water is possible, with an average distance of 2m. Since the aim of the test was to prove possibility to perform a virtual communication in a water system, further tests should assess the maximum length using an ideal frequency within 10-100KHz, according to our previous results. By mean of Feko simulation, it was possible to propose a wide range of antenna shapes. The entire antennas studied were proposed to maximize scuba ergonomic, reducing
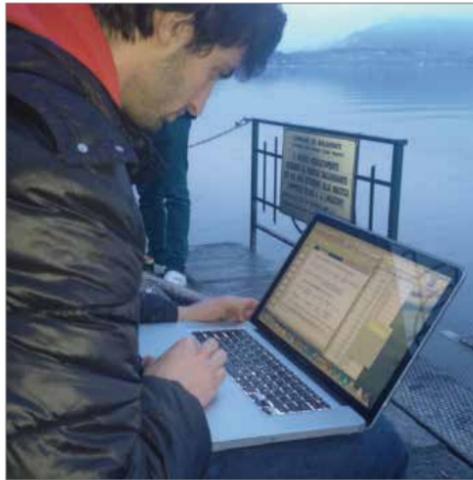
4. Experimental test on underwater propagation in fresh water – Theoretical analysis [Andrea Manzoni, Belgirate, 03.2013]

5. Experimental test on underwater propagation in fresh water – System detail [Belgirate, 03.2013]
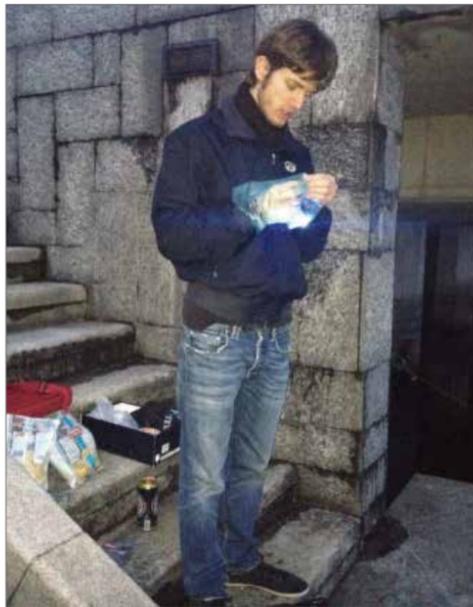
6. Experimental test on underwater propagation in fresh water – Set up [Nicola Peserico, Belgirate, 03.2013]

7. Experimental test on underwater propagation in fresh water – Set up [Simone Merlo, Belgirate, 03.2013]

potential communication distance without interfering with the diving activity.

Some of the results were successfully discussed during the APS/URSI 2013 conference (Orlando, July 2013, USA) by some of the team members, leading to potential collaboration with the European Space Agency. To realize the cover of the device, an innovative coating was developed based on a composite material made of a high hydrophobic polymer reinforced with ceramic particles to achieve water impermeability and scratch resistance. Main scientific innovation was a demonstrated barrier capability, showing properties of a layered material in a single material. Compared to classical material for underwater applications, as stainless steel and aluminum, this coating could represent a cheaper solution, theoretically with no or few interactions with the wireless system and with the possibility to couple perfectly with any kind of device shape and size. Electrical and mechanical test performed on the material (synthesis method, kinetics of polymerization, wettability, permeability and dielectric constant) showed good results and verified the expected properties. Indeed, further study would be necessary to determine experimentally material effects on electromagnetic signal attenuation and interaction with the propagation field, along with a characterization of long-term effects of saline water on coating and device. Currently, a M.Sc.'s thesis is ongoing on the topic, from which some results were taken and could investigate some of the open question addressed.
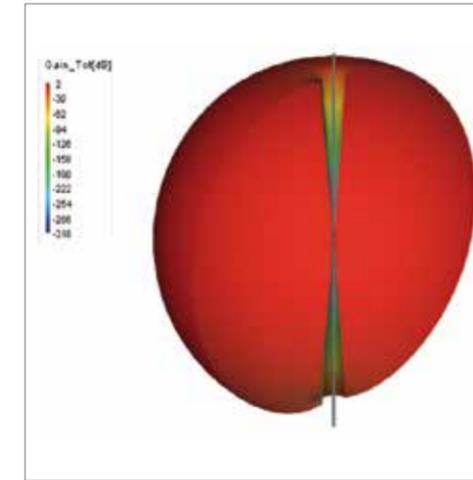
8. Antenna design: analysis of total gain
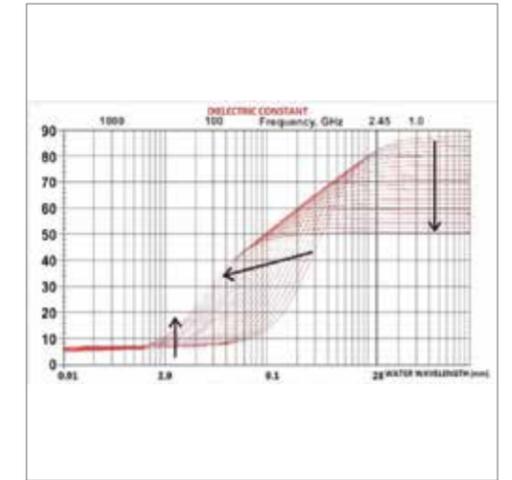
9. Dielectric constant variation with frequency and water wavelength.

10. WISE-SOS presentation at APS/ISNC-URSI IEEE 2013 Conference in Orlando (FL) [Nicola Peserico, Matteo Marascio, Andrea Manzoni]

EMIMT
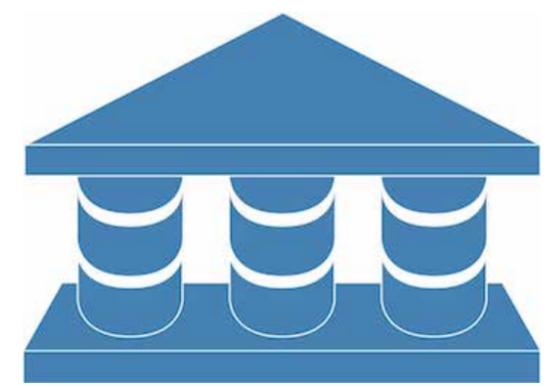
E-GOVERNMENT MEETS INTEGRATION AND MINING TECHNIQUES
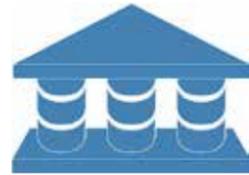
EMIMT
E-Government meets integration and mining techniques

5

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PROJECT DESCRIPTION

People shop online, book hotels and flights online. This happens because the data needed to complete these tasks are easily accessible and a lot of websites allows users to query the Web to obtain enough information to be confident.

In many countries, citizens take for granted the fact that government and local authorities should make a variety of data sets available to the public. This data sets span a variety of topics such as economic indicators, crime statistics, educational data, government spending and campaign contributions. The new generation of tools for managing and visualizing data have empowered data activists, led by journalists, who are turning this data into visualizations and stories that are spread by social networks and seen by millions of people.

These visualizations, stories and public attention, in turn, lead to new questions and hence a demand for additional data. This scenario brings the pressing need for the creation of an ecosystem of tools and data that enable us to discover good data, create useful artifacts from it, and contribute it back to the Web. Many tools are developed to this aim and some experiences (such as Google Fusion Table) have demonstrated that, if you provide good tools for data management and visualization, there are plenty of data enthusiasts who are eager to use them to create more value from data and put it in the eyes of the public.

This project aims to propose a framework tailored to extend the internet revolution to public administrations. This is a step forward the exploitation of all the information we have about government and society for a better understanding of the actual situation allowing people to relate objective data available online or offline with news articles, blog posts or other comments enriching data with information about the mood of people.
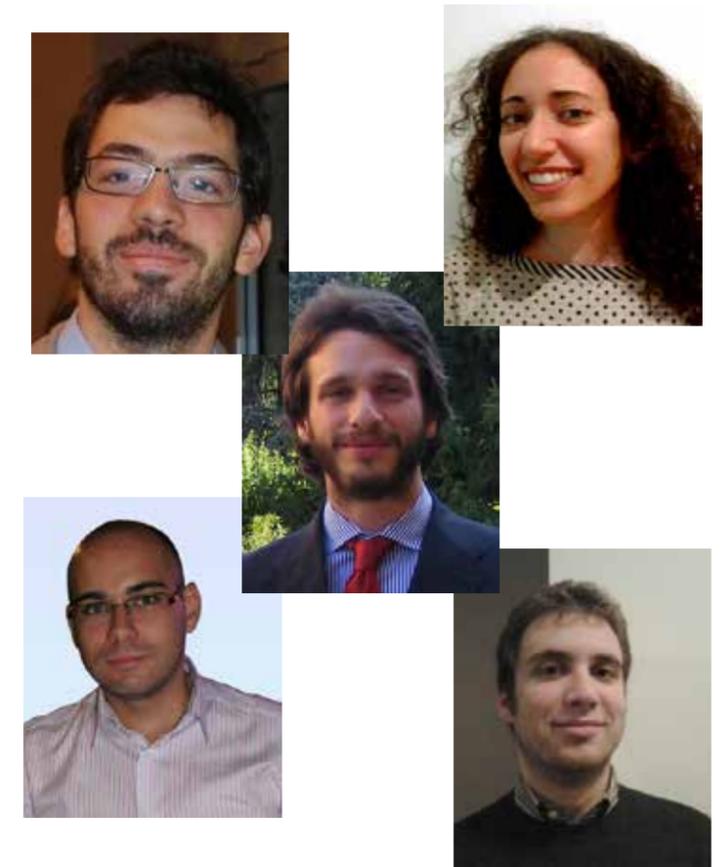
This project tries to provide an idea of a framework that could fill a part of the gap. Firstly we propose a protocol, a way to organize the economical information such that different data from different administrations is comparable. Once the data is organized our final output is a web application that provides information at different levels. There will be the possibility to download the raw data set, to look at visualizations and to play around with data.

In order to give a taste of the possibilities offered by this new scenario, we decided to focus on economical data, balance sheets from the Italian public administrations and to focus on few demonstrative data exploitation.

EMIMT
E-Government meets integration and mining techniques

TASK & SKILLS

Mariangela Rizzo approached the themes of transparency in public administration and open data through a detailed study of the state of art. She analyzed municipalities balance sheets and contributed to the definition of new "social" indicators for the assessment of a city. Mariangela Rizzo defined also the criteria to use in the data-mining process.

Piero Franceschini analyzed different types of business models based on PSI data that provide services to citizens with an added value. In the case of municipalities, Piero studied the situation and proposed a business model that offers several possibilities to existing and to new firms and improves the relationship between citizens and politics due to increased transparency

Edoardo Colombo dealt with the technological and design aspects of the project. He designed the web application infrastructure, choosing the technologies to be employed: database system and web application framework.

Moreover he designed the XML schema to represent the data and he chose the data visualizations along with the web design to be implemented.

Matteo Aletti analyzed the balance sheets structure and its contents in order to help the development of a well suited data storage strategy.

Furthermore he contributed to the understanding of the economical based indicators of a city. He proposed an analysis approach in order to perform interesting comparisons between municipalities.

Davide Sanapo focused his attention on Open Data and on Open Linked Data; in particular he studied the possibility of using the OLD framework thinking of its possible advantages. Moreover, he analyzed the requirements that data should have in order to be completely accessible and to be used for government settings. He took part in the decion process for the technological aspects.

INTRODUCTION

People shop online, book hotels and flights online. This happens because the data needed to complete these tasks are easily accessible and a lot of websites allows users to query the Web to obtain enough information to be confident. This project aims to propose a framework tailored to extend the internet revolution to public administrations. We decided to focus on economical data, balance sheets from the Italian public administrations. Even though the city of Florence can be considered in step with the times, providing a vast amount of open data, the majority of towns is rather lagging. In most of the cases they just publish the balance sheets in a .pdf format, which moreover it is a scan of the printed version, resulting in a piece of information that is quite useless in our era, where computers can parse, analyze data, given that it is in a machine readable format.

This project tries to provide an idea of a framework that could fill a part of the gap. Firstly we propose a protocol, a way to organize the economical information such that different data from different administrations is comparable. Once the data is organized our final output is a web application that provides information at different levels. There will be the possibility to download the raw data set, to look at visualizations and to play around with data.

Knowledge spreading can and must be seen as a way of fostering people critical thinking and reasoning. This does not mean that a common citizen with no experience whatsoever can improvise herself a politician or an economics expert. Nevertheless new ideas, inputs can arrive from more people than usual, and a better awareness of what is going on can prevent the affirmation of populist leaders and ideologies.

THE BUSINESS MODEL

After a short introduction about PSI (Public Sector Information) at European level, there is an analysis of the impact on public welfare which it causes. Then, there is a comparison of several business models of companies using the PSI as raw data. In our case, the PSIH (PSI Holder) is represented by an Italian municipality, who decides to put on-line data about its balance sheet and its expenses. The proposed solution is that of a private company that operates mainly as intermediary with other players in the market (B2B), but that also makes the data available to the public in downloadable formats. The free channel, i.e. the service of visualization of balance sheet data with some elaborations, is financed by the municipalities, which in this way obtains also a gain in transparency and "reputation". The B2B channel, that is the selling of services about economics of municipalities regarding mainly tenders, is made up of commercial relationships between our company and the companies who are interested in public works of the municipalities.

DESIGN

For each topic we can identify experts and non-experts. When we talk about data there are those people who feel comfortable with downloading raw data and build their own analysis using

specific tools and techniques, and we have the person from the street. For this kind of user we can only assume that she can perform normal web browsing tasks and no more than that. Therefore we have to produce some visualizations that enable this category to have information instead of just data. Between them we can imagine the intermediate level, a person who is not capable of dealing with raw data, still she is not that unskilled. We want to provide tools and not static visualizations, i.e. we want to give her the ability of exploring the data. The Expert Level: The expert is considered that kind of user capable of her own analysis. Therefore we have just to provide the raw .xml file for downloading.

The Non-Expert Level The non-expert is assumed being able to perform basic web browsing (with a certain amount of confidence), and nothing more than that. Keeping this fact in mind we had to think about static tools enabling her to understand, i.e. passing from data to information.

The Intermediate Level The intermedi-

ate user is not capable of performing her own analysis, still a mostly static visualization of the data may not be what is more suitable for her. Therefore we want to provide something more interactive. Our inspiration came from the famous TED talk by Hans Rosling filmed in February 2006, where he presented a quite interesting data exploration tool that now can be found at gapminder.com. More recently Google made a similar one that can be found at google.com/publicdata.

TECHNOLOGY

There are several technological aspects that need to be tackled. First of all we have to develop a data format to represent the balance sheets provided by the public administrations. The data format must be both human and machine readable, according to the W3C guidelines on Open Data for Open Governments. Therefore we decided to use XML as data format which guarantees the aforementioned features. The next step consists in building a web application able to provide the

required services. First of all we need a database where the informations need to be stored and a way to organize it. We decided to use PostgreSQL and to keep the schema as simple as possible, featuring just one table. Then there is the necessity for a web application framework to build the dynamic web pages that will be served to the user. Sinatra resulted to a good choice, being open source and indicated for fast prototyping.

OPEN LINKED DATA

The idea of the Semantic Web is built around the concept of the "Web of Data" which means moving from the existing "document centric" Web to a "data centric one".

There are potential benefits for institutions in using the principles of Open and Linked Data in different areas, but, of course, data must respect some constraints.

Anyway, there is still a degree of confusion regarding the key concepts of the Semantic Web and linked and open data.

DATA ANALYSIS

We decided to focus on balance sheets because they are mandatory and quite easy to find on the municipalities websites. We first analyzed the structure of a municipality balance sheet and then figured out how to understand the information hidden inside of this data.

We provided different tools to analyse and measure the economical behaviour of the administrations. Once a common point of view is provided it is finally possible to make objective comparisons and interesting analysis that should be useful both to citizens and to administrations. A first descriptive analysis has been followed by a deeper correlation analysis, by means of data mining techniques and association rules.

CONCLUSIONS

In the end we think that our project can successfully be deployed for the following reasons:
- It offers a standard framework and communication protocol among the municipalities, this being what lacks the most in the Italian peninsula;
- it offers a feasible business model

that could improve both the politics and the economics of public administrations;
- as confirmed by the survey, there is a real need for the service we designed;
- we took into consideration the way citizens interact with data and structured our work into three levels in order to offer a fully enjoyable experience by different kind of users;
- we chose technologies that allow a fast and easy implementation and deployment; they are all well documented and open source.

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MCDA
for cultural heritage

MULTI-CRITERIA DECISION ANALYSIS FOR CULTURAL
HERITAGE CONSERVATION AND DEVELOPMENT

MCDA for cultural heritage

Multi-criteria decision analysis for cultural heritage conservation and development

6

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PROJECT DESCRIPTION
The challenge
The enhancement of built cultural heritage is recognized as a major element for strengthening the economic base of a territory as it fuels development through its attractiveness for inhabitants and external visitors, in terms of both tangible and intangible values.

Furthermore, the collective nature of built cultural heritage due to the large number of persons using it simultaneously makes the decisions affecting cultural heritage involve different stakeholders holding multiple and conflicting values. By this multidimensional nature, the decision makers need to consider many criteria such as integrity, reversibility, financial balance, social benefits.

In this context the goal of this multidisciplinary project is to point out different development scenarios for the castles of the Region Valle d'Aosta according to the requirements of the Spatial Multiple Criteria Decision Analysis approach.

Team A_ A future for the Valle d'Aosta Castles: How to assess development options within a regional context
Team A was in charge of exploring an assessment methodology based on Nijkamp's theory of wares, multicriterial techniques and spatial softwares (GIS) to help the decision maker generating and evaluating different scenarios and choosing the best action to implement at the scale of each castle in order to enhance them basing on their specific historical and social background. The work of the team was continuously related to the one of team B in order to develop a final evaluation tool which outcome would also consider the future of each castle within the macro-territorial vision, avoiding the risk of wasting the opportunity of a balanced development of the whole region.

Team B_ Defining development strategies for the Valle d'Aosta Castles' system: a multcriteria spatial decision support tool
Team B focused on setting an evaluation tool with in order to

help the Soprintendenza per i Beni e le Attività Culturali enhancing the Cultural Heritage network in the Valle d'Aosta territory through a more exhaustive understanding of which kind of strategies should be fullfilled. Firstly, the evaluation tool can be used to define macro-scale strategies that do not directly affect the single castles but upgrades the system and, secondly, to evaluate and choose which action (among the ones planned) should be implemented for each castle. It was also considered how the strategies proposed at a macro-scale level (the system-scale) influence the actions submitted at the micro-scale level (the castles-scale).

The results
The multidimensional analysis of the Valle d'Aosta Region and its castles' system,   combined with the use of advanced evaluation techniques, has led the project teams to the de¬velopment of two innovative, flexible and widely usable assessment tools, to support decision makers who are committed to define the development strategies of built cultural heritage. Both the evaluation systems were structured by the involvement of the Regional Soprintendenza per i Beni e le Attività Culturali, raising a high level of consensus concerning the decision criteria and the development options proposed.

project **6A**

Assessing alternatives for single cultural goods

TASK & SKILLS

Simone Albertini

analyzed the organizational structure of Valle d'Aosta and contributed in the financial collection of data. He was the official photographer during the workshop in Valle d'Aosta.

Martina Cividini

worked on the ecological analysis at the scale of the castle. She helped in the production of the maps and in the ANP model development.

Aurelio David

worked on the social analysis and contributed in the phase of characterization of the castles. He was in charge of the tutors-team communication.

Luca Peruselli

analyzed the data about the cultural events taking place in and around the castles. He searched for best practices and participated in the phase of the characterization of castles.

Violeta Popova

analyzed the close-range accessibility and infrastructure system. She searched for the best practices and was in charge of coordinating the final report development and correction.

Noemi Zito

analyzed the organizational structure of Valle. She contributed in the best practices research and in the phase of characterization of the castles.

ABSTRACT

Conservation and enhancement of built cultural heritage is one of the crucial factors in the long-term development of a region, but how do public institutions choose the best policy to adopt in order to tackle such a complex collective issue? The problem is indeed quite hard to tackle, as its degree of complexity is even higher than the management of other kind of goods (i.e. social housing, public facilities) for at least two reasons:

- First, when dealing with cultural heritage, the most appropriate strategies of enhancement are often rooted on the history and based on the embedded values of each cultural good. Assessing value and finding the right action to implement is a harsh task which cannot be reduced

to parameters, nor can be done by comparison, as the concept of "similar goods" would be misleading.

- Second, the risk concerning architectural goods is that if circumstances lead to a deadlock, not assuming any management strategy at all could impact negatively not only in terms of wasted opportunities for the growth of the host region, but also in terms of material decay, which can eventually lead to the loss of it.

This means that decisions have to be made, but sometimes the challenge becomes even more arduous due to both the presence of different stakeholders having different priorities, and shortage of resources, as in the contemporary economic crisis.

It is in this framework that the project MCDA for Cultural Heritage aimed to find an innovative way to deal with such a situation, working with the Regione Valle d'Aosta on its portfolio of thirteen castles. In particular, team A was in charge of exploring a new methodology based on Nijkamp's theory of wares, multicriterial techniques and spatial softwares (GIS) to help the decision maker generating and evaluating different scenarios and choosing the best action to implement at the scale of each castle in order to enhance them basing on their specific historical and social background. The work of the team was continuously related to that of team B in order to develop a final tool which outcome would also maintain the macro-territorial vi-

1. Issogne, September 2012. Exploring functionalities of new tools. Taken by: Simone Albertini.

2. Sarre, September 2012. Visit at the castle of Sarre. Taken by: Aurelio David

3. Aymavilles, September 2012. The castle of Aymavilles. Taken by: Aurelio David

4. Fenis, September 2013. Visit at the castle of Fenis. Taken by Aurelio David

sion of the whole region.

UNDERSTANDING THE PROBLEM

In order to better understand the requirements of the tool to be developed, it was necessary to understand the needs of the Soprintenza and get the proper knowledge about the castles, the territory of Valle d'Aosta and the actors involved in the decisional process.

Such information were obtained firstly by an intensive workshop in Valle d'Aosta, where most of the actors were met and interviewed. This helped the design team in both gaining a comprehensive awareness of how decisions had been made in the past years and the current situation each castle is in. In particular, the first analysis carried out focusing on the castles, outlined a very heterogeneous portfolio, with differences in the state of preservation, function and relationship with the surroundings. Some of the castles had a unique character, and a solid function well integrated with the socio-eco-

nomic fabric of the region, but a wide number of them lacked both a strong identity and proper sustainable program.

Furthermore, the lack of a systemic fashion to organize information about the castles and the territory resulted in increasing difficulties for the Soprintendenza in managing them, with frequent cases of not optimal allocation of resources.

To sum up, we needed a tool that would take into account the aforementioned issues, and that would help the Soprintendenza in the definition of the right program for each castle, starting from a well-organized local-based knowledge and that would assess the various impacts on the different aspect of the territory.

EXPLORING THE OPPORTUNITIES

Once the problem was defined, it was broken down to two macro areas of research:

- Data selection: what kind of informa-

tion could be useful in the preparation of a development castle-scale strategy? How could data be assembled in order for the Soprintendenza to have a complete vision of the whole region?

- Generation and evaluation of local strategies: which criteria determine the most suitable program for each castle? What are the impacts of each choice to the physical and cultural fabric of the territory?

Unfortunately, the state of the art is very poor when it comes to the specific field of Cultural Heritage management and, as some prior investigations outlined, there is a complete lack of instruments concerning the decisional process. However, there are some unrelated techniques or procedures that could come in handy, both for what concerns the analysis of the specific features of the castles and their surroundings, and for the evaluation of the impacts of the newly adopted programs.

5. October 2013. The coaxial matrix.

6. March 2013. Sorting and localizing the castles in the territory.

7. Ussel, September 2012. Visit to the castle of Ussel. Taken by Aurelio David

In particular, we are referring to the well-known SWOT[1] analysis, which is very useful to highlight weaknesses and opportunities; the GIS, a powerful tool to georeferentiate data through maps; and the ANP (Analytical Network Process)[2] , which is a multicriterial-based technique that can help in organizing and analyzing complex decision.

In fact, one of the main challenges of the project was to combine and apply such techniques in one unique and innovative methodology that would be useful for the main goal of the enhancement of the castles.

Furthermore, since our aim was to cooperate with team B and its studies at the scale of the region and the formulation of macro strategies, a common framework to gather synthetic information about the most important

topics (economy, identity and society, events, nature and landscape, mobility and accessibility, organization) was established basing on Nijkamp's wares[3]. This methodology was shared between the two teams, so that the data of both teams could have been exchanged and compared.

GENERATING A SOLUTION
The solution of our project is a tool revolving around a spatial SWOT of the most important elements contributing to the enhancement or the hindrance of a given portfolio of cultural goods, which can be used both for what concern the analysis of data and the evaluation of a given set of alternatives, through an ANP-based network model.

The tool, which can be applied for any generic portfolio of cultural goods, consists of the following:
- A common thematic framework (based on the wares) is used to gather synthetic data with respect to the

SWOT methodology. These data are referenced as "elements", and have to be geo-referenced through a GIS software and displayed into interactive maps, divided between positivity and negativity;
- The elements are then organized in a weighted network based on the ANP technique, linking all the collected elements with one another when relationships and mutual influences are present among them. The multiple actors involved in the decision making can input their opinion in the model, expressing what and to which degree each thematic group of element can affect the enhancement of the system. This result in priorities: fields and elements that are more important than others, and that strategies and programs should take into consideration. All these data are displayed in maps of synthesis;
- Investigation about the history of the single architectonic goods, their relationship with the territory and the local people (the process of characterization), together with a research on the best practices, will then suggest possible programs that can be implemented on each cultural good. In this phase, it is crucial to consult the maps with a focus on the single good, rather than on the territorial scale;
- Such programs can be evaluated through a coaxial matrix that links them with the various aspects of the territory, represented by the wares

concerning economy, ecology, mobility and accessibility, identity, events and organization. This evaluation consists of two parts: one first highlights the prerequisites needed for the program to be successfully implemented, and then, the impacts each one has on the territory. This way, a set of alternative programs can be evaluated at once, with those having major positive impacts on the prioritized thematic fields being most desirable than the others. The existence of the various maps displaying the elements already sorted in the same layers through which the assessment of prerequisites/impacts is made, is a big help for this task;
- The matrix connects each local-scale action with every possible macro-scale strategies elaborated with the procedure thought out by team B, in order to have a complete overview of what can be implemented at both scales for the territorial enhancement.

The problem of the management of a portfolio of cultural heritage goods is strictly related to the genuine knowledge of the goods themselves and the territory, with its tangible and intangible aspects, which are intertwined. Therefore, when providing a tool for helping the decision maker in choosing the best alternatives for the enhancement of cultural goods, we opted for one that could embed the phase of knowledge prior to the proposition and evaluation of a set of alternatives. We fulfilled that need through the continuous use of the same framework of SWOT and wares logic for both the collection and the evaluation of data at the beginning and at the end of the process. The outcome of the application of such method for the case of castles of the Valle d'Aosta was very positive, but not without some weaknesses. The need for a spatial organization of data becomes a bit tight when it comes to non-physical data, such as the intangible, cultural ones

that are very important when dealing with cultural heritage. Nonetheless, despite the way we managed to solve this specific problem, the tool seems to be promising when it comes to assessing alternative actions for cultural heritage management enhancement, as the combination of the layering of reality provided by the wares and the ANP model minimizes complexity reduction and is very responsive to gather inputs by the multiple points of view of the multiple actors involved in the decisional process.

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project 6B

A tool to evaluate and implement strategies at the system-level

TASK & SKILLS

Carolina Anselmino investigated the social capital of Valle d'Aosta. She cooperated for the thematic maps generation. She contributed to define the strategies-evaluation tool. She analyzed the micro/macro scale integration.

Boris Bresciani investigated cultural opportunities and events of the region, linking them with the castle system. He worked as coordinator for the final thesis development.

Giulia Ceriotti inspected environmental aspects of the region. She helped to generate thematic maps. She elaborated focus group results, ANP software implementation and results. She contributed to define the strategies-evaluation tool.

Carmen Pietrafesa analyzed different case studies to identify best practices which could help in defining strategies. She also helped the analysis of the macro/micro scale interactions.

Zhaoyuan Li analyzed the financial aspects of Castles system. He also helped in the best practices analysis and research.

Alessandra Piatti investigated the infrastructural elements of Valle d'Aosta and the castles accessibility. She helped in the elaboration of maps and spatialization of data.

Sofia Spinelli analyzed the economic situation of the system in terms of revenues and expenses. She collaborated in the ANP results analysis.

ABSTRACT

This project focuses on the Cultural Heritage management and enhancement. Nowadays decision makers have to face a strong economic crisis that forces them to rationalize the expenses. Because of that, Valle d'Aosta region was deeply interested in developing a tool that could help in decision making processes in the Cultural Heritage field; particularly, for a system of 13 castles spread on the regional territory.

The project can be split into two main parts: one dedicated to data collection and in getting acquaintance with the territory, while the other dedicated to the tool development. After a week-long workshop in Valle d'Aosta visiting castles and meeting the stakeholders, it was possible to use all the data collected for a SWOT analysis. The SWOT and information were then reorganized into a network through the ANP tool to get a dynamic description of the territory including tangible and intangible aspects.

A focus group with the stakeholders defined priorities and peculiarities. The big challenge was to integrate the ANP with the spatialiazation that enriches the model deeply because strengths, weaknesses, opportunities and threads are physically placed and detectable. Through the use of GIS tool thematic maps were generated, embedding the data collected and the priorities expressed. The maps were then used together with best practices analysis to propose different strategies.

The final step was to evaluate the strategies proposed and to verify the feasibility at castle-scale, through the development of a dynamic tool that took into account all the elements and the stakeholders opinions for the strategies evaluation. In conclusion, a deep knowledge of the territory is fundamental for the strategy definition, and a rational tool is useful not only for strategies evaluation but also for a better knowledge of the system analyzed. Also, general advices for strategies definition in the Cultural Heritage field can be extracted.


1. Sarre, September 2012. An eye on the territory. Taken by: Aurelio David
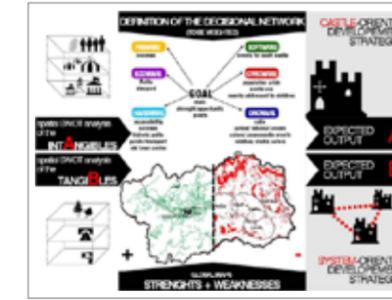
2. February 2013. The analysis at the global scale
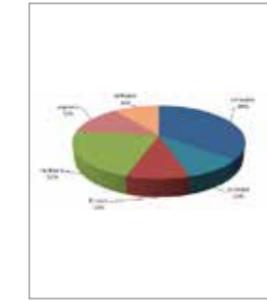
3. September 2013. Priorities from the stakeholders
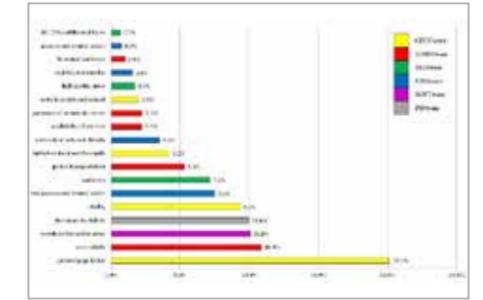
4. September 2013. Elements of relevance, according to the priorities from the stakeholders

UNDERSTANDING THE PROBLEM

The Soprintendenza per i Beni e le Attività Culturali – the Governement Department responsible for Cultural Heritage – of the Valle d'Aosta Region has a wide range of Goods to manage. Although it is an autonomous region, the current economic crisis is deeply affecting the availability of resources of the public sector; it is becoming harder to understand towards which strategies and policies to invest.

The Cultural Heritage field is a quite peculiar one:

- the value of goods is difficult to assess, yet there is not a shared method
- goods already exist and are decaying, decisions have to be made fast and should be more than simple preservation
- goods belong to the society at large, but the only actor in the decision process is usually the Government Department
- the legislation about this kind of goods is very strict (at least in Italy), making privatization and refunctionalization unlikely to happen

Therefore, it is possible to understand why we were commissioned by the Soprintendenza: we were asked to develop a tool which could help decision makers in the Cultural Heritage field. The mean can be particularly fruitful for a case study such as the VDA Region; in fact its autonomy allows the analysis of the territory to be at different scales without being too dispersive, and facilitates the collaboration with the different stakeholders.

The system which we were asked to deal with is composed of 13 castles spread over the Region; they belong to different eras and different typologies, have different characteristics, different functions and a different preservation statuses. Therefore it is a particularly complex system, which has to be linked with the natural and cultural richness of the Region; this complexity needs to be captured by the tool and

the method carried out.

The deep analysis of the territory was the kick-off needed. Therefore, we travelled to the VDA Region for a weeklong workshop; it was there possible to visit all the castles belonging to the system, to meet the stakeholders and to experience the area in its wholeness. This made it possible to go on to step 2: the SWOT analysis of the territory.

EXPLORING THE OPPORTUNITIES

The SWOT analysis evidenced the complexity of the system analyzed. The first challenging task was to organized all the data collected into a complete scheme of the territory that could include all its tangible and intangible peculiarities; different features of the region have mutual interactions and impacts, we needed not only a scheme but a dynamic description of the territory as a network. Also, we required a tool which could integrate the theoretical model that includes
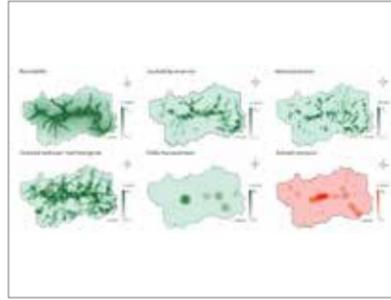
5. June 2013. Data spatialization: tangible aspects
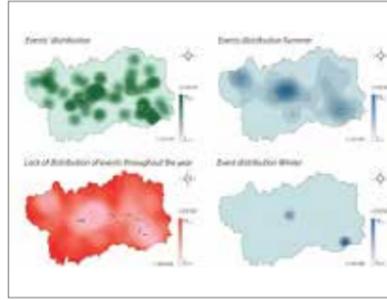
6. June 2013. Data spatialization: tangible aspects
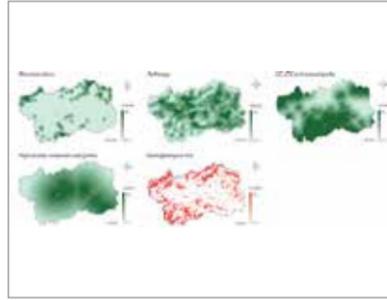
7. June 2013. Data spatialization: tangible aspects

8. February 2013. The analysis at the global scale

9. October 2013. The SWOT analysis, according to the priorities from the stakeholders

10. October 2013. The SWOT analysis, according to other priorities (environmental scenario)

11. June 2013. Best practices example: the implementation of a fidelity card.

12. June 2013. Best practices example: the implementation of a transportation network
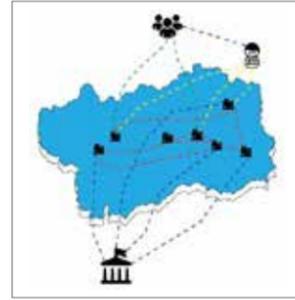
13. October 2013. The evaluation of strategies based on the actions at the castle-scale

tangible and intangible aspects with the spatialization of the information, strengths and weaknesses; in fact, we were aiming at the enhancement of a physical wide territory, not of just a system.

Since they involve numerous criteria, these kinds of problems are normally faced through MCDA (Multi Criteria Decision Analysis) tools, which family is very wide due to the diverse nature on the decision boards. Despite this variety, no existing tool integrate MCDA and spatialization concept for territory enhancement. ANP/AHP (Analytic Network/Hierarchy Process) methods stood out as the most suitable MCDA tool for at least overcoming theoretical system description and priorities definition; while for the spatialization problem we opted for one of the most innovative tool: the GIS. Then the greatest challenge was the integration of the two exiting and deeply different tools.

Several difficulties were encountered

in different fields. First of all, we had to deal with public bodies: huge amount of data are stored but hardly available, even in a limited and autonomous territory where it is possible to be in direct touch with the Soprintendenza. Secondly, considering the territory in a broad sense – including intangible aspects – made our system description complete but we had to overcome difficulties in defining intangible indicators and in spatializing not physical information. Finally, we collected data at different scales: difficulties were faced in scaling local information up as in deriving micro-scale information from the macro-scale ones.

GENERATING A SOLUTION

After the analysis, we organized a focus group at the Soprintendenza office, where we invited the main stakeholders involved in the decision process: employees of departments involving Cultural Heritage, managers of museums, mayors, and so on. They

cooperated with us to define priorities; leading to a better understanding of the territory, identifying peculiarities and vocations to indicate possible strategies.

We were now able to generate thematic maps which embeded all the information collected, weighted depending on the priorities defined through ANP; it is a totally new concept, which allows the decision makers to see directly on the territory the preferences acknowledged. A sensitivity analysis can be carried out, to exploit how different priorities translate in a different understanding of the land. The spatialization enriches the model deeply because strengths, weaknesses, opportunities and threads are physically placed and detectable; it is a quick mean to manage the big amount of data.

Exploiting some case studies, we were able to identify some best practices to implement for the system of castles of the VDA Region; questioning also ANP priorities and GIS maps, we
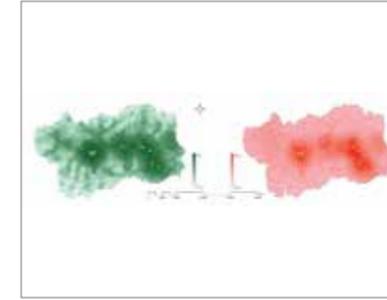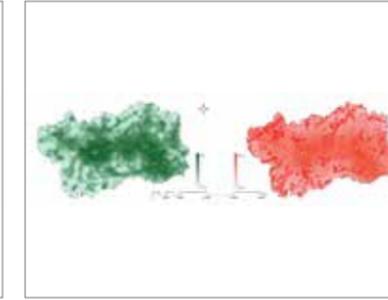
were able to propose possible strategies. The latter needed to be formally evaluated: we propose a dynamic tool which weights strategies according to what feature they influence and the relative importance they gain; the tool is particularly useful because allows decision makers to use it themselves, without the help of the experts. In fact, any other strategy can be proposed and evaluated with the same method; it leads to a better understanding of where energy, time and money should be invested.

Afterwards, it is necessary to investigate how the strategies proposed at a macro-scale level (the system-scale) influence the actions submitted at the micro-scale level (the castles-scale); to see what strategies are concretely feasible. It was interesting to unmask that the most of the strategies recommended had to be implemented at the castle-scale; it was therefore impossible to identify them as system strategies, since they revolved around spe-

cific characteristics of the castles.

In conclusion, the work led not only to a set of tools to help decision makers enhancing the Cultural Heritage network in a territory; but it also led to a better understanding of which and how strategies should be fullfiled. A beforehand implementation of macroscale strategies that do not directly affect the system – but upgrades the system – has to happen; then the tool can be used to evaluate and choose which action (among the ones planned) should be implemented for each castle.

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Re-Condo

**RETHINKING CONDOMINIUM.
URBAN SCENARIOS AND DESIGN PROPOSALS FOR A TRANSFORMATION
OF THE MIDDLE-CLASS HOUSING STOCK IN MILAN AND TURIN**

MULTIDISCIPLINARITY AND INNOVATION ASP PROJECTS 8

RE-CONDO: RETHINKING CONDOMINIUM_URBAN SCENARIOS AND DESIGN PROPOSALS FOR
A TRANSFORMATION OF THE MIDDLE-CLASS HOUSING STOCK IN MILAN AND TURIN

Re-Condo: Rethinking condominium.

Urban scenarios and design proposals for a transformation of the middle-class housing stock in Milan and Turin

7

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PROJECT DESCRIPTION

Between 1950s and 1970s, Milan and Turin experienced an impressive growth in housing production. A consistent part of this building boom was made up of condominiums that aimed at meeting the cultural and spatial needs of an emerging middle class. Such factors, together with economic and regulatory aspects, deeply influenced the formal, typological and technological solutions adopted in these buildings.

Contemporary architectural culture has never paid much attention to this "ordinary" housing stock: nevertheless, several issues are now arising concerning its growing age and its resistance to typological transformation, which partly contrasts with the evolution of living practices and quality standards. Nevertheless, condominiums represent an important part of contemporary urban heritage and offer potential opportunities in terms of "dense living" housing and energetic and technologic upgrading.

