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FP7-ICT-2007-2 | Project 223925

Validation report of the case study in Italy

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Short abstract	This intermediate report of WP8 describes the user validation activities for the Italian case study. An overview about developments and improvements that have been implemented according to the users feedbacks is given. The main focus is on the Lenvis' component named Health Impact Decision Support System (HIDSS): a framework able to: access to heterogeneous data sources (data bases, services, repositories of files, etc), integrate information among them, and provide users with a set of services related to historical and forecasted information about air quality and related health impact. HIDSS has been fully integrated within the Lenvis collaborative network and is on-line and working; the extended set of its functionalities is reported as well as the useful feedbacks provided by several professional and non-professional users. All the end users validation activities, already performed and planned, for 2011 are described.		
Keywords	Case study, applications, lenvis portal, user validation		
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COOPERATION

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Glossary and Acronyms

TERM	DEFINITION
API	Application Programming Interface
Business Intelligence	Computer-based techniques mainly devoted to provide historical and current business information and identify prediction of future trends. Main BI functions concern reporting, on-line analytical processing, statistical and data mining analyses and business performance management
Be	Benzene
CO	Carbon monoxide
Conditional Probability Table	Given two events A and B, the conditional probability of A given B is the probability that A occurs given the occurrence of B. For calculating conditional probabilities, is usually useful to report the probabilities (i.e., the frequencies) into a table (conditional probability table) related to each outcome versus each of the independent variables.
Confusion Matrix	A matrix computed to provide a summarization about performances of predictive or classification models
DAC	Data Access Component
Gadget	Dynamic web content which can be embedded on a web page. A gadget can be developed using the Google Gadgets API
HIDSS	Health Impact Decision Support System
HMM	Hidden Markov Model
Likelihood	Usually a function of the parameters of a statistical model stated as: the Likelihood of a set of parameter values given some observed outcomes is equal to the probability of those observed outcomes given those parameter values
Markov Chain	A mathematical model which describes transitions from one state to another among a finite set of possible ones: the next state depends only on the current state and not on the past. Markov chains have many applications as statistical models of real-world processes
NO_2	Nitrogen dioxides
NO_x	Total nitrogen oxides
O_3	Ozone
PM10, PM2.5	Particulate Matters
Query	A precise request for information retrieval with database and information systems
REPOS	A Service Oriented Reporting Business Intelligence tool developed by the lenvis partner ESA
SO_2	Sulphur dioxide
Web service	"*A software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically Web Services Description Language WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP (Simple Object Access Protocol) messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards*." (as defined by the World Wide Web Consortium, W3C)
Wrapper	Some software application or method able to call another one with the aim to perform some specific operations. Usually developed/used with the aim to integrate specific functionalities in other system avoiding code reimplementation

1. Introduction

1.1. Objective of this deliverable

The main objectives of this deliverable are:

- to report all the performed validation activities during 2010 and 2011.
- to present the improvements and updates, based on users feedback, to the technical achievements, in order to enable and sustain the exploitation of the Italian case study, as previously defined in Deliverable 8.1.

1.2. Objective of user validation

User validation of the Italian case study aims at demonstrating and spreading among different communities of users the usefulness of the several services provided by Lenvis network. In particular, for this case study, focus is both on environment and health related services for the cities of Milano and Bari, covering:

- historical and real-time environment data retrieval, integration/fusion and visualization, mainly for air quality.
- pollution level prediction based on simulation modeling
- warnings/alerts for pollutant thresholds violation
- evaluation of pollution limitation policies
- forecasting of hospital admissions, in the short term, according to pollutant level prediction

1.3. Outline of report

This document describes the validation activities carried on up to now and is articulated into 6 principal sections, including the introduction and the conclusion section.
The second section provides the general description of the Italian case study, including the problem description, users definition and their requirements (WP1), technical developments and validation (WPs 4 to 7), and the chosen strategy for user validation as described in D8.2.
In section 3 the application of the Lenvis products in the Italian case study is described.
The performed user validation is described in section 4, including the description of the user meetings and the received user evaluation feedback and recommendations.
Finally, in section 5 the a global analysis of obtained results is done. Section 6 reports some interesting conclusions.

2. Case study general description

2.1. Problem description

The wide urban area of Milan, which coincides with the Province of Milan, has a population 3,884,481 (2006) and is exposed to high levels of air pollutants all the year round. At present, the main air quality problems are represented by pollutants such as nitro-oxides and especially ozone, particles such as PM10, PM2.5 and hydrocarbons, such as benzene. It is established and reported in the scientific literature that there is a health hazard associated to some pollutants as, for example, particles.
The problem in the Bari's urban area is the same as in Milan with the difference that the main pollutant to be considered is high ozone concentration in some periods of time along the year. Moreover this area suffers of summer "heat waves" that can increase the health problems of a part of the population, typically the elderly component.

2.2. Foreseen contributions and products

Lenvis provides environmental and health related services useful for both cities of the Italian case study: Milano and Bari. We first report the *products* that environmental and healthcare stakeholders can adopt to be supported in their decision making activities, in both the cities. Then we specify the *contribution* of Lenvis for each one of the two instances of the Italian case study.

Lenvis products:

- warnings/alerts when a pollutant concentration is over the limit value mandated by law (according to DIRECTIVE 2008/50/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, of 21 May 2008, on ambient air quality and cleaner air for Europe, 2008),
- evaluation of the effectiveness of pollution limitation policies (through Markov-based Models),
- health risk map obtained by calculating the impact on health based on pollution level,
- hospital admissions forecasting, in the short term, depending on predictions of pollutant concentrations.

