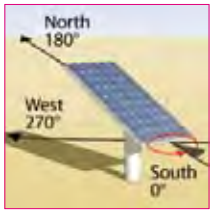
Multidisciplinarity and innovation

ASP projects 5

ALTA SCUOLA POLITECNICA



POLITECNICO DI MILANO
POLITECNICO DI TORINO

polipress

Multidisciplinarity and innovation

ASP projects 5

Preface

This book marks the fifth cycle of students that have completed their course of studies in 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 that share the desire to offer to selected and talented students with an interest on multi-disciplinarity a highly-innovative course of studies.
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 seven 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 contribution (as illustrated in this book), and follow residential courses, thereby enjoying a stimulating earning experience. The significant growth of industrial sponsors that has occurred in the last 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 promising, and we are encouraged in continuing and improving this endeavour with the same enthusiasm shown by our ASP students.

Prof. Giovanni Azzone, Rector, Politecnico di Milano
Prof. Francesco Profumo, 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 for the year 2011 is presented below and their valuable support is hereby gratefully acknowledged.

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 scientific, economic and juridical research; education; art; preservation and valorization of cultural heritage and activities and of environmental assets; health; assistance to the socially deprived categories.
In 2009 the Compagnia awarded 682 grants in its areas of activity, amounting to 121.4 million euros. Notably, 118 grants were awarded in the Research sector, amounting to 30 million euros, and 45 grants were awarded in the Education sector, amounting to 13.8 million euros.
The Compagnia pays particular attention to advanced research and to the development of scientific and technological centres of excellence, seen both as catalysts and multipliers of research and higher education initiatives. It supports the reinforcement of Torino's university system, especially through the promotion of excellence at Politecnico di Torino and the University.
The commitment of the Compagnia in the field of Education is focused on university and postgraduate education, starting from the growth of human capital, internationalisation and the provision of infrastructures, with special attention to the conditions that assure equal access.
In this context, the ASP's focus on excellence and innovation – besides characterising it as a valuable initiative *per se* – gives this programme the capacity to enhance the global attractiveness of the Universities involved and foster, within the leaders of the future, a specific attention to the interdisciplinary and international dimension of nowadays society. The programme also represents an interesting synergy among educational institutions located in the north-western region of Italy.
The Compagnia has supported ASP since 2007: the grants are aimed at funding scholarships for the ASP course beginning in the year, requiring a special attention to students not based in Piedmont, or with an immigrant origin.

www.compagniadisanpaolo.it

Fondazione Cariplo, established in 1991 as a nonprofit organization with the purpose of furthering the common interest and the public good in various fields, is today – thanks to the sheer size of its assets (over 6.36 billions euro) - one of the world's leading philanthropic entities annually funding grants to organizations for the fulfillment of selected projects and initiatives.
The Foundation's assets, which are the fruit of the labour of generations of men and women, though considerable, are not sufficient to solve the many problems afflicting the civil society in Lombardy, Italy and the entire world. Therefore, Fondazione Cariplo efforts focus on the improvement of the living conditions in the local community. To Fondazione Cariplo this means improving the living standards of individuals as well as their social, cultural and economic environment. Fondazione Cariplo nurtures those conditions which enable individuals to achieve their potential, express their personality, freely pursue their inclination and fulfill themselves. Fondazione Cariplo gives priority to financing specific projects rather than providing general aid to organizations. This is, in fact, the only way to precisely assess whether a program is innovative and responds to the needs of the community.
The Foundation nurtures a breeding ground for scientific research, technology transfer and the development of applied research findings, by backing synergic actions geared to the creation of networks and partnerships, the participation in international projects, the development of human capital, the production of better knowledge and improved scientific communication, as well as the dissemination and enhancement of applied research findings.
In 2010 Fondazione Cariplo awarded 1.193 grants in its various areas of activity, amounting to 187.2 millions euro (+6.8% annual rate). 117 grants were awarded in the scientific research and technology transfer area, totaling 37.9 millions euro. Between 2008 and 2010 the scientific research sector of Fondazione Cariplo received about 1.500 applications, processed 1.350 funding requests, and funded 371 projects.
Fondazione Cariplo pays particular attention to the support and promotion of human capital development, particularly by focusing on a limited number of projects whose purpose is to start activities capable of achieving excellence in university and post-university studies. Furthermore the Foundation is also firmly convinced that actions supporting "excellence human capital" must entail a close connection between training and teaching activities, on one hand, and research and exposure to an advanced international scene, on the other.
These are the reasons underlying Fondazione Cariplo decision to support the ASP, an advanced international Faculty able to attract the best young foreign students and capable of Italian high profile graduates education.

www.fondazionecariplo.it

CAMERA DI COMMERCIO
INDUSTRIA ARTIGIANATO E AGRICOLTURA
DI TORINO

Along with an ever diversely assorted graduate education offer with 15,000 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 ranks 12.3% of Italy's investments in R&D and it is the first Italian region for private R&D investment. The region invests 1.9% of its GDP in innovation, and the private sector investment in R&D constitutes almost 80% of the total R&D expenditure.
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 nearly 238,000 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, three 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, Liguria) is one of the European biggest areas, with a population of almost 15 million people and more than 1.200.000 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, with a special attention to the contemporary art, education and organization of international events, as Torino Celebrations of 150 years' unity of Italy and Milano Expo 2015.

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

www.to.camcom.it

accenture
High performance. Delivered.

Accenture is a global management consulting, technology services and outsourcing company, with more than 215,000 people serving clients in over 120 countries. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. The company generated net revenues of US$21.6 billion for the fiscal year ended Aug. 31, 2010. In Italy, all Accenture's group companies employ more than 9.500 people (Milan, Rome, Turin, and Verona) and generated net revenues of 973 million Euros in the fiscal year ended Aug. 31, 2010.

We are able to deliver leading-edge solutions to our clients by bringing together highly talented people in a creative, multicultural and collaborative environment, where everyone is strongly encouraged to make the difference through innovative, non conventional ideas.

As the global demand for highly skilled people grows, education excellence is increasing in importance. Accenture supports Alta Scuola Politecnica as we are committed in helping young talented people, with a passion for innovation and a deep interest in multidisciplinarity, to develop their potential and capabilities through qualified academic initiatives, contributing to their continuous improvement.

To learn more about Accenture visit

www.accenture.com

Barilla
The Italian Food Company. Since 1877.

Barilla, originally established in 1877 as a bread and pasta shop in Parma, is today one of the top Italian food Groups: Leader in the pasta business worldwide, in the pasta sauces business in continental Europe, in the bakery products business in Italy and in the crispbread business in Scandinavia.
The Company has been managed for over 130 years by one family's entrepreneurial experience and is now run by the fourth generation. Always oriented toward proper diet through exceptionally flavoured and nutritionally balanced products intended for daily use, Barilla became popular worldwide due to its attention to the quality of its products, the result of significant investments in research, innovation and technology, as well as communication.
Barilla owns 50 production facilities (14 in Italy and 36 outside Italy), of which 10 are directly managed mills that provide most of the raw materials for the production of its pasta and bakery products.
Barilla exports to more than 150 countries. Every year more than 3,000,000 tons of food products, with the brands Barilla, Mulino Bianco, Voiello, Pavesi, Wasa, Harry's (France, Spain and Russia), Lieken Urkorn, Golden Toast (Germany), Alixir, Academia Barilla, Misko (Greece), Filiz (Turkey), Yemina and Vesta (Mexico), are featured on dining tables the world over. The Number1 brand, a Group company engaged in logistics activities, stands alongside the product brands.
By respecting its own traditional principles and values, which still feel current today, by considering employees a fundamental asset and by developing leading-edge production systems, Barilla has become one of the world's most esteemed food companies, and one that is recognized worldwide as a symbol of Italian know-how.

www.barillagroup.com

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 71 offices in 41 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.

www.bcg.com

LUXOTTICA 50 YEARS OF EXCELLENCE

50 years of carefully planned growth.
Luxottica Group is a global leader in premium, luxury and sports eyewear with over 60,000 employees, more than 6,300 optical and sun retail stores in North America, Asia-Pacific, China, South Africa and Europe, a strong well-balanced brand portfolio and a global wholesale network involving 130 different countries.
The Group's products are designed and manufactured at its six manufacturing plants in Italy, two wholly-owned plants in the People's Republic of China and one plant in the United States devoted to the production of sports eyewear.
People who work at Luxottica are dynamic, flexible, passionate, open to diverse environments, have innovative ideas and international backgrounds.
Continually seeking new talent around the world, Luxottica chose to work with the Alta Scuola Politecnica because it's the ideal partner for redressing what is a serious shortcoming in the national system. This will be done by leveraging the forces of two universities (Milano and Torino) which alone provide around 30% of graduate engineers entering the marketplace in Italy every year, and at a very high academic level. Further, the selection process candidates undergo ensures an appropriate level and international approach in line with Luxottica Characteristics and environment. Good schooling and participation in this 2-year interdisciplinary course will reflect solid skills and above-ordinary learning agility, as well as a will to excel and a spirit of sacrifice, both indispensable on the road to excellence. Being able to interact with students on these projects in our production facilities is a great opportunity. Luxottica and "Alta Scuola Politecnica"– partnership for excellence.

www.luxottica.com

McKinsey&Company

McKinsey & Company, global leader in management consulting, is proud to be sponsor of Alta Scuola Politecnica (ASP), a prestigious source of excellence within the Italian academic landscape.
We firmly believe that at Alta Scuola Politecnica students 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

UniCredit Global Information Services

The landscape of information and communication technology is constantly evolving: for this reason UniCredit Global Information Services (UGIS), the Global ICT Company of UniCredit, as well as following closely the technological evolution from an industrial perspective, seeks to keep in constant contact with the academic community that has always been a source of innovation and ideas that may be of interest to the business.
Initiatives such as the Alta Scuola Politecnica that involve talented young people, giving them the opportunity to express their talent and their skills in projects that do not remain only simple cultural exercises, but that can be transposed into business reality, cannot but meet the approval of UGIS.
The project that has been chosen to work with the Alta Scuola has two objectives: building sustainable and environmentally friendly technological solutions and start thinking about the potential of EXPO 2015, trying to imagine how innovative technologies can support the Group in increasing its business contacts with customers. In 2015, the Bank will certainly be different from today: the shift towards sales channels more innovative than the traditional "counter" has already started some time ago.
But there is also another reason that has led UGIS to support this initiative, which goes beyond the realization of the project itself. The company believes in the skills of young people, and these guys (who will enter the UniCredit "world") will be able to imagine the near future, utilizing their technological and multi-disciplinary expertise, to create added value. It's an investment in human capital which, inter alia, is reflected in the multinational vocation of the Group and of the company itself, involving talented people also from foreign countries.

www.unicreditgroup.eu

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Summary

Alta Scuola Politecnica: from Adolescence to Adult Age

The **Alta Scuola Politecnica** (ASP) is a school of excellence rooted within the Politecnico di Milano (PoliMi) and Politecnico di Torino (PoliTo). Every year, since its foundation in 2004, ASP selects 150 young and exceptionally talented students among the applicants to the Master of Science programmes in Engineering, Architecture and Design of the two Universities. The **mission** of ASP is to provide society with high-profile graduates combining in-depth (vertical) disciplinary knowledge from their Master of Science programmes with interdisciplinary (horizontal) competencies that are needed to work in a truly multidisciplinary environment. The same programme is offered to all ASP students, regardless of their school of origin. In order to achieve this target, the two-year ASP programme is built around two major elements:

- full-immersion, week-long **ASP Interdisciplinary Courses**, dedicated to the development of interdisciplinary expertise between the very different technical backgrounds of the ASP students;
- continuous, two-year **ASP Multidisciplinary Projects**, developed by small multidisciplinary teams of students, academic tutors, and companies or public institutions.

The ASP programme runs in parallel with the Master of Science programmes offered by the two Univeristies; at the end of their ASP studies, students who complete the programme receive a double degree from PoliMi and PoliTo, as well as the ASP diploma. Graduates from ASP have founded the ASP Alumni Association, a lively and well-connected cluster of former students who maintain strong connections with ASP and who periodically meet for sharing cultural and social activites. Thanks to this curriculum, ASP graduates are expected to significantly contribute to a future class of talented professionals, capable of leading innovation processes in a variety of fields, in Italy and abroad. In the words of the ASP advisory board and of the sponsoring corporations, ASP is effectively developing "a new kind of technical graduate".

This volume presents the final results of the multidisciplinary projects of the V Cycle of ASP, while the VI and VII Cycles are still ongoing. Since its foundation, ASP has progressively grown to include a community of about one thousand students and Alumni. The first seven years of activity have been characterized by an evolution though continuous change – coherently with the strongly innovative, pioneering, and exploratory nature of the ASP programme. Such evolution has led to a growing awareness of the ASP approach and its values within the board, the students and the tutors. This article offers readers a brief description of how ASP has been growing from adolescence to adult age and provides recent data on its current status; subsequently, testimonials from ASP Alumni and sponsor institutions are collected.

Seven Years of ASP

In the seven years of ASP history, Management of the School has moved from Milano to Torino and then back to Milano. ASP is managed by a Board of eight professors (four from both universities) with different backgrounds, representing architecture, design, and engineering; the main tasks of the Board concern the management of courses, projects, and students' careers. ASP educational activities in these seven years have been carried out by a large body of about 500 professors, from both the two founding Universities and other academic institutions, who have tutored projects and courses; moreover, about 200 private and public institutions have contributed to projects as sponsors and/or active stakeholders.

Admission

The admission process, i.e. the yearly selection of 150 ASP students forming a cycle from the set of applicants, is very demanding since the quality and success of ASP depends on forming a community of students who are not only talented from an academic point of view but also passionate about the themes that underlie the ASP programme. Figure 1 shows the total of eligible applications (i.e. with respect to academic requirements) and admitted students at PoliMi and PoliTo in the last four cycles. Since 2007, ASP has 3 admission channels.

	APPLICATIONS		ADMITTED STUDENTS		FOREIGN STUDENTS	
CYCLE	MILANO	TORINO	MILANO	TORINO	MILANO	TORINO
IV (2007)	174	110	83	57	18	8
V (2008)	251	230	90	60	28	11
VI (2009)	293	200	90	59	22	13
VII (2010)	240	255	90	59	26	8

1 *Admissions in the last four cycles*

As far as **regular students** from PoliMi and PoliTo are concerned, applications are invited from the top 5-10% students from every course of studies in the fifteen Schools of the two Universities. The figure of merit used for such pre-selection is a weighted product of credits and marks for all exams passed at the end of their fifth semester in the Bachelor of Science programme; this figure evaluates students in terms of quality and speed in their studies. By construction, this group of potential applicants is evenly distributed among all study courses, thereby avoiding uneven distributions of students which occurred in the first ASP cycles, when applicants were selected by using an absolute figure of merit. Normally, about 50% of pre-selected students apply to ASP and subsequently about 50% of these are selected through an interview, before summer vacations; admission is subject to completing the Bachelor of Science programme and enrolling in the Master of Science programme.

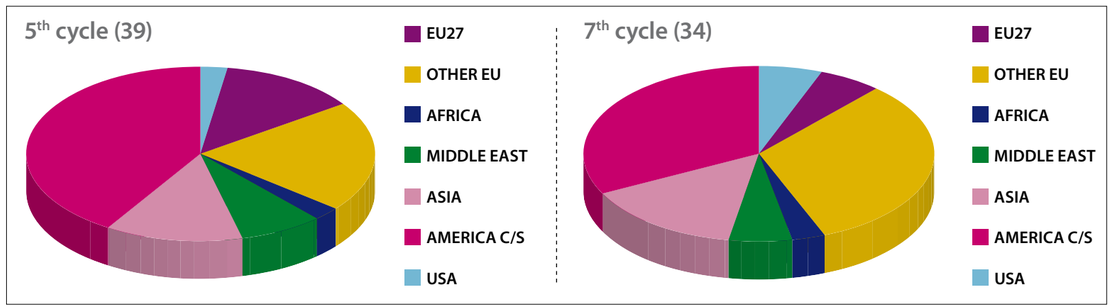
International applications are processed during the spring in parallel to admissions to the Master of Science programmes of the two Universities, in cooperation with the Internationalization offices. The most promising applicants are preselected based on their rankings, as produced by the offices in cooperation with the admissions commissions of each programme.

Finally, a "call for applications" from all students is open until about mid October; applicants must have obtained their Bachelor of Science with average marks exceeding 27. The main purpose of this call is to admit **students from other universities** who decide to move to PoliMi or PoliTo; in any case, this call is also open to regular students from PoliMi and PoliTo and to foreign students.

In the selection of ASP applicants, primarily their understanding of the ASP programme and desire to invest in interdisciplinary education is assessed. Selection is carried out through a face-to-face or a Skype interview; great significance is also given to a motivational letter accompanying the application. In general, about twice as many students as are admitted are interviewed.

During the last three years, foreign students have ranged from between 39 (in the V cycle) and 34 (in the VII cycle), representing a multiethnic population from all over the world.

Women are well represented in ASP with a percentage which has grown from 30-35% in the first 4 cycles to about 40% in the last 3 cycles; in the VII cycle, 44% of students are female.



2 *International students in ASP, V and VII Cycle*

Courses

Since the beginning in 2004, ASP offers six courses in each cycle, equally divided among the two years of Master of Science studies. All courses are offered during the spring semester so that ASP students are free from ASP obligations during the first semester of the second year, when many of them participate in exchange programmes – such as the Erasmus programme. During the last seven years, many changes have occurred in ASP courses. Normally, one or two new courses are opened at every new cycle. Meanwhile, the overall course programme has evolved and consolidated and new teaching methods have been experimented. Professors teaching at ASP are both from the two Universities as well as from leading national and international institutes, including Cornell, MIT, Harvard and Amsterdam University among others. Below is a description of the course offering planned for the VII Cycle.

Courses are clustered into three pairs. The first pair of courses is dedicated to understanding the factors that favor innovation as a participative and socio-technical phenomenon and the common principles of design that underlie all technical professions (engineering, design, architecture) in a way that fosters creativity and team-working. The second pair of courses provides practical abilities related to innovation management and to analyzing complex decision-making problems in the public and private sphere. Finally, the fifth course discusses sustainability as a global and multidisciplinary problem, while the sixth course presents case studies in which the top-down approach to problem solving typical of engineering schools is contrasted to the creative, bottom-up approach typical of the schools of architecture and design.

Courses are residential; students are taken offsite and away from Milano and Torino, typically for one week; if possible, courses of two cycles in the same week and in the same location are offered so that two generations of students have an opportunity to meet together. During 2011, one week in March was spent in Belgirate on Lake Maggiore and two weeks will be spent in May and July in the Alps, in Bardonecchia and Sestriere, in the facilities that hosted the Olympic Villages in the Torino Winter Olympic Games.

Thanks to continuous monitoring and to student feedback, it has become clear that ASP courses have special traits which distinguish them. Firstly, ASP Courses have a participative structure; students are involved in study groups and discussions, leading to short presentations by students, given either in front of the entire class or within smaller groups. Secondly, ASP courses are closely linked to ASP projects, either because the subjects taught in the former can be directly applied to the latter (e.g. understanding the project stakeholders and potential conflicts, defining a business model and so on), or because projects can provide material for case studies which are discussed within student groups.

Projects

Projects are the second backbone of ASP education. Coherently with the ASP cultural approach, projects must be at the leading edge of innovation, complex and systemic; they deal with ill-defined problems, involving a number of stakeholders and a significant degree of ambiguity and uncertainty. Students must correctly assess existing solutions, analyze the needs of the various players and stakeholders involved, define technical solutions and plan an innovation process within the project domain, evaluating feasibility and impact with respect to different aspects (technical performance, response to the needs of the parties involved, socio-economic impact and sustainability). This "problem setting" approach implies that ASP multidisciplinary projects must start from the identification of "innovative concepts", perform the analysis of their feasibility and implications and conclude with a well-defined solution in terms of technological, social, and economic implications. Projects are not usually expected to delve deeply into specific disciplinary details; this marks a clear difference with respect to the work performed during the development of a Master of Science thesis which is generally oriented to "problem solving" with a narrower and more focused approach.

While all ASP projects must be oriented to innovation and multidisciplinarity, from the VI cycle on, certain structural differences have led them to be grouped into two categories: design-driven projects and technology & research-driven projects.

- Design driven projects are characterized by a broad level of multidisciplinarity and focus on innovation scenarios that are mostly unexplored from a technical, structural and functional point of view. Students must first understand the problem at hand and then find a technical solutions.
- Technology & research driven projects address a technological innovation scenario where multidisciplinarity is the main focus; the field has already been covered at the level of research activities and students must explore opportunities for technology transfer and industrial applications.

The two different kinds of projects are usually expected to generate different final outcomes:

- Design driven projects deliver a final result that explores the problem situation, compares possible solutions and evaluates the feasibility of the most promising and innovative options more thoroughly;
- Technology & research driven projects start from a more restricted project brief and aim to deliver a feasibility study of a solution which is compared to others and selected based upon its properties, with a number of demonstrators which assess the feasibility in well-defined, specific dimensions of the solution space.

Projects are either proposed by ASP sponsors or by Professors of the two Universities. The ASP Board mentors sponsored programmes during their preparation by associating them with tutors belonging to the Universities and selects among proposed projects the best suited to ASP, in either of the above two categories. Every project has a principal academic tutor, an interdisciplinary team of tutors representing both Universities and one or more external institutions as stakeholders.

Projects are then presented to students at the beginning of the ASP programme and accompany them throughout their education in ASP. The final exam consists of a presentation of project results. Grouping of students into teams, with about six students each, is performed by the ASP Board on the basis of the students' preferences which are collected immediately after the project presentations. Projects having few preferences are typically dropped at this stage. Each project has normally one or two teams working in parallel, although in some special cases projects may have three teams.

During the schools, students have some allotted time to deal with projects and receive feedback from the ASP Board, especially during a "project midterm" presentation. However, each team is free to organize work independently; students also have a budget (approximately one thousand euro each) to be spent on achieving the project goals, e.g. covering the costs for site visits, buying materials or services, etc. Similarly, tutors have a small budget which is provided in the form of a research grant transferred to the principal tutor's department.
Companies involved in projects have pointed out that a period of about twenty months (from admission to graduation) is too long for the typical corporate project. Project scheduling has therefore been changed by recommending that the first year be spent in preparatory work (state of the art, requirement collection, identification of stakeholders and of their needs) while the core of the project activity should take place during the last seven months of the project and in close connection with external companies and institutions; in practice, this is also the time when students devote most of their efforts to project work.

News from the V Cycle and beyond

This book is dedicated to the projects of the V Cycle. Below is a brief summary as well as some of the most recent ASP news.
During the V Cycle, 51 Professors from both Universities were involved as project tutors and 82 Professors were involved as course professors and tutors. This book describes 10 projects with 24 teams; out of these, two teams were evaluated with "excellent" at the final exam by the ASP Board. They were: Team C (TrackMI - Applying Tracking Technologies to Urban Planning and Design) of the project EXP-HOST (Great events and hospitality. Milan Expo 2015 and Turin Italia 150: new concepts and formats for new populations), and Team B (Flights with zero emissions) of the project PURE WINGS (H2-supplied electric aircraft. Enabling technologies for innovative hydrogen aircraft propulsion with operation costs and logistics impact evaluation).
These two projects have interesting follow-ups: the technology transfer offices of PoliMi and PoliTo are considering the project TrackMI for filing a patent application and students are working on a business plan for a startup (that will be incubated in the PoliTo Technology Incubator). The Pure Wings project is participating in the international 'Airbus Fly Your Ideas' competition, sponsored by Airbus. In addition, students of the "WillChair" project won the "LIFEBILITY AWARD FOR SOCIETY" competition, sponsored by the Lions' Club of Milan.
The project DigiLife: Network Enabled Business Fabric was sponsored by Accenture. There is a growing interest from companies in sponsoring projects, since the VI Cycle has four sponsored projects (proposed by Procter&Gamble, ENI, Reply and Barilla), and the VII Cycle has two sponsored projects (proposed by Accenture and Unicredit). In the VII cycle, a project in cooperation with IIT, the Italian Institute of Technology, has been activated as the result of a MoU between ASP and IIT.
During December 2009, ASP convened its Advisory Board for the second time. The Board is constituted by Professors Robert C. Armstrong (Deputy Director of MIT Energy Initiative, Cambridge, MA, USA), Eric Goles (from Universidad Adolfo Ibáñez, Santiago, Chile), Yongqi Lou (Deputy Head of Art & Design Department, CAUP Tongji University, Shanghai, China) and Konrad Osterwalder (Under Secretary-General of the United Nations and Rector of the United Nations University, Tokyo, Japan). The Advisory Board spent two days revising the ASP programme and talking to students, professors, and the ASP Board. In the end, the final report describes ASP as a high quality programme providing a unique contribution to interdisciplinary education, capable of promoting excellence and of creating enthusiasm and engagement, with high quality students who are happy and enthusiastic about the programme. In the words of the committee, "ASP creates a new kind of graduate, best equipped to tackle the problems of tomorrow."
During March 2011, ASP convened its Sponsors Committee for the first time, constituted by the Cariplo and SanPaolo Foundations, the Turin Chamber of Commerce, the European Patent Office and nine companies: Accenture, Barilla, BCG – The Boston Consulting Group, ENI, Luxottica, McKinsey&Company, Procter&Gamble, Reply and Unicredit. In the presence of the two Rectors, Giovanni Azzone and Francesco Profumo, and of six Alumni, headed by their President Alessandro Pradelli, members of the committee have substantially endorsed the ASP programme, at the same time providing important suggestions for improvement; some sponsors testimonials are provided afterwards.
ASP is currently tightening links with other European and International educational activities with a similar approach. Students from the Technical University Delft will attend the Spring ASP School in 2011 for a first student exchange, while discussions are ongoing with Purdue University (Prof. Michael Dyrenfurth) and with the iFoundry Programme at the University of Illinois at Urbana-Champaign (Prof. David Goldberg) for students and academic exchanges.
In summary, there is evidence that ASP is exiting adolescence and entering adult life. With five completed cycles, ASP has collected a wealth of useful experience; the main ASP asset is a growing community of one thousand young, enthusiastic and talented students and alumni.

The ASP Board

Stefano Ceri (Director) and Marco Cantamessa (Vice Director)
Franco Bernelli and Romano Borchiellini
(Student Careers)
Costanzo Ranci and Marco Trisciuoglio
(Courses)
Elena Baralis and Paola Bertola (Projects)

Alumni ASP. Our mission and vision

The Alta Scuola Politecnica is truly a unique experience from a student perspective: 150 talented people interacting for more than 2 years, sharing ideas and developing multidisciplinary skills. The courses held in weekly sessions (the above mentioned "full-immersion") led to the creation of solid and long-lasting friendships among us. Furthermore, during the Master of Science students consider themselves "ASP students", not only PoliTO / PoliMI students. ASP experience goes far beyond the university experience.
The willingness to keep these relationships alive through the ASP spirit led to the creation of the ASP Alumni Association. The ASP Alumni was then created in mid 2007 by a group of students of the first cycle, with the support of the ASP Board.
The ASP Alumni is organized as an Association, with its Statute and Directive Board (CD). The President and CD members are elected by the former students and are in charge for 2 years. CD is formally composed by the President, 12 elected members and 3 members from the former CD. In reality there is a group of more than 25 people directly working for the Association.
Our key mission is to carry forward the great experience that

ASP has been for all of us, giving the possibility to regularly get together with old friends, to meet students / Alumni from the different cycles and also to help the current students in starting their working experience. We want to develop the curiosity, the multidisciplinarity and the passion that ASP gave us.
ASP Alumni is a building block of the ASP project and will keep on growing year after year. After only five years, the association counts few hundred members and you can meet new people during every event. Our vision in the long run is to create a wide community with "ASPers" from every cycle sharing ideas and discussing about the most various set of topics.

When it all started

As mentioned above, the ASP Alumni Association was formerly created on the day of the Graduation Ceremony of the 1st ASP Cycle, on June 28th, 2007. However, the Alumni Association is almost a consequence of the concept of community created in the ASP experience: the idea of an Association was already part of a discussion of the ASP Board (together with the students) during the last year of the first cycle. During the ASP Graduation Ceremony, in front of the former ASP Director, Prof. Roberto Verganti, the Executive Board, the Mayor of Milan, Letizia Moratti, and the two Rectors of Politecnico di Milano and Politecnico di Torino, Prof. Giulio Ballio and Prof. Francesco Profumo, the ASP Alumni Association turned into "a dream come true". Prof. Francesco Profumo, together with the subsequent ASP Director, Prof. Roberto Zanino, and Vice-director, Prof. Stefano Ceri, also took part in the first ASP Alumni Event at the Politecnico di Torino on October, 6 th, 2007.
Several students from the first cycles of ASP were soon involved in developing the Association, its concepts and ideals, and, above all, its community of people. In the first months the people of the elected Board developed the structure of the Association. Nevertheless the collaboration with the ASP Staff and Board has always been a very important element in order to manage the complexity of the organization.
In early 2010 the new Board has been elected and kept on working in order to build a solid organization. Passion is still guiding us more than everything else and, even if there are clear roles within the Association, we always help each other in every kind of duty emerging. As in the first days, we meet every month on a Saturday morning in order to monitor improvement and plan the future actions.

What we do

ASP Alumni organizes 2 institutional events every year and a series of informal "happy hours". These events are mainly organized between Milan and Turin areas in order to continue the cooperation between the two cities.
The first and most important ASP Alumni institutional event is organized in autumn. It is a formal event, structured around a different topic every year. The concept of the event is to understand deeply the building blocks of a specific topic, selected every year, through the experience that our guests, leading expert on selected arguments, share with us. In the past years we discussed about the "Environmental sustainability of automotive industry" in 2008, about "Meritocracy" in 2009 and about "Entrepreneurship" last year. Our guests included *Stefano Re Fiorentin*, Director of Innovation for Fiat Group, *Roger Abravanel*, leading consultant, journalist and opinionist, *Marco Boglione*, founder and President of BasicNet (Kappa, Superga, KWay) and *Carlo Ratti*, a worldwide famous Italian architect.
The second institutional event is organized in spring and is more informal. The goal of the spring event is to visit interesting places with the key objective of meeting old and new ASP Alumni. In the past years we visited *Venaria Palace*, one of the most famous castle in the Turin area built in the XVII century, after its renovation, Gardaland, the most famous Italian amusement park, and Fenestrelle, a fortress in the Piedmont area.
Through the year, we also regularly organize "happy hours" aiming to stay connected with the ASP Alumni of your city. In the past years, on top of Milan and Turin, we organized some happy hours also in Paris and London, given the high concentration of ASP Alumni working in these cities.
As a key heritage of the last year, ASP Alumni is launching a set of actions aiming to help students in starting their working experience. Our idea is to leverage on our experience on different topics, such as the practical explanation of different working possibilities (industrial companies, consultancy, banking, PhD, etc.), presentation on MBA possibilities, CV preparation, mock-up interviews, etc.

The future

As earlier mentioned by the ASP Board, after less than a decade the ASP project developed "one thousand young, enthusiast, and talented students and alumni". We will keep on learning and working both as a community and as individuals, in order to pursue our goal of building a wide and solid network and in order to shape our future.

The ASP Alumni Board

Alessandro Pradelli (President)
Carlo Ballerini (Vice President)
Matteo Bianchi
Mattia Bogino
Filippo Bolzonello
Marco Bruno
Nicola Francesco Dotti
Mauro Fassino
Giorgio Feletto
Giuseppe Gazzilli
Silvia Invernizzi
Riccardo Ocleppo
Elena Perego
Arturo Petrozza
Serena Pollastri
Giacomo Vigorelli

"I think that Alta Scuola Politecnica has helped me increase my self esteem and my ambitions and added an important feature to my professional and personal profile."

Anna De Vigili, ASP 1st cycle
Architect, Ateliers Jean Nouvel (Paris). Now working on a project of a new concert hall for Radio Denmark in Copenhagen

"The whole experience has contributed to my growing up though I am not able to precisely assess the real benefit. A fundamental instrument is the capability to develop and manage multidisciplinary projects, such as the one developed during the ASP program."

Claudio Roncuzzi, ASP 1st cycle
R&D engineer (material science engineer) at the main Research Center of Saint-Gobain Isover Group

"I joined the ASP programme because I really believe that it is an incredible added value in my CV: as I've been working in college research and education since I graduated, this element of merit has been really appreciated by the Professors I have been working with so far. "

Alessandra Pandolfi, ASP 1st cycle
PhD Student at Politecnico di Milano

"My experience at ASP was phenomenal. The highly selective nature of the school, communication in English, quality of the courses, financial aid and the possibility to establish relationships with students with rational backgrounds but with a different field of application were all essential points of my education at ASP."

Pietro Rabassi, ASP 1st cycle
Bain & Company, Associate Consultant
United Nations Economic Commission for Europe (UN/ECE), Consultant

"The distinguishing aspect of ASP courses and projects is that you have to deal with new problems that at a first glance appear complex and unfamiliar and you can only come up with a solution relying on the knowledge of other team members and thinking in a different way."

Marco Chino, ASP 2nd cycle
Associate Consultant, Bain & Company

"ASP offers the possibility to go into more depth on issues which are not taken into consideration by ordinary university courses.
The value of this school is to create a community of students coming from different engineering, architectural and design courses."

Elena Negro, ASP 2nd cycle
Mathematical engineer. FIAT, Virtual analysis dept. (acoustic field)

"Before the ASP experience, I had never faced the challenge of working hard with other students to develop a multidisciplinary project in the field of innovation. Everything was new for me: dealing with topics unrelated to my technical background, interacting with people from different faculties (engineers, designers) and of different nationalities (two of my project colleagues were Chinese), analyzing the trends of the market related to the project, interviewing managers and experts and so on.
Even if we had to face many difficulties we managed to achieve all our targets..."

Simone Sala, ASP 2nd cycle
PV Engineer @ Services for Electronic Manufacturing

"ASP is an excellent school of life.
Side benefits: open-minded approach, curiosity, need for mind-sharing, becoming and feeling part of a community, keeping in touch with ASP friends, increasing self-confidence."

Silvia Invernizzi, ASP 1st cycle
Architect, Patrizia Pozzi Landscape Architecture

"Professionally speaking, ASP helped me in my last year and was the key to success in my interviews. Certainly the project helped me get in touch with the "real world" and gave me the opportunity to work in a heterogeneous team in terms of curricula and of geographical location. The opportunity to speak English and the open-minded approach of the school broadened my way of thinking and behaving."

Edoardo Prina, ASP 2nd cycle
Proposal Coordinator in Siemens Energy Renewable, Wind power

"The ASP experience has increased my propensity for teamwork and my ability to compare myself with different professions. In particular, the Multidisciplinary Project was the best opportunity for communication and teamwork with different cultural and professional skills, both in science and humanities as well as in the academic and business fields. The results of that exercise are now fundamental to my everyday working experience."

Carlo Guala, ASP 1st cycle
Researcher at R&D Department of INVATEC S.p.A.

"Studying at the Alta Scuola Politecnica allowed me to create a wide network of students who are among the best in their field. The unique experience of getting to know and working with them was extremely enriching and stimulating and still continues today."

Federico Palma, ASP 1st cycle
Building engineer, Studio Associato Garilab

"Thanks to this experience, I believe I have grown as an independent, creative person, able to take initiative and deal with responsibilities. Alta Scuola Politecnica has definitely contributed to shaping my mind in an open and international manner, providing me with the ability to deal with different cultures and customs."

Luca Sironi, ASP 2nd cycle
Project Engineer at Brembo S.p.A., Brake Discs Division

"The ASP experience gave me all the assets needed to succeed in the highly competitive environment of international professional careers and I am doing all my best to use these assets, applying the ASP values in my work life. I definitely appreciate how ASP is successfully filling a gap between highly specialized engineering studies and the increasing need for managers able to create dynamic knowledge networks across disciplines and cultures."

Arturo Petrozza, ASP 1st cycle
Junior Consultant, Roland Berger Strategy Consultants

"I would have not said it at the beginning. What ASP left me, and I mean something useful in my job, is not a backpack of university theories. I could spend hours in describing it. I will try to summarize it at most, in three points:
To be open minded.
It made me think over what I did after.
The importance of a group, a community."

Daniel Tiago Guzzafame, ASP 1st cycle
Fiat Group Automobiles, International Quality Operations

"Among all the value that ASP lodged in me, surely interdisciplinarity is the one that in the working world is the most useful for me.
Every day I have to work with both engineers and designers to match functional and aesthetical aspect inside one only object. ASP teaches me to analyse the different points of view and not to favour only mine."