The aim of the Re-Condo project is twofold. First, it aims at investigating the evolution of the living practices and the actual technological performances of condominiums through field research and a collection of case studies. Second, it aims at developing scenarios for the future transformation of condominium buildings and the urban sectors they define, with particular regard to architectural redevelopment, typological reversibility, as well as to technological, energetic and infrastructural improvement towards efficiency and consumption lowering.

Initially, the two teams shared a preliminary phase of analysis, in which they studied the recent urban policies promoted in Milan and Turin and focused on a series of urban sectors in the two cities that were deeply characterized by the presence of condominium buildings constructed during the second post-war decades. After this preliminary phase, the two groups articulated their work in two different levels. Team A was mainly involved in the development of design solutions at the scale of the building and the single dwelling

unit. Four building complexes have been chosen in the two cities as study-cases, and four transformation scenarios have been developed on them, paying particular attention at the relations between innovative housing programs, the physical constraints and opportunities offered by the building structures, and the surrounding urban and social contexts.

Team B was mainly involved in the development of an interface tool aimed at promoting a widespread process of condominium upgrading. The proposal deals with a web platform, promoted by the Public Administrations, and implemented to intensify the communication between the different actors involved in the process of condominium upgrading, to foster the dissemination of international best practices in the field of building upgrading, and to facilitate people to access information and building regulations.
These two working lines have represented the two integrated sides of a potential public policy to be promoted by the Urban Centers in Milan and Turin, which have tried to consider both the strategic aspects as well as the design aspects.

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project **7A**

Re-Condo: Rethinking condominium.

New concept proposals for condos rethinking

TASK & SKILLS

Silvia Comi has an architectural academic background, and she made research on the urban context through various layers and tools. She was also involved in choosing the best hypotheses for the further development of the project.

Roberta Di Matteo has an architectural academic background, and she was involved in the analysis of the urban context and the case-study buildings. She also worked in choosing the best hypotheses for the further development of the project.

Carmelo Guido Galante, as energy engineer, after the analysis of existing systems in the case-study buildings, proposed some technological solutions in order to improve the project in terms of sustainability and adequacy to the contemporary needs.

Andjelka Muric participated in the urban analysis with other group members, which was the most important part of the project, and later on, worked on different possible systems of interaction between the inhabitants, in order to sustain built future scenarios.

Margherita Persello researched on the building phase of the condominiums chosen as case-study, in particular she focused on how the structures and the installations were constructed. In a second phase she focused on possible solutions in order to increase energy efficiency in the buildings.

Olga Shubina, coming from the field of study of Architectural Preservation, has been dealing with historical maps of urban sectors and buildings. Later on, she helped to develop the design hypotheses, according to the present-day building legislation.

Andrea Zammataro participated in the first part of the research, by producing maps and diagrams of the urban sectors and of the case-study buildings. Then, after collecting the necessary data, he explored hypotheses for the development of the project, also in relation to the stakeholders that could be involved.

ABSTRACT

Between the 1950s and 1970s there was a growth in housing production in the cities of Milan and Turin; the major part of this building boom was made up of condominiums. Social, economic and regulatory aspects influenced the typological and technological solutions adopted for these buildings, which were adjusted to the needs of emerging middle class in that period. However, since more than 40 years have passed, the socio-economic aspects, as the most important ones have changed.

The subject of the project is to analyse the current context and the actors' new needs, and to re-think this important part of contemporary urban heritage in order to satisfy new requirements and needs. First of all two areas were chosen: Zona 6 in Milan and Barriera di Milano in Turin. These areas show a high concentration of condominiums built between 1950s and 1970s, and they have been recently affected by some innovative urban policies promoted by the two Municipalities, such as Variante 200 and the program Urban Barriera in Turin and the urban transformations project linked with the new metro line M4 in Milan. These neighbourhoods have been analysed through different tools, like maps and diagrams, and 4 condominium buildings were selected as exemplar case studies.

In a first phase of the research, we have identified some of difficulties that actually prevent the condominium stock to be addressed by widespread upgrading actions: the lack of communication be-

tween the actors, the economic unfeasibility of the process, and the fact that upgrading hypotheses often do not satisfy all the involved actors' requirements at the same time.

The second phase consisted of a redistribution of the goals between the two teams. On the one hand, team B focused on the lack of communication between the different actors, developing an online platform, where the inhabitants of the condominiums could find all the necessary information to promote a redevelopment of their building within the existing urban regulations. This platform could be very useful considering the complexity of the network and the huge number of stakeholders. On the other hand, team A has focused on the design of four different concept solutions, addressing to four urban dynamics, that could at the same time meet the needs of the actors involved, especially inhabitants of condominiums, and guarantee the economic feasibility of the process.

1. Typological analysis of Zona 6 in Milano

2. Example of urban plan of Zona 6 in Milano with the building in Piazza Tirana highlighted
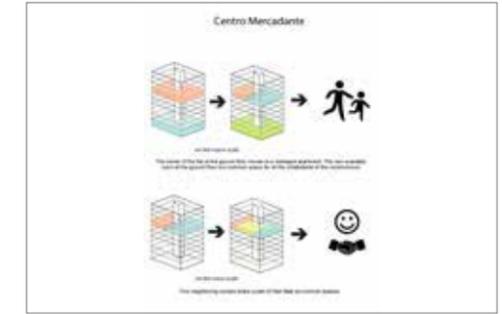
3. Concept of co-housing in Via Mercadante in Turin

UNDERSTANDING THE PROBLEM

Between the 1950s and 1970s in Italy occurred the so-called building boom in close relationship with a large and unexpected expansion of the Italian economy. In this period the population of Turin and Milan increased a lot because millions of Italians moved from the South and the North-East of Italy towards the richer and industrialized areas of the country.

The answer to this huge and unexpected growth was the construction of many new dwellings –most of them organized according to the model of the condominium – both in the central and in the peripheral areas of the cities. Condominiums had to meet two main targets. The first one was to satisfy the cultural and spatial needs of an emerging middle class through the typology of the "appartamento". The second one was to guarantee the issue of property, and give to each family a perception of stability. In this way, the condominium became the leading housing model,

being shaped in its formal, typological and technological by the interaction of these factors, together with economic, urban and planning aspects.

Currently, the scenario appears to be very different: in particular the socio-economic aspects have changed influencing not only people's needs, but also the structure of the society and the type of inhabitants of condominiums. Today these buildings present several emerging problems: some of them are connected with their growing age, others concern the difficulty to adapt buildings to the new spatial and typological needs of the contemporary society. However, within this complex context, condominiums still play a relevant role: they represent an important part of contemporary urban heritage and must be adapted in order to meet again the requests of their new inhabitants.

EXPLORING THE OPPORTUNITIES

During the first phase of the project, teams have worked together focusing

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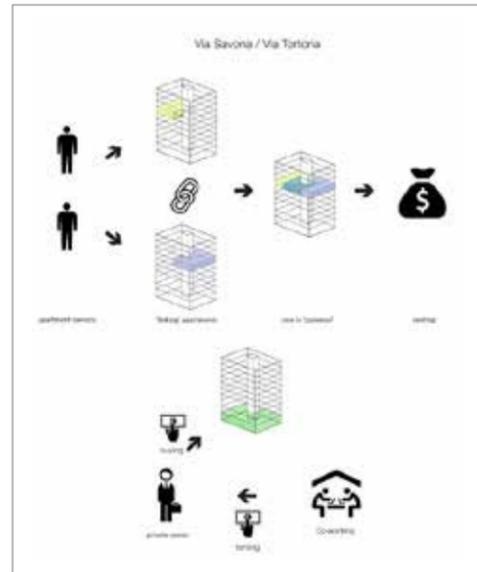
4. Concept of co-working and reduction of the apartment size in Via Savona in Milan

**5. Concept of social residences and services in Piazza Tirana in Milan**

6. Concept of temporary residences in Via Porpora in Turin

7. Example of intervention on a building of the complex of Via Savona in Milan

on the analyses and the comprehension of the complex issue of updating and enhancement of condominiums.

This phase of the work was focused on the reading of bibliographic sources, study trips, lectures held by tutors or experts from different fields and meetings with several people and organizations, who helped teams to collect as much information as possible related to the project context. At the same time a research on building redevelopment experiences was carried out to be aware about the state of the art. The information obtained showed some efficient strategies that could be taken in consideration during the design of the

proposals, but also improved when some problems were pointed out.

After the research phase, the areas chosen for the analysis were Zona 6 in Milan and Barriera di Milano in Turin. The reasons why these areas were chosen are the presence of condominiums built between 1950s and 1970s as well as social and urban dynamics that are also typical for other areas of the cities. Different maps were elaborated to underline these different dynamics in the selected areas. Team A drew up the maps of Zona 6 in Milan, while team B did the same for Barriera di Milano in Turin. These maps indicate the construction period and the typology of the buildings, the owner (public or private), urban and social aspects of the areas (implementation of policies of social and urban regeneration, existing or planned infrastructure networks).

According to the general analysis, the second phase of tthe project was focused on the selection of four buildings within the areas to be considered as

case studies. At the end of the research and analysis phase, the conditions that have made difficult a widespread intervention on this stock until now were identified: lack of communication between the actors, economic unfeasibility of the process and the problem that interventions often do not satisfy all the involved stakeholders' requirements at the same time. Then a reorganization of goals between the two teams was made: team B focused on the lack of communication by developing an on-line platform, while team A has been focused on the design of proposals that could at the same time meet the needs of actors involved, especially inhabit-

ants of condominiums, and guarantee the economic feasibility of the process.

GENERATING THE SOLUTION
As far as the project task of team A is concerned, the requirements of the actors involved (inhabitants, investors, public administration and contractors) were identified, also according to the analyses that were previously carried out. The economical feasibility resulted as the most important requirement for all the actors, in order to activate the process of redevelopment. In addition, inhabitants also had requirements related to their social and spatial needs, connected with different dynamics inside of each chosen case study. In the following part the main characteristics of the concept proposals are elaborated according to the identified urban dynamics.

The first case study is a condominium situated in Turin, in Via Mercadante. It is very suitable for a concept of cohousing because of the demographic com-

position of the neighbourhood, which is also characterized by a low-rise building fabric organized all around courtyards that constituted relational spaces. The economic feasibility is guaranteed since the strategy allows those families that already live in the buildings to reduce their costs . Moreover, the sharing of duties and free time among different families can improve the condominium model from a social point of view.

The complex of condominiums in Via Savona in Milan is located in an area undergoing a gentrification process. The concept consists of two proposals. The first one foresees the interaction of two or more individuals who, considering their changing needs, divide their two big flats in three smaller apartments, with the objective to sell or rent the new one. The second proposal foresees the purchase of some apartments and the subsequent transformation into offices by a private investor, integrating them into a rich network of small temporary showrooms linked with the neighbourhood of design and fashion.

The residential building situated in Milan in piazza Tirana was chosen because of its location: it is a neighbourhood which does not represent an attractive point of the city because of the lack of local services. Therefore, the concept proposes the creation of social apartments and the insertion of services that are not present in the area. The economic feasibility is guaranteed by the low prices of the apartments. Another advantage is the closeness to

the projects of urban redevelopment planned by Municipality of Milan in the yard of San Cristoforo.

The last case study in Turin, in Via Porpora, is located in a neighbourhood equipped with regional facilities attracting flows of city users. In particular, it is close to one of the largest hospitals in Turin representing an attractive point. Thus, temporary dwellings can be a viable proposal to satisfy the needs, presently ignored, of this category of users. Moreover, since an intervention at the super condominium scale is proposed to guarantee the feasibility from a management and economic point of view, a general hypothesis to deal with large scale interventions is also provided.

The contexts where the buildings are located are representative of recurring urban dynamics, which are spreading in many Italian cities. In this perspective, even if we have developed a specific design for each of the four case studies, the related proposals are intended to set some general interventions principles that could be exported to similar situations.

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project **7B**

Re-condo web platform:
enhancing requalification through communication

1. Program results Gephi, possible controversies among actors

2. Program results Gephi, Map of concepts related to energy efficiency objective

3. Diagram of objectives

TASK & SKILLS

Cristina Calleri, sustainability design, Politecnico di Torino
She was involved in archive researches, analysis map developing and organized the focus-group using the Superdecision software.

Marcello Fantini, energy engineering, Politecnico di Milano
He dealt with stakeholder requirements analysis by means of ANP methodology , studying of multi-criteria analysis methods and organized the focus-group using the Superdecision software.

Sara Mangialardo, building engineering, Politecnico di Milano
She worked on Inhabitants and administrators interviews, she conducted research on public policies and analyzed the website economic feasibility.

Gregorio Pecorelli, architecture, Politecnico di Milano [team controller]
He was involved in archive researches, analysis map developing and he developed the website mock-up.

Laura Suico, Interior design, Politecnico di Milano
She dealt with analysis map developing, she organized the focus-group using the Superdecision software and developed the website mock-up.

Ani Zakaryan, architecture, Politecnico di Milano
She worked mainly on the state of the art analysis, she developed the analysis maps and she conducted research on existing case-studies in Europe.

ABSTRACT

The condominiums built between the years 1950s and 1970s represent a large part of the architectural heritage of the major Italian cities. Today this type of architecture is no longer responding to the needs of the new inhabitants of these spaces both by the energetic and the functional point of view.
The Re-Condo project focuses on the analysis of this phenomenon from a multidisciplinary perspective and it

wants to intervene through the creation of tools and useful models for the redevelopment of two different contexts in the cities of Milan and Turin.
The main objective of the project is to create a possible intervention protocol that improves the communication between the different involved actors easing the complex process of intervention.
We have organized the work into three different phases: context research, analysis of the possibilities of intervention and creation of a prototype.
During the first phase the two teams worked together to analyze the two contexts of intervention in the city of Milan and Turin.
We have created four different types of maps, summarizing the main features of the two cities.
In the second phase, the Team B was involved in the creation of a web platform to create a relation between the different involved actors. We divided them in three main categories: inhabitants, municipality and construction companies.
At this stage of the work it was impor-

tant to gather the information of the urban centers, which played an important role in connecting the various stakeholders. Moreover we involved experts and inhabitants during all the phases of the project.
Through the use of the ANP method (Analytical Network Process) we have identified the best structure for the online platform. Then we organized a focus group to check with some experts if our choices were correct.
At the end the group was able to create a protocol of intervention that led to the creation of a final prototype. We have proposed a new and innovative manner to build a web site creating a new sense of community and a participatory process that could incentive new urban transformations.
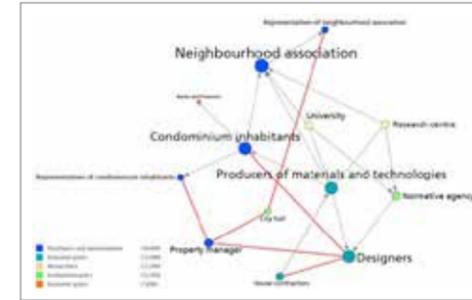
UNDERSTANDING THE PROBLEM

As we said before, the goal of our project is to define a protocol of intervention for the recovery of the huge stock of condominiums which derives
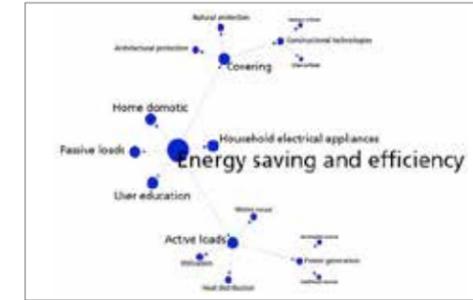
from the Italian economic and urban boom.
We organized the first stage of the project into three separate phases: the preliminary analysis of the areas of intervention, the requirements analysis phase and the last phase of the creation of a plan of intervention.
During the first phase of analysis we wanted to understand the characteristics and the changes over the years of the two considered cities (i.e. Milan and Turin).
We identified two areas that we considered relevant in the urban transformation of the cities. We chose the district of Lorenteggio located in the southwest of Milan, and and the neighborhood of Barriera di Milano places in the northeast part of Turin.
For the two districts we designed different concept maps that would help us to analyze the evolution of the urban area in its architectural, political and social aspects.
The proposed maps were divided into

four different types: historical, typological, of the social policies, and public and private property.
At the end of the editing of the maps, we discussed the results with some experts that helped us in identifying the requirements of the project.
After that we identified four main objectives that characterize the intervention protocol: functionality, energy efficiency, quality of life and social cohesion.
In order to understand and clarify the several requirements of the project, we classified them using a structured method (Bottero et al, 2005)l
During the research phase, we established a profitable connection with the two Urban Centers that allowed us to deal directly with the local realities. Furthermore Urban Centers helped us to communicate with professors and professionals in the re-qualification sector in the two cities.
At the end of this phase we accurately identified the main requirements:
▪ Urban Aspects

MULTIDISCIPLINARITY AND INNOVATION   ASP PROJECTS 8

RE-CONDO: RETHINKING CONDOMINIUM_URBAN SCENARIOS AND DESIGN PROPOSALS FOR
A TRANSFORMATION OF THE MIDDLE-CLASS HOUSING STOCK IN MILAN AND TURIN
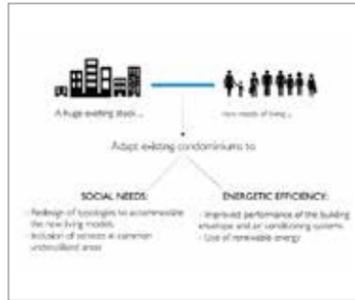
4. Second diagram of objectives
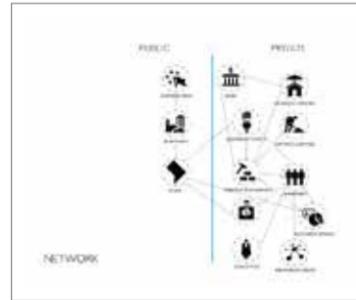
5. Diagram of the actors involved

6. Solution diagram

7. Diagram of the web platform

8. Diagram of the web platform without subtext

9. Diagram of our work

Involving the population in the decision process
- Economic Aspects
Involving local companies into area transformation
Promoting local responsibility and citizen care for the re-qualified area
- Environmental Aspects
Enhancing the inhabitants consciousness for the energy saving
Solving the local critical situations for the health of citizens
We also individuated three main key issues for the requalification in the two cities:
- A livable environment
Solving the local critical situations for the health of citizens
Enhancing the inhabitants consciousness for the energy saving
- A new start against the crisis for the local companies
Involving local companies into area transformation
Enhancing the requalification business

- A new picture of the neighborhoods
Promoting local responsibility and citizen care for the re-qualified area
Involving the population in the decision process
Shaping a citizen designed neighborhood

EXPLORING THE OPPORTUNITIES
At the same time we made a research on the good requalification practices in Europe.
At the end of the first ASP year we had a study trip to Paris, where we met experts in the field of urban regeneration.
In particular we had a crucial meeting with the Director of Lamsade, Professor Alexis Tsoukias, who introduced us to the topic of Decision Aiding formal models. We used this tool in the next phase of the project applying the ANP method (Analytical Network Process).
Most of the case studies that we studied in Paris concerned the public property. On the contrary the main characteristic of our stock (i.e. condominiums) is the

scattered private property that involves many owners. So we tried to scale the case studies to the Italian situation.
We understood that in order to propose an optimal solution, it was necessary to solve the complex system of interactions among the different stakeholders.
To address the complexity of this network we decided to apply a systemic approach that is normally used to solve the decision problems to a urban transformation issue. This structured method is called Analytical Network Process.
This methodology derives from the AHP, Analytical Hierarchy Process, which is used in the Multi Criteria Decision Analysis to structure a decision problem through a network of relations that generates a hierarchy of the possible solutions. Applying of this method we can classify several alternatives according to the different weights that we gave to the objectives.
The use of this tool helped us to realize that crucial issue for our project was to create a network to improve the com-

munication among the different stakeholders.
Our idea wants to generate an online platform that allows a meeting of the inhabitants, the municipality and the companies.

GENERATING A SOLUTION
The Re-condo web site wants to promote an effective communication using an updated and clear platform. In particular, a key point of the project is the creation of a network that allows the different involved actors to facilitate the communication operations.
The platform is divided in two different areas: an informative section and a part that contains several cases of good practice and innovative simulations.
The first informative part is organized into four different categories:
- Developers / Promoters
- Options of Intervention
- Costs / Funds
- Law / Administration

The goal of this section is to generate a continuous exchange between the supply and the demand in the requalification building sector. The tool wants to promote and spread innovative technologies in the field of energy saving and innovative construction.
The second part is dedicated to case studies and virtual simulations. In this section we can find both national and international projects.
From the point of view of the private investors, the tool can spread information and advertisements and it can also simplify the administrative procedures.
The system could also generate new partnerships among companies. Finally the tool is an interesting opportunity for the municipalities to boost the urban transformations at different scales from neighborhoods to individual buildings .
To verify the tool structure that we designed, we organized a focus group. The focus group was a structured discussion with renowned experts of requalification where we could check the

validity of the elements of our system.
For the data processing we used a ANP dedicated software called Super-Decisions which allowed us to critically analyze the responses.
During the two years of research we encountered several times the inhabitants, who participated in all the phases of the project.
The fundamental goal was to create through the web platform a new sense of community and to promote a participatory process. We tried to provide a solution to share the common goals among the involved actor to promote new interventions that can improve the quality of life of the inhabitants, the neighborhood, and finally the city.

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PARLOMA

PARLOMA
A Communication System for Deafblind People

8

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PROJECT DESCRIPTION

Parloma team consist of five students with different scientific backgrounds: computer science, mechatronics, physics and biomedical engineering. The multidisciplinarity of the group made it possible to achieve excellent results, thanks to a strong collaboration between each team member, all giving their own scientific contribution to the success of the project, working with synergy and passion.

The stakeholders of the Parloma project are several and with different tasks and goals and can be divided into Internal and External ones. As for the Internal stakeholders, the tutors Paolo Prinetto and in particular Marco Indaco, representing the Polytechnics of Turin, monitored the development of the project in its entirety, and contributed in the realization of the sign acquisition, recognition and transmission modules together with the CNR-IEIIT. Calogero Oddo, representing Scuola Superiore Sant'Anna, provided the team with the receiving system, the robotic hand, and helped in the implementation and testing of the device. Carlo Geraci, from the École Normale Supérieure, provided his expertise in linguistics and put the group in contact with Lega del Filo d'Oro. The External stakeholders of Parloma project are all the device users, in particular the deafblind people that are represented by the Lega del Filo d'Oro. They will gain the most benefit from the development of Parloma. Other users that could be identified as stakeholders are deaf people or hearing people that want to get in touch with the deafblinds and can buy only the acquisition device.

The PARLOMA project aims at designing and developing a system for the remote communication between two people who are respectively:

- Deafblind and Deafblind
- Deafblind and Deaf
- Deafblind and Hearing (with knowledge of sign language).

The human need to communicate is strong. In particular this is evident in the case of deafblind people: this disability denies access to both vocal and sign languages, but communication is still in place through Tactile Sign Languages, which are Sign Languages (used by deaf, normally seeing people) that are modified in order to convey meaning through tactile feedback. In their relations with the outside world, deafblind people can use the residual writing competences they have in one spoken language (e.g., Italian) and can receive messages through a transposition of the same language (e.g., Braille, Malossi, writing on the palm). However, these solutions are not optimal because proficiency in voice of deafblind people is variable and often limited. Indeed, tactile sign language has showed to be the most effective communication system because it relies on the linguistic competences they have gained before the development of their blindness. The principle is to create a system able to transfer sign language (SL) from one point to another, in such a way that a Deafblind remote receiver can understand what is signed from a remote signer. The signer communicates resorting to sign language; the system captures it, and provides the output in tactual sign language (TSL). The output is sent through the web and received by the receiver that can understand it by touching an interface based on anthropomorphic robotic arms and hands. The TSL is synthesized by means of movements of arms, palm and fingers.

Summarizing, the final objective is to capture and transfer remotely the message produced by the signer in such a way that it can be represented using low cost and anthropomorphic interfaces. Indeed, the project poses the basis for the first worldwide level experimentation of a "telephone for deafblind people". For this purpose, this project is not dealing with issues related to semantic and syntactic signs recognition; in fact, these aspects should be addressed only while considering transpositions between different languages (e.g., translation between spoken Italian language and written versions of Italian Sign Language).

The final system will be validated through the usage of visual and tactile versions of Italian Sign Language. The team wish to stress that the terminology embedded in this project is independent from the chosen Sign Language. Therefore, PARLOMA project emerges as a cross-sign languages technological tool; indeed, it could be used to remote transfer messages in every sign language nowadays used in communications. The project has received full support from "La Lega del Filo d'Oro", an Italian association that brings together and actively supports more than 100'000 deafblind and multisensory impaired people.

PARLOMA
A Communication System for Deafblind People

TASKS & SKILLS

Chiara Pintor (Biomedical Engineering) contributed in the bibliographic research, using design methods to find the best solution. She also took part in the design and development of the hand cover and helped the group in its management. (Team controller)

Giuseppe Airò Farulla (Computer Engineering) worked on identifying stakeholders and use cases, implemented communication policies, developed the coding parts of the project.

Giorgio Micotti (Physical Engineering) participated in the research activity, worked on a 3D model of the hand and its kinematics, developed the coding parts of the project.

Ludovico Orlando Russo (Mechatronic Engineering) worked on developing both the front-end recognition system and the back-end robotic technology, developed parts of the project.

Alice Rita Salgarella (Biomedical Engineering) took part in the state of the art analysis, exploring the different solutions and collaborating in the concept development. She also contributed in the design and development of the hand cover.

ABSTRACT

As Aristotle said, "Man is by nature a social animal". One of the main characteristics of human beings is the will to be together and form communities; doing this, we are able to help each other. A crucial condition to enable this cohesion is to share a language: that is the only way to communicate and cooperate in an effective way.

In its typical form, the human language is conveyed through acoustic-vocal modalities. In deaf people, this modality is not accessible and language finds naturally other ways. This modality is called gestural-visive: the meaning is codified in the poses made by hands, by gestures, and by facial expressions, and it is then received through the optical apparatus. Sign Languages are true natural languages, exactly like vocal languages, which means they have a complete grammar and can convey every possible meaning; but they're totally independent from the latter.

Deafblind people can use neither vocal nor sign languages, in the latter case because they lack a way to receive the meaning expressed by the signer.

For this reason their communication is based on a different mechanism: the receiver's hands are placed on the ones of the signer in order to follow the signs made. Since the communication is still based on sign language, these variants are called Tactile Sign Languages (TSL). Therefore, while it is possible for two normal speakers or two signers to communicate in presence of one another or remotely (either through phone calls or video-calling systems), at the moment there is no way for two deafblind people to communicate with each other if they're not in the same place, given the basic need to touch each other's hands.

The PARLOMA project set as a goal to enable this remote communication, developing an haptic interface which would be able to reproduce Tactile Sign Language locally, in order to keep communication natural and immediate for deaf-blind people. In these 2 years, the project has targeted the Italian Tactile Sign Language, the variant used by Italian deafblind people and the ones involved with this community; later on,

1. PARLOMA team at work

2. PARLOMA team at work

3. PARLOMA team with ASP friends

the support will be extended to other tactile languages spoken in other parts of the world.

SUBPROJECT DESCRIPTION

The term deafblindness describes a condition that combines in varying degrees both hearing and visual impairment creating a severe disability which is different and unique. The main common disease is the Usher Syndrome, which can tackle the hearing in the early stage of the life, making the subject blind during adultness. Therefore deafblind subjects learn the sign language (SL) used by deaf as their first language, then, when blindness occurs, they modify it in tactile sign language (TSL). TSL is the only way deafblind people can use to communicate: it consist of touching the signer's hands while they are gesturing through SL in order to understand the sign made.

The necessity of being in the same place to communicate is a real burden to maintain social relations and to keep

a relevant place in society, moreover it should also be considered that between deafblind people, or between deafblind people and social operators, the mutual interaction is based not only on language but also on a social, emotional, intellectual and physical growth. However, those relations can be abruptly truncated if, for any reason, the conditions that permit those people to live in the same place change.

The number of deafblind people in Italy is not clearly declared, as a matter of fact there are no official data available because a real counting has not been done yet. It is possible to estimate that deafblind people are between 3000 and 10000, particularly the target for this project is composed by a group of 2000-5000 people.

Moreover it is necessary to consider that the stakeholders network is also composed by other 10-40 people per deafblind, including relatives, co-operators, signers, deaf and other deafblind, continuously in contact with each

subject during their life. Among this group we consider also deaf because deafblind are strongly in contact with them before blindness occurs; when they become also blind they are forced to interrupt these relationships because the mobility related to their new way of communication causes a significant increase of costs. The communication between deafblind is very high expensive; the contribution given by the Department of Health is often insufficient for their necessities. This situation is even worse considering everyday communications, because no financial aids are provided. As a matter of fact, deafblind need to pay a personal interpreter in order to satisfy their desire of communication. This difficult situation causes a progressive decrease of meetings between deafblind and consequently a reduction of the network.

These difficult conditions enhance the research and development activities of the group: the main goal is designing a communication system which may de-
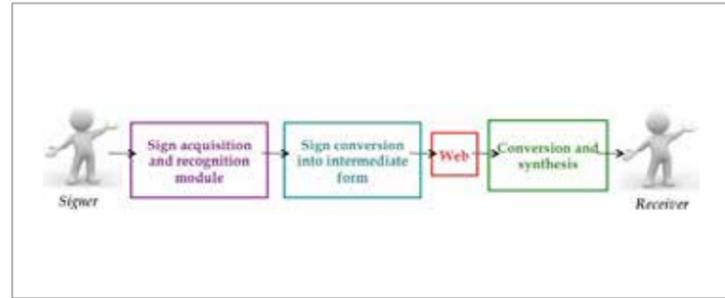
4. Pipeline of the remote communication system

5. Feasibility study

6. Hand segmentation within the development solution

7. Representation of the robotic hand

crease their isolation and enable better relationships between deafblind people and between deafblind and the entire community. The solution proposed by the project is a remote communication system based on the tactile sign language, the remote transfer of information allows a better inclusion of deafblind in the society because there is no necessity for them to be in the same place to communicate.

PARLOMA had to face hardware and software issues, that concerned both the sign recognition module (front-end) and the sign reproduction module (back-end); moreover, it was crucial to define a protocol to link these two elements.

With respect to the sign recognition module, several state-of-the-art techniques in the field of computer vision were analysed as suitable for the final purpose of the project. In particular, the team has realized different concepts based on some of the available technologies and has chosen a specific so-

lution. As far as software, only very few techniques are able to perform robust sign recognition; a small number of algorithms for hand pose tracking based on non-invasive technologies are proposed in literature, so the team had to develop an entire algorithm able to perform these tasks based on the chosen technology.

For what concerns the back-end side, at the very beginning it was obvious that the sign reproduction module had to necessarily be anthropomorphic, thus a system based on an anthropomorphic robotic hand has been chosen. In this scenario, the most relevant problems were choosing an existing robotic hand, since that is a system too complex to be developed in a few years; and design a specific cover in order to emulate also the tactile feedback from a real human hand.

Moreover, different ways to link the different modules were proposed in order to allow them to communicate in real time using a standard and secure re-

mote connection.

The main challenge of the project was to design a system optimized to work robustly and in real time. The front-end solution has been mainly based on a well known hand tracking approach based on depth map, 15 Degree of Freedom (DoF) tracking, appearance-based that uses a random forest classifier. This approach, however, was deeply reshaped and optimized in order to obtain a robust and fast algorithm; paralleling GPU programming was also considered. Moreover, a very complete training set based on several 3D models of hands of different dimensions and structures, has been built from scratch in order to obtain a more robust classifier.

The proposed solution has been thought as a pipelined system that starts with the sign acquisition phase (front-end) and ends with a robotic actuator (back-end). The overall system pipeline aims at acquiring the message coded in Sign Language by means of low-cost technologies (since this im-

plies a high potentiality to play a key role in the market). Among all the possible alternatives, a depth system has been chosen to identify human hands; an algorithm appearance-based has been implemented to recognize the shape of the hand that is, at each moment, in front of the acquisition device. In this way it is possible to recognize the movements done by the human hand. After that, the system can generate an intermediate representation composed of all the information encoding the pose of the hand and the wrist.
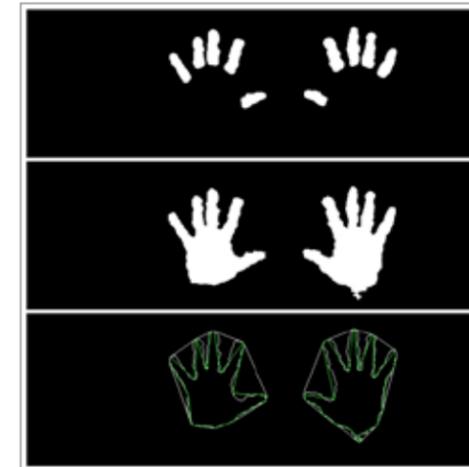
The system will send the encoded message through the web; this message can be also encrypted and signed to ensure privacy and authenticity of the communication. A receiver module can receive (and, if needed, decrypt)

the message in order to generate commands suitable for the robotic hand. The robotic hand will reproduce the message in LIS. The receiver can later understand the message by simply touching the haptic interface. Summing up, the developed system will perform the following basic operations:
- Sign acquisition and recognition (front-end)
- Sign Conversion into an intermediate form
- Transmission
- Conversion and Synthesis (back-end).

Among all the considered devices usable for the receiver side, differences are in mechanisms, sensory equipment, performances and objectives, and the ready-made solutions all have consid-

erable costs. To overcome this critical limitation, which would negatively affect the societal and commercial impact in the follow-up of the project, the team has capitalized on the leading experience that Scuola Superiore Sant'Anna had over the last 20 years within the development of robotic upper limbs and tactile sensors. Finally, a big effort has been spent on designing a cover which is the most suitable for the tactile sensation. The main issue was finding an appropriate material and the manufacturing technique, as a matter of fact the goal was to project a cover able to reproduce the anthropomorphic features and to suit the robotic shape.

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SMART.MAP

**SMART SENSITIVE CITY.
NEW MAPPING FOR XXI CENTURY CITIZENS**

SMART.MAP
Smart Sensitive City. New Mapping for XXI century citizens

9

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PROJECT DESCRIPTION

The challenge
Information technologies offer innovative ways to deal with urban space. EXPO 2015, as occasion to promote the local and regional area values, requires an original idea of mapping able to record, analyze and represent dynamically the complexity and heterogeneity of the hosting territory. The project aims to produce innovative senseable images of the city enhancing accessibility to the Event at various scales and gathering proactive feedbacks as profitable resource and legacy, through building expectations, field and immersive maps available on 2.0 smart-devices. Contents and tools design will be applied to two layers of mapping: 1) a layer of field maps and points of interaction with the users; 2) a layer of sensitive or immersive maps.

Clarifying the problem
Territory hidden values, mapping and technologies are the main key words of the project, interpreted in two hypotheses:
1. technology as a tool to gather documents, information and knowledge (Heritage/Cultural path)
2. technology as a pro-active system to implement the meaning of a territory (Via d'acqua/EXPO)

The teams proposals
Team A worked on the first hypothesis, offering an innovative experience to discover the cultural heritage. They set up the technological issues, the contents and contents-display part, focusing on the innovative dimension of the tool/contents relation.
Overall objective: to develop a set of maps for an interactive experience of the city through an application, that will help visitors to get use of Expo facilities, linking the exhibition site with Milan urban structure. Layering cultural heritage, knowledge and events, results in that technology not only permits to be global and ubiquitous, but reinforces the local dimension of heritage.
In meta-prototyping phase were defined pre-set routes basing on specific parameters as time availability, individual

preferences, resident or foreign visitors, current user position. A sketched structure for the IT interface assessed the feasibility of the overall project, working out a business plan flexible to the expected users and stakeholders.

Team B worked on the second hypothesis. After the joint preliminary research with Team A, focused on the defined context of the EXPO Waterway thanks to a clear plan of actions. Working on the tool/contents relation they found their innovative surplus in the engaging cultural/business model.
Overall objective: the enhancement of Milan as water city through an interpretation of itineraries.
They worked on the implementation of agricultural community designing strategies, creating a smart community and a common brand to develop "Glocal" (global+local) businesses. This approach aimed to contribute to the physical definition of the Waterway metropolitan context as a new public realm of the cities that surround it. The reached objectives could be: an immersive, customized, interactive and social experience; user-context direct interaction; enhanced awareness of citizens on their neighborhood; enhanced attractiveness of the city for tourists.

project **9A**

S.H.O.W. MI
Search for Hidden Opportunities and Wonders in Milan

SMART MAP

S.H.O.W.MI

Search for Hidden Opportunities
and Wonders in Milan

TASK & SKILLS

Kai Chen, Architecture heritage preservation and enhancement
He studied the sustainable heritage strategies and how the app can contribute to the public and government.

Luca Cioria, IT Engineer
He developed the application and the logic inside. He took part to the realization of the algorithm to manage the logistics flows and to interact with other smartphone applications.

Giovanni Fassio, Management Engineer
He supervised the economical part of the project and the business model generation. He realized the algorithm to connect people in a social real network

Filippo Pozzoli, Building Engineering and Architecture
Team controller. He supervised the whole evolution of all the branches of the project, verifying the overall congruence, deeper focusing on contents and narrations.

Sonia Pravato, Interior Design
She dealt with the state of the art and the development of the mobile application graphic interface, supervising

all visual output and presentation.
Anastasiia Stryzhevska, Architecture
She was responsible for the architectural and historical research and subsequent selection of entities that were about to form the app's database of points of interest.

ABSTRACT

Project Smart.Map S.H.O.W MI (Search for Hidden Opportunities and Wonders in MIlan) aims to show the cultural heritage of Milan and the stories hidden in it, through dynamic and personalized itineraries to be articulated according to one's preferences, on available time and resources and on the starting point and the intended destination. The final application we plan to develop aims to narrate the urban space in Milan through a drift inspired by Situationists practices and an approach of sensory exploration, connecting the Expo site, key – stone for international visibility of the territory - with Milanese urban fabric. The virtual link created turns into a physical one, as in "Digital Islands", aiming to propose a new and innovative experience not only for tourists, but more important for the citizens.
Starting point of the routes becomes the initial position, identified by GPS and other advanced technologies. The city is rebuilt without pre-established paths, thanks to the inclusion by the user of its individual preferences; from these the algorithm creates a custom itinerary, allowing immediately to discover places, stories and events connected with the needs of the user. Further content is available only when the visitor arrives in the established place, in order to enlarge the local dimension, intended as local and deep discovery of a specific place, and to increase the exploration of a place thanks to a different way, with strong focus on the environment and on the quality of contents generated by experts from various disciplines.
The paths can be saved and shared with other users in real time, cultivating the social aspect that is now more than ever indispensable, allowing peo-

1. First view of the app

2. User preferences insertion
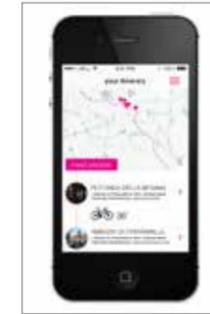
3. The app creates your own customized itinerary
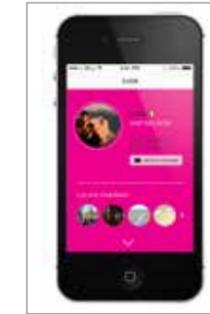
4. Social Real Network_User profile

ple with the same interests to get in touch and, for example, to use and explore the same route. In order to encourage citizens to new discoveries towards a more aware consciousness of public networks, synergies with the network of public transport, small businesses and other facilities in Milan are expected.
Users can furthermore create a personal diary to collect all moments, pictures and emotions and share their experiences.
Briefly, the goal is to provide the set of tools for a unique experience of the city through narrative actions, using the two main dimensions the world is moving through: sharing and customization.

UNDERSTANDING THE PROBLEM

Project show.MI aims to create a new way of city mapping in order to work out custom trips around the town, offering people a different approach when visiting or living in a city.