2.2.1. Lenvis contribution in Milan:

1. Statistical analysis of historical datasets related to air quality and hospital admissions: correlations pollutant-to-pollutant and pollutant-to-admissions (cardio-vascular and respiratory adverse events);
2. Evaluation of the "Ecopass" effectiveness through a Markov-based Model: analysis of Stationary Distributions for winter seasons form 2002-2003 to 2010-2011. In particular, it has been pointed out that probability to persist in a PM10 concentration level lower than the limit value mandated by law (50μg/day) increased with the application of the Ecopass.
3. Hospital admissions forecasting in short term based on a Markov-based Model learned from air quality and health data referred to the period November 2010 to April 2011.

2.2.2. The test case scenario in Bari

Lenvis contribution:

1. Models representing the relation between ozone concentrations and the occurrence of hospital admissions for respiratory diseases such as asthma, bronchitis, allergies etc., useful to forecast the environmental conditions which most deeply affect health. The results of such simulations, made available to public authorities, could be the basis to define better traffic management and air quality plans in the area.
2. Forecast simulations to supply warning messages about high ozone episodes and related effect on health in advance (48h for air quality info, 3-7 days for health information) to the population and local authorities. The results are available through the lenvis portal to public environmental and healthcare stakeholders.

2.3. Users and User requirements

Since the beginning of Lenvis design and development, several potential users, afferent to different communities, have been identified and involved as active part of the project (Deliverable 1.2). Their role has been - and is - crucial for developing, validating and improving all the Lenvis services. For the Italian case study, involvement resulted different according to the different user profiles:

- non professional users have been enrolled to compile questionnaires about usability and friendliness of the web portal and accessibility to the services,

- young non professional users (Y-generation) have been also enrolled to compile the aforementioned questionnaires in order to evaluate differences in acceptance according to the diverse "technology appeal",
- professional users, both healthcare and environment stakeholders, have been more deeply involved with direct face-to-face interviews.

The most important user requirements that were identified in Italy can be summarised as follows:

Professional users
- Provision of up-to-date localised environmental data;
- Meteorological and air quality models for forecasts and simulation;
- Health risk assessment models and indexes;
- Need for increased communication with citizens.

Non professional users (public)
- Information should be easy to find, without the need for downloading. This points to the need for customisable websites.
- Focus on advice or suggestion on what to do, in for example condensed and clear alerts.

A detailed overview of the user requirements found and the methods used to acquire these have been reported in D1.2

2.4. Technical validation

On the basis of the problems defined, the requirements expressed by the users and feedback of the user platform during the lenvis project, a number of application products have been developed. These include real-time or up-to-date data streams, domain and case study location numerical models for making predictions, lenvis portal gadgets and web-applications. Where appropriate these applications make use of lenvis technologies, such as time series data web-services, grid data web-services, localisation services such as gps, and portal registration and user profiling services.

In section 3 details of the application products developed for the Italy case studies can be found. Applications have been subject to technical validation by the lenvis project team, on the basis of user profiles and use cases. This work is part of WP7.
The user profiles and use cases have been defined in cooperation with WP8 case studies.

3. Case study application products

Unimib, together with partner MB (Municipality of Bari) will validate the lenvis component HIDSS (Health Impact Decision Support System), a framework that, through an uniform way to query heterogeneous data sources such DBMS, Web Services or structured text files, offers to the Lenvis user the possibility to predict, in the short term, the health effect (number of hospital admissions) on the basis of the current and predicted situation of pollution.
In the following figure is depicted the architecture of Unimib component underlying the data integration feature.