Stella Barchiesi, ASP 1st cycle
Architect, Phiequipe consultant for interior yachts design

"The ASP is mainly a community of people that does not end once the school program is finished. The community of course begins with the school, grows and becomes a real network of people afterwords, with the Alumni ASP association that makes an effort to continue and to develop the ASP principles through the motto:
innovation, friendship makes it better!
Being good at school is just a small part of our lives. Demonstrating our personal values through human relationships conveys the ASP program an added and positive value to the entire society."

Giulio Sovran, ASP 1st cycle
Architect @ Sovran Architects, Bern

"The ASP has been the educational experience that completed and uniquely enriched my academic path. Among all the things I learned, ASP taught me the importance of being able to interact and work with other people as a unique way to achieve higher results.
I decided to live the *ASP experience* fully: many people I met during the ASP are now among my best friends. I'm still in contact with most of them and are those I think of when it has to do with business, work opportunities or simply going out for dinner!"

Riccardo Ocleppo, ASP 3rd cycle
Electronic engineer, Gruppo Dylog – Buffetti

"From almost two years, I also serve as President of the ASP Alumni Association. The importance of a wide and active Alumni network will be more and more important for the success of ASP.
ASP not only has been key for my professional development and for broadening my vision, but gave me the possibility to meet a lot of stimulating individuals and friends"

Alessandro Pradelli, ASP 3rd cycle
Mechanical engineer, Management consultant and entrepreneur

BCG
The Boston Consulting Group

"The Boston Consulting Group and ASP have a long-standing and mutually successful relationship. Our experience with ASP has been excellent on many dimensions.
The students are extremely well prepared and show a high level of academic background, creative thinking, team building and communication skills.
We very much appreciate the structure of the ASP program as it gives students the possibility to develop skills which perfectly match our internal needs.
We could say that ASP develops great business minds and BCG gives them the opportunity to become great business leaders."

Gioia Ferrario, Recruiting Director, BCG

Reply
concept

"The high level skills we found in students in the ASP Team, powered by the multidisciplinary context and stimulated by the bottom-up creative approach, gave us the chance to experiment a new paradigmatic method which the conventional disciplinary approach was not able to provide. For us the ASP project is now also a sort of important Process Engineering experiment. For ASP students this is a great opportunity to the main background of that *cultura politecnica* distinguishing each 'authentic engineer'. The same elements can be a problem for other students who, deriving no satisfaction, are less involved and mainly go along with others.
Companies like ours are now quite demanding when it comes to newly hired skills and ASP courses are not only an opportunity for students to improve their educational background but also an opportunity for companies to get to know in advance potential candidates for their positions."

Daniele Marietta Bersana, Senior Consultant Concept Reply B.U. of Santer Reply S.p.A.

UniCredit
Global Information Services

"... The cooperation with Alta Scuola has been an extremely positive experience for UGIS: in fact, it has allowed us to compete with other large companies in proposing projects and, at the same time, to meet students of the Milan and Turin Politecnico Universities, very meticulous students interested in contributing to the implementation of a market idea. We expect a lot from the added value that these students will create, we believe it represents for us an opportunity for growth, confirming the Group's international vocation and the importance of technology in supporting the business..."

Giuseppe Salomoni, Head of Architectures, Innovation & Strategic Projects UGIS - UniCredit Group

"We consider ASP as a top-notch source of minds and therefore we are enthusiastic to contribute to the development of young talents by sponsoring this institution."

McKinsey&Company

Gabriele Vigo, Partner, McKinsey & Company

PROJECT 1

Digital Logistics

DigLog
Innovations for Urban Mobility

TRANSFORMING REGIONAL-SCALED FREIGHT LOGISTICS WITH DIGITAL INTEGRATION

Digital Logistics
Transforming regional-scaled freight logistics with digital integration

project 1

Monitoring and optimization of traffic for freight transports in Torino, with the contribution of new ICT technologies. The company partner is Telecom Italia.

PRINCIPAL ACADEMIC TUTOR

Carlo Rafele
Production Systems and Business Econimics, Politecnico di Torino

ACADEMIC TUTORS

Marco Ajmone Marsan
Electronics, Politecnico di Torino

Flavio Boscacci
Architecture and Planning, Politecnico di Milano

Gino Marchet
Management, Economics and Industrial Engineering, Politecnico di Milano

Roberto Tadei
Control and Computer Engineering, Politecnico di Torino

Roberto Maja
Industrial Design, Arts, Communication and fashion, Politecnico di Milano

Claudio Demartini
Control and Computer Engineering, Politecnico di Torino

Alberto De Marco
Production Systems and Business Economics, Politecnico di Torino

EXTERNAL INSTITUTION

Telecom Italia Labs

EXTERNAL TUTORS

Andrea Bragagnini
Telecom Italia S.p.A.

Maura Santina Turolla
Telecom Italia S.p.A.

TEAM A

Silvia Agresti [Team controller]
Management, Economics and Industrial Engineering

Laura Cignetti
Industrial Engineering and Management

Mylène Perrein-Peduzzi
Building Engineering/Architecture

TEAM B

Samuele Bellani
Physics Engineering

Francesco Borrello
Computer Engineering

Marco Montagner [Project Communication Coordinator & Team controller]
Industrial Engineering and Management

Francesco Pasini
Management, Economics and Industrial Engineering

PROJECT DESCRIPTION

The field of information and communication technology (ICT) is continually changing as new technologies are developed. A number of current technologies (e.g. wireless communication technologies) are relevant to mobility applications. Intelligent transportation systems (ITS) encompass a broad range of communication-based information and electronic technologies integrated in transportation system infrastructures and in vehicles themselves. Integration of these systems among companies continues to be a challenge.

Digital Logistics is a project with the objective of implementing potential scenarios in terms of organization, ICT technology, traffic models and political decisions related to improved solutions for lower traffic impact in a large urban center such as Turin. Digital Logistics is a large-scale vision both in terms of geographical scope and industry involvement.

With reference to the ZTL (limited traffic) area of Turin, the challenge is to create a shared system aimed at:

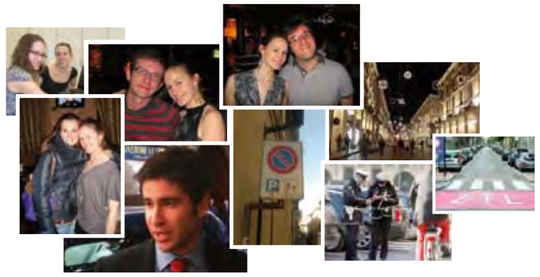
- integrating the players managing information flows and transactions (telecoms, roads, logistic services, logistic service providers, public bodies, etc.);
- converging ICT and sensor networks (mobile cell networking, satellite positioning, ZigBee, traffic sensors, on-board units, etc.);
- redesigning logistic processes to optimize cost, social value and environmental impact.

Based on the underlying converged intelligence, the project has researched future applications to enable dynamic management of freight distribution, as well as dynamic simulation and policy making.

The project involved a variety of expertise: telecom and electronic engineering, logistic engineering, operational research, urban planning and transportation expertise, etc.

The project has been developed by two multidisciplinary teams focused on different aspects:

Team A focused its attention on the improvement that can be achieved by integrated optimization of deliveries in the city center by a single carrier, operating in the last mile of the distribution.



The team used decision support systems to analyze, optimize, and direct or regulate flows. An economic and environmental analysis was also developed as well ample benchmarking research of similar cases.

Team B focused its attention on possible technological solutions to the problem, intensifying collaboration with Telecom Italia. The focus was on a mobile phone application using a Telecom Italia framework as well the integration of other wireless systems (i.e. ZigBee) for various communications from the field.

There is significant potential for new models to set congestion pricing strategies which could focus on computation of optimal tools via variable road pricing strategies to adjust the toll level according to the traffic on the network.

The vision is one of system connection convergence, capitalizing on the capacity of integrating systems and technological infrastructures to enhance communications, interconnections, data exchange, visibility, and traceability of mobility in the city. This could be obtained by developing a strategic design approach focused on horizontal integration as well as vertical implementation.

The project has shown the huge opportunities for improvement on this issue. Developments could come from a real time approach, integration of Reverse Logistics, synergy with healthcare transportation and a unique logistic platform for all city deliveries.

project 1A

Sustainable Freight Logistics in Turin

Redesign logistic processes into an intelligent shared system in order to optimize cost, social value and environmental impact

ABSTRACT

Logistics and freight transport are an important issue in North-West Italy, especially in Turin. The objective of our project is to integrate different transport modes and develop a single eco-friendly carrier solution. In order to optimise transportation we exploit the new opportunities provided by up-to-date technologies which could provide us with real-time, integrated information. In particular, we deal not only with optimising flows from a physical and economical point of view but also take into account innovative parameters, such as the social and environmental impact, with the aim of sustainable development for the city. Firstly we analyzed a number of comparable cases in Italy (Padua) and abroad (London) in which state-of-the-art solutions have already been implemented. In particular, we analysed in greater detail the flows, the scale and the needs of the main stakeholders in order to have a comparison before focusing on the study of the specific flows and issues in Turin. For example, some characteristics of Turin are: the presence of SITO, the road-rail distribution hub of Turin, the lack of integrated solutions regarding all the various logistic operators, flows and traffic picks during the day...
Once we gathered the data and reached a good level of knowledge of the situation, we assessed the opportunity to integrate flows and to develop a service. In order to validate the feasibility of our idea, we studied the "as-is" state compared with the "should-be" solution. Not only did this involve the feasibility of re-organisation of flows but also the fulfilment of user requirements. This part was developed in collaboration with the municipality and we explored the real problems concerning citizens, shop keepers and carriers with surveys and interviews.
Finally, we focused on the implementation of software to simulate our suggested solution. Once organised into a single carrier, the software calculates the optimized route for each vehicle of the fleet and the distribution of goods and customers among them in order to minimise the negative externalities and maximise transportation efficiency, thanks to the integration of data from different sources, such as traffic conditions and shop demand.

TASKS & SKILLS

Silvia Agresti analyzed the state of the art of freight transport in Turin and explored alternative solutions implemented in other cities.
Laura Cignetti developed the freight transport optimization model and organised interviews and surveys.
Mylène Perrein-Peduzzi focused on the initial technical and economic feasibility of the economic and environmental model.

1 *Carriers' routes - as is state*

2 *Optimized routing*

UNDERSTANDING THE PROBLEM

In recent decades, markets have become more instable and turbulent due to the high level of innovation, the reduced product life cycle and other factors such as time to market, globalization, higher interconnection between technologies in the production process and higher competition intensity. As a result, companies needed to be more flexible and modify production organization from a specialized and integrated solution to a network of "core business" companies linked together with "just-in-time" processes. These changes in production organization and globalization of economies have completely modified logistics with three main evolutions: the hub and spoke distribution model (system of connections arranged like a cart wheel in which all traffic moves along spokes connected to the hub at the centre), the rationalization of stock and sorting areas and the concentration of logistic operators. Retail distribution, in particular to the city centre, requires small batches transported over small distances with high transportation frequency which has increased goods traffic in the city.

Because of this increase in commercial flows and a similar increase in private traffic, transport has become a crucial problem for every large city. On the one hand, economic growth of the city required this traffic. On the other hand, this traffic, in particular road traffic, has many negative externalities on the quality of life of the local population and on the environment: traffic jams and extended transportation time, noise, risk of road accidents, pollution, etc whilst the population is increasingly sensitive to these issues. The concept of sustainable development, today at the heart of every political speech, is both a consequence and a catalyst of these expectations as it proposes an alternative model of economic development which gives more priority to people.

What is more, cities want to change, become sustainable and must succeed in order to fulfil both the economic and environmental interests of the local population. We have studied a possible way to improve goods transport in the city of Turin and to reconcile these different interests of flexibility and speed of goods transport and of reduction of traffic externalities.

EXPLORING THE OPPORTUNITIES

Today, many logistic operators deliver goods, once or twice daily, using vans which travel from the logistic platform of the operator in the suburb of the city to customers. Customers often need to receive large quantities of goods in good condition together with a high quality service the same day of the order or at least a few days later. Their main concerns are the speed and punctuality of service. In general, the seller chooses the operator and the mode of transport. Although customers pay the cost of goods transport, the competition between the different logistic operators guaran-

3 *Shopkeepers' survey main result*

4 *Turin*

tees low cost and quality service. Because of the importance of rapid service and the multiplicity of the operators, load saturation (load factor) is low and the global goods traffic in the city is not optimized. Also, we have adopted the point of view of the municipality which would like to improve goods traffic in Turin. Our aim is to find a way to reduce externalities of goods traffic in Turin and to optimize it without reducing the service quality (punctuality, speed) or significantly modifying the price which could alter the competition among logistic operators. The idea is to manage collectively the transport of goods which enter the city in order to increase load saturation, reduce the number of routes and use more sustainable means of transport (train, low carbon vehicles, etc). To incentivate operators to participate in the project, we need on the one hand to imagine the solution with them and to integrate the service. On the other hand, we must pay attention to redistribution of benefits to all the stakeholders in this new solution: for example, the reduction in traffic during certain hours (to avoid noise during the night for the population or to create pedestrian precincts at some point) could be compensated by facility of access to the delivery area (parking space, access to limited traffic area, etc). Concerning these facilities, we studied different cases in Italy and in Europe which helped us understand the state of art and the key problems, met the various stakeholders (logistic operators, shops, municipalities) and analyzed the specific characteristics on Turin.

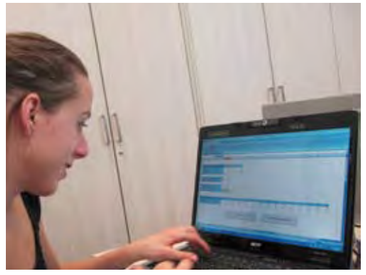
GENERATING A SOLUTION

Integration of different freight into a single eco-friendly carrier is something completely new to Turin. Nowadays, transportation issues no longer concern the improvement of vehicles or infrastructures: everything focuses on service and its organisation. We tried to explore what could and needed to be improved for commercial transportation into/out of the city centre from a different point of view, not only taking into account the economic profitability but also other aspects in terms of safety, environmental impact and ad hoc solutions.

The basic concept is that, by optimising routing of a single vehicle solution, not only is it possible to reduce journeys in terms of distance covered, time, stress, CO_2 emissions, etc. but also to better organise the load-mix of goods and improve vehicle saturation: in one word efficiency. For this, we suggest to use a single carrier so as to take advantage of economies of scale to optimize vehicle saturation and reduce the number of journeys. We have carried out an economic and environmental evaluation of the "as is" state and the "to be" state to guarantee the feasibility and pertinence of our solution. At the same time, we have worked with the stakeholders of this project (municipality, shopkeepers, carriers, etc) to take into account their real needs and problems so as to integrate them in our solution. Through this work, our objective was not just to provide "a new urban freight plan" but rather to provide one for the specific case of Turin and to deliver it.

5 *Traffic in Turin*

6 *ZTL(limited traffic area) gate*



7 *The VRP model*

Starting with this idea we studied and developed two different possible solutions. In the first case, the fleet of vehicles delivers goods in one step. The second case regards two routing steps which means that the goods are first carried to a storage point in the city centre and then distributed to the shops via optimised routes. From a hypothetical point of view, the double line routing could be more efficient because it further reduces the average distance covered within the ZTL and exploits the reduced traffic conditions during the day. However, there are many problems with this solution: utilisation of a larger fleet of vehicles, higher costs of storage points and lower quality of the service (in particular, longer delivery times). This led us to choose a single-line routing.

What is more, our project is in line with the municipality plans to reduce environmental impact of transportation, improve and support services to the city centre and expand pedestrian precincts. Dealing with the implementation of a single carrier is not an easy choice as it could involve problems related to the reduction of competition among logistic operators which on the one hand could lead to higher cost and lower quality of the service. On the other hand, logistic operators sustain that deliveries to the city centre are the least profitable and more time consuming which means that they may agree with the municipalisation of the service.

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project 1B

INTELNAVI: a new frontier in urban logistics

ABSTRACT

North West Italy is a very densely populated area in which houses and factories are spread all over, leaving little space for logistic routes. Due to this restriction, together with limited availability of funds and lack of decisions by local governments in recent decades, logistics is becoming a huge problem for this region, particularly in the large urban areas, in mountain passes and in the port of Genoa.

With the growth of human settlements, particularly around large cities, improvement of physical infrastructures is even more expensive and opposed by local communities, bringing the problem to a dead end.

Support in overcoming this Gordian knot could come from ICT which has revolutionized many fields in recent years. The possibility to collect data and to rapidly process and use it in order to improve the generation of solutions could change the classical approach to logistic problems and particularly to goods handling and delivery by enlarging boundaries and allowing the incorporation of negative externalities.

The desire to obtain a tangible result led the team to focus attention on a single side of the logistic problem: the urban delivery system.

With the significant cooperation of Telecom Italia Research & Trends department, our main industrial partner, the team has explored communication technologies: those available today and in the near future, selecting the best to fit the problem we focused on.

In attempting to improve the delivery system in the city centre, our team hypothesised that the solution could lie in a better use of the loading/unloading areas, with an increase in their number and the possibility to reserve them, as well as to foresee their use by private vehicles when not reserved. The reservation system, to be useful, needs to communicate to drivers the route to be followed and the areas to be used.

After having met with various experts, private carrier companies, publicly owned logistic companies and local governors and having worked with Telecom Italia, we developed our concept and the business model of our idea. Moreover, we built a pilot project in order to demonstrate its feasibility.

TASKS & SKILLS

Samuele Bellani dealt with the preparation of the business model and the creation of a widget for real time navigation.

Francesco Borrello is responsible for computer studies and implementation of the required code.

Marco Montagner is the team controller, responsible for integrating the individual pieces of work in a general framework. He is also responsible for the solution to manage loading/unloading areas.

Francesco Pasini is responsible for the state-of-the-art activity and contacts with public and private companies involved in the project.

1 *Francesco Borrello at work in Telecom Italia laboratories*

2 *The team, during a break from work on the project*

UNDERSTANDING THE PROBLEM

Logistics and freight transport are creating great interest in discussions concerning the environment and energy savings. We have a large amount of data from traffic devices (cameras, vehicle detecting devices, etc.), payment systems, turnpike roads and mobile devices, but nowadays all this data is not collected or integrated together. The original purpose of the Digital Logistics Project was to conceive an integrated and real time information flow management system in North-West of Italy in order to develop new services for the community and to reduce city pollution.

The first part of the project activity, which lasted about one year, was aimed at defining narrower boundaries for the project, at better understanding Telecom Italia (the main industrial partner) requests and at studying the state of the art of traffic monitoring and communication technologies.

Since the desire of stakeholders was to end the project with a tangible result, the team decided to focus the analysis on one side of the problem. By considering the large amount of work that Telecom Italia has already done in prototyping urban parking systems that could have been useful to the project (and it will be), the project was oriented to the goods delivery system in the city of Turin. Therefore, the aim of the project was re-defined to conceive a new logistic system for freight directed to the ZTL (limited traffic area) of Turin in order to contribute to reducing traffic in the city centre and to decreasing the logistic cost of freight delivery during the "last mile".

This choice - to focus the project - was also supported by the significant difference between long and short range transport which has little in common.

In fact, while with long-range transport real time updating of road conditions is not necessary, inside a city centre traffic conditions must be taken into account in order to define the best route to reach the destination.

Furthermore, a study of Intelligent Transport Systems was completed in order to design our system.

EXPLORING THE OPPORTUNITIES

The quest for innovative solutions to support logistics and freight transportation in Turin required exploration of existing alternatives in other cities both in Italy and in Europe and a comparison of possible scenarios that could end up competing with our final results, both in technological and economical terms.

We worked on four axes:

- Interviews with academic subject experts in the fields of intelligent transport systems, urban planning and application of telecommunication technology to mobility.
- Visits to privately and publicly owned companies which are already dealing with and providing digital solutions for transportation issues. We visited the Interporto di Torino, an integrated logistic hub in the province of Turin. We visited 5T in Turin which is currently offering traffic congestion monitoring and public vehicle positioning services. We also interviewed the managers of the mobility department of the municipality of Turin and the manager and IT manager of the Interporto di Padova which successfully completed a city logistic initiative in recent years.

3 *The software running on the cell phone*

4 *Screen to show the trip, as shown on the cell phone*

- Collaborating with Telecom Italia, we developed an in-depth understanding of the currently available and future technologies. In particular, we focused on technologies available to develop portable applications on mobile phones and on proximity communication technologies, with particular attention to ZigBee, to monitor vehicle and goods flows.
- Personal investigations and web research focusing on best practices in other European cities which are using digital solutions for freight transport.

We soon realized that technology currently available on the market could be adopted in a digital logistic system: mathematical settings of the vehicle routing problem (VRP) are well known and robust, navigation systems are used in everyday life and there are a number of different communication technologies (Wi-Fi, GPRS, ZigBee and RFID) that can be successfully used in this field. What is still absent is the integration in a unique platform of different technologies in order to conceive an integrated and real time management system able to receive and send information and data in real time.

5 *The main page of the project web site*

GENERATING A SOLUTION

The solution elaborated by our team provides an innovative answer to the problem of freight transport in complex urban environments and is supported by the preparation of a business plan exploring its technical and economical feasibility.
From a technological point of view, our solution is a platform designed to help logistic operators manage deliveries in an efficient and cost-saving manner by supporting their operations in Turin. In particular, the system's main functions are:

- Real-time congestion information and route optimization: it is possible to find and suggest optimal routes to the desired destinations by taking traffic conditions into account.
- Route re-optimization: the system can re-optimize routes to the desired destinations in response to changes in traffic conditions (e.g. accidents) and/or the arrival of a new customer order.
- Automatic parking search and reservation: the system is able to find and reserve a free parking place close to the destination.

Drivers use these services through a visual and interactive terminal placed in their vans: it can be a dedicated navigation device or an advanced mobile phone. The device can communicate with a central system that provides updated routes to dynamically reach the destinations.

6 *Car illegaly parked in a loading/unloading area*

7 *TVan parked on the sidewalk during a delivery*

8 *Van parked correctly in a loading/unloading area and van illegally parked on adouble line*

9 *Three cars parked in loading/unloading areas*

10 *Van parked on pedestrian crossing and on a corner during deliveries, in the meantime space behind a car illegaly parked in a loading/unloading area*

To demonstrate its feasibility we built a pilot project in collaboration with Telecom Italia.
We designed and developed a widget, an application for mobile phones, using Bondi©, a useful framework allowing implementation of advanced widget applications. The route optimization service is already provided by many devices and many logistic carriers have their own optimization software so we decided not to focus on this aspect but to integrate one of these software products in our application.
The widget can display the map of the city of Turin, indicate the updated optimized route and the parking areas to be reached and destinations to be served, obtain necessary information by querying a central system and return to it updated information regarding the process. We also developed part of this central system focusing on the communication between the mobile application and the central server and designing it to facilitate integration among different systems and services already implemented by Telecom Italia, such as their prototyped parking reservation system. The real-time communication between the central server and the widget has been implemented in a complex and cost-saving manner by combining mobile network technology (GPRS/UMTS) and SMS services.

From an economic point of view, excluding any labour costs, we estimate system implementation costs of approx. 80-100 k€, including the purchase of all required devices (computers, mobile phones, printers, screens), and the installation of ZigBee receivers. Starting from the second year, we estimate the running costs will be approx. 15-20 k€ and revenues of approx. 30k€ could be generated by selling our technology on the market.

NOTE

The project involved access to confidential material prepared by our industrial partner, Telecom Italia, that remains its sole property and that we cannot disclose without its permission. We express our thanks to Telecom Italia for the support and technologies provided, in particular Ing. Bragagnini, our interface.

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PROJECT

2

UC@Mito

@MITO

URBAN COMPUTING FOR MILANO AND TORINO

UC@Mito
Urban Computing for Milano and Torino

project 2

UC@MITO is studying the integration of computing, sensing, and actuation technologies into everyday urban settings and lifestyles in collaboration with CEFRIEL

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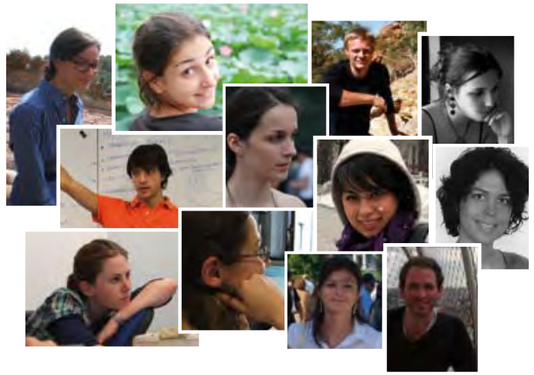
PROJECT DESCRIPTION

Our cities face many challenges. The Urban Land Institute (www.uli.org) has recently formulated some of the major challenges in the following questions:

- How can we create more choices in housing, accommodating diverse lifestyles and all income levels?
- How can we reduce traffic congestion yet stay connected?
- How can we include citizens in planning their communities rather than limiting input to only those affected by the next project?

Information and Communication Technology (ICT) is playing an increasing role in addressing these challenges. The methodical application of ICT to urban settings has many names. IBM calls its initiatives in this direction “smart cities”. SIEMENS calls “sustainable megacities” the result of massive application of ICT to urban settings. In this ASP project, we adopted the more technology-oriented term “Urban Computing”, which in 2007 was defined as “*the integration of computing, sensing, and actuation technologies into everyday urban settings and lifestyles*” (IEEE Pervasive Computing special issue on Urban Computing, 2007).
The project teams set as goal for this ASP project to (a) conduct a multidisciplinary study of Milan and Turin urban settings placing special attention on the challenges that the cities will face in a large scale events such as the EXPO 2015 in Milan and the 2011 celebrations of 150th anniversary of Italian unification in Turin; (b) to conceive a broad set of innovative applications of Urban Computing for Milan 2015 and Turin 2011; and (c) to select a subset of these services based on their feasibility and present them to relevant stakeholders.
In the beginning the two teams of students collaboratively studied the state of the art and the offer of Urban Computing services currently globally available. Then, the two teams independently faced the challenge of conceiving innovative Urban Computing services for Milan and Turin.
Team A focused on three fields of interest: Mobility, Society and Safety. Their concept, *ConnecTown*, is a modular data mash-up



platform which allows citizens, tourists and municipalities to share geolocalized and real time information about mobility, society and safety through a unified and user friendly interface.
Team B proposed *Where A Mi?/Where TO?* envisioning the installation of a series of wireless hotspots that serve as a spatial forum for online word of mouth information exchange. *Where A Mi?/Where TO?* is composed of three parts: a hardware system - a network of WiFi hotspots -, a software system - a live feed platform - and a spatial system - a set of pieces of urban furniture - that together facilitate local information exchange between citizens, businesses, visitors and city governments.
The results were presented to the Chamber of Commerce of Turin and, thanks to their feedback, a feasible pilot project proposal was assembled for “Salone del Gusto 2010”. The proposal, namely *ConnecToMi*, has three faces: the provision of free wireless hotspots in "Salone del Gusto" and other important public spaces; the provision in the WiFi connection page of the Web Portal of "Salone del Gusto" together with some information provided by the Chamber of Commerce of Turin (e.g., the gastronomic guide "I maestri del Gusto”); and real time monitoring through the WiFi of the visitors' activity (e.g., who has been visiting whose booth) to be used by "Salone del Gusto" organizers.

project 2A

ConnecTown...ConnecToMi

ABSTRACT

The UC@MITO project originates from the intention to apply and experiment a new analytical approach to the city of Turin and Milan by improving different kinds of social connection through the use of widespread technologies such as Wi-Fi and smartphones.

Analysis of the context, of the state of the art in the Urban Computing field and identification of possible users and related requirements led, in a first phase, to the recognition of three different fields of activity - mobility, safety and society. They represent vital and demanding areas of city management and planning. This "breakdown phase" created the premises for the process of macro-concept generation that dealt with the integration of different services in a multi layered solution.

The elaborated concept, called *ConnecTown*, is a modular platform allowing sharing of information generated and consumed by different players including citizens, event organizers, visitors, tourists, and municipalities. The platform consists of an all-in-one system offering real-time and geo-localized information about mobility and transport, safety and city flows from existing resources and anonymously collected data.

As a further integration phase the two project teams worked jointly to find an appealing solution for a precise stakeholder, the Chamber of Commerce of Turin. The outcome of this step was the creation of *ConnecToMi*, a pilot project proposal that applies the ConnecTown platform to a public wireless infrastructure based on the Where A Mi?/Where TO? Project in the context of the Salone del Gusto fair in Turin.

TASKS & SKILLS

Volha Anisimava gathered information about the existing solutions and was involved in the definition of user needs and requirements.

Daniele Campobenedetto coordinated the group work organizing the sub-groups and managing the relationship with team B in the initial and in the final phases of the project.

Jelena Crnogorcic analyzed and evaluated the urban impact of the project in its different phases and focused specifically on the privacy issues involved in the project definition.

Adriana Granato studied the output of the concept creating the logo design and the user interface. She contributed to the overall graphic presentation of the project.

Sara Magliacane contributed to defining a technological solution for the final concept analyzing existing technologies and interviewing institutions and data providers.

Federica Nasturzio coordinated the conception process identifying objectives and targets in each phase for each sub-group and managing the integration process for the definition of a main concept.

UNDERSTANDING THE PROBLEM

The reasons behind this research are various: first of all the fact that "human interaction with and through computers is becoming socially integrated and spatially contingent" (Greenfield, 2007); then the importance of the urban environment, meant not only as a real place but also as a virtual space containing interactions and information, even if fragmented and not integrated; last but not least the evolution of the role of citizens as city users in the urban environment.

The main goal of this work is to reuse data and technologies that already exist in a specific urban environment and integrate them with real time information to design an increasingly responsive environment, improving quality of life and attractiveness of a place.

EXPLORING THE OPPORTUNITIES

The implications of ICT in architecture and urbanism alter the way we conceive the space. In order to address these issues, the design process was characterized by several phases and a continuous design pattern.

Firstly, the team performed an analysis of the state-of-the-art of urban computing services. The review of existing projects and studies, such as Citysense (http://www.citysense.com/) or Urban Atmosphere (http://www.urban-atmospheres.net/), allowed a better understanding of the subject and of the potential benefits of the application of ICT to city life. In this phase the team conducted a series of interviews with possible stakeholders (such as Municipalities, Technology Providers, Event organizers) and attended product presentations (e.g., Ghostway) and exhibitions (e.g., ITN Expo).

Subsequently, the initial conceptualization by the group was refined by means of a "needs analysis" that implied the classification of the main stakeholders, players and their requirements (image 1). The needs analysis pointed to the identification of three specific fields of interest: safety, mobility and society. The selection was made by considering the most common problems and difficulties that emerge in the relationship between citizens and urban space.

Actors	Resources	General objectives	Specific objectives
Municipality	Coordination & data	Make the city competitive (all aspects).	Integration and improvement of existing services (efficiency). Statistical data about city flows.
Technology providers	Technology	Sell products or services.	Opportunity to enter a new market.
Data providers	Data	Provide more effective services and advertise.	Wider use of the service due to integration. Feedback data from the customer.
Event organizers	Coordination	Attract visitors and participant with publicity and effective service.	Higher quality of services due to integration and real time positioning and data.
Sponsors	Financing	Attract customers and investors in order to improve business.	Advertising and meeting customers needs in real-time.

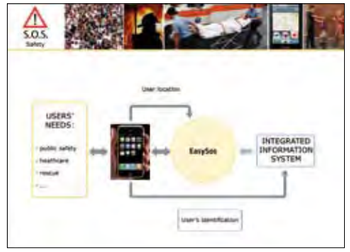
1 *Stakeholders objectives and requirements*
This matrix shows the main stakeholders of ConnecTown underlying the kind of resources they can involve in the project, their principal goals, and why they could be interested in joining the service.

The team developed three micro-concepts that address specific problems: the "safety micro-concept"(EasySOS: image 2) concerns the protection of sensitive categories of people in the city and increase the overall public safety in the city; the "mobility micro-concept" (SmartMove: image 3) focuses on the efficiency of public and private transport in the city and its environmental footprint; the "society micro-concept" (LiveTown: image 4) considers the communication between citizens and the way they "use" the city and its services by tracing fluxes of people.

GENERATING A SOLUTION

Initially, the team planned to select only one sub-problem for further development. However, during the research the team members perceived that the three concepts were complementary and that they could be integrated in one unique concept, able to create the added value of the aggregation: ConnecTown.

ConnecTown is a **modular platform** that simplifies the deployment of applications that require geo-localized and real time data mash-ups. It allows seamless sharing of information generated and consumed by different players in the city, including citizens, event organizers and municipalities (image 5). The



2 *Safety Micro Concept, EasySOS.*
Users in an emergency situation can use EasySOS application to call for help. The rescue team receive from EasySOS the position of the calling person and also his medical situation information.

3 *Mobility Micro Concept, SmatMove.*
SmartMove has access to existing databases, to real time sensors in the city and to user generated information. Through these sources it is able to elaborate answers to the users' needs.

4 *Society Micro Concept, LiveTown.*
LiveTown is a free geo-localization based application offering information about the Expo and the city in real-time, while collecting anonymous information about the flows of people in the city.

platform offers an **all-in-one system** which provides **real-time and geo-localized information** about mobility and transport, safety and city flows by integrating existing resources and anonymously collected data. The concept functioning is summarized in image 6 and image 7.

Users can access ConnecTown from the Web, smart-phones equipped with a GPS or from fixed position devices such as totems located in the city's focal points. We designed the interface (image 8) to be user-friendly and intuitive. Moreover, according to their profile, users have the possibility to access different kind of information.

The real-time geolocalized data is obtained by **tracing the position** of users and vehicles connected to the platform but revealed only to other users which were explicitly authorized by the owner of the data. The **anonymized data** are used only to create statistics to detect unusual concentrations of people or vehicles in one specific place and to follow the behavior of the flows of masses of people and traffic in the city.

ConnecTown provides a **unified analysis of real-time data streams** about the city, facilitating an efficient usage of transport means and supporting the organization of large events as well as assisting everyday urban planning practice. Furthermore the Safety module guarantees effective intervention in case of emergency and need of all those subscribing to this service.

The ConnecTown concept aims at exploiting the **large event vector** to explore solutions which can be applied in the context of the event, but also in everyday life. The extensibility ensured by the modular structure of the platform makes the system versatile to different situations, helping to scale from a small size experiment to a city-wide network.

The ConnecTown business model is based on two sub-models, one involving public and the other involving private players. Public players, for example the municipalities or tourist promotion agencies, finance the infrastructure and offer public data in exchange for real-time information, tourist promotion and dissemination of data useful for the citizenship. On the other side, private companies can reach their clients in a more effective way through "g-local" and personalized advertising. To demonstrate the feasibility of ConnecTown, the team interviewed a number of companies offering similar services. The most interesting ones were *Plasboo* (http://www.plasboo.com/) and *Futur3* (http://www.futur3.it/), which confirmed the sustainability of ConnecTown's business model.

5 *ConnecTown concept moodboard*

6 *Platform structure.*
Three modules collect data from different institutions and sources (existing databases, real-time anonymous data and user-generated content). These sources are processed by the platform. Users can seamlessly access these resources through a mobile phone application or other devices. The modular structure allows an incremental implementation strategy.

7 *ConnecTown platform layers, main users, specific databases and possible queries.*
The core of the platform is a map system that allows the positioning of users. The different kind of users can obtain answers to their needs from the different kind of data involved and processed by the platform.

8 *ConnecTown interfaces.*
On the left: citizen-visitor's mobile phone interface. One the right: Municipality's computer interface.

At this point of the process a meeting with the Chamber of Commerce, main stakeholder of the project, suggested a further development: the proposal of a unique project combining the work of team A and team B in order to elaborate a pilot project for the "Salone del Gusto 2010".

The final result of the integration of the concepts is **ConnecToMi**, a pilot project proposal based on the provision of free wireless hotspots in the "Salone del Gusto" and in other strategic areas in the city, and a Web platform accessible through the connection page of the Web Portal of "Salone del Gusto". The users enter the platform giving their consent for personal data processing and from this moment on they can access information about events, tourism, services, help and transport. On the other hand, the municipality and event organisers obtain statistical and real-time data about mass flows and traffic as well as feedback concerning urban services.

The ConnecToMi project proposal was sent to the Chamber of Commerce, to the StartCup Milano Lombardia competition and also presented in Shanghai during the Expo. The feedbacks obtained from these institutions were convincing enough to suggest the transition to a future "implementation phase".

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project 2B

Where A Mi?/Where TO?