At the moment, there is a lack on the market for a tool allowing tourists and citizens to get valuable, up-to-date and involving information about a city. There are several applications meeting some of these needs but no one, at the moment, frames the whole picture. Deepening in, we can experience a lack of perceived quality in quite all guiding apps, above all concerning interesting itineraries and interesting stories to tell about a place.
The itineraries that could be easily found on the market are standard ones developed by common users or by professionals, where only the most remarkable places are shown and the information are given in sort of a didactic way, not tailored on every users' preferences.
Now, with Expo 2015 expected to bring loads of new visitors in Milan, there is an unmissable chance for filling this gap. show.MI is what we ended up with: an application for smartphones providing an integrated experience

that will let citizens and tourists discover concealed wonders of Milan and experience must-have-done local traditions, guiding them with smart itineraries thought to meet to their very needs.
After the understanding of this possibility, we ran on a detailed market analysis in order to know which are the functionalities that people would like to have in a city guide app, coming out with different results to shape our app, adding, for instance, social and gaming functionality as an answer to "sharing" needs or the possibility to interact with people to create what - we cannot conceal - we are proud to define "social real network".
The other big challenge we had to deal with was the selection of places of interest and the creation of the itineraries. How to find interesting stories and to attract people in discovering new places and how to create a perfect itinerary for every person were only two of the main things we had to focus on. It was not bed of roses to combine the necessity of a cultural and edited itinerary with an "app philosophy", where everyone could add, share and edit everything just clicking one button.
At last, we focused our attention on possible targets and stakeholders. It is not trivial to understand who could benefit more from our app and which are the stakeholders that could pop in. Adding commercials, means of transport and famous places are only few of the topics we tried to depict and exploit.

5. You can play with the past, learn about place in a different way, try to understand what it was and what is now

6. You can check-in in new place, earn badges and share this with friends

7. Play with the app, search for interesting things and try to be faster than your friends

8. All your experiences, your pictures, your visit will be stored on the cloud and will create your personal and own diary!

EXPLORING THE OPPORTUNITIES

Given these premises, the project focused on the following aspects.

Points

Being quality oriented in terms of content we made a research about buildings and public spaces that might have a potential to enter in our list of points of historical and cultural value. We discovered that Milan has 42 museums, 200 historical buildings and almost 1500 monuments. Since we wanted to show them within their cultural and historical context we had to define a rather short list of points to be able to produce content based on serious research that involved consultations with various experts. We picked the objects giving a priority to their ability to tell stories, valorizing less known but potentially interesting objects as well as the famous ones providing less known facts about them. In our case innovation lays in the engagement of new technology we use to tell the old stories to keep them alive.

Algorithm

We had to choose the mode of creation of itineraries that will guide our users through the city. We had two different options: either predefined paths or customized ones. Our favor was given to the last one due to better correspondence with the philosophy of our app.

Layers

We had in mind the idea of multiple thematic layers from which, in the end only three survived. We believe that the

selection of the most crucial ones creates an additional value to our project. We carried out a survey to define the ones that are the most appealing to our potential.

Infrastructure

This virtual application had to have physical points of access. We had to somehow communicate our existence. Having started with the idea of the creation of a network of point of access through the active QR codes that were aimed to lead our users to the app we abandoned it because of two reasons. First one is that now, two years after the start of the project QR codes technology is already quite obsolete. Second is our unwillingness to participate into the creation of unnecessary visual pollution with which contemporary cities are already full. We decided to connect to the existing infrastructure. We gained the permission of EXPO to integrate the communication of existence of our product in the newly created Isole Digitali. There will be 30 of them by 2015 and being scattered in the whole city they are perfect for why we need them.

GENERATING A SOLUTION

introduction

The proposed solution is a smartphone application that integrates all the concepts developed so far, namely an intelligent guiding system, a platform to deliver quality content and a social interaction environment to connect users. The aim is to generate a

9. A frame of the first promo video made with team B
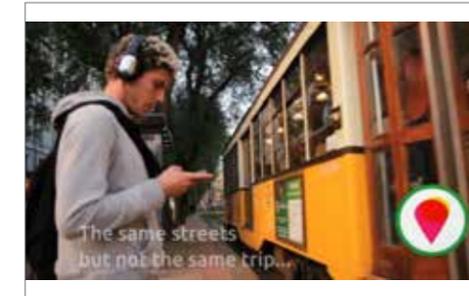
10. A frame of the first promo video made with team B(2)
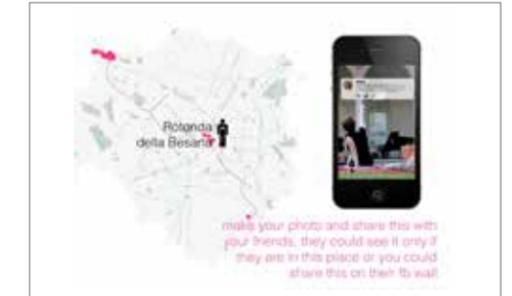
11. A frame of the video about the project

distinct added values for tourists and, even more importantly, citizens, transforming the experience of living Milan into something memorable and fun.

Unlike a traditional guide, show.MI develops a two way interaction with its users. Content is proposed in an interactive form, with a layer of gamification to better engage users.The show.MI application

We tried to leverage the full potential of the smartphone and rethink the experience of exploring a city with a new, modern mindset. The key feature is the intelligent generation of custom itineraries, based on user preference, time constraints and dynamic adaptations along the way. This is deeply integrated with the real time guidance feature, that optimizes the travel path and the employ of public transportation thanks GPS, Wifi and our proprietary algorithm. You concentrate on the experience and the discovery, the app takes care of the logistics.

An additional layer on top of itinerar-

ies is the gamification. Places can hide secrets to discover, challenges to take. Points are acquired following the path, and additionally coupons and discounts on tickets. All these challenges and experience will be provided thanks to augmented reality, such as the possibility to see the past in the smartphone instead of the presence of a structure, or using other tools such as Google Goggles or our proprietary gamification tools.

The third layer, after intelligent itineraries and gamification, is the social layer. We call it a social real network, a social network whose main focus is to have people meet and share in the real world. By crossmatching itineraries it's possible to have groups of people, with common plans and interests, meet in person. Also here, a proprietary algorithm is able to identify users with similar interests, to connect them and to allow them to meet in the real world. This could be made before, during and after the experience. Ad-

ditional sharing features are available in the app, such as sharing photos of places or additional comments, suggestions and reviews.

The underlying foundation that makes all this possible is the quality content and the focus on the experience. We aim to give new value to the impressive cultural heritage of Milan, exposing the hidden wonders and the forgotten secrets. A fun experience for tourists but also a valuable tool to raise awareness of our heritage among the citizens.

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project **9B**

WA.AG Network
Water-Agricultural smart maps for fertile metropolitan territories

1. Login page of the application

2. Users' experiences are tracked and stored in their personal page

3. Users can access the selected itinerary and confirm or modify it

4. Users can get information about the points of interest directly from the navigation map

5. Users can get information about the points of interest directly from the navigation map

TASK & SKILLS

Massimo Allevi participated to the preliminary study of the problem and to the generation of the solution. He took contact with the main external stakeholders, interviewing several of them, and he was actively involved in the final elaboration of the solution.

Marco Cremonesi worked on the problem-setting phase, the generation process and he also developed possible scenarios of the solution. His main role was to analyze and to solve the problems related to the feasibility aspects.

Michela Delbosco took part into the problem-setting phase and carried out territorial analyses. She worked on issues related to systemic design, branding and graphic user interface and she was actively involved in the final elaboration of the solution.

Giuseppe Doronzo participated to the analysis of the case studies and in generating possible solutions. He worked on the formalization of the chosen solution and on the economic feasibility of the project.

Heghine Pilosyan has been involved in the initial problem- and target-setting phase, and site analysis. She coped with the conceptual and graphic aspects of the project, along with the definition of possible combinations of several concepts.

ABSTRACT

Expo 2015 will be an exceptional possibility to promote the potentialities of the city of Milan and of its surroundings. WA.AG project, one of the two sub-project of Smart.Map, has been developed together with the new Waterways designed by Expo spa in the west area of Milan, with the main goal of turning this area into a smarter and outstanding example of improvement and awareness of the territory.

Since the beginning it emerged the consciousness that an inclusive approach towards all the major actors of that area was necessary for the success of the Expo event and in order to have a lasting legacy for Milan. So, the main actors identified have been the department of the public administration in charge of the green areas of Milan; DAM (Distretto Agricolo Milanese), a district which includes all the major producers of agro-food products in the province of Milan; local associations that currently occupy and manage that area and tourists-citizens, towards whom the entire system is designed.

Several analysis have been carried out in order to understand their requirements and to find out a response to them. For example, the modern techniques of dynamic mapping allowed territorial enhancement and the creation of a common brand. Moreover, case studies of outstanding examples of technologies implementation in urban context have been also analyzed. So the project evolved from a first phase of research to a second phase

of development of a solution.
The final output of the project is a system composed of an application for smartphone and a web-based related software. The designed solution aims to rediscover the local culture and to enhance the territory through the definition of itineraries and the creation of a network of local businesses under a common brand. The cooperation among local entities and the innovative technologies are the key factors to allow the operation of the system. Moreover, an e-commerce platform will be added to allow the commercialization of products both at local and global scale.

UNDERSTANDING THE PROBLEM

Expo SpA, the company in charge for the design and the realization of the Expo 2015 event in Milan, is the main external institution involved in the project, together with SIEP/IALE (International Association for Landscape Ecology). The aim of the project is to

reconstruct the historical relation between the city and the waters of Milan through the project "Waterways", connecting a work of urban and ecological requalification with the Expo event. This will also create a strong connection between the city center and the surrounding area of Milan.

The requirements of Expo have been the enhancement of the visiting experience for tourists and citizens, the possibility to create a legacy for Milan, both for the territory and the society, with a focus on sustainability themes and the use of new technologies.

According to this, the final objective of our team can be summed up in three main sub-objectives: the promotion of Milan and its metropolitan area as agricultural water city, the valorization of local businesses and the creation of a proactive mapping system to create and allow an immersive, customized, interactive and social visiting experience for both tourists and citizens.

The final users of our service will be:

the department of the public administration in charge of the green area of Milan; DAM (Distretto Agricolo Milanese), a district which includes all the major producers of agro-food products in the province of Milan; local associations that currently occupy and manage that area and tourists-citizens, towards whom the entire system is designed.

The main goal of the DAM is to foster agricultural activities and sustain small and medium enterprises operating in the metropolitan area of Milan through the maintenance of public goods, fields and waterways and through the requalification of landscape.

Public administration has showed to be well pleased versus the Smart.Map-WA.AG project because it fully meets its objectives regarding the preparation of the city for the Expo event, like the census of all the operating farms and companies around Milan, included services offered.

6. Users can discover itineraries and events on the web application

7. Local producers can upload data within the virtual marketplace and use the e-commerce platform to sell their products
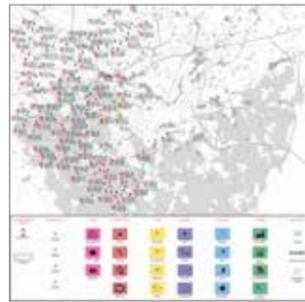
8. Map of the points of interest and linear matrix used for their analysis
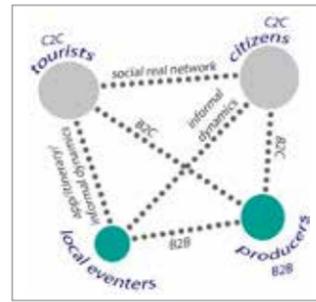
9. Network of interactions among the involved actors

10. Scheme of how three kinds of users can interact with the platform and the application

The analysis carried out to define the users' requirements showed that citizens consider the opportunity to discover new places and to increase the awareness of the territory a fundamental factor. Therefore, interests for Expo's themes and curiosity for new technologies and social aspects of the visiting experience have emerged and have been taken into account all along the development of the project.

EXPLORING OPPORTUNITIES

The development of the project has been divided in a phase of research and in a phase of solution development.

The first research phase included a deep analysis of the context and of all the requirements of the involved actors, which led to the definition of final objectives to pursue in agreement with our main external institutions partners. Conferences about smart cities highlighted major opportunities to exploit in the metropolitan city of the future,

while an analysis of the services currently available for tourists and citizens showed most common features of existing applications for smartphone, as well as several lacks that our system could compensate.

Several case studies have been examined and used for the final solution too. Eataly, the new company dedicated to the promotion of high quality Italian food around the world, has been analyzed as an interesting case of supply chain management in the food industry, in order to understand how they select the partners and how they keep a relationship with them.

TianTian has been useful to understand how technology can be used in an easy way to allow small food producers to sell their products on the web with simple and intuitive tools.

Distretto 33 carries out and supports several projects of territorial enhancement in the west area of Milan. A project called Landscape Expo Tour (LET), by LAND Srl and Fondazione

Cariplo, has been identified as qualified provider of itineraries and a cooperation with them has been started to include the LETs into our platform.

Finally, MatchingMarkets, a project by the MIT Senseable City Lab, represents an attempt to create a network of local producers through the creation of an e-commerce platform, while Lo-Cast, a project developed by the MIT Mobile Experience Lab, is a very useful attempt to better understand how evolving media technologies could be used to improve connections between people and their social, cultural and physical space. Two members of the team met the creators of this last project in Boston, in the MIT campus.

The second phase represented the development of possible solutions of the project and it has been divided into three main sub-phases. Firstly, an initial collection of data have been carried out, through several interviews to potential final users of our system, on-site inspections, conferences,
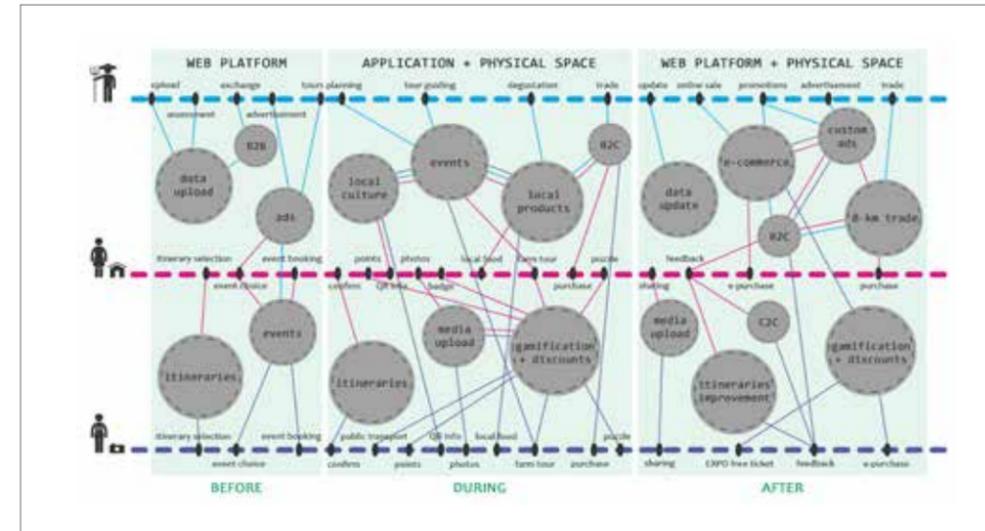
meetings and lectures with experts on different issues related to our project together with the studies of existing solutions. Secondly, the creation of narrations, the discovery of the meaning to convey, also through the realization of a brand around the new Waterways and the design of a network of relations among final users. Finally, the integration with technology, smart devices and web platform , the creation of uses cases and the final definition of the business model.

GENERATING A SOLUTION

As a starting point for enhancing the considered territory, several points of interest have been identified and analyzed through the principles of interac-

tive storytelling narrative, based on a linear matrix used to describe the interactions user-context in each point. Ten existing qualified itineraries have been identified and provided by LET project. Finally, a layered map has been designed in order to create a relation between the morphology of the area, the itineraries, the actors and the events.

The final output of the project is a system composed of an application for smartphone and a web-based related software. Through the application it will be possible to interconnect the discovery of the territory, which refers to the layered map, with the producers present on it and the events organized by them. Thanks to the e-commerce

platform that will be integrated within the system and connected to the other layers, local producers will be able to sell their products to citizens and tourists even after the visit.

The system will be characterized by all the last features of new applications, in terms of user experience and usability issues, while the maintenance of the system will be assured through paid advertising and commissions on each commercial transaction performed on the platform.

The designed solution is oriented to a rediscovery of local culture through the definition of itineraries and the creation of a common brand to simplify horizontal and vertical relationships between local producer and customers. New technologies play an important role because they will allow the cooperation among local entities and the internationalization of their typical products.

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NHEC

NEA HUMAN EXPLORATION CONCEPT

NHEC
NEA Human Exploration Concept

10

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PROJECT DESCRIPTION

In 2011, the International Space Exploration Coordination Group (ISECG) formulated a shared Global Exploration Strategy providing, in two different mission scenarios, the guidelines for the next decades manned and unmanned space exploration activities.

The 'Asteroid Next' challenging mission scenario foresees two human visits of a Near-Earth Asteroid (NEA) up to 2035. Most of the key capabilities and technologies have been identified, but some of them shall be more investigated. For instance, in order to enable humans to effectively complete in-situ mission objectives by guaranteeing the most suitable access, in-space destinations (e.g. NEAs) systems shall be more deeply studied.

In the described frame, the NEA Exploration Crew Vehicle to be designed would represent a multiple destinations and related tasks manned space system, able to explore different small bodies and free flying in their proximity. The multidisciplinary project mainly focuses on mission analysis and design, as well as on ergonomics evaluation of the interior spaces for a baseline design of this vehicle. The two teams worked on two different mission concepts, but with a common aim, i.e. to maximise the scientific return of a human mission to a planetary body such as asteroid 1999JU3. The vehicles that they conceived have different dimensions, and this affects their pressurization, as well as the number of astronauts they can carry: consequently, the concept of operations will vary according to the above-mentioned features.

The innovative character of such missions is indeed confirmed by their quick advancement in the state of the art. For example, ESA is looking to the future of space exploration in terms of advanced concepts designed to explore, prepare and help humans in the very harsh conditions found in deep space environment. A group of scientists from the Keck Institute for Space Studies in California thought of a robotic asteroid

capture vehicle, which would enable to grab a small asteroid and anchor it to a convenient point in space, like one of the Earth-Moon Lagrangian points. This would save the long time necessary for the astronauts to reach the asteroid, and the scientific study closer to home would benefit from an environment that is less hostile than that found in deep space. Moreover, the role of a deep space mission would be paramount in a long-range human exploration strategy. Among the various pathways to Mars, NHEC would certainly contribute to the integration of robotic and human missions, to the preliminary development of new space systems and the incorporation of technologies still to be enhanced, and to the management of human performance risks.

A multidisciplinary approach is maintained throughout the project, in order to simultaneously deal with all the issues that the design task asks to solve. The European Space Agency was the principal stakeholder to be identified for further development of the present mission, since its interest in building a sustainable human space exploration endeavour is continuously growing.

ASTRID:
THE NEXT GIANT LEAP

TASK & SKILLS

The team is composed by members that cooperated in an extremely integrated way in order to fully exploit the synergies due to their different backgrounds. However, considering their main areas of expertise, they were in charge of different aspects. **Lorenzo Ferrario** and **Giacomo Gatto**, aerospace engineers, conducted the mission architecture trade offs and a research about power systems, attitude control systems and space suits; they also supervised the integration process. **Martina La Vista**, architect, focused on possible configurations of the spacecraft and on ergonomics. **Francesco Robotti**, energy engineer, worked on power generation and information handling systems. **Tiziano Viganò** was in charge of the grabbing systems and drilling technologies.

ABSTRACT

Near Earth Asteroids are an amazing source of knowledge of the Solar System due to their ancient origin, and a perfect test bed for future missions to Mars.

Following the ISECG's Exploration Strategy, the team has been assigned to the conceptual design of a spacecraft for the in-situ analysis of a Near Earth Asteroid (NEA). This vehicle has to detach from a mother-ship, approach the celestial body, deploy scientific payload on the surface and collect samples.

The work has been conducted on a feasibility analysis level, with focus on the technological aspect. Currently developed technologies and expected advances in each field of space engineering have been considered. This conditioned the conceptual study, opening to the exploitation of conceptually new designs and solutions for overcoming serious limitations of the current technology.

The concept presented is that of a 2 men crew vehicle with independent landing capabilities and enough power

to allow complex instruments on the surface of the asteroid with respect to a robotic mission, in order to collect a wider variety of samples. Moreover, Extra Vehicular Activities (EVAs) can be easily performed by crew members, thus increasing both variety and quantity of samples. Some contamination prevention concepts and information handling technologies have been conceived after the experience of four decades of EVAs.

The final outcome resulted in a highly sustainable conceptual design: since most of the technologies involved have already been tested, the required advance of the technology is limited to few fields.

Moreover, some of those newly proposed solutions have either been developed in other fields, but have shown the capability of adapting to the characteristics of this project, or will find other applications outside the space industry, thus providing technological spin-offs.

In conclusion, the work presented can be used as a starting point for a more detailed design phase that will lead, hopefully, to missions that will help the humankind to answer questions it has been posing for hundreds of years: the origin of the Solar System and, more important, the origin of life itself.

UNDERSTANDING THE PROBLEM

A description of the specific analysis of the project made by the team, e.g. the working out of the general brief
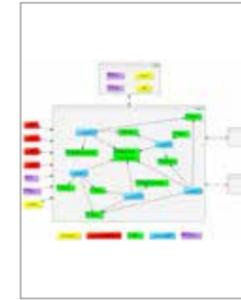
1. Team internal structure and interaction with stakeholders.

2. Example of habitative russian module. Reliable design, but complete absence of ergonomics and comfort.

3. Cupola view reproduction. A feeling of the confinement an astronaut may experience in the space might be appreciated observing that Cupola is the biggest existing window on the Space.

4. Example of ISS hatch.

5. One of the research modules of the ISS. Limited space and very high density of controls and instruments to reduce volume at minimum.

6. Training activity at the Soyuz Simulator. Simulation of the approach and docking phase of the Soyuz Spacecraft to the ISS. This activity has been extremely useful to appreciate a current example of command and control system of a spacecraft.

received by the customer, focusing needs and targets.

While analyzing a space-related project, the definition of the requirements and the identification of drivers is of fundamental importance. The level of complexity of the system and the integration in a single mission of an enormous amount of different aspects, ranging from technological to diplomatic, may be faced only with a clear understanding of the basis on which the whole project has to be developed. While requirements are set by international standards, the general brief and the objectives required by the institutions represent a good starting point for the identification of main drivers. Therefore, basic yet fundamental aspects of a space mission such as safety and success can be recognized. In fact, the safety of the crew and of the equipment must be never put at risk and the result of the planned activity should be as certain

as possible since the cost of such missions (both in terms of human lives and economical) is enormous. Moreover, the knowledge and know how return must be high, thus, in situ analysis, wide sample collecting and uncontaminated reentry are other significant drivers to be considered. It follows, indirectly, that the ability to perform extra vehicular activities and to avoid contamination is another main driver.

EXPLORING THE OPPORTUNITIES

A description of the specific project challenges and their respective possible solutions, with reference to the state of the art and the existing alternatives. In this part the students can also illustrate some critical passages of researches or experiments carried out.

The architectural decision of developing a 2-men crew pressurized vehicle

with deep sampling capabilities for asteroids exploration leads to a series of specific project challenges:

- The approaching and "landing" phase (usually referred as "grabbing") are conditioned by the microgravity environment and by the nature of the asteroid;
- The necessity to collect deep samples implies the need for heavy and consuming instruments (e.g. a drill), thus a high power availability is needed; moreover, a proper storage system must be assessed;
- The necessity to perform EVAs leads to the assessment of an airlock or airlock-like sub-module with contamination prevention and of an information handling systems.

When grabbing is considered, the almost null gravity of the asteroid im-
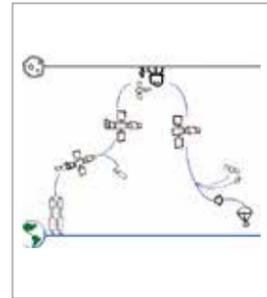
7. General Architecture of the Mission
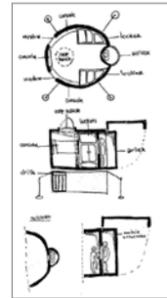
8. Preliminary drawings of possible configuarations

9. One of the innovative solutions considered: the Mechanical Counter Pressure Suit.
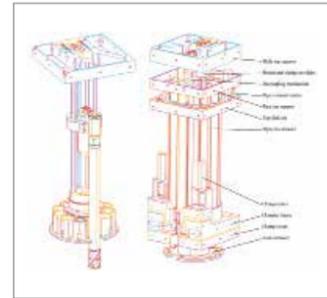
10. Deep Sampling Drilling System components/Valtion Tieteellinen Tutkimuskeskus

11. EVA Egress rendering

12. Underwater training for manual sampling in microgravity conditions.
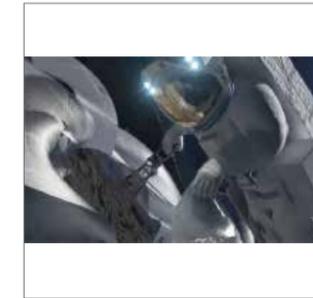
13. Manual sampling activity with the aid of anchoring equipment

14. Artist's view of a possible exploration vehicle configuration
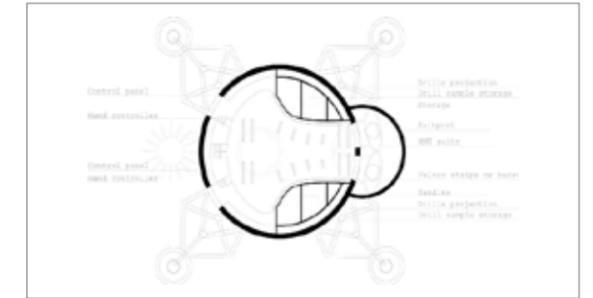
15. Plan of the developed solution

poses the design of some retaining mechanism for avoiding the spacecraft to bounce away after the touchdown. Even a non-grabbing option can be chosen, in this case the spacecraft shall ensure a stable parking position nearby the asteroid for the time required to perform all the scientific in-situ analysis, with reasonable margin. The attitude control during the Rendezvous and the Docking phase assumes in both cases a fundamental role; after a first study of the state of the art, since the Technology Readiness Levels (TRLs) and the performances of the existing technologies are more than satisfactory, standard systems have been considered.

For what concerns sample collection, adequate instruments and their power source have to be identified. Existing space-drills and new configurations have been studied, considering the harsh environment of the targeted body (i.e. microgravity, material form, temperature, dust and solar radia-

tion). Moreover, dimension and weight constrains and reliability, robustness and contamination requirements play an important role in the choosing of the system. However, the main focus is on the power system that has to keep instruments and systems running. The main alternatives considered are energy storage and energy storage supported by a power generation subsystem: Lithium-Air batteries and Radioisotope Thermoelectric Generators (RTGs) have been analyzed. Both solutions exhibit pros and cons, mainly linked to complexity, unforeseen events management and safety issues; therefore, a thorough trade-off study has been necessary.

Furthermore, the need of the space crew to perform EVAs poses major issues that have to be considered, such as the atmosphere loss avoidance, the minimization of penetration of contamination agents and of dust deposited on the suits and the ease of wearing, the comfortable fit, and the safety of

the suit. All these aspects have been faced considering different donning and doffing possibilities (i.e. air-locks and suit ports) and different kinds of suits (i.e. the Constellation Suit and the innovative Mechanical Counter Pressure Suit) and performing a thorough trade off analysis. Finally, the use of a information handling system derived from military aviation is suggested in order to allow an easier data management.

GENERATING A SOLUTION

A description of the developed solution, pointing out its elements of innovation, its advantages and disadvantages compared to the other considered alternatives, let alone possible validations.

The proposed solution has been developed considering the ASP focus on multidisciplinarity and innovation while filtering concepts and well-established technologies with qualitative criteria of technical viability.

In the proposed scenario, to reduce critical phases and increase system safety, the 2-men crew vehicle performs a single landing after an explorative probe validates the asteroid as a significant target. This avoids a predeployed structure and a precursor robotic mission to set it, thus increasing the flexibility of the overall program. The rendezvous phase is performed using a system that features cold gas thrusters, to avoid contamination, supported by momentum wheels. In this way, it will be possible to use the same hardware both for the attitude control and for propulsion. Then, the spacecraft grabs the surface of the asteroid anchoring to the soil as it touches down by means of ice screws on the legs and harpoons. Once secured on the surface, the vehicle deploys the high power payloads for sampling and provides a safe haven to astronauts during their EVAs. Part of the high power payload is made of low volume and low mass extendable drills:

pipes are located in a carousel which, through rotation, selects the proper pipes (e.g. the ones for ultrasonic drilling or the ones with specific tools) and locates them in the correct position for the assembly. Once the drills are activated, both astronaut exit the spacecraft to deploy a series of anchoring equipment (i.e. circumferential cables, harpoon anchors, ice screws, and surface nets) that will be crucial both for experimentation, since there is little knowledge on how such systems will work in an unknown microgravity environment, and for mobility. Afterwards, the collection of low depth samples from the surface can begin. These phases are performed using innovative maneuvering units that can be donned and doffed in a suit-port like fashion, thus drastically reducing the risk of contamination.

The power system that allows such mission to proceed smoothly features the combination of a modular RTG with Li-Air batteries. This solution, de-

16. Proposed solution rendering
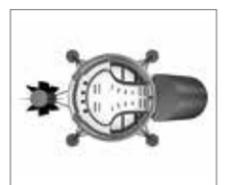
17. Vehicle possible interiors configuration

spite requiring an higher volume, does not impose any limit on the duration of the operations and, at the same time, solves the problem of peaks management, exploiting as much as possible the continuous production of the RTG in order to recharge the batteries, thus increasing the maximum deliverable power.

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A Friendly Manned Interface

TASK & SKILLS

Niccolò Alessandri was involved in the user requirements definition and in space architecture studies.

Margherita Censi carried out the state of the art research on exploration activities and described the preliminary possible scenarios. Her main task was also the study of the psychological aspects.

Alessandro Ciani developed a research on already existing exploration space vehicles. He investigated the new vehicle concept, estimated its dimensions and worked on the solutions for mobility aid.

Alessandro Cingoli was in charge of studying the state of the art of docking techniques. He then produced the requirements and contributed to the design of the final solution.

Chiara Gastaldi concentrated her efforts on exploration systems, conducted a deep analysis of the state of the art before defining the exploration equipment and the concept of operations.

Luca Levrino, team controller, coordinated the group work and checked team progresses. He provided the target description, proposed mission architectures, and especially concentrated on the creation of the vehicle concept.

Ricardo Repenning carried out the research on batteries and power sources in space missions. He then developed different docking solutions on which he conducted several experiments.

ABSTRACT

Exploring space strengthens the future of humanity in a common cause, as it stimulates innovation and inspires individuals. Nowadays, it requires intense international cooperation to achieve incredibly challenging objectives, which our team tried to interpret and translate into suitable requirements in order to design an innovative space mission concept. Among the stakeholders we identified there are in fact national and international space agencies, such as ESA or NASA.

Sending Man to a Near-Earth Asteroid (NEA) is an extraordinary but unprecedented challenge, whose scientific return will outweigh the investment required. Unfortunately, the deep space environment is very hostile, and many issues such as microgravity effects, radiation shielding and extreme temperatures have to be carefully seen to. Moreover, to allow astronauts to perform Extra-Vehicular Activity (EVA), spacesuits are equipped with effective life support systems. However, if the spacesuit, and the equipment attached to it, is too bulky, astronauts' agility could be compromised, resulting in loss of both safety and scientific return of the exploration mission.

As a consequence, our focus was on overcoming these issues, so as to design a small unpressurised vehicle able to support mobility, maximising human agility as it has never been proposed before, but always considering safety as a main driver: for these reasons it was named NEA Robotic Friend (NRF). Its design is mission-oriented, since it is driven by a thorough study and planning of the whole mission scenario, which takes into account psychological aspects as well as ergonomics and visual comfort arguments. In other words, our work was intensively devoted to provide an outline of the whole mission, so that we also investigated exploration activities and selected the hypothetical related equipment. Maximising the use of spin-ins, we even proposed some solutions, culminating with an astronaut pouch for temporary sample storage, and a foam harpoon

B01. Artistic representation of Hayabusa-2 approaching asteroid 1999JU3.

B02. Astronaut performing an EVA using the Manned Manoeuvring Unit.

B03. Example of a Man-in-Can vehicle.
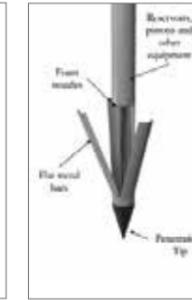
B04. Foam harpoon, with nomenclature.

for docking attempt.

UNDERSTANDING THE PROBLEM

The needs and targets that we were provided with by the customer are among the most recent and innovative research interests in today's space science – and beyond. For this reason, not only the requirements' generation reflects the task that we were assigned, but also the design issues that we confronted.

The high level requirement of the mission is to conceive a small, possibly non-pressurized, vehicle so as to allow close approach of NEA 1999JU$_3$. Since no particular constraints other than these were imposed, we operated all the remaining design decisions. A substantial state of the art research was certainly the first way to get acquainted with the subject, but it was not enough. Because a mission is indeed centred on the protagonist, i.e. Man in our case, we had the lucky chance to interview two astronauts, from whom we collected some of the most useful information, particularly about space ergonomics and psychology. On the other hand, to increase our technical knowledge and to validate some of our choices, we visited two facilities of the European Space Agency (ESA), an institution that could potentially become a partner of the project: at the European Astronaut Centre we learnt about the astronaut training, whilst at the European Space Research and Technology Centre we participated in a symposium on advanced space technologies for robotics and automation.

The multidisciplinary character of the project was never abandoned, and all the competences offered by each member of the group were exploited at best. For these reasons, emphasis was laid on the entire NEA proximity phase of the mission, and on the creation of a concept responding to the basic functional requirements rather than on in-depth technical choices, thus leaving a further technological analysis

for future research studies. In fact, it is our belief that in order to successfully design a vehicle, it is necessary to analyse the environment in which it will operate. Most of the design solutions that we came up with are derived from a careful study of the mission scenario, by means of a deep joint analysis of both the scientific output and the human needs. In the aim of designing surface mobility procedures and the related systems, three drivers were identified to make the necessary decisions, namely:

- safety of the astronauts;
- reliability of the system;
- simplicity of the system and of the operations.

EXPLORING THE OPPORTUNITIES

NEA 1999JU$_3$ will be visited by the Japanese robotic mission Hayabusa-2 (**B01**). The analyses carried out by this probe will be useful in investigating the origin of organic matter and water in the solar system. Besides, before our human mission planned for 2033, a robotic precursor will be sent to the target to perform further studies. A state of the art research provides us with important hints, for example: more sites on the same NEA are likely to be explored; thermal experiments have to be conducted to validate existing thermal models and/or put bases for new ones; surface and subsurface samples must be collected; traces of water or amino acids should be searched for. More importantly, asteroid's di-

B05. Foam harpoon approaching the asteroid's soil.

B06. Foam harpoon penetrating the asteroid's soil.

B07. Foam harpoon ejecting foam into the asteroid's soil.

B08. Experimental setup for the foam harpoon prototype.

B09. Ergonomic study 2

B10. Exploration activities with the aid of the MARS.

mensions are paramount to plan the activities: it is almost spherical, with an 870 m diameter and it is 980 m long. In the state of the art analysis we found that two different vehicle concepts have been proposed for NEA explo-

ration: the Manned Manoeuvring Unit (MMU) and the Man-in-Can. MMUs (**B02**) are anthropomorphic vehicles hosting the Portable Life and Support System (PLSS), as well as the propulsion and attitude control systems. They support astronauts during EVA, and were used only for a few times for maintenance operations on the International Space Station because they were reckoned too risky, but they have recently been reconsidered for NEA exploration. On the other hand, the Man-in-Can (**B03**) is a pressurized spacecraft conceived for ISS maintenance, and later repurposed for exploration activities. Starting from the analysis of pros and cons of these two vehicles, the NRF concept arose to overcome the limits of both, and to directly fulfil the specific requirements of an asteroid mission.

High-level trade-offs and decisions also involve docking techniques and exploration systems. Due to the uncertainty of the docking process–very lit-

tle is known about soil properties–the safety of the whole mission could be compromised. Therefore, we devised a harpoon whose feasibility would be tested on this NEA in view of future missions: as a start, we outlined and conducted experiments to measure the performance of a harpoon using foam after ground penetration (**B04, B05, B06, B07, B08**). As for the exploration equipment, we selected it from the literature, also trying to be confident about the on-going increase of technology readiness level: for instance, we preferred an ultrasonic drill over a more common rotary drill.

GENERATING A SOLUTION

The central role of the human being in such a mission prompted us to consider psychological aspects when designing the NRF: in effect, mission success is mostly dependent on astronauts' performance. The shape and dimensions of our vehicle are then proposed pursuing an ergonomic design

(**B09**, dimensions in cm): studying the concept of operations and the mobility procedures we deduced spacecraft dimensions, understood how to support movements by means of tethers and handholds, created a dual redundant moving platform that we named Mobility Aid Rototranslational System or MARS (**B10** and **B11**), and accounted for a cargo where to store samples and tools (**B12**). NRF design (**B13**) includes a platform and four poles that can be mounted just before the 8-days long NEA proximity period begins.

These poles:

- improve attitude control: in all, there are 24 thrusters, 12 in the basis and 12 in the poles;
- provide a valid source of diffuse illumination (**B14**);
- provide handholds for astronauts;
- provide an interface for mating with the mother ship;
- support the cargo module containing all the equipment.

This 'friendly manned interface' is a vehicle not only serving as shuttle between the mother ship and the asteroid (like the MMU), but also supporting all the scheduled activities once the destination is reached. In this configuration the two astronauts are always on-board; the NRF supports mobility and maximises agility removing bulky loads from around them (unlike both MMU and Man-in-Can). To increase safety, only one astronaut at a time performs the exploration activities, while the other provides assistance

B11. MARS in rotated configuration.

B12. Drill inside the cargo module.
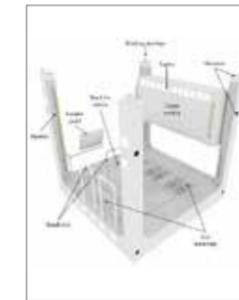
B13. NRF, with nomenclature.

B14. Illumination of the asteroid's surface.

B15. Tongs.

B16. Surface sample collection.

B17. Safe Sample Pouch.

B18. NRF travelling from the mother ship to the asteroid.

B19. NRF approaching the asteroid.

B20. Team B logo

and is always ready to steer the vehicle back to the mother ship in case of failure, as well as help his EVA-partner. Moreover, the NRF acts as a small laboratory to support the mission, since it can analyse scientific data in order to carry out specific operations such as *in-situ* spectroscopy and neutron detection, which require a real time analysis. Concerning tools, tongs (**B15**) and rakes/scoops (**B10**, **B11**, **B16**) are used for surface sample collection, and a pouch was designed to temporarily store samples (**B17**), whereas drills (**B12**) are for in-depth coring. In general, we tried to maximise the employment of spin-ins, i.e. terrestrial technology that could be modified to suit space applications.

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ReCoUAV

**INNOVATIVE HIGH DEPENDABLE AND RECONFIGURABLE
FLIGHT CONTROLLER FOR UNMANNED AERIAL VEHICLES**

ReCoUAV: Innovative High Dependable and Reconfigurable
Flight Controller for Unmanned Aerial Vehicles

11

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PROJECT DESCRIPTION

The purpose of this team project is the investigation of potential future applications of Unmanned Aerial Vehicles (UAVs) for civil purposes. The first task involves the analysis of the UAVs state of the art and the identification of the normative that regulates their flights: the standard procedures were identified by direct contact with mainly ENAC (the Italian policymaker for Commercial Aviation and Aeronautics). The request of higher mission complexity and systems re-configurability as well as the need of increased flight performances progressively require efficient onboard processing systems, and among the different electronic technologies for avionic applications the Field Programmable Gate Arrays (FPGAs) was studied as an effective solution for their flexibility and reconfiguration capabilities. The analysis of the control system took into account the presence of fault tolerant codes, accelerometers and different sensors in order to realize a completely autonomous and dependable flight control. The analysis of electric and thermal configurations of the propulsion system was done with the purpose to identify the best suitable solution following mission requirements. The second task concerns the research of possible stakeholders for this technology and the definition of preliminary designs according to given targets: the demand of the UAV technology for civil applications arises from the low manufacturing and operational costs of the systems, but thanks to its high degree of innovation a wide range research was carried out: as a result, some of the possible applications were identified and specific missions were selected. The targets of these missions were carefully evaluated and translated into detailed specifications for the design phase through regular group meetings. After this, the design phase was performed through an iterative procedure in order to integrate the different subsystems into a feasible solution in terms of technical requirements and costs competitiveness.

1. Hot spot identification with an IR camera

2. ADC Micro multispectral camera

3. Example of picture taken by a multispectral camera

U-Quad: Universal Quadrotor

project **11A**

TASK & SKILLS

Roberto Alicino

as aeronautical engineer, defined the main scenario and the preliminary design of the UAV.