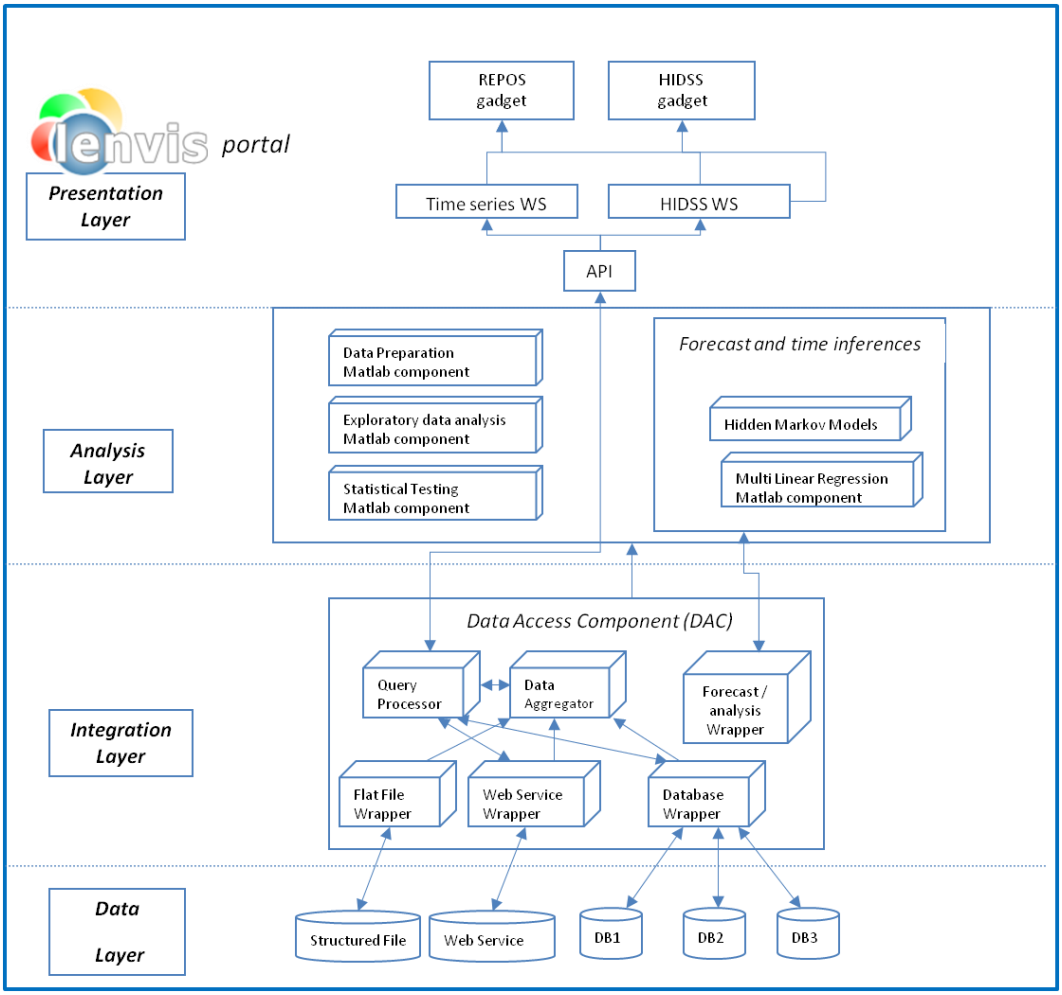


Fig. 1 HIDSS component architecture, Data sources access and integration

HIDDS has been designed to be used also as a basic infrastructure by other applications, like for instance Business Intelligence tools, to retrieve heterogeneous data of different nature and data series, like sensor measurements (e.g. environmental samples of different quantities), non-sequential data; e.g. people lists, clinical records, etc. The approach followed is to access uniformly heterogeneous data sources (the containers of such data), integrating them logically without modifying their content or structure.

3.1. Data streaming

The HIDSS exposes, through the Lenvis data time- series web-service, data regarding the two Italian case studies: health and environmental data of the city of Milan and Bari (for the description of their peculiarity, see the chapters 3.1 and 3.2 of the Deliverable 8.1).
All this data is being used by the HIDSS forecast gadget and is being archived by the SOBI REPOS to allow professional users to analyze it later.

3.1.1. Milan Use Case

In the city of Milan the examined environmental network consists of nine automatic acquisition and recording stations that continuously measure both chemical substances and meteorological quantities. The network of sensors has been deployed by the local environmental authority ARPA Lombardia (http://ita.arpalombardia.it/ita/index.asp).

Each of them is equipped with a variable number of chemical sensors in the whole city (some of them aren't actually in activity). Each sensor measures the concentration in air (in µg/m3) of one among: gas molecules C_6H_6, NO_2, SO_2 , CO, NO, NO_x; solid *particles* PM_{10} , $PM_{2.5}$, TSP (Total Suspended Particulate).

In the following figure 3, white circles are the locations of the pollution monitoring stations.

Fig. 2 Milan case study

Concerning the data to be related to the health risk, for the city of Milan we have initially obtained health data from:

- the Alee-ao project (hospital admission data);
- Italian Auxologic Institute (hospital admission data);
- Humanitas Clinical Institute (emergency admission data);
- Emergency hospital admissions "118". During the last year, a new database containing the daily number of first aid missions for cardiovascular and respiratory diseases has been obtained by Azienda Regionale Emergenza e Urgenza (Regional Agency for Emergency and Urgency, Milano 118).

A description of this data is provided into deliverable D6.4 and summarized in the following table:

Table 1. Health data collected.

City	Hospital	Type of data	Contents	Period
Milan	ALEE-AO project	Hospital admissions	patient ID and pathology	1st January 1998 – 31st December 2009
Milan	Italian Auxologico Institute	Hospital admissions	patient ID and pathology	1st January 2005 – 31st June 2008
Milan	Humanitas Clinical Institute	cards acceptance of first aid (emergency admissions)	patient ID and pathology assigned to the triage nurse	1st January 2004 - 31st December 2009
Milan	Azienda Regionale	first aid (118 admission)	timestamp, number of admission for each	1st January 2010 – 30st April 2011

	Emergenza e Urgenza		pathology	

3.1.2. Bari Use Case

The Municipality of Bari has an air quality monitoring network currently consists of a mobile laboratory and 8 monitoring stations. The picture below represents the map of the Bari area with the arrangements of stations.

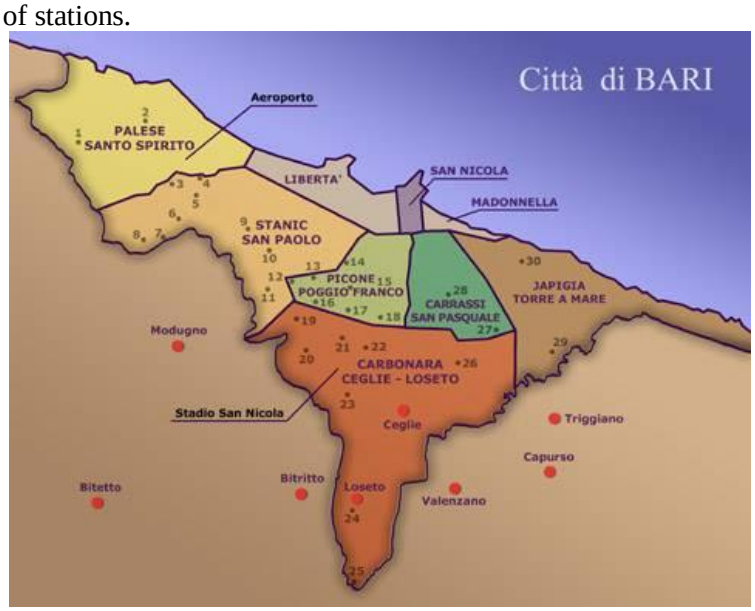


Fig. 3 Bari case study

A daily measurement of PM_{10} are available for each monitoring stations which are placed in different typologies of urban areas according to the prescriptions of the international directive.
The air pollutant monitoring section of Arpa Puglia web site (http://www.arpa.puglia.it/ReteRilevamento/Aria.aspx) permits to visualize at real time the air quality state for each monitoring stations; each point correspond to a station, the colour refers to an air quality scale.