ABSTRACT

Team B of the UC@MITO project responded to the initial Alta Scuola project call with a concept entitled "*Where A Mi?/Where TO?*". *Where A Mi?/Where TO?* envisioned the installation of a series of wireless hotspots that serve as a spatial forum for online word of mouth information exchange. It was the conviction of Team B that spatial and virtual environments needed to be not only superimposed but integrated in one policy and project design that would favor not only citizens of Milan and Turin but similarly promote the legibility and accessibility of these to visitors arriving for upcoming large events like EXPO 2015 and Torino 2011. *Where A Mi?/Where TO?* is both a software and hardware project, complementing online services and virtual information with urban furniture interventions to provide a spatial forum for information sharing. *Where A Mi?/Where TO?* is composed of three parts: a hardware system, a software system and a spatial system. The hardware system refers to the installation of wireless hotspots in Milan and Turin. Software system, instead, refers to the installation of software in hotspots capable of providing user authentication, storing user activity and allowing for the exchange of local, real time information. The final system, the spatial system, consists of the construction of a number of spaces to promote and facilitate Internet connectivity. Such spaces are considered a crucial conjuncture of virtual and spatial information exchange. The project culminated with the presentation of a pilot project in combination with Team A of the UC@MITO project entitled ConnecToMi.

TASKS & SKILLS

Matthew Arancio: context survey, concept work, document drafting, team controller.
Maricica Cozma: computer systems consulting, case study analysis.
Marc Leyral: architectural systems consulting, graphic work
Sara Lora: concept work, architectural systems consulting, graphic work, documenting drafting.
Roberta Musso: concept work, architectural systems consulting, graphic work.
Sanaz Mirzaei: context survey, concept work, document drafting, graphic work.

UNDERSTANDING THE PROBLEM

Milan and Turin are both marketing themselves as "large event cities"; as such, both cities need to provide suitable infrastructures to not only **host** and facilitate the movement and interaction of touristsbut also to provide for the **collective good** of the greater metropolitan community through a qualitative increase in services. Taking advantage of the creative energy associated with ongoing events and the upcoming EXPO 2015 and Torino 2011, *Where A Mi?/Where To?* proposes to incrementally modify urban public spaces and open up new forums of information exchange to city users.

The city is thus forum of information exchange. With this assumption, a general identification of four user populations (citizens, businesses, visitors, and government) allowed for further brainstorming about possible information exchange that is currently lacking. Initially brainstorming was then confirmed by a series of interviews and meetings conducted with the Emilia Romagna Regional Telecommunications Project (PITER). Players at both the regional and local level were interviewed and policy solutions ultimately promoted to a combination of regional coordination but local project intervention to promote such information exchange. Stakeholder needs and objectives in the Emilia Romagna context were extrapolated and applied instead to the cases of Milan and Turin. In Turin there is regional coordination under the Piano Strategico adopted in 2006 but no local project initiative for wireless connectivity. In Milan there is currently no overarching regional policy or local project initiative to promote wireless internet connectivity.

In the end Team B identified the need to provide wireless connectivity and online information exchange through a spatial project intervention.

EXPLORING THE OPPORTUNITIES

Case studies in the area of Urban Computing and connectivity were presented in a conference on Urban Computing and policy

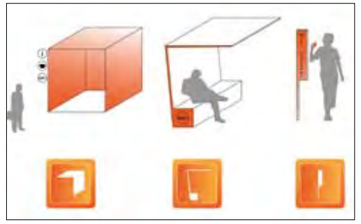
1 *A photomontage showing the configuration of a Where A Mi? space at Porta Genova*

innovation entitled Wireless Cities in Bologna on June 17th, 2010. The case studies for the UC@MITO Team B project were chosen as exemplary of the panorama of wireless service provision in urban spaces. They similarly provide ongoing insight into the challenges faced in wireless service provision and will thus serve as a scaffolding to better understand possible project solutions for Team B's UC@MITO project. Three general themes that appear throughout the case studies include:

- **Wireless service provision and a platform for access to wireless hotspots**
  seen in a project called LUNA(http://www.futur3.it/rete-luna/), a wireless and online authentication platform strategy currently being implemented in Trento. Luna is composed of a hotspot system and user profile management system that is available to benefit both citizens and visitors to the city.

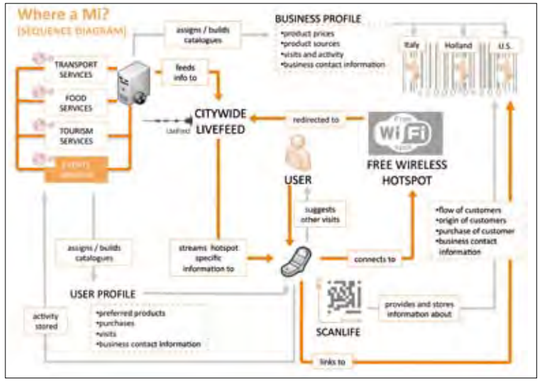
- **Place making through local information software**
  seen in a project entitled Bologna Smart (http://www.bolognasmart.it/), a smart phone application that allows tourists to access information regarding Bologna's main tourist and shopping attractions. The software also provides GPS services, directing users to specific attractions.

- **Online services including profile storage, taste recommendation and local information sharing**
  exemplified by the websites Stumble Upon (http://www.stumbleupon.com/), Hop Stop (http://www.hopstop.com/) and



2 *An image showing the three Where A Mi? / Where TO? spatial concepts: the cube, the bus stop and the quick stop. These concepts were later translated into a pilot project for the Turin Chamber of Commerce.*

3 *A photomontage showing the hypothetical configuration of a ConnecToMi space in an event setting; such a strategy was suggested for an event space like the Salone di Gusto in Turin.*



4 *The Where A Mi? / Where TO? Software System*

NYC Now (http://www.brooklynnow.com/). Stumble Upon is a website that allows rapid web surfing based on personal preference, storing preferred sites to provide for future recommendations. Hop Stop is a public transit solution website that allows users to chart routes without the use of a car. NYC Now is a local, New York based website that provides up to date, neighborhood specific information for Manhattan and Brooklyn.

GENERATING A SOLUTION

Where A Mi?/Where TO? proposes keeping word of mouth human, creating a spatial dimension for information sharing.

The system itself is composed of three parts: firstly, a hardware system composed of free wireless hotspots distributed across the city in important public spaces. Secondly, a software system composed of a mobile platform generating a user profile accessed either by laptop or Smartphone connections. The software system is also composed of a Livefeed that streams real time information based on the user's location. Finally, the third element of the Where A Mi? / Where TO? project is a spatial system composed of the creation of a "place" for internet connectivity.

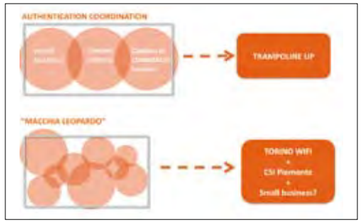
A number of guiding principles shaped the Where A Mi? / Where TO? project concept. These principles are the following:

- The standardization of data services
- The provision of free forums of information access
- Moving beyond the traditional urban experience
- Creating new ways for city users to communicate
- Rethinking the use of already available technologies

In terms of the hardware system, a public – private partnership approach was implemented, following the strategies of Bologna. This concept, called "macchia di leopardo" (leopard spot) guarantees WiFi in major public spaces. Secondary and tertiary public spaces are instead coordinated by individual store owners that make use of a city negotiated "package" that provides wireless from a selected service provider (image 6).
The software system is broken down into three parts: an authentication component, a geo-localization system and a Livefeed. A major component of research for the *Where A Mi?/Where TO?* project in this regard has been exploring and generating software solutions to ensure public wireless provision in accordance with the Legge Pisanu. This law, mandated by the Italian government, requires that all private online activity be traceable. A safe and coherent authentication system was thus identified as a fundamental task in providing and facilitating wireless accessibility and services (image 4).

The spatial system, finally, is composed of the cube, bus stop and quick stop. These concepts are a series of urban furniture interventions designed to subtly modify existing public spaces. The cube is a form that would appear in central spaces, like main squares and stations. It would be a large presence that would also provide information about registration services, Internet hotspot locations and similarly information about ongoing neighborhood or citywide activities and large events. The bus stop would be a sheltered place to sit and connect to the Internet along major transportation corridors and in secondary squares and pedestrian spaces. The quick stop is a place to quickly access the Internet to check email or figure out geographic location (images 1, 2, 5, 7).

5 *Where TO? Hotspot Concept; the aim is to subtly suggest the comfort of public internet connectivity, generating new activity in already important public social spaces.*



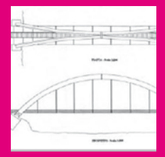
6 *Where TO? Service Distribution Concept. Authentication recognition would be a federation of the city of Turin to provide coverage to citizens, the Chamber of Commerce representing businesses and visitors in the city and finally the university providing for students. The macchia leopardo was proposed because it uses public-private partnerships to diffuse wireless, thus minimizing the cost to the city for wireless provision.*

7 *Where TO? Hypothetical Spatial Distribution in the city of Turin.*

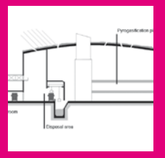
CONNECTOMI

The fusion of Team A's ConnecTown project and Team B's *Where A Mi?/Where TO?* project is ConnecToMi. The project ConnecToMi was proposed to both the Turin Chamber of Commerce and the Lombardia Start Cup project innovation competition

ConnecToMi has two faces: firstly, the provision of free wireless hotspots in important public spaces and secondly, the compilation of the real time data related to user activity to be used and responded to by city administrations and large event organizers. Such a project superimposes virtual and physical presence of users and administrations in key public spaces, creating a new layer of meaning and activity to already active urban spaces like squares, pedestrian plazas and important transit nodes. Team B contributed to this effort by providing strategies for spatial distribution in the city of Turin, contacting local players involved in wireless service provision to participate in the pilot project and generating architectural models and diagrams for the WiFi hotspots. Composed mainly of architects and urban planners, Team B sought to implement and share its hardware and spatial solutions to wireless connectivity and real time information exchange in the ConnecToMi project (image 3).



PROJECT **3**



VALORiver

CONTRATTO DI FIUME DEL Torrente Sangone

SUSTAINABLE VALORISATION PROJECT OF THE SANGONE RIVER

project 3

VALORiver
Sustainable valorisation project of the Sangone River

VALORIVER works to a project about territories of the Sangone river in the boundaries of the city of Turin in collaboration with Basin Authority of Parco del Po

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PROJECT DESCRIPTION

The Challenge
The project is related to the implementation of the Sangone River Basin Contract, a voluntary agreement among public and private players involved in the management and use of water resources, aimed at the enhancement of the river's resources and its territory.
More than other wide-area programs and planning tools, the River Basin Contract requires multidisciplinary approaches aimed at defining innovative and sustainable design strategies and choices.
An innovative characteristic of the River Basin Contract is the involvement of institutional players and the local population, contributing to the construction of priorities or to the implementation of sustainable strategies.
This extremely complex characteristic requires negotiation among the teams of students, local governments (10 Municipalities), wide-area institutions (Region, Province of Turin, River Basin Authority) and certain stakeholders. Moreover it requires new approaches and methods for defining large and local plans and projects (not only related to urban design and architecture).
The last aim of the project is the definition of design methodologies that can be used as a model for the sustainable development of the territorial system of the River Contract, exportable in other contexts.

The teams
Three different teams of students addressed the project, choosing different and integrated approaches.
Team A worked on a decision support tool, a Multi-Attribute Decision Making technique (starting from an interpretation of the hexagon model by Njikamp), using the Analytic Hierarchy Process (AHP) that can be applied to assess ex-ante, on-going and ex-post the sustainability of different scale projects. This technique has been tested on four planning projects, located in two critical areas of the Sangone basin (Bruino, Rivalta and Nichelino).
Team B worked on a tool to educate inhabitants on a waste disposal process. The project is carried out in a large area along the river, aimed at creating confidence in waste management processes, promoting active citizen participation. Thematic routes related to waste treatment are designed as a territorial museums along the river.
Team C worked on a local waste management platform that could be situated in an area near the Interporto of Orbassano, chosen after a negotiation with the Province and other institutional players. The proposed platform has an innovative concept in terms of the technologies employed and the building design itself (considering the Isséanne Incinerator of Issy le Moulineaux on the Seine and the ecosite of Semardel in Vert le Grand, Paris, visited by the student team).

The results
The three teams identified different approaches to implement sustainability on different scales (local and large), with multidisciplinary approaches and diverse goals (project assessment methodology, large educational system project, local technological and innovative project).
Teams B and C have developed solutions addressing the theme of waste management, an opportunity to gain awareness concerning waste treatment and to reclaim territories on large and local scales. Waste becomes the subject of architectural, landscape and detailed design experiments with long-term effects on large scale development, integrating sustainability in a new design vision.
Team A, working on hierarchical analysis (AHP), proposes an assessment model to evaluate project sustainability. This tool can be used by different subjects (public authorities, designers) and in different phases of the design process: ex-ante - to analyze the existing situation -, on-going - as a self-assessment tool and/or as a selection criteria among different design areas or project choices - and ex-post - to define monitoring strategies.

project 3A

SuRPIAs
Sustainable River Planning Assessment

TASKS & SKILLS

Antonella Celenza studied the hydraulics indicators. She then focused her attention on the Bruino-Rivalta area, studying the state of the art indicators (in particular services, public transport and social cohesion) and furthermore analyzed the two projects planned in the area.

Dario Conti Papuzza analyzed the projects proposed by municipalities in the Sangone Action Plan, a document of the River Contract. He also analyzed the territory of the Sangone river basin from a historic, cultural and structural point of view. This study led to the development of a set of landscape indicators. Furthermore he participated in survey activities.

Matteo Giuliani studied the ecological, infrastructure and natural capital indicators via the use of WODA software for simulation of ecological variables and the use of ArcGIS software for manipulation of geographic data. Furthermore he focused on the study and application of Multi-Attribute Decision Making techniques and, in particular, of the Analytic Hierarchy Process.

Diego Molinari focused on the definition of the general evaluation framework based on the study of sustainable development models. Also, he defined indicators in the public policy area, covering social and political aspects of the assessment (including field survey activities). Furthermore, he developed communication tasks in an international sustainability conference.

Nadia Ortolan studied the state of the art of the Municipal territory involved in the River Contract and, in particular, the Nichelino indicators (in particular services, public transport and social cohesion) and furthermore analyzed the two projects planned in the area.

ABSTRACT

The sustainable planning of a river basin is one of the most challenging problems of urban and territorial planning, further enhanced by the requirements of European directives (such as the Water Frame Directive). Therefore, innovative methodologies are necessary to promote an integrated and participative approach to planning in vast and complex territories.

One of the most interesting cases in Italy is the experience of the Sangone River Contract in the Piedmont Region: it is a voluntary agreement aimed at integrating environmental and land planning policies, as well as an opportunity to experience a participative approach to planning, involving many institutional players. Starting from the projects included in the River Contract, signed in 2009, this work aims to develop a decision support tool assessing the sustainability of the river basin planning projects using Multi-Attribute Decision Making techniques. The hexagon model proposed by Njikamp and Opschoor is adopted in order to describe the concept of sustainability. The six proposed categories derived from that model are considered as the main branches of a hierarchical tree containing criteria and indicators; through the application of the Analytic Hierarchy Process, it is possible to produce a preference ranking of the alternatives (projects) considered.

The proposed assessment is applied considering four projects, regarding two critical areas of the Sangone basin: Bruino-Rivalta and Nichelino. After comparing the values of the indicators and weighting the importance of each branch of the tree, a ranking based on the sustainability of the proposed projects has been obtained.

1 *The Sangone River*

2 *The Sangone basin*

3 *Sustainability hexagon model (Nijkamp and Opschoor, 1997)*

4 *The two project areas*

UNDERSTANDING THE PROBLEM

This work starts from a wide scope: to improve the sustainable development of the Sangone River. Understanding the problem constituted itself a challenge; the first step required to study the current situation of the basin.

The Sangone River flows for about 50 km in the Piedmont Region, crossing territories of different municipalities. The tricky aspects of the Sangone area are the low quality of river habitats, hydro-geological problems and the presence of deteriorated areas along the river.

The River Contract is a voluntary agreement among public and private stakeholders, aimed at integrating environmental and land planning policies; moreover, it is a governance instrument that promotes the participation of different institutions and citizens. The Contract, which aims at sustainable development of the river, was signed in 2009 and collects programs and projects to be implemented in the basin.

The main players involved are the following:

- Regione Piemonte
- Provincia di Torino
- Ente di Gestione del Parco fluviale del Po
- 11 Municipalities
- Autorità di bacino del Po
- AIPO (Associazione Interregionale Po)

The efforts of the Team have been focused on defining a general evaluation procedure, based on the River Contract, which ensures effective integrated planning.

EXPLORING THE OPPORTUNITIES

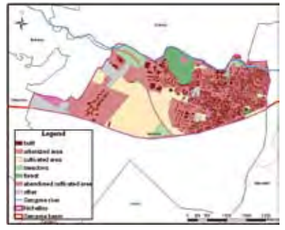
The River Contract follows the principles of sustainable development as fundamental drivers of its objectives. However, although sustainability is a widely accepted concept, it is difficult to translate into practical terms.

Thus, it is difficult to define a "state of the art" in sustainability assessment. Methods are ad-hoc, based on multiple theoretical models, and there are no universal standard procedures to evaluate simultaneously aspects which are different and contradictory in nature.

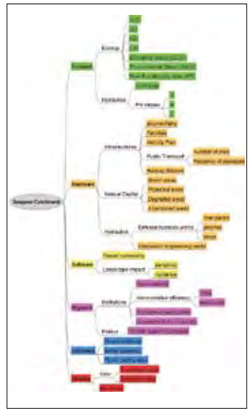
The classical definition of sustainability considers three main elements: *economy*, *environment* and *society*. However, reality is much more complex and a more sophisticated framework is required to obtain a more comprehensive and precise description.

The *hexagon model* proposed by Nijkamp and Opschoor (1997) was selected as the most appropriate solution. The intention of the model is the identification of the necessary conditions for achieving public policy success, categorizing the sustainability evaluation into six main elements:

- Ecoware (environmental interests)
- Hardware (implementation of technologies)
- Software (information and decision support systems)



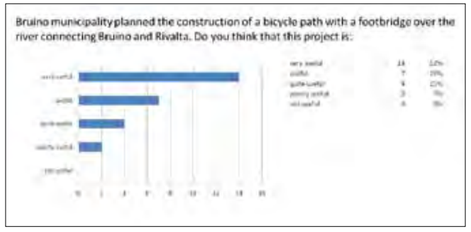
5 *Nichelino project area (land use)*



6 *Hierarchy of criteria and indicators*

- Orgware (administrative systems and governance)
- Civicware (community interests)
- Finware (economic and financial systems)

In order to consider all the elements ensuring sustainability according to the hexagon model, a Multi-Attribute Decision Making (MADM) approach is necessary for dealing with complex systems, comparing several alternatives and considering different objectives and criteria. Many MADM techniques have been proposed in literature: *Simple Additive Weighting* (SAW), *Multiplicative Exponent Weighting* (MEW), *Analytic Hierarchy Process* (AHP), *Analytic Net Process* (ANP) and *ELECTRE methods*. In particular, it was established to use AHP (Saaty, 1994): this method is based on the subdivision of the complex problem into a hierarchical tree of criteria and indicators that simplify the understanding of the problem itself. Then, the analysis provides an aid to the Decision Maker who, making several paired comparisons and specifying his/her preferences using a verbal scale, produces a preference ranking of the considered alternatives. The AHP is performed through three fundamental phases:

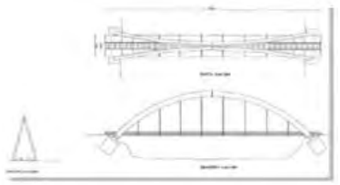


7 *Results from the survey for institutions* **8** *Results from the survey for citizens*

- breaking down the problem and definition of the hierarchy of criteria
- paired comparison and estimate of criteria priorities vectors
- synthesis of the preferences.

GENERATING A SOLUTION

Since the Sangone Basin is too vast, the research was focused on two smaller areas, Bruino-Rivalta and Nichelino, as it was necessary to describe deeply the characteristics of the territory.
A set of indicators was defined in order to take in account the interests of all the stakeholders. The evaluation of different projects as well as of different alternatives of the same projects can be performed during all the design phases: *ex-ante*, *in-itinere* and *ex-post*. The ex-ante and ex-post evaluations consider a wide set of indicators. Instead, the in-itinere evaluation is restricted to a subset of indicators which can estimate the effects of the projects.



9 *Project of the footbridge in Bruino-Rivalta*

All the indicators were then grouped into the sustainability hexagon model categories, adapting them to the specificity of the Sangone River Contract: Ecoware (river), Hardware (territorial aspects), Software (landscape), Orgware (Institutions), Civicware (citizens) and Finware (economy).
The subsequent step was the evaluation of the indicators and an extensive research was developed in order to understand the current situation. For the majority of the indicators, institutional websites of the two areas and the publications of the Sangone River have been considered. For assessing other specific indicators, two surveys were carried out, one for citizens and another for institutions, with the support of the Provincia di Torino and Sferalab, a private consulting firm.
Once completed the description of the current situation, a set of projects planned in the two areas was analyzed:

- A bicycle path with a footbridge over the river, which is part of the pedestrian connections of Sangone Valley greenways. This project unites the existing greenway, the naturalized area in Bruino and bicycle paths in Rivalta.
- Reduction of river bank artificiality by recreating the local environmental characteristics in order to restore the damaged balance and help promote tourist fruition of the territory.
- Recovery of abandoned areas near the river, in order to reclaim green belt land.
- Cleaning up of Nichelino's river bank and creation of a beach to be used for sport, therapy and promotion of local products.

The indicators were determined considering the current situation as well as the planned projects and their values were compared

10 *Project of the beach in Nichelino*

by consulting experts in each field. Then, priorities were established using weights to define the importance of each branch of the indicator tree according to the preferences expressed by the Decision Maker (G. Betta of the Provincia di Torino).
Finally, via the application of the AHP method it was possible to obtain a ranking of the different projects based on their sustainability.
A main drawback in this analysis is the subjectivity resulting from the decision maker judgment (which is really hard to remove). Nevertheless, the process is open and transparent and can be applied during all the phases of a River Contract: firstly it allows development of a detailed study of the current situation, then estimation of project effects in order to design the best alternatives for each as well as to compare different projects and finally definition of a monitoring strategy.

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[2] T.L. Saaty. *Fundamental of Decision Making and Priority Theory with the Analytic Hierarchy Process*. RWS Publications, Pittsburgh, USA, 1994.
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project 3B DEL Torrente

Trust Trash

ABSTRACT

The Sangone River territory has been the scenario of significant changes in recent decades due to industrialization and expansion of the Turin metropolitan area. These changes happened through processes in which environmental issues and the quality of life of its inhabitants have not been seriously considered. In response to local crises the River Contract was formulated as a tool to promote redevelopment projects within the basin and to stimulate cooperation between the various municipalities. One of the main objectives of the Action Plan defined by the River Contract is the promotion of initiatives aimed at public environmental awareness; the *Trust Trash* project has this purpose, regarding specifically the waste disposal issue.

The project is structured around three main areas: solid waste disposal, industrial and agricultural waste and water treatment and intake. Different disposal facilities linked to these issues are situated throughout the territory. The project creates pathways connecting them in the real world and through a web interface.

Our main goal is to raise awareness towards environmental issues and to create confidence in waste disposal processes, mainly by promoting active citizen participation. Through our initiative we provide the population with an opportunity to interact with and check in real time data on local waste management and environmental pollution.

We have designed receptor cells that are easy to assemble and place along the routes. Such structures allow citizens to interact with the facilities and to work on system monitoring, data submission and exposure through Wi-Fi and touch-screen technologies. Synchronization of receptor cell data is executed by a Brain Module to be installed in the Gerbido incinerator, a project which has been core to many local conflicts. Furthermore, data collected concerning waste disposal in the region will also be available on the *Trust Trash Web Portal*, which is designed to be the main interface for information exchange with and between citizens about waste, events and other territorial issues.

The whole project has been conceived by using and developing infrastructures and services already existing in the area, such as bus lines and other facilities, and reclaiming areas impacted by the River Contract. This advantage facilitates implementation of a project with a limited amount of resources and time.

TASKS & SKILLS

The team worked in synergy developing the territorial analysis and a macro scale diagnosis, while each member was in charge of the following tasks:

Elena Bignamini was responsible for the analysis of stakeholders, interaction with citizens, external institutions and local companies.

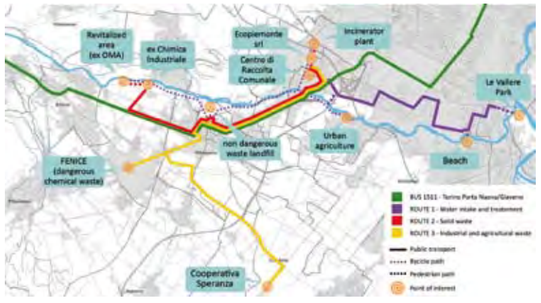
Eduardo Cademartori designed the physical structure of the project, conceiving receptor cells and bus stops, and was responsible for managing project identity.

Giulia Pasetti carried out the state of the art analysis and designed the Trust Trash interface informing citizens about waste and water management in the Sangone basin.

Erika Tagliaferri carried out an economic analysis to determine the feasibility of the project and analyzed the incinerator decision making process.

1 *Trust Trash logo*

2 *Water use and waste disposal analysis in Sangone Basin*



3 *Trust Trash thematic routes*

UNDERSTANDING THE PROBLEM

The Sangone River Basin, which extends from the *Alpi Cozie* to the southern part of the Turin metropolitan area, is a vivid example of territorial transformations resulting from vigorous industrialization a region has been subject to. Decades of indiscriminate use of water resources and riverfront have entailed heavy use of the basin. After a long process of mobilization of public and private parties the Sangone River Contract was signed as a reaction to the critical situation of the territory, leading to the approval of a shared action plan.

This convention outlines clear obligations borne by administrations and citizens. The paramount goals are to recover the environmental quality of the basin and redevelop riverside areas, to connect existing bike paths, to coordinate events in the area and raise awareness about environmental issues.

The creation of new facilities for water and sewage treatment, the closure of landfills and their replacement are measures already established by the River Contract, which attempts to implement by 2015 in the Sangone River Basin the European Directive 2000/60/EC on water quality.

Furthermore, a new incinerator is planned for the near future in Gerbido, providing a new landscape in the Sangone territory. This project has caused much controversy among citizens, concerning the impact of the facility on the local community, landscape and environment. Needless to say, it has also weakened citizen confidence in territorial development processes. It must be remembered that, in 2000/2001, the participatory process "*Non rifiutarti di scegliere*" (i.e. "Do not refuse to choose") was held in order to identify a suitable location for the new incinerator, displaying a list of sites in which Gerbido was not present.

Waste management plays an important role in the Sangone basin landscape and the territory requires, in addition to environmental redevelopment projects, actions to promote the restoration of social balance and citizen confidence in processes. The Trust Trash project arises from these issues, attempting to be an interface between citizens and actions taking place in the region.

4, 5, 6 *screenshots of Trust Trash interface: real time information about regional waste management, citizens' reports and tourism information*

THE PROJECT

The project plans to promote citizen awareness and persuasion regarding waste management. Most of the time aversion to facilities, expressed by attitudes such as NIMBY (Not In My Back Yard), is resolved simply by hiding their character by redecoration of their exterior. This strategy was adopted, for instance, in the waste disposal plant in Vienna. By investigating opportunities we have concluded instead that the best way to pursue our objectives is to make waste disposal processes clear and visible in their entirety. Our concept arose from the need to reveal the identity of facilities, as exemplified in the Naka Incineration Plant in Hiroshima.

"[…] the exterior of the plant should be intentionally visible as an indispensable facility needed by contemporary cities and the interior should be somehow public, which would help enhance the significance of the plant as an urban facility." (Yoshio Taniguchi)

In this sense Trust Trash project is focused on the existing infrastructure related to waste treatment or disposal in the Sangone River territory, and is organized into three thematic routes:

- Route 1 – touching interest points related to the water intake and treatment, such as restoring river banks, parks and purification plants.
- Route 2 – touching interest points related to solid waste, such as the Gerbido incinerator, disposal facilities, landfills.
- Route 3 - touching interest points related to industrial and agricultural waste, such as industrial waste treatment plants, agricultural sewage treatment plants, former industrial sites.

The basis of the information pathways along the territory are waste management facilities chosen not only for their typology but also depending on their position in the territory and their proximity to existing public transport lines and cycle paths. This project characteristic was selected for its ease of accessibility and its relation to economic benefits, in addition to the convenience of building a network among already existing facilities.
Regarding our objectives and constraints, we defined a number of project guidelines, such as:

- Precise project presence along routes reflecting the identity of our initiative throughout the territory;
- Easy modification and implementation of routes, according to the incessant development of the territory such as the closure of some facilities and the opening of new ones;
- Rapid and economic project execution;
- Low environmental impact, using recycled and waste materials.

Receptor cells were designed to be placed along routes and were basically developed using containers available on the market, adapted according to different project requirements. Their layout and furnishing will be subject to competition among local artists

7, 8, 9 *receptor cells' insertion in different contexts: in a fluvial park, in a waste disposal facility and as a bus stop in Orbassano*

who can design, within a limited budget, the decoration of a container using recycled and environmentally-friendly materials. This strategy lends a more vibrant cultural-artistic atmosphere to the territory and stimulates participation in the project.
Receptor cells are not only intended to indicate project presence in the basin but also to facilitate facility monitoring and visits. Another type of container will replace bus stops along Trust Trash routes with new features such as E-ink panels (technology with low environmental impact and very low energy consumption) which show local and public transport data. Functions are integrated with Wi-Fi and interactive touch screens connected to the Trust Trash Web Portal. This online platform is an essential tool to link and synchronize all receptor cells to bus stops, employing user input.
On the portal it is possible to verify events in the area and to monitor real-time data concerning environmental pollution and waste disposal with a high degree of interactivity. It also enables reporting of events or illegal waste disposal along the basin.
Receptor cells placed along bike paths and green areas combine informative functions with recreational spaces, while the interiors of disposal facilities provide mainly exhibition spaces. A special role is reserved to the brain module that not only allows for selected visitors access to the incinerator but also manages and summarizes data collected along the routes. Furthermore, during the coming years when a number of facilities will be closed their modules will to be transferred to the incinerator area as a testimony of the evolution of the Sangone basin.
By choosing prefabricated elements, relatively widespread technologies, easy to install alternatives and proposing minor modifications to some bus routes in order to reach points of interest, we fulfilled the purpose of rapid implementation and low cost. We also offered a source of economic return by installing advertising displays providing the project with a viable payback period.

Finally, we proposed a project which was easy to implement and with moderate costs to spread knowledge and information aimed at reducing conflicts, avoiding prejudice and clarifying that proposed changes in the territory serve the common interest.

project 3C

VALOrization
Innovative waste management

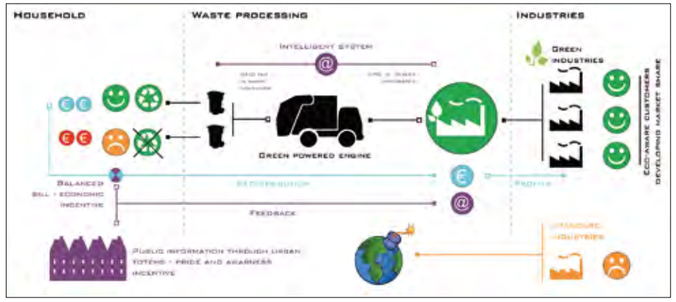
ABSTRACT

We can see in Italian newspapers these past months how waste management became an overarching problem. However, the waste issue spreads out far beyond the national borders and is a serious global issue for future generations.
The VALOrization project proposes to tackle the waste issue, relying on the opportunity offered by the Sangone River Contract, by presenting a new innovative waste management system.
Our study investigated the needs of local stakeholders and, starting from a general analysis of product life cycle and virgin raw material depletion, we came up with the idea of considering waste no longer as a source of pollution and annoyance but as a true wealth to be capitalized on.
The VALOrization concept is to think about waste as raw-material sources that should be harnessed in order to be reused in production cycles. The VALOrization ecological platform is thus able to process waste to produce usable raw materials, biomaterials – as crop fertilizer or compost – and energy that are sold to create a benefit. The waste producers – households, industries, collectives – are rewarded for the well-sorted and good quality waste they are able to provide, with the consequence of incentivating good behaviour. For this purpose, we studied a simple tracking system for collection of personalized data.
We choose to proceed with our project by trying to consider all the aspects of platform integration. This is very important for such a settlement, in order to reach a high level of acceptability, involving citizens from the very outset and ensuring very low pollution levels and total transparency on environmental matters. For this reason, we carry out an impact study to determine the best site for the platform and an architectural simulation of what it would look like and how it could be integrated into the landscape.

TASKS & SKILLS

Antonella Amati worked with the project's main stakeholders in the Sangone valley, surveyed and interviewed local representatives.
Giulia Ciccone overviewed the state of the art in waste management and focused more specifically on the Italian standards and laws.
Louis Gilbert worked on the project concept and focused on the corporate/financial aspects to issue the VALOrization guidelines and principles.
Chiara Marchino analyzed the territory to bring out the most suitable implantation for the VALOrization platform.
Paola Penna studied the platform layout and the architectural feasibility of the project.

1 *VALOrization logo*



2 *VALOrization business model*

UNDERSTANDING THE PROBLEM

The study area is located in Piedmont (Italy) and is part of the Province of Turin. It is a geographical region extending along the river Sangone. This river is about 47 km long and its basin spreads over 340 square kilometers, which equals 2.5 times the city of Turin metropolitan area. The Sangone valley includes 15 municipalities with a population of about 280.000 people.
The area is characterized by various critical issues, including water pollution produced by industrial discharges and the problem of illegal dumping and building materials left on the land by construction companies.
Our first analysis of the regional environmental challenges, supported by the specific Italian problems and scandals allows us to pinpoint the critical issues of waste management and their deep repercussions within the territorial fabric, sustainability issues and economic networks. It was quite relevant to us that, considering the vital importance of waste management for a territory – currently, the Sangone Region produces about 110,000 t of waste per year – it seems to be a subject to be ashamed of, unworthy of development and innovation: pecunia non olet.
For this reason, we decided to deal with the theme of waste with the objective of proposing an innovative model for waste management, based on the River contract of the Sangone valley which proposed a framework for supporting sustainable initiatives.
We started from the analysis of the current situation and prepared a brief overview of current techniques and standards in Italy and in Europe. We then conducted several interviews with local stakeholders, such as citizens, public officials, those responsible for waste management, ecologists, etc.

EXPLORING THE OPPORTUNITIES

Based on the preliminary analysis and stakeholder interviews, the team worked on proposing an innovative approach to waste management for the valley, focusing on the overall life cycle of products and studying in particular the "cradle to cradle" approach.
What are the citizen issues? How do we cope with these issues? What is the most efficient way of bringing innovation and eco-efficiency to waste management?
We finally came up with the idea that, reversing the usual scheme of waste collection as a service, waste could be seen as raw material and households should be considered as material pits. The aim of waste management became "to harvest and provide the best raw material in order to generate profit from it". We came up with a business model and tried to give it "physicality", with an urban and architectural project, to model and to simulate its practical functioning and impact on the territory.
We thought that such a project should be sustainable in terms of economic, social and environmental aspects. The company we baptized "VALOrization" will comply with the following guidelines:

3 *Sangone Valley: identification of suitable zones*

4 *Platform masterplan*

1. VALOrization's core activity is to produce high quality, low-priced, pre-processed materials
2. VALOrization must be able to harness the "waste mines" within the Sangone valley and be able to expand to a larger reference territory
3. VALOrization activities are all established in one site, the VALOrization Platform
4. VALOrization integrates the principles of green economy and should be sustainable both from the environmental, economic and human point of view
5. VALOrization aims at being a leader and pioneer in the waste industry
6. VALOrization is very careful to minimize and monitor the impact of its activity on Nature and on the Sangone territory

We then documented innovative projects abroad and visited two of them in Paris, comparing our hypothesis with the experience of local managers and architects.
The first approach to the project was the choice of the most suitable location for the waste treatment plant, among different suitable sites.
We identified two possible locations, both situated within the municipal boundaries of Rivalta di Torino, and the team produced for each of them a detailed territorial and environmental analysis using a multicriterial procedure (Saaty, 1980 and 2005).

We identified the most important kinds of plant-related impact and divided these into Benefits, Opportunities, Costs and Risks, according to the Complex ANP methodology, to compare with each other. The results highlighted the second location, a fallow area located between Rivalta, Orbassano and Beinasco, near to the Tangenziale Sud of Turin and the Interporto of Orbassano, as the best choice, maximizing opportunities and benefits, reducing risks and construction and maintenance costs.