Kevin Dietrich Dongue Dongue

as mechanical engineer, studied the main aspects and issues of the propulsion system and mechanical transmission.

Letterio Mondo

as electronic engineer he had a central role in the definition of the control system, based on a FPGA integrated circuit.

Gabriele Persichilli

determined the main stakeholders for the project, managed the relationships with them and selected the payload required to fulfill the mission requirements.

ABSTRACT

According to the US Department of Defense, a UAV can be described as: "A powered vehicle that does not carry a human operator, can be operated autonomously or remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload". They are use normally in Dull, Dirty and Dangerous missions, in which their usage can prevent humans from being hurt.

Even if, at the moment, UAVs are mainly used for military applications, during the last years the civil market for this new technology has increased, and it is expected to become more and more important in the next few years. In fact, there are a lot of missions in which a UAV can be used for civil purposes: search and rescue, firefighting detection and support and law enforcement are only some few examples of the field in which a UAV could be helpful. Regardless the category of the system, the core of the UAV technology resides in the control system, which can be based on very different type of processors: among them, a FPGA (Field Programmable Gate Array) was chosen, thanks to its ability to be reconfigurable according to the mission to be accomplished.

The objective of the project was the investigation of the possible application of the UAV technology for civil purposes and the preliminary design of a system based on a FPGA technology capable of fulfilling the requirements proposed by the different stakeholders.

In order to meet such objective, the strategy of the team was first to analyze the current state of the art of UAV for civil applications, identifying potential fields of use and the main stakeholders involved. The meetings and the exchange of information with them allowed us to better understand their needs and consequently to elaborate a conceptual and innovative solution able to satisfy several requirements. The result has been a highly reconfigurable platform, able to house different payloads in order to accomplish several different missions.
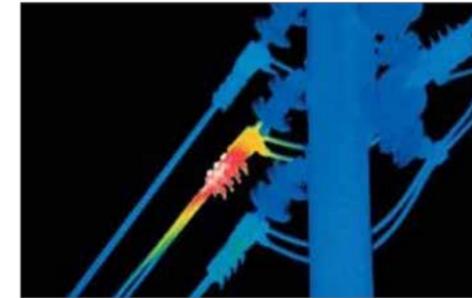
UNDERSTANDING THE PROBLEM

The first step needed to accomplish the objectives of the projects consisted in a wide market research, in order to better understand which were the most important issues related to this new technology. Soon, the team found that, at the moment, the principal obstacle to the diffusion of the UAVs in civil applications is due to particularly limiting criteria which need to be respected by the unmanned aircraft in order to achieve the required permit to fly by the national civil aviation authority. In fact, even if there are some attempts to develop common guidelines for the future regulations of the market, nowadays differences can still be found from state to state, such as the maximum service ceiling or the maximum distance allowed between the ground pilot and the vehicle.

In Italy, for example, the ENAC has recently released a preliminary regulations draft about UAV, in which are specified some of the prerequisites to be respected in order to receive a permit to fly for a particular civil application. A common factor among the different national regulations consists in an extreme attention to prevent or at least to reduce at minimum the possible damages caused by the UAV in case of partial or total failure. As a consequence of that, all regulations set restrictions about MTOW (maximum take-off weight), maximum AGL (above ground level) altitude and maximum distance from ground operators, airports and populated areas permitted. In addition, at the moment no UAV would be allowed to fly in non-segregated airspace (although some exceptions can be temporarily considered for scientific purposes), in order to avoid undesirable collisions with manned aircrafts: the reason lies in the fact that, today, there is no control system or algorithm that meets all the requirements established by national civil authorities (FAA in particular). Such a system should be able to react at least as a human pilot in the case of a possible collision, i.e. being capable of detecting in advance dangerous approaching aircraft (Sense) and performing a maneuver to prevent it (Avoid), all in a few moments. Therefore, even if it is possible and probable that regulations would become less restrictive within a few years, the whole team decided to carry on the project keeping in mind these considerations, in order to first conceptualize and then design a vehicle that may be market-ready in the very near future.

EXPLORING THE OPPORTUNITIES

Once understood the constraints to be respected, the team focused on finding applications compatible with them. Therefore, the intent of using the UAV as a platform for testing the behavior and performance of electronic devices at high altitude (one of the first application considered) was discarded, also because the feasibility study with re-

4. Example of flight plan setup

5. Example of aerial photogrammetry
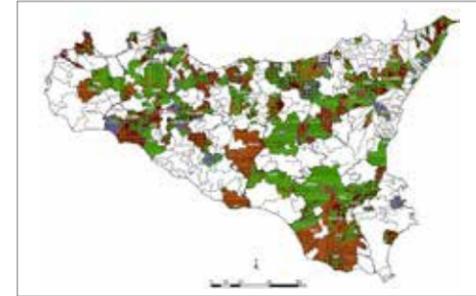
6. Sicily Operative Map of zones with fire risk

7. 3D CAD model of the quadrotor
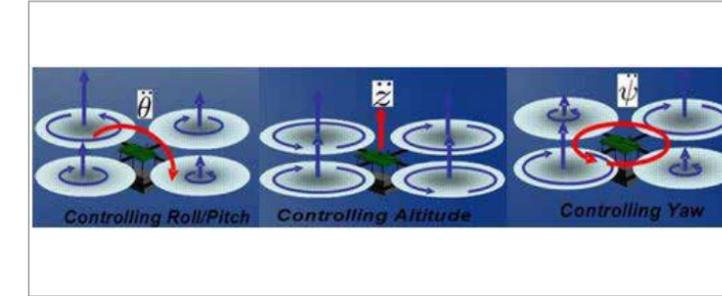
8. Quadrotor control

9. FPGA Virtex5 by Xilinx®

gards to the available resources gave a negative result. Thereafter analysis of low altitude application was performed, such as:
- Detection of hot spots in power lines and electrical power transformers
- Monitoring illegal dumping of waste and chemicals in waters and industrial zones
- Aerial photogrammetry
- Monitoring progress of civil engineer projects
- Cultural heritage monitoring

Among them, the identification of the Corpo Forestale dello Stato as a potential stakeholder for our project has risen a new point of study: in fact, it deals with fire and the extinction process. The possibility to innovate in this application stands in the introduction of UAVs usage in the post-fire monitoring. A comparative study between the currently used technology for this type of missions and the UAV has been performed. Additionally, the consideration of Corpo Forestale dello Stato as

potential stakeholder has significantly shifted the paradigm and has put into play the quadrotor as the best configuration to be employed.
Generating a solution

Considering the several aforementioned potential opportunities of UAV usage, it was clear that by choosing one specific mission the others will be generally excluded, since each mission has its own particular technical requirements and payload. In fact, except for the typology of UAV frame (fixed or rotating wing), which is obviously extremely binding for a specific mission, it was clear that the related payloads and sensors cannot be all mounted on one single UAV for space and weight reasons and also because an extremely performing motherboard able to manage and interact simultaneously them should be mounted on the UAV.
Since there would be no innovation in developing such a project, the team

decided to reframe the problem from its foundations, in particular focusing on the impossibility of the simultaneous presence of a lot of equipment onboard, which on the other hand would guarantee the versatility of our UAV. The solution to this problem was the concept of a "universal UAV frame" able to house various kinds of equipment depending on the specific mission on which the user can easily mount on and remove the required payloads and sensors to fulfill different tasks. In particular, a quadrotor configuration over a fixed wing one has been chosen, mainly because of:

- Easiness of use and control (movements result only thanks to the difference in thrust between the rotors)
- Hovering and VTOL (Vertical Take-Off and Landing) capability
- Reduced mechanical complexity
- Limitations imposed by regulations in terms of altitude and distance achievable would made useless a

fixed wing aircraft, more suitable for wide area coverage.

As a result, the remaining problem was the high performing motherboard needed to distinguish and manage the different payloads and sensors for each mission setup: such motherboards are available on the market, but usually their dimensions and cost are exaggerated for small UAVs.
Therefore, the team realized that such an extremely performing device was not necessary in this case, finding as the optimal solution the FPGA (Field Programmable Gate Array), a completely reprogrammable board, guaranteeing a high grade of reconfigurability of the UAV.
Finally, the choice of the propulsion system was performed: considering the aforementioned applications, an electrically driven propulsion, instead of an internal combustion one, revealed to be the most suitable solution for all of them. As matter of fact,

a UAV powered by an internal combustion engine would require a tank filled with gasoline which might create great damages in case of failure or crash of the UAV. Other advantages of the electric solution stands in the recharge of the primary source of energy which are the batteries and can be done quite easily and the fact of being eco-friendly. On the other hand, the main disadvantage consists in the maximum endurance achievable (generally less than 1 hour): however this aspect was not considered critical for the applications analyzed, because all of them usually require less time to be accomplished.
In conclusion, the team conceptualized a highly reconfigurable UAV able to perform several missions thanks to its unique characteristic of being extremely accessorizable with the required payloads and sensors, supported by a completely reprogrammable motherboard able to manage all the onboard equipments.

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1. Control system architecture

2. M190 rendering

Versatile UAS: overview and preliminary design

project 11B

TASK & SKILLS

Matteo Di Luca after identifying possible stakeholders and their needs, defined UAS requirements at system level; he made the multidisciplinary design of the UAV platforms, from the aerodynamics to the systems integration through the CAD model, and coordinated the results of the other team members during the design phase.

Cristian Rostiti analyzed the sensors and studied the pros and cons of different technologies available. He created a preliminary design of the control system focusing on versatility, re-configurability and failures avoidance. He also gained information about the Italian and European regulations and possible developments in the short term.

Marco Arnoletti analyzed the state of the art of Unmanned Aerial Vehicles and met stakeholders; he analyzed possible alternatives for the propulsion system of the final solutions and identified possible harsh environmental operational conditions for the UAV.

Qianwen Gao provided the analysis of the control system, assessed possible data transmission architectures and designed the assisting system for stable control; she also investigated the payload requirements and their possible physical implementation on the model.

ABSTRACT

Unmanned Aerial Systems (UASs) have been developed for Military applications and until recently this was their only purpose. UASs are complex systems and their industry includes a broad supply chain providing a large range of enabling technologies. The project deals with future civil applications of the system and aims at exploiting the huge potential behind it. They can contribute to boost industrial competitiveness, promote entrepreneurship and create new businesses in order to generate growth and jobs. The team deeply studied the UASs theoretical framework, from the regulations to the state of the art. Through

a series of meetings with project tutors, external institutions and possible stakeholders the group identified appealing applications for UASs. Stakeholders' requirements were carefully pinpointed and the team was ready to assess competitive design solutions. The challenge was to provide a reliable architecture with low manufacturing costs. Two UAS versatile concepts were provided and assessed from both technical and economic point of views with special attention paid to reliability and failure tolerance.

A first UAS performs sea surveillance: every day, Guardia Costiera performs fishing vessels monitoring activities and migratory fluxes control at sea over a wide area South East of Lampedusa island (Southern Italy). A long range UAS was designed in order to meet the requirements identified together with Guardia Costiera and to maximize the patrolled area.

A second UAS was designed for environmental monitoring in collaboration with CFVA. Together with Sardinia's local institutions, a concept that performs environmental monitoring at
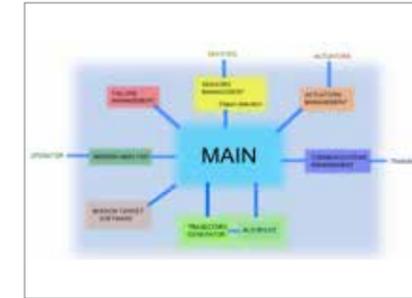
high resolution with low operational costs was defined. This UAS platform was also adapted for a third scenario in collaboration with Valle d'Aosta region (Northern Italy) in order to perform several dedicated environmental monitoring missions with low operational costs.

From a regulatory point of view, UAS potential has been limited by flight authorisations. With its contribution in underlining the potential gain behind UAS applications for civil purposes, the project also contributed to motivate policymakers to change the current regulations.

UNDERSTANDING THE PROBLEM

UAVs were not used for civil applications until recently. The team had to identify feasible civil applications that could improve from a technical and economic point of view current activities of potential stakeholders and investigate their interest and willingness to exploit the change. The outcome of

several meetings with potential stakeholders was an intention to adopt our solutions contingent upon particular features of the final product. In order to answer their needs the UAS had to be reliable and multiple failures tolerant; furthermore, where a manned system was already used, the UAS had to guarantee equal or better performance but at lower costs. Our multidisciplinary team had the potential to design the required new concepts. UASs are very complex, they require a wide range of skills and expertise and our different backgrounds were a powerful source of creative ideas for innovative solutions.

EXPLORING THE OPPORTUNITIES

Stakeholders asked for very demanding solutions from both a technical and an economic point of view and satellites represent an alternative technology that could respond to their needs. However, costs associated to satellites are higher than UASs that represent

an optimum with their high performance at low operational costs. The challenge of the project was to help demonstrating UASs potential providing a robust architecture with respect to failures. Italian and European UAS markets are underdeveloped in comparison to US or Israeli markets and this is mainly due to the lack of a clear regulation. This was the situation in 2012, at the beginning of our project and only recently European Union Member Countries deliberated to establish, around 2016, a common regulation for medium size UAVs [1]. Thus, UAV European industry is in its early years and there is a lack of UAS solutions for plenty of applications. Furthermore, for several civil applications US and Israeli solutions are obtained adapting machines originally developed for military purposes with important drawbacks on the system's final cost.

Focusing on performance, versatility, reliability and costs our team designed from scratch completely new solutions. A preliminary project of a complex system has to be subdivided in several activities in order to reduce its complexity. However, the difficulty consists in correctly organizing those tasks and concatenates them in a logical way, minimizing the impact of subtasks' delays on the final solution [2]. In this sense, we faced the challenge to manage a complex project not only for the several technical domains involved but also for the economics and business strategy aspects that we considered.

3. UAS schema for the communication system
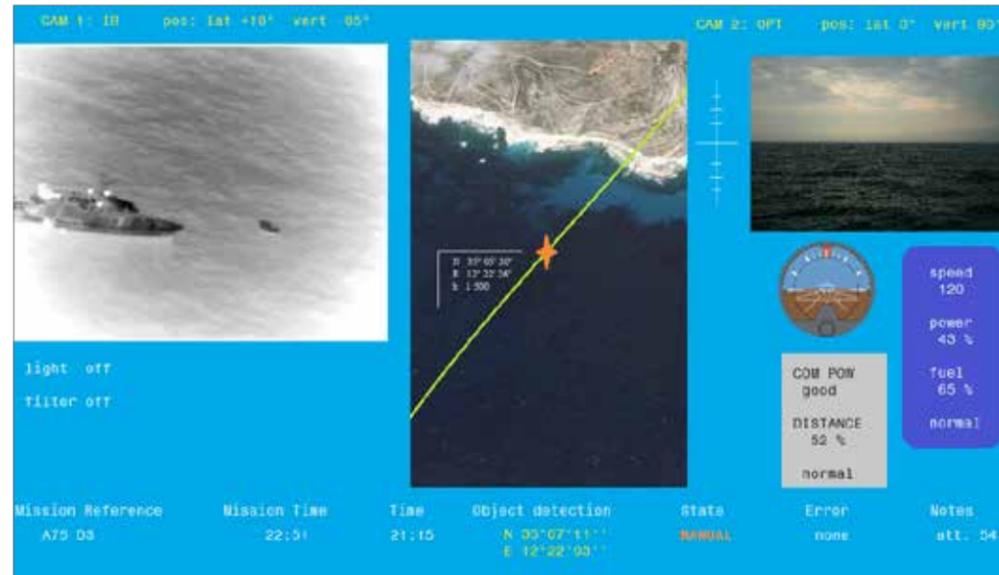
4. Concept for the Ground Station monitor

5. Manual and automatic modes for UAV control.

GENERATING A SOLUTION

Two UAS versatile concepts were provided and assessed from both technical and economic point of views with special attention paid to reliability and failure tolerance (control system architecture is given Figure 1).

The first designed UAS solution, the M180 (Figure 2), provides sea surveillance and is able to replace boats and aircrafts from Guardia Costiera to perform fishing vessels and migratory fluxes monitoring in Southern Italy. In order to reduce UAS interference with Commercial Aircraft traffic, the UAV was designed to operate at relatively low altitude (3.5 km): in this condition the UAV reduces its observed area

and a long range was required to ensure a wide overall monitored area. With the low altitude requirement, Infra-Red camera was the best solution with respect to Synthetic Aperture Radar currently on board of military surveillance UAS. The system is designed for boats and objects detection while a satellite communication system allows for live streaming of video images to the ground station (Figure 3 and Figure 4) and thus direct manual control when needed (Figure 5). An expensive satellite communication system was the only possible solution to meet Guardia Costiera's requirement of live video streaming. Similar to a glider, the M180 has a high aerodynamic ef-

ficiency, lowering the amount of fuel required for a long range mission and consequently structural components' mass which is required to overwhelm loads during the flight. M180 is able to monitor in 12 hours a 60 km x 60 km square area almost in every environmental condition during day and night time over the whole year. Its control system shows several redundancies such as an object avoidance subsystem dedicated especially to avoid bird strikes and fixed obstacles. Particular attention was paid to the propulsion system, which was shown to be a major cause of system loss. A combustion engine provides the required reliability and in case of failure on solid ground

the M180 would glide landing without any major consequences; for an emergency landing on sea, a particular system with airbags was conceptualized in order to insure the buoyancy.

The aerial vehicle is versatile with its capability to perform several activities with some minor changes: an example could be the National electric grid monitoring or the environmental monitoring on wide sea area. Apart from its failure tolerant control system architecture, M180 performs activities at lower costs than existing solutions and with wider monitored area with respect to conventional solutions (boats and helicopters). This high degree of innovation is confirmed by the recent decision of the Italian government to launch the "Mare Nostrum" project that aims to improve the sea surveillance also through the use of UAV systems.

A second UAS, the M65, was designed for environmental monitoring in collaboration with CFVA. Together with Sardinia's local institutions, a concept that performs environmental monitoring at high resolution with low operational costs was defined. M65 is able to monitor a 36 km x 36 km square area almost in every environmental condition during day and night time over the year. In this case a direct streaming of video images to the ground station was not a requirement and a radio communication system was used. A higher degree of freedom in the subsystems design (model
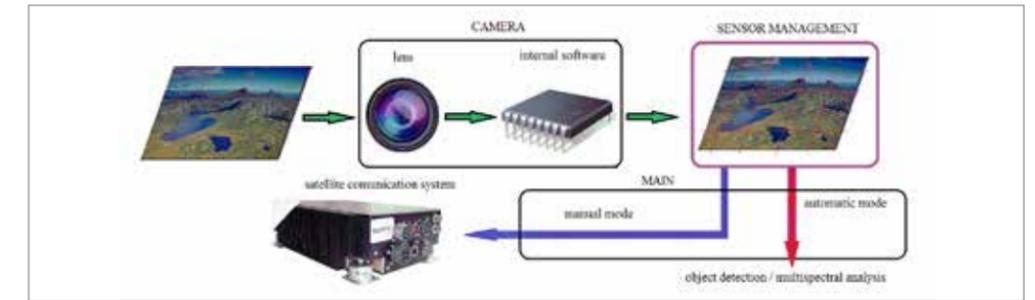
frame, engine and fuel tank system) was possible and also in this case a CAD model was provided together with a study of components installation inside the frame and a structural analysis of major components. The M65 model was also adapted for a third scenario in collaboration with Valle d'Aosta region (Northern Italy) in order to perform several dedicated environmental monitoring missions. After several meetings with local institutions (mainly ARPA), a mission was defined and the model had to detect and study the air temperature vertical profile over the atmosphere and the dedicated instrumentation was defined. M65 is innovative considering its purposes and the high flexibility of possible payloads. Furthermore, with its failure tolerant control system architecture and the object avoidance subsystem, M65 provides great reliability at lower costs with respect to traditional systems.

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[2] Reg Austin "Unmanned Aircraft Systems - UAVs design, development and deployment", Wiley Publication (2010)

ADDITIONAL MATERIAL

[3] Link to an article of an important Italian journal about the "Mare Nostrum" project delivered by the Italian government after the recent tragedy in Lampedusa island: *http://www.lastampa.it/2013/10/14/italia/cronache/sbarchi-al-via-la-missione-del-governo-arrivano-i-droni-per-evitare-le-tragedie-wJ1d-br32vmLgNT02mtyFjl/pagina.html*

Colorado

**COMMUNITY-BASED POLICIES FOR NATURAL RESOURCE
SUSTAINABLE DEVELOPMENT**

Colorado
Community-based policies for natural resource sustainable development

12

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PROJECT DESCRIPTION

The project compare problems, approaches and solutions applied to   the sustainable planning and management of natural resources in two distinct geographical landscapes: the 5 Terre (marine environment) and the Valle Varaita (alpine region). The final aim is to develop as far as possible innovative policies in order to manage local resources that trying to solve the problems related to those particular lands, showing how the land itself characterizes the whole process of decision making.

These regions are characterized by a highly diverse orographic and hydro-geological systems, strong biodiversity, and intense land use by different and competing stakeholder communities. The Project will focus primarily on the problem of forest and water management, considered under different perspectives: ecosystem and biodiversity preservation, sustainable economic exploitation, and natural risk management.

The work methodology will be multidisciplinary. The observed natural resources systems has been investigated for what concerns:

1. the characterization of the multiple planning and management objectives reflecting the different stakeholders' communities that impact the system;
2. the modeling of the system dynamics, for the purpose of simulation and optimization to inform and support decision-making;
3. the role of local communities in the participative definition of sustainable resource exploitation policies;
4. the role of ICT as an enabler of better decision-making, also with a reference to the emerging paradigm of social networking and crowdsourcing, as potential tools for improving the participation of stakeholders in a co-deciding process;
5. the role of Geographic Information Systems, especially in the open source domain, as a means for mapping the territory and its salient features, collecting and integrating relevant data, and supporting the communication of the anticipated effects of planning and management actions to a broad audience;
6. the role of emerging Participatory GIS (PGIS) in enhancing spatial information management and planning.
7. the role of end user's mobile devices as a complement to traditional sensing technologies (human sensor networks, remote meters)

The project should have relied on a strong collaboration with the Faculty of Geography and Environmental Sciences of the University of Colorado Denver, which specializes, among other things, on the research of development policies for the sustainable use of natural resources, but the plan changed during the two years and this collaboration failed. A parallel work on field was conducted in both the Italian regions exhibiting comparable natural resources management scenarios.

project **12A**

5 Terre Smart Start

TASK & SKILLS

Henrique Dadalto Sahao, team controller, managed contacts with the external institutions of Colorado. He also worked on the concept of "smart community", finding international successful experiences.

Martina Draghi and **Maria Ferrara** worked together on the project business plan and on the elaboration of the application contents. Concerning external contacts, Martina managed relations with suppliers and dealt with the economical analysis, while Maria was in charge of managing the communication with local institutions in Cinque Terre and dealt with social needs analysis.

Fjolla Iljazi worked on tools analysis and dealt with the technical development of the smartphone application.

Guido Lorenzi was in charge of the promotion of the project to the municipality of Turin, exploring alternatives for the replication of the project.

Lai Lu, focused on the research of the existing tools used for population involvement, evaluating and comparing alternatives in Henrique's case studies.

Elena Richermo joined Martina and Maria in business plan development, focusing on geological aspects. She also worked on possible alternatives for the monitoring of the paths. Before dividing the tasks, the whole team worked together in understanding the problem and defining the main objectives of the project.

ABSTRACT

The project has the aim of developing policies and strategies to involve the population in the management of the natural resources of their own territory. In particular, the efforts of the team are directed towards communities where nature itself is the primary economic good. The analyzed case study is the Italian area of the *Cinque Terre* (SP), whose villages and natural resources were heavily damaged by the disruptive flood in October 2011, revealing the ineffectiveness of the previous management strategies. The project consists in a network of smart tools, through which a system of policies is able to involve the whole community (residents and tour-

ists). All these actions should contribute to favour the awareness and the involvement of the population towards the creation of a smart community. Policies are put into effect by three interrelated programs, each of them addressed to a specific class of stakeholders, aiming to make people collaborate in solving their main critical problems. These problems are related to the preservation of natural resources (e.g., paths' monitoring) and they emerged from the community itself through appropriate surveys proposed by the team. In one of the three programs, called *"Active path"*, the team developed a smartphone application able to involve and exploit tourists in monitoring the trails, through a rewarding system which can promote, at the same time, local products. The whole system was designed with a special concern to its real socio-economic feasibility: local institutions and technical suppliers were contacted, a market analysis and a marketing plan were done and a complete business plan was proposed, attesting the self-sustainability of the proposed solutions within 3 years since the kick-off. The project was submitted to the announcement *"Smart cities and communities"* promoted by the Italian Ministry for University and Research and got totally financed. The project team is still working on the executive design, in collaboration with the Municipality of Vernazza and the NPOs *SaveVernazza* and *Vernazza Futura*, in order to realize the project within summer 2015.
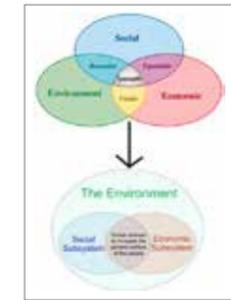
1. The two visions of sustainability
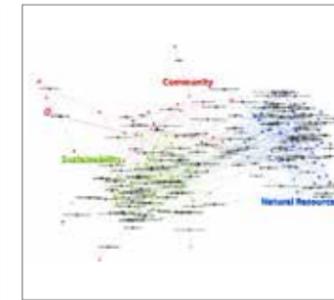
2. Project keywords analysis processed by the software Gephi

3. State of the roads in Cinque Terre one year after the flood. (Corniglia, September 26th, 2012. Author: Martina Draghi)

4. View of villages and terraces in Cinque Terre. (Vernazza, September 7th, 2013. Author: Lai Lu)

5. Beginning of a path with a view on Vernazza. A totem will be installed here. (Vernazza, September 8th, 2013. Author: Lai Lu)

UNDERSTANDING THE PROBLEM

At the beginning of the two-years designing journey, team A was appointed to focus on the social aspects of the complex problem concerning how to design good policies to involve communities in the sustainable management of their own natural resources, in such a way that both the territory and its community could get some advantages. During the early stages, in order to better clarify the problem framework, the team examined in depth two key concepts: *sustainability* and *community*, trying to understand their reciprocal relationships.

The recent awareness about the limits of world resources has led the global community to start thinking about the concept of sustainability, with a specific concern on the necessity of a change of the present growth development paradigm towards a more sustainable one.

The team explored the evolution of the sustainability concept in the last thirty years, starting from the first definition that involved three pillars: the economic, the social and the environmental one. These three aspects had the same importance in the sustainability concept. Then, further bibliographic studies led the team to think about sustainability in a different way: the environmental sustainability must have the highest priority. In fact, if the endurance capacity of the environment decreases, both the common good delivered by the social system and the output of the economic system decrease. It is thus clear that natural resources are also economic and social resources: they are the foundations of human life at all levels and their good and sustainable management is required to ensure a proper quality of life for all the world population.

A deeper analysis of international experiences showed that, the shrinkage of economic resources leads to the worsening in the safeguard and management of natural resources. The

involvement of the community could successfully compensate these difficulties, strengthening the bond between individuals and, thus, producing a benefit in social terms.

EXPLORING THE OPPORTUNITIES

The need to preserve the environmental goods without compromising the well-being of the society led us to consider the concept of Smart Community suitable for the purposes of the project. Focusing our attention on the Italian case study of the Cinque Terre, we performed a market analysis using different questionnaires; in particular, we handed out two different types of surveys. The first one was addressed to both the resident population and the resident tourists. The second one, instead, was an online questionnaire sent using social networks to a sample composed by people of different ages and regions, who represent the potential tourists for the area. In this way we discovered the real needs of

6. Exploring paths: sensible points to be monitored. (Corniglia, September 8th, 2013. Author: Elena Richermo)
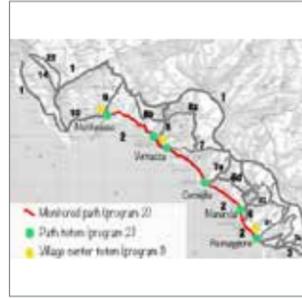
7. Map of paths chosen by the team for the monitoring program and totem location.

8. Concept scheme of the global system designed by the team.
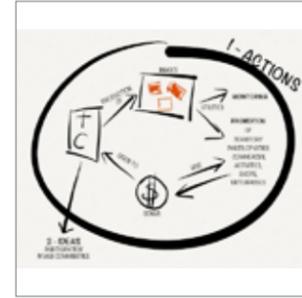
9. Actions and benefits of programs 1 and 2.
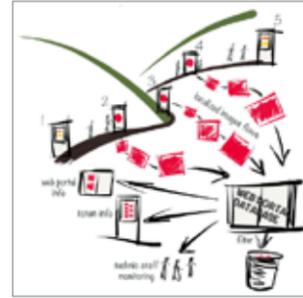
10. Actions and benefits of programs 1 and 2.
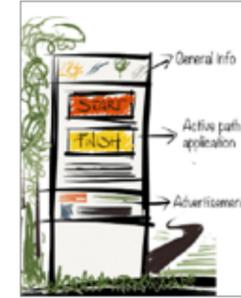
11. Sketch of totem user interface.
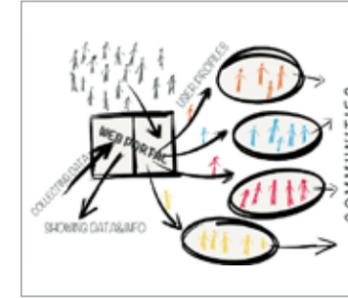
12. Visual concept of the "Keep calm and participate" program.

13. Smartphone app: login page.
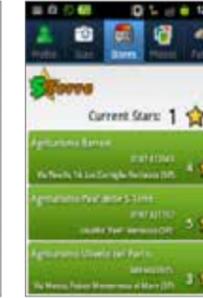
14. Smartphone app: list of local agricultural business.
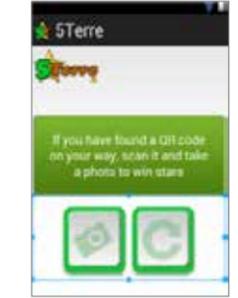
15. Smartphone app: photo upload.
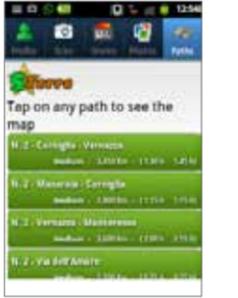
16. Smartphone app: list of the paths.

both the local population and the tourists. One of the main problems which emerged from the analysis concerned the monitoring of the territory, and, in this particular case, of the trails, because they represent a network which connects the different communities of the Cinque Terre. At the same time, the population has to be directly involved in the monitoring activity in order to feel as an operating part of the community. Starting from this assumption we excluded the possibility of installation of a network of sensors which could control the state of the slopes. In fact, in this case people would be completely passive. Therefore, in order to make them active, we have proposed three alternatives: the local responsibility system, the totem system and the active tourism.

The first one provides that the control of the sensitive areas is carried out by local producers, who would acquire more visibility for their products through the advertisements along the paths. The second one consists in the installation of multi-functional totems in strategic places, while the active tourism would favour a low-season volunteering to take charge of the environmental needs.

To find the best solution, the team carried out a multi-criteria decision analysis using the weighted sum method. At the end, the idea of the totem system has reached the highest total performance value, especially because it directly involves the population in the monitoring of the paths.

GENERATING THE SOLUTION

The designed community-based policies are expressed through three inter-related programs.

The first program is named *"Cinque Terre and memory at hand"* (program 1). Using multimedia interactive totems installed in the center of villages, this system is oriented to guarantee to the community useful information in real time, to give a space for the promotion of local firms and products and to show to the users, through some simple questions, the impact on territory of their own life styles, recalling images of recent negative events.

The second program, *"Active Path"* (program 2), aims at involving the tourists in the monitoring of some of the most popular paths, encouraged by a rewarding system (free tastings), which also works as promotion of the local farms. Therefore the team created a smartphone application, through which the users of the trails will take photos in significant and delicate points to testify the state of the paths. These images will be sent to a control center and used to plan the interventions to perform. Moreover, the app supports tourists, driving them along the paths through a complete list of maps of the hiking paths .Then, even in case of unavailability of inter-

net connection, it allows tourists to check the location of the businesses participating to the program, discovering the tastings they offer. Eventually, the users can have access to the image gallery where the most recent pictures are posted. Interactive totems at the extremities of the paths allow tourists' registration to the program. The third program, *"Keep calm and participate" (program 3)*, is the completion of the previous initiatives and deals with the creation of a web portal with a double function: exchanging data with both the totems and the application and, simultaneously, creating a platform through which the citizens can group themselves in web communities, on the basis of similar profiles. The aim of web communities is the crowdsourcing for a sustainable future of the territory. Different forms of "social volunteering" could be generated from these web communities, as experienced in the previously mentioned case-studies. This project is in-

novative in terms of relations it creates between technologies and communities: a network of smart tools has been generated by selecting the best communicative and interactive technologies, integrating and specifying them to fulfill different needs. The system framework may be replicated in various Italian and international contexts: the last part of the project, indeed, explores possibilities concerning replications in territories where a smart and sustainable tourism could improve the quality of the environment. Its extension to other realities is also fostered by the results coming from the feasibility analysis. The latter highlighted that the network of smart tools will be self-sustainable in just three years from the launch of the project. As far as the initial project cost is concerned, it has been estimated around 195.000 €. It will be totally financed by MIUR and it includes material (mainly purchase and maintenance of the totems), programming and promotion.

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Co-ME:
Community Mountain Energy

1. The location of the area. Author: Constantin Sandu

TASK & SKILLS

Vittoria Camisassi [architect] handled with other mates the research of the particular context where the team carried on the project and supported the work over district heating with some technical aspects related to house heating system. Participated in Developing the strategy, in the community involvement stage and in the analysis of the results.

Sara Scaramellini [energy engineer] evaluated the possibility to exploit the biomass source available and in particular the chances offered by a co-generative power plant fueled by biomass. The focus was on the thermal energy produced and its exploitation, according to the peculiarities of the application under study.

Alice Berardo [environmental engineer] found the possible stakeholders and got in touch with them with other teammates. Obtained more information about district heating costs and evaluated possible solutions from a social and environmental point of view. Asked directly the survey questions to involved people and analyzed at the end the results.

Constantin Sandu [regional planner] carried out demographic analysis of the area and designed a possible track of the district heating pipeline and evaluated the social along with the environmental impact.

Luca Vanoli [management engineer, team controller] performed the preliminary feasibility analysis in order to highlight the potential weak points of a district heating plant, develop the survey for the community involvement suggesting to integrate it with common marketing techniques. He helped draw the final report for the stakeholders with the overall results.

Mengying Wu [electronic engineer] examined the state of the art of decision making process from a theoretical point of view.

Luisa Villani [civil engineer] participated in meetings with local administrators to evaluate a successful strategy and technical data with the aim to increase community involvement and avoid problems related to the construction of new heating district in Frassino.

ABSTRACT

The CO-ME project aims to develop an approachable method for involving people in decision making about natural resources management.

To reach its goal the team has focused on energy management in small communities. In particular we concentrated on a mountain village in the Valle Varaita (CN, Italy), as an example to develop a feasibility study for natural resources management, taking into consideration decisional strategies made in the contest of local community. This case study is an ideal opportunity to better exploit the vast amount of natural resources in the perspective of a sustainable development of the territory.

The project started with a search for a case study in Italy that could be suitable for the team's objectives. After getting in touch with the Alpine Space Program, we learnt that there are lots of policies to preserve, improve and develop the alpine valleys and Valle Varaita was already inserted in this program. The team met Andrea Dematteis, university department pro-

fessor and also President of a local company named Azienda Naturale Gestalp. The Valle Varaita resulted to be a leader in terms of efforts for energy and food production. Being built in Frassino, there is a new cogeneration power plant, for both electricity and thermal energy, fueled by local biomass (woods scraps) as well as a wild meat factory. While electricity will be sent to the national network the thermal energy still needs a distribution project.

With reference to the new opportunities available to the village of Frassino, this project could be seen as a further experiment for the valley. The team set a decision making process which assembled all the stakeholders and enhanced the relevant role which should be played by local inhabitants. In particular, the marketing technique of segmentation was used to get the best feedback from the community, showing that a good communication between citizens, administration and companies, could be successful in terms of peoples' willingness and global benefit. In conclusion, the final intention of the team would be to make suggestions (as a result of this research) for future projects related to a sustainable management of natural resources in which a decision making process should be adopted and transformed in relation to a specific context.
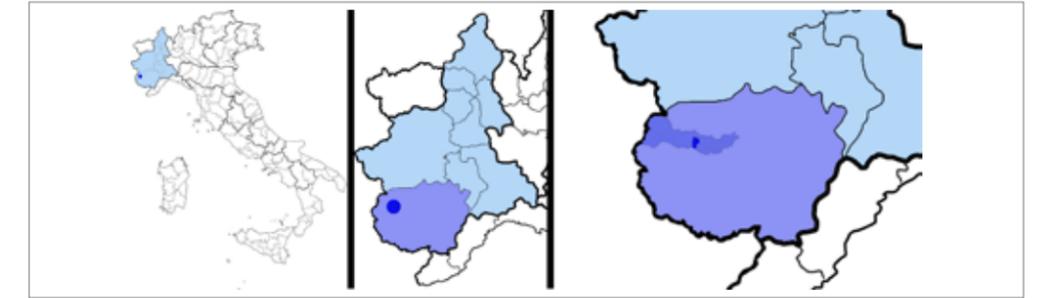
UNDERSTANDING THE PROBLEM

CO-ME is a project designed to develop a community decision making process method in order to evaluate problems and offer the best solution for the community itself. This method has to take into account all socio-economic and environmental aspects of the place in which the project is set and includes how different ways of interaction with local people can influence the final solution. The team decided to use as a study area the Valle Varaita (Cuneo, Piedmont), because even if it has a large range of natural

renewable resources exploitable for socio-economic development, it is experiencing shrinkage problems.

The Valle Varaita is characterized by an alpine landscape, lakes, ancient villages, ski slopes and tasty agricultural products which makes it a popular tourist destination during summer months. However it is subjected to a complex steady depopulation that continues to the present day due to a reduction of employment opportunities and a lack of accessibility. For example, from 1981 to 2011 there has been a reduction of -5.1% in the overall population and a rise of 4.1% in the over 65's.

In order to tackle these problems, we established a synergy with the *CE.RI. GE.FAS* (Centro Ricerca Gestione Fauna Selvatica), a university organization, which is also focusing on researching socio economic models that evolve sustainable development. This organization operates in the villages of Frassino and Sampeyre, in the middle of

2. 27 Ottobre 2013. Part of the team which makes the interviews. Author: Vittoria Camisassi

3. 27 Ottobre 2013. The biomass plant that is being built in the area of Frassino. Author: Vittoria Camisassi
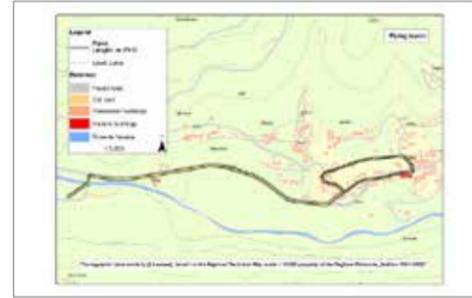
4. The layout of the pipes for the district heating system. Author: Constantin Sandu

5. The location and the diverse type of users that emerge after the interview. Author: Constantin Sandu

6. Part of the team with the mayor of Frassino Bernardino Matteodo. Author: Vittoria Camisassi

the valley.   A result of the findings of this organization was the creation of the "Azienda Naturale Gestalp", which has started the construction of a co-generation power plant, for both, electricity and thermal energy by using local biomass (woods scraps). While electricity will be sent to the national power network, the excessive thermal energy still needs a viable utilization project, which incorporates the local people needs, economic advantages as well as environmental preservation.