3.2. Modelling applications

In lenvis a set of services is developed that, given the actual concentration of air pollutants, weather conditions and geographical locations of the emission sources, allows the forecast of the pollution concentrations in a given area for the next days. A relevant aim of the project is to leverage on-line environmental monitoring and simulation modelling into alerts during episodic pollution events, in order to inform people of the current environmental situation, to give warnings to health care providers about expected peaks in requests of hospitalization, to support public authorities in deciding which actions have to be carried out (e.g. prevent risks by reducing excess pollution and minimizing exposure, prepare hospitals to peaks of emergency admissions). The data produced by these services are used by HIDSS gadget system as soft sensors, i.e. virtual sensors that produce data for the future. Based on this data, HIDSS can provide health impact forecast for a longer period.

3.2.1. Air quality modelling

The Air quality system fully described in the LENVIS Deliverables 5.2 and 8.3.b consists of three different sub-systems:

1. *MM : Meteorological Model*. This is a system giving the description of wind, temperature, water content and turbulence fields in the atmosphere, in three dimensions and with a spatial resolution going down to three km (nesting).

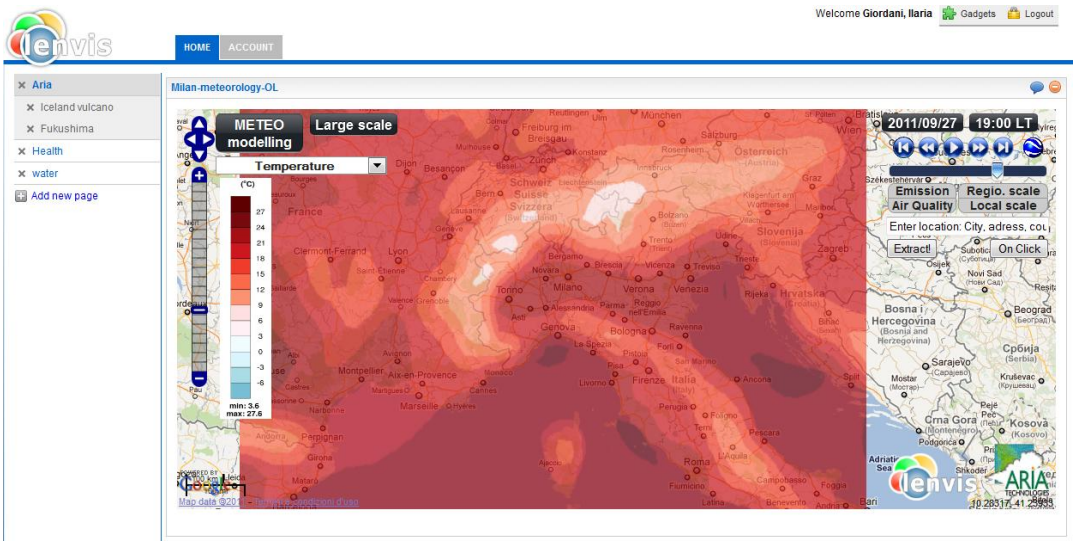


Fig. 4 Meteorogical model gadget

2. *EM : Emissions Model*. This is the subsystem where all emissions are compiled and organized in order to be ready to drive the chemical-transport Air Quality Model.

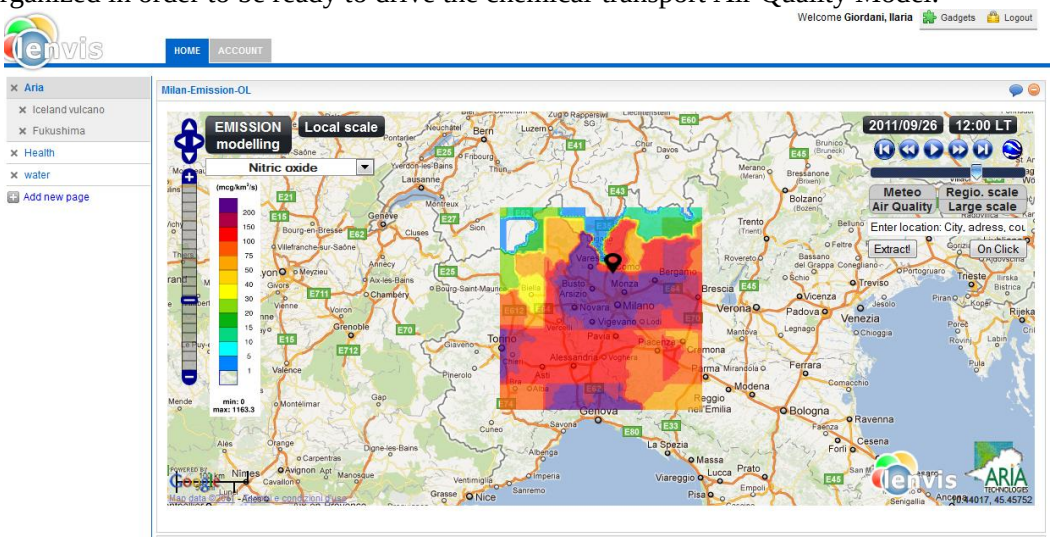


Fig. 5 Emission model gadget

3. *AQM : Air Quality Model*. This is the core system, using input from EM and MM in order to estimate 3D concentrations and 2D depositions for a complete list of substances (gas and particles) present in the atmosphere, taking into account the full system of chemical reactions and physical processes that can occur.