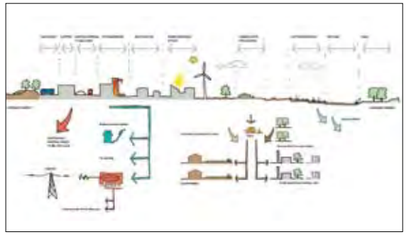
GENERATING A SOLUTION

VALOrization takes the form of a private company with balanced public and private ethical values and a strong employee shareholding to ensure that the 3P's are represented equitably and allow responsible corporate governance.
Waste is harvested directly at its primary sources by an intelligent tracking system based on the use of RFID tags and integrated scales to keep records of the provider's output. Waste is processed in the platform to produce only usable raw materials, biomaterials and energy that are sold to eco-aware industries.
Waste producers who are able to deliver high quality "product" are rewarded by financial compensation with a very simple system that works like an electricity meter in PV cell-equipped houses, distinguishing two flows: sorted waste and final waste. Each price is calculated integrating the fixed costs of waste management but the sorted waste price computes the wealth generated by the sale of material and the price for unsorted or final waste reflects the high cost of "material extraction" as well as the damage to nature.
One of the main goals of VALOrization is to be accepted and to demonstrate via attention to the environment to be a true asset for the territory by:

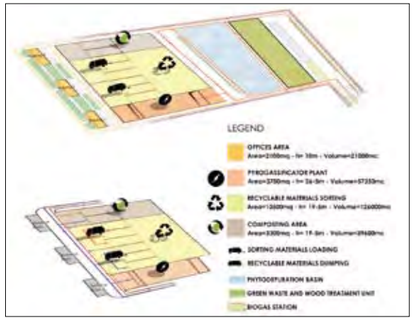
1. Reducing its environmental impact and territorial pollution at source
2. Measuring and documenting its impact on the environment and making it available to citizens
3. Implementing continuous improvement, funding research and providing up-to-date systems

From a technical standpoint, the waste management platform is divided into two parts. The external part processes green solid waste in fertilized and heating fuel and purifies water whilst the internal part treats final waste thanks to the pyrogaseifier, whereas presorted materials are processed in the semiautomatic sorting unit and wet waste is turned into biogas and crop fertilizer in the methanation unit.
The project's main feature is the integration with the surrounding landscape: it is important for the plant to have a positive visual impact with its surrounding environment in order to become a strong starting point for the enhancement of the landscape.
The building consists of two parts: one accommodating the pavilions for the waste treatment facilities; the other used for office space, laboratories, educational facilities and meeting rooms. The pavilion and truck road system are 5 meters underground in order to reduce the visual impact of the platform on its surroundings. The pavilions have a green roof sinuously descending to the park with different heights that help create a dynamic volume for the building.
The south-facing office, laboratory and meeting room buildings are positioned between the pavilions and the highway whilst a set of gardens makes the space between the buildings more attractive.
A flourishing green vegetation façade screens the building and garden complex, constituting a strong and characteristic element, easily recognizable by those passing by on the highway.

5 *Platform render*



6 *Scheme design of the Platform*



7 *Platform layout*

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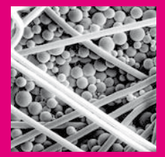
PROJECT 4



EXP-HOST

GREAT EVENTS & HOSPITALITY

GREAT EVENTS AND HOSPITALITY. MILAN EXPO 2015 AND TURIN ITALIA 150: NEW CONCEPTS AND FORMATS FOR NEW POPULATIONS

project 4

EXP-HOST
Great events and hospitality. Milan Expo 2015 and Turin Italia 150: new concepts and formats for new populations

Experimenting, with the support of Assolombarda, innovative formats for hospitality during great events and to match the demand of non-traditional city users

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Architecture (Construction)

PROJECT DESCRIPTION

The project has explored the possibility to forecast certain features and requirements of visitors to large events, who as we know, have an increasing impact on city organization.
Milan Expo 2015 will attract millions of visitors and in 2011 Torino will host the celebrations for the 150th anniversary of the Unification of Italy, events characterized by important urban transformations and by an exceptional influx of visitors.

Within this background, the project has selected a number of main issues:
- to investigate profiles of visitors specifically attracted by the general theme of Milan Expo "Feeding the planet, energy for life"
- to design innovative, inclusive formats of hospitality structures for a better match with the requirements of non-traditional visitors
- to refer to the requirements related to the Expo main event as a feature of a pilot project dealing with the topic of hospitality emergencies
- to give effective support to define requirements and to offer better services to visitors and city users by means of new applications of tracking technologies
- to include new players in an innovative pattern of entrepreneurship.

A very innovative, experimental and multidisciplinary approach was required to try to match such issues, taking into account the approach of public bodies, the design of structures with characteristics of flexibility and possibility of re-use according to the changing demand and attention to environmental issues, concerning land use, sustainable mobility, reduction of pollution and energy costs.
Discussion with external tutors and players has been fundamental to adjust the goals and the research and design steps:
- Maria Teresa Broggini of the Municipality of Milan suggested exploring the availability of the "cascine" in the NW sector of the city to host the proposed "cells" and the creation of a company for their supply
- Andrea Bragagnini of Tlab (Telecom and Politecnico di Torino) provided support to the students of team C to experiment an application for tracking the "virtuous" mobility behaviour of visitors
- Mr. Rabajoli of Ferrino Spa provided an expert contribution in the field of temporary structures, especially for those already produced and experimented as emergency shelters.

An important input during the problem definition phase was constituted by the study trip to Shanghai: discussions with colleagues and CAUP students, direct experience visiting the Expo site and understanding some organizational issues.

Three projects have been developed by the teams according to this general framework.

Team A. LOCALIZ@Mi. A Strategic Approach to Localization of Hospitality Structures during Major Events
Three architects with different specializations, a building engineer and a communication designer have implemented an interesting piece of research to outline non-traditional profiles of visitors and have mapped possible alternative solutions for their accommodation requirements. They experimented the integration of the cells proposed by group B in one of the "cascine" in NW Milan, selected and indicated by the Municipality of Milan.

Team B. Wall_s. Innovative hospitality typologies
The group comprises three architects, a product designer and a management engineer. Two main outputs of the work are represented by a piece of research comparing various solutions to the provision of flexible, temporary, low cost accommodation structures and by the design of a "cell" that can be assembled to create different aggregations, sold or rented according to the requirements of customers. The Expo event provides the opportunity to experiment the interest of different stakeholders in the product. The team has met the Ferrino Company in San Mauro Torinese to get project feedback.

Team C. Applying tracking technologies in urban design and planning
The students of this team, three architects and a building engineer, have successfully dealt with a project aimed at creating a digital device able to encourage visitors and city users to leave aside polluting transport means for their movements: the mobile application can describe user movements and give them an allowance in the case of "virtuous" behaviour. The team intends to carry out the application design together with Telecom Italia.

project 4A

LOCALIZ@Mi
A Strategic Approach to Localization of Hospitality Structures during Major Events

TASKS & SKILLS

Elena Abbate developed an accurate problem formulation while conducting the main case study analysis and its interactions with the proposal. She coordinated the project, mediating between the different points of view in the group.

Valentina Chiappa Nunez worked on the main analysis contributing to the problem setting. She developed the project strategy and focused on mapping the city through the analysis of people's needs.

Guido Emanuele Fucci contributed in developing project guidelines, problem setting and market analysis. He also analysed the economic and financial aspects of the project.

Angela Gigliotti contributed in developing the problem setting and focused on the main analysis. She also followed the application of the project strategy by studying the case study.

Jeanet Tello contributed in developing the preliminary research and then the problem setting, but mainly she dealt with the qualitative analysis of the specialist visitor requirements and drafting of the questionnaire to Personas (archetypes).

ABSTRACT

The project deals with the theme of hospitality during Mega events. Starting from the point of view that Mega events can be considered as one of the biggest development opportunities for the host cities, the project addresses these potentialities, introducing a new way of considering hospitality.

The EXP-HOST project takes into account Milan Expo 2015 as a case study. We focused our work not by considering "hospitality" as a general need but analysing the strict correlation to the theme of this event "Feeding the Planet, Energy for Life". As this theme refers to "new" solutions for the planet, this project refers to a city attempting to deal with "new" people that behave in a "new" way and can be hosted in "new" structures; "new" intended as sustainable practices.

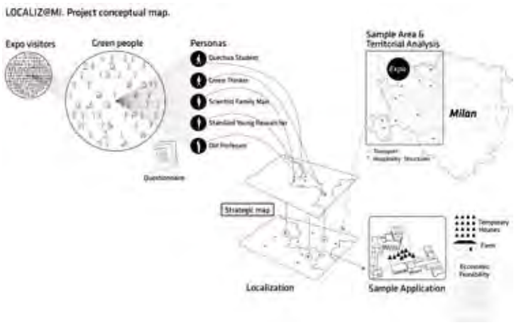
Our team considers the urban point of view of the hospitality theme looking for a more participative planning method than usual, proposing an innovative strategic approach to localization of hospitality structures that takes into account both the potential of the area and visitor requirements which are often overlooked, leading to failure of hospitality policies of host cities.

This approach, therefore, combines the objective quantitative information of conventional territorial analysis with qualitative subjective information obtained by studying demand. For the demand analysis we outlined visitor profiles -called Personas- using questionnaires ("Design Research method") to investigate their desires and requirements in terms of accommodation and stay.

Essentially the visitor analysis is the starting points to build the final output -the Strategic planning approach- but also proved to be an output of the project itself. In fact, it provoked the interest of various stakeholders such as the Municipality of Milan which believes that such research could improve even the most penalized tourist segments in the city wanting to invest in this target.

The innovative qualitative localization strategy represents a new resource for planners but also for investors who, being more aware about user requirements, can decide where to build their accommodation structures and where to invest, beginning to see things from the visitor point of view.

1 *Evocative Graph of the project Localiz@Mi*



2 *Localiz@Mi Project Flow Diagram*

UNDERSTANDING THE PROBLEM

The project concerns the problem of hospitality during Major events which represents a critical issue due to the significant impact of interventions carried out and the re-use of structures after the event, i.e. when the peak of tourist demand ends.

To better understand the impact that such an event has on the urban region hosting it, we analysed a number of case studies of previous major events (Hanover Expo 2000, Turin Olympic Games 2006, Zaragoza Expo 2008, Shanghai Expo 2010). We analysed mainly the hospitality strategies in order to determine their success or failure. We noticed a difficulty in forecasting tourist flows to understand visitor needs and to re-use the new hospitality structures built at the end of the event. Also a workshop at Shanghai Tongji University, which is a partner of the Politecnico di Milano, was useful to evaluate the local policies in the hospitality field in preparation for the Shanghai Expo 2010 and to understand firsthand the meaning of a Mega event and its implications.

The EXP-HOST project also takes into account the Milan Expo 2015 as a case study to analyse problems related to hospitality in order to generalize and solve the issue for all Mega events.

As a matter of fact, an Expo -that is an international exhibition of the technological, commercial and cultural world- is the major event *par excellence*, in which millions of visitors alter the equilibrium of the host city. For this reason we consider that a Universal exposition may represent the model of a Great event on which to reflect on innovative hospitality concepts and formats for new kinds of populations. In particular, we chose as a case study Milan Expo 2015 because it will be the next major event in terms of time and importance and because it is a situation we can investigate more deeply and closer. This makes our project more concrete and feasible.

According to the assumptions of ASP courses that focus on innovation and sustainability as a cornerstone of the project and the theme of Milan Expo 2010 which is *"Feeding the Planet, Energy for Life"*, the EXP-HOST group decided to focus its work on a specific type of hospitality, developing an offer for a target composed of "new populations", sensitive to ecological issues and environmental and social sustainability, what is now called "sustainable tourism", bearers of particular values and needs compared with traditional tourism.

This "green target" is the innovative point that unifies the projects of the three EXP-HOST teams. Each one has treated and developed the hospitality issue based on this kind of visitor, according to different declinations and points of view.

EXPLORING THE OPPORTUNITIES

The project aims to enhance the hospitality system and its impact on the territory, searching for sustainable and innovative solutions to the problem, according to the supply/demand gap, to visitor requirements and to the facilities, transport and logistics of the city.
The project, Localiz@Mi, deals with many study subjects by the means of different approaches: an architectural theme related to design of hospitality structures, a more technological one connected with the idea of providing innovative services to visitors and a theme of city planning in order to localize new accommodation.
Our team decided to focus on the last issue, considering also the specific skills of each member.
The project started with some suggestions:

- How can we understand the demand for hospitality, which is very different in its segments according to the different kinds of people who will look for hospitality structures in Milan?
- How can we experiment innovative ways of locating hospitality structures to better match the demand of non-traditional city users?
- How can we relate the topic of better and more inclusive hospitality with the general theme of Milan Expo *"Feeding the Planet, Energy for Life"*?

Therefore, answering these questions, the goal of the project was to define an innovative approach to allow planners and investors to locate accommodation in the context of major international events, taking into account the potential of the area but also the demand, in order to find the best solution to the problem.
Target knowledge is not usually taken into account during the planning process except for "participative planning". However, we consider that the participative planning approach is not suitable in the context of such events because it requires a faster and more flexible tool.
Moreover, we noticed the problem of the lack of exhaustive qualitative and quantitative studies on visitors to Mega events that invalidates hospitality policies of host cities. Therefore, our team explored the opportunity to analyse tourist profiles in order to match their needs with the hospitality supply.

GENERATING A SOLUTION

The project generates two outputs and an application to a sample case in order to verify its effectiveness.
The first result of our research was a detailed analysis of visitor profiles. Using the "Design Research" method we built a specialist profile of non-conventional niches of users to whom standard hospitality services are not addressed, in order to understand their needs and requirements concerning accommodation and services.
This stimulated the interest of the Municipality of Milan which considered it a useful piece of research on the most penalized tourists in the city, giving them the opportunity to know more about this target to invest in it. This single output has been used by the other EXP-HOST teams to define the target of their products.
The second output is a new localization strategy that combines objective and quantitative information of conventional territorial analysis with the subjective and qualitative information obtained by studying demand. This information is graphically transposed into a map in order to underline the best areas to locate hospitality structures.
Essentially the demand analysis has been useful as a means to build the final output -Strategic planning approach- but proved to be an output of the project itself, stimulating the interest of various stakeholders.
To better understand the project we have summarised the work phases:

- **Design Research_Building** *Personas*: a qualitative analysis for customer definition.
  We analysed a specific type of visitor to the Milan Expo 2015, particularly interested in the theme *"Feeding the Planet, Energy for Life"*: professors, researchers and students dealing with the Expo fields of study (such as agronomy, environmental science, chemistry, biotechnology, etc.). Starting from questionnaire results, visitors were classified into "clusters", in compliance with the amount of visitors they represent; subsequently, the Personas were formulated (specialist visitor archetypes). Five Personas emerged: "Quechua Student", "Green Thinker", "Scientist Family Man", "Standard Young Researcher" and "Old Professor". We focused our project on the first three archetypes, which belonged to the category we were focused on, that is "sustainable tourists". We discovered their desires and requirements in term of accommodation and stay.
- **Territorial Analysis_ Potential of a territory**: study of infrastructures and hospitality structures in a sample area.
  After a study of the Milan territory we chose a sample area as a case study in which to create the strategic map. The choice was made according to the Personas' desires and needs -*"green area for green people"*-. This is the North-West part of the city, near the Expo site, in which there are parks, farmlands and facilities required by our target (e.g. cycle lanes).
- **Mapping_ Building a planning strategy**: combine the information of the two analyses in a single map.
  We linked needs of certain types of unconventional user, graphically transposed in a plan, with the potential of the sample territory in order to identify the best place to locate hospitality structures.
  The map underlines various suitable sites to locate accommodation for "green visitors". We chose one of these, verifying the effectiveness of the planning strategy.
- **Application of the planning strategy_ Cascina Sella Nuova:** application of the new planning strategy to a real case study to evaluate its effectiveness.
  In the NW part of Milan, the analysis of existing buildings underlines the potential of many historic farms to become new hospitality structures. They are able to host, for example, "the temporary homes" -*"Wall_s"*- designed by EXP-HOST Team B.
  We chose Cascina Sella Nuova, which stands out from the others in the area, for its strategic location and services as well as for the desire of the Municipality of Milan to renovate it.
  We analysed the economic feasibility of the intervention with a business plan which demonstrates the correctness of the choice: location and type of accommodation -temporary homes- are suitable for "green visitors" who guarantee the demand for this new supply in the city.

3 *The GreenThinker, one of the main Personas individuated, and her typical day during the visit in Milan*

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project 4B

Wall_s
Innovative hospitality typologies

ABSTRACT

The concept of hospitality is commonly interpreted with accommodation, in the same way the objective of our team project was that of providing an answer, in some way innovative, to the problem of extraordinary influx of people during major events.
The Milan Expo 2015 with its theme "Feeding the Planet, Energy for Life" has been our field of activity and the scenario for the test of our concept.
Most of the past Expos have solved the problem of accommodation demand by building permanent structures which have seldom found an equally useful reuse. To avoid such a mistake, since the first hypothesis, we all agreed that our solution would have focused on flexibility and reuse potential.
Basing our choices on the data on expected visitors, the surveys conducted by our colleagues of Team A and the already existing accommodation offer in the Milan area, we decided to focus our proposal on a specific target of users: low budget, environmentally friendly and high-tech sensitive people.
The solution developed is a module for a hosting camp: a light structure which uses only high performance materials, completely disassemblable and storable in a box which is also part of the structure itself. The module is almost self-sufficient in terms of energy needs thanks to the application of textiles with energetic properties and the integration of PV panels on its roof.
The output of the project comprises not only of the design of our accommodation solution but also a business plan for its management.
Creation of a service company in charge of the purchase and the management of the cabin has been hypothesized, both during the Expo period and after. Among the possible reuses of our module we considered other major events, the need for emergency shelters following natural disasters and calamities in general, the demand for new structures for naturalistic tourism and the demand for exhibition space for temporary events.

TASKS & SKILLS

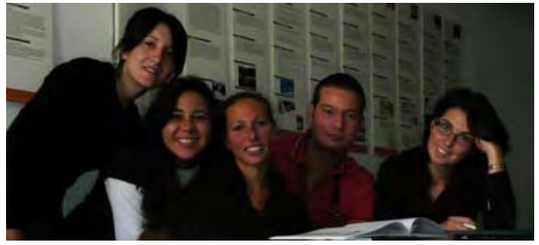
Ana Victoria Faria Delfino helped in the problem-setting phase and contributed in designing Wall_s' concept, working in particular on the visual output.

Martina Gallia contributed in the concept-generation phase, taking into account the state of the art of temporary hosting modules and the requirements of the target-user arising from the research process.

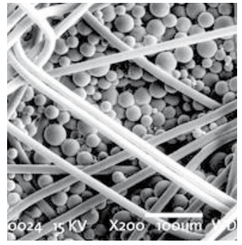
Yanina Guerzovich gathered information on previous major events in relation to the accommodation topic. She also focused on temporary hosting modules, elaborating an in-depth state of the art and collecting information on minimum standards in disaster response.

Vincenzo Mongiello contributed in testing the feasibility of each solution proposed and dealt with the development of the business plan for the final solution, collecting data to confirm its feasibility.

Louena Shtrepi helped in the definition of the solution and its design process, with particular focus on the systems and technologies with which Wall_s is supplied.



1 *Team_B during a working session at the Politecnico di Milano*



2 *Microscope image of paraffin globules enclosed in textile fibers*

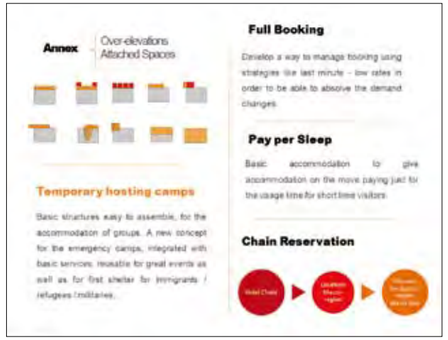
3 *PCM fabric sample*

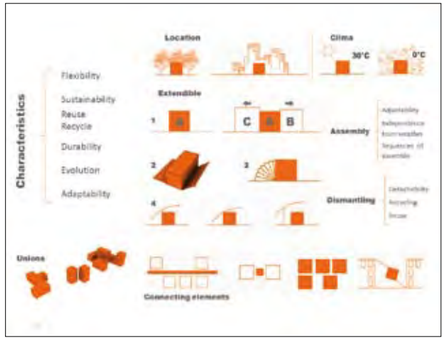
UNDERSTANDING THE PROBLEM

To arrive at the definition of *Wall_s* as a coherent and effective response to the hospitality problem we had first to identify what have been in the past other solutions to the same issue and their upshots. The visit to the 2010 Shanghai International Expo was really helpful in this sense and underlined the importance of a temporary solution for the accommodation needs of an event which already brings many permanent changes to the territory in which it is hosted. Another important step was to understand what stakeholders we would have to deal with in the Milan Expo scenario (Municipality of Milan, Assolombarda, One-works, citizens and visitors) and their requirements.
The Municipality in particular made a very clear request: it supported the inclusion of our solution in the project, already promoted, of requalification of the "cascine" network in the Milan area. We decided to use this cue as a realistic field in which to test our project.
A period of analysis then followed during which we defined more clearly the hosting camp as a model for our project and listed several key words on which to focus during the design process. Our object needed to be flexible, disassemblable and storable, transportable, reusable and customizable; moreover we decided to work on its energetic needs designing it as energetically autonomous as possible. Finally, the feasibility of the whole project had to take into account costs and returns which, addressing a low budget market necessarily meant that the cell would have low costs both in the production phase and in its maintenance.

EXPLORING THE OPPORTUNITIES

In the first brainstorming sessions, together with the idea of a hosting camp, we came up with the option of working with a system of annexes, over-elevations and attached spaces that would have taken advantage of the recent "House plan" law to spread the accommodation offer over the entire Milan macro-region. The complexity of the management of so many private interventions within a close and fixed deadline persuaded us to abandon this option. We also thought of developing an innovative booking system which would have put in a network all existing structures in the macro-regions and attracted visitors outside the crowded city centre with offers of countryside experiences and particular holiday packages. Another alternative booking option, for particularly low budget visitors, would have permitted payment of stay per hour and not per day, as is conventionally used. Together with the tutors we decided to put aside these two options with the intention to integrate them in a subsequent plan for management of physical structures spread throughout the territory.
The fourth and final approach was that concerning the design of an innovative module that would have been added to already





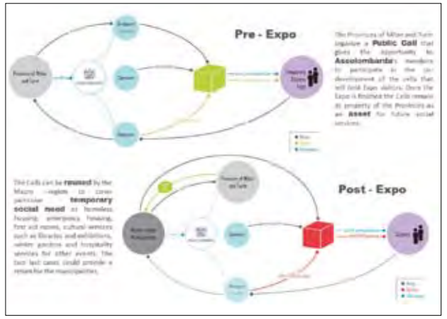
4 *Result of the initial brainstorming session: first concepts*

5 *Visual representation of the concept key words*

existing hospitality structures, such as the "cascine" network, to supplement their accommodation offer. After the event, this module, alone or aggregated into camps, could be re-used for several purposes, including shelter in emergency contexts.
The design of the new cell turned out to be more complex than imagined, especially because of the vastness of the state of the art on this topic and therefore the difficulty in proposing something really new in some way.
The shapes that our object assumed have undergone a lot of changes, according to the materials and technologies we decided to adopt. A good intuition which significantly contributed to the shaping of *Wall_s* was the opportunity to use a fabric as a vertical partition and to store and protect it, rolled inside the structural tubes themselves. One of the problems which shaped *Wall_s* the most was its thermal insulation and the fact that we decided to maintain the textile element on its envelope. Firstly we thought of using a cover made of ETFE, a high performance polymer already used for architectural purposes, but its cost was unsustainable; we then designed a double cover made of polycarbonate panels which, on the other side, did not provide sufficient thermal performance. After some deeper research and the help of the firm Ferrino Spa, in the person of Dr. Rabajoli who gave us important tips about properties, costs and uses of high-tech textiles, we opted for the application of PCM (Phase Change Material) both in our vertical partitions and in a ventilation plant for cooling and heating the cell.

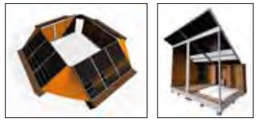
GENERATING A SOLUTION

Wall_s, the final output of the design process, is a cell of minimal standard dimensions (2 x 3 m approx.).
Inside the furniture provided comprises a single bed, a table and a locker and plug-in and wi-fi connection. Thermal regulation is provided by a system of fans connected to a PCM unit which exploits the properties of this material to maintain a stable temperature inside the cell.
The whole module is designed to meet the requirement of a shared experience in contact with nature: the transparent ceiling (provided with darkening screens) provides a view of the sky from inside the cabin, even when lying in bed. The shape of the cell is designed to be flexibly attached to form double, triple, etc, modules for the accommodation of couples or families. The structure of the settlements shaped into closed, semi-closed or linear gatherings makes them very flexible, easily adaptable to different customer requests or site characteristics.
Wall_s' external aspect immediately communicates its high technical standard thanks to the presence of PV panels on its



6 *System Maps showing the collaboration between the private and public sector with a final social value*

7 *Wall_s constituting elements*



8 *Example of a Wall_s settlement in a circular aggregation*

9 *Wall_s double module*

10 *Wall_s*

11 *Shanghai model at the Shanghai Urban Centre*

12 *Team B Working Session at Tongji University*

roof and the special fabric of the vertical partitions. Its reduced dimensions make it fit into a single box of just 2.05 x 1.85 x 0.57 m and its lightness (50 kg approx.) allows it to be assembled by just two people. These features also make *Wall_s* easily storable and transportable.
To assure the feasibility of our project we drew up a financial plan and integrated it into the business plan for the development of the entire work.
In order to be able to produce and manage a reasonable number of *Wall_s*, we adopted the advice of Dr. Maria Teresa Broggini (Municipality of Milan) to create a service company to promote our product and be in charge of its procurement and management, both during the Expo period and after. The idea is to generate a sort of distributed centre of hospitality throughout the territory, according to the customer needs and expectations, in terms of location, cell shape and services provided.
During the first-phase, the main target is represented by travellers arriving in Milan for the Expo. A key aspect will be the suitable location for *Wall_s* cells in order to integrate them with the surrounding urban texture, leveraging on the idea of eco-sustainability, which is the main theme of the Expo.
The Expo-phase will moreover provide a great opportunity to exploit experiential marketing which means leveraging on the Expo as a window to guarantee visibility of the cells for potential customers who may want to try the cells in the future.
The extra-Expo phase will be focused on attracting other targets such as temporary exhibitors, occasional travellers interested in environment and eco-sustainability offers and finally possible customers for the use of the cell as an emergency home.
The two phases will not necessarily be contiguous: they may partially overlap, but a different allocation of resources seems appropriate since the first phase would last just 6 months, in accordance with the Expo period, while the second may last many years, until such time as the business plan becomes economically viable.

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project 4C

Track Mi
Applying tracking technologies in urban design and planning

EXP-HOST Great events and hospitality. Milan Expo 2015 and Turin Italia 150: new concepts and formats for new populations

ABSTRACT

The enlarged metropolitan areas of Milan and Turin will in the next few years be the stage for major events such as Italia 150, Turin 2011, and Milan EXPO 2015.

The **hospitality** structure of the host city for a **major event** is crucial to its appeal, thus physical and virtual infrastructures for mobility as well as services being available for visitors are crucial indicators of the hospitality level offered by the urban environment.

We decided to focus on Milan **EXPO 2015** because of the large scale of the event and because of its theme "Feed the planet, energy for life", which of course embeds the concern of dealing with its environmental impact as well, considering the **21 million visitors** expected.

Our project aims at exploiting the potential of tracking technologies as a tool for a policy aiming at reducing the CO2 emission rate in the city and at making people more likely to use the public transportation system and shared means of transport, while encouraging their **ecological awareness** and behaviour on the one hand and improving the efficiency of the transportation system on the other.

The main strategy identified consists of providing incentives for ecological behaviour concerning mobility: an **ecological footprint** related to the mobility pattern of an individual on a tracked trajectory will be elaborated by means of a GPS based web/mobile application (or a RFID bracelet) and by a series of tags spread out in the city on the public transportation system. This system will allow the user to start his own personal track record with a few simple moves, in total respect of his privacy. The main incentive strategy identified is a discount on the EXPO ticket, but many other facilitation processes can be started up for environmental and cultural-related activities.

In order to evaluate the economic sustainability of the project on behalf of the Expo organization, we investigated the Break Even Point of the strategy in terms of number of visitors. The requirements of the technological system, of the tracking tool and of the mobile application were depicted also from an interface point of view, in order to carry out the application design together with Telecom Italia.

TASKS & SKILLS

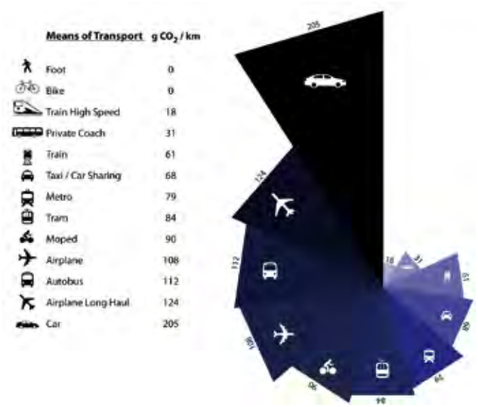
Fabio Favoino was responsible for evaluating the impact of EXPO mobility demand, for sensitivity analysis and for evaluating the incentive strategy impact.

Jonathan Maj carried out the state of the art technology documentation and developed the graphic interface of the mobile application.

Roberta Sassone was responsible for the state of the art documentation concerning major events and developed the technological system architecture.

Abel Silva Lizcano carried out the economic evaluation of the proposed incentive strategy and the definition of the mobile application features.

1 *Milan's public transportation mobility network*



2 *Comparison of CO2 emissions of the main means of transport*

UNDERSTANDING THE PROBLEM

The first step we took in order to understand the problem consisted in schematizing the field of investigation into two main areas: the context we had to work on, Milan EXPO 2015 and major event related hospitality issues, and the tools we had at our disposal, **tracking technologies** and electronic devices.

We had the opportunity to speak with EXPO Spa, the company in charge of developing the project, to better understand the issue and the theme of Milano EXPO 2015, 'Feeding the planet, energy for life'. Alongside committing to the main players involved in the major event organization, we also had the opportunity to directly experience the significance of a World Exposition by making a study trip to Shanghai, China.

Finally, as far as the technological issue is concerned, documentation on the state of the art of tracking technologies allowed us to understand their functioning and their operational potential.

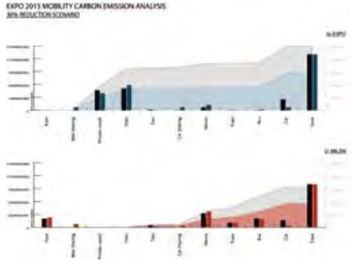
Moreover, the analysis of some previous application experiments carried out gave us a hint of the strength embedded in this tool and helped us clarify the concept of real time tracking with all related issues and concerns (data gathering and final utilization, devices required, etc..).

EXPLORING THE OPPORTUNITIES

Analyzing the state of the art of tracking technologies, we understood that this tool could give us the opportunity to improve and enhance the EXPO experience which, as demonstrated by former major events and their impact on the host cities, has often proven to be harmful rather than beneficial.

Keeping past experiences in mind, we finally felt the need to improve the tourist related services of the city while safeguarding the quality of the urban environment, by limiting pollution, controlling traffic, reducing wastage of natural resources and energy consumption. With relation to this ambitious aim, we tried to redefine the **concept of 'movement'** of citizens, EXPO visitors, commuters and simple tourists travelling through the city and making use of public transport.

These sessions produced two different ideas.



3 *EXPO 2015 carbon emission analysis*

4 *Example of the digital application interface*

5 *Track Mi, the concept*

Our first alternative was mainly focused on visitors and consisted in providing a real time, spatially-related vitality index of the city, a sort of urban electrocardiogram, on fixed itineraries, helping visitors to move into the bustling centre of the city.
The second proposal was strictly related to the mobility system of the city of Milan and it concerned the way in which people are accustomed to move. In this case, the tracked trajectory of visitors and citizens was associated with the means of transport they utilized, in order to record everyone's personal ecological footprint.
Although the first idea had significant appeal and was very challenging, the second was chosen in accordance with the tutors and the stakeholders because of the possibility to fulfil the stakeholders' requirements and of the achievable added value, such as improving the public transportation system, monitoring how people experience the city in order to better plan future events, encouraging people to use more public transport and behaving in a more ecological manner while expanding the experience of the local reality of Milan.
Keeping very clear in mind the Expo theme, moreover, the slight pedagogic side to this kind of solution can be perceived as well; the project, in fact, aims basically at attracting sceptical or uninterested visitors and at reinforcing and communicating the importance of sustainable mobility behaviours within the city.
The educational declination of the whole strategy, of course, does not prevent the stakeholders (EXPO, ATM, FS, Milan Municipality and Milan Chamber of Commerce) from deriving a beneficial effect from it.

GENERATING A SOLUTION

In this phase the support of the two new main stakeholders, GTT and Telecom Italia, was essential to focus on the task and to restrict the range of solutions, mainly technical, we had to choose among.
From the technological point of view, the main difficulties were those of relating the tracked trajectory to the transport means and to overcome the **privacy issue**. Following different consultations with the two main stakeholders, the most suitable technology was chosen from the various systems proposed. Although the chosen event is in Milan, the consultancy was carried out with stakeholders from Turin because of the innovative project they had been working on in the recent past.
The research on privacy concerns and tracking technologies made us understand that the concern is mainly referred to the perceived privacy and to the usefulness of the service. We finally set up a **double technological system** structured through two alternatives:

- The first one, called **'centralized'**, does not need any effort on the part of the user because the personal device tracks the trajectory automatically. This is possible thanks to a **RFID bracelet** that records all transits via tags located on public means of transport, bike sharing stations and so on.
- The second one, called **'decentralized'**, allows the user to decide when to be tracked and when to upload personal data to the system. He/she simply has to start the application on his/her **electronic device** (a mobile phone) and just by taking a picture of **tag codes** spread around the city and on all public or shared means of transport the path tracking begins. This solution provides the user with total control on his/her private information and it has been conceived, on the one hand, for those people who need more privacy control and on the other for those who wish to commit to the ecological footprint record.

6 *Beijing, 11 May 2010, 'Jonathan Maj'*

7 *Beijing, 8 May 2010, 'Fabio Favoino'*

8 *Luxemburg, 18 April 2010, 'Roberta Sassone'*

9 *Shanghai, 1 May 2010, 'Abel Silva Lizcano'*

10 *Milan, 25 October 2010, 'Team working session'*

11 *Beijing, 10 May 2010, 'The team visiting the Beijing Olympic site', from left to right Fabio Favoino, Jonathan Maj, Elena Abbate, Valentina Chiappa Nunez, Roberta Sassone, Yanina Guerzovich, Abel Silva Lizcano*

A **green point** accumulation system was designed to support both of strategies in order to reward virtuous users with discounts on EXPO tickets. EXPO organization will simply access the average and aggregated data or the ecological footprint of every user as a green point accumulation, while the tracked trajectory will be exclusively managed by the user him/herself.
A positive approach to ecology was chosen in order to invert the punitive strategy of fines, adopting an **incentive strategy** in order to reward the most **"ecological-oriented" users**. In our opinion this strategy has the potential to lower visitor mobility impact and, at the same time, to be useful in increasing the value of the experience throughout the city during the major event.
The discount on the EXPO ticket was chosen as the incentive because in our opinion this could increase the event's appeal with respect to visitors. In order to implement such a system on the city scale after the event a different incentive strategy can be evaluated, such as discounts on transportation tickets and/or leisure activities.
The collaboration set up with one of the main stakeholders, T-Lab by Telecom Italia, will probably lead to the implementation of the mobile application managing and entwining the three main characteristics of the project (transportation and mobility system, tracking technologies, green point accumulation reward process) on an operational basis.