EXPLORING THE OPPORTUNITIES
Once the assignment had been chosen, the team decided to face it with a community decision making process. The first step was a meeting with Cerigefas, where it emerged that for the problem concerning thermal energy management there were some solutions which could be taken into account: the creation of heated greenhouses for agriculture production (good for this area with its climate limitations), wood industrialization proc-

ess, in particular the wood fibre, and the construction of a district heating for Frassino.
After team's brain storming sessions and the evaluation of all the ideas with Dematteis (Cerigefas president) it was highlighted that district heating could be the best solution also taking into account the problem of depopulation in winter.
This scheme seemed to be the favored one, because it would benefit the community with a better heating system and moreover the fossil energy consumption would be reduced. From an economic point of view the profits would be shared amongst the community, the administration and the company working on it (Azienda Naturale Gestalp).
The team got in touch with a company which constructs district heating systems, in order to have more information about feasibility and costs keeping in mind the local climate condition (mountain valley, lower temperatures).

This step was fundamental because it allowed the team to elaborate the Gestalp's initial investment, stressing the importance to have enough consumers.
After choosing how to possibly manage thermal energy, the next step of the process was to involve the community in order to guarantee its benefit, not only by the chosen solution, but also by directly query the local population on its needs, opinions and interests. An appropriate way to communicate with citizens had to be well studied before, exploring the social context in which the valley is set.
The team decided to base its strategy on the *market segmentation* and so examined different possibilities and methods of subdivision and communication taking into account all the variables that play a role in this social context. The most suitable combination which emerged was to subdivide citizens into groups by age and social-economic status in order to choose the

best method to convoke people (internet and websites, surveys and meetings, house to house visits). Working directly on site allowed CO-ME team to better understand the local reality and slightly change the strategy (from groups to individuals).

GENERATING A SOLUTION
Bearing in mind the needs pointed out in the previous section, the team's strategy was devised in order to get the best solution. We finally approached the users individually by home interviews in order to directly record worries and queries related to their personal needs, as well as better explain the proposal. First of all, taking into consideration the cautious mountain attitude, the Frassino's Mayor sent a letter to possible users (around 30), to inform them of the team's presence in the village.
The survey was divided into three main parts. The first was an introduction about the citizen her/himself and her/his opinion in order to define the group identity arose from segmentation and to use consequently the specific approach. The second section was about their actual use of domestic heating to get the state of art of heating management and sources used. The last one was related to the heating district with the associated individual costs.
Finally, 22 out of the 26 house holders (who represent 21 building units) answered to the survey.
The results highlighted that almost
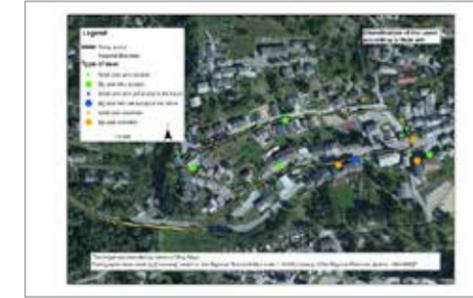
everyone really appreciated this decision making method, based on the direct involvement of users from the beginning. Unexpectedly, they showed a real interest about the possibility of the district heating construction and almost 60% are interested in a possible connection to the new heating system, others (11%) could do it in the future. However a relevant amount of worries about management and cost-effectiveness of this system were recorded, underling the importance to communicate with final users and develop the project based upon their necessity.
From the feasibility study the team proposed three scenarios: the first is the pessimistic one, in which only the 60% would make the connection; the second considers that in the future (in three years) also the other 11% would; the third, most optimistic, where both would do the connection from the beginning. The economic-financial analysis demonstrated that all the scenarios may bring benefit to the company it-

self, but especially to the binomial Gestalp-citizens, demonstrating that it is worth to carry on a more profound study with professionals.
The district heating represents a very good opportunity for the Municipality of Frassino to become a competitive area (due to the potential of future services and low cost energy) in order to develop new activities and counter act the problem of depopulation. Of course the direct involvement of citizens played a fundamental role in the decision making, stressing that successful policies may arise only if there is a synergy between the involved stakeholders.

BBC-I

Banking Business
Customer Internationalization

BANKING BUSINESS CUSTOMER INTERNATIONALIZATION

BBC-I:
Banking Business Customer Internationalization

13

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PROJECT DESCRIPTION

Most Small and Medium Enterprises (i.e., SMEs) hardly dare to extend their business abroad alone. In Italy only 7% of SMEs operators are active in the international business. They often do not have a dedicated export department, resources to analyze in depth the market, they do not speak the language and they are not fully independent in evaluating potential partners.

However, a good chance for Italian small companies to overcome the economical crisis started in 2008 and to ensure their future growth and development could be to concentrate their efforts and resources on expanding their business abroad. To achieve good results in their export activities SMEs have to penetrate foreign markets rapidly, at low cost and by maintaining control on core technologies and products. At the same time they are forced to adapt product features to requirements and preferences of the local customers. Thereby it is possible to identify several obstacles which companies have to face before affirming their position abroad. Entrepreneurs have to find and evaluate potential partners, overcome differences in business cultures which may include language limitations and a lack of knowledge about foreign accounting rules in terms of tax lows, banking legislation and so on.

Traditional services to support SMEs in their market expansion and internationalization decisions still continue to exist but their value and ability to satisfy companies' needs is turning to be weaker. To give to SMEs new opportunities and create a global market, innovative services are needed. To this aim, in the last years a great number of agencies, banks and government bodies enlarge the scope of its support activities and variety of provided services.

UniCredit is currently active in supporting SMEs to trade abroad by means of an Internet—based environment that allow small companies to access a variety of services to facilitate their business extension abroad, also leveraging on the wide customer relationship franchise of UniCredit. The aim of the project is to propose new ideas to effectively and efficiently support SME companies in easily extending their business abroad to:

Provide a wide range of innovative services, covering at 360 degrees all the needs of import/export of small companies (e.g., services for import-export transition, integration with banking services, insurance assistance).

Define innovative interaction models to support companies to engage with a foreign counterpart (e.g., new techniques for matching and evaluating companies).

Analyze customizations for specific application domains (e.g., food and vine, fashion and clothing, interior design, automation and mechanical).

project **13A**

Online Tool for SMEs Internationalization Support

TASK & SKILLS

Stefano Chianese: Explored the opportunities of existing social networks and studied their integration within the proposed project solution. He designed the main frame of the final solution and analyzed solution compliance with stakeholders' needs.

Chiara Ferrero Merlino: team controller. Worked on the assessment methodology and on the creation of a ranking system for a better understanding of customers' needs. She analyzed stakeholders' requirements, studied the economic sustainability and designed the architecture of the solution.

Giuseppe Scapeccia: Systematization of benchmarking results – development of broad criteria to analyze web-sites, alongside with their in-depth classification. He analyzed controversial aspects of the solution making them converge towards a valuable product for stakeholders.

Michele Spagnuolo: Always updated on recent online tools that helped the team to optimize project workflow and meet important deadlines. Statistical analysis of benchmarked web-sites, along with all types of visual materials – team logotype, charts, and tables. He supported the architectural study of the portal.

Irina Zolotukhina: Allowed to enlarge the scope of benchmarking by introducing Russian internationalization web-portals into it. Integration of the Benchmark results into the needs assessment algorithm. She verified the consistency between busi¬ness and technical aspects of solutions, helping in better shaping the different alternatives.

ABSTRACT

The past 30 years gave birth to a new phase of globalization. National economies and domestic markets intertwined intimately with international ones through trade, foreign direct investments and short-term flows of capital, workers and technology. Companies have been overcoming their geographical constraints and exploring global opportunities, also with the political support: establishment of trade and economic unions; free zones; common markets; trade agreements; etc. The internationalization process requires deep pocket, expertise and knowledge of foreign markets, which often represent a major challenge –or even a barrier– for small and medium enterprises (SMEs). Unfortunately, Italian SMEs are no exception. They often lack dedicated export departments or resources to analyze the foreign market in depth; they have difficulties with foreign languages and they are not fully independent in evaluating potential partners.

However, a large number of institutions are ready to provide SMEs with services aiming at supporting their expansion decisions and offering a broad knowledge to overcome the existing barriers. Government bodies and Chamber of Commerce have traditionally backed enterprises in their internationalization, while the rapid ICT development and the massive penetration of the internet are setting major challenges in meeting companies' needs. Technologies are becoming strong tools to support SMEs' internationalization and the integration of online social interaction platforms into a unique online platform can represent an innovative resource for companies' international growth. As a consequence, numerous agencies, banks and state institutions are not only focusing on helping SMEs go online, but they are also working to enlarge the scope of their support activities. As a matter of fact, the offered services should not only be tailored to SMEs' requirements, but they should also be implemented on a unique and innovative web portal.

Project's main issues and proposed solution.

In order to meet the project key objectives and the stakeholders' needs, four phases were defined: 1.Benchmark analysis; 2.Needs investigation; 3.Problem solving and model definition; 4.Business case. This structure was meant to cover the whole cycle for an idea-generation: from the analysis of the current scenario regarding services fostering SMEs' internationalization, to its validation on the field through interviews; from the creation of an evaluation model identifying best practices, to the implementation of a final solution.

Proposed solution:

The suggested solution is an integration to the present "UniCredit International" website with a set of services and add-on tools to answer SMEs' needs identified in the first 3 phases of the BBC-I project.

Advantages:

The proposed solution aims at answering to a call for a novel and social-based approach to those traditional services already offered online for the internationalization of SMEs. The principles of simplicity and user-friendliness have been pursued in order to provide entrepreneurs with a softer approach towards the more traditional services, many of which already available on the "UniCredit International"
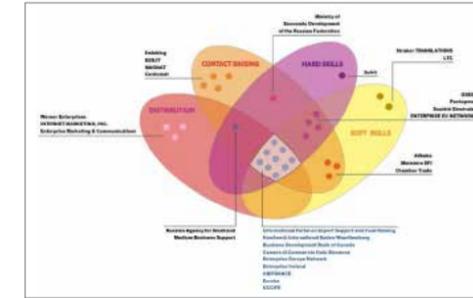
1. Benchmark Analysis Output: Graphical Representation of Provided Services
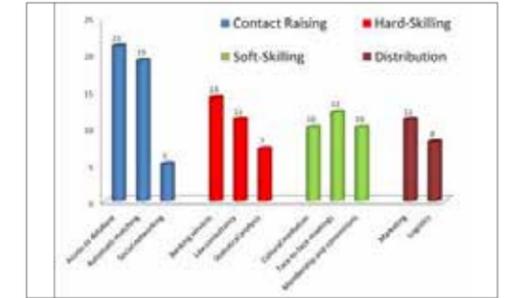
2. Benchmark Analysis Output: Provided Services Statistics

website. Moreover, the proposed solution aims at integrating the existing portal with completely new services (e.g. need for permanent personnel abroad) and introduces new interactive interfaces for the presentation of traditional offline services (e.g. face-to-face meetings). The proposed set of solutions aims at rendering business abroad easier, safer, more fluid and less challenging for SMEs, also thanks to warranty of UniCredit, which acts as mediator between the two contracting SMEs. In conclusion, the suggested solution brings forward a novel business model for SMEs to approach, establish and maintain successful export relations (e.g. The Export Test and The Export-Hub).

UNDERSTANDING THE PROBLEM.

The first two phases of the project, also referred to as "understanding the main problem", were focused on analyzing the project environment, describing the state of the art and investigating the needs which SMEs pursue in their internationalization process.

Firstly, a Benchmark Analysis was performed to analyze best practices and experiences within various industries that could be overtaken, improved and applied in other business fields. The main purpose was to study and categorize different internet portals or websites offering services to steer SMEs' internationalization. 23 different websites were considered, the majority of which operating in the EU (15). Russian internet portals (6), Canadian (1) and Chinese (1) ones were also studied. Moreover, "Chamber of Commerce" –a worldwide community– was taken into account. A common form of evaluation was proposed; a macro classification of all the offered services and a further sub-division into specific activities were performed. The identified macro-areas are: 1. Contact-raising; 2. Hard-skilling the client; 3. Soft-skilling the client; 4. Distribution; 5. Further classification, specifying the
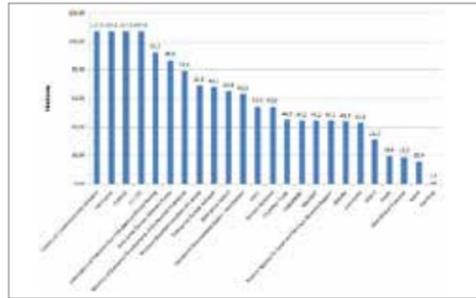
3. Assessment Methodology applied
retroactively on the benchmarked websites

commercial paradigm of the web-site and its geographical area (Figure 2). In addition, social platforms which were not directly dedicated to trade activities were also analyzed –LinkedIn, Tripadvisor, Kickstarter– in order to explore new sources of user-friendly and social paradigms. The Benchmark Analysis highlighted the most diffused and successful features and services that current internationalization-supporting websites offer and that it would be worth synthesizing into one unique online platform (Figure 3).

Secondly, the Needs Investigation was performed, in order to explore which problems SMEs do actually face in their expansion process and which services they judge helpful in overcoming such challenges. Teams A and B prepared a questionnaire and jointly interviewed 75 representatives of Italian SMEs who had taken part to "Matching 2012", a fair promoting the creation of business networks, which was held in Milan in November 2012.

An assessment methodology was then developed, translating the collected qualitative information into quantitative data. The results of the interviews were merged together with previous investigations performed by UniCredit in 2011, and then integrated with the four macro-areas of services identified by the Benchmark Analysis. An index of the importance that interviewed SMEs gave to a particular service was also introduced through the entry "Services Perceived Importance". The Needs Investigation offered a better understanding of the most required services among those currently available online and highlighted new services which had not been retrieved in the Benchmark Analysis.

EXPLORING THE OPPORTUNITIES.
The results of the first two steps of the project – Benchmark Analysis and Needs Investigation – became controversially both a source of inspiration for the final solution and also a barrier to meet the stakeholders' requirements. The two main findings, which then set the guidelines for the final solution, were: the effectiveness of traditional services; best practices and low ranking of social-based platforms, which are indeed interconnected.

First of all, it became obvious that modern SMEs look for simplicity and do not require highly innovative and complex services. There is still a consistent request for basic services for the establishment of an efficient trade system, such as: assistance in distribution and marketing activities; full range of financial and law consultancy; insurance and loans.

Secondly, examples of best industry practices still resulted in traditional offline institutions –mainly of government nature– combining the most requested services (Figure 4). This represents a great possibility for the development of online platforms, given the presence of a vacant niche, but also sets a necessity for SMEs to undergo an educational and mind-shifting process and move towards digital support.

Finally, the paradox of social interaction needs. On one hand, social-based platforms resulted to be of low interest among entrepreneurs, who declared to see no need or practical value in them. These considerations might have represented a barrier for the further development of the online paradigm and justified the low diffusion of the social concept among the benchmarked websites. On the other hand, a wish for social interaction and physical communication as a direct support to the internationalization process was revealed, indicating that such features should be integrated into an online solution.

GENERATING A SOLUTION.
Most emphasis was placed in finding an innovative answer to both UniCredit and SMEs' requirements. The result is an online platform conceived as an International Network of Enterprises

where companies can virtually meet, share best practices and develop a successful strategy to bring their business abroad (Figure 5). The real innovation lies mainly in the Social & User Friendly aspect of the portal and in its advantageous accessibility through tablets and smart phones. Each SME will represent a user inside the platform, with its own profile, reporting information relative to the company, its products and a professional timeline with collaboration, successful investments and actions undertaken in foreign markets (Figure 6).

The profile will be visible to the other companies of the network, including the numerous enterprises with which UniCredit is in contact worldwide. A chat integrated with services of online translation will allow entrepreneurs to establish contacts with each other without intermediaries. Just like in the most common social networks, it will be possible to create groups among SMEs, reflecting common areas of interest such as export/import activities in a certain geographical area or similar commodities sector. Forum, newsletters and dedicated pages will publish articles on profitable economical initiatives, investments and events, reporting references to the profiles of SMEs, distributors and retailers.

The portal will also offer services in order to increase SMEs' knowledge and sensitivity towards export: a market intelligence tool to help entrepreneurs in finding the most favourable countries

4. Graphical Representation of the services
available on the portal

5. Rendering of the proposed portal

to export, access to statistical data and market researches. SMEs will be also helped in finding and evaluating their counterparts. A research engine and an automatic matching system will suggest the entrepreneur-user a list of companies that might be commercially interesting. More traditional services as consultancy and financial products will be also available on the portal.

UniCredit will act as the administrator of the portal, while consultancy, statistical data and searching engines will be outsourced. From a feasibility point of view, basic services like the creation of the profile or the access to statistical data will be included in the regular subscription for an enterprise bank account at UniCredit. Upon payment of an additional fee, it will be then possible to access further premium services.

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BBC-I:
Banking Business Customer Internationalization

TASK & SKILLS

Arianna Scolari focused on the implementation of the assessment methodology and on the development of the final solution.

Enrico Buggea worked on the market analysis, on the creation of the concepts and in the analysis of the economic sustainability of the proposed solution.

Roberto Castiglione focused on the collection and mapping of the SMEs needs, on the implementation of the assessment methodology.

Lorenzo Grosso worked on the definition of a methodology to select the proposed solution and took part in the organization of conferences and meetings.

Giacomo Rontini worked on the state of the Art, on the collection and mapping of the SMEs needs, on the implementation of the assessment methodology.

ABSTRACT

Italian Small and Medium Enterprises have a strong presence in the socio-economic context of the country since many people are involved, but only 13% of them are active in the international business. There are numerous obstacles they have to face in this process: absence of dedicated export departments; inadequate resources to analyse the market and evaluate potential partners; inadequate foreign language skills. To be successful exporters SMEs have to penetrate foreign markets rapidly, at low cost, keeping control on core technologies and products, while adapting product features to local customer requirements and preferences. The process of internationalization requires expertise and resources mainly in terms of investments and knowledge of the foreign markets, which are usually limited in case of SMEs. So they need to be supported in their expansion abroad. Traditional agencies like banks and public entities provide lots of services for SMEs but there is still room for improvement. After in-depth field

researches, directly involving SMEs' entrepreneurs, emerged the idea of proposing an innovative integrated and user-centred package of services providing information and advisory about business opportunities abroad. Entrepreneurs do not have to find services from each agency but services are provided directly through Internet and new technologies. The package includes also the organization of virtual fairs that satisfies the need of physical contact at a limited cost. The problem of receiving updated information is overcome through a research centre that collects information and forecasts from traditional channels integrating them with those available on social networks, through data mining techniques and information aggregators. The research and consulting services are available both with traditional methods and via web-based and smart channels: the entrepreneur may be connected from any location and ask operators for information and advice on specific requests.
Understanding the problem
The preliminary part of project required a deep investigation on the context where several stakeholders were involved. Taking into account the complexity given by economic, technic and social aspects, the multidisciplinary approach in this field of research allowed to solve most of the difficulties. At first, the team performed an analysis of the current scenario to understand the role of traditional agencies and existing services in facilitating the inter-

1. Complete assessment methodology.
Author: Giacomo Rontini, Roberto Castiglione
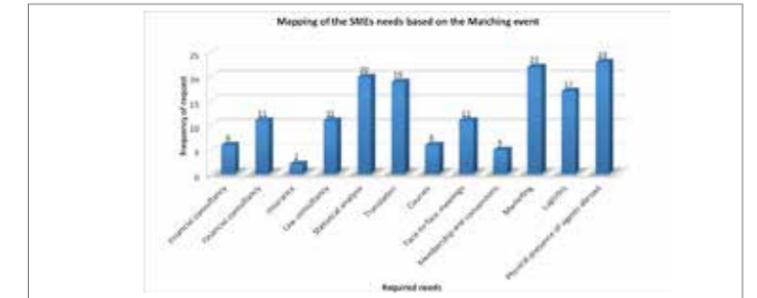
2. Mapping of the SMEs needs based on the Matching event.
Author: Giacomo Rontini, Roberto Castiglione

nalization process of SMEs and then furthermore the needs and requirements of those in the process of internationalization. The first analysis was carried out by performing a benchmark analysis of public agencies and banks focusing on their potentials and effectiveness but also on their drawbacks and lacks. Existing agencies offer market statistics and information on other counties, legal support, financial services and insurances, but most of them act as intermediaries with complex and time wasting procedures. The second analysis required a direct contact with Italian SMEs to assess the effectiveness of existing services and discover SMEs needs. This was realised through the participation to "Matching 2012", an event in which it was possible to interview directly Italian entrepreneurs and following-up activities with specialists and those entrepreneurs. The main finding was that traditional services are not able to help globally the expansion of Ital-

ian firms abroad since they are incomplete and not user-centred. The SMEs needs were classified in four main categories: contact raising, that means the possibility to come in touch easily with potential counterparts; hard-skilling the client, related to professional knowledge and tools allowing the firm to work within its core business; soft-skilling the client, connected to social, communication and self-management behaviours; distribution, concerning marketing and logistics.

EXPLORING OPPORTUNITIES

The analysis of the market and the classification of stakeholders' needs were the starting point to design new solutions. The aim of the project was to find innovative services to combine with Uncredit International, which is a package of services offered to SMEs to help them in expanding business abroad. The most attractive ideas have been selected in order to accomplish a unique product customer-oriented and

profitable for its stakeholders. The primary inputs rose from the lack of integration between services offered in the market. It became evident that modern Italian SMEs are looking for effective and pragmatic services. They want to be in the middle of the internationalization process and need to be conducted all along this tough path. Moreover to build business strategy abroad the information knowledge is fundamental. Italian SMEs need a deep insight on the economic environment, fiscal conditions, regulatory constraints and business opportunities abroad. These services are already offered by other Italian institutions but entrepreneurs do not perceive these information as up-to-date and user-friendly with the effect of losing a lot of opportunities abroad. Furthermore customized communication and distribution channels and tailored support are the primary declinations of the generic need of "physical contact" expressed by SMEs. Nevertheless many companies

3. Traditional agencies rank on the base of the fulfillment of the needs expressed in the Matching Event. Author: Giacomo Rontini, Roberto Castiglione
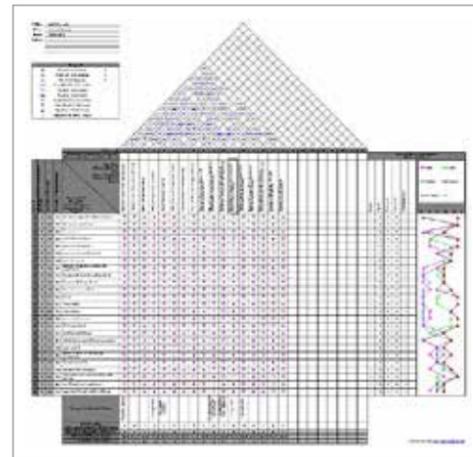
4. QFD method. Author: Enrico Buggea, Arianna Scolari, Lorenzo Grosso, Roberto Castiglione

5. The relation between Unicredit International and 4ACO company

6. Screen shot smart app. Author: Giacomo Rontini, Enrico Buggea

7. Keywords of the final solution: internationalization services offered by 4ACO. Author: Giacomo Rontini, Enrico Buggea

8. Screen shot virtual fair. Author: Enrico Buggea

9. Team composition Team B. Author: Enrico Buggea, Roberto Castiglione, Lorenzo Grosso, Giacomo Rontini, Arianna Scolar

still perceive the huge investments in terms of competences, management and marketing activities as the highest barrier to overcome before satisfying this need. Social network and virtualization are great opportunities to solve this problem at a lower cost. Thanks to the advent of the latest generation technologies, smart client applications have been a natural evolution from the traditional architectures. The team enhanced these opportunities by creating new services and communication channels, of which the main reachable benefits are rapidity, efficiency and cost cutting in a global network.

GENERATING A SOLUTION
The team, after more than one year of team working, performed brainstorming sessions according to its members' skills and characteristics in order to generate different solutions that could fulfill the wide range

of stakeholders' requirements. A multi-criteria decision tool helped in the selection of the optimal concept consisting in a package of innovative services called 4Aco that is integrated with Unicredit International and tries to exploit most of the opportunities left in the market. In particular, 4Aco consists of two main services: Research Centre and Virtual Fairs organization. 4Aco Research Centre provides Italian SMEs with deep insights about how tomorrow will differ from today in the international context and from such insights comes opportunity. It offers reliable and up-to-date information about business opportunities abroad for each country and each industry. Working as an integrator of information, the service

allows clients to select the country and the industry concerned, the area of interest and find lots of reports about the selected combination. The innovative part of this solution consists in the combined usage of traditional and new sources of information: the search and forecast about politics, economics, risks, regulations and business are made mainly through database analysis while the market information research, that includes analysis and forecasting of market/product trends, consumers' preferences and competitors' positions, is performed both through traditional methods (web searches, online questionnaires, customer feedback forms) and by inferring data widespread in social network through clustering algorithms and association rules. The Research Centre is also integrated with a strategic advisory team that, using the information gathered during the research activities, helps Italian SMEs

face all the problems related to the expansion process. The innovation of 4Aco resides not only in the services provided but also in the channels used to deliver these services. In particular, the research and the advisory services are offered with traditional and innovative methods. The main innovative channel is the 4Aco SmartApp. Clients are informed with alerts when a new business opportunity matching with their business profile is available and then they can access to any kind of report they need to evaluate that business opportunity. A personalised virtual consultancy can be also offered through the SmartApp. Moreover, from this app, it is possible also the access to the financial and insurance services offered by Unicredit. The other main innovative service of the 4Aco package is the Virtual Fairs organization. It involves the foreign counterparts giving them the possibility to connect and visit booths from their com-

puters; the Italian exhibitors can rent virtual booths with content including videos and downloadable brochures and also have the opportunity to share and exchange business cards, chat with visitors and start a Skype conversation with future clients.

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An evaluative reflection on the effectiveness and added value of the path
Assessment report

INTRODUCTION

The Alta Scuola Politecnica was founded in 2004 as an initiative of excellency promoted by the Politecnico di Milano (PoliMi) and the Politecnico di Torino (PoliTo), and proposes a path parallel to that of the two-year master's degree. At the end of the two years, the graduate will obtain an ASP Degree as well as a double degree from the Politecnico di Milano e Torino.

Aimed at talented and international young people, the ASP places particular emphasis on the multidisciplinary approach as a core and distinctive concept to promote and implement innovation in the fields of engineering, architecture and design.

Out of the 150 students admitted each year (90 candidates for the PoliMi master's degree and 60 for the PoliTo master's degree), approximately 25% of these are foreign students. The selection procedure gives particular importance to the previous university career of the first degree (60% of ASP students graduated with honours), motivation and the interest that the student shows for innovation and a multidisciplinary approach, as well as knowledge of English.

The ASP has adopted English as its official language for educational activities as well as for internal and external communications.

The educational path, promoted by both Politecnici, is divided into courses and projects whose substantial purpose is also aimed at revealing the "polytechnic culture" that unites graduates of different disciplines:

a. The *ASP courses*, aimed at developing interdisciplinary skills, have the specific objective of creating the basis for promoting and implementing innovation in its diverse aspects. These are intensive courses, Summer, Spring and Winter School. The courses last one week each, use non-traditional teaching methods and are based on time for reflection and discussion in restricted teams;

b. The *ASP projects* proposed by academic tutors and/or by external organizations (businesses and public institutions), are provided by multi-disciplinary and highly heterogeneous teams that come from different faculties/graduate courses from both Politecnici. These projects enables students to experiment with complex situations and to measure their measure their skills and competencies in planning, problem settings and problem solving, teamwork as well as multicultural and multidisciplinary interaction.

In particular, the courses and projects aspire to give a method with which they can thoroughly face complex problems (problem setting, stakeholder analysis) with creativity (definition of concepts by exploring available technological solutions) and concreteness (technical, industrial and social feasibility assessment). This method shapes the mind, which can be defined as "polytechnic culture" (or even, *design thinking* or *methodological design*).

The students can use all the services that both Politecnici offer the students as well as a series of economic advantages such as:

- Exemption from payment of ASP tuition fees;

- Availability of a budget for the conduct of multi-disciplinary projects;

- Free hospitality and transfers during the Summer and Winter school.

Moreover, foreign graduates with a first-level degree from foreign schools may be provided with a scholarship, while those who have a three-year degree from Italian universities may be offered a *one-off* contribution.

In 2013, a seventh round of graduates has been completed and a ninth round has started. From 2005 to present, there have been 818 ASP graduates, of these 101 are foreign, 524 are male and 292 are female students.

To develop the *community* experience that started during the first ASP cycle, in 2007 the ASP Alumni Association was founded with the purpose to create a stable network of contacts among graduates and to offer support to students of future ASP cycles.

At the end of the seventh cycle of activity, it seems relevant to answer some questions to evaluate the effectiveness and added value of the ASP path, through a predominantly qualitative approach that enables to interact with the various stakeholders who have experienced and are experiencing this venture, in order to understand the elements that make "the difference" and "the effects" of this difference clear:

1. What are the **distinctive features of the ASP path** compared to the Masters degrees path of the two Politecnici? In addition to strengthening the **multidisciplinary approach** and **orientation to innovation** (explicit objectives of the ASP), are there are other features that enable to acquire additional skills compared to colleagues attending the two-year masters? For example, do the teaching methods used enable to better develop the **analytical skills and dialogue reflection**? Or the **ability to work in a team**? Or the **ability to relate with approaches and colleagues who belong to different cultures**?

2. Given these distinctive features, **what is the added value**? **What are the expected results and those actually detected today by participants**? For example, **is the transition path to the job market**

shorter? Is the **job placement permanent** in terms of contract and/or is it **more qualified** from a professional point of view? Or, do you believe that the **distinctive** skills acquired compared to colleagues who did not attend the ASP are **seen in the medium to long term** (beyond 10 years after the path) and that, therefore, the influence needs to be verified by assessing the **career path in time**? Can a potential **gender impact** be seen (female presence is about one-third)?

3. Compared to a general objective to increase human capital quality in the country has the opportunity to attend a school of excellence help li**mit the "brain migration" phenomenon**? Has it been able to **attract talent** from other countries?

4. What effects does the active presence of a graduate association (**ASP Alumni Association) have from a new students point of view** (peer comparison, ability to rely on a network once the path is completed, etc.) **and from an individual professional career point of view**? (For example, having an international network of former classmates makes it easier to work abroad or have a career in a more international company, etc.).

5. In relation to **reference professional figures** (Engineers, Architects, Designers, etc.), do job placements show **different outcomes** that could be attributed to attending the ASP? For example, is there a greater proportion of graduates who choose an **academic career** rather than a **professional career different** than the career of reference? Are there **differences in the type of companies** that the students work in (larger, more international, etc.)? Are there **different effects in the three disciplines** (Architecture, Engineering, Design)?

6. Are the effects visible in terms of **innovation** in the three fields of Engineering, Architecture and Design? What are these innovations? Are there differences in the students coming from the two Politecnici?

It is important to remember that attending a school of excellence and being together with people who have the common trait of being distinctively "better" (objective data) and more "motivated" (largely subjective data: motivated to study more? further career advancement? etc.). Compared to those who are "out there" having a psychological effect that certainly effects no only the path and university period, but also the presentation to the job market and the professional choices made. In other words, there is an element that we might loosely define as strictly psychological (perceptual) that is important to understand in order to understand the extent attitudes and choices are influenced. In fact, concrete results do not necessarily and essentially determine the efficacy and added value of this type of path.

This report tries *to point out and consolidates the two different levels that we assumed would emerge in the various dimensions, or rather, perception (image and representation) and the extent of the actual results (actual employment/training status)*.

METHOD

The evaluation process was divided into work phases aimed at internalising the different viewpoints of the main stakeholders who, for various reasons, are/were involved in this training experience (instructors and company representatives). As for the students, the choice, which was shared with the Client, was to focus attention on those who have already completed the path and have, therefore, been able to effectively ascertain the effects of the ASP path.

These phases had a temporal sequence. The results of the different assessment plans have been reassembled and presented in this report.

- **Phase 1 - The instructors**
Objective
The objective of this work was to reconstruct the perceptions regarding the distinctive features of the ASP path in its two different expressions (courses and projects) in

order to:

- Share the evaluation questions and the investigation process;
- Define the set of results and the smile level (in respect of these results the satisfaction level, or the expected positive results, is achieved);
- Possible strengths and weaknesses.

Methods and instruments
8 face to face and telephone semi-structured **interviews** were carried out with **6 professors** and **2 tutors** (from both the PoliMi and the PoliTO), who were identified with the help of the Client. The interviews were differentiated in order to involve both witnesses who contributed to the emergence of the ASP, and witnesses who undertook their partnership with ASP more recently. As well as professors coming from the three different disciplines.

- **Phase 2 - The companies**
Objective

The purpose of this work phase was to reconstruct:

- The reasons/expectations underlying the collaboration (sponsorships, recruitment of graduates, participation in projects);
- The assessments of the skills of the graduates included, generally, and compared to traditional graduates;
- Possible strengths and weaknesses.

Methods and instruments
9 face to face and telephone semi-structures **interviews** were carried out with **9 companies**, which were identified with the help of the Client. 1) Sponsor companies, 2) who recruited graduates, 3) companies involved in ASP projects were interviewed in order to have a differentiated situation compared to the various relationships with the companies and with relation to the insertion of the three different graduate profiles.

- **Phase 3 - The graduates**
Objective
The objective of this phase was to reconstruct the transition to the job market or other educational path from the time of graduation to now *of all young people who graduated when the work started.*
The assessment activity highlighted some temporal data regarding the occupational and/or training status of the graduate that was considered relevant for the transition analysis activities and which enabled a comparative analysis in relation to the outcomes of other training programs (3 months after graduation/6 months/12 months, for people who graduated several years ago the status was detected by adding 6 months stock up to the date of the interview).
In addition to reconstructing the transition to work or further training programs after graduation process, particular attention was given to the assessment of the effective development of additional skills compared to traditional path (multi-disciplinarity, multiculturalism, innovation, team experiences, etc.) and the influence of the networking activities that accompanies the graduates through the Association.
The investigations were carried out in close collaboration with the ASP Alumni Association, which has helped to support not only the organization but also the content of the questionnaire used.

Methods and instruments
Two assessment plans were used for this phase:

- A s*tructured questionnaire given via the Internet*, in Italian (https://it.surveymonkey.com/s/Italian_ASPers) and in English (https://it.surveymonkey.com/s/English_ASPers), divided into useful sections to respond to the assessment questions developed in the first two phases. Starting from the ASP Alumni Association members (currently, about 700 graduates in approximately 20 countries, 50% of which formally enrolled in the As-

sociation), an attempt was made to interview as many graduates as possible with a census-type logic (also through the use of Facebook and the ASP and Association mailing lists). This questionnaire, the results of which have been processed and presented through a set of indicators replicated over time, returns information related to the entire transition process and information related to the career of the first graduates (2007) of the ASP, therefore, a time lapse of 6 years, which is certainly enough time to establish a stable professional status. Given the importance of the instrument in the economy of the investigation, the draft questionnaire was discussed with the Client and with the ASP Alumni Association, in order to make it as comprehensive and representative of the companies surveyed as much as possible;

- A focus group created at the ASP Foundation with 8 alumni who were strongly involved in the Alumni Association (members of the Board, organizers of initiatives involved in the courses as a mentor, etc.).

- **Phase 4 - Assessment report**
This Assessment report was drafted based on the work phases. The Work group will be available to explain and circulate the assessment results in a way deemed suitable.

THE VIEW POINT OF THE STAKEHOLDERS
1. THE INSTRUCTORS

The interviews with 9 teachers (coordinators of courses, project tutors and teachers) from the two Politecnici offer a *more complex and differentiated view than those that emerged from the discussion with companies and graduates, but they basically converged. This articulation is mainly determined by the respondents' "ASP experience" level* (some respondents continuously collaborated and other had a more intermittent collaboration). However, it also has

to do with being a member (of having been a member) of the Board. In deed, this position enables to have a more global and updated view of the current status of the ASP. We will return to this aspect in our conclusions. In this section, we want to give a summary of the positions that emerged from the shared visions and by going over the main questions that guided the assessment activities and final thoughts.

1.1 The *mission of the* ASP

In general, the respondents seem to share the idea that the "reason" underlying the ASP experience is that *of wanting to create an opportunity for the best students of the two Politecnici* and to give them the opportunity to experiment with "something" that is different from the normal university path. According to some, without giving the ASP a particular *mission* or a particular identity and finalization (even if, in truth, it is, there was a clear and implicit idea that it was to form different professionals, more "holistic" and without those professional barriers that characterized and characterize the traditional profiles of Engineers, Architects and Designers). However, for others the mission was entirely clear even if the path and methods for implementing it were brought into focus progressively (e.g. motivational interviewing for admission that certainly represents a key moment for clarifying those distinctive and founding features of the School that were introduced only a few years after the foundation of the ASP).

A respondent affirms that "*developing transversal skills*" was the mandate on which the ASP began to work and this meant deciding what were the soft skills of the Engineers, Architects and Designers. This respondent said, "*we focused on the design capacity*" and, with respect to this, we have tried to understand what skills were to be developed.

Therefore, according to the respondents' opinion of this initial input, over time the ASP has defined a training offer that offers basic social and economic preparation, a strong focus on the management of innovation and design processes and attention to something that was initially defined

as interdisciplinarity but is currently, and more correctly, defined as multidisciplinarity.

In essence, the idea was to create an educational path that was not specialized in any of the three fields, but was not typical and integrative of traditional skills. In this logic, multidisciplinarity was not a goal, but a useful tool to achieve the purposes of having an integrative and transversal path compared degree paths.

As already mentioned, this view is substantially shared, but it is interesting to observe how each of the interviewed teachers offer "his/her personal point of view" and not knowledge transmitted by the organization, despite the fact that, over the years, there have been some events aimed at socializing, spirit, *mission*, teaching methods and a pedagogical approach that were more consistent with the purposes of the ASP.

1.2 The educational path

There is a somewhat shared opinion that *the ASP offers students a very interesting path based on the size of the "community" instead of the multidisciplinarity*. Through the ASP, students are not given a training aimed at reinforcing "vertical specialization", but they are given an education that is more complex, transversal and more articulate.

The socializing element, the belonging to a community of peers, is among the most interesting elements of the ASP, together with *the opportunity to work with a real client* (through projects), which is considered quite rare in regular university courses. It is interesting to note how this position is not only sustained, as we will see later, by former students but is also recognized by the interviewed instructors who see the "*community*" as an essential instrument for consolidating the multidisciplinary approach.

However, according to some, from a training point of view, *the teaching dimension should still be improved.* A respondent states, "when you are asked to teach an ASP

course, you are told that these are the best students from both Politecnici. So, you prepare a course for your best students and try to create a multidisciplinary program, but you turn to people who are specialized in your field. But, the audience has a very diverse background. We must learn to change the way we teach. *We need to invent the didactics.* Something is being done along these lines (e.g. working groups instead of lectures), but it is all linked to the initiative of individual teachers not the distinctive character of the School".

This position, which is shared by some of the respondents, could also be affected by, as we mentioned earlier, the different level of the "ASP experience" in addition to the different "levels of participation" in the initiatives that the School has in place to try to socialize the pedagogical approaches and teaching methods as much as possible. However, from the interviews it is clear also that this could also be attributed to a lack of communication on the part of those who work daily to improve and refine the training offer. We will return to this aspect in the final comments.

However, according to others this problem is not as significant. The "ASP methods" are additional and complementary, and do not change or create new professional sets. It was simply stated "we have tried to give something extra to the best student to prevent them from leaving". Moreover, according to these other respondents, over the years the teachers who managed the ASP have constantly monitored and raised the bar (especially in courses, rather than projects) in order to create a high quality path.

In summary, according to some, the ASP serves to "keep" some good students in school and to add some elements of innovation in their educational path. It does not serve to attract new students and to train new professionals. For others, however, the transversal skills acquired are useful to train non-traditional professionals with good problem setting skills, which are even higher than the problem solving skills. These skills are very appealing to the companies.

1.3 Appeal and excellence

The trainers interviewed have *a substantially positive opinion that is convergent with the type of students selected to attend the ASP and in relation to the quality and effectiveness of the selection system.* Students defined as "of excellence" on the curricular, motivational and potentiality level. According to some, these students need to be offered services and "conditions" of excellence, and abandon the "pauperism and disgracefulness" that has been gradually established in recent years by chipping away the students' perception of "being part of a privileged path" and though this decreasing their level of motivation. *According to some, maintaining the exclusivity of the path is an essential condition for the success of the ASP.*[1]

1.4 Internationalization of the path

Again, in relation this aspect, the respondents show a different degree of knowledge regarding the recruitment system. According to some, much of it is left to chance in the sense that *there is not a structured system of external relations* for which foreign students coming to the ASP are the result of individual and somewhat random choices. In truth, the applications of foreign students are filtered by the Internationalization Offices of the Universities. The names provided (approximately 10% of applications) are selected through subsequent interviews.