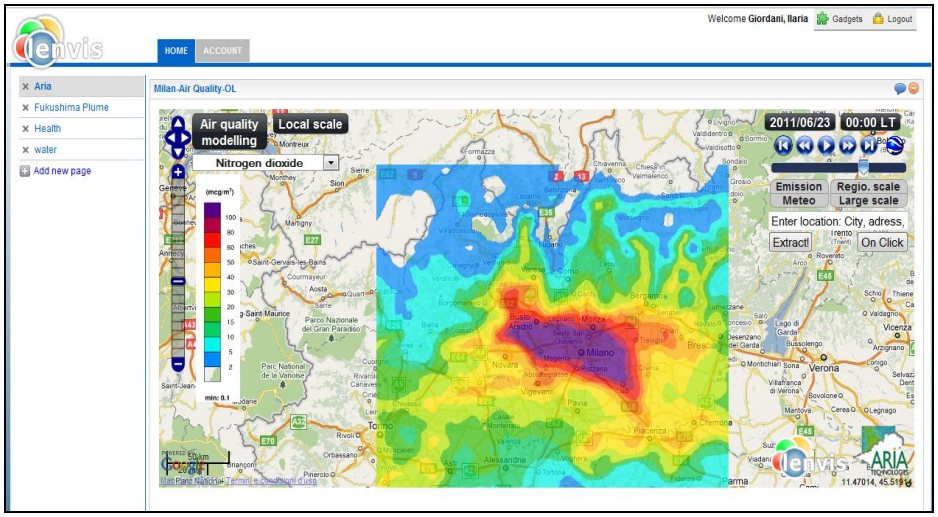


Fig. 6 Air Quality model gadget

The Air quality system has been configured for the simulation of meso-scale meteorological flows over the whole set of LENVIS case study over the Noord-Brabant province and Milan and Bari area.

General architecture for forecast

As presented in Fig. 7, Fig. 8 and Fig. 9 above, the meso-scale meteorological simulations respectively over NB province, Milan and Bari areas must start from a very large outer geographical domain, and proceed through the use of nested (Deliverable 5.1) domains down to the scale for which dispersion modelling can be efficiently applied..

Both the initialization conditions and the boundary conditions for a meso-scale simulation must be provided by a global scale model (covering all the globe). The NCEP in the U.S.A. (National Center for Environmental Prediction) daily provides 10 days of forecast free of charge the ftp connections to download sites, where data from the global model are available. The resolution is 1 degrees (about one grid cell every 100km), so that nested models must go from that resolution down to 3 km resolution.

In the time diagram below, the INPUT DATA to a WRF simulation are shown as a combination of “External grib” datasets (note that the output of global circulation models is generally encoded in GRIB format, a universal language-independent method to encode meteorological fields), and of “obs” the meteorological messages regularly provided on the World Meteorological Loop by every participating country for example. The diagram shows that the external forcing from NCEP/GFS is almost imposed every 6 hours. For the LENVIS sites global model outputs provided by NCEP every 3h in forecast mode are used. The sequence of programs Implemented also allows to do assimilation, in the present setup of WRF for LENVIS, no data assimilation was activated.

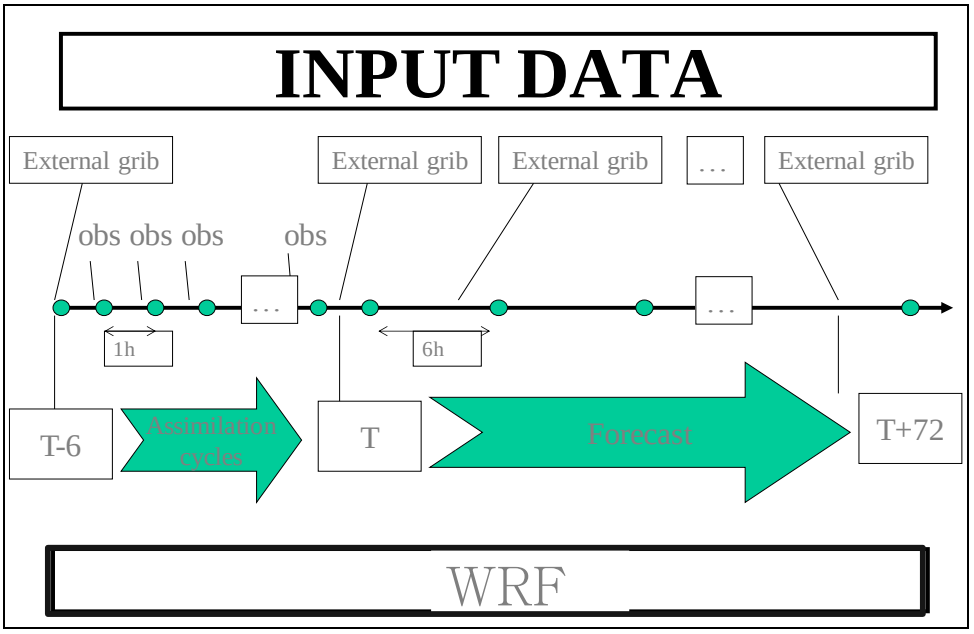


Fig. 7 Schematics of forecast data flow.