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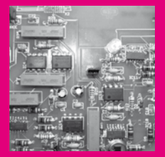
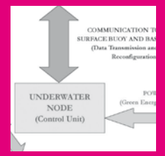
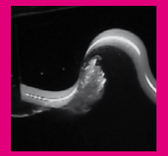


PROJECT 5





WIMSAE

WIMSAE

WIRELESS INTELLIGENT MONITORING SYSTEMS FOR AQUATIC ENVIRONMENTS

WIMSAE
Wireless Intelligent Monitoring Systems for Aquatic Environments

project 5

The project aims at providing a real-time distributed monitoring and management system for lowdepths aquatic ecosystems (with Queensland University)

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PROJECT DESCRIPTION

Widespread, real-time monitoring of aquatic environments is essential if we are to meet the management needs of climate change, environmental monitoring, emergency management, water resource limitation and the wider sustainability of industries such as tourism, fisheries and agriculture. In view of the continued and expansive impact of phenomena such as climate change and waterborne pollution, local, national and regional economies are being hit such that entire societies are now facing potentially fundamental alteration to their lifestyle and associated resource base.
Accordingly, the capacity to obtain real-time information on environmental changes and impacts is paramount if we are to effectively grapple with such a dynamic situation and to then adapt to, or mitigate, the changes that occur. Whilst a range of potential technical solutions currently exist on the market, none of them satisfy application constraints and, typically, require very large financial and technical input.
This project aims at addressing some technical issues so that a cost effective, robust and easily installed monitoring system is available for real-time monitoring in low-depth aquatic ecosystems. The reference monitoring technology is a wireless sensor network which can provide a closer look at the aquatic environment and develop accurate interpretations based on real-time "in field acquisitions" in a globally accessible, collaborative marine data analysis.
The teams aimed at addressing three main aspects related to highly complex ICT framework. More specifically,

Team A was primarily involved with sensorial aspects and data processing at the unit level. Here, the need to identify low cost sensors has pushed students to study, design and implement a new version of the Photosynthetic Active Radiation sensor. The physics analysis was paramount to characterise the validity of the idea, design the conditioning stage and carry out the calibration and validation phases. The sensor PCB is available, well connected to the processing unit which also mounts distributed intelligence for controlling data acquisition and remote transmission. The level of multidisciplinary cooperation obtained within the team was excellent.

Team B was involved in studying the data propagation aspects by addressing the physical transmission among the network's nodes and defining the best protocol to be used. The team was asked to investigate electromagnetic propagation (EM) by studying advantages and limitations of such a technology w.r.t. acoustic alternatives and how to obtain the best performance at the physical and MAC layers. An accurate analysis of EM propagation in seawater was conducted together with a study of the best MAC layer to operate in the given environment. Results show severe limitations in the use of EM propagation. Despite the lack of previous competences, the work conducted was well coordinated and obtained satisfactory results.

The main purpose of the activity of **Team C** was to define an energy scavenging system for the wireless sensor node. The choice of the best architecture is driven by the total amount of energy required by the node, the node cost and the size of the scavenger system. The team has identified the best architecture in terms of volume and cost. An underwater hydroelectric turbine was designed and the entire power management system designed and simulated. Moreover, for low power application an innovative energy scavenging system based on flexible piezoelectric elements moved by the tidal current flow has been proposed. The multidisciplinary level of the project is high, ranging from fluid dynamics to materials and power electronics.

To sum up, the goal of the project was achieved by the teams. Students have learned how to work within their respective groups and address engineering aspects to reach the desired target within the established deadline. Details can be found in the project annexes.

SAE project 5A

Smart Sense

ABSTRACT

Aquatic environment monitoring is a complex operation which needs high-tech devices and innovative and cost-effective deployments; in particular, the characteristic harshness of these environments presents several additional issues that make the design process even more challenging. The monitoring system presented resorts to WSN (Wireless Sensor Network) technology, i.e. a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions. Our team focused on the development of the underwater sensor node, with special focus on data collection and management by also assuring that power consumption is compatible with the constraints imposed by the underwater energy harvesting system.

The expression "aquatic environment" identifies a wide range of natural conditions characterized by different water origin (saline or freshwater), quality (level of pollution), territorial conformation (shallow/deep water) and final usage; each one has different environmental issues according to its own characteristics. A large group of environmental variables can be measured and these variables have to be chosen and the appropriate sensors selected according to the specific site monitored. In a preliminary study the team explored all the sensors commonly used in the existing applications for underwater monitoring and their availability on the market.

Our benchmark test was the marine environment as it is the harshest in terms of operating conditions such as fouling and corrosion. Two sensors were selected to conduct a feasibility study and build a working prototype. For these sensors, a management system was designed considering all the user requirements and providing a smart entity able to proactively interact with the other entities of the system. Finally, the team considered the problem of detecting sensor failure caused by wear and tear effects of the aquatic environment, especially marine, in order to avoid erroneous data collection.

TASKS & SKILLS

Andrea Allegrini provided the theoretical support to understand environmental phenomena. Besides, he focused on the state-of-the-art analysis.

Alicia Hinostroza Castillo was in charge of designing and implementing the circuit for the sensor and interfacing it with the microcontroller.

Valeria Rho studied possible solutions to develop the underwater sensor by analyzing existing prototypes and trying to fit them to different scenarios.

Alessandro Sassone was responsible for the software managing the microcontroller used for the underwater node and its interface with the sensors.

Moreno Ursino studied and analyzed the statistical tools to be applied to data collected by sensors in order to detect possible failures.

UNDERSTANDING THE PROBLEM

Social players. A matter of primary importance for understanding the problem is to identify the stakeholders and formalize their constraints. The main players we identified were:

Environmental institutes and organizations whose aim is to preserve the marine ecosystem by reducing the negative impacts that global climate changes have on them. Possible achievement of a working and reliable monitoring system may represent an important contribution to recognizing the hazardous changes in the environment. It should be considered, however, that they stress attention on the system impact on a given environment, i.e. the system has to comply with minimum safety requirements for such ecosystems.

Research community which nowadays is very involved in the climate change topic and eager to obtain data for elaborating more accurate models. Here, the required features are customizability and re-configurability.

Organizations and communities making profit from marine resources, e.g. tourist and gastronomic sectors; they need a system to help prevent the destruction of the ecosystems their incomes are based on.

Companies producing the sensor nodes which are currently being used for performing equivalent measurements could cooperate in our project development or not, depending on how we approach the improvement of the current specifications.

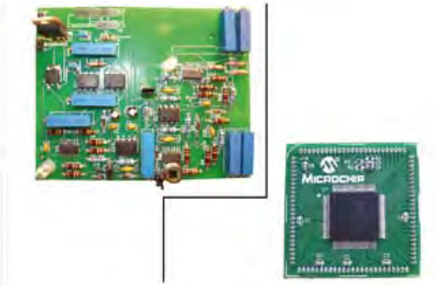
User requirements. Here we clarify the key points we needed to address while developing the project:

Reduced energy consumption. Energy supply and energy harvesting is difficult in the considered ecosystems due to the harsh environment. Our system should operate by minimizing energy consumption without reducing its efficacy or efficiency. Dynamic management of measurements and detection of data to be discarded immediately after acquisition would avoid energy waste.

Intelligent & efficient measurements. High propensity to external disturbances of this kind of system makes detection of both disturbed and non-relevant measurements crucial. Moreover, since the system is not exposed to constant in-situ maintenance, it should autonomously acknowledge whether it has stopped working correctly or not by discerning between changes in the measurements due to environmental changes and those due to system malfunctioning.

Non-intrusive system. The golden rule of any measurement system is not to interfere with the site under inspection. In this case, disturbing the system may not just make our measurements invalid but may also endanger the marine environment.

Cost effectiveness. Despite the fact that many solutions have been presented and are already available on the market, their high cost means they are not -viable in the large majority of possible applications.



1 *PAR sensor prototype (left); vmicrocontroller used in the control unit (right)*

EXPLORING THE OPPORTUNITIES

Existing monitoring systems for aquatic environments have global architectures that substantially differ from the required structure (e.g. ship-based sampling, drifting buoys, cabled seafloor observatories, etc.); therefore, the same basic constraints and requirements should be addressed in different ways.

Our attention has been extensively devoted to the design of an underwater sensor node that could meet a wide range of applications and be suitable for long-lasting activity. It should consist basically of a control unit managing data collection and process-

2 *PAR sensor prototype*

3 *Microcontroller used in the control unit*

4 *Evaluation board with the microcontroller used in the control unit*

6 *Oral session during the 3rd International Conference and Exhibition on Ocean Energy (Bilbao-Spain, 6-8 October 2010)*

7 *Team members working at the assemblage of the sensor prototype*

ing and representing the 'smart core' that can adjust the system operation to changing requirements.

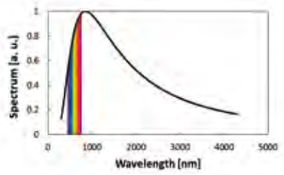
Sensors. We verified that, usually, a limited number of physical quantities provide the principal indicator to study water quality and its impact on environmental conditions; depending on the specific monitoring site, the node has to be provided with different kinds of sensors measuring a subset of the afore-mentioned quantities. Despite the specificity of each monitoring site, temperature and the amount of PAR (Photosynthetically Active Radiation) have to be strictly monitored as fundamental indicators. Plenty of temperature and PAR sensors are already available on the market but some of their technical features make them inappropriate for our purpose (i.e. they are designed to be used in very deep waters with no respect for power consumption and/or to provide highly accurate measurements that go beyond the purpose of this kind of system) and they are extremely expensive up to the point of preventing large-scale use. Nevertheless, we studied their basic operation principles to subsequently design new sensors.

Control unit. The management unit of the node should offer great flexibility and ease of configuration as well as dynamic power management to deal with the small amount of energy available. Thus, we focused on particular families of microcontrollers especially designed for low power demanding applications and considering that their low computing potential must neither limit data acquisition and transmission nor processing activities. Moreover, we paid particular attention to microcontrollers providing all the development tools necessary (and reasonable from the cost point of view). Efficiency observed in previous similar implementations guided us towards the final choice.

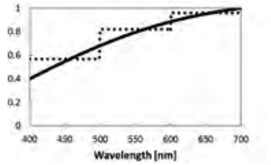
Algorithms for intelligent operation. Mathematical studies led to the assessment of possible options to detect failures with data collected by sensors. A vast bibliographical survey was carried out in order to find statistical tools with suitable properties (non-parametric, dependent data, etc.) and four different algorithms were finally selected.

GENERATING A SOLUTION

Technical solution. The final design of the PAR sensor correctly reproduces the required spectral response. This goal was achieved exploiting standard optoelectronic and electronic components, i.e. selective photodiodes and operational amplifiers and passive components respectively; subsequent prototype calibration and testing proved that reliable estimation of PAR magnitude is obtained. The accuracy of measurements is lower than that of global benchmark instruments; however, the designed sensor retains a key feature, that is the capability of reconstructing the

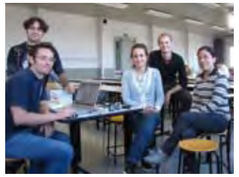


8 *Plot of the average spectrum of solar radiation (solid line) and reconstructed spectrum measured by PAR sensor (dashed line)*

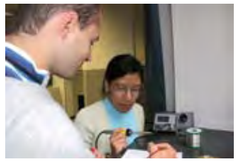


9 *The highlighted spectral range represents the fraction of solar radiation that is photosynthetically active and has to be measured*

10 *Basic architecture of the underwater sensor node*



11 *Team A during a meeting at Politecnico di Milano (from left to right: Moreno Ursino, Alessandro Sassone, Andrea Allegrini, Valeria Rho and Alicia Hinostroza Castillo)*



12 *Team members working with the soldering station to assemble the PAR sensor*

spectral composition of incident radiation (different plants use different wavelengths while doing photosynthesis).

Similar criteria aimed at trading off required performances against complexity were used to choose the most suitable components to design a temperature sensor.

The computing core of the system was prototyped by choosing a suitable microcontroller. On the one hand, it is interfaced with data collection sensors to and on the other with the communication port in order to transmit data and also receive commands. The system is indeed capable of responding to special events and configuring itself, obeying a protocol developed for this purpose. Special attention has been paid to develop a set of functions making the system reconfigurable: the user may change some features such as sampling frequency, temporal range of integration and data transmission frequency; certainly, a key-point of the system is found in this wide range of opportunities allowing long-lasting activities where operational conditions may vary significantly.

As far as the CDT (Change Detector Test) algorithm is concerned, the four solutions previously selected were analyzed from the mathematical and computational points of view, trying to balance efficiency with ease of computation.

Environmental considerations. Our solution is compatible with the surrounding natural environment and the local ecosystem. The final system negligibly impacts on the environment, even if the sensor node is external to the ecosystem; nonetheless, we believe that this configuration generates the lowest environmental impact.

Economic implications. The basic components used in the underwater nodes pave the way for further system diffusion since they can be easily found in the market. As a consequence, the cost for a sensor node unit (i.e. the underwater control unit and its related fixed costs, such as software for system management) makes the system viable also in low-budget scenarios where traditional monitoring approaches proved not to be affordable and is expected to decrease with the improvement of the technology involved.

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project 5B

CORAL CALL

_WIMSAE_Wireless Intelligent Monitoring Systems for Aquatic Environments

ABSTRACT

The work of our team consisted of the realization of a wireless system for underwater communication with limitations due to energy harvesting and the general WIMSAE project features. The first step was research on the state-of-the-art technology in the wireless communication field. This allowed us to discover that the required electromagnetic (EM) solution was a possibility, even though less developed with respect to other implementations: pros and cons of each one were evaluated.

In fact, EM transmission suffers high absorption losses which are strictly dependent on the frequency used: in particular, only low frequencies (no greater than 100kHz) can be reasonably adopted to transmit the signal. On the other hand, the signal is less susceptible to being reflected by the many obstacles which it comes across (coral, rocks, etc.). Moreover, even if not directly linked with the WIMSAE objectives, an EM signal may provide a high bit-rate and a low delay.

Analytical computations have been performed, as well as numerical simulations, in order to choose the best kind of antenna and transmission frequency. At these low frequencies - in order to reduce the signal absorption – the efficiency of the antenna and small dimensions are contrasting requirements, since a too large antenna would damage the surrounding region: a trade-off between these conflicting needs has been made. The issues of transmitting consistent data packages with reduced energy consumption have been discussed and solved in collaboration with the other teams.

Finally, we had to decide a suitable routing protocol strategy. In particular, the available transmitting power directed us toward a *multi-hop* solution: the information bounces from node to node until it reaches the central node, which is connected to a buoy, and then conveyed to the beach station. Hypotheses on the topology of the network of nodes have been attempted also, even if, more likely, the topology will have to empirically take into account the 3D characteristics of the coral reef environment.

TASKS & SKILLS

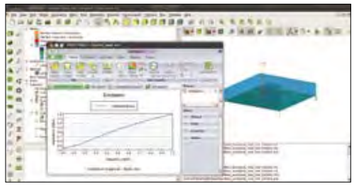
Claudio Baldizzone focused on the environmental impact, the economic issues and the general problems occurring with the implementation of the device.

Stefano Cavaletto analysed the physical aspects of the wireless communication and the properties of the electromagnetic propagation in shallow seawater.

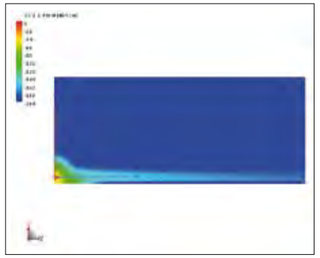
Luigi Ciavarella dealt with the physical aspects as well, comparing the different typologies of wireless signals which are suitable for our work conditions.

Jewel Okyere-Benya focused on the MAC and routing protocols that govern data transmission among the nodes of the network.

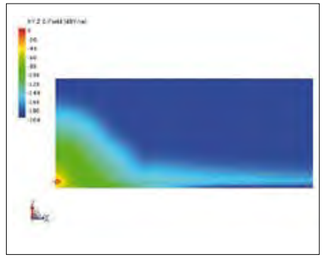
Lorenzo Zanon performed numerical simulation, validating or confuting the hypotheses on the physical and structural parameters of the system.



1 *The FEKO simulator interface*



2 *The attenuation of the EM field generated by a dipole antenna placed on the seabed, at a depth d=15 m, working at a frequency of 1 MHz (FEKO)*



3 *The attenuation of the EM field generated by a dipole antenna placed on the seabed, at a depth d=15 m, working at a frequency of 50 kHz (FEKO)*

UNDERSTANDING THE PROBLEM

The aspect of the WIMSAE project our team had to deal with was the communication among the nodes composing the underwater network. A wireless system was preferred to a cable network in order to reduce as much as possible the impact on the marine ecosystem, keeping in mind sustainability issues. Problems related to deploying the sensor network had to be minimized as well.

We focused on both the propagation and the protocol issues in an underwater environment. This is a challenging communication mean on which there is renewed research interest: it has peculiar characteristics since it usually presents a complex morphology with a variety of elements (rocks, marine fauna and flora, etc.) which in several ways affect the signal used for carrying the information. Such environment is completely different from free space, a homogeneous medium which, normally, does not strongly affect the transmitted signal.

It is therefore clear that the study we performed consisted of a trade-off process between the physical constraints and the objectives to be achieved through a constant analysis of the emerging pros and cons.

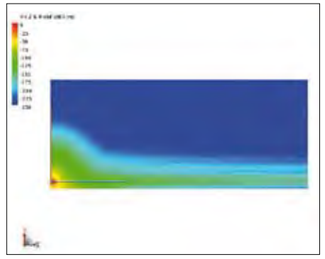
EXPLORING THE OPPORTUNITIES

Our research had to deal with a large number of issues ranging from signal propagation problems to the need for a node deployment procedure as simple as possible. The main design aspects we considered were the physical transmission alternatives, the design of the antennas and the choice of the best protocols among those proposed in the literature.

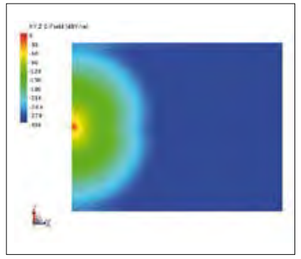
After an exploration of the state of the art, we identified three potential transmission solutions: acoustic, optical and electromagnetic (EM). Acoustic communication is the most widely adopted solution in underwater environments (sonar in submarines, fishing, etc.). Unfortunately, in the case considered, the acoustic signal interferes with the frequencies emitted by the shrimps inhabiting the ecosystem. Furthermore, the morphology of the coral reef, due to the multiple reflections on solid surfaces, renders this technology inadequate for such an application.

At the same time, the main drawback of optical communication is the extremely rapid absorption of the signal in seawater. Moreover, it has the further disadvantage of scattering by suspended particles and high levels of ambient light in the upper part of the water column, especially in the turbid and shallow water of the coral reef.

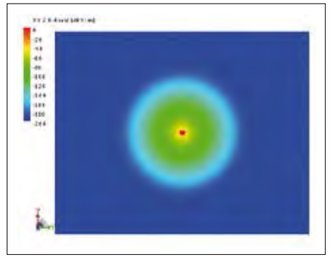
Although EM communication has the great disadvantage of high absorption losses in seawater, it does not suffer from noise-related problems and multiple reflections as much as the acoustic solution does (at least in the specific environment we consider). For such reasons, our customers and sponsoring institutions viewed the implementation of an EM solution as a promising



4 *The attenuation of the EM field generated by a dipole antenna placed on the seabed, at a depth d=15 m, working at a frequency of 200 kHz (FEKO)*



5 *The EM field generated by a submerged dipole antenna, at a depth d=15 m, working at a frequency of 100 kHz (FEKO)*



6 *The EM field generated by a submerged dipole antenna, at a depth d=15 m, working at a frequency of 100 kHz, on the orthogonal plane with respect to the dipole orientation (FEKO)*

7 *An isosurface for the EM field generated by a submerged dipole antenna, at a depth d=15 m, working at a frequency of 100 kHz (FEKO)*

alternative to the acoustics and they specifically required it. In addition, even if we focused on the implementation of the WIMSAE project, we were always conscious that an EM underwater communication system may find useful applications since it allows a high bit-rate and low delay. Also this argument drove the involved institutions to favour this solution.

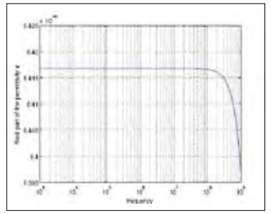
Once the EM solution was chosen, a feasibility analysis was carried out keeping in mind the constraints imposed by the required specifications (reliability, efficiency, cost effectiveness) and by the available technology.

Due to attenuation in seawater, relatively low frequencies (around 100kHz) had to be used. At this frequency, however, the dimensions of the antenna, which should be comparable to the wavelength in order to have an efficient irradiation, become very large; on the other hand, the environmental impact of our system drives us to reduce this dimension. Thus, a conspicuous part of the project had to deal with this major issue, trying to establish a trade-off among these two conflicting needs. Moreover, a *forced* reduced size of the antenna introduces power losses: the input power, provided by the energy harvesting device, must be considerably bigger than the effectively irradiated power. Furthermore, in order to fully exploit the potential of the designed wireless apparatus and to increase the effectiveness of communication of the underwater antennas (among themselves and with the buoy), some possible topologies of the network have been considered.

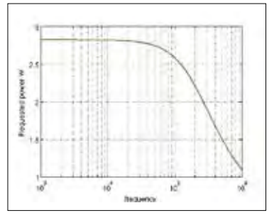
Finally, a suitable protocol is needed in order to fully exploit the potential of the apparatus. At this stage, our work consisted of a survey and deductions on MAC (Medium Access Control) protocols. An exhaustive review of the most promising and suitable protocols has been made in order to qualitatively establish which protocol would give the best performance. The investigation was addressed to comply with the requirements of reliability, energy efficiency, fairness, large number of nodes and adaptability to possible modifications in the network topology. However, the choice of the protocol was influenced by the constraints arising from the expected applications, e.g. low data rate, latency and scarce energy resources.

GENERATING A SOLUTION

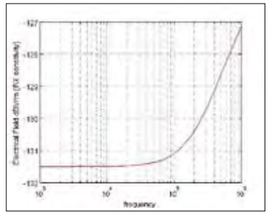
As a first step it was necessary to characterize the seawater environment in terms of quantities related to EM propagation (mainly the dielectric permittivity). That information allowed us to focus on the study of the electric field generated by a wire antenna which seems to be the only possible solution at the considered frequencies.



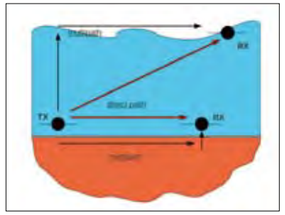
8 *A plot of the real part of the seawater permittivity (at temperature T=20°C and salinity S=35 ppt), as a function of the frequency of the crossing wave*



9 *A plot of the electric power needed by a dipole antenna (with length L=1 m) in order to irradiate a power of P=100 mW, as a function of the frequency*



10 *The minimum electric field magnitude detected by a receiver in our work environment, as a function of the frequency*



11 *Multi-path and direct path propagation from a transmitter antenna (TX) to a receiver (RX), in shallow waters*

Initially we tried to exploit a multi-path propagation skill in order to make each antenna on the seabed communicate with a receiver on the sea-surface. The multi-path strategy is based on the assumption that the attenuation suffered in a short all-water path is higher than the one along paths that are longer but cross different media. In particular, the possible paths are water-air or seabed-water. As a matter of fact, free space and sand have a smaller conductivity than seawater and this reduces the signal attenuation. The best choice would be to direct the signal to the water-air path which is the least attenuated.

This property could be exploited when dealing with a shallow water environment, since the transmission distances could be significantly increased. Conversely, in the WIMSAE context the water depth is expected to be greater than 10 meters, thus preventing the adoption of an effective multi-path strategy. As a result, we were forced to implement the following solution: the nodes communicate in a wireless manner on the sea-bed and the signal is transferred via a cable to a buoy and from the buoy to the beach-station.

The modelling process was conducted through approximated analytical computations and then improved with simulations by means of a suitable modelling software. The best work frequencies turned out to be lower than about 100 kHz. At these frequencies, impedance mismatching and consequent heat losses arise, if one wants to keep the dimension of the antennas reasonable. This frequency suits the load of information which has to be delivered (about 100 Bytes, on average once or twice an hour) and the available power, guaranteed by the energy harvesting device.

Considering that the nodes lie in a radius of approximately 50 meters and the distance between them is on average 10 meters, we have verified some important and useful hypotheses for the topology of the node system. More precisely, these regard the attenuation trend and led us to suggest the implementation of a *multi-hop* routing strategy.

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[3] L. A. Klein, C. T. Swift. An Improved Model for the Dielectric Constant of Sea Water at Microwave Frequencies. *IEEE Transactions on Antennas and Propagation*, vol. ap-25, no. 1, January 1977.

project 5C

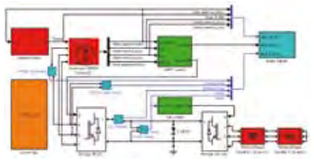
Energy harvesting technologies

ABSTRACT

The development of a wireless network of sensors poses a great challenge in terms of supplying the energy required for its functioning. While sea-surface buoys can exploit the energy from the sun or from wave motion, sensor nodes on the seabed need alternative sources of energy; one of the few options available, and the more interesting one, is tidal flows, which represent a renewable source of energy with a high degree of predictability.
Technologies currently available on the market or which are being studied by the scientific community mainly concern the implementation of large-scale plants to produce marine renewable energy and reduce the dependence on fossil fuels. For our project, however, small and compact devices are needed to power the sensor nodes. To develop a system fulfilling our requirements, two main routes were considered: (i) electroactive materials and (ii) tidal turbines. The first technology relies on the capability which some materials have in generating a voltage when they are subjected to mechanical strain. The second option exploits the flow of water currents in order to make a power generator spin.
The analysis of the capabilities and drawbacks of both technologies led to the decision to implement the tidal turbine option, mainly because of the greater power it can provide to the system. However, the option of electroactive materials was not completely discarded and some studies were conducted in order to understand the potential development of such technologies in the future.
Some numerical simulations were then carried out to assess the power production capabilities of our solution. Finally, to provide some guidelines for the development of a prototype, a study was made of the most relevant technical issues of the device, such as choice of material, anti-(bio)fouling strategies, waterproofing and energy storage systems.

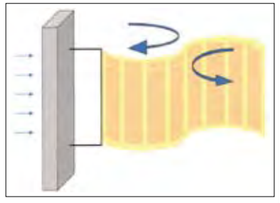
TASKS & SKILLS

Federica Barbieri focused on the electronics of the device, carrying out the related simulations and the issues concerning waterproofing.
Matteo Ghidelli worked on the existing piezoelectric eels technology and on the choice of materials for the turbine.
Manuel Intini studied the dynamics of tidal flows and focused on tidal power technologies analyzing the suitable device for the purpose.
Nicola Martino analyzed the local context, explored the capabilities of electroactive materials and coordinated the work with the other teams.
Juan Pablo Varon Tamayo studied the energy storage technologies and was involved in the electronics simulations.

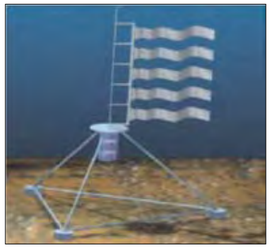


1 *Example of an electronic scheme for numerical simulations in Simulink*

2 *Bilbao, 4 oct. 2010. Manuel and Matteo with Andrea Allegrini (from team A) at ICOE 2010 (Bilbao, Spain)*



3 *Scheme of a piezoelectric eel converter. Author: Ocean Power Technologies Pennington, NJ*



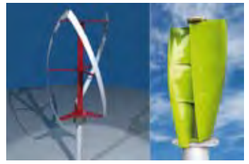
4 *Idea for a tidal flow converter based on an array of piezoelectric eels. Author: Ocean Power Technologies – Pennington, NJ*

UNDERSTANDING THE PROBLEM

The main objective of our study was to develop an energy-harvesting device able to power an underwater unit composed of a certain number of sensors and a communication system with the necessary electronics. Since this unit is supposed to be placed some meters under the sea surface, solar energy is not available nor is it possible to exploit the motion of waves. The most effective solution is therefore to rely on sea currents generated by tidal phenomena since they present a predictable behavior providing a reliable source of energy for our system.
The possible scenarios in which the sensor network was planned to be tested are Heron Island or Stradbroke Island, in Queensland (Australia), to monitor a portion of the southern Great Barrier Reef; however, implementation of the system can be interesting also in other shallow water environments (such as rivers, harbour basins, etc). Moreover, the architecture of the network is not fixed but depends on the actual details of the area to be monitored. For these reasons, the energy-harvesting device should be flexible enough to adapt to different external conditions.
The main constraints to be met by the device are the ability to produce the energy required for the functioning of the whole unit, given a certain profile of the water speed over time. For this reason, working in coordination with the other two project teams was of paramount importance. Other requirements identified were cost-effectiveness, robustness, scalability and environmental compatibility.

EXPLORING THE OPPORTUNITIES

Drawing energy from tidal currents requires non conventional devices. Almost all tidal power devices are meant to be large scale (up to several MW) as we learned during our stay at ICOE in October 2010. Research today is quite focused on high power devices and even in such cases investment profitability is difficult to assess. Moreover, system modularity rules out any possibility of resource sharing, so cost effectiveness becomes more crucial.
In order to find a suitable solution for our needs we had to rely mainly on scientific literature. Two main technologies were identified that could serve our purpose.
The first was electroactive materials and in particular the piezoelectric eel; it exploits the current flow to produce periodic oscillations in a membrane of a polymeric piezoelectric material with strip geometry that responds by generating a voltage. The power produced by such a device is however limited, a few dozen mW, depending on the dimensions and flow conditions. We therefore



5 *Vertical Axis Turbines for wind power generation" (Author "Gravitonium Fuller House")*

6 *A 1m piezoelectric eel being tested in Carderock Naval Base (Maryland, US)*

7 *Bilbao, 4 oct. 2010. Part of the team at ICOE 2010*

8 *Oostende, 13 oct. 2010. Part of the team in the exposition room at EurOcean Conference (Oostende, Belgium)*

9 *Oostende, 13 oct. 2010. Part of the team in Oostende, Belgium, to attend the EurOcean conference*

tried investigating other types of materials (such as dielectric polymers). Unfortunately, even if they are in theory able to supply more energy, the mechanism on which they are based was clearly not compatible with the constraints of our system.
The second option relies on tidal turbines. The issue of kinetic flow conversion benefits from mature technologies in wind power production. Several analogies incur when investigating water turbines but demanding tasks are encountered in modelling, design and maintenance. We focused on vertical axis turbines since they are compact, simple and above all reversible: rotation always occurs in the same direction, independent of flow direction. Darrieus, Savonious and Gorlov turbines have been investigated, considering power output, overall efficiency, working range and machining.
For energy storage, two different technologies were studied: lithium-ion based batteries and supercapacitors. Batteries have high energy density, which makes them useful for long periods of work, but have the disadvantage of having low charge and discharge rates. Instead, supercapacitors have a longer life cycle and higher rates of charge/discharge and this characteristic makes these devices useful for transient handling. Given the characteristics of the environment we are working on, the features of both these devices would be useful for the system; consequently by using a hybrid storage system it is possible to take advantage of both of them.

GENERATING A SOLUTION

The analysis carried out in the first phase of the project showed that the electroactive materials technology is at a too early stage of development and is not yet capable of providing the power our system requires.
We then focused our attention on the tidal turbine option in order to propose a suitable solution. Self-starting is a key factor, since it simplifies the electronics. Savonius turbines can spin without power consumption at start-up but their poor efficiency and strong irregularity at certain flow speeds make them difficult to match with a simple motor. Straight Blade Darrieus devices are the only ones available on the market but they are far from the commercial stage and very few manufacturers, such as Alternative Hydro-Solutions, have been taking up production to order. We chose Helical Blade turbines which merge fairly good performance with self-start capacity; our device has a nominal power of 30 W at a rated current speed of 1.6 m/s. This means total daily delivery of about 200 Wh in the most likely local conditions, ensuring power continuity and simultaneous storage for the chargeable unit. The turbine is robust and experiences low mechanical

10 *Aerial view of Heron Island, in the southern Great Barrier Reef*

11 *Milan, 12 oct. 2010. Juan Pablo e Federica on the flight to Bruxelles, to attend EurOcean 2010 Conference*

12 *Milan, 3 sept. 2010. Members of the three WIMSAE teams working together*

13 *External 3D rendering of the turbine system*

14 *3D rendering of the turbine system (exploded view)*

15 *3D rendering of the turbine system (section)*

stress thanks to the helical arrangement of the blades.
In order to obtain more accurate data on the power production of the device and to verify a suitable match between propeller and generator, we carried out numerical simulations of the turbine and the related electronic circuit in Simulink. In particular we had to develop a custom block based on a suitable fit of the available experimental data. We tested our model considering different current flow profiles, based on the information on tidal behavior, to assess system capabilities in different situations.
We also analyzed some technical issues of the device, such as materials, biofouling and waterproofing. For the material, we propose a particular aluminium alloy based on mechanical stress data gathered from experimentation carried out on low power tidal devices. However, we conducted a broader analysis trying to identify other possible solutions, evaluating their performance and cost.
Regarding the problem of biofouling, a coating is requested because of the aggressiveness of the environment. Currently some specific paints can be found on the market to address this problem but their biocompatibility is not assured and they are quite expensive. We found some interesting alternatives in biomimetic solutions that are currently under research and seem to provide good results without environmental issues.
Even if the option was discarded, we concluded our analysis with a study of the possible development of piezoelectric eels to understand whether they have some potential for future applications. We found that some new electroactive materials, such as piezo composites, with better performance than the usually employed PVDF, can be found on the market but their cost is too high; however, we believe that, should they become cheaper, they could provide a competitive alternative to the tidal turbine option.

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Fas.P.onSite.

FAS.P on site

PROJECT 6

HOW STRATEGIC AND SERVICE DESIGN CAN CHANGE THE FASHION CYCLE

project 6

Fas.P.onSite.
How strategic and service design can change the fashion cycle

Fas.P.onSite, is a project of knitwear on site production, made together with Shima Seiki, with a peculiar product-service offer and a unique user experience

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PROJECT DESCRIPTION

The challenge The idea of the service was to experiment a new model of *onsite knitwear production/distribution* in order to suggest an alternative vision to the dramatic phenomenon of de-localization of production activities. *Fas.P.onSite* is a new brand-service of *on demand* design, production and sale of customized knitwear. It is based on integrating these different phases in the same physical place (shop/workshop) localized inside the city. This approach can be at the same time environmentally conscious and innovative in term of business model and customer experience suggesting a new vision of fashion cycle development. The different solutions focus on service design as a tool for structuring different service ideas, user experiences-interactions, service interfaces, touchpoints, evidence and business models.

The teams

Team A _ Dsign
The first project uses *advanced knitting technology* to build *Dsign*, a *physical creative hub* for fashion (knitwear) sector; it is a place that provides services, tool and space targeted to fashion students, designers-professionals and fashion companies who work in knitwear garment creation-production-distribution. *Dsign* offers a co-working space for creative together with production and s activities, short educational programs and initiatives and many support activities and facilities dedicated to the fashion world.

Team B _ Techstylist
Techstylist focuses on the idea of *personalization* of the knitted garment through the use of technology. A new buying experience is realized through the use of state-of-the-art three-dimensional motion capture systems which allow a 3D personal avatar to be built in order to simulate garment fitting before it is made. A web interface allows the user to create a personalized garment design: starting from a set of possible solutions, each user can create a specific and unique item that can be then produced.

Orders could then be created directly in the shop or could be done on the web site: they will be produced in a de-localized production site and each garment will be delivered to the user.

Team C – EtiCo
EtiCo proposes a new articulation of the whole knitwear production chain; it aims to create a laboratory-shop where design, production and sales activities are concentrated in the same physical place.
Everything here has to be sustainable: starting with producing only the items ordered (on demand), eliminating the concept of *unsold* and waste using certified natural yarns and tracing the design-to-delivery processes, activities and resources.
The principles of *sustainability* and *transparency* of the process are communicated to customers not only by the products but also making visible the whole process in the store and on the finished item certified via a special label called *virtual DNA*.

The results These service proposals provide an attempt to change the production-distribution chain of the knitwear sector. Using integrated and multidisciplinary strategies and competences each project has pinpointed an innovative approach: *Dsign* using technology as the starting point to create a new incubator for creativity in fashion system; *Techtstylist* creating a new design-shopping experience combining motion-capture, web technology and social networks; *EtiCo* building a new model and reinventing a competitive advantage for the knitwear production-distribution chain.

project 6A

D-sign

ABSTRACT

D-sign is a place which provides services in terms of space, tools and visibility to emerging fashion designers and other creative players in knitwear fashion, fostering their creativity and promoting social acceptance and strong links with territorial specificities. It represents a hub for creativity in fashion and, in particular, in knitwear fashion.

In designing our service we envisioned a concept based on the idea of merging: we believe that gathering people, knowledge and technologies could catalyze innovative processes. From a first point of view, our large open space will unify different functional areas: emerging designers and creative people working in fashion, as well as photographers, will share the same space and the same facilities and machinery only for the time they need or can afford. This will obviously translate into a cost for each person which is lower than the cost of renting a boutique and will also spark new ideas through synergies.