According to some of the trainers interviewed, in the beginning, they stated that they imagined the ASP could become a centre of attraction for the Master Program of the Politecnici, but this has been minimal. The ASP does not have the ability to change the choices made by master's degree students because it offers only 30 credits in two years. The financial incentive has a greater role in the ability to change choices, especially those of foreign students and, for this reason; the selection process for these students was and

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1   In this respect see the part of paragraph 3.2 relative to the reasons that graduates have to enrol in the ASP.

is more severe. However, it is stated the amount given to them should be maintained in order to guarantee the international nature of the School. For this reason, foreign students should be better supported, particularly in the university path, even before the ASP path.

This last point is widely shared among the respondents. It is said that there is awareness of this problem, but it is not easy to solve due to cultural reasons (for example, the foreign students have little understanding of the "rejection of the grade", necessary when the constraint of a "27" average is not satisfied), and due to the basic preparation received in the various countries of origin.

1.5 Relationships with companies

According to some, companies are mainly interested in the ASP because "they trust in the School's selection process". In general, however, there is a shared view that this *dimension of the relationship with companies is underrated and underused by the ASP*, even because of the low ability to relate with these companies. It is said that the main problem is to translate the needs of companies (that are always too specific or too vague) into projects that may have an educational value.

Moreover, it is also believed that it would be useful to count on stronger private funding, not only for economic reasons but also for reasons of greater finalization of the ASP mission.

1.6 Expected Results and occupational outcomes

Thanks to the proposed approach, ASP graduates have access to unconventional career paths: for example, entrepreneurial, managerial or focused on integrated design. For years, opportunities in multinational consulting companies have been considered one of the major and successful outputs. Then there are the fields of engineering and a small proportion of graduates who have goon to work in the field of research. All of these opportunities are consistent with the initial spirit of the ASP

However, some of the respondents believe that "more attention" should be paid to the future of the graduates. The transition path is not followed and, basically, nobody knows much about what actually happens, however there are no *placement* problems. In truth, during the path, students come into contact with companies through projects and through meetings with a more informative purpose and with mutual knowledge, but, in fact, as we shall see in the chapter on graduates, the data on *placements* gathered by the Politecnico do not keep in mind ASP attendance and it is difficult to obtain differentiated information compared to regular graduates unless ad hoc surveys are carried out.

However, according to other respondents, the ASP path is very effective since it accelerates the career process. This is because the interfacing with "qualified diversities" that are being trained in a special and protected environment such as the ASP is highly anticipated.

Even the highest percentage of doctorates generated by the ASP (see the chapter on graduates) is judged in differently. According to some, this is quite justifiable (although it should not be considered an added value) since the ASP has a concentration of top students. According to others, the output is not desirable for a school of excellence that should have a privileged partner in the companies. On this aspect, there is a certain degree of difference between the two Politecnici. While, for the PoliMi this opportunity immediately proved to be an output that was not fully consistent, for the Politecnico di Torino, it seems that the doctorate represents one of the career opportunities. However, everyone agrees that it has never been a specific and explicit objective of the ASP.

1.7 Elements of the path's efficiency that need improvement

Despite the articulated positions on the various issues addressed, *the ASP is widely considered to be an important experience, which has enjoyed great freedom and few con-*

straints. "It was a pilot experience with few tensions and conflicts and with a great ability to interact with staff and different cultures. It worked fine because it does not belong to the game of power, discussions and professional identities. However, this strength is currently a limit because the ASP counts for little". According to some, it is for this reason that the articulated strategy of the two centres should be reintroduced.

Apart from these positions, a point shared by everyone is that *the relations between the ASP colleagues and between the ASP and the two Politecnici, and also between the PoliMi and PoliTo should be consolidated*. According to some of the respondents, these relations had some intensity at the beginning (also with meetings for socializing innovative teaching methods and instruments), but they have weakened over the years. In particular, the exchange between the teachers who rune the ASP and those who are responsible for a part of the path should be strengthened in order *to develop a consolidated set (or, a set used by everyone) of methods, instruments and contents that are different from those used in normal paths*. Because, it is not sufficient to make the lessons more complicated. They need to be "different", otherwise some students will follow and other not given the diversity of the profiles in the classroom.

In addition, it is believed that *the ASP diploma must acquire greater reputation* (especially international), otherwise it is not recognized as a distinctive element of the two Politecnici. However, this situation also depends on the fact that the ASP does not have a particular legitimation within the two Politecnici and does not have an institutional role.

If, in its initial reason, the ASP was intended to retain good students in the two Politecnici, currently, according to some respondents, the main problem is attracting new students. However, to do this, the ASP needs to use new strategies within the University and needs to be heavily modified. It is currently "a light structure (30 credits in two years) that works closely with the curricular path. Instead, in order

to attract new students, it should be structured internally. What is needed to attract an engineer is different that that needed to attract an architect, and so on".

Other respondents, however, argue that, from the point of view of content, there could be a "lighter" path for students, but it needs to be kept high and needs to maintain its obvious element of exclusivity.

There is a shared opinion that the multidisciplinary project is the major innovation introduced by the ASP path (especially for Engineers) and, therefore, ways to further enhance this part of the educational path need to be identified. Regarding the issue of *links and connections among the courses and projects*, the respondents have different options, probably due to their imperfect knowledge of the overall framework that characterizes the ASP training offer. In other words, this connection between courses and projects is one of the main points on which the school has invested and has produced a gradual and steady improvement over the years. However, this improvement is not a heritage known to all those who have a less intense relationship with the ASP (or rather, who are not board members or who have not collaborated in the last few years).

The positions on the possible evolutions of the ASP are articulated. On the one hand, it is claimed that these distinctive skills that the ASP provides should become a "little more curricular". Also because it is difficult that a course this short, even if it is intense and accompanied by residential experience, could substantially modify the profile of a person. On the other hand, other respondents insist, however, on the need for the ASP to maintain its exclusivity that gives it its feature of "excellence".

2. THE COMPANIES

2.1 The contribution and rationale behind corporate support

As previously noted, the assessment activities carried out through telephone and face to face interviews, involved 9

of the companies that contribute, or have contributed in the past, to the Alta Scuola Politecnica path.

These companies operate in different sectors (It and communication services, financial activities, business consulting services, construction and manufacturing industries with a strong differentiation of activity), mostly based in the Milan area.

The role of companies within the path differs depending on the type of cooperation that they have chosen to activate with the ASP, if they participate in the educational path as a *sponsor*, *project tutor* or through the *recruitment of graduates (or through a mix of these roles)*.

In fact, some of the companies surveyed collaborate with the ASP in the dual role (e.g., as a sponsor and project tutor or as sponsor and hiring graduates at the end of the path), while more than half of the companies surveyed are exclusively engaged in corporate tutoring activities in the multidisciplinary projects. The majority of company representatives interviewed are currently corporate tutors within the 9th cycle of the ASP, some have, however, experienced active and continuous collaboration by participating in the development of projects, even in previous cycles.

Among the motivations behind corporate sponsorships, there is, first, *the recognition of the high quality of the path, the interest in developing innovative projects and the ability to recruit graduates with the best profiles. If the first reason, the quality of the path, is common among all companies surveyed regardless of the type of collaboration activated, the second and third reasons are, however, closely related to the field in which the company operates.*

For example, the ability to recruit graduates with the best profiles is relevant in particular for consulting firms (company B and D) that, as a sponsor, may provide a contribution to support ASP activities, opportunities for the organization of events for the presentation of the company or marketing activities aimed at identifying students (mostly engineers) with the right skills and who are interested in the world of business consulting. Although company presentation events are organized with the Politecnico and other universities, the difference here is that while the latter are addressed to thousands of students participating in one of the many business presentations, with the ASP there is the possibility, in addition to the implementation of orientation during the school (Spring Summer and Winter), to directly contact students by organising targeted recruiting

events and other specific initiatives. However, it is difficult to achieve collaboration on projects due to some of the consultancy characteristics: strong mobility of staff that would make it difficult to successfully follow an ASP multidisciplinary project with a long duration compared to consulting projects (with a average life of between 3 and 6 months). These are companies that sponsor the path from its inception, in one case with full continuity, and in another case with a break of a couple of years.

For other corporate sponsors (I) – even in the case of a company that was a sponsor in the past (A), and for corporate tutors of projects (C, E, F, G, H), the rationale underlying support to the path arises mainly from the interest to develop innovative projects **"***with the purpose of a specific application in the industry, although, in reality, this may not effectively be applied".*

These companies work in different sectors (IT and communication services, financial activities, construction and manufacturing industries with a strong differentiation of activity), and they are all interested in the development of innovative research projects aimed at bringing academia to industry, convinced that this collaboration will, on the one hand, support the teaching method and, secondly, extend or strengthen relationships between companies and centres of higher education.

As part of the corporate tutoring, the advantage given by the sponsor "status" given to a company who collaborates exclusively on projects, this is more nuanced and materializes, from what emerged from the interviews, into a greater influence in the definition of project themes, while there was no evidence of other aspects relevant to the company with respect to the role of sponsor.

Specifically, the contribution of company tutors within multidisciplinary projects consists of a connection with teachers on issues that are then developed in the projects based on the participation of students. Once the group of 12-13 students is created, the tutor periodically holds meetings

with the students involved regarding the orientation activities during the execution phase of the project.

However, if we exclude consulting firms that have a strong interest in recruiting students, for some of the other companies surveyed there would be a willingness to develop projects for identifying young people to be hired by the company (in recent years some of the companies have hired young graduates), but the economic crisis has reduced, if not zeroed, recruitment, and internal dynamics (such as the mobility of corporate tutors who change role or office) do not ensure work placement of the students at the end of the path.

For almost all companies surveyed, the corporate support to the ASP path stems from previous relationships with professors of the Politecnici of Milano and Torino, with which they already had project or master forms of collaboration. These are companies that have experience rooted in collaboration with the academic world, not only with the Politecnici, and who began working after they were invited to be involved in the project by the teachers. Beyond these relations, it seems that the ASP path was not well known by the corporate world (*"I do not know how many in the business world actually know about the ASP, before starting our collaboration we did not know about it"*).

2.2 Distinctive elements of the path

Among the distinct elements, companies immediately recognize the **multidisciplinarity** of the path that allows students to take courses and to consider different aspects that go beyond the specific skills of Engineers, Architects and Designers. *The main interest, if not the only interest, of the companies surveyed seems aimed at Engineers of the ASP path who seem to offer opportunities to develop transversal skills and prepare well-rounded, more flexible and dynamic profiles.* In the opinion of those interviewed, facing technological, economic and environmental, etc. themes transfers to the disciplines seems to be the element

Table 2.1 – Type of collaboration with the ASP

No.	Companies	Business Sector	Campus	Type of collaboration		
				Sponsor	**Tutor**	**Recruiting**
1	A	Financial activities	Milan	**X***	**X**	
2	B	Consulting activities	Milan	**X**		**X**
3	C	Manufacturing	Forlì		**X**	
4	D	Consulting activities	Milan	**X**		**X**
5	E	Manufacturing	Milan		**X**	
6	F	Manufacturing	Rome		**X**	
7	G	Construction	Milan		**X**	**X**
8	H	Manufacturing	Milan		**X**	
9	I	It and communication services	Milan	**X**	**X**	
			Total	**4**	**7**	**2**

* Corporate Sponsors in the past, but not currently

of greater interest that gives added value to the master's degree course path.

Another distinct element that emerged in many of the interviews was the **selection** of students that produces a high-profile basin and that allows companies to work on multidisciplinary projects or to contact better prepared and motivated students for recruitment activities. The companies expect that ASP students have a slightly higher level based on the initial selection process that intercepts students with a high average, good knowledge of English and good motivation, essential for supporting a path that all respondents considered to be very challenging.

As has already been pointed out, most of the company representatives interviewed are involved in developing multidisciplinary projects. Therefore, their focus is particularly aimed at the implementation of projects that, in parallel to teaching, are considered as the element of **innovation**, albeit with different degrees of opinions, conditioned by the specific focus of the work done, the company's expectations regarding the final result of the project[2] and the presence of the "right people" in the work group. What emerges is that innovation is not something that is taught, but it depends very much on the people involved and if they have good ideas or not. Of course, a multidisciplinary environment such as the ASP can give exciting stimulation and produce results of some value, but by itself is not sufficient to produce innovation (*"you're not innovative just because you went to ASP"*).

In this sense, the **group work** assumes significant impor-

tance; it is considered an added value that enables the exchange between profiles and cultures, and encourages the development of non-specific projects, but complex projects in which different approaches and skills come into play. Beyond the creation of multidisciplinary projects, group work is also particularly appreciated by consulting firms who see it as an opportunity to enhance the interpersonal skills of the students *("the ability to immediately work in a group allows you to develop the ability to communicate and interact with others, something that not all graduates are able to do")*, the **internationalization of the ASP** path is also favoured because it allows students to dialogue with other realities, both on a cultural and a technical level.

2.3 Skills of the students and the needs of the companies

In relation to the skills of the students and how they respond to the needs of companies, from the interviews two main view points emerged, which could be identified as: "persuaded" and "doubtful". Among the "persuaded", corporate consulting companies play an important role; these are the more active companies, among those interviewed, in terms of hiring. The "doubtful" are some companies of the manufacturing sector that collaborate as corporate tutors in multidisciplinary projects.

The "persuaded"

The respondents assessed the overall skills of the students as very good. These respondents acknowledge a good technical preparation and good ability to work in a team. As previously noted, the selective nature of the path means that ASP profiles are excellent at the beginning (the origins of these students is mainly two prestigious universities such as the Politecnico di Milano e Torino) and that, compared to traditional graduates, the articulation of the path, the multidisciplinary nature allow to develop academic and more "classic" skills (technical, analytical, logical), and relational transversal skills (that some prefer to identify, perhaps more

correctly, soft skills as personal capacities and features).

Compared to traditional graduates, ASP students show great attention to detailed issues, have more of an open mind as well as better analytical and problem solving skills. It is expected that the students have better features in terms of soft skills, and this expectation seems to be widely met:

"In my sector you need to be resourceful, have a certain mental agility, good dynamic characteristics, and these are exactly the features of ASP students".

"I find them to be prepared [...] also in terms of relationships, the ability to introduce themselves and talk about their experiences, which is something that Italian students usually lack".

The companies recognize that the students have good ability to manage workloads, since the ASP educational path, in addition to the standard of universities, is particularly burdensome in light of the multiple commitments provided. Some believe that the ASP graduates benefit from a significant load of activities in work environments where a good dose of "resistance" and a good ability to manage multiple commitments is needed.

The respondents also assess the linguistic skills as being mostly above average and are considered important for entering the job market, if not essential for working in business realities (such as corporations) that operate on a global scale, and in particular in some sectors, such as that of the consulting firm, where the project allocation system is often done on a global scale.

This group of respondents believe that the profile of the graduates respond well to the needs of their company, with greater belief by those who address the ASP for recruiting activities, who also highlight a good recognition of the profile compared to traditional graduates:

"It is easier for me to remember ASP students compared to the others. I attended the Politecnico and so I have a special focus, I find it easier to remember students from

the Politecnico rather than those from Bocconi University, and I believe that it is easier to detect the ASP students".

The "doubtful"

For this group of respondents, the profiles of the ASP students less responsive to the needs of companies that, involved in the projects, expect to meet young people with skills superior to those of traditional graduates, especially in light of an environment of excellence in which they develop their own training.

"Our expectations were very high because we imagined finding young people that were one step ahead since they came from a selection from the two Universities Excellencies. They are well prepared and come from a good training background, but I did not feel that they were one step ahead".

In one case, it was noted that, in the implementation of the project, there were expectations to work with students with special technical skills or special problem solving skills, but at the moment there seems to be no particular differences with respect to educational collaborative relationships implemented with master's degree students.

This opinion was based on a short-term collaboration (at the time of the interview the project was not yet in its final phase) and so it is important to point out that this could change in future months when the team work goes live. Moreover, the impression of the respondent is that the project has a very applicative nature, but that perhaps exceeded this start-up phase does not meet the expectations, there may be opportunities for students to express their skills by highlighting the potential of a graduate from a highly specialised school.

It would be appropriate to better meet the needs of companies: *"creating profiles that are not only academically excellent, but that are prepared to be equally excellent in the*

area that they will work in, this is what the reference industry requires and should be the joint goal of a collaboration relationship".

What emerges is that the companies believe that the skills of students are too theoretical and that, overall, there is a very didactic approach to the implementation of the projects. Moreover, the "time" factor is problematic: the time that students dedicate to projects is considered insufficient and too extensive to obtain results, while companies, by contrast, have a diametrically opposite approach, more applicative and centred on a minimum amount of time.

2.4 Graduates and the employment market

In the opinion of many of the companies, the ASP path allows to get closer to the working world, unlike other degree courses (through projects and collaborations with the companies), and to have a privileged view (participation in presentation of companies as part of the path).

However, in most cases, this proximity to the companies that collaborate with the path does not seem to guarantee real employment opportunities for the students, irrespective of the experiences of some of the sponsors who openly have *recruiting* purposes. In the past, some of the companies interviewed had the chance to hire some of the graduates after an internship, but currently state that they are not in a condition to offer working opportunities. The possibility that some companies could host students for placements or internships is still present, but seem mostly to be occasional situations and not structured collaboration between ASP and businesses.

Therefore, the path does not seem to have particular specific features in terms of occupational opportunities deriving from the collaboration between ASP and businesses. This could happen if companies were to use this relationship to recruit people, but, as we have seen, the reasons of most companies are different, especially in light of the difficulties arising from this period of economic crisis. In the

opinion of some of the corporate tutors, there seems to be a real possibility to hire some profiles that are deemed particularly interesting as well as, maybe, different offers in terms of project ideas and commitments by companies to develop more targeted skills when implementing multidisciplinary projects.

If the ASP profile does not have a preferential outlet with partner companies (for some, as we have seen, it is, or at least, was before the crisis), some respondents believe that this is narrower among other companies: *"I do not know how many in the business world actually know about the ASP, before we started collaborating we did not know about it and we were not able to assess the weight of the path".*

For everyone the focus is on Engineers, there is little if no attention on the other professional figures (Architects and Designers). In the opinion of the companies, the professional outlet for ASP graduates is non-diversified, but closely linked to the experience of the master's degree. The multidisciplinary approach is considered an added value from which an ASP engineer compared to a traditional engineer can benefit the most because it offers a more *"all-round"* profile. Obviously much depends on the personal skills of the graduate since the ASP path is not sufficient to ensure successful employment; on the other hand, it is believed that much also depends on the ability of the selector to understand that an ASP student can offer better results.

For consulting firms that have the opportunity to select the ASP graduates, this added value is visible not only when entering the job market, but also in terms of career development.

"History has taught us that ASP students do not do better on average in the selection process or, at least, have features more in line with what we are looking for (it is not said that they are better suited to all realities), but they also have a career path, not only entry into the career, that is respected".

2.5 Company offers

At the end of the interviews, company representatives were asked to identify possible areas for ASP path improvements in order to respond more adequately to the needs of companies. Some proposals emerged regarding **improvements in the *placement*** of students and others on **improving the implementation of multidisciplinary projects**.

The **first group** of offers came from not only companies interested in *recruiting* but also from a company convinced that it is essential to support APS student employment, even outside of the nation.

- There should be *more work on soft skills* as well as technical transversal skills because this could further enrich a profile that is already of high quality. It would be useful to work on the development of skills that could help to establish the best graduates in the job market (ability to speak in public, know how to make offers to companies). The proposal is to take into account these aspects that are very attitudinal during the selection process.

- The *relationship with external companies could be improved*, in terms of managing students and projects, relationships with companies and the opportunities for the students. The ASP prepares excellent students that, however, the market does not recognize, as it should. This would be useful for improving the placement of graduates (which is already fairly good), identify non-traditional transition paths and better enhance the distinctive skills acquired during studies in the ASP path.

- The path could be *more internationalized*, also providing knowledge on foreign job markets and the differences that exist between these and the Italian job market. The proposal is to offer lessons that will guide the students in various career opportunities, giving them a real and concrete vision of the possibilities that exist in the world, and explaining how to prepare and present themselves abroad.

On the other hand, the **second group** of offers is more relevant to the organization of the path, and particularly to multidisciplinary projects. These proposals arise from some difficulties and identify possible solutions.

- There was a fairly high turn over in work groups (people going abroad, or people working on their thesis). It takes time to amalgamate the group and bring it to a common goal. At this time those available are not always sufficient to achieve good results. The proposal is to activate *a path to prepare the companies for the projects that allows the company to define the proposal in time.* This could happen starting 6 months before the release of the invitations in order to perfect it 3 months before and to be ready right away so that there is enough time to implement something concrete (on this issue we should highlight that there are constant adjustment and that, therefore, the ASP is fully aware of this problem).

- A *greater balance between teaching activities and projects* is needed. The students often spend their spare time on the projects, very often there is not enough time to develop the project, as the company would like. In many cases, it was necessary to press the ASP tutors to have the work results assigned to the students. Among the various meetings, often 2-3 months pass before businesses have contact with the students. The proposal is to organize the path so that the commitments (didactics and projects) of the students are not constantly overlapping. The number of months available for the project could be reduced and the activities concentrated in order to obtain better results in terms of work continuity and in terms of greater applicability (very desirable for some companies). As in the previous case, this aspect also shows constant developing activities.

- The students have a certain distance from the business world. It has been seen that the approach used to implement the projects is too theoretic and not applicative; this limitation is considered quite common in Italian universities. The proposal is to *engage students in activities that*

have a more applied nature, not only in terms of projects, but also more generally within the path. A second proposal emerging from the consideration that there is a significant gap between students and companies is to organize *more events that remove the students from the academics* (company visits, participation in trade fairs etc.).

- Finally, focus was placed on the *patenting of ideas* that may arise during the project. There is not enough clarity and there are also different rules for patent protection in the two Politecnici that can be very problematic. The proposal is to *define, at the very least, clear regulations to refer to* if it is not possible to standardize the rules.[3]

3. THE GRADUATES

3.1 Results of the survey

3.1.1 Features of the Alumni involved in the survey

Over two-thirds of the respondents are from the Politecnico di Milanoo and, for both Universities, there was a significant preponderance of Engineers compared to Architecture and Planning graduates and, even more, those of degree courses in the Design disciplinary area.

Without particularly significant differences between the two Universities, about 60% of the ASP graduates who took part in the survey were male (see Table 3.2.), with a quite small presence of women among the alumni who have completed a master's degree in Engineering and much more consistent for those who have done their studies in Design and Architecture and Planning.

For both the Universities, about 10% of the total involved in the survey were foreign ASPers, with high levels among Design and Architecture and Planning graduates (see Table 3.3).

Net of graduates of foreign citizenship (assuming that they have in fact already chosen a foreign path and decided to attend the ASP), if we take into consideration the Italian ASP graduates, more than half of these have had one or more study experiences abroad during their studies (Erasmus, Athens program, internship or dissertation period abroad, etc.) and 35% participated in these experiences specifically during their ASP studies (see Tab. 3.4).

On the contrary, the share of ASP graduates who during the last two years of their degree course have carried out work activities probably because of the "double" load of commitments deriving from the contemporary frequency of the Master's degree lessons and the carrying out of activities offered by the Alta Scuola Politecnica (ASP courses and projects, seminars, summer schools, etc.): 47.8% of Alumni have never worked during the two year period of the master's degree and 39.9% have only carried out occasional or seasonal work, compared to just over 12% who have continuously carried out commitments, which, in more than half of the cases, were part time activities (see Tab. 3.5). For the few who worked continuously during the last two years before graduation (around 33 people) it was almost always activities that were completed prior to ASP graduation (72.7%) or protracted only for the months immediately following graduation (18.2%); only 3 ASP graduates out of 33 (less than 10%) still continue to carry out the employment that started before graduation from the ASP (1 from the V and 2 from the VI cycle, who respectively graduated in 2010 and 2012).

Therefore, it is possible to assess the job placement probability and the actual attractiveness of the ASP diploma for companies, net of distortions related to the maintenance of existing occupations.

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3   The issue has been designed by both Politecnici showing differences in the two statues, which complicates the regulation of intellectual property. In the past, the two Politecnici developed a proposal; however, the sponsor companies did not share it since it did not provide for the transfer of intellectual property, but only a priority to the purchase.

Table 3.1 – Alumni based on disciplinary area and the University of origin (%)

Disciplinary area	From which Politecnico do you come from?		Total	No.
	Politecnico di Milano	Politecnico di Torino		
Engineering	71.8	71.6	71.7	193
Architecture and planning	19.3	23.9	20.8	56
Design	8.8	4.5	7.4	20
Total	**100.0**	**100.0**	**100.0**	**269**
No.	**181**	**88**	**269**	

Table 3.2 – Alumni based on gender, disciplinary area and the University of origin (%)

From which Politecnico do you come from?	Disciplinary area	Gender		Total	No.
		M	F		
Politecnico di Milano	Engineering	73.8	26.2	100.0	122
	Architecture and planning	26.5	73.5	100.0	34
	Design	6.2	93.8	100.0	16
	Total	**58.1**	**41.9**	**100.0**	**172**
	No.	**100**	**72**	**172**	
Politecnico di Torino	Engineering	81.7	18.3	100.0	60
	Architecture and planning	15.8	84.2	100.0	19
	Design	25.0	75.0	100.0	4
	Total	**63.9**	**36.1**	**100.0**	**83**
	No.	**53**	**30**	**83**	
Total	**Engineering**	**76.4**	**23.6**	**100.0**	**182**
	Architecture and planning	**22.6**	**77.4**	**100.0**	**53**
	Design	**10.0**	**90.0**	**100.0**	**20**
	Total	**60.0**	**40.0**	**100.0**	**255**
	No.	**153**	**102**	**255**	

* In 14 cases there was no indication of the gender.

Table 3.3 – Alumni based on citizenship, disciplinary area, and the University of origin (%)

From which Politecnico do you come from?	Disciplinary area	Citizenship		Total	No.
		Italian	Foreign		
Politecnico di Milano	Engineering	95.4	4.6	100.0	130
	Architecture and planning	80.0	20.0	100.0	35
	Design	75.0	25.0	100.0	16
	Total	**90.6**	**9.4**	**100.0**	**181**
	No.	**164**	**17**	**181**	
Politecnico di Torino	Engineering	92.1	7.9	100.0	63
	Architecture and planning	95.2	4.8	100.0	21
	Design	25.0	75.0	100.0	4
	Total	**89.8**	**10.2**	**100.0**	**88**
	No.	**79**	**9**	**88**	
Total	**Engineering**	**94.3**	**5.7**	**100.0**	**193**
	Architecture and planning	**85.7**	**14.3**	**100.0**	**56**
	Design	**65.0**	**35.0**	**100.0**	**20**
	Total	**90.3**	**9.7**	**100.0**	**269**
	No.	**243**	**26**	**269**	

Since the participation level observed among graduates was not very high, the survey coverage rate (see Tab. 3.6) does not enable to consider the survey representative from a statistical point of view; however, in our opinion it is interesting for the discussion of some issues.

On the other hand, the participation level detected is interesting if the features of the Alumni involved are analysed on a disaggregated level; in fact, the participation rate is inversely proportional to the time elapsed since graduation with graduates of the VII cycle and ASPers of the V and VI cycle superior to the average.

It is also interesting to take not of the higher involvement in females and among Italian graduates compared to foreign graduates.

Table 3.4 – Italian alumni based on disciplinary area and the University of origin and participation in study programs abroad (%)

From which Politecnico do you come from?	ASP cycle	Study programs abroad		Total	No.
		No study experience abroad	At lease one study experience abroad		
Politecnico di Milano	I-II-III cycle	62.3	37.7	100.0	53
	IV-V cycle	32.5	67.5	100.0	40
	VI-VII cycle	43.7	56.3	100.0	71
	Total	**47.0**	**53.0**	**100.0**	**164**
	No.	**77**	**87**	**164**	
Politecnico di Torino	I-II-III cycle	39.1	60.9	100.0	23
	IV-V cycle	45.2	54.8	100.0	31
	VI-VII cycle	48.0	52.0	100.0	25
	Total	**44.3**	**55.7**	**100.0**	**79**
	No.	**35**	**44**	**79**	
Total	**I-II-III cycle**	**55.3**	**44.7**	**100.0**	**76**
	IV-V cycle	**38.0**	**62.0**	**100.0**	**71**
	VI-VII cycle	**44.8**	**55.2**	**100.0**	**96**
	Total	**46.1**	**53.9**	**100.0**	**243**
	No.	**112**	**131**	**243**	

Table 3.5 – Alumni who have carried out occupational activities during the degree course by disciplinary area and the University of origin (%)

From which Politecnico do you come from?	Disciplinary area	Did you carry out working activities during the two years of the master's degree?					
		No, I never worked	Yes, I carried out occasional or seasonal work	Yes, with part-time continuity	Yes, with full-time continuity	Total	No.
Politecnico di Milano	Engineering	54.3	31.8	7.8	6.2	100.0	129
	Architecture and planning	34.3	60.0	5.7	0.0	100.0	35
	Design	31.2	43.8	12.5	12.5	100.0	16
	Total	**48.3**	**38.3**	**7.8**	**5.6**	**100.0**	**180**
	No.	**87**	**69**	**14**	**10**	**180**	
Politecnico di Torino	Engineering	47.6	39.7	6.3	6.3	100.0	63
	Architecture and planning	47.6	52.4	0.0	0.0	100.0	21
	Design	25.0	50.0	25.0	0.0	100.0	4
	Total	**46.6**	**43.2**	**5.7**	**4.5**	**100.0**	**88**
	No.	**41**	**38**	**5**	**4**	**88**	
Total	**Engineering**	**52.1**	**34.4**	**7.3**	**6.2**	**100.0**	**192**
	Architecture and planning	**39.3**	**57.1**	**3.6**	**0.0**	**100.0**	**56**
	Design	**30.0**	**45.0**	**15.0**	**10.0**	**100.0**	**20**
	Total	**47.8**	**39.9**	**7.1**	**5.2**	**100.0**	**268**
	No.	**128**	**107**	**19**	**14**	**268**	

Table 3.6 – Survey coverage rate

	ASP Graduates					Graduates who participated in the survey						Survey coverage rate				
Cycle	Italian	Iternational	Total	F	M	Italian	Iternational	Total	F	M	N/A	Italian	Iternational	Total	F	M
I	127	2	**129**	35	94	13	0	**13**	8	5	0	10.2	0.0	**10.1**	22.9	5.3
II	101	15	**116**	40	76	29	3	**32**	20	10	2	28.7	20.0	**27.6**	50.0	13.2
III	98	15	**113**	40	73	34	1	**35**	22	12	1	34.7	6.7	**31.0**	55.0	16.4
IV	99	12	**111**	36	75	31	3	**34**	23	9	2	31.3	25.0	**30.6**	63.9	12.0
V	93	24	**117**	49	68	40	6	**46**	26	18	2	43.0	25.0	**39.3**	53.1	26.5
VI	100	16	**116**	47	69	42	3	**45**	27	17	1	42.0	18.8	**38.8**	57.4	24.6
VII	99	17	**116**	47	69	54	10	**64**	27	31	6	54.5	58.8	**55.2**	57.4	44.9
TOT	**717**	**101**	**818**	**294**	**524**	**243**	**26**	**269**	**153**	**102**	**14**	**33.9**	**25.7**	**32.9**	**52.0**	**19.5**

3.1.2 Transition from the ASP path to employment

In general, ASP graduates seem to elicit good interest from the production system. In fact, more than two-thirds received job offers after completing their studies. However, there were marked differences based on the degree obtained, with higher appeal among Engineer graduates (more than 80% received job offers) compared to Architecture and Planning and Design graduates (approximately one out of three, as is highlighted by Tab. 3.7).

The number of offers received by VI and VII cycle graduates is lower than those of the Alumni of previous courses (see Tab. 3.8).

Finally, the gender gap is considerable (77.8% of the males versus 54.9% of the females received job offers). This is not so much related to the different performance in path, but rather to the educational choices made upstream, with a much lower proportion of women in the field of Engineering compared to those in architecture and design (see Tab. 3.9).

Table 3.7 – Job offers received after ASP graduation based on disciplinary area and University of origin (%)

From which Politecnico do you come from?	Disciplinary area	Job offers received after ASP graduation		Total	No.
		No offers	Offers received		
Politecnico di Milano	Engineering	19,2	80,8	100.0	130
	Architecture and planning	74.3	25.7	100.0	35
	Design	62.5	37.5	100.0	16
	Total	**33.7**	**66.3**	**100.0**	**181**
	No.	**61**	**120**	**181**	
Politecnico di Torino	Engineering	17.5	82.5	100.0	63
	Architecture and planning	57.1	42.9	100.0	21
	Design	75.0	25.0	100.0	4
	Total	**29.5**	**70.5**	**100.0**	**88**
	No.	**26**	**62**	**88**	
Total	**Engineering**	**18.7**	**81.3**	**100.0**	**193**
	Architecture and planning	**67.9**	**32.1**	**100.0**	**56**
	Design	**65.0**	**35.0**	**100.0**	**20**
	Total	**32.3**	**67.7**	**100.0**	**269**
	No.	**87**	**182**	**269**	

Table 3.8 – Job offers received after ASP graduation based on cycle and University of origin (%)

From which Politecnico do you come from?	ASP cycle	Job offers received after ASP graduation		Total	No.
		No offer	One or more offers received		
Politecnico di Milano	I-II-III cycle	29.1%	70.9%	100.0%	55
	IV-V cycle	32.6%	67.4%	100.0%	46
	VI-VII cycle	37.5%	62.5%	100.0%	80
	Total	**33.7%**	**66.3%**	**100.0%**	**181**
	No.	**61**	**120**	**181**	
Politecnico di Torino	I-II-III cycle	24.0%	76.0%	100.0%	25
	IV-V cycle	14.7%	85.3%	100.0%	34
	VI-VII cycle	51.7%	48.3%	100.0%	29
	Total	**29.5%**	**70.5%**	**100.0%**	**88**
	No.	**26**	**62**	**88**	
Total	**I-II-III cycle**	**27.5%**	**72.5%**	**100.0%**	**80**
	IV-V cycle	**25.0%**	**75.0%**	**100.0%**	**80**
	VI-VII cycle	**41.3%**	**58.7%**	**100.0%**	**109**
	Total	**32.3%**	**67.7%**	**100.0%**	**269**
	No.	**87**	**182**	**269**	

By analysing in more detail the origin of job offers, even if the highest percentage comes from companies not involved in the Alta Scuola Politecnica, *approximately 14% of the ASP graduates received job offers from ASP sponsor companies ASP or otherwise companies who were project partners implemented in the various cycles, and this is consistent between the two Politecnici.* Even the graduates who received job offers from universities, institutions, public institutions and professional firms are also significant (more than 20%).

Among the graduates who have received job offers, 16.5% never refused these offers while 83.5% refused the offers. Among the reasons for refusal, a prevailing fact is that the job proposed was not deemed interesting, with a decidedly marginal assessment of the economic dimension of the offer.[4]

More than 57% have found employment and another 25% are still studying in comparison with a share of Alumni seeking employment equal to about 17% within three months immediately following ASP graduation. Therefore,

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4   Among other reasons, there is the fact to have been able to choose other offers deemed better, regardless of whether the offer received was not less interesting or poorly remunerated. Moreover, in some cases the ASP graduates refused the offer because they had intentions on working elsewhere (mainly abroad).

Table 3.9 – Job offers received after ASP graduation based on disciplinary area and gender (%)

From which Politecnico do you come from?	Gender	Job offers received after ASP graduation		Total	No.
		No offer	One or more offers received		
Engineering	M	16.5	83.5	100.0	139
	F	20.9	79.1	100.0	43
	Total	**17.6**	**82.4**	**100.0**	**182**
	No.	**32**	**150**	**182**	
Architecture and planning	M	75.0	25.0	100.0	12
	F	63.4	36.6	100.0	41
	Total	**66.0**	**34.0**	**100.0**	**53**
	No.	**35**	**18**	**53**	
Design	M	100.0	0.0	100.0	2
	F	61.1	38.9	100.0	18
	Total	**65.0**	**35.0**	**100.0**	**20**
	No.	**13**	**7**	**20**	
Total	**M**	**22.2**	**77.8**	**100.0**	**153**
	F	**45.1**	**54.9**	**100.0**	**102**
	Total	**31.4**	**68.6**	**100.0**	**255**
	No.	**80**	**175**	**255**	

on the one hand there is a positive result since there is a reduced time lapse (consistent with the offers received), but on the other hand there is also a very strong inclination to pursue academic studies that is higher among graduates of the last few cycles (see graph 3.3).

There is a quite significant difference relative to the different types of Master's degrees obtained, with much higher success rates (employment and reinsertion in education and training) for Engineers (around 90%) compared with Architects, Planners and Designers (approximately 60%, as shown in Tab. 3.10).

In most cases, those who continue to study continue with a PhD program[5], and the main reason is to further improve backgrounds – increase of skills (28.8%) and increase of professionalism (18.2 %) – compared to about 22% that choose to study for reasons related to the employment

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5   On average, 77.3% (81.8% of students from the PoliMi and 68.2% from the PoliTo) of those who continue studies, there is a much lower average of those who continue with master, another specialty or studies abroad.

Graph 3.1 – Job offers received after ASP graduation based on University of origin

■ Total   ■ Politecnico di Torino   ■ Politecnico di Milano

Job offers from other subjects
- 21,6%
- 27,3%
- 18,8%

Job offers from other companies
- 48,7%
- 51,1%
- 47,5%

Job offers from companies that are partners in ASP projects
- 4,1%
- 3,4%
- 4,4%

Job offers from ASP sponsor companies
- 9,7%
- 9,1%
- 9,9%

Job offers from Poliplacement
- 11,5%
- 5,7%
- 14,4%

0,0%   10,0%   20,0%   30,0%   40,0%   50,0%   60,0%

Graph 3.2 – Job offers received after ASP graduation based on disciplinary area and gender

■ Total   ■ Politecnico di Torino   ■ Politecnico di Milano

Other reasons
- 17,0%
- 12,9%
- 19,2%

The job offer was not interesting
- 51,1%
- 50,0%
- 51,7%

The job offer was not stable enough
- 13,2%
- 16,1%
- 11,7%

The job offer was not sufficiently remunerated
- 28,0%
- 29,0%
- 27,5%

The graduate did not want to work at that time
- 16,5%
- 12,9%
- 18,3%

0,0%   10,0%   20,0%   30,0%   40,0%   50,0%   60,0%

field (especially to secure the best career opportunities) and an approximate 15% that deem continuation of studies as an intermediate step because they want to pursue an academic career. There is a very strong willingness to continue studies abroad, which is even more pronounced among ASP graduates from the Politecnico in Torino (see Tab. 3.11).

However, if we analyse the progression of the employment status of ASP graduates over time, we see a trend towards gradual integration into the job market by those who have

decided to enter the job market (with specular reduction of people seeking employment) and, by contrast, a certain tendency to return to studying.

If we exclude those who have not yet held a job (because their ASP studies have just ended or because they have immediately entered a new study path), the percentage of those who have maintained their first job is quite substantial if we exclude graduates of the first three cycles for which many years have lapsed since their graduation from the Alta Scuola Politecnica.