Another important feature evidenced by the figure is the existence of a « Spin-up » period, where the model runs without consideration for its output, so that the equations have some time to reduce the unbalances created by an obviously imperfect initialization. There is no golden rule to determine how long this "Spin-up" sequence must be. In the LENVIS, implementation a classical value of 12 hours is applied.

Configuration

In this section, we present choice performed for the WRF application over LENVIS case study (Milan and Bari Area).

For the present project, we decided to nest the WRF model to final resolution of 3 km. Even if the model doesn't run on 2-way nesting mode (cf Deliverable 5.1), a classical ratio of 3 is defined between each domain.

Milan and Bari area domains were respectively as evidenced in Table T1, T2 and figures 8-9 below, and the time step and domains were chosen according to our usual practice for mid-latitude simulations. The time step in seconds was taken typically as 6 times the horizontal resolution in kilometers. This is a recommended value given by the WRF developer (NCAR).

In the domain denomination:

- **LS** stands for **Large Scale**,
- **RS** stands for **Regional Scale**
- **LcS** stands for **Local Scale**

Table 2 Computational domains covered the Milan Area

Domain	Number of points	Resolution	Domain size	Time step
LS	55* 55	27 km	~1500 km * ~1500km	**120 seconds**
RS	55*55	9 km	~500 km * ~500 km	**40 seconds**
LcS	55*55	3 km	165 km * 165 km	**13 seconds**

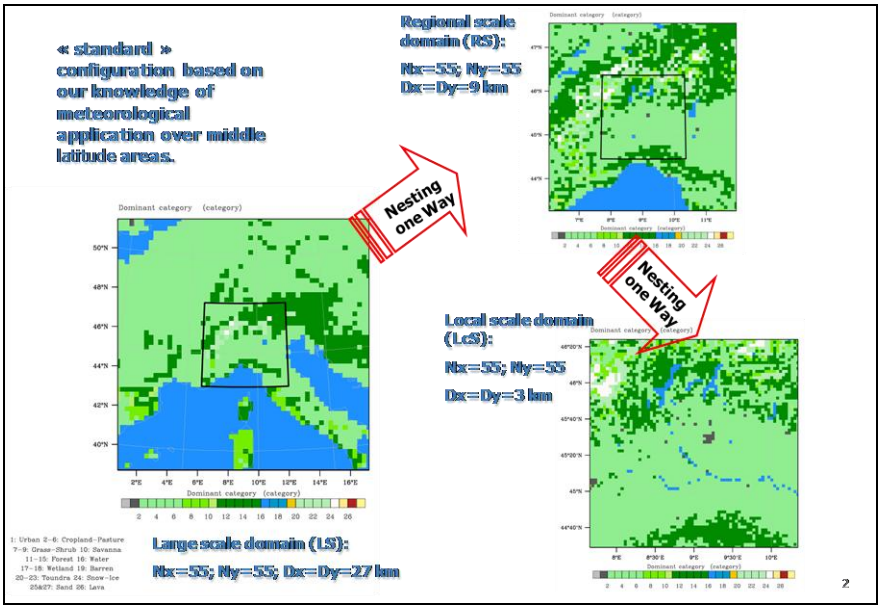


Fig. 8 WRF domains covered Milan province.

Table 3 Computational domains covered the Bari Area

Domain	Number of points	Resolution	Domain size	Time step
LS	55* 55	27 km	~1500 km * ~1500km	**120 seconds**
RS	55*55	9 km	~500 km * ~500 km	**40 seconds**
LcS	73*55	3 km	165 km * 165 km	**13 seconds**

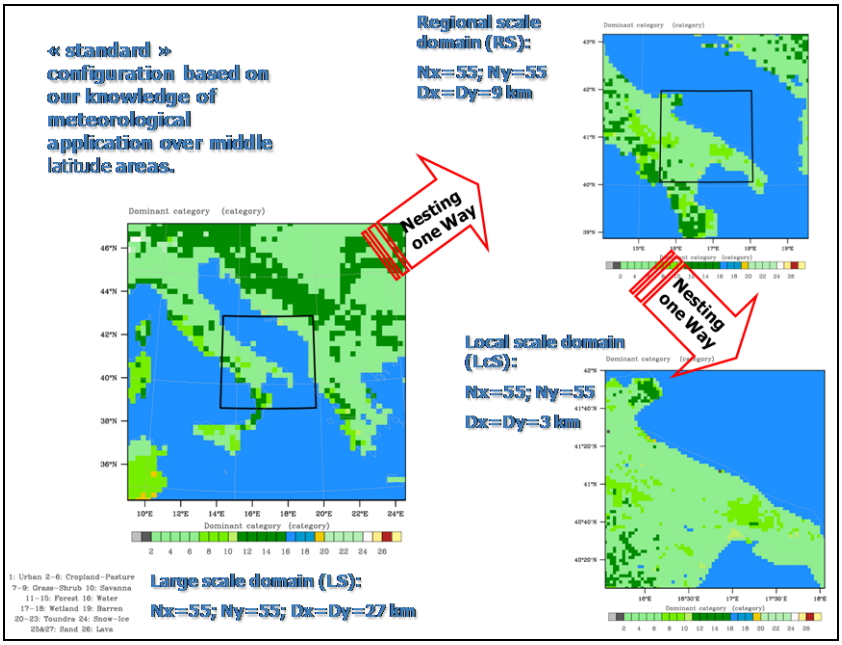


Fig. 9 WRF domains covered Bari Area.