The variety of events held in the space, open every day also to external customers, will also modify the common relationship between designer and customer in the fashion industry. In D-sign, customers are not only buyers of the final product but can personally meet designers, view their creations, share impressions and suggestions or simply spend some time together. Entering our space, the customer itself can experience what we call a "widespread sense of creativity", everyday different, from that arising from an active lab during the day to those originated by fashion shows, showcases or cultural events in the evening.

Aiming to become a unique expression of the urban context in which it arises, D-sign also strengthens its link with the community, renewing an abandoned space in the industrial district and transforming it into a cultural center and a meeting point, boosting the feeling of locality with the use and advertisement of local products.

TASKS & SKILLS

Domenico Barile and **Ekaterina Vasilyeva** managed the economical and financial research area contributing to the definition of the new business model and its feasibility by comparing to other models and branding strategies, developing management models and market analysis.

Paolo Cerutti has worked at the definition of service offer and service identity, at case studies, and at the 3d realization and rendering of final space model.

Giovanni Comoglio has worked at the definition of service offer and service identity, at case studies and at the development of final space concept.

Marco Triverio elected team controller at the beginning of the project, managed team organization - Skype and physical meetings, finances and so on - worked mainly on case studies, visits and service definition.

1 *A glimpse of Bovisa (Milano), the location chosen to for D-sign*

2 *An urban proactive role: Dsign enables urban reconversion processes through the experience of fashion production*

3 *The machinery core is the distribution pivot of all Dsign spaces: local producers area, café area, shop area, down to the hub and private area*

4 *D-sign logo*

UNDERSTANDING THE PROBLEM

From the initial phase of the whole Fas.P.on Site project all three of our teams had the task of designing a concept of a new kind of fashion store which could combine a shop and an atelier (lab) in order to emphasize the idea of total customization in knitwear fashion and the idea of innovative lab-store where all steps of the fashion knitwear design and production process could be done in a few hours. Such a place should attract customers who can enter to create their own unique garments together with fashion designers (with the help of *Shima Seiki* technology) in just a few hours. In order to better understand the concept and the aim of our project and possible solutions, we analyzed many case studies concerning different aspects of the project concept.

After the first phase of the project the teams split and started to focus on very different problems, solutions and possible aspects of the project. We decided to work on the "social" aspect of the project and aimed to design a physical place where different kinds of people can become part of an experience characterized by social and environmental sustainability. Our space targets all the creative talents involved in fashion knitwear production who can meet in our place and design and produce fashion items, do fashion shootings and catalogues, participate in workshops by themselves or with third-party companies and of course exchange experience. Our goal was to find a solution to make it possible to aggregate all creative players in knitwear fashion in one place by proposing a multiple service (creation, production, photo laboratory, catwalk, workshops etc....) in order to share knowledge and create synergy but also hold knitwear fashion events in order to make the concept of our potential "client" wider. Moreover, we aimed to offer an alternative channel to make knitwear garments, show them through a wide variety of events, offer a space also for involved third-party companies, etc.

The main problems were related to defining: *which categories* of potential *users* could be interested in a service providing space, tools and visibility through events; which *activities* could take place in our fashion hub of creativity; exactly in which *space areas* the hub could be divided and finally how these three categories of our project could be interconnected and integrated with each other with the aid of different touch points and interfaces in the place.

Moreover, this hub of creativity in knitwear fashion should have a strong link with territorial specificities, such as potential creative players on the territory, food and wine producers and textile producers. More in general, the combination and integration of all of these different kinds of local traits could create a sustainable, appealing, and unique experience. After discussing some of the ideas we came to the decision to have the following categories of

4 *The hub shared workspace: basic tools to enable the starting of creative careers*

5 *This map shows the potential interactions among the different subjects involved in the Dsign system*

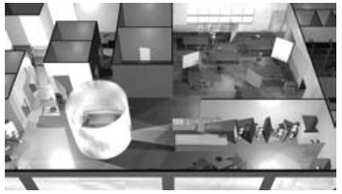
clients/users:

- Undergraduate designers
- Newly graduated designers
- Designers trying to become entrepreneurs and create businesses
- Fashion photographers
- Graphic and web designers
- Theatrical creative artists
- Fashion editors
- Brands (both small and large) interested in playing a role in our ecosystem
- Third-party companies to hold workshops in fashion or technology
- Buyers of knitwear garments

The next step was to find an integrated solution for the possible activities in the physical place, having all its possible components thoroughly defined in a uniquely identifiable yet interconnected way.

EXPLORING THE OPPORTUNITIES

During the exploring opportunities phase we thought about the resources we could use in the hub, about categories and potential quantities of our users (market analysis), about a unique and clear concept which could connect everything into one: the idea of social impact, knowledge sharing and synergy in knitwear fashion, appropriate supply for the demand of different users, creating an alternative channel to make knitwear garments, to show them through a wide variety of events, to offer a space also for involved third-party companies etc. So, after deciding on categories of customers to focus on, we started to think about all their possible needs and all activities which might take place in a creativity hub. User activities could be the following: 1) get your space and get your services, 2) learn and practice, 3) meet, work and innovate, 4) knit your garments and take part in an event, 5) promote and sell the garments, 6) buy knitwear, 7) have a rest in a recreation area or in a café, relax, cook and discuss with other creative people and with customers. After this, we tried to identify possible space areas connecting with the previous activities in a unique way: 1) common space, 2) ateliers and private rooms, 3) support services and all working spaces, 4) common space and production room, 5) and 6) shop space, 7) café and small kitchen. In our space concept we have made a clear distinction between different places for different activities but we have also made them interconnected and possible to interweave. We want our users to identify themselves with a part of the space but, at the same time, to identify with the whole hub and all the other users.



6 *General view of Dsign spaces. From lower left side: local producers corner, YourDesk area and private rooms, the ateliers, the hub shared workspace, café/relax area, shop area, "back" area (restrooms, storage, events kitchen, back office). In the middle, the machinery area surrounded by its glass pivot*

7,8 *The multifaceted hub space: views of the common space in shared workspace mode and catwalk mode*

GENERATING A SOLUTION

Final outcomes of the D-sign project have been the service definition, a virtual space concept, detailed in a 3D model, and an accurate market analysis based on the assumption of locating the space in Bovisa, Milano. In accordance with the guiding ideas of *customization* and *modularity*, the service offer for each designer and creative talent has been developed and organized into packages, realizing that such a configuration could better meet user needs in terms of flexibility and economic saving. Starting from a *Basic* package, offering each designer a shared desk, available at hourly-based rates, he or she could build up the service, space and machinery offer to best meet his or her needs with a modular approach perfectly suiting the variable demand for an emerging creative artist.

The same approach has been applied to the design of the space. Instead of keeping different functional areas completely detached, D-sign aims at merging activities, sharing knowledge and producing synergistic effects from different fields in fashion creativity. The *Shima Seiki* machinery represents the core of our space, visible inside a transparent "bubble" located in the middle of the open space. On the other hand, each of the other areas has been conceived as completely flexible and transformable: basic tables, shared during the day among several creative artists could be joined to become a stage or a catwalk during evening events or fashion shows; textile room dividers, printed with creations from incubated talents, could define an on-the-go private meeting room inside the open space, and so on.
Various events held inside D-sign, some of them at a fee, such as courses and workshops, with others free of charge, sponsored by local producers or fashion brands. During some of these, garments designed and produced by our talents could be exhibited and sold with a face to face contact between creator and final customer. The large variety in revenue opportunities, from incubator fees to café incomes, from sponsorships to contributions for participation in workshops, has the positive effect of lowering margins on the final price of knitwear, with respect to the single on-demand piece produced with *Shima Seiki* technology, in order to provide a significant contribution to the establishment and growth of designer activities.

project 6B

Techstylist

ABSTRACT

Coming up with a successful idea in a mature industry such as the fashion industry is no easy task. On one side there are the high-end firms which sell luxurious items and the "status" that comes with them to wealthy individuals. On the other there are giants like Zara or H&M with innovative business models which are able to provide new collections every one or two weeks. If the traditional models of selling clothes are thus already covered, what is there left that has not been fully explored yet? Where could a new start-up actually avoid the fierce competition of such firms and benefit from un-eroded margins? The answer to such question is high-tech customization which is the pillar of our project, developed in the past two years as part of the Alta Scuola Politecnica program in collaboration with the design faculty of the Politecnico di Milano. Such answer has not only been provided in a theoretical or abstract manner but has been elaborated in the form of a business plan whose ultimate goal is to create profit. With the term high-tech customization we refer to a new niche within the fashion industry in which customers can design, within the technologically feasible degrees of freedom, their own garment and can try it on before it has even been produced, thanks to a virtual changing room system which uses augmented reality technologies. In this way customization and purchase of the knitwear item does not have to happen in a traditional store but can be carried out online through an ad-hoc web application. Moreover, a centralized production facility becomes possible and enables considerable cost-savings. The only physical contacts with customers are the flagship store, which has the role of promoting the brand but also that of helping people in finding their way in such an innovative purchasing experience, and the temporary stores where augmented reality videos will be shot and made available on the web-site. Such stations will be nomadic in order to maximize the number of potential customers. The name chosen for the company which will implement this business model is Techstylist.

TASKS & SKILLS

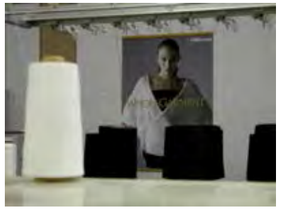
Federico Franzi, architect, studied the aspects, not only architectural, of the shop, the temporary stores and the production phase and analyzed the technologies used in the retail sector.

Valdrin Koshi, cinema and media communication engineer, analyzed which technologies are needed for the design, development and support of the service.

Riccardo Lavrano, management and production engineer, focused on several areas of the project, from the definition of the value proposition to the analysis and the feasibility of the best business model for this innovative new fashion player.

Carlo Serafini, management and production engineer, was the team-leader and also focused on several areas of the project, from the definition of the value proposition to the analysis and the feasibility of the best business model for this innovative new fashion player.

Nariné Tchilinguirian, industrial designer, focused on the visual communication of the project and developed the touch points between the product/service and the client.



1 *Image taken during the team's visit to Shima Seiki Headquarters in Carpi Carpi (MO), 18 June 2009*

2 *Detail of the Shima Seiki Wholegarment knitting machine Carpi (MO), 18 June 2009*

3 *Detail of the Shima Seiki Wholegarment knitting machine Carpi (MO), 18 June 2009*

4 *Techstylist logo*

UNDERSTANDING THE PROBLEM

It may seem to be a paradox but in a world characterized by globalization in which there is, still today, a progressive levelling of tastes and where it is possible to find the same things almost everywhere, the need and the desire to be different is becoming increasingly important.

This new trend has been understood by all the most important fashion brands (from sportswear to luxury items) which are now offering, in addition to the traditional collections, items that can be personalized by their customers according to their tastes.

In addition, also the role of the customer has been changing in the past few years: clients are no longer passive subjects but want to be part of the process, be players in the production system and, in addition, want to live their shopping activity as an "experience".

Of course, such experience needs to be innovative in order to be recognized as interesting and precisely for this reason, in our project, "innovation" is one of the crucial concepts, in addition to "technology", "customization" and "on site". Our project has, indeed, as its main purpose to design an innovative experience related to the fields of shopping and knitwear.

The first part of the project was dedicated to a survey of the state-of-the-art of the fashion industry and to a phase of brainstorming and keyword listing. This was a very useful starting point since it allowed us to consider every aspect of Fas.PonSite without ruling out any idea when it was still too early to make plausible assumptions.

The initial idea emerging from this research was to concentrate the design/production of the knitwear and its sale in one single place and to allow the customer to co-design his own garment which would then be available in the right size and shape by exploiting the opportunities enabled by Shima Seiki technologies.

However, during the second phase of the project, a deeper analysis of the technologies involved and a better delineation of the target (men-women between 25-40 years interested in fashion, high-quality garments and new technologies) led us to modify the original idea, focusing more on the concepts of innovation-customization-technology and deeming the "on site" concept no longer fundamental: as a consequence of this choice, design, production and sales are no longer in the same place.

EXPLORING THE OPPORTUNITIES

Our project had the initial idea of creating a service in which customers could customize their clothes in order to offer not only a product but the experience of being a stylist as well. The intent of full customization was certainly appealing and revolutionary but it soon became clear, after speaking with specialists

5 *A customer ready for the motion tracking, with the colored tracking spots*

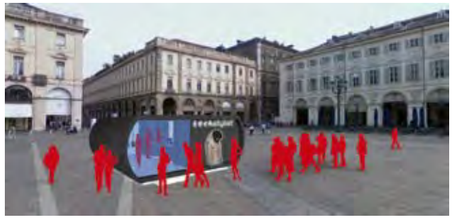
6 *Internal view of Techstylist flagship store*

7 *Internal view of Techstylist flagship store*

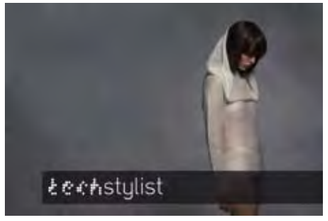
from the machinery manufacturer, Shima Seiki, how the timing and costs of the process worked against the success of the business model. The degrees of freedom available for customizing clothes had thus to be considerably reduced in order for the business idea to stand on its feet. Shima Seiki software is in fact not very flexible and, aside from minor changes such as different colors for the garment, a whole new design is required after any change in shape and size is made. This forced our group to redefine the value proposition: could we still offer something innovative enough to convince the customers to change their clothing purchasing habits? What could replace full customization as the key value driver of our service?

The solution emerged from the great amount of research carried out in the first months of the project. The information gathered revealed new technologies, already available on the market, which could enable a service based on a lower degree of customization but with the advantage of being an on-line based and hi-tech experience in which customers could try their new garment on an avatar generated through a body scanner. The new degree of customization was now assembly-based, meaning that customers are able to create their garment based on combinations of basic "pieces", predesigned by our stylists. This allows an entire different approach to production which lowers costs considerably. Another problem emerged as an in-depth study was made on how to provide visual feedback of the customer wearing the chosen product, in order for him/her to be able to make a decision before actually seeing with his own eyes what he/she will purchase. As previously mentioned, the initial idea was to use a body scanner which would create a digital avatar of the person. On this avatar a 3d version of the garment would be juxtaposed. This solution, however, proved to be very costly and with poor performance concerning the customer experience goals we had set for the business model. Seeing a digital-self wearing a dress just would not convince someone to buy something "blindly" so we had to find an alternative: our research on motion capture technologies provided the answer. A video of the person substituted the avatar and in this video the user would see him/herself wearing a 3d version of the chosen knitwear, synched with his body shape and movements thanks to motion capture technology.

It is thus clear how, starting from an initial idea, our approach was almost one of trial and error in which at each stage our solutions were tested against the hard facts. Our trials however, were never random, but driven by the new trends emerging in the fashion industry in recent years: mostly the growing interest in personalization and customization and the idea of "unservice", meaning that customers are starting to appreciate a "do-it-yourself" philosophy assisted by technology which gives them a sense of independence and creative control.



8 *The Techstylist mobile temporary shop, here in Turin, piazza San Carlo*



9 *Techstylist website, the tool of the creation phase*

10 *Techstylist website homepage*

GENERATING A SOLUTION

The initial and main characteristic of the Fas.P.onSite project was the ambitious idea to create a new business model for the fashion/apparel industry, offering customers the highest level of customization/personalization at each single purchase and producing "on-site". As a result of the research phase, this aspect has been deeply developed in our project, starting from the consideration that people have specific needs not adequately satisfied by the current clothing offer. Only a few examples of products exist, many of which are accessories and not clothes, that can be shaped and designed by the final user. So the definition of a new service, able to fill this void in the current fashion system, represents the core task of the project. At the end of two years of research and analysis, an innovative proposal has been formulated, in terms of retail experience, purchasing process, production process and brand strategy. The client becomes an active part in the whole creative process, thanks to an innovative implementation of existing technologies. The purchasing process is no longer only the simple selection of an existing item but an incredible make-to-order experience in which the user buys a unique fashion piece designed just to satisfy his/her own requirements. This innovative process is mainly based on Shima Seiki Wholegarment technology and on the innovative integration of other devices to create an on-line based business. There is still the need for a flagship store to spread this new brand- concept in the fashion market and to give to customers the possibility to experience the entire process but no additional point of sale is required. Instead, temporary stores will be opened in the main Italian cities. In these locations potential customers can create their own digital video, used in the next steps of the purchasing process, which is on-line based (the company's website is the main tool to place an order) and still assures the best wearability without physical fitting of the selected item. This digital bodyprint/video is key to developing this innovative business idea and create a web fashion community, part of the website itself, based on the sharing of videos and clothes already designed or purchased. The final aspect of the project addresses production: after having studied the constraints of the machine and design software and after having taken into account the economic feasibility of the project, the initial idea of on-site production has been dropped in favor of production concentrated in a single delocalized facility which enables significant economies of scale. The possibility of using multiple production facilities to reduce logistic costs will be addressed only after having observed the first economic results and having studied the actual demand patterns.

project 6C

etiCO

TASKS & SKILLS

Laura Lalario, architect, studied the eco-fashion trends, underlining the main issues of the traditional fashion industry. She then contributed to the creation of the etiCO brand, its strategy definition and positioning on the market. Moreover she followed the project in all the different phases, contributing to the team member coordination.

Francesca Morroni, interior designer, was the main person responsible for the etiCO shop development, mainly defining its architecture, design and functionality. Moreover she was co-responsible for creation of the brand identity and strategy definition.

Enrico Prunotto, mechanical engineer, was primarily responsible for market analysis, development of the etiCO manufacturing and logistic architecture and the economic feasibility analysis. Moreover he had a coordination function as team leader.

Elisa Ratto, communication design, was responsible for market positioning, defining the brand identity, its values and the marketing strategy. Moreover she focused her attention on the product, choosing styles, shapes and materials. Finally she developed the packaging and the entire communication strategy.

Mario Sangiorgio, computer engineer, focused primarily on problem setting, underlining the main challenges and developing alternative solutions. Moreover he was co-responsible for web-platform conceptualization.

Luca Schiatti, cinema and media communication engineer, analyzed the different technologies needed for the design, development and support of the service. Moreover he was responsible for the web-platform conception and development.

ABSTRACT

The EtiCO brand exploits new concepts for the design, production and sale of fashion items. The project aim is the reduction of both garment wastage, i.e. garments which are often unsold and stored in deposit ready to be sold at discount as well as energy consumption and chemical products. Following these aspirations we develop a service aimed at becoming a sustainable alternative for the knitwear industry, proposing top quality garments with a low environmental impact.

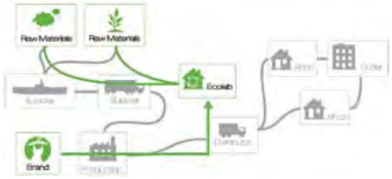
Our core peculiarities are: on-site production to reduce the distance between suppliers and final consumers; on-demand manufacture in order to decrease unsold goods; zero collection, composed of simple and evergreen garments and accessories (i.e. jumpers, cardigans, sleeveless vests, gloves, socks, thighs, scarves, swimming costumes, etc.). Moreover we aim to go beyond seasonal turnover; utilize local suppliers which are able to provide high quality natural fibres in natural shape, avoiding chemical treatment also in the dying phase; finally we aim to be transparent, in order to obtain total traceability of every single garment.

The distinctiveness of the service is the eco-friendly approach combined with the most innovative technology able both to link collection designers with the single shop and provide an added value to the purchase through the identity card, the virtual DNA of the item, a certificate allowing the consumer to have access to the entire garment information. We will propose a modular web-based interface as a large fashion engine shop to link designers, clients, suppliers and local producers. With this new architecture we will create a networked industry in which fast response and flexibility are the key values. The project can be defined as a hub of technology at the service of the environment, producing *what it is needed, where it is needed, when it is needed*.

1 *The Project logo*

2 *The problematic: the fashion wastes*

3 *The project objective*



4 *The new supply chain*

UNDERSTANDING THE PROBLEM

The textile/fashion industry is one of the Made in Italy fields of excellence; it is composed of a diversified, specialized and complete industrial chain with many small-medium companies spread throughout the country or concentrated in certain industrial districts (Biella, Carpi, Castel Goffredo, Como, Prato, Vicenza, etc).

Focusing on the production-distribution chain, delocalization and disintegration through outsourcing programs in order to increase company turnover, neglecting the gradual impoverishment of know-how, immediately come to the fore. Moreover, such global chain generates a significant impact on the environment due to the massive consumption of energy for transportation which adds to the already important quantity needed for garment production. Therefore, fashion is responsible for a dissipative attitude, in particular considering its proposal of short-life materials and so many synthetic fibres with high environmental and energy costs.

On the contrary, a green and consumer health care attitude suggests the use of natural fibres (cotton, silk, linen, hemp, etc) which are carbon neutral, 100% biodegradable and could be produced without any chemical treatment. Moreover they are also more comfortable and healthier for consumers.

Following this trend, Eco-sustainable fashion becomes a new tendency. It uses natural raw material and non-toxic dyes, is environmental friendly, respects the expertise of the artisan, is a local driver, is ethically certified and develops a program of total traceability. Stressing this idea it is possible create a shorter supply chain where design, production and sale phases are located in the same place with consumer involvement in both the conception and the production phases. Such co-creation enriches the purchase act with an emotional experience, generating a plus for the client. Moreover, utilizing on-demand production also contributes to avoid waste, generating a new type of consumer, educated in eco-sustainability and eco-fashion, which will even be able to influence the choices of manufacturers and stylists to generate a new eco-trend.

The core assumptions are client as a creator of value together with a new "quality" concept in relation to the quality of life; this feeling will give rise to the joy of wearing a knitwear item that brings with it a cultural plus and the certainty of performing an act of care for the environment.

EXPLORING THE OPPORTUNITIES

In order to sieve different solutions and design an innovative service, an intense research activity was developed through different fields, from the raw materials industry to recent and innovative forms of business model.

Since the project aim is reduction in environmental impact in

5.1 *Technology selection: Shima Seiki machines*

5.2 *Shima Seiki: the machines producer*

6 *Approaching the yarns*

7 *Yarns available on the market*

8 *Selected yarns for the etiCO shop*

9 *Wholegarment Collection*

the entire fashion chain, the first research step was directed both towards the exploration of new eco-yarns available on the market (i.e. Milkofil, yarn coming from nettles, wood, etc.) and the identification of local suppliers. Following this goal, we went through different innovative fibre producers, such as Ecotech and Maclodio, with whom we discussed a hypothetic yarn supply together with the feasibility of our project from an entrepreneurial point of view. Concerning factory outsourcing, a comparison with the "0 km" in the food sphere was carried out in order to apply this concept to the fashion industry, avoiding both lengthening the chain and gradual impoverishment of know-how.
Subsequently, analysis of the Shima Sheiki machines, software and device programming allowed us to explore the potential of the Shima knitting process and to design a fast and high quality service able to reduce time and wastage and to develop on-site production. On-site and on-demand manufacture required both the design of a zero collection suitable for easy and reasonably vast production and setting up of all the necessary manufacturing processes, such as knitting and washing.
Having defined design, products, supply and production steps we then focused on the business models and specifically we investigated different solutions, ranging from a franchising model to a network of independent businesses licensed by the main company. In the meantime, we proceeded with a market survey, based on an analogy with the Bio food industry, trying to understand the potential catchment area and the appreciation of people for eco-friendly fashion brands.
Finally, the entire service was planned, focusing on every single phase, from the choice of clothes to garment delivery, trying to detail each as far as possible. The final proposal was therefore enriched with the definition of a brand and its strategy.

GENERATING A SOLUTION

Given the premises explained in the previous sections the proposed solution goal is to re-organize and optimize the supply-chain for the fashion industry.
The proposed solution takes into account the entire process, optimizing as far as possible every single step and providing a framework to support the creation of a sustainable fashion industry. This is the starting point to change customer attitude and increase awareness on environmental issues.
To achieve this goal the project proposes the creation of a company, etiCO, which creates and supports an eco-network able to connect sustainable yarn producers and eco-shops, the local fashion drivers. In this eco-shop, production and sales will be merged creating an on-site and on-demand service which deeply modifies the purchasing experience.
This innovative structure will be tested with a pilot shop embracing the company philosophy to validate the model before starting the franchising network.

10 *The product*

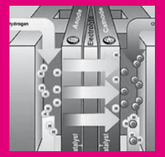
11 *Another product type*

12 *The Item Virtual DNA*

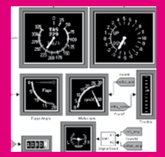
13 *The item Virtual DNA reader*

14 *Share the item Virtual DNA*

To fulfil these requirements, the project takes care of yarn provisioning by selecting a single supplier (Chianti Cashmere) that meets high environmental standards. Moreover, the supplier should be able to provide a periodic restocking of small quantities of sustainable and high quality yarn, in order to match the needs of on-site production. The quality of the yarn is a key factor in the production of valuable clothes and helps make them appealing regardless of the production methodology distinguishing the process proposed.
The innovative way of producing clothes on-site and on-demand is a very important point from the waste reduction perspective since it allows producing only items that are actually sold. In fact when a customer enters the shop, he/she chooses the model and the materials from a catalogue (i.e. sleeveless undershirt, turtleneck jumper, roll collar, turtleneck collar, etc.); then he/she selects a few add-ons in order to create a basic customization of the product. Finally, when the order is placed, a machine will proceed to create the item. Every produced item will be associated with its own identity card (Virtual DNA) containing detailed and specific information such as production methods, materials used, environmental footprint and a short history of the ideas that led to the collection and the item design. This will both guarantee complete product traceability and provide a richer purchasing experience.
This production model also requires changing the way goods are delivered: the customer is no longer able to pick-up the items immediately on leaving the shop. On the contrary, when the items are available, the customer can choose whether to have a direct pick-up in the shop or use a home-delivery service provided by sustainable transportation. A shop workload simulation shows that the items could be delivered the day after order placement even in the busiest period of the year. This aspect makes the methodology appealing not only for customers more involved with environmental issues but is also acceptable for mainstream customers.



PROJECT 7



Pure Wings

PUREWINGS

H2-SUPPLIED ELECTRIC AIRCRAFT. ENABLING TECHNOLOGIES FOR INNOVATIVE HYDROGEN AIRCRAFT PROPULSION WITH OPERATION COSTS AND LOGISTICS IMPACT EVALUATION

project 7

Pure Wings

H2-supplied electric aircraft. Enabling technologies for innovative hydrogen aircraft propulsion with operation costs and logistics impact evaluation

Pure Wings: technology simulator of an innovative electric ultralight plane, propelled by fuel cell, operating within the future hydrogen economy scenario

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EXTERNAL INSTITUTIONS

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Marko Radeta
Communication Design

PROJECT DESCRIPTION

Now more than ever, the establishment of a sustainable energy future is one of the most pressing tasks of mankind. The increasing prices of fossil fuel sources and the climate change issues moved the research to new fields and new frontiers. In the world of aeronautics, this problem is becoming a key issue due to the high energy and fuel consumption and the growing number of flights.

In this framework, we tried to merge the technical competence and the economic aspects in order to make a feasibility study of hydrogen-fuelled aircrafts and to design a sustainable and clean ground support system for regional or international aircrafts. A ground support system aims to provide the aircraft with energy while it is waiting for takeoff in the airport.

The project sets itself into a larger context: the SkySpark challenge (http://www.skyspark.eu), whose goal is to design and build a complete “ecological” aircraft. The SkySpark project was born in 2007, when prof. Paolo Maggiore research group, from Politecnico di Torino, joined the startup DigiSky of Maurizio Cheli. They worked together for the official project launch (at the beginning of 2009) and its realization (the first great result was the first fly during Word Air Games in Turin, June 2009), and now they all participate in its continuation.

The task of the project was divided between two teams. Team Inside was in charge of the feasibility study whereas Team Outside was decided to design a hydrogen-fed ground support system that could be used in a real airport.

The feasibility study was carried out by assessing the performances that an hydrogen-fed electric powertrain would allow if extended to different aircraft models, both considering the 2010 and the expected 2030 technology scenario and evaluating case by case the resulting cost-feasibility and environmental impact. Moreover, a deeper analysis was taken by means of a simulator of the Pioneer 300, the aircraft considered in the SkySpark project.

In order to design the hydrogen-fed ground support system, Team Outside decided to study major hydrogen production

systems in terms of energy required, CO2 emissions and costs, and to analyze all GPU-system components: from the hydrogen production, to its compression and storage and its utilization in the fuel cells.

For a better comprehension of the project feasibility, the first objective was to base the whole study on two case studies (Levaldigi and Malpensa) in order to highlight the problematic issues and the potentialities of the solution. An analysis had been made to understand the real advantages of such a solution, the time needed to charge/discharge the hydrogen cylinders, the extension of solar panels and storage facilities. The idea was to create an extensible model for aircraft support system (a modular unit), that could be applied and scaled to any airport.

Another important objective was to underline safety problems and issues related to the H2 production and usage, and the necessity of a plan to incentive the diffusion of a “hydrogen economy”.

project 7A

Inside PW

ABSTRACT

Inside Team focused on estimating the feasibility and the potential of H_2 propulsion for the aviation sector. More specifically, the study took its first steps within the SkySpark initiative by DigiSky, which promotes less polluting air solutions revolving around the development of a fully hydrogen-powered electric aircraft.

To address the objectives of its main stakeholders Pure Wings Inside Team needed to understand the issues arising from hydrogen-based air transportation and place them within a common, general, multidisciplinary representation of current and future trends and demands.
A wide variety of information from scientific literature regarding the hydrogen economy in all its aspects was collected in order to investigate and clarify the state-of-the-art of this topic; the study then passed through a fairly complex set of engineering models and numerical simulations, analysed the outcome of a long term market forecast and finally ended up with a set of projections regarding the global aviation industry.

With current technology, the analysis demonstrates that hydrogen-propelled aircrafts are a feasible and competitive alternative to common jet fuel aircrafts, at least for 2-seat general aviation planes. Performance analysis shows that with the current design, 400 km at average cruising speed of 250 km/h are achievable; however, the application of H_2-supplied powertrains to aircrafts with more than 2 seats does not appear cost-effective for the time being, since it would result in excessively low payloads, except in the case of considerably reduced ranges.
The study ends with the identification of a possible technological alternative including an on-board ethanol-reformed fuel cell. The outline of benefits and constraints of this solution and a discussion concerning its feasibility and the expected impact over the next few years close the work.

TASKS & SKILLS

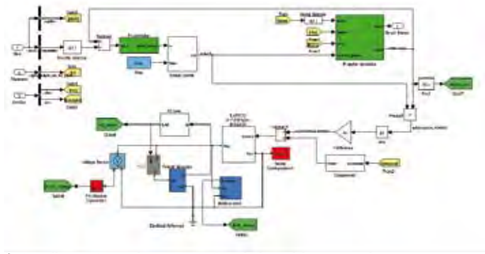
Noemi Chiappin, Team Controller, was responsible for the coordination of the team and for the relationship with Team B. She investigated the environmental footprint of the aviation industry and the impact that hydrogen might have in reducing it.
Andrea Montebelli provided expertise in the research concerning fuel cell systems and H2 production and storage.
Giovanni Moretti carried out research on electric propulsion and elaborated a final scenario on forecasted improvements in aviation technology.
Alessandro Morselli was responsible for the creation of the Simulink model of the aircraft and for its validation. He also analysed H2-aircraft performance and emergency situations.
Federico Nitidi concentrated his efforts on analysing future projections in terms of air market demand and in building a likely scenario of H2-propelled aviation for coming years. He also helped in the overall coordination of the study.
Michele Tamagnone participated in building, structuring and optimising the simulator.

UNDERSTANDING THE PROBLEM

Focusing on the aviation industry, this project is inspired by the 21st century energy challenge with the goals of assessing the potential of future hydrogen-propelled electric aircrafts, carrying out a feasibility study of this technology and forecasting its impact over the next few years.

Sustainability has become a very strong and important topic in every field in relation to the recent scientific issues on climate change. Despite representing only a small share of the total, aircraft- generated emissions are growing rapidly: the challenge is the development of technological and operational improvements and new government policies in order to control and possibly reduce this rate of increase.
At present, innovations are mainly related to engines, aerodynamics, flight mechanics and materials, but in recent times attempts have been made to apply new green technologies to aircrafts such as hydrogen and solar cells. SkySpark project, which PureWings have been inspired by, goes in this latter direction by exploring and promoting the choice of hydrogen for aircraft propulsion.

It is fundamental to understand that the study of the environmental impacts related to each technical proposal must consider the whole life-cycle from fuels and energy vector production to the final use. This is a complex process because every phase can introduce new variables and uncertainties.
Policies represent another very important factor to be taken into account when talking about sustainable solutions. Government support is necessary to develop new technologies, to make them economically viable and to introduce them onto the market.
An additional key-point regarding aviation is safety. Airplanes are actually the safest means of transport, and this is partially due to the high sensitivity of public opinion towards air crashes which are often fatal. It is hence fundamental for new technologies not to introduce further risks but rather to possibly increase current safety margins.



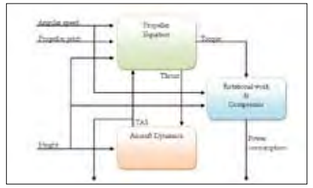
1 *Propeller, engine and powertrain Simulink models connected Screenshot from the simulator*

The complexity of the problem also shows the need for an appropriate instrument capable of addressing all the aspects necessary for the analyses – the collaboration with The Mathworks thus provided the Team with suitable tools to create an ad-hoc flight simulator.

EXPLORING THE OPPORTUNITIES

In recent years the air industry has shown interest in alternative energy sources offering a potential for reducing greenhouse gas emissions. During the first stage of Pure Wings, various technical opportunities were explored and their state of the art was evaluated.
Team Inside investigated the properties of fuels produced from alternative sources and considered new propulsion systems, ending up with a layout based on electrical motors driven by fuel cells and batteries. In particular, novel promising fuels, like hydrogen, biomasses and biodiesel, were mainly considered in this study and compared to common fossil-based sources.

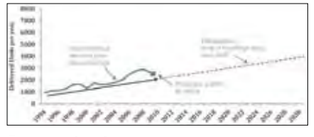
Focusing on H_2 as a plausible energy vector for aeronautical applications, the main issues to be taken into account are production and storage. The most common and industrially used means of generating hydrogen were analysed and compared, including steam methane reforming, partial oxidation and water electrolysis.
Different ways of chemical storage (in which the hydrogen atom is chemically confined inside organic and inorganic molecules)



2 *Graphic representation of the system of equation necessary to compute aircraft performances*

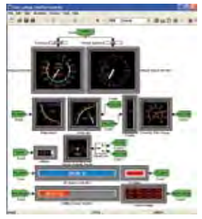
3 *Simulator top level*

4 *Flight Gear interface*
Screenshot of Flight Gear graphic interface



5 *Historical performance and projections for light aircrafts market*

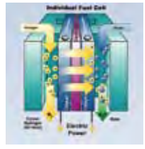
6 *Pure Wings proposal: an internal ethanol-reformed SOFC coupled with an on-board ethanol tank and a start-up steam tank*



7 *Fligth instruments and sensors modeled with Simulink*

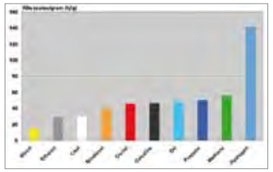
8, 9 *Screenshots of the running simulator*

10 *Team A at work*
Milano, September 2010



11 *Fuel cell schematic representation*

Source: http://www.greenjobs.com/Public/info/industry_background.aspx?id=12



12 *Specific energy of the most common fuel*

Source: http://greenecon.net/with-choices-like-biodiesel-and-ethanol-what%E2%80%99s-the-best-fuel-for-your-vehicle/energy_economics.html

13 *Hydrogen production today*

Source: Don Fraser (Dynetek Industries Ltd.), Solution for Hydrogen Storage and Distribution, The PEI Wind-Hydrogen Symposium, June 22 to 24, 2003

and physical storage (in which H_2 molecules are physically retained without chemical bonds) were also investigated, carrying out a preliminary cost analysis as well.
A research on recent progress in fuel cell technology was also undertaken in order to better understand which preferable direction the scientific community is moving toward.

The structuring of the flight simulator meant an additional degree of technical expertise and judgement to be introduced. Many approaches to this computational task were considered, ranging from those detailing the intrinsic dynamics of each component to more manageable alternatives looking directly at their assembly as a "unicum". The final choice was to mathematically describe the minimum number of system components (i.e. fuel cell, inverter, electric motor, batteries, propeller and storage tank) and let the overall response ensue from their dynamic interaction over time.