Graph 3.3 – Employment conditions right after ASP graduation based on cycle

Legend:
- Did not study, did not work and was not looking for work
- Student
- Unemployed
- Still looking for first employment
- Employed
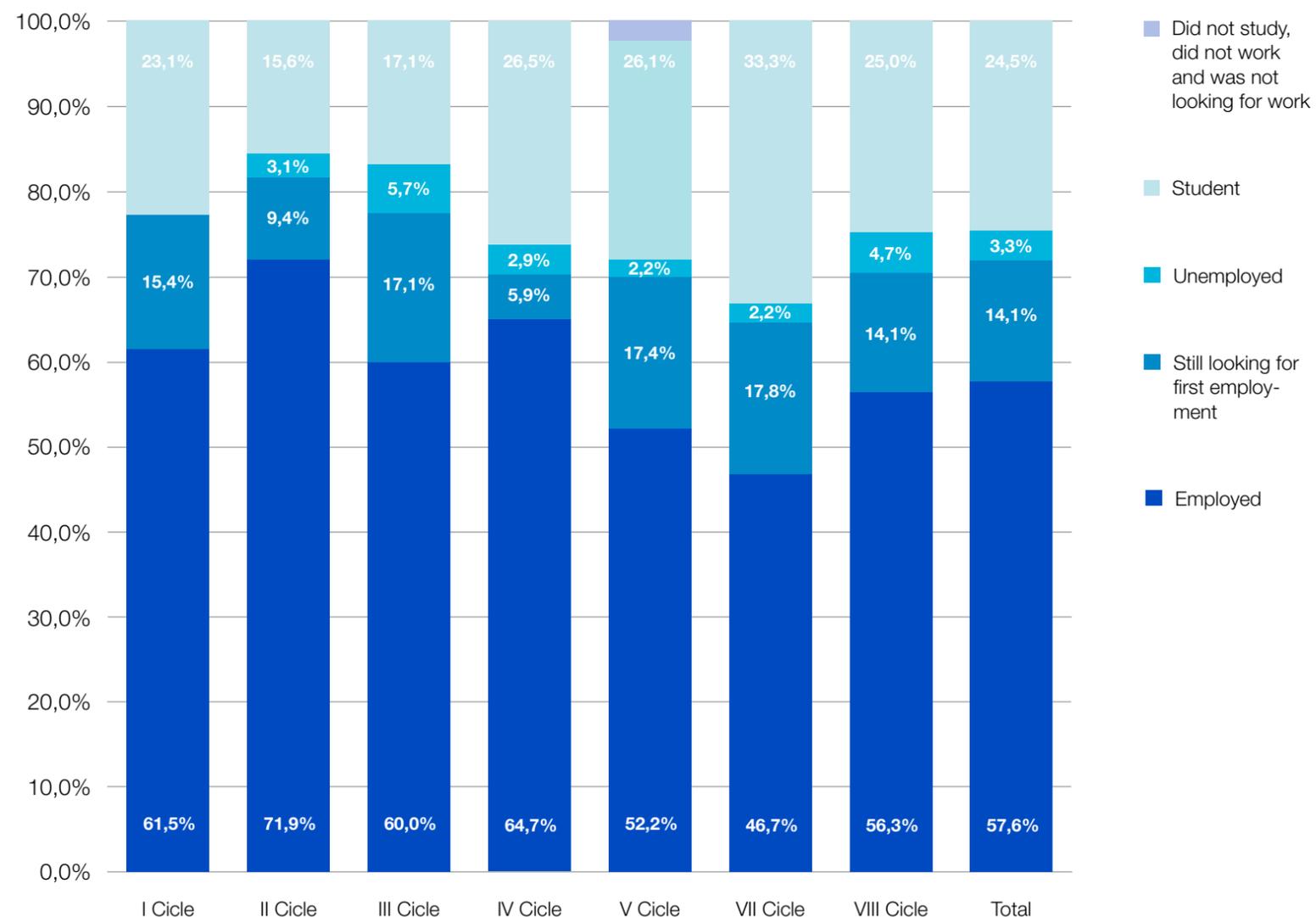
Table 3.10 – Work conditions right after ASP graduation based on disciplinary area and University of origin (%)

From which Politecnico do you come from?	Disciplinary area	Employed (all contractual forms, including those with VAT registration)	Still looking for first employment	Unemployed still looking for employment	Students (including those enrolled in PhD programs and scholarship holders	Did not study, did not work and was not looking for work	Total	No.
Politecnico di Milano	Engineering	63.1	7.7	0.8	28.5	0.0	100.0	130
	Architecture and planning	57.1	22.9	8.6	11.4	0.0	100.0	35
	Design	43.8	18.8	12.5	18.8	6.2	100.0	16
	Total	**60.2**	**11.6**	**3.3**	**24.3**	**0.6**	**100.0**	**181**
	No.	**109**	**21**	**6**	**44**	**1**		**181**
Politecnico di Torino	Engineering	60.3	9.5	3.2	27.0		100.0	63
	Architecture and planning	33.3	47.6	4.8	14.3		100.0	21
	Design	25.0	25.0	0.0	50.0		100.0	4
	Total	**52.3**	**19.3**	**3.4**	**25.0**		**100.0**	**88**
	No.	**46**	**17**	**3**	**22**			**88**
Total	**Engineering**	**62.2**	**8.3**	**1.6**	**28.0**	**0.0**	**100.0**	**193**
	Architecture and planning	**48.2**	**32.1**	**7.1**	**12.5**	**0.0**	**100.0**	**56**
	Design	**40.0**	**20.0**	**10.0**	**25.0**	**5.0**	**100.0**	**20**
	Total	**57.6**	**14.1**	**3.3**	**24.5**	**0.4**	**100.0**	**269**
	No.	**155**	**38**	**9**	**66**	**1**		**269**

Table 3.11 – Place of studies right after ASP graduation based on University of origin (%)

Where were you studying right after ASP graduation?	From which Politecnico do you come from?		Total	No.
	Politecnico di Milano	Politecnico di Torino		
Politecnico di Milano	63.6	4.5	43.9	29
Politecnico di Torino	0.0	27.3	9.1	6
Other Italian university	2.3	13.6	6.1	4
A foreign University	31.8	50.0	37.9	25
Other organization/institution	2.3	4.5	3.0	2
Total	**100.0**	**100.0**	**100.0**	**66**
No.	**44**	**22**		**66**

Graph 3.4 – ASP graduates employed in the various moments based on cycle
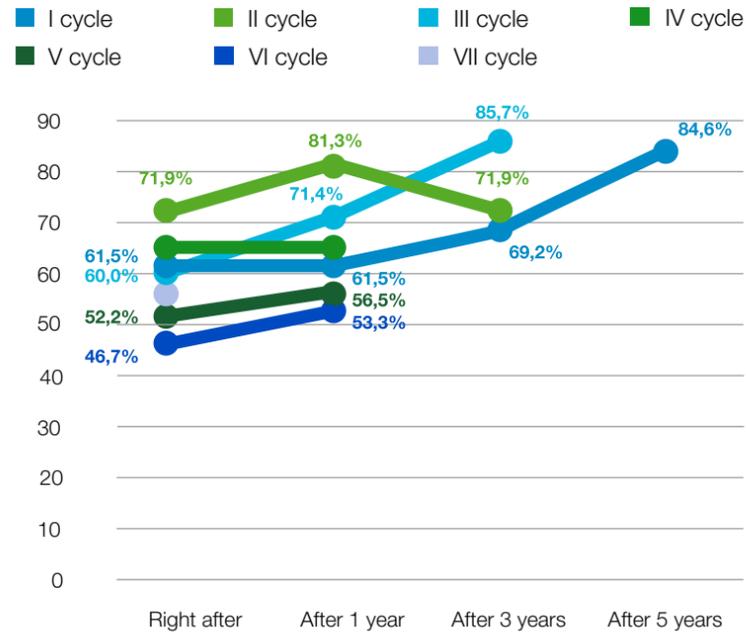
Graph 3.5 – ASP graduates employed in the various moments based on cycle

Once again, the analysis of the motivations shows a certain "strength" of ASP graduates on a whole in the job market since, in half of the cases, the change of job was the result of a choice because in the meantime these graduates found a job with more career opportunities (31.1%), better paying (almost 13%) or more coherent job (5.3%) or because the graduate decided to return to school (13.6%), compared with 1 in 4 who had to find work at the end of a fixed term contract.

Graph 3.6 – ASP graduates not employed in the various moments based on cycle

3.1.3 The main features of employment

A large majority (87.7%) found employment immediately after ASP graduation, with significantly higher amounts of those who entered self-employment among graduates in Architecture and Design compared to Engineering graduates (see Tab. 3.12).

The percentage of permanent employment is just over 27% of total employment, compared to just under one-third with a fixed-term employment contract and lower amounts of semi-subordinate and atypical employment (18%), and formative contracts (about 10%, to which another 10% of formative experiences in work environments such as internships and work placements, which are often carried out abroad, must be added).

However, if the attainment of a more stable position seems to require more time, we also need to point out that in some cases positions of some importance have also been offered

right after graduation: against predominantly self-employed workers who work as freelancers and consultants, among employed workers, more than 13% of the graduates are hired for executive positions, even if the most widely used qualification is that of high-and medium-skilled people (almost 40% of employees).

The perception of the congruence in employment found right after ASP graduation compared to the skills acquired as part of the path compared to those acquired with a master's degree is of great interest. In fact, in face of a low overall proportion of occupations deemed entirely inconsistent, there is a significantly higher sense of coherence compared to the Master's degree path. In other terms, it seems more difficult for a job to "perfectly" adhere to the skills matured during the ASP path, which may partly be due to the fact that the ASP allows to acquire transversal skills related to what has been defined as "polytechnic education" and soft skills (relational and behavioural transversal skills).

Table 3.12 – Type of work right after ASP graduation based on disciplinary area and University of origin

From which Politecnico do you come from?	What type of work did you carry out right after ASP graduation?	Disciplinary area			Total	No.
		Engineering	Architecture and planning	Design		
Politecnico di Milano	Employee	96.3	60.0	42.9	86.2	94
	Self-employment	3.7	40.0	57.1	13.8	15
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**109**
	No.	**82**	**20**	**7**	**109**	**13.8**
Politecnico di Torino	Employee	94.7	66.7	100.0	91.1	41
	Self-employment	5.3	33.3	0.0	8.9	4
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**45**
	No.	**38**	**6**	**1**	**45**	**8.9**
Total	**Employee**	**95.8**	**61.5**	**50.0**	**87.7**	**135**
	Self-employment	**4.2**	**38.5**	**50.0**	**12.3**	**19**
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**154**
	No.	**120**	**26**	**8**	**154**	**12,3**

Graph 3.7 – Coherency of the work performed right after ASP graduation with an ASP diploma and a master's degree based on disciplinary area

Legend: ■ No   ■ Partly   ■ Yes
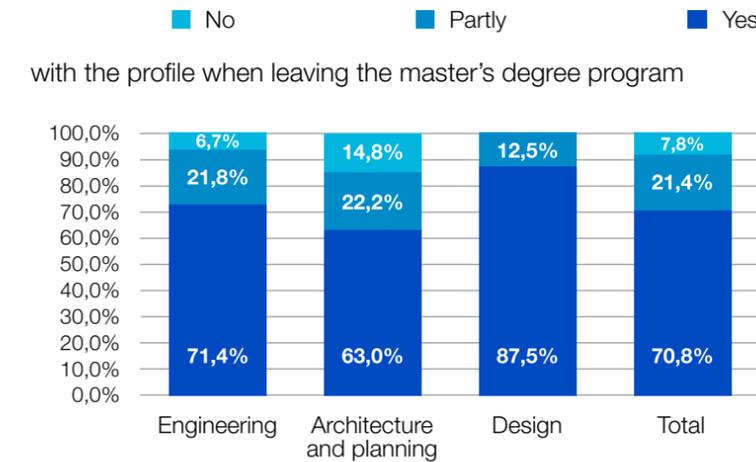
with the profile when leaving the master's degree program

with the skills acquired with the ASP diploma
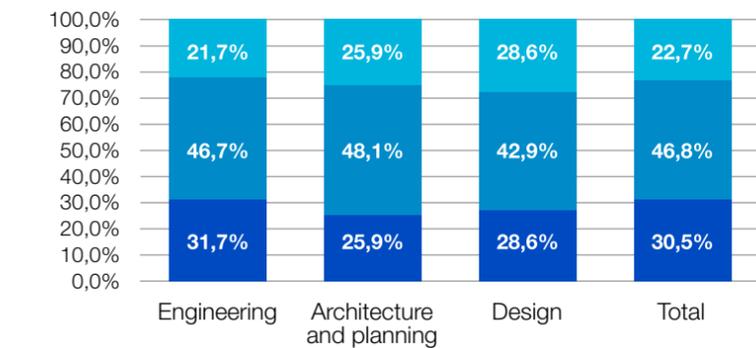
In both cases, these are skills that do not allow to identify professional opportunities specific to the ASP diploma if not, maybe, relative to management and strategic consulting (as highlighted by the analysis of strong and weak elements for the ASP path presented below). Without doubt, this makes it more complicated for ASPers to reason in terms of consistency of the found job with the competences matured during the ASP path. In other words, it seems

that the ASP graduates are struggling to express an opinion on the consistency of employment, not knowing how to relate the "additional ASP skills" to the defined professional opportunity.

Moreover, as we will see later (Section 3.1.4) the respondents do not have doubts that these additional skills have actually been achieved. They also do not have doubts about their choice for a qualified occupation and that they will have better career opportunities in the future.

Box 1– Some comparison data

The *placement* data emerged from the survey shows that it seems interesting to try to contextualize the data relative to job placement and the training choices of ASP graduates that emerged by referring to all graduates from the Politecnico di Milano.

It is important to note that we are not able to make a real comparison for several reasons: the surveys[6] were not always carried out at perfectly equivalent time intervals, the number of graduates in Engineering, Architecture and Design compared to the total population of graduates may not be homogeneous in terms of discipline origin of the ASP graduates (with possible consequence in terms of *placement*) and there are many different "absolute numbers" involved (which becomes much more significant when referring to all graduates of the Politecnico). However, it is an interesting activity that enables to confirm some results that emerged from this survey.

The most "objective" benchmark data seems to be the possible comparison between the survey data and the follow up carried out on the graduates of the first 3 ASP cycles (with reference to only the PoliMi Italian citizen graduates) and those on the total of Italian specialised/master's degree graduates from the Politecnico di Milano inferable from the placement surveys included in the Reports produced by the Assessment group of the University (carried out one year from the degrees obtained in 2007, 2008 and 2009 and approximately 1 and a half/two years for the 2010 graduates), while reference to the results of this survey was made for data relative to ASP graduates from the IV cycle.

Out of the total specialised graduates of 2007, at the time of the interview the percentage of those employed was equal to 88.3% compared to 5.7% of the subjects looking for their first or new employment and 5.5% of the students. When taking into consideration the sole component that really entered the job market, net of the students and inactive subjects, the percentage of employed people jumps to 93.9%. The survey data on ASP graduates from the I cycle (who concluded the path in 2007) show 73% employed subjects, 3.2% of the subjects looking for their first employment and 23.8% students. Again, in this case, if we remove the amount of students and inactive subjects, the employment rate jumps to 95.8%.

If we take into consideration the total amount of specialised/master's degree graduates from the PoliMi of the subsequent year, 2008, 7.2% continues to study (74% are enrolled in a PhD) and the total number of people employed in the labour force is 92% (98% engineers, 88% architects, 91% designers), while among the graduates of the II cycle, 32.6% are students, and the employment rate is equal to 96.8%.

The 2009 specialised/master's degree graduates from the Politecnico of Milan, 8.3% continued with their studies (8 out of 10 cases continued with a PhD), while the employment rate (only compared to the labour force) is 94% (98% Engineers, 88% Architects and 91% Designers). The results of the ASP graduates of the third cycle, which concluded the Alta Scuola Politecnica in 2009, again with reference only to the PoliMi components, 21.2% are students and there is an employment rate of 97.6%.

On the other hand, if we refer to the 2010 graduates, the last for which information from the university is available, the placement survey shows a share of students equal to 8.8% and an employment rate, if we only consider the

"work force" (employed + unemployed and those looking for their first job), of 93%. While, the ASP graduates of the IV cycle, who completed the path in 2010, at 1 year from graduation the percentage of students jumps to 35.3% and the occupation rate, calculated according to the same criteria, is equal to 100%.

Finally, we should make a note of the stable employment found: among the specialised/master's degree graduates from the PoliMi, those employed with a permanent contract on the total number of workers employed are 45% among graduates in 2007, 38.8% among those of 2008, 42.2% among those of 2009 and 36.4% among those of 2010; while the survey of ASP graduates from the first three cycles shows that the overall amount of those with stable work is equal to 62.9% for graduates of the I cycle, to 73.9% for the II cycle, 33.3% among those of the III cycle, and about 40% among those of the IV cycle.[7]

Therefore, all the methodological limitations already expressed, the comparison proposed seems to show, on the one hand, *confirmation of the absence of significant problems for ASP graduates to enter the job market compared to their colleagues who graduated from the Politecnico (in terms of the probability of inclusion, and with respect to employment stability), and, on the other hand, it shows a much stronger propensity to pursue university studies compared to their colleagues, probably in part related to the input selection made on ASP graduates.*

3.1.4 The distinctive features of the ASP path

In order to better interpret the information collected with respect to the transition to employment and employment features, we considered it useful to examine the distinguishing features of the ASP path and the added value offered compared to the master's program and if there is really a professional file (what it consists of) when graduating from the ASP.

Compared to the reference professional figure of the degree course (Engineer, Architect, Planner or Designer), about 80% of the students (regardless of relevance to the University of origin, disciplinary area or cycle of reference), it is believed that the ASP has given added value (in terms of different skills).

The Alumni see this added value mainly as the acquisition of transversal skills (the ability to working teams, ability to solve and analyse problems, etc.) and in the multidisciplinary approach (respectively 92% and 85% approximately), while only slightly more than half of the graduates believe that the ASP offers added value in terms of an international and innovative focus.[8]

In particular, it was found that the ASP graduates believe (with no significant differences according to the cycle of reference) that having attended the Alta Scuola Politecnica was (somewhat or very) useful, compared to their colleagues who completed the master's degree at the Politecnico but that were in the same university course (Engineering, Architecture and Planning, Design), primarily due to the acquisition of additional skills useful for enhancing employment opportunities of their profession (over 75%), but, in fact, did not represent an added value for finding a job consistent with the professional figure (Engineer/Architect/Planner/Designer) graduating from the respective degree courses (approximately 30%).

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6   These are census-type surveys that involved only Italian graduates, among which ASP graduates could be included (the variable was not originally detected), but this would be a very small number of subjects compared to the total number of respondents, that does not invalidate the overall data.

7   In this case, it is recommended to always use caution when interpreting the data, because of a relatively small number of ASP graduates involved in the survey.

8   Less than 2% of graduates make reference to another value added, mainly linked to the size of the elitist school (the guarantee of being "top student"), the relationship with the business world and networking.

Table 3.13 – Added value of the ASP path compared to the professional figure of the master's degree program based on disciplinary area and University of origin (%)

Added value	University	Disciplinary area			Total
		Engineering	Architecture and planning	Design	
Transversal skills	Politecnico di Milano	92.3	93.3	91.7	92.5
	Politecnico di Torino	95.9	82.4	66.7	91.3
	Total	**93.5**	**89.4**	**86.7**	**92.1**
Greater focus on innovation	Politecnico di Milano	51.0	56.7	41.7	51.4
	Politecnico di Torino	53.1	58.8	66.7	55.1
	Total	**51.6**	**57.4**	**46.7**	**52.6**
More international approach	Politecnico di Milano	59.6	46.7	58.3	56.8
	Politecnico di Torino	49.0	35.3	100.0	47.8
	Total	**56.2**	**42.6**	**66.7**	**54.0**
Multidisciplinary approach	Politecnico di Milano	83.7	83.3	91.7	84.2
	Politecnico di Torino	89.8	88.2	66.7	88.4
	Total	**85.6**	**85.1**	**86.7**	**85.6**
Other (specify)	Politecnico di Milano	1.9	6.7	0.0	2.7
	Politecnico di Torino	0.0	0.0	33.3	1.4
	Total	**1.3**	**4.3**	**6.7**	**2.3**

57% of the Alumni believe that the additional skills acquired from the ASP path (evidently different from the skills acquired from a master's degree study) are needed for a quick transition into the job market once school is completed (with a lower perception of this usefulness in Architects and Planners), while the proportion of graduates who consider that the ASP can offer added value in finding stable employment was significantly lower (on average less than one-third, with rates much lower for Architects, Planners and Designers, as shown in Tab. 3.14).

Finally, approximately half of the graduates give the ASP path additional usefulness in order to obtain skilled pro-

fession (from a professional position point of view), work abroad and better career prospects in the medium to long term (more than 10 years after graduation).

When faced with an item that explicitly asked if they felt that the professional opportunities for the ASP graduate was different than that of the master's degree of reference, we found that there was differentiation in the positions of the various Alumni: 43% feel that there is a difference compared to the approximate 20% who do not see differences in career opportunities or, instead, believe that, in fact, there is a preference for ASP graduates.

Graph 3.8 – Compared to colleagues who obtained the same master's degree in the same university course from the Politecnico, attending the ASP was useful because... based on University of origin

Legend: ■ Total   ■ Politecnico di Torino   ■ Politecnico di Milano

Working abroad: 52,8% / 46,6% / 55,8%

Better career prospects in the medium to long term: 54,6% / 52,3% / 55,8%

Obtain skilled job: 49,4% / 43,2% / 52,5%

Find work that is consistent with the professional figure master's degree course: 30,5% / 27,3% / 32,0%

Obtain stable employment: 35,7% / 43,2% / 32,0%

Additional skills that are useful for entering the work force right away: 57,2% / 53,4% / 59,1%

Skills to enhance employment opportunities for the professional figure: 76,6% / 77,3% / 76,2%

Table 3.14 – Compared to colleagues who obtained the same master's degree in the same university course from the Politecnico, attending the ASP was useful because... based on disciplinary area

	Disciplinary area			Total
	Engineering	Architecture and planning	Design	
Skills to enhance employment opportunities for the professional figure	74,6	82.1	80.0	76.6
Additional skills that are useful for entering the work force right away	60.6	44.6	60.0	57.2
Obtain stable employment	40.4	8.9	15.0	32.0
Find work that is consistent with the professional figure master's degree course	31.1	25.0	40.0	30.5
Obtain skilled job	54.9	32.1	45.0	49.4
Better career prospects in the medium to long term	54.4	53.6	60.0	54.6
Working abroad	51.8	58.9	45.0	52.8
(No.)	193	56	20	269

Table 3.15 – You believe that the privileged professional opportunities for the ASP graduate are… based on disciplinary area and University of origin

From which Politecnico do you come from?	You believe that the privileged professional opportunities for the ASP graduate are:	Disciplinary area			Total	No.
		Engineering	Architecture and planning	Design		
Politecnico di Milano	The same that can be achieved from a master's degree	16.9	28.6	43.8	21.5	39
	A different opportunity compared to the master's degree	41.5	42.9	43.8	42.0	76
	There are not privileged opportunities	25.4	20.0	6.2	22.7	41
	Don't know / prefers not to give an answer	16.2	8.6	6.2	13.8	25
	Total	100.0	100.0	100.0	100.0	181
	No.	130	35	16	181	
Politecnico di Torino	The same that can be achieved from a master's degree	17.5	28.6	0.0	19.3	17
	A different opportunity compared to the master's degree	47.6	33.3	75.0	45.5	40
	There are not privileged opportunities	17.5	19.0	25.0	18.2	16
	Don't know / prefers not to give an answer	17.5	19.0	0.0	17.0	15
	Total	100.0	100.0	100.0	100.0	88
	No.	63	21	4	88	
Total	The same that can be achieved from a master's degree	17.1	28.6	35.0	20.8	56
	A different opportunity compared to the master's degree	43.5	39.3	50.0	43.1	116
	There are not privileged opportunities	22.8	19.6	10.0	21.2	57
	Don't know / prefers not to give an answer	16.6	12.5	5.0	14.9	40
	Total	100.0	100.0	100.0	100.0	269
	No.	193	56	20	269	

Table 3.16 – You believe that the privileged professional opportunities for the ASP graduate are… based on cycle and University of origin

From which Politecnico do you come from?	You believe that the privileged professional opportunities for the ASP graduate are:	ASP cycle			Total	No.
		I-II-III cycle	IV-V cycle	VI-VII cycle		
Politecnico di Milano	The same that can be achieved from a master's degree	30.9	19.6	16.2	21.5%	39
	A different opportunity compared to the master's degree	36.4	41.3	46.2	42.0%	76
	There are not privileged opportunities	21.8	23.9	22.5	22.7%	41
	Don't know / prefers not to give an answer	10.9	15.2	15.0	13.8%	25
	Total	100.0	100.0	100.0	100.0%	181
	No.	55	46	80	181	
Politecnico di Torino	The same that can be achieved from a master's degree	20.0	17.6	20.7	19.3%	17
	A different opportunity compared to the master's degree	48.0	50.0	37.9	45.5%	40
	There are not privileged opportunities	20.0	14.7	20.7	18.2%	16
	Don't know / prefers not to give an answer	12.0	17.6	20.7	17.0%	15
	Total	100.0	100.0	100.0	100.0%	88
	No.	25	34	29	88	
Total	The same that can be achieved from a master's degree	27.5	18.8	17.4	20.8%	56
	A different opportunity compared to the master's degree	40.0	45.0	44.0	43.1%	116
	There are not privileged opportunities	21.2	20.0	22.0	21.2%	57
	Don't know / prefers not to give an answer	11.2	16.2	16.5	14.9%	40
	Total	100.0	100.0	100.0	100.0%	269
	No.	80	80	109	269	

3.1.5 The expectations and satisfaction level of the alumni

At the time of enrolment, the expectations of the future Alumni were quite diversified: more than one quarter believed of the prospect of attending a path that was more "international" compared to the master's degree and a similar proportion aimed to choose a path that would guarantee good career prospects. Approximately one out of five wanted to attend the Alta Scuola Politecnica to develop their education on topics of interest, while a much lower number (10% of responses) were attracted to the ASP simply for the purpose of *placement*. Finally, approximately 5% enrolled in the school for other expectations related to the desire to attend a "different" path

Graph 3.9 – Satisfaction level of expectations at the time of enrolment at the ASP based on the type of expectation

Legend: ■ Very ■ Quite agree ■ Slightly agree ■ Not at all ■ Doesn't know /no answer

- Total: 27,5% | 48,6% | 16,6% | 0,4%
- Guarantees of job placement: 18,5% | 40,7% | 14,8% | 22,2% | 3,7%
- Good career prospects: 25,7% | 44,6% | 20,3% | 9,5%
- Further education on topics of interest: 27,1% | 54,2% | 15,3% | 3,9%
- Attending an international course: 31,1% | 50,0% | 16,2% | 2,4%
- Other: 38,5% | 53,8% | 7,7%

0,0%   10,0%   20,0%   30,0%   40,0%   50,0%
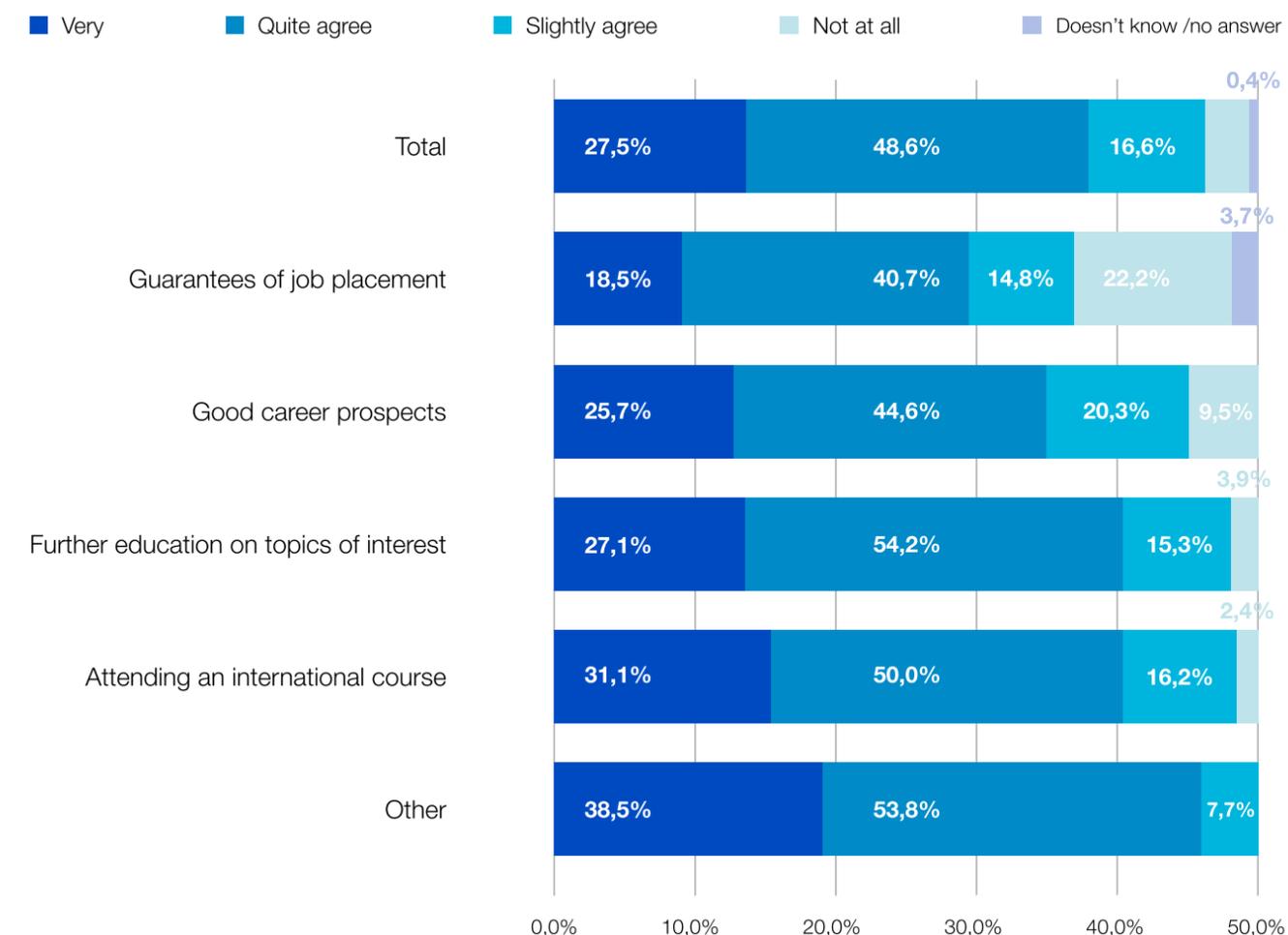
Table 3.17 – Main expectations at the time of ASP enrolment based on disciplinary area and University of origin (%)

From which Politecnico do you come from?	What were your main expectations when you enrolled at the ASP? (indicate the prevailing expectation)	Disciplinary area			Total	No.
		Engineering	Architecture and planning	Design		
Politecnico di Milano	Attending an international course	31.5	22.9	37.5	30.4	55
	Further education on topics of interest	17.7	28.6	25.0	20.4	37
	Good career prospects	27.7	31.4	12.5	27.1	49
	Guarantees of job placement	9.2	8.6	6.3	8.8	16
	Other	4.6	5.7	12.5	5.5	10
	Doesn't know/No answer	9.2	2.9	6.3	7.7	14
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**181**
	No.	**130**	**35**	**16**	**181**	**130**
Politecnico di Torino	Attending an international course	19.0	19.0	75.0	21.6	19
	Further education on topics of interest	28.6	19.0	,0	25.0	22
	Good career prospects	30.2	23.8	25.0	28.4	25
	Guarantees of job placement	9.5	23.8	0.0	12.5	11
	Other	4.8	,0	0.0	3.4	3
	Doesn't know/No answer	7.9	14.3	0.0	9.1	8
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**88**
	No.	**63**	**21**	**4**	**88**	
Total	**Attending an international course**	27.5	21.4	45.0	27.5	74
	Further education on topics of interest	21.2	25.0	20.0	21.9	59
	Good career prospects	28.5	28.6	15.0	27.5	74
	Guarantees of job placement	9.3	14.3	5.0	10.0	27
	Other	4.7	3.6	10.0	4.8	13
	Doesn't know/No answer	8.8	7.1	5.0	8.2	22
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**269**
	No.	**193**	**56**	**20**	**269**	

instead of the master's degree ("to broaden my horizons", "attend a school with a broader perspective and that was multidisciplinary compared to a normal degree") and that had excellent features ("attend a school of excellence that offered something in addition to my basic course"), or due to the ASP networking ("get in touch with international students", "get to know smart people who are motivated and full of passion", "to meet and make friends

Table 3.18 – Satisfaction level of expectations at the time of enrolment at the ASP based on disciplinary area and University of origin (%)

From which Politecnico do you come from?	What were your main expectations when you enrolled at the ASP? (indicate the prevailing expectation)	Disciplinary area			Total	No.
		Engineering	Architecture and planning	Design		
Politecnico di Milano	Very	30.5	20.6	13.3	26.9	45
	Fairly	44.9	61.8	53.3	49.1	82
	Little	17.8	14.7	26.7	18.0	30
	Not at all	6.8	2.9	6.7	6.0	10
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**167**
	No.	**118**	**34**	**15**	**167**	
Politecnico di Torino	Very	31.0	22.2	25.0	28.8	23
	Fairly	48.3	44.4	50.0	47.5	38
	Little	12.1	16.7	25.0	13.8	11
	Not at all	6.9	16.7	0.0	8.8	7
	Doesn't know/No answer	1.7	0.0	0.0	1.3	1
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**80**
	No.	**58**	**18**	**4**	**80**	
Total	**Very**	**30.7**	**21.2**	**15.8**	**27.5**	**68**
	Fairly	**46.0**	**55.8**	**52.6**	**48.6**	**120**
	Little	**15.9**	**15.4**	**26.3**	**16.6**	**41**
	Not at all	**6.8**	**7.7**	**5.3**	**6.9**	**17**
	Doesn't know/No answer	**,6**	**0.0**	**0.0**	**0.4**	**1**
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**247**
	No.	**176**	**52**	**19**	**247**	

Table 3.19 – Strong points in the ASP path based on cycle and disciplinary area (%)

	Multidisci-plinarity	Interna-tional approach	Peer group compo-sition (multicultural, different Universities and degrees)	Net-working	Projects	Team work	Innovation	Elitist envi-ronment of excellence	Contacts with com-panies	Other	No.
				Cycle							
I-II-III cycle	38.8	20.0	12.5	18.8	5.0	10.0	2.5	7.5	7.5	6.3	80
IV-V cycle	38.8	21.3	8.8	23.8	6.3	5.0	6.3	20.0	5.0	3.8	80
VI-VII cycle	33.0	15.6	7.3	22.0	9.2	19.3	7.3	18.3	6.4	6.4	109
Total	**36.4**	**18.6**	**9.3**	**21.6**	**7.1**	**12.3**	**5.6**	**15.6**	**6.3**	**5.6**	**269**
				Disciplinary area							
Engineering	32.1	17.6	9.8	21.8	6.2	11.4	5.7	18.7	5.2	4.1	193
Architecture and planning	46.4	17.9	5.4	19.6	3.6	14.3	5.4	10.7	8.9	7.1	56
Design	50.0	30.0	15.0	25.0	25.0	15.0	5.0		10.0	15.0	20
Total	**36.4**	**18.6**	**9.3**	**21.6**	**7.1**	**12.3**	**5.6**	**15.6**	**6.3**	**5.6**	**269**
				University of origin							
Politecnico di Milano	38.7	18.8	11.6	25.4	8.8	13.3	5.5	12.2	7.2	5.5	181
Politecnico di Torino	31.8	18.2	4.5	13.6	3.4	10.2	5.7	22.7	4.5	5.7	88
Total	**36.4**	**18.6**	**9.3**	**21.6**	**7.1**	**12.3**	**5.6**	**15.6**	**6.3**	**5.6**	**269**

Table 3.20 – Weak points in the ASP path based on cycle and disciplinary area (%)

	Not well known in Italy	Not well known abroad	Not very effective for in-sertion into the job market	Organisatio-nal limits	Poor quality of courses	Limits in the ASP projects	Focus only on Engineers	Other	No.
				Cycle					
I-II-III cycle	12.5	2.5	7.5	10.0	21.3	10.0	8.8	5.0	80
IV-V cycle	7.5	1.3	13.8	15.0	16.3	5.0	12.5	6.3	80
VI-VII cycle	8.3	7.3	10.1	16.5	18.3	7.3	11.0	4.6	109
Total	9.3	4.1	10.4	14.1	18.6	7.4	10.8	5.2	**269**
				Disciplinary area					
Engineering	11.9	4.7	11.9	14.5	20.7	8.3	3.6	4.1	193
Architecture and planning	0.0	3.6	7.1	14.3	8.9	5.4	33.9	3.6	56
Design	10.0	0.0	5.0	10.0	25.0	5.0	15.0	15.0	20
Total	9.3	4.1	10.4	14.1	18.6	7.4	10.8	5.6	**269**
				University of origin					
Politecnico di Milano	7.2	2.8	10.5	15.5	19.9	9.4	11.6	6.1	181
Politecnico di Torino	13.6	6.8	10.2	11.4	15.9	3.4	9.1	3.4	88
Total	9.3	4.1	10.4	14.1	18.6	7.4	10.8	5.2	**269**

with people who have a high profile and with a different background than mine"), and partly for "practical" reasons ("take advantage of the scholarship", "have support of the residence"), with no significant changes over time (and among the graduates of different cycles) and with a more marked attention to employment (probability of inclusion and quality of the work) among graduates in Engineering, Architecture and Planning compared to Designers, who were more focused on the international dimension.[9]

On average, for 76% of the Alumni involved in the survey

these expectations were satisfied overall (very or fairly), with a more positive perception for those who enrolled with the believe that they would find a path that was more international than the master's degree and that would en-able to enrich the skills more specific to their profile with other aspects of interest, the expectations in terms of the added value on the professional level with respect to ca-reer prospects (70%) was low and, this was even lower, in relation to the guarantees of job placement (less than 60%).

The greater level of satisfaction is found among by Engi-neers, followed by Architects and, in last place, by De-signers, while there is not a significant difference based on the Politecnico of origin (see Tab. 3.18).

Among the strengths of the ASP path, in the perception of the students who attended,[10] is the multidisciplinary approach of the ASP path, followed by the networking capabilities and the international tendency of the path (evi-denced also by the decision to study the path in English). It is also significant that approximately 15% of the graduates have attributed the elitist path of excellence to the image of the ASP especially in terms of its ability to select talent who are offered the opportunity to concretely collaborate with each other on projects of interest (see Tab. 3.19).

In contrast, the items of greatest weakness seem to be the poor quality of the courses (for some these are too theoretical, others believe that they are not interesting,

and others believe that the courses are too generic, etc.) that are limited in terms of organisation (primarily related to the conciliation of lessons with exam sessions of the master's degree and, in any case, the presence of exces-sive and bureaucratic rigidity), the lacking effectiveness of the School in terms of *placement*, such as concrete support to graduates entering the job market and an im-balance for Engineering and consulting, with obvious dis-advantages in terms of the usefulness of the school for Architects, Planners and Designers (especially in relation ASP corporate sponsors and project partners).

Another factor of great importance is that more than one out of three graduates deem that a weak point of the ASP is its scarce recognition both Italy and abroad. Indicating that there is an absence of a "brand" or a strong "brand" of the ASP.

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9   However, it should be noted that the disaggregated data for the mater's degree needs to be interpreted with some caution given the numerical imbalance highlighted in the introduction and, in particular, the low number of Design graduates.

10 ASP graduates were asked, in the form of an open question, to ex-press the strengths and weaknesses of the ASP path, which were then retrospectively recoded based on the answers.

3.1.6 The alumni network

The interaction with the ASP Alumni Association seems to acquire meaning and motivation gradually while one progresses the ASP path. In fact, the Association does not seem to be a reference point for those who have decided to enrol at ASP before this decision is final (less than 10% have occasional contacts) or as soon as the path starts (approximately 25% have had contact, almost always occasional), while it acquires a greater role during the two years (as an occasion for dialogue amongst peers, to have specific information and to resolve organisational problems but also as a professional network) and, especially, right after graduation when choices regarding the professional or learning future of the graduates since the reasons that lead to contact are mainly related to the fact that the As-

sociation is considered a useful network when entering the work world and to find jobs abroad or in an international company (see graph 3.10 and Tab. 3.22).

Moreover, the assessment of the usefulness of the Association at the various stages also confirms this: the average rating assigned on a scale of 1 to 10 is lower than sufficient before and right after enrolment, equal to 6.7 during the two years and grows to 7.5 right after graduation (see Tab. 3.21).

Overall, only one quarter of the ASP graduates have never interacted with the ASP Alumni Association, never registered to the website[11] or never had other direct or indirect contact. After all, only a small group of Alumni, as already shown in the table above, has a more active participation in the Association, while the majority is limited to more spo-

Table 3.21 – Average rating assigned to the usefulness of the ASP Alumni Association based on the phase of the ASP path, disciplinary area, cycle and University of origin

	For those thinking about enrolling to the ASP	Newcomers to the ASP	For ASP students	For ASP graduates
Politecnico di Milano	5.66	5.80	6.60	7.50
Politecnico di Torino	5.98	6.30	7.00	7.52
Engineering	5.81	6.01	6.82	7.54
Architecture and planning	6.06	6.20	6.67	7.45
Design	4.58	5.00	6.11	7.32
I-II-III cycle	6.21	6.31	6.97	7.58
IV-V cycle	5.96	5.95	7.00	7.19
VI-VII cycle	5.32	5.74	6.37	7.69
Total	**5.77**	**5.97**	**6.73**	**7.51**

11 In the majority of cases, those who did not register on the website do not give a reason for not doing so. Students of the last cycle who thought about enrolling and the small number of Graduates who do not feel that this type of networking is not useful or who have not thought about registering because of a lack of time or who, for logistic reasons, were not able to participate in the network are excluded.