Number of vertical levels, WRF comes with 51 levels as recommended by NOAA. The standard vertical distribution given by the NCAR has 37 layers and mainly dedicated to meteorological application. The NOAA vertical grid adds many layers in the boundary layer (from ground au 2000m in the middle latitude) which is critical for Air quality application. This parameter is likely to impact all of the results, as it has an influence on the numerical stability as well as the vertical heat exchanges from the ground to the atmosphere.

Both the Digital Terrain Model (DTM) and the land-use characteristics were extracted from the USGS-based database used by WRF, without specific refinements or corrections.

This choice is probably sufficient for topography and landuse, considering that we only reach a relatively low resolution (3 km),

Finally, The implementation has been done with “default” parameterization as given by the NCAR. this following set is supposed to work best in most of the cases for site in the middle latitude.

Emission model (EM)

This section and the next section only attempt to give an overview of the emission Inventory Implemented in the LENVIS case study.

Emission input data: Global Inventory.

The operation of AQM requires an emission inventory both at the Large Scale (LS) and at Regional Scale which must be derived (if possible) from internationally approved databases. The available emissions inventories at the global scale are generally limited to primary pollutants: CO, NOx (NO & NO2), SO2, VOC, NH3, PM10 and PM2.5 [RETRO: http://retro.enes.org/reports/D1-6_final.pdf; GEIA : http://www.geiacenter.org/].

Over Europe, the UNECE/EMEP continental emissions inventory gives you access to national total, sector and gridded emissions for the listed areas (Fig. 10), years, pollutants/activity classes

and total/sector categories. Several different type of data sets can be accessed: To fuel the AQM model the Emissions used in EMEP models are taken into account. Pollutants in the Emissions database are divided into four different groups:

- **Main Pollutants:** The main acidifying and atrophying pollutants.
- **PM:** Particulate matter: PM10, PM2.5, TSP.
- **Heavy metals**: As, Cd, Cr, Cu, Hg, Ni, Pb, Se and Zn.
- **POP**: Persistent organic pollutants.

In the EM model only Main Pollutant and PM are used. These pollutants are available over four distinct emission categories linked to the four sets: NFR90(http://www.ceip.at/fileadmin/inhalte/emep/reporting_2009/Rep_Guidelines_ECE_EB_AIR_97_e.pdf), NFR02(http://www.unece.org/env/documents/2002/eb/ge1/eb.air.ge.1.2002.7.e.pdf), NFR01(http://www.emep.int/emis2006/eb.air.ge.1.2001.6.add1.e.pdf), SNAP 1997. In the CHIMERE Model (AQM) SNAP categories are required as activity sector distribution.

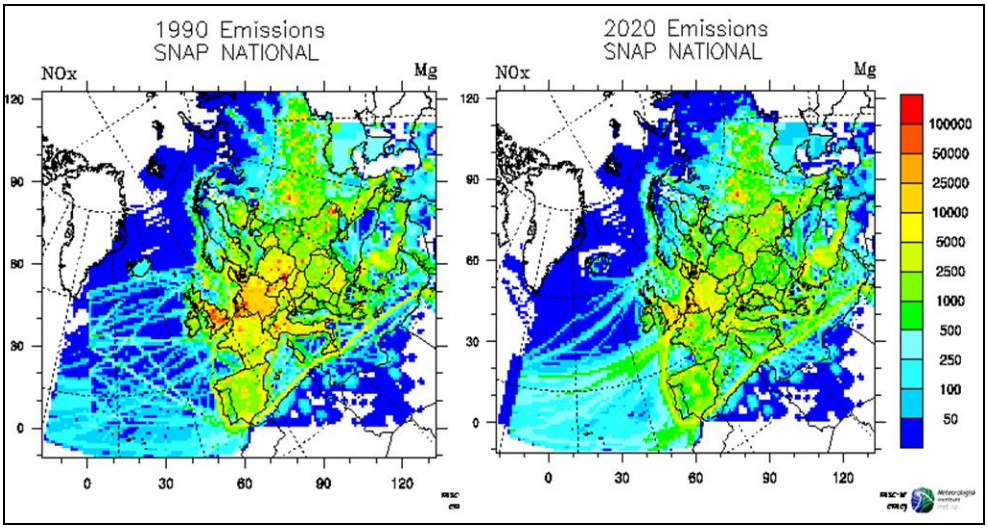


Fig. 10 Comparison of NOx emissions for year 1990 and 2020 (EMEP inventory).

Emission input data: local Inventory

1. Local emission Inventory over the Bari area
   The national APAT 2000 Emission Inventory will provide the basic information on the emissions at the local scale domain, namely Large Point Sources (LPS) and area sources (SRF). Standard ARIA Emission files (AEF) and related spatial surrogates, time modulation and speciation files will be provided to Emission Manager system (cf Deliverable 5.2) to derive diffuse (at the requested resolution, 3 km) and point emission files needed by CHIMERE chemical-transport model. All these Input Data became available during the E2SP project and used in the same context for the LENVIS project.

2. Milan area local emission Inventory
   Aria implement in the EM model, the emission inventory made available on the web with the precision of an Italian province (http://www.sinanet.apat.it/it/inventaria/disaggregazione_prov2005/database_provinciale/view). This is still better than EMEP. This inventory is quite detailed: surface emissions, with SNAP classification and all pollutants needed by the CHIMERE Chemical transport model (NOx, VOC, CO, SO2, PM10 and PM2.5). Nevertheless, a lot of polygons are still very wide face to the resolution of the AQM model over the last nested domain (3km).

AQM model

As detailed in the Deliverable 5.2, the AQM is based on the CHIMERE chemical- transport model.