The state-of-the-art study turned out to be a crucial phase, especially for the final feasibility analysis, where possible extensions of the Pure Wings H_2-system to a variety of aircraft models was examined; this followed the Team's genuine belief that a reliable assessment of the impact that each technological solution may have in the long term is possible only when the surrounding context is taken into account and properly clarified and analysed.

GENERATING A SOLUTION

The analysis performed covered four principal aspects of hydrogen powered aircrafts:
Hydrogen system weight, which is higher than common systems and influences the payload and the maximum number of passengers carried on each aircraft
Hydrogen system volumes, since hydrogen requires large storage tanks, due to its low density
Costs, a fundamental aspect for the feasibility of the project
Environmental impact, required by the objective of reducing emissions.

The feasibility assessment revealed that the effectiveness of the H_2 system – at least in the layout herein examined – is currently bounded to the 2-seat category of general aviation aircraft, already accounting for a reduction in typical ranges compared to traditional fuels. The 2030 technological projections forecast the possibility of extending the system up to 4-seat aircraft with a maximum range around 600 km.
At present, the cost analysis identified an increase in production costs of about one fifth in comparison to traditional air propulsion, whereas the H_2 system appears to be cheaper in service. The cost scenario forecasted for 2030 traditional and H_2–based powertrains will probably tend towards alignment.
The environmental impact will depend on the type of hydrogen production which will be available.

The innovative content of Team Inside results is divided on different levels. Firstly, from a consulting-oriented perspective, it is expressed by the ad-hoc projections regarding future improvements expected for H_2-based systems that the Team analysed.
This was done by monitoring relevant historical trends for several components of the hydrogen supplied powertrain and by applying engineering judgements to establish plausible mid-term performance forecasts. Combined with a thorough understanding of the aircraft market and industry, this approach allowed us to estimate the actual margins for extension of this propulsion technology up to 2030.
If considered under a computational and analytical light, the construction of a flight simulator able to assess aircraft performance, resource management and safety limits represents a second source of innovative inspiration.
The idea behind this was to set up a flexible tool capable of reproducing aircraft behaviour. A modular system was developed in Simulink: users can modify, add or change subsystem blocks and easily analyse the behaviour of different powertrain layouts. Moreover, the availability of a graphical interface allows real-time checks of the airplane in-flight performance and responses to pilot inputs.
Ideas for future technological improvements were also developed and a feasibility study focusing on the utilisation of an internal ethanol-reforming fuel cell was carried out as a further innovative suggestion.

project 7B

Outside PW

Pure Wings H2-supplied electric aircraft. Enabling technologies for innovative hydrogen aircraft propulsion with operation costs and logistics impact evaluation

ABSTRACT

The increase in wealth over the last thirty years has led to an increasing demand for air transportation (especially business and tourism airplanes). As a consequence, aviation emissions and energy requirements have increased and alleviation of environmental impact has become a harder task. In addition, we can nowadays observe another important phenomenon: the expansion of small airports. Air companies are increasingly focusing on taking advantage of minor airports in order to reduce costs and solve the emerging problem of shortage in the number of available runways.

Aircraft producers are now focusing on new research areas concerning alternative energy sources and fuels, in particular fuel cell propulsion. In this framework, taking its inspiration from the SkySpark project, the Pure Wings project concerns the design and measurement of a sustainable H2-fed ground support system. A ground support system provides aircraft with energy while they are waiting for takeoff in an airport.

Our idea focuses on producing hydrogen by photovoltaic electrolysis, directly in the airport, storing it in pressurized cylinders and using it in the fuel cells of the GPUs.

The system has been studied basing on the energy demand of two different airports (Levaldigi and Malpensa), in order to highlight the issues and the potential of the solution. Finally, we considered the need for a strategic government plan in order to make the transition to a hydrogen economy possible (not only in the aircraft sector but in the entire transportation sector). A "Hydrogen Program" is necessary for research implementation, management of projects but also for safety issues related to the use of hydrogen and, last but not least, the diffusion of the "hydrogen-culture" and sensitization population of the on the need for this transition.

TASKS & SKILLS

Luca Chiarandini worked on economics and feasibility, responsible for communication with external institutions

Marco Ciuffreda design aspects and fuel cell study, operating cost analysis

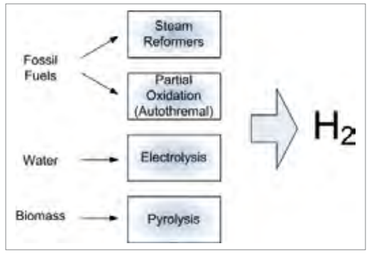
Margherita Dallorto worked on solar plant and GPU measuring

Marta Nadia Guzzafame responsible for team coordination, economic evaluation and government plan conception

Marko Radeta analyzed H_2 security aspects; graphic work for public presentations

	Levaldigi	Malpensa
Power output	20 kW	120 kW
Continuative Operation Time per Usage	20 min	45 min
Number of daily operation	2	10

1 *Case study airports data*



2 *H2 sources and production methods*

Solar	143 723	€
Electrolyzer	280 000	€
Compressor	2 000	€
Storage	133 200	€
Fuel cell stack	21 000	€
TOTAL	**579 923**	**€**

3 *Cost evaluation*

UNDERSTANDING THE PROBLEM

Pure Wings, which studies a sustainable transport system and the use of hydrogen for CO_2 emission reduction, led us to the decision to design a "green" ground power unit, a mobile unit capable of supplying power to an aircraft parked on the ground. We designed a self-sustained unit, conceived to work as a module, consisting of the parts necessary to service a single aircraft during a fixed-length ground operation. The entire project consisted of the simulation of two case studies (Levaldigi and Malpensa airports), chosen because the first is a small regional airport whereas the second is an international hub, in order to explore two different situations.

The Pure Wings idea consists of hydrogen production by means of renewable sources, its storage in tanks and, finally, its use in the fuel cells of the GPUs.

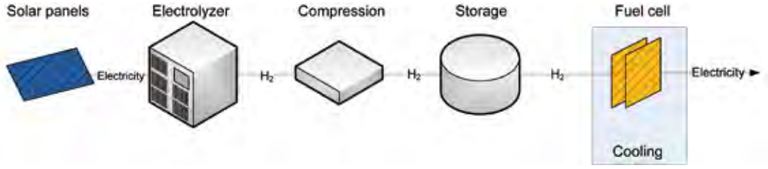
Pure Wings started analyzing the various H_2 production methods and their costs in order to indentify the best and most competitive solution. The analyses carried out were based on the H_2A Production and Delivery model approach and tools developed by the United States Energy Department. Subsequently, different fuel cell types were analyzed and the daily overall energy required was calculated. Following these evaluations, we decided to produce H_2 via solar electrolysis and therefore we analyzed different methods to dimension the solar plant and decided to use an innovative tool created by the Joint Research Centre (JRC) in Ispra, "Photovoltaic Geographical Information System (PVGIS)", useful to carefully estimate the quantity of solar energy available per year in each site.

On the basis of the results obtained, we explored component prices in order to determine the H_2-GPU plant cost, comparing it with traditional solutions.

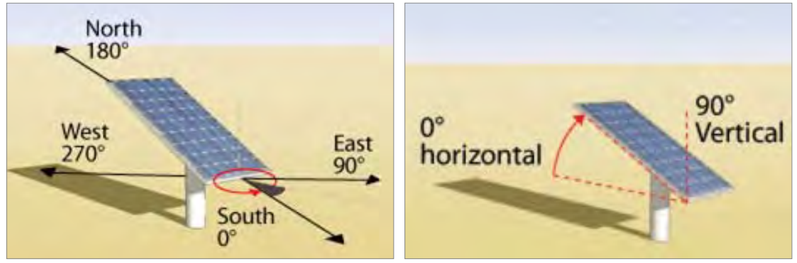
GENERATING A SOLUTION

A brief list of requirements for a single apron is shown in Fig.1. While for Levaldigi one apron is enough, Malpensa airport needs tens of GPUs because of the enormous number of flights per day.

We analyzed both distributed and central H_2 production methods (Fig. 2). Subsequently, we decided to produce H_2 via distributed electrolysis. This choice was mainly due to this method's advantages: the production unit can be located at the consumer refuelling site, the unit capacity can be tailored to site fuelling requirements, no delivery infrastructure and lower capital investment are required, etc. In our particular case, we chose the solar electrolysis method because we wanted to use renewable sources in order to create a truly "green" system. In addition, we



4 *Final Pure Wing system layout*



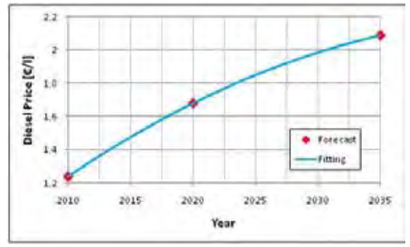
5a, 5b *Slope or tilt (a) and azimuth (b) angles*

decided airports are not located in windy regions (so, no wind electrolysis) and there are ample surfaces available for the solar panels (which could be positioned both on the roof of the airport structure and on the surrounding grounds).
From the cost analysis of solar electrolysis an actual cost of about 22€/kg H_2 emerged, but this cost is expected to decrease to 4-5€/kg in 2015-2020. This is about three times the cost of hydrogen produced by central coal plant in its future projection (estimated to be €1.68/kg). We understood that, in order for PV electrolysis to become competitive in future, either the PV module or the electrolyzer costs must be reduced by one order of magnitude.
By trading off pros and cons of each kind of fuel cell examined we chose the PEM fuel cell for our GPU because it can be appropriately designed to achieve the desired output power, is flexible and clean and has an affordable cost.
The daily energy required has been estimated as:

- 13.3 kWh (0.96 kg H_2/d in the fuel cell) for the Levaldigi apron
- 900 kWh (60 kg H_2/d in the fuel cell) for a Malpensa apron

In both our case studies we chose typical commercial PV modules (Sharp ND-Q2E3EF (162 W)). In the case of Levaldigi the PV field comprises 132 modules for a total area of 176 m^2 and an installed peak power of 21.4 kW (test conditions). The annual estimated production is 23,400 kWh. For Malpensa, 74,000 modules are required, accounting for 12 MW of peak power covering about 100,000 m^2 and producing 14,000 MWh per year for one GPU. These values must be multiplied by the number of aprons needed for this large airport which we estimated to be about 60, if we consider that every GPU feeds 10 aircrafts per day. Such a PV field is theoretically possible but its management appears complicated and expensive. This can be a severe limitation for project implementation in an international airport such as Malpensa. Following this first conclusion we decided to analyze storage and economical aspects only for the Levaldigi GPU.
On the basis of the results of this phase, the main component costs has been determined, based on market research, in order to understand product characteristics and prices. For each component, many possibilities were examined and evaluated from both the technical and economic point of view. An estimation of the total cost of a Pure Wings apron is shown in Fig. 3.

6 *Global irradiation and solar electricity potential for optimally-inclined photovoltaic module in Italy*



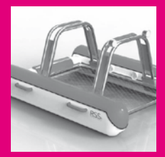
7 *Diesel forecasted price and fitting curve*

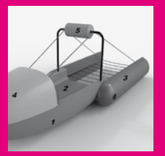
8 *Team B logo*

CONCLUSIONS

The Malpensa project does not have the advantage of the scaling factor, at least at the present day. The bigger the airport, the larger the PV field and the larger is the initial investment required. The Levaldigi apron concept could be a sustainable pilot project and it should be implemented in order to understand its possible market evolution and to carry out further studies.
From our analysis, PV hydrogen production appears possible in the near future and the resulting estimated H_2 cost is quite affordable. Local production and direct utilization of hydrogen permits a significant cost reduction and solves many safety problems related to transportation and storage of this gas. Despite this, the current cost of a traditional GPU is about 40,000€ while the cost of our system is many times higher. Of course there are several aspects in favour of our project, such as the longer life cycle of solar panels (40 years) in comparison to traditional GPU (5 years) with lower maintenance and fuelling costs. However, it must be noted that if a large initial investment is required, government intervention is necessary with appropriate incentives and research funds. So, Pure Wings suggests a government plan to incentivate the project and make it viable in the near future.
Concerning the safety problems related to hydrogen, the H_2-GPU solves many of the possible criticisms that could be raised. Hazards are significantly reduced thanks to the fact that no pipelines are used for storage and transportation but rather already tested and approved cylinders and in an airport there is all the necessary space to put the system far enough away from people. Moreover, accidental dazzling, caused by the solar panels, of pilots during landing and taking-off can be avoided by correct exposure and inclination.
Despite this, we suggest government and institutional interest and intervention in order to create an appropriate legislative system for hydrogen production and usage. With an appropriate strategic and support plan, and the appropriate technology, we definitely believe that hydrogen can become a reality.

PROJECT 8





RSS

RSS+
Robotized Saving System

ROBOTIZED SAVING SYSTEM

RSS
Robotized Saving System

project 8

The RSS project is designed to save unanimated bodies accidentally fallen in water. It can be self-operating. Tulton srl is interested in producing the object

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PROJECT DESCRIPTION

The present project focused on the design of a robotized rescue system to be employed as a recovery tool on water in several difficult situations. The device is intended to rescue endangered people floating on water such as in flooded areas, in bad weather conditions, in a war scenario or because of an unexpected event or accident. At present there are no reliable tools available to safely and quickly rescue anybody in such endangered situations without exposing others to risk their own lives. Therefore, the proposal was to study a remotely controlled rescue system or one with an automatic search system that could be self-operating. Following an accurate analysis of the drowning process, we decided that the means should also be able to rescue inanimate bodies.

The research initially focused on two different types of products, according to the task to be met: a SAVER robot, designed to save swimmers in trouble along the coast and a RESCUER robot, finalized to be operative in open waters or in a war situation, broadly speaking, in extreme conditions. The second needed to be possibly dropped or parachuted on water, either by a vessel or by helicopter. The challenge for the teams was to study the problem and finally define the product parameters in terms of safety, performance, type of propulsion, maximum speed, batteries and structural design with attention to impact resistance and recovery operations, recovery area for inanimate bodies and, last but not least, the remote control system and Audio/Video communication.

To fulfil this difficult task, many different skills were necessary: essentially, mechanical engineering, aerospace and naval engineering, telecommunication and electronic engineering and design. The two teams that worked on the project were created in a way to distribute as evenly as possible the various available skills; in fact, in a first phase they worked together aiming to study the problem as a whole and then to define several different concepts. Once chosen the best two proposals, projects have been carried out at the same time independently.

As a final result, two innovative and feasible RSS have been defined; both conceived by combining technologies already available in different fields. Both are RESCUERs, conceived to be used in open sea or flooded areas but definitely with a different design configuration: one with a single hull and the other with double hull in order to facilitate victim rescue procedures. In case of continuation of the project, an accurate simulation of various technical aspects such as hydrodynamics, structure and control should be included.
At the end, it would be necessary to develop a prototype, finalized at experimental tests in order to validate the project. Possibly the involvement of a number of companies already contacted may lead to large-scale production of the RSS. If the system proves to be effective in most conditions, the world of Search & Rescue at sea will have a new and valuable technological tool.

project 8A

_RSS_Robotized Saving System

TASKS & SKILLS

Pietro Bersezio worked on patent research, technical features of propulsion systems and accumulators. He managed team work and communication with academic and external institutions.
Alberto Leopaldi worked on technical features of sensors, localization of the victim and rescue system.
Leonardo Orlando worked on technical features of propulsion systems and analyzed how external institutions may use the project results.
Alessandro Palmas worked on technical features of structural design and carried out the feasibility analysis of the project.
Sarah Thénot took care of graphics, logo and developed the 3D model of the concept.
Erika Vaniglia worked on patent research, technical features of control systems and remote control devices.

All members gathered information on the state of the art, performed interviews to possible users and developed the final concept with its sub-systems.

ABSTRACT

The project had to face several different issues which can be grouped in four main categories: environmental adaptation, control, victim search and rescue system.
For the design process, the worse environmental conditions must be considered which means: rough sea, night time operation, smoke or fog visibility limitations, and windy and/or stormy weather. The final concept has been designed to meet both these demands and to maintain limited dimensions. It is equipped with a GPS –like localization device and lights (both above and below the sea surface) to cope with night time and limited visibility situations; shape and propulsion system have then been studied to be suitable for floating in rough sea and also stormy weather.
The robot will be remotely controlled: as it has to float in areas where people are present, no control errors are allowed in order to be sure that the robot will not cause harm. The remote control is designed to be intuitive and straightforward. Two monitors show GPS-like position and camera images, a joystick is used to control both the RSS displacement and the rescue system.
Concerning how to locate the victim, two different possibilities are considered. In the first case the hypothesis is that the victim is equipped with a GPS system so that a monitor in the remote control station shows the distance between the RSS and the target point: once in proximity of the target, the robot can be guided through the use of the camera so as to clearly find the exact position of the person. The other possibility is that the victim does not wear a localization device. In this case, once the position is approximately known the search must be performed only with the aid of the camera and camera arm which can perform the search also below sea surface.
The rescue system must be reliable and not a one-shot type: for this reason, the choice of an electrically driven net structure which is lowered and is then returned to the initial position has been made.

UNDERSTANDING THE PROBLEM

The initial analysis of the project regarded the definition of user requirements, considering that, when talking about a robotized rescue system, two categories of "users" can be identified: the "rescued" and the "rescuers".
In the first case, research has shown that:

- The minimum average elapsed time before death is 6/7 minutes if drowning occurs in sea water.
- In case of hypothermia, this length of time depends on the temperature of the water: however, it is greatly increased compared to drowning.
- Depending on the state of consciousness and whether the victim is wearing a floatation device, four different positions can be assumed by the person in the water, the most problematic of which, for rescuers, is the *battler position* under water.
- For bio-medical reasons, it is commonly recognized that a horizontal position during a rescue manoeuvre is the only safe alternative.

As far as the rescuer is concerned, although almost all the possible stakeholders were interviewed, what emerged were relatively trivial considerations, mainly regarding cost and overall dimensions, both having to be as low as possible. This can be traced back to the fact that a sense of wariness is perceived towards an unmanned rescue system intended to work in hazardous environments.
The identified requirements are, therefore:

- Good handling with small movements;
- High resistance and ability to move against currents and in rough waters;
- Ability to change velocity in size and direction;
- Capability of saving a person in a safe manner and to protect him/her from water;
- Easy-to-use interface both for the rescuer and the rescued: it must be visible from afar, it must not scare the person, it must have handles and the controller has to be easy to use;
- Readiness to work: low periodic and easy maintenance and easy replacement of damaged components;

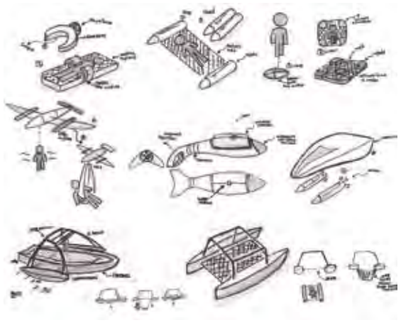
1 *Subsequent phases of the drowning process*

- Ease of storage: possibility to close the system to save space on ship decks.

EXPLORING THE OPPORTUNITIES

Deepening the analysis, three different specific scenarios, depending on which a different solution can be proposed, are identified, i.e. beach scenario, open water environment or flooded area.
As far as the beach scenario is concerned, both automatic [1] and supporting lifesaver systems [2] have already been developed. In this case, since the main cause of death is drowning, the device should also have an in-water camera since the problem is frequently lost time due to searching for the person who is already under water.
In the open water case, the robot should also be able to search for victims and locate them as fast as possible; to do that it should be interfaced with worldwide standardized systems for sea search, such as the *Cospas-Sarsat* system, which works with a GPS signal. Whether the victim is provided or not with a GPS transmitter, a camera should nevertheless be necessary to approach the victim in the last phases of the mission or to locate him/her when the distress signal is given by someone else. In this case, the existing alternatives are mainly focused on floating devices [3], able to reach the position of the person but not to automatically rescue him/her, or on aerial vehicles able to throw

2 *Example of an extreme condition scenario where RSS could be used*



3 *Brainstorming of initial exploration of alternatives and scenarios*

a floating device to the person [4] or to correctly identify his/her position [5]. No automatic rescue system is currently available, neither on the market nor in the concept stage.
During or after a flood there is the need to save as many people as possible but since weather conditions are usually very bad and places where people need to be rescued are often narrow and not easy to reach, on very few occasions is rescue by helicopter or boat feasible. Moreover, specialized flood rescue units are rare and often rescuers pay with their own lives for their improvisation.
The system developed here will be optimized for an open sea environment both for civil and military rescue.

GENERATING A SOLUTION

Several different concepts to save a person in open water have initially been explored.

After comparison, the final solution adopted was that of a catamaran, i.e. a double-hulled boat which should reach the correct location and rescue the victim by using a net. The advantages of this solution are: possibility to use the space between the two hulls to pick up the victim, stability in rough waters, the higher speed of catamarans, manoeuvrability and lightness compared to mono-hulls.

The structure is composed of two fibreglass hulls joined together by an aluminum upper structure which ensures rigidity of the system. To increase stability in case of very severe sea conditions, hulls are equipped with tubular rubber. The rescue system is made of an aluminum rectangular frame, placed between the hulls, to which a net is bound on three sides. When the victim is reached, the netted frame is lowered into the water and then lifted with the victim.
The definition of technical features of the robot represented final step of the project and was the result of analysis and comparison of different solutions:

- Propulsion system: in terms of propulsion type, marine propeller engines and hydrojet engines were compared. Ducted propeller engines were chosen since they offer better performance in terms of power, weight, cost and reliability. After a deeper analysis on fuel systems, an electrical propulsion engine was chosen because of the efficiency, ease and reliability of control. Engine sizing was carried out starting from the robot dimensions and weight: the power required of each of the two engines was found to be 1.98 kW.
- Rescue system: it consists of three rollers, two located in the hulls while the third is placed in the rear part of the robot, perpendicular to the others, on which the net is wrapped. An electric motor finely controls the motion of the rollers, thus moving the frame.
- Sensors: In the case in which the victim is equipped with a GPS signal, providing the robot with the same sensor and transmitting the signals to the remote controller, the relative positions of the robot and the victim can be visualised. Moreover, a HD video-camera will allow the rescuer to see the victim during rescue. Finally, in order to establish a direct contact with the victim, an audio communication system will be installed.
- Power supply and electrical system: lithium batteries were chosen since they offer better performance in terms of energy density and efficiency compared to lead acid batteries. Battery size depends on the duration required: at this early stage of the project, 30 min duration was chosen as reasonable in order to make the robot lighter and cheaper.
- Control system: wireless satellite transmission was chosen to control the robot, thus allowing high speed transmission of large amounts of data. Such a system requires the installation of a telemetry system on board, managed by a personal computer, which governs the transmission of signals and distributes the same to the components of the robot.

4 *Structural 3D render of final concept*

5 *Structural 3D render of final concept with the net lowered*

6 *Schematic sequence of rescue operations the robot can carry out*

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project 8B

_RSS_Robotized Saving System

BOOMERANG

ABSTRACT

This project stems from the following motto: "Saving lives without putting other lives in danger". The Sea Search & Rescue world is a field where this clear and simple condition is in practice never fulfilled: the rescue of shipwrecked people, of people lost in open sea, of people having fallen overboard in harsh weather conditions and of missing people in flooded areas is a high risk task where success is closely connected with rescuer skills and training. Nowadays the most varied technological aids are available, both in preventing the event and in helping the rescuer, but, analyzing in detail the rescue procedures, one can perceive how they have experienced no important and radical changes: some rescuers must necessarily approach the victims by boat or by helicopter, putting their own life in danger and facing considerable difficulties in keeping the rescued person safe.

Our solution is the "Boomerang": a robotized rescue system (alias RRS), a remote-controlled craft designed to be easily displaced from a rescue ship or from a helicopter, to move quickly towards the victim and to safely rescue him/her. The structure of the vehicle is intentionally quite simple and all the components and technological equipment are state-of-the-art devices, already available on the market: this helps the feasibility of the product and reduces its cost, without being detrimental to innovation which instead arises from their combination. The description of the craft and its function will be dealt with in detail; broadly speaking, it is a compact boat, a little longer than the height of a person, about 2.5 meters, so that it is able to host the victim lying down safe and protected. To be fast and easily controlled, it uses a single hull configuration powered by an internal combustion engine and a jet drive, similar to the personal water craft propulsion. The rescue procedure is based on a mobile net installed between a pair of floating hulls: this constitutes the aft of the craft. Finally, the Boomerang can be easily stored, being foldable in the middle.

One can see clear advantages for a rescue organisation such as the Coast Guard in having a new system such as the Boomerang, as well as for the crew of a large ship in the event of man over board: difficulties in quickly reaching the victim and getting close enough and problems in identifying his/her exact position during the night or in bad weather can be overcome, without putting rescuers lives in danger at all.

TASKS & SKILLS

Luca Boccalini worked on the systems for victim search and studied state-of-the-art technologies on the market; implemented the 3D model.

Marco La Rosa contributed to determination of the scenario and deepened state of the art analysis and market exploration.

Marcella Maltese defined the scenario and helped structure requirements, participated in concept definition by illustrating all ideas.

Federico Parietti collected technical requirements, helped in feasibility analysis of the final concept, focusing in particular on the rescue procedure.

Francesco Rizzi studied state-of-the-art technologies relating to propulsion and focused on the Boomerang propulsion systems, in collaboration with a number of domestic ship builders.

All members performed interviews and contributed to the various concept definitions.

1 *U.S. Coastguard helicopter performing Search action in very dangerous weather conditions, extreme conditions scenario*

2 *Coastguard Sikorsky S61N and RNLI Lifeboat performing Rescue action, Salthill Air Show 2003*

3 *Existing automatic solutions: EMILY in front of Malibu's Zuma Beach on the left, concept of Seascout by designer Andre Harley in the right top corner, SARPAL craft by ISE (International Submarine Engineering) at the bottom*

UNDERSTANDING THE PROBLEM

The entire research and design activity started from the intuition that there was no offer on the market. In fact, the Robotized rescue system project is a market pull innovation in which a problem or need is identified in a specific market and consequently resources and technologies are gathered to provide a solution.

All through the history of navigation, the greatest risk a sailor might face is to fall into the sea; this event might put in danger not only his but also the life of those who go to his rescue (fig. 1) and sometimes of the entire boat. Nowadays specific tools are designed to prevent such accidents and water rescue has become a true profession.

Consequently, the aim of the project was mainly to design a robotized rescue system to be employed as an autonomous tool in recovering victims in open seas, without risking other people's lives. The endeavour was, in fact, to eliminate the danger for the rescuer by providing a highly independent apparatus which could be self-sufficient or controlled from a distance, able to rescue both conscious and unconscious victims.

EXPLORING THE OPPORTUNITIES

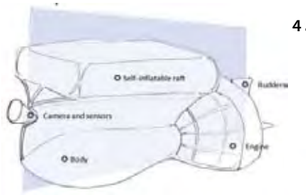
All nations in the world have organized national rescue organisations (fig. 2), military - Navy, Coast Guard, Air Forces - as well as hundreds of private lifeguard and rescue associations. Moreover, as clearly specified in all treaties and regulations, all boats are involved by law in Search and Rescue operations whenever necessary. The market for a Robotized Rescue System thus appears broad and diversified at first sight, from SAR forces (Coast Guard above all) to private yachts and the merchant navy.

Despite years of important technological development, the maritime Search and Rescue procedures are today almost the same as in the past: research on new procedures and automatic robotized tools to help sea rescuers and avoid their exposure to risky situations is very lacking. Data on the results of marine Search and Rescue appear quite stable in time and, even if the overall success of every SAR action is not to be taken for granted and depends on many separate efforts, including SAR programs, support and facility management, rescuer proficiency and boating safety and prevention, introduction of automatic systems in the world of Search & Rescue appears as a launch pad for better results in the future.

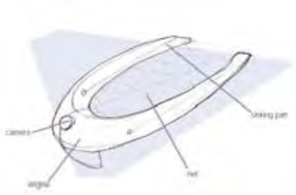
Very few examples of automatic rescue systems are available today and none seems able to fulfil the requirements which the challenges of SAR present. Figure 3 shows some examples. SAR operators do not nowadays have sufficient technological support and the success of the mission relies almost totally on their skills.

GENERATING A SOLUTION

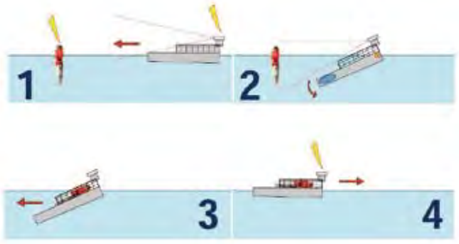
Our team initially generated several different concepts (submarine, fig. 4, and some above surface solutions, fig. 5 and 6). We finally chose and developed the most promising, called "Boo-



4 *SeaScooter concept, a submarine solution*



5 *First sketchy concept of Boomerang, above surface craft with rescue procedure from stern*



6 *Anther above surface solution, with rescue procedure from prow*

merang", maintaining the best ideas of the others and aiming to obtain a feasible and functional product.
The main idea behind the development of the "Boomerang" concept is to combine the propulsion advantages of a single hull configuration with the life-saving advantages of a double hull configuration. This becomes possible if we consider the RRS as a vessel with two separate directions of motion (fig. 7).
The Boomerang is a small and relatively light craft, about 2.5 m long and 1.2 m wide when operative, which can be stored in a more compact configuration, entirely folded on itself thanks to a rotary joint in the middle (fig. 8). Figure 9 shows the main components:

- Part 1 represents the single hull and contains (together with Part 4) the internal combustion engine and the hybrid module;
- Part 2 constitutes the survival capsule: the protected environment created in the middle of the vessel to host the rescued body;
- Part 3 is the double hull, essential in the rescue procedure, to stabilize the craft and protect the rescued person;
- Part 4 contains the system sensors, a communication interface and first-aid instruments;
- Part 5 is a strong arch with different purposes: the main is structural since it facilitates closing the craft and the rescue procedure; it also represents the extraction device, being equipped with a "skyhook" mechanism to pull the RRS out from the water with the rescued person inside it. On this arch there are also cameras and antennas.

The rescue system constitutes the most complex and important part of the Boomerang concept. The two red semi cylindrical shapes are floating bodies which can rotate around a peg placed at their base and connected to the single hull. When the RRS is deployed, these stabilizing hulls are rigidly blocked in the horizontal position. They also form a protected environment in which the rescue can take place. Between the two hulls there is a flexible net, mounted on a rigid frame (both represented in black). The frame is not fixed to the two red floating hulls but can rotate independently thanks to two cables passing over the central arch and reaching the front shield (Part 4) where an electric motor regulates their length and tension. The RRS reaches the victim in propulsion mode, therefore proceeding with the single hull ahead. Once the body is close, the boat quickly turns and starts approaching the victim in reverse, from the side of

7 *Schematic working motion of Boomerang solution*

8 *3D render of final concept, closed in the storage position*

9 *3D render of the Boomerang*

10 *Engine and jet drive of a Personal Water Craft, our ideal propulsion solution*

the two red hulls. At this point the central black net is lowered into the water so that the RRS can gently take hold of the body with a slow backward motion. When the body is in the net, the two cables pull the net upwards to the original horizontal position and the victim is safely placed in the survival capsule. Here the body is protected and secured to the vessel. An engine liquid cooling system regulates the temperature of the soft bed of the survival capsule, helping the victim to fight hypothermia. In this compartment all the interfaces to for interaction between the control center and the victim are also installed, as well as a first aid kit, ready to be used if needed.
The device is powered by an internal two-cylinder, two-stroke combustion engine. The propulsion system is a jet drive which guarantees safety and the possibility to move in every direction. This very compact engine has a huge amount of power at very low purchase and operating costs. It is also easy to manufacture and install since it is already available on the market and no particular expertise is required to maintain it (fig. 10). A smart hybrid module was added to this engine. It consists of a set of batteries to store the electrical energy produced by an electro-mechanical drive unit coupled with the flywheel. It is therefore possible to drive the jet with zero-emissions (considerably increasing the operating range and time) which is particularly useful when the device is forced to navigate at low speed in the return phase to the boat or run the electrical rescue equipment.
The Boomerang concept is controlled from a distance by a team of experts on land or on a rescue ship. In any case, it is essential to guarantee a continuous flow of video and sensor data from the onboard systems of the device. Concerning positioning and video assistance for remote craft control we believe it should be initially equipped with:

- GPS system, an emergency beacon such as *Satellite3 406 Cat II 406 MHz* (produced by *ACR Electronics)*;
- A normal video device;
- A thermal-imaging device, a camera working with infrared wavelengths;
- A night vision device.

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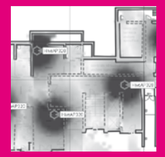

Willchair

willchair

PROJECT 9

REINVENTING THE WHEELS... INTO WILLS

Willchair
Reinventing the wheels... into wills

project 9

WillChair involves ASP students, producers and end users in developing a new generation of electric wheelchairs integrating high tech with user centered design

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PROJECT DESCRIPTION

The scope of the willchair project, from its very beginning, was left intentionally broad and unfocused aiming at having the students find their way in the complex world of assistive technologies for mobility impaired people. Students have been encouraged to apply a *User Centered Design* approach in order to change the project paradigm starting from user needs rather than market requests. The complex context of disability is characterized by the presence of different players around the end user, e.g., National Health Service, care providers, assistive technology producers, hosting facilities as well as user relatives and assistants. Starting from the Sim-patia case study, Fumagalli competencies, Infosolution technological advice and involving users, the three teams have applied the user centered approach focussing on completely different aspects of the multifaceted willchair challenge.

Wheelchair procurement and the social network around this event.
willchair.com is an online social network where the disabled can meet, share experiences, feelings and doubts, propose and consult ideas, find reference documents and discuss in forums. Via these activities each user contributes to fill in its own profile by answering interactive questions, participating in polls and contributing to the forum. Besides providing the user a sense of inclusion in *the* willchair.com *community*, the network has an uncommon value for the care provider when used to supplement the evaluation of the medical specialist and for assistive technology producers and suppliers, furnishing them with reliable data about the disabled population and its demands. This opens a new business model where user provided information becomes the new common driver for all players involved.

Interaction with the wheelchair itself and architectural barriers.
Clever is a foldable manual wheelchair for both indoor and outdoor use with specific propulsion aids. In its design, user requirements regarding lightness and foldability have been taken into account together with bio-mechanical requirements concerning manual propulsion efficiency. User desiderata have been accomplished by

the design of a manual wheelchair, rather than an electric model, with a foldable and lightweight frame. Bio mechanical requirements have been achieved by the design of an integrated, lever-based propulsion system. The novel lever system makes it easy to overcome obstacles, provides various ranges of speed and higher bio-mechanical efficiency while maintaining user acceptance.

Interaction between disabled people and a residential building hosting them.
bSafe aims to provide a technological platform able to automate and support different activities in nursing homes for disabled people. The aim is to solve specific needs of all those involved (e.g., care providers, medical staff, the disabled, relatives, rescue personnel, etc.). bSafe can operate in two particular configurations. It provides support to the disabled, operators and visitors in completing normal actions, such as environmental control, asset location and information flow management. It is able to manage emergencies in an efficient way, supporting rescue procedures and helping in coordination of rescuers, medical assistants and the disabled themselves. The common factor of these two services is the technological capability of knowing the location of people inside the building and delivering this information by means of ad-hoc devices targeted to specific abilities.

What's next? According to the user centered design approach, the expected evolution of these concepts should be the creation of a prototype for iterative refinement in field, receiving feedback from actual users until the process converges. This, however, has been intentionally left for future ASPers.

will project 9A

b|SAFE

ABSTRACT

Often disability is not an individual issue. There are contexts where disabled people live together in residences, assisted by qualified staff. In these cases, there are particular needs, mainly arising from the disproportion between the number of medical assistants and disabled people.

The b|SAFE project is an integrated system for indoor localization which provides added-value services for all the players involved in a residence for disabled people and supports rescuers and medical assistants in managing emergency situations. This is possible by exploiting technologies that nowadays are low cost and reliable, such as WiFi networks for instance.

b|SAFE can operate in two configurations. In the first one, it provides support to the disabled, operators and visitors in completing everyday actions, such as environmental control, asset location and information flow management. The goal of the second configuration is to improve emergency management: the system simplifies and speeds up rescue procedures, supporting and coordinating firemen, medical assistants and the disabled themselves. The common factor of these two services is the technological capability of knowing the position of people inside the building.

In order to define the concept, the team completed the following activities: at first, we carried out a number of field interviews in order to understand the context of a residence which hosts disabled people. Through brainstorming, the team identified the specific needs and produced a list of appropriate requirements. With the help of techniques used in user-centered design, these requirements were contextualized in different usage scenarios. At this point, after taking into account various localization technologies, the existing regulations concerning rescue procedures and interface design, we identified WiFi technology as the solution for indoor localization, provided guidelines for interface design and produced a hazard analysis in order to study the effect of possible faults.