Table 3.22 – Interaction with the ASP Alumni Association based on the phase of the ASP path and University of origin

		From which University do you come from?		Total	No.
		Politecnico di Milano	Politecnico di Torino		
Before enrolling to the ASP	No contact	92.0	87.3	90.4	170
	Occasional contacts	8.0	11.1	9.0	17
	Frequent contacts	0.0	1.6	0.5	1
	No.	125	63	188	
Right after enrolment to the ASP (approximately during the first 3 months)	No contact	74.1	73.7	74.0	165
	Occasional contacts	23.8	26.3	24.7	55
	Frequent contacts	2.0	0.0	1.3	3
	No.	147	76	223	
During the ASP path (excluding the first months)	No contact	49.1	38.4	45.5	115
	Occasional contacts	43.7	45.3	44.3	112
	Frequent contacts	7.2	16.3	10.3	26
	No.	167	86	253	
Right after obtaining the ASP diploma	No contact	28.1	27.3	27.8	74
	Occasional contacts	53.9	50.0	52.6	140
	Frequent contacts	18.0	22.7	19.5	52
	No.	178	88	266	

radic interaction: 49% participated in some events, 44.6% had contact by e-mail, 7% through Facebook and social networks, and only 3.7% participated in all (or almost all) the events offered/organized.

However, apart from the ASP Alumni Association, the ASP path leaves a "a legacy of contacts", especially with stu-

dents from other disciplines (92.7%) and other universities (79.5%), which is less with foreign ASPers (62.5%) or other cycles (51.3%), even though the ASPers with which the graduates have remained friends and have constant contact in real life is not very many (on average, less than 10).

Graph 3.10 – Reasons for contacting the ASP Alumni Association based on phases of the ASP path

■ Before enrolling to the ASP   ■ Right after enrolment to the ASP   ■ During the ASP path   ■ Right after ASP graduation
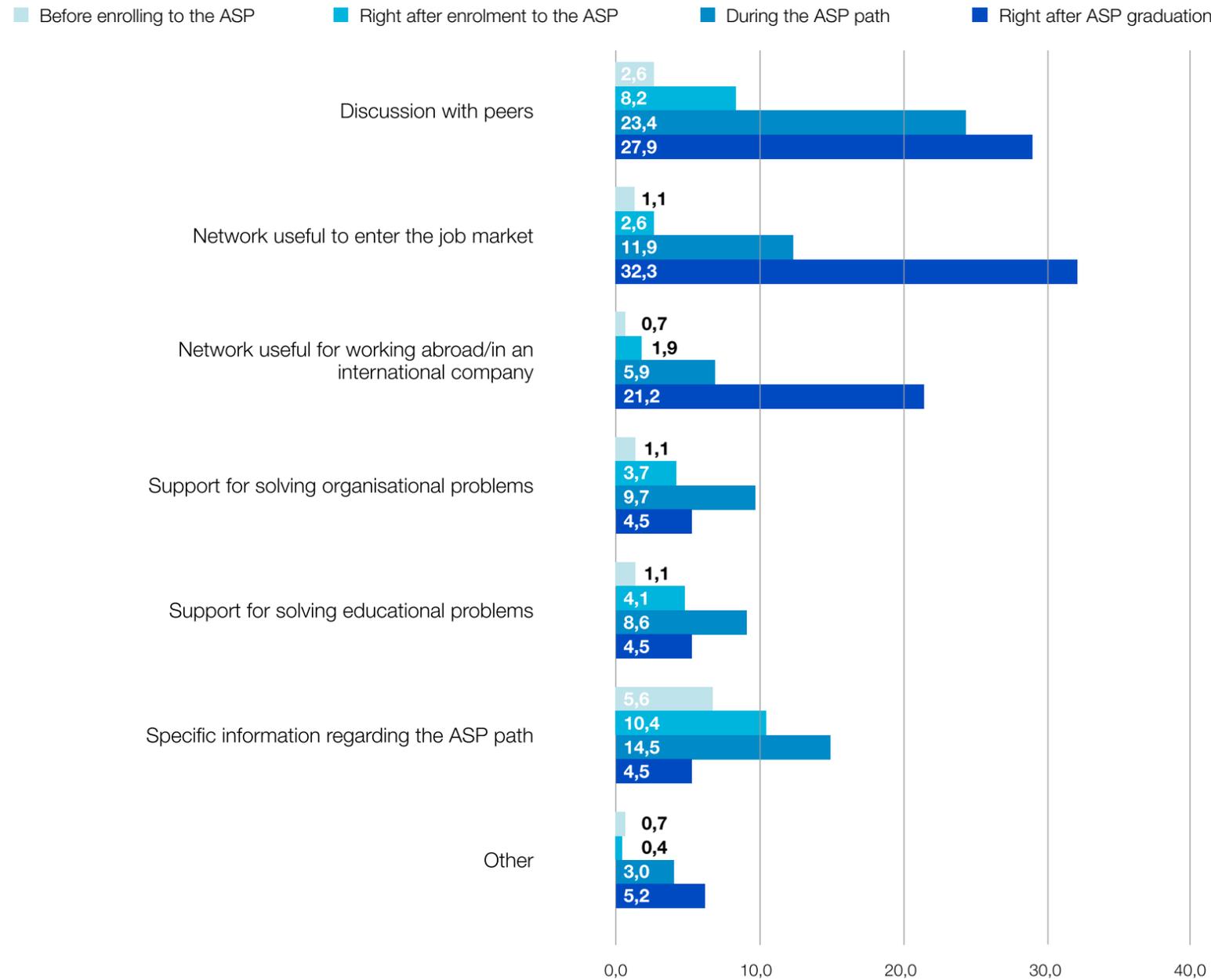
Box 2 – Foreign ASP graduates

Out of the 101 ASP graduates of a nationality other than Italian, 26 participated in the survey by filling out the questionnaire. Although this is a proportion of graduates that is not representative of foreign ASPers, we considered it appropriate to provide key information with specific reference to the "international" component of the graduates in order to account for any differences in the results, attitudes and behaviour of this subgroup with specific characteristics.

Right after the conclusion of the ASP path, 53.8% are already employed and 27% are looking for a new or their first job, compared to 19.2% who decided to continue studies with a tendency to enter the job market immediately after the end of higher studies compared to their Italian colleagues, without a difference between the two Universities. Those who continue to study (Engineers more than others) do so mainly with a PhD and, in 3 out of 4 cases, remain at either the Politecnico di Torino or in Milano instead of choosing another university abroad.

Table 3.23 – Employment conditions of foreign students right after ASP graduation based on disciplinary area

Disciplinary area	Employment conditions right after ASP graduation				Total	No.
	Employed	Still looking for first employment	Unemployed still looking for employment	Student		
Engineering	54.5	-	9.1	36.4	100.0	11
Architecture and planning	62,5	12.5	25.0		100.0	8
Design	42.9	28.6	14.3	14.3	100.0	7
Total	53.8	11.5	15.4	19.2	100.0	26
No.	**14**	**3**	**4**	**5**	**26**	

As reported regarding the total respondents of the survey, the majority of the respondents (10 out of 25) are graduates from the VII cycle[12] and graduates from the Politecnico di Milano (17 vs. 9 from Torino); 11 are Engineers, 8 Architects and 7 Designers, more than half (15 out of 25) are women, mainly distributed in master's degree courses in Design (7 out of 7), Architecture (6 out of 8), while the Engineer graduates are mostly men (9 out of 11).

All of these graduates are employed: 42.9% of the foreign graduates with permanent employment, 28.6% have fixed-term employment and another 14.3% have a foreign contract (in one case this contract was for permanent employment and in another it had permanent duration), while another 14.3% of the cases were on the job training. The functions carried out mainly pertain to design (one-third), R & D (one-fifth) and commerce (one-fifth), with a strong presence in the areas of Information and Communication and Professional, scientific and technical activities in the private

12 The other participants in the survey are: 3 from the II cycle, 1 from the III cycle, 3 from the IV cycle, 6 from the V cycle and 3 from the VI cycle.

sector rather than in the public sector (*especially in important companies*). *Half of the foreign employees found work abroad* and just over one-third remained to work in Lombardy or in Piedmont, compared to a lower number that remained in Italy and moved to other regions. 30.8% for the work is fully congruent with the skills acquired with the ASP Diploma and for 53.8% it is at least in part congruent with these skills, while the coherence with the professional profile upon graduation from the master's degree course is respectively 61.5% and 15.4%.

Among the *reasons that led foreign students to attend the ASP,* there is, especially, the desire to follow a path that offers a good possibility of a career (30.8%), but also the willingness to enter an international course and strengthen the training on topics of interest (both 26.9%), while almost nothing pushes to find a job through the ASP. Overall, 73.1% have satisfied (very or somewhat) their expectations, recognizing in almost all cases the ability of the Alta Scuola Politecnica to offer an added value, in terms of skills, compared to the reference professional figure of the relative degree courses (engineer, architect, planner or designer). *For 9 out of 10, the added value is represented by the multidisciplinary approach, for 8 out of 10 by transversal skills,* while just over half refer to innovation.

The strengths indicated by foreign graduates are quite in line with those of the overall Italian colleagues (multidisciplinary, international approach, networking and team work), while among the elements of weakness, in addition to the already seen criticism of the excessive focused attention on engineers and consultants and some organizational limits, foreign graduates complain of the fact that there is a penalty for foreign students (including the use of Italian rather than English in the working groups) and the limit of an international approach that should actively promote international relationships and not just "recruit" students.

Finally, in terms of contacts with the ASP Alumni Association, more than half of the graduates had contacts during the two-year attendance or right after obtaining the diploma, but these were mainly occasional contacts via e-mail or by registering at the Alumni website.

3.2 An in-depth study with the Alumni

The viewpoint of graduates was investigated through a focus group organized in collaboration with ASP Alumni (Association of Former Students of the Alta Scuola Politecnica) founded in June 2007 and that currently has more than 700 members in approximately 20 countries around the world.

The group of respondents

Before entering discussion, it is appropriate to address some of the master information in order to contextualise the considerations below. The 8 graduates who participated in the Focus Group (5 males and 3 females) strongly participated in the Association (5 of them were members of the Board) and therefore, it is a rather homogeneous and coherent group in terms of internal relations, although not from the point of view of the ASP vision, as will be seen below.

Half of there are 27 years old, one is 25 years old and the other three are respectively 39, 30 and 32 years old. They are Italian, except for one foreign graduate. Almost all of them (7 graduates) attended the Politecnico di Milano (5 Engineering, 1 Architecture and 1 Design). The one graduate who attended the Politecnico di Torino is an Engineering graduate. As will be seen below, the strong representation of Engineers is not casual, but may be considered explanatory of the particular impact that the ASP has on graduates in this area.

From the job placement point of view, this is a very diversified group. Except for one person who graduated 5 years ago and another who graduated 1 year ago, the others all graduated from the ASP 2,3 and 4 years ago. That said, they all have a job as employees: 5 with permanent employment and 3 with an apprenticeship contract. The positions covered are quite good: 1 manager, 2 middle managers, 1 highly qualified technician and 4 highly qualified employees. This should be emphasized because the path of the graduate that we have classified as "manager" is quite explanatory. In truth, this is a highly qualified employee attending a full-time MBA course, at the conclusion of which there will be a shift to senior management. On the other hand, one of the young people with an apprenticeship contract is attending a postgraduate specialisation course at the Politecnico di Torino.

Moreover, it is interesting to see that 7 out of 8 graduates work in important companies with more than 250 employees, and only 1 graduate works in a small company (less than 50 employees). From the point of view of employment sectors, 5 work in "professional, scientific and technical businesses", 2 work in "Manufacturing" and 1 works in "IT and communication services".

The places of work are Lombardy (5), Piedmont (2) and another EU country (1). In none of the 8 cases are these companies of which these graduates were aware during the ASP path. In fact, 4 cases were found through an independent initiative, 2 cases were intermediated by the ASP Alumni network of contacts and only in 2 cases was there direct contact from the companies.

Why choose the ASP?

The reasons behind the choice of the ASP are fairly homogeneous among the respondents, but not considered to be representative of the majority of ASP aspiring students. If, in fact, for the respondents the main reason is due to the opportunity to enter into a "more elite" course of study, it is clear, however, for some of them, the economic dimension is of importance ("I had a considerable economic advantage: the fact of having housing was what made me decide to study at the ASP"). To some, this dimension represents the main element of attraction for the majority of the students who decide to enrol at the ASP. The motivational interview, which was introduced a few years after the foundation of the ASP, has equalized, to some extent, the importance of this factor, which remains, according to some, predominant or at least very relevant (particularly for foreign students).

It should be emphasized that within the group of respondents the importance attributed by some to the economic dimension (and by some, as mentioned, considered prevailing for ASP aspirants) has crated some confusion ("I did not expect to find people who did it for money in this room" / "I would not want to convey a message that foreigners come here only for money") and disorientation, as if the presence of an economic motive could spoil the image and the idea of a path of excellence. In other words, in our opinion there should not be a relation between the two factors: regardless of whether or not one appreciates the economic benefits associated with such registration, the fact that a young person has been accepted to the ASP because it has the requirements should prevail.

Thus, if the two aspects (the possibility of elite studies and economic opportunities) are parallel, prevailing one or the other depending on the more or less "elite" vision of the ASP, none of those present claims to have chosen the ASP depending on their previous widespread knowledge of an attractive "brand" or "good reputation" at their University or among their friends, even if this is also attributed to the "young age" of the School.

According to the respondents, the arguments submitted to support these two visions are based on the existence of two main groups of students. It is said that the "elitist dimension" is prevalent in people who are already studying at one of the two Politecnici, while the attraction of students from other regions or from abroad is driven primarily by the opportunity of scholarship and related facilitations, albeit accompanied by a course of study of the highest level. The possibility of a double degree, compared to "only a few more hours of study" is a third dimension that can help motivate the choice of the ASP, even if widespread scepticism of its actual value prevails. In one case it was stated that knowledge of the double degree is not widespread and appreciated by companies and so this was "omitted" during job interviews. Almost everyone agrees that it may be a factor that supports the choice to

enrol in the ASP, but it does not count during the transition to work.

The discussions show that among students who prefer the "elite" dimension of the studies there is a large percentage, the so-called "specialists of schools of excellence": young people who enrol in all programs of excellence plausible and then chose the one offering the best possibilities. ASP is not considered one of the latter, not because of an adverse opinion of the school (quite the opposite), but because the ASP does not have the "classic" profile of schools of excellence. We will return to this important aspect below.

The expectations

As can be imagined, since the choice of the ASP was not dictated by a precise knowledge of the course and its potentialities, the expectations were not very precise at the time of enrolment. *Let's say that everyone agrees on the fact that they expected "to learn something new and to have a competitive advantage in the job market" and "to be part of an environment linked to excellence and multidisciplinarity"*.

When explicitly asked about satisfaction (opinion at the time and current opinion) of the initial expectations, articulated answers were given. *Those present stated that they were completely satisfied, but this is a non-representative group* (as we have shown, from the beginning the group of participants in the Focus Group defined themselves as "unique"). In other words, according to the respondents, a good part of the ASP graduates do not express the same level of satisfaction expressed by the latter.

This representation is sufficiently shared by those present, even if the reasons put forward to explain the (alleged) dissatisfaction of many of the graduates are different. *According to some, the dissatisfaction of the ASP path is due to the fact that the value of the ASP should not be sought in the content ("what is taught"), but in the community (of students) that helps to create it. If a person is not interested*

in the network and the community, it cannot appreciate the path. According to others, the dissatisfaction is related to the lack of interest in the multidisciplinarity. Some are very good in their course of study, but do not appreciate contaminations.

This representation seems to be the result of a very "pushed" conception of the *community*, influenced by the active role that almost all Focus Group participants have in the Association. By simplifying, this means that if a graduate does not recognize and does not participate in the community, then he did not understand and did not appreciate the ASP path.

Therefore, according to the respondents, it would seem that the opportunity to participate in a multidisciplinary community of peers within a dimension considered elitist (or rather, not for all students) would implicitly represent (and currently represents) the substantial expectation related to attending the ASP path.

The identity of the ASP and the profile of the ASP graduate

One of the issues that became important in the discussion has to do with the *identity* of the ASP. The opinion that "the output target is not clear" is shared: according to some this was a specific choice of the ASP setting. According to others this is because there was not adequate thought or that it was unclear. *In essence, it has been stated that it is not clear if the "ASP product" exists and what it is if it does actually exist.* It is interesting to note how this lack of clarity seems to be very much in line with the findings in the survey regarding the difficulties detected when forming an opinion of the coherency between employment and skills acquired with graduation.

In particular, some have criticized the choice of not making the ASP a "business school oriented towards innovation"; a profile that is believed would have been much appreciated by the companies that would facilitate insertion

into a managerial path. However, it should be mentioned that this opinion (as well as that relative to the difficulty in defining the "ASP product") seems to belong more to the participants of the first cycles than those of more recent cycles, when motivational interviews were not carried out and some of the distinctive features of the ASP were not adequately communicated to those who wanted to register.

On this specific aspect, there is a clear difference between the Engineers and "the others". An opinion that is shared by the participants of the Focus Group is that *the ASP path is particularly useful for Engineers, especially Management Engineers* (which facilitates, among other things, a managerial type path), less accustomed to working in teams and to interact with other disciplines. This particular added value of the ASP for Engineers did not emerge only here, as will be remembered, and certainly should be taken into account in the logic of the general discussions on the school. However, we will return to this discussion below.

On the other hand, others believe that the ASP does not have and should not have anything to do with schools of excellence in the traditional sense, but it is characterized (must be characterized with more force) as an opportunity to address issues and multidisciplinary settings and to "network" with peers who have the same transversal interests. In other words, it is not used and should not be used by those who want to become the best Engineers (Architects and Designers) and who, therefore, want to further investigate their discipline of reference on a technical level. It is used (should be used) by those who want to become "contaminated", compete, and create networks that continue to exist after graduation. The ASP Alumni is the evident result of this vision, even if graduates who also have opposing views and a critical opinion of the ASP path participate in this.

It seems that *the multidisciplinary dimension and the network and are not just values recognized by all, but are*

the main distinguishing features, even compared to other dimensions such as innovation and creativity.

During the interviews it was clear that there was some difficulty in "profiling" the ASP graduate and in summarising the additional skills acquired. Basically, in the end they all had a shared opinion that the ASP graduate:

- Is more capable of working in a team;
- Is more capable of working with different professionals;
- Is more curious and open-minded;
- Has more negotiation skills and articulacy;
- Is more capable of managing complex situations;
- Is more aware that the success factor is not only skill

and that these more significant additional skills are due to the so-called "soft skills", even if they are not exhausted.

Let us dwell a moment on this particular issue because it was repeatedly discussed during the Focus Group, and also emerged in some interviews with instructors and companies. According to some of the instructors interviewed, reference to the "soft skills" is an understatement with respect to the nature of the transversal skills that are acquired during the ASP path; the importance given to those transversal skills of a relational and behavioural nature that, to be precise are defined as complementary to "hard skills" (technical skills) should be explained. The relational and behavioural transversal skills enhance and strengthen the spirit of collaboration (teamwork), the sense of belonging, creative aptitude and flexibility to change. They are developed and are the unavoidable basis to operate in a multicultural environment. As we have seen, these are the transversal skills to which our respondents attribute particular importance and towards which the companies show appreciation, obviously, by offering more qualifying jobs and jobs with the best opportunities.

The educational path

On the subject of educational contents the participants interviewed seem to have a shared opinion that is somewhat critical.

In general, there seems to be agreement on the statement that the ASP was designed "to measure for Management Engineers" and that "Technical Engineers serve to compete with the Management Engineers".

It is worthwhile to discuss this issue, which emerges implicitly from the survey, in order to dispel some important misconceptions. The history and evolution of the ASP does not at all seem to confirm the idea that the school was designed "for" Engineers. On the contrary, the strong and consistent emphasis placed by the school on all those dimensions that, however, bring attention to interdisciplinarity, contamination and the basic polytechnic education is evident. Probably, as stated by one respondent, on this issue graduates tend to confuse the added value of the ASP with the "adjacency" of skills already acquired during the university path. Architects and Designers are "adjacent" to the participation models proposed by the ASP compared to the Engineers that, therefore, are "more distant", and they tend to have a better view of the advantage and the added value of the School.[13]

In particular, it is stressed that the courses taken were not always well connected with each other and that it is difficult for people attending them to understand the added value of a course compared to their discipline. More specifically, it was believed that not all instructors have the same ability to deal with the themes of innovation, creativity and to highlight the transversal features and added value of the contents.

At times the connection between courses and projects is considered weak. In this respect, it is interesting to note that *the emphasis placed by the instructors interviewed on*

13 In this regard, we believe that the metaphors used by one of the respondents are quite explanatory. "If a group of people enrol in a skiing course, the greatest benefit is for those who could not ski at all, rather than for those who already knew something about skiing".

the possibilities offered by the ASP to implement projects in multidisciplinary teams is certainly shared and that they hope for reinforcement of this. It was stated that it is more difficult to convey theoretical content to students belonging to different disciplines, while the real problems facing the multidisciplinary dimension takes on obvious features. The courses should tap into issues affecting everyone because very transversal and should be less attached to the three disciplines.

In essence, the content covered in ASP should be very different than those that are treated in the courses at the Politecnico. In this sense, we seem to understand that the "elitist" expectation that led some to enrol in the ASP could also be interpreted. The excellence of the path and content of these statements can be assimilated into the request to do things very differently. Certainly innovative and creative, but, different from what is done in normal university paths. Moreover, we should better stress the fact that the ASP allows to acquire good teamwork skills.

It is important to emphasize that the opinions summarized above regarding these important issues (connection between courses, connection between courses and projects, educational content) are affected by and reflect the evolution matured over the years. If we take into consideration the substantial "young age" of the ASP, we could say that each cycle experienced constant and progressive interventions aimed at overcoming this type of problems.

Of course, since the respondents refer to their specific experience, this development has not always been understood and observed.

The positioning of the ASP in the university community

An opinion that is strongly shared by the respondents is that *the ASP is not sufficiently appreciated by both Politecnici even though these established the school.* If, on the one hand, it emphasizes the importance of this collabora-

tion, on the other hand it is believed that this synergy is not exploited adequately.

There is also a shared opinion that the ASP is not sufficiently known among Italian universities and even less so abroad.

On this dimension of the international positioning of the ASP, on the one hand, the different viewpoints of the stakeholders who respond are highlighted. On the other hand, the "communication" problems mentioned above are evident.

There is no doubt that when the graduates (those who participated in the survey and those who participated in the Focus Group) responded to this question they had in mind the entry into the job market rather than the quality of the educational path. Or rather, since the companies with which they came in contact after graduation do not know the ASP, they are geared to think that the ASP is well positioned nationally and internationally. This statement reflects subjective data (determined by the experience of individual respondents), but also objective data. In fact, we need not forget that this School is quite young and, therefore, the relative number of ASP graduates who entered the job market in these last few years (818 young people graduated from the 7 completed cycles, but an important number remained in the university circuit).

Obviously, the instructors' answers to this question reflect an opinion relative to the "academic" placement of the School rather than the knowledge that the job market has of the ASP. However, the differing opinions shown here reflect a more or less updated knowledge of the relations that the School has activated in these last (few) years. In fact, there have been important initiatives activated on the internationalisation level in the last few years[14] and there is evidence of appreciation from foreign realities with which

14 For example, the Como Innovation Summit (a forum that involves the innovators in the industry), of which two editions were held (2012 and 2013). In addition, the international advisory board of the School is made up of leading figures from a variety of American, Chinese, Japanese and other academic institutions.

the ASP has activated relationships. In our opinion the fact that this position is undervalued by academic graduates and relatively well known by those who have daily contact with the ASP is a matter worth discussion. On the one hand, this can be attributed to communication activities and reinforcement of the not very structured and systematic brand.

On the other hand, of course, increased support from the two Politecnici would contribute to better disseminate the actual position of the School.

Relationships with companies

As mentioned above, according to respondents, *the ASP is not a brand that is recognized by the companies*. It is interesting to note that, during the interview, the corporate dimension was always left to the side, as if the participation in the ASP path did not have (should have) a particular impact in the transition and entry into the job market. This is not surprising since one of the initial motivations for enrolment was not the easier or more interesting entry into the work world.

According to respondents, *the ASP is not used to facilitate transition to the job market, but enables to acquire transversal skills ("soft skill") that enable to work better*. Even though there are profiles (Managerial Engineers and Technical Engineers) that obtain more benefits from the ASP in terms of skills that can be used on the job market.

As mentioned above, the respondents believe that this *is not an "ASP product" (or is not an obvious product) and that this conditions the relationship with the companies*.

ASP Alumni

As mentioned in the introduction, all Focus Group participants have a pretty tight relationship with the Association and, therefore, the ideas that emerged during the interview should be interpreted to understand the reasons for this involvement.

Again, we are faced with shared answers: *the Association enables to maintain a certain level of updating (with the various initiatives organised), it is a useful network at a professional level and also provides an opportunity to maintain and develop that dimension of community that was experienced and that, during the path, was seen as a fundamental ASP experience.*

Moreover, it is interesting to note how the participants attribute, not so implicitly, the Association with the mission of giving the students the School's "sense of identity". That sense of identity that poorly transmitted by the ASP has been created by gradually through the experiences of those who attended the school.

We are not talking big numbers, but a solid core of Alumni motivated to keep alive and enhance the experience, and who are motivated to enter the educational process of the school; it is worth reflecting on how to better "exploit" these.

...In the end

All respondents are greatly satisfied with their current professional position and everyone acknowledges that "at least some merit" should be given to the ASP. Not so much because the ASP "has churned out a winning product," but because once graduates enter the working world they were able to exploit the additional skills that gave them a performance that was probably better than their colleagues who did not attend the school.

As seen in box 1, which attempts to make a comparison between the *placement* of graduates from the Politecnico di Milano and ASP graduates, in the years considered there are constantly a few percentage points in favour of the ASP graduates in terms of job placement and in terms of the quality/stability of employment obtained. Therefore, that "bit of merit" to which the respondents refer is not only subjective recognition, but also an objective fact, and perhaps attending the ASP should be systematically internalised in the

placement surveys of the two Politecnici in order to better monitor and asses the transition path at the end of studies.

OUR POINT OF VIEW

In this section, we will summarize the elements of greater interest to the evaluative thought on the experience gained by the ASP thus far, and we will try to explain our "third" point of view and our interpretation of all aspects that have been put on the table by the various stakeholders interviewed.

First, we find tat prodding critical thinking of what this experience currently represents (and what it could represent in the future) was a very suitable temporal choice. Not only because there is a change in the direction of the School that, obviously, suggests the development of new strategies and policies (not necessarily different), and because the "right" number of years have lapsed in order to consider if the ASP is currently what it was expected to become when it was founded. Or if, regardless of the expectations, if the ASP is currently liked by the three stakeholders involved: students, companies and universities.

Before entering into discussion, **there are three aspects that need to be taken into consideration when reading the discussions below.**

First of all, **the ASP is still too "young" for some effects to be fully evident** (this applies to the job market's knowledge of the "ASP product", or rather, of graduates that enter the companies, which is still too few in terms of numbers, in order to have an image that is open and in order to develop a debate on the distinctive character).

Secondly, **the ASP seems to be an atypical subject in the framework of Schools of excellence** and its "uniqueness" is also, maybe the reason why various respondents still find it difficult to delineate a clear picture of the school. We did not carry out in-depth analysis along these lines but, in short, the ASP seems somewhat atypical

in terms of its mission, in the structuring of its training path, the number (somewhat higher) of the students involved, the costs (somewhat lower than other realities of this nature) and with which it is able to implement its activities.

Finally, substantially, in our opinion **the ASP seems to be a very positive reality that works.** Beyond the critical observations that have been highlighted and that we mention here as possible areas for improvement in the future, the objective data shows us that the ASP graduates have better performances than the already first-rate performances of the Politecnico in terms of occupation, the occupation found (which is contractually more stable and more qualified). And, the positivity does not lie so much in the 3 or 4 percentage points in favour of ASP graduates (although this is significant), but in the fact that *these higher percentage points show that there is a specific and distinctive product acknowledged by the job market, regardless of the awareness of the stakeholders involved*. Sure, we did not assess the counterfactual impact and we cannot be certain that these results would not have been equally achieved since the ASP collects the best students of the two Politecnici. However, the set of data and information gathered helps us in formulating this opinion. *As already highlighted in the previous pages, it would be important for the placement monitoring and assessment of the two Politecnici to highlight the attendance of the ASP in order to give certain evidence for this opinion.*

That said, we review some considerations that emerged from the interviews with the three stakeholders involved: students, companies and universities, in order to highlight some possible areas for improvement. Once again, we emphasize that the *different "levels of ASP experience and updating"* of the respondents (the years in which they attended, the among of time that they have been involved, their position outside of the School or the Board) may have affected their perception of problems and their degree of relevance. However, it seems important to give them importance because we believe that it is "a problem" if the

degree of ASP experience and updating prevent them from having a correct image of the School.

Back to us, the order in which we cited the stakeholders is not accidental: defining a "product" by assuming the student as the first final beneficiary could lead into a direction that is not necessarily identical to what would result if the companies were identified as the final user of the "ASP product".

And, this is the first aspect that we have paid attention to. In the specific case of the ASP, we believe that the effort of putting the research of results that are equally interesting for both the students and the businesses "on the same level" is interesting and, therefore, it would be useful to focus, more precisely, on an "ASP product" that, in this case, may provide an (explicit) added value to the students and businesses. A "product" that forestalls and facilitates the "match" both in the path of transition to the job market and during work experience.

The *placement* data tells us that the companies have probably perceived the distinct features of the ASP graduate. It is important to have greater awareness of this in the graduates and increased communication of this distinctiveness on the job market. It is equally important that the ambiguity that is occasionally "spread" relative to the issue of the "business school" be definitively resolved. The ASP is not a business school and it never intended to be. This is one of the choices that define the atypicality referred to above.

However, *the above brings us to another important issue regarding the identity of the ASP* that the attention of the interviewed graduates focused on. As we have seen, in their opinion, the "profile of the ASP graduate" can be summarised in the ability to work in a team, to work with different professional competences, to be more curious and open minded, have negotiating skills and articulacy and a greater awareness that the success factor is not only in having good grades. AI skills that are greatly appreciated by the

companies. This is definitely of lesser interest for those who want to pursue a university career. To this we add that the ASP students have good knowledge of English, and this is a very important added value for all companies interviewed.

As can be seen, there is consistency between the "additional skills" referred to above (and with respect to which there is substantial sharing of views among all stakeholders interviewed) as well as on the emphasis that educators put on the issues of multidisciplinarity and networking ("the conditions are created so that students from different disciplines enter into relationships and maintain a network even after the completion of studies").

Therefore, we would like to say that the experience of the ASP could be much more appreciated if it's mission were clearly defined (and, more importantly, communicated): *a School of Excellence (because it enables to acquire various and additional skills compared to those attending the traditional university path) and a school geared to train profiles that are professionally more attractive to companies because there is the guarantee that the graduates have a good grasp of English, have acquired the soft skills required to move well within a company from the start, have had the chance to experience of concretely implementing projects, they have better abilities in problem setting as well as problem solving. They also have better career opportunities.*

However, the sharing of this paradigm entails some adjustments.

To start, it would be useful to clarify *the ambiguity that surrounds the existence of schools of excellence (not only the ASP).* Schools are of excellence if they provide a service of excellence and make an excellent product, which is acknowledged by the recipients of the product. It is not enough to bring together a group of talented students by offering something different from what they normally would have and something that is exclusive from what their "non-ASP" colleagues have. Also, with regard to the students, it

should be clear that it is not enough to want to be "in an elite and exclusive environment", but the carrier motivation should be identified in the output, in "what they want to do in life". This does not mean, that we need to necessarily exclude a young person who wants to pursue a university career from attending the ASP, but certainly this young person must clearly understand the contribution that the ASP path has on its occupational choice. If this is the case, *the motivational interview (the fundamental importance of which is recognized by everyone) should be used to clearly communicate the mission of the ASP, the "ASP product", the ASP "expected result" as well as the impact that attending the ASP has in relation to the frequency of a university course rather than for the insertion into a company.* We believe that this is exactly what is happening since throughout the years the motivational interviews were increasingly defined. What we want to emphasize here is that this aspect must be given maximum and constant attention in order for the picture to be clear to everyone.

This last aspect is fairly nullifying because dealing with it could better define a "priority system", so to speak, in the educational path. *The interviewed companies all acknowledged the value of the experience and of the ASP students. However, almost all have expressed different opinions about the commitment of the students with whom they worked. And, all have posed the problem of where the ASP project is placed with respect to the university path and the organisation of the company.* The problem is that, almost always, the realization of the project "collides" with a substantial number of university commitments to which students give priority (exams, Erasmus programs, etc.). Furthermore, even the graduates have complained about a significant overlap of commitments between ASP and University.

This leads us to the very important issue of the relationship between the ASP and Politecnico of reference. The previous sections make it clear that this is

a relationship that needs to be improved. There may perhaps be too much emphases, but it *certainly does not seem that the two founding Institutes fully exploit their creation.* A school of excellence should be the flagship product of the University that promotes it, it must be acknowledged by all and it should have a national and international image. It should be a spendable brand to attract students from other regions, countries, etc. In short, we do not think that this is the image that emerges. Some (not only the graduates) believe that the School "is given a bad vision", either because it removes energy from the students who attend, or because there are differences between the two groups of teachers (teachers who teach outstanding students in a School of excellence are by definition excellent), or because, in the end, what is taught "counts for little".

Thus, we note relationships that certainly hinder the very idea of programming the two paths (the "normal" path and that of the ASP) in order not only to enhance and connect what is taught by both parties to the most (thus entering into the discussion of contents), but also useful so that the burden of commitments and deadlines do not fall on the individual students (organization). We understand that this certainly is not easy, but we believe that it is an issue that needs to be addressed and investigated.

Mind you, the educators (coordinators, teachers, tutors) do their best. This is recognized without a shadow of a doubt. However, it is correctly translated as a much more "personal" commitment of the individual, rather than a result of an organizational decision. One of the companies interviewed sated, if the "purpose of this collaboration is to introduce these young people to the management of a product or technology development process, this process is split up into tasks, deadlines, outputs, than the tutors cannot write me and inform me that these young people are not coming to meetings because they have exams. The companies do not operate and projects are not done like this".

This position is reinforced by the fact that **many of the respondents (both graduates and trainers) complain of a "connection" between courses and projects that is not always full and understandable, as if they were two parallel paths that have a life of their own and to which the other "life" of the normal university path is added.** As we have already noted, these problems are known and have been the subjects of constant and gradual improvement over the years. However, evidently, this is a path that is not finished and on which it is important to maintain the pressure.

All of the opinions referred to here lead us to a series of discussions. **First of all, it would be good to deal with this problem of the relationship between the ASP and the reference Institute.** We believe that this should be a concern particularly for the two Politecnici, even before the ASP. It is true that the two Institutes have a more than affirmed brand, and that there graduates do not have particular *placement* problems. However, changes in the job market are not cyclical, competition is high, and having a School that offers a lot of skills requested by the companies (data supported by the best *placement* results as well as by stable and qualified employment) means being able to communicate that the two Institutes are able to form professional figures that are "different" from those normally produced. This is, as has been seen, a diversity that is well appreciated by the companies, even if not all instructors interviewed agree on the existence of this result. In our opinion, facing this problem means, in summary, the following (some of which are already being implemented):

1. *Giving a firmer profile to the role and mission of the ASP* by greatly directing it towards the business system and with "product" that enriches Engineers, Architects and Designers, so that the two Politecnici, through the ASP, give the market "also" professional figures that are a bit different than those usually trained: This means giving a clearer explanation that the ASP allows to strengthen and consolidate those transversal skills recognizable and

traceable to what has been defined as "polytechnic education". However, it also helps to acquire the relational and behavioural transversal skills (soft skills);

2. *Reorganizing the ASP contents by strongly focusing on the projects*, by increasingly "containing" and "aiming" the courses to the implementation of projects. In other words, defining the courses to some extent as "instrumental" to the implementation of projects that are expected to become the "core" of the ASP. Which also implies a different focus to the organizational dimension (to be determined with the companies beforehand) in order to reconcile the maximum activity of university students and their more "professional" activities related to the project. The interviews with the companies were very explanatory in highlighting how the item considered a priority in the relationship with the ASP is not so much, and only to be found in, easier selection of personnel (a motivation that, in recent years, has progressively diminished and is, in any case, linked to the consulting companies and Engineers), but the opportunities provided by the project to set up a team with company staff and young people who are fresh from studies to work on research and innovation teams (technological and product innovation, in particular). For the companies, these are occasions that are dominated by the daily difficulties and increasingly reduced and difficult in terms of implementation;

3. *Activate a communication campaign that will help consolidate and communicate a brand applied not only in Italy but also abroad.* An opinion that is widespread among instructors and the graduates interviewed is that the number of foreign students have a "skill" level that is significantly lower than that of the Italians (often also for linguistic problems) and that the attractiveness of the economic benefits more than the quality of the School is invalidating for these young people. Perhaps it is worth reflecting on whether the channel used to identify foreign students is the most suitable for securing the

best students, or if the subsequent selection process and procedure can be further improved;

4. *Integrate and consolidate the group of ASP instructors.* Or rather, integrate the group with more instructors who are not part of the two Politecnici and with instructors who belong to different disciplines as well as those who belong to the corporate world. This is already done, but it seems important to emphasize the opportunity to give priority attention to this "external" dimension. It is important, in particular, that all instructors have high coordination and/or project mentor skills. The role of course coordinators and project tutors is considered invalidating by all: the success of a course or project depends on the abilities of the coordinator or tutor. There are excellent teachers who cannot do neither one nor the other. Therefore, it would be useful for the ASP to select the "best" coordinators and tutors. We suppose that the results of assessments that the students make at the end of each course are along these lines. Finally, strengthening the instructor group identity through "training socialisation" that strengthens the relationships and exchanges, urges the use of specific instruments and methodologies, active monitoring systems and systematic assessment of the results and so on. Once again, we know that there have been initiatives along these lines that have not always offered the hoped-for participation. However, this may also be a teaching selection element;

5. **Reinforce *the role of the ASP Alumni Association in the ASP path.*** In our opinion, the dimension of network that the ASP has been able to develop is a very important and interesting result that the School could further improve to the benefit of future graduates, by offering initiatives that become an integral part of the ASP educational offer. A comparison between "almost" peers seems quite interesting starting from the dual experience: having been ASP students and being, currently, people in qualified positions in the working world.

6. **Improve internal communication**. We know that you should never "close" a conclusion with a criticism, but we will make an exception. There is a consistent finding that has emerged in the course of this work that there are few people who have the whole picture of the situation. From the instructor point of view, those who are not a member of the Board find it difficult to be firm in what they do and in the thought underlying what they do. From the graduates' point of view, if a graduate is not part of the Alumni Association and are not an active part of the network, it is difficult to them to have a serious thought on the path they have undertaken. In terms of the companies, all of them talk about their specific experience and their specific relationship with the ASP, but it does not seem that they have ever participated in a group. *In short, this seems to be the classic situation in which a lot is done, it is done well but little is known.* To say that there is a lack of communication that should be improved considerably may seem trivial, but if the defect did not exist, many of the somewhat critical comments that emerged during the interviews would not have had reason to exist as they would have been surpassed;

7. **Improve external communication**. The ASP, as we have had the chance to highlight, is a somewhat unique and atypical product in the framework of Schools of excellence. The two Politecnici, whose important synergy gave rise to the ASP, should foster this experience by making it grow and making it known to other universities, businesses, potential users (young people and their families). Thus, an activity of external communication that strengthens the brand of the School in the mind of the large audience that, while not contributing directly to determine the nature and quality of education, helps spread the fruition, use and fame. In this logic, and given the special features of the ASP, it would be useless to a carry out an in-depth investigation aimed at comparing it with other Schools of excellence that operate at the national and international level. Not so much to position the ASP in a best or worst ranking, but in order to highlight its distinctive dimensions.

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 eight 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 tenth birthday, complemented by testimonials from ASP Sponsors and Alumni.

For further information on ASP:
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