TASKS & SKILLS

Stefano Baglio worked mainly on the technological part, providing a complete and in-depth benchmarking on localization technologies, useful to define technical aspects related to positioning issues. He also played a key role in studying failure effects in the system.

Giancarlo Mantovani provided his contribution in integrating heterogeneous features of the b|SAFE application, following all project aspects from a horizontal point of view. His support was crucial in applying methods for translating user needs into technological requirements and in completing the hazard analysis.

Edoardo Serpelloni completed many field interviews, collected a large quantity of information from all the players involved in the b|SAFE project; not just the disabled but also those assisting them. His work has been fundamental to understand which user needs were to be transformed into solutions.

Irene Taurino provided her contribution mainly on aspects concerning the interaction between disabled people and the environment they live in. She made fundamental research on interface design for disabled people, devices and techniques used to improve their life style and evacuation procedures during emergencies.

b|SAFE Our purpose, their wellness

1 *Project logo*

2 *Sim-patia, Valmorea (CO)*

3 *Concept functional specification table: it is a list of users' needs coming from interviews and brainstorming*

b|SAFE Concept functionality	E	N
Localization of assets and devices, such as wheelchairs, disabled, medical assistants, smartphones, etc...		
Autonomous displacement of wheelchairs toward meeting points, for people with high cognitive disabilities.		
Possibility for operators to decide whether or not to activate the automatic functions of the wheelchairs.		
In case of emergency, the possibility for the operator to speak to disabled people in danger, with the goal of calming them.		
The possibility to indicate to the disabled people a dangerous situation. The system is developed in order to face different kinds of disability.		
Possibility for some disabled with certain kinds of disability to contact other hosts inside the residence.		
Possibility for some disabled to carry out actions on the environment, such as opening/closing windows, doors, non hazardous household appliance.		

Concept functionality: short description of what the system should do
E : Concept functionality is available in emergency situations
E : Concept functionality is not available in emergency situations
N : Concept functionality is available in normal situations
N : Concept functionality is not available in normal situations

UNDERSTANDING THE PROBLEM

The problem of disability is very complex. Disabled people have the right to be involved in community life with a minimal number of barriers. Sometimes a disabled individual is affected by more than one disability (visual, hearing, speech, cognitive and mobility impairments). As a result, different types of actions are needed to achieve complete integration of disabled people in society in general.

The difficulties the disabled have to face in everyday life may be amplified by the disproportion, in number, between disabled and those who assist them. The aim of the team was to design, in the context described above, a concept that solves specific needs of players involved, not only the disabled. On the one hand, b|SAFE aims to help the disabled and medical assistants in everyday life; on the other, it aims to improve emergency management.

Finding a solution to this problem was a stimulating challenge since we had to cope with many variables, such as for instance the variability in disabilities affecting people, the limited number of medical assistants or the differentiation of player interaction in a context such as a nursing home.

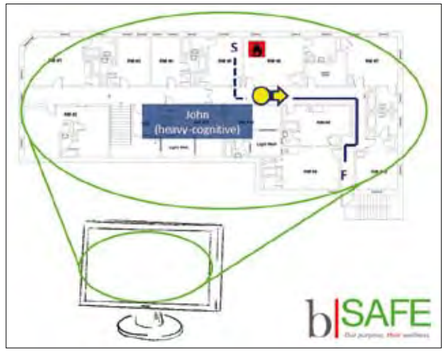
EXPLORING THE OPPORTUNITIES

Once the context had been defined, we started deepening our knowledge on nursing homes and the needs of those involved. Firstly, we carried out a number of interviews in field at Sim-patia, a residence where disabled people live and are assisted as well as being one of our stakeholders. From this phase, we understood that, as far as everyday activities are concerned, there are many unsolved requirements, such as for example the possibility for the disabled to control the environment (opening windows, shutters, doors, etc.) or for visitors to be more independent inside the building. At the same time, we noticed different needs in emergency situations. For instance, Sim-patia does not have any special system or infrastructure to cope with emergencies but follows standard procedures which, in most cases, have a low percentage of success. The awareness of this fact encouraged us to consider an innovative solution to improve rescue effectiveness which could also be used in everyday life.

The abovementioned interviews led us to write a *concept functional specification table* which is a list of requirements that may not have an answer on the market in terms of products or services. This helped in formalizing the complexity and breaking down interviews and brainstorming.

In order to set these functionalities in conceivable contexts and to identify sub-problems inside the main issues listed in the concept functional specification table, we decided to use

4 *Image from the storyboard: an operator rescues a disabled person during an emergency*



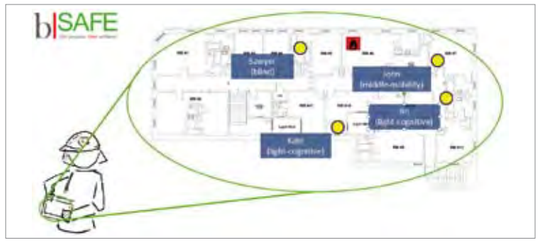
5 *Operators interface for the AutoDrive functionality*

6 *Visitor interface: instructions on how to reach a friend inside the building*

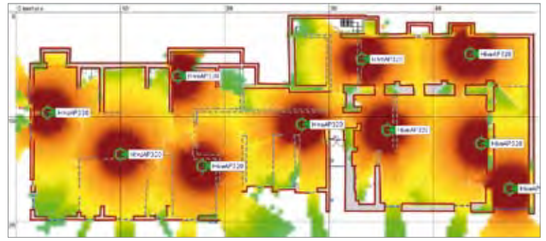
a technique called *personas*. Personas are archetypal users of a system representing the needs of larger groups of users with similar requirements.
Starting from these personas, we further analyzed the usage scenarios of our concept, producing six *storyboards*, namely six groups of illustrations showing events involving devices and functionalities of our system. The storyboards show that the system can work in two configurations. In the first, it provides support to the disabled, operators and visitors in completing everyday actions, such as environmental control, asset location and information flow management. In the second, the system supports rescuers and medical assistants in managing emergencies: it allows operators to contact the disabled in order to calm them, it helps rescuers by showing the position of disabled people in danger and it enables autonomous dispatch of wheelchairs in cases of severe-cognitive disabilities. The common factor of these two configurations is the technological capability of knowing the whereabouts of people inside the building: we thus understood that b|SAFE had to be based on the key issue of positioning.
According to these functional specifications, technological requirements were defined (e.g. 1-3m accuracy in determining position, soft/hard real time requirements in data transfer, etc.). These specifications were the basis in defining the b|SAFE concept.

GENERATING A SOLUTION

Starting from requirements obtained from user need via the process described above, we completed a benchmarking phase and subsequently worked on the b|SAFE application.
Benchmarking concerned three different sectors: an in-depth analysis of localization technologies, exploration of regulations and procedures to be followed during emergency situations and, finally, some research on how to design an interface for disabled people.
Benchmarking on localization technologies provided two important aspects: the technologies available on the market and the indicators to compare them. For instance, important indicators for the localization system are the real-time issue or the accuracy of location data in terms of distance. Once the research was completed, we compared the requirements defined by the storyboards, namely technological specifications arising from user requirements with the indicators characterizing different localization technologies.



7 *Firemen interface: position of disabled people in danger during an emergency*



8 *Access Points strategic placement*

This process led us to choose the technological features of the b|SAFE system. For determining position, we chose a WLAN-based centralized system able to manage localization data and device communication. This technology guarantees respect of constraints, flexibility in terms of integration of new access points in existing infrastructures, compatibility with devices able to connect to WiFi and a unique architecture for both positioning and data exchange activities. A reliable emergency power supply (UPS), a secondary control room and a mesh network option are also expected to provide redundancy in case of possible failures caused by emergencies. All requirements are satisfied by room-level location accuracy. This choice delegates fine positioning tasks (mainly required for activities such as autonomous wheelchair dispatching towards safe meeting points) to wheelchair onboard devices. This led to performance enhancement concerning navigation quality, security and emergency management.
An important task in designing the system was to determine the position of access points inside the building to ensure a certain level of coverage in each area of the environment, even in the event of a number of failures. A hazard analysis was completed in order to understand the effects of failures regarding access points and other parts of the system.
Once the technological architecture was defined, we used information collected from the benchmarking on evacuation procedures and interface design for disabled people to define other important features of the b|SAFE system. In order to provide an appropriate level of detail, for every scenario described in the storyboard, we focused on a single disability to provide a solution for the user interface and procedures to be followed during an emergency. Repeating the same process for different disabilities, it is possible to integrate interfaces and define rescue procedures for these new conditions.

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chair project 9B

Willchair.com

ABSTRACT

The '*willchair.com*' project comes to life with the purpose of filling the gaps present in the actual system of wheelchair prescription, supply and purchase, in order to allow a disabled person wishing to buy a wheelchair to fulfil their real desires and needs. Nowadays, the disabled are often compelled to face a series of problems and obstacles (alone or helped by parents or care providers) due to the limits of the actual system which prevents them from obtaining a wheelchair really suiting their needs. Therefore, the idea is to create links among the various realities involved in the system, connecting them to the final user, that is the disabled. The three main players which interact (directly or indirectly) during this process are the National Health Service, organized into a network of Local Health Authorities (called ASLs), wheelchair manufacturers and suppliers and the community of practice, formed by the disabled and other people involved in the system who decide to share their knowledge and experience, ideas and interests through the exchange of information (for example, in Web communities).

The conceived solution is '*willchair.com*': a bridge between the disabled and the overall system made up of the three players described above. '*willchair.com*' is a social network service in which registered users can not only communicate, share opinions and experience and inform and be informed but they can also suggest innovative ideas concerning the wheelchair world. These ideas, together with the needs and desires of the disabled, collected through a set of questions proposed to users on the website, are sold to interested wheelchair manufacturers in order to finance the service. This way, informed companies can design and create products, better satisfying market demand (namely, wheelchair users). Moreover, the information collected from each user is recorded in a personal form he/she can take to the doctor issuing the wheelchair prescription who is able to recommend the product which better meets the patient's needs and tastes.

In short, '*willchair.com*' is a circle (figure 3) connecting all the players of the system to the strict reality of the disabled, placing them in the centre at last.

TASKS & SKILLS

Gabriele Cepile studied the privacy policies and developed the '*willchair.com*' questionnaire, taking care of finding the appropriate way to communicate with disabled people. He also worked on the design of the website sections.

Enrico Mattiazzi met disabled people to collect their stories and experiences. He worked on the business plan, dealing with the feasibility and sustainability of the social network.

Devis Peressutti analyzed the state of the art of disabled web services. He studied the healthcare system in Italy in depth, looking for pitfalls in the system and for mechanisms driving bureaucracy.

Laura Piscicelli developed the design process behind the project. She also used her talent to design a logo for the website and to develop a web user interface which was easy to understand and use.

Wilbert Samuel Rossi organized the different sections of the website. He was responsible for improving connectivity and potential of the website. He was also active in meeting people working with disabled people.

UNDERSTANDING THE PROBLEM

Since the initial project phase and subsequently in all the following, a user-centred design approach was adopted. This makes the user, with his/her needs, desires and limits, the centre of attention and is aimed at optimizing the product to be created around him. In order to understand the real needs of wheelchair users and identify the deficiencies of the actual system, a series of interviews with disabled people, relatives and care providers to the disabled was conducted. This was also possible thanks to the collaboration of the external project institution, '*Sim-patia*', which manages an assisted residence for disabled people.

The first phase consisted of the comprehension of the context in which the disabled live and the ways this interacts with the system itself. In order to show the problems detected, the personas design tool (that is a representation of typical users through fictional characters) was used.

The result of this preliminary project step was the definition of a complete scheme of players involved in the wheelchair prescription, supply and purchase system and their mutual interactions. There are three main interacting players:

- the National Health Service (NHS), with a widespread distribution of ASLs on the national territory, which defines rules and procedures the patient must follow to obtain a wheelchair, as well as managing the delivery system;
- wheelchair manufacturers and suppliers which design, produce and provide wheelchairs, aiming to meet market demand on the basis of what little information has been collected on user needs and desires; manufacturers are connected to the ASL network through the figure of the medical specialist or orthopaedist, in charge of prescribing a suitable wheelchair for the patient, taking into account not only the medical aspects but also the bureaucratic procedures, often complicated, set by the NHS and the availability of a small selection of products according to contracts with suppliers and personal preferences;
- the community of practice, which is a place of active knowledge sharing and often a source of innovative ideas concerning the wheelchair world, is almost completely unexploited by manufacturer companies; nowadays, this community can interact with the manufacturer network almost exclusively via a service, called SIVA, provided by the non-profit organization '*Fondazione Don Carlo Gnocchi*' in its centres and on its web portal, aimed at informing the disabled and assisting them in the selection of the wheelchair most suitable to their needs and tastes.

This description highlights the principal limitation of the whole system: interactions among the players involved are often not effectively aimed at fulfilling the real needs of the disabled.

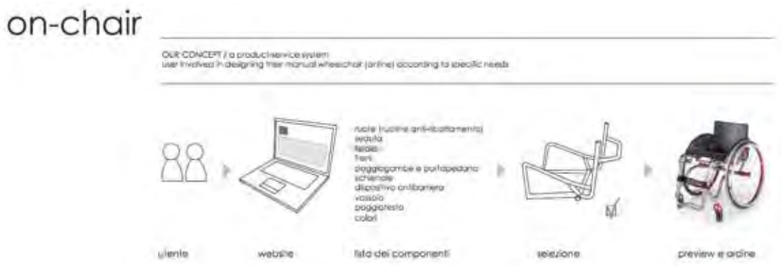
1 *Logo of willchair.com*

2 *Personas design tool*

EXPLORING THE OPPORTUNITIES

After defining the actual system with its gaps and limitations, the second step consisted of formulating the project requirements, according to the needs of disabled people and the goals of those involved in the system. In this phase, significant support was provided by the external project institutions, in particular '*Sim-patia*', and the wheelchair manufacturer '*Fumagalli*', which supplemented the information collected in international specialized fairs.

Initially, the main project requirement identified was to create



3 *Our first concept*

a service allowing direct interaction between wheelchair manufacturers and users in order to design new kinds of wheelchairs, completely customized by the user itself, thanks to the use of adaptable modular frames, innovative materials and features. Therefore, the first project idea was to create a web service in which the user could design and personalize his/her own wheelchair with the components existing on the market and, finally, buy it. This concept, however, turned out to have certain problems: there is no information concerning compatibility among items from different wheelchair models, the patient cannot obtain a complete refund in case unnecessary accessories are added to the basic wheelchair and, most of all, this solution does not involve all the three players of the system in the same way but rather focuses only on the relationship between wheelchair manufacturers and the community of practice. In addition, the SIVA web portal already partially provides a similar service, consisting of the possibility of looking up an on-line data base of available solutions (wheelchairs and accessories).

So, the second and final concept aims at meeting a wider requirement: to create a service permitting disabled people to interact directly and effectively with all the players of the system. This service is '*willchair.com*'.

GENERATING A SOLUTION

The '*willchair.com*' idea is to create a social network service tailored for disabled people, with the aim of linking the three main players of the overall system to the wheelchair user, fostering the circulation of useful information among them. The correct use of such information by each player can lead to a global improvement of the condition of social inclusion of the disabled and fulfilment of their needs and desires.

As the service creates a complex information network among the disabled and system players, it must perform different functions: to allow users to share and comment on opinions and ideas, to inform and be informed about the wheelchair world; in short, to take part in an active community of practice. But, at the same time, personal information about disabled people is anonymously collected from user profiles, forum discussions and ideas proposed and voted by users, with the aim of helping manufacturers create products more suitable to their needs and the ASL system to provide a better service to disabled people. This variety of functions is reflected by the division of the '*willchair.com*' site into three sections:

- a personal area ('*will me*') with the user profile and an attractive question wheel, which is reminiscent of the project logo and is the first means by which the user can fill in the profile itself;
- a community area ('*will us*') with an online chat, a forum where the user can share his/her experience and knowledge with the rest of the community and a space where ideas can be proposed and voted; moreover, questions, ideas and suggestions submitted here in specific frames or pop-up boxes can be commented on or voted and concur to complete the user profile;
- a medical area ('*dr. will*') in which the user can read and print a form containing all the useful information collected in the user profile and rearranged in a structured format, with the aim of helping the disabled to increase the awareness of his/her own necessities and assisting the specialist in selecting the most suitable wheelchair; here, he/she can also find important reference documents.

In addition to the structure and functions of the '*willchair.com*' site, the main aspects that were studied in order to evaluate the feasibility of the presented solution are:

- legacy and privacy issues, related to the collection and processing of sensitive user data;
- economical sustainability of the project, analyzed through a detailed business plan; in particular, the site is financed mainly by selling market analyses on user data to interested wheelchair companies;
- communication aspects and, in particular, the choice of an effective, engaging and delicate questionnaire format and a simple, clear and attractive graphical user interface, contributing to make surfing in '*willchair.com*' and participation in its community an agreeable, as well as useful and enriching experience.

4 *Actual vs. Will system*

5 *The SIVA portal, the service supporting evaluation provided by Fondazione Don Carlo Gnocchi*

6 *willchair.com Homepage*

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hair project 9C

Clever

ABSTRACT

The project focuses on people with different degrees of disability, from temporary difficulties in deambulation to diseases which permanently reduce mobility to the use of the upper limbs only. With a user-centered approach, i.e. interacting with the disabled and other stakeholders to collect their requirements, we came up with the design of *Clever*. This provides disabled people with more efficient mobility to maintain a degree of autonomy, quality of life and social inclusion as close as possible to that of the general population. The essential concepts describing the heart of our project are:

- *Attractiveness and Design*: user-centered design means attention to what the user wants and needs. A good-looking and convincing wheelchair would help the disabled person feel more comfortable and integrated in society. Important, in this context, is the possibility to retract the lever when not necessary and to customize the chair by choosing colours and materials.
- *Mobility*: this principle is strictly related to the objective of designing a wheelchair adaptable either to an indoor or an outdoor environment. Mobility means first of all *transportability*, implemented via a light aluminium structure with a collapsible frame and removable rear wheels. *Ease of movement* was therefore compulsory, achieved by the introduction of the lever itself, through the possibility of changing the front wheels depending on the type of use (large wheels for outdoor use, small casters for indoor areas) and a geared system able to adapt the transmission ratio according to the terrain conditions (uneven or downhill road, etc.). In the end the *comfort* needed to be guaranteed, in particular in terms of adjustability of seat cushions and footrests.
- *Health*: this "guideline" led us to the conception of a leveraged propulsion system, integrated on the wheelchair, to help the user reduce the effort involved in motion (+60% in mechanical efficiency) as well as achieving a more stable and upright position (as opposed to the continuously curved and swinging posture necessary when pushing on the classical handrims). Safeguarding user health is enhanced by particular attention to ergonomics (thanks to the use of orthopaedic backrests and cushions) and safety (achieved through brakes, an anti-tipping system and a resistant and stable frame).

TASKS & SKILLS

César Di Filippo is a student in Industrial Engineering and Management at the Politecnico di Torino and the team controller.

Eleonora Maggioni is a student in Biomedical Engineering at the Politecnico di Milano.

Michela Perrini is a student in Biomedical Engineering at the Politecnico di Torino.

Domenico Petrella is a student in Electronic Engineering at the Politecnico di Milano.

Francesco Rinaldi is a student in Mechanical Engineering at the Politecnico di Milano.

In order to develop our interdisciplinary skills and go beyond our own technical expertise, we decided to be collectively in charge of each phase of the project, under the supervision of the team controller and of the most knowledgeable of us on each specific topic.

UNDERSTANDING THE PROBLEM

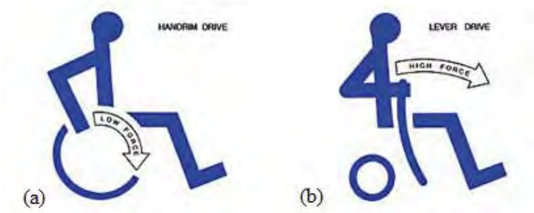
The objective was to design not only an innovative, technologically feasible and economically sustainable product but, above all, adherent to the needs of the disabled. For this reason, we applied a user-centered approach to the project [1]. We defined the project stakeholders and collected user requirements using different communication channels. Subsequently, these were summarised by means of the "Personas" method and translated into different types of requirements.

Disabled people were the central stakeholders of the project, surrounded by an environment of people and institutions interacting with them. Assistants, relatives and clinicians but also healthcare residences and wheelchair manufacturers can be considered as stakeholders. The involvement of each was investigated, studying the role of clinicians with a desktop research on biomechanics and physiology in manual wheelchair propulsion and considering two partners in the project, *Sim-patia* and *Fumagalli*, as examples of healthcare residences and wheelchair manufacturers respectively.

In particular, we focused on collecting the requirements of disabled people, the real users of wheelchairs. Their opinions were collected by visiting *Sim-patia*, research on Italian and international forums dealing with the issues of motion disability, interviews and questionnaires: the main need perceived by users was the necessity of lighter, more transportable and safer wheelchairs.

The biomechanical research was useful to detect the problem of excessive physical effort in traditional wheelchair propulsion. Moreover, other concerns that emerged were the physical diseases that can follow from prolonged use of a traditional wheelchair. The possibility of overcoming obstacles and use of the arms for extended periods with different kinds of propulsion system also emerged [3].

From the translation of needs into psychological, biomechanical and technical requirements, the overriding necessity turned out to be a system enabling disable people to overcome obstacles and reduce physical effort, without renouncing a manual wheelchair allowing them to use their own force for as long as possible.



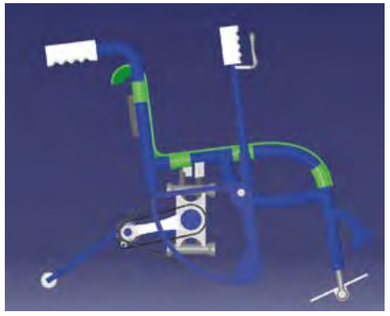
1 *The conventional handrim wheelchair propulsion do not use arm strength efficiently. (b) The lever drive system maximizes efficiency by allowing the arms to push along their optimal path throughout the entire stroke*

EXPLORING THE OPPORTUNITIES

We began to identify the opportunities in the industry the product will compete in. In the case of *Clever*, we will be competing in the wheeled mobility market. For this, we developed a competitive analysis based on Porter's five forces analysis. From the industry analysis we discovered that the market size for manual wheelchairs was quite high. According to industry lifecycles, manual wheelchairs are in the growth phase: it is a fragmented industry in which new entrants are possible. In particular, the largest market for wheelchairs is in developed countries.

Subsequently, a broad exploration of current market solutions was carried out. The analysis was focused on existing wheelchairs with at least one of the features we were interested in: lightness, pliability, hybridity (i.e. the possibility to change the type of wheels as necessary) and presence of propulsion aids. We found several wheelchairs meeting such criteria. These were used to understand the limitations and potential of the current market: we found a segment with some unmet needs which corresponds to products combining important characteristics such as lightness, pliability or modularity and ability to overcome obstacles. This analysis helped focus on the development of an in-

2.1, 2.2 *Front view of a 3D CAD model of the Clever, with particular attention to the (a) outdoor and (b) indoor configurations*



3 *Side view of the frame, with evidence on the leverage system and the anti-tip device*

4 *Clever logo*

tegrated product, a combination of a traditional manual wheelchair and a propulsion aid. Therefore, we proceeded with an in-depth comparative product research on the different kinds of propulsion aids existing on the market.
The range of alternative solution concepts was very broad in order to ensure a good solution in response to user needs. Nevertheless, we performed concept screening to reduce the number of concepts rapidly and to improve *Clever*. We compared them according to safety and usefulness. With this analysis, we attempted to understand the deficiencies of products with respect to potential user needs and to explain why propulsion devices are not widely used. Ranking of concepts referred to a measure of performance and system safety, together with size and weight: from this exercise it emerged that the safety profile and ability to overcome obstacles were greatest in those products not negligible in terms of size and weight. On the contrary, the lightest devices were not able to deal with any kind of obstacle. The conclusion was that there is a lack of products able to satisfy the criteria of lightness and to be able to overcome as many obstacles as possible. Therefore, it is necessary to find a compromise depending upon the disabled person's needs. For development of *Clever*, we focused on lever systems, a good compromise between the need to reduce user effort while increasing the ability to clear most hindrances, together with lightness.

GENERATING A SOLUTION

After translating the collected needs into product requirements and having explored in depth the current wheelchair market, we came up with the concept of *Clever*, a foldable manual wheelchair for both indoor and outdoor use, made of Aluminum-Zinc-Magnesium alloy 7075. It is easily transportable thanks to its light and pliable frame, with removable rear wheels. Its propulsion is improved by a lever system, integrated on the wheelchair, which can be retracted when not in use: it facilitates overcoming obstacles, has the possibility to go backwards and a different range of possible speeds [2], together with biomechanical advantages. Another benefit is provided by exchangeability of the front wheels which can be chosen small or large depending on indoor or outdoor use. Finally, outdoor movement is aided by efficient braking, suspension and anti-tipping systems.
In our understanding, the *Clever* wheelchair is advantageous for several reasons. Its exterior look, just like a normal manual wheelchair, would make it psychologically acceptable for a large proportion of disabled people; the lever system enhances the physical potential of the arms and facilitates outdoor movement; finally, the foldable and light frame facilitates portability of the chair.
The outcome of the research phase has been an important conclusion which actually turned out to be the real cornerstone of our design: even if at the beginning we intended our project to be a breakthrough in the wheelchair market, users represent a particular segment of the market that does not need stunning innovation. From the research on biomechanics and physiology in manual wheelchair propulsion, it emerged that, although users are often unaware of it, they need to improve their physical condition when dealing with wheelchairs [3]. *Clever* has an "incremental innovation" in an acceptable fashion, fundamental to improving the physical condition of the user. This is the result of a combination of perceived user requirements and the clinical necessity to safeguard their physical abilities and health.

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PROJECT 10

DigiLife

NETWORK ENABLED BUSINESS FABRIC

project 10

DigiLife
Network Enabled Business Fabric

Innovation in ICT is changing services, organizations and workplaces. By cooperating with Accenture, the project will analyze such scenario and its benefits

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PROJECT DESCRIPTION

The project identified an innovative solution aimed at satisfying the increasing demand for remote work services. The solution was based on an analysis of the academic literature in order to understand the evolution of different models in different periods. Instead of focusing on the (in some sense) trivial "work at home" paradigm, the project considered the needs of a growing number of "dispersed / mobile" workers (freelancers, creative workers and commuters) with intense communication needs (to and from their company and/or customers) which cannot be completely fulfilled by existing mobile technologies.
According to a multidisciplinary approach, the project took into account technological, organizational, social and cultural aspects, legal issues, advances in the telecommunications infrastructure and state of the art experience. After having analyzed all these different aspects, the team defined trends for the diffusion of remote work practices in Italy. The empirical analysis was based on case studies focused on novel aspects of remote working emerging in the last 2-3 years. Analysis of pilot experiences involving many employees in Accenture and Telecom Italia, based on interviews of both employees and researchers, added many useful insights. Following the analysis of case studies and European regulations, the team identified requirements (related to business models, potential users, expected effects on productivity and the role of technology) to be met, in order to satisfy the growing demand of applications for remote workers.

The last part of the project shifted its attention to the design a temporary workplace, available in public open spaces, combining an innovative workplace concept with new opportunities for supporting mobile workers. Such solutions satisfy constraints arising from communication habits and work organization in Italy and can be easily replicated all over the country, especially in locations where travellers spend many hours a day. In designing such solutions the team also focused its attention on the key factor that telecom operators might be interested in being a partner in such a system. The large scale diffusion of this kind of solution will probably take place in a few years, also because in recent years telecommunication companies are in search of new services. Future developments of the project will be focused on both diffusion patterns throughout Italy and the positive effects this might have on work productivity.

project 10A

_DigiLife_Network Enabled Business Fabric

DigiLife-Cell?
Network Enabled Business Fabric

ABSTRACT

The project goal was to identify an innovative solution to better satisfy the increasing demand for remote work services in Italy.
We started analyzing the development of remote working, also considering the social and geographical nature of Italy, legal issues and technology facilities and later moved on to examine the present situation. After having considered all these aspects, we defined the most likely and realistic trend of remote work in Italy. Thanks to interviews managed together with Accenture and Telecom Italia remote workers, we were able to understand the business and technical requirements. By analyzing several cases we learnt that there is an increasing demand for remote work services and companies welcome this trend since it increases worker productivity. Having understood the general trends, advantages and user requirements we considered the constraints due to 'Italian' communication habits and the work organization of SMEs.
To avoid the risk of being too general and widespread we decided to focus on a specific location (Milan) and to identify certain types of users (freelance and SME workers). In this way it was possible to concentrate on a particular social-cultural context and its dynamic life style.
Our solution is the "Cell" project: cells are temporary workstations in public open spaces provided by a leading Italian telecommunication company as a partner of entire system. This is a service offering rentable and mobile work modules which are individual and private but can be transformed into collective spaces when joined together. Our proposal is addressed to satisfy the needs of freelancers, creative workers and commuters and their increasing demand for a private place in which to work when in Milan for business or leisure.
One advantage of our idea is that it allows people to use their time more effectively and more productively. We decided to locate the modules in strategic public locations for people travelling within (metro stations) and to and from (airports, railway stations) the city. Public spaces offer an important business opportunity: they are a natural arena for advertisements. The choice of an Italian telecommunication company as provider benefits from its core knowledge and resources; in exchange it will benefit from visibility and new users of the service. Moreover, a service until today reserved only to an elite class of business people will be provided to a wide range of users.

TASKS & SKILLS

Andrea Bandini carried out part of the primary and secondary research, particularly concerning the legal and regulatory aspects. He also took part in the development of the scenarios and the final conception of the 'Cell' product.

Yong Han worked mainly on the primary and secondary research phases and, in particular, on organizing the document for the final report.

Deniz Ozgur worked on the primary and secondary research, concept development, and strategic design of the service and subsequently on the interior, exterior and communication design of cell modules.

Albert William Pozzi worked on the problem setting phase, the development of new scenarios and the definition of the final solution, always focusing on feasibility aspects. He also carried out the market and economic analysis.

1.1, 1.2 *Personal usage scenario of the work cell*

2 *Modules joint together, collective usage scenario of work cell*

3.1, 3.2, 3.3 *The modular interior furniture made of moveable and transformable parts allows a flexibility to user: The table moving back and forward on a rail with openable parts*

UNDERSTANDING THE PROBLEM

The goal of the project was to identity innovative solutions to satisfy the growing demand for remote work in Italy. In order to have a more realistic perspective on this issue in coming years, the team took the decision to act on a multidisciplinary basis by considering jointly the dynamics of telecommunication infrastructures (including prices, availability, etc), social and organizational aspects, legal issues, etc.
The analysis and design of future remote work application started from the review of academic literature focused on remote working in the last 30 years. Such review made it possible to identify stages of development, including how the nature of work and human behaviour has changed due to technological and organizational dynamics. It also gave the team a better understanding of the application issues, made it possible to develop feasible and realistic assumptions about the transformation of the workplace and showed how the speed of technological innovation in the telecom industry outpaced most of the forecasts and changed assumptions underlying past models.
The empirical analysis developed case studies focused on novel aspects of remote working emerging from recent trends. The team analyzed experiences in Accenture and Telecom Italia by interviewing both employees and researchers in these companies. After analyzing several case studies and European regulations, the team identified fundamental requirements (related to business needs, user needs and technical needs) for remote working in the next decade: it then shifted from the theoretical to the practical aspects of the problem in Italy. It highlighted social issues to be dealt with in Italy, such as external effects on productivity and work organization, the importance of face-to-face communication, etc. Talking to several users, we realized how the enthusiasm towards changing workplaces can make work more productive for companies and improve time allocation for employees. Constraints in the introduction of new work practices arise mainly from the Italian "communication" style and the work organization of SMEs.
The last part of the project was focused on the design of a new solution for remote working that could meet all the constraints and requirements pointed out in our work. Given the number and importance of travelling workers and the limitations of mobile telecommunication infrastructures and handsets, we focused on a solution that could be used by travelling employees

which is coherent with social-cultural conditions in a modern city like Milan.
In designing such a solution we considered detailed aspects such as the type of user (primarily freelancers or SME workers, but also students, travellers etc.), the importance of a "dynamic" life style (frequent travel, interacting with location and people but still continuing to work, etc), etc. As a result we discovered the "public space" as an area of opportunity in which, in current conditions, our user cannot find a private and comfortable space to work individually or collaboratively.
Within such a solution we also focused our attention on the role of "key players", such as telecom operators, which must take the lead in the development of a nationwide infrastructure (with appropriate pricing policies) and "local institutions" which must make space and other facilities available.

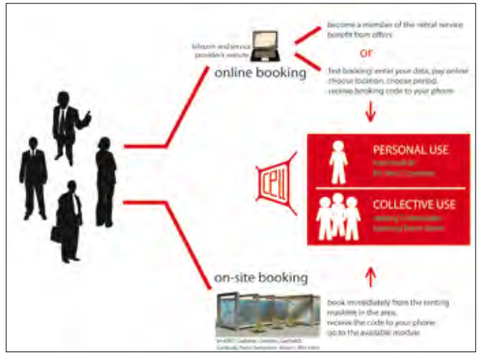
EXPLORING THE OPPORTUNITIES

As for the dynamic nature of work in our era and in the lives of our target users, people are in a state of adaptation and flexibility in the face of change from one position to another in an organic manner. Many people, especially the type of user we chose - freelancers, creative workers and commuters (SME agents, consultants, representatives, small studios) - can work anywhere but need more than just the capability to send emails. In this context, there are many opportunities for workers, enterprises and also telecom companies which require a new concept of "evolved mobility".
Up to now, the many developments in network technologies are producing rapid changes in the behaviour of inhabitants as parts of urban fragments: in particular, all solutions in the work area today use internet in such a way that people often become very isolated. As a result, from a social perspective, these developments improve people lives but also make them increasingly isolated. Furthermore, the increase in mobility and remote communication does not eliminate the need for face to face communication, as highlighted in the interviews.
In this environment, an area of intersection can be found in

4.1,4.2 *Construction sketches showing the architecture of the cell: generating simple solutions using the cad tools*

"public spaces" in the city which represent an interesting area of opportunity for functional and social reasons. Indeed, public spaces as a "city pattern" have the potential to link people with one another, enable flexibility along with mobility and increase productivity through social satisfaction as a source of inspiration. Furthermore, they can provide space and a better allocation of time during travel within (metro stations) and to and from (airport, railway station) the city by creating private spaces in the public area suitable for work activities.
In conclusion, public spaces can be used as a provocative and motivating area for working people to exploit their time more effectively and be more productive. As a business opportunity, public spaces have another dimension. Since they are open, visible and represent a cross road for inhabitants, they are a natural arena for publicity of related services. With these features, public spaces are another potential opportunity for businesses. **After having defined** two main themes - **"work in public spaces"** which links nature and technology and **"creative workstations"** which underlines the inspirational and transformable side of work - we focussed on possible solutions and decided on the idea of '***temporary workstations in public spaces'.***

5.1,5.2 *The work cell in outside environments*



6 *Offering our model as a business scenario for a telecommunication brand and the booking options of the service*

GENERATING A SOLUTION

What?
Our answer is the 'Cell' project which is ***a service of rentable and mobile work modules that are individual and private but can be transformed into collective systems when joined together.*** Indeed, one module is for one person and an additional person can be accommodated inside as a guest whilst, for larger groups, the separator between two modules can be opened and, thanks to, mobile tables on rails, the space becomes a meeting room for 4-5 people. Customers can rent the module for the required amount of hours either online (by becoming members) or directly at the workstation and receive a code on their mobile phone to gain access.
Where?
The location will be in certain areas in the city such as Cadorna, Garibaldi, Centrale (the intersection of the metro and the railway), Cordusio (close to business customers), Parco Sempione, Malpensa, Linate and Rho Fiera. Thanks to modularity, cells may be used in other event locations (such as Salone del Mobile or other exhibitions and career days) and are easy to transport, assemble and dismantle, always without destroying the city infrastructure.
Who?
As for the players, we chose an Italian telecommunication company as provider since it also has network resources: it will benefit from acquiring new customers and also visibility from investing in supporting "contemporary work culture" in Italy. On the other side are the users who will be able to work privately whilst still feeling part of the city, working and living with other people. In addition, collaborative work will be enhanced by the possibility of joining several modules together. In conclusion, since in Milan this kind of services, which provides work space, is only available for an elite class of business people in airports or hotel lobbies, we will also be able to support non-VIP workers and the temporary work culture which has a huge potential for the future of work in Milan.

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