Model result Presentation:

The MM, EM and AQM model daily run and produce 48h hour of forecast. The results are presented in maps. The, and the user can localise by zooming and scrolling the map, and the user can customise forecast period, forecast horizon, variables to display and type of animation. 3-D visualisation with topography in Google maps, allows can generate for showing intuitive animations that allowing professionals and public users to search results e.g. visualise the development of see an upcoming episode of SMOG developing event (Fig. 12, Fig. 13 and, Fig. 14).

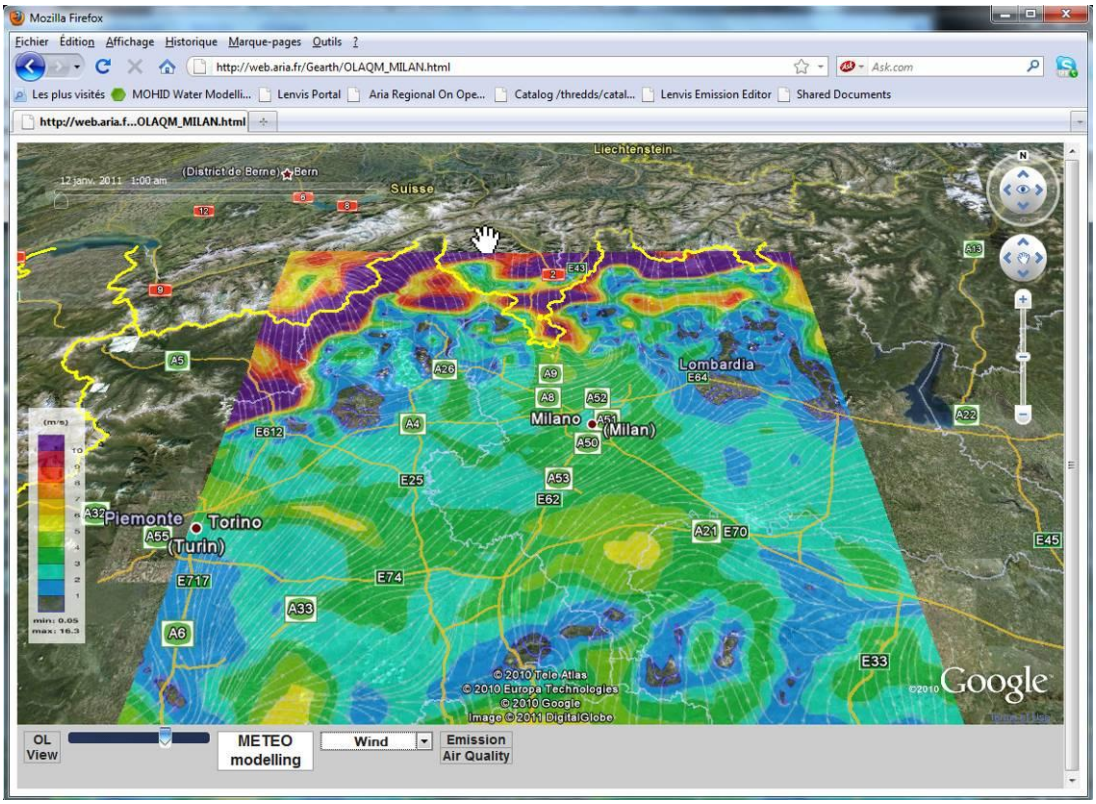


Fig. 11 aAir quality modelling in the Milan Area. Wind speed. Google Earth feature (Only supported by Chrome, FireFox and Internet Explorer).

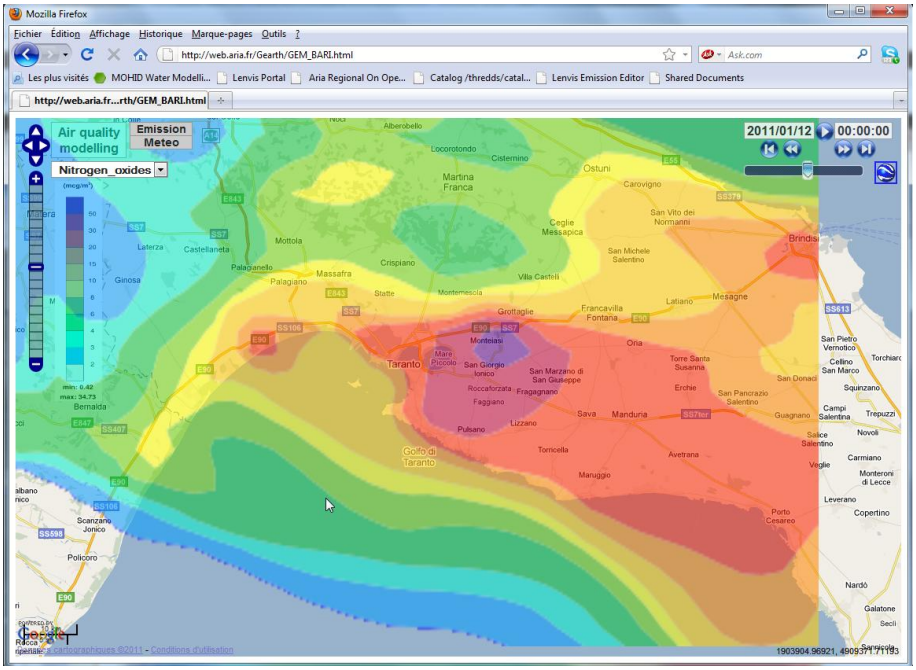


Fig. 12 Air quality modelling in the Bari area. Nitrogen Oxides (NOx) concentration. Open layer feature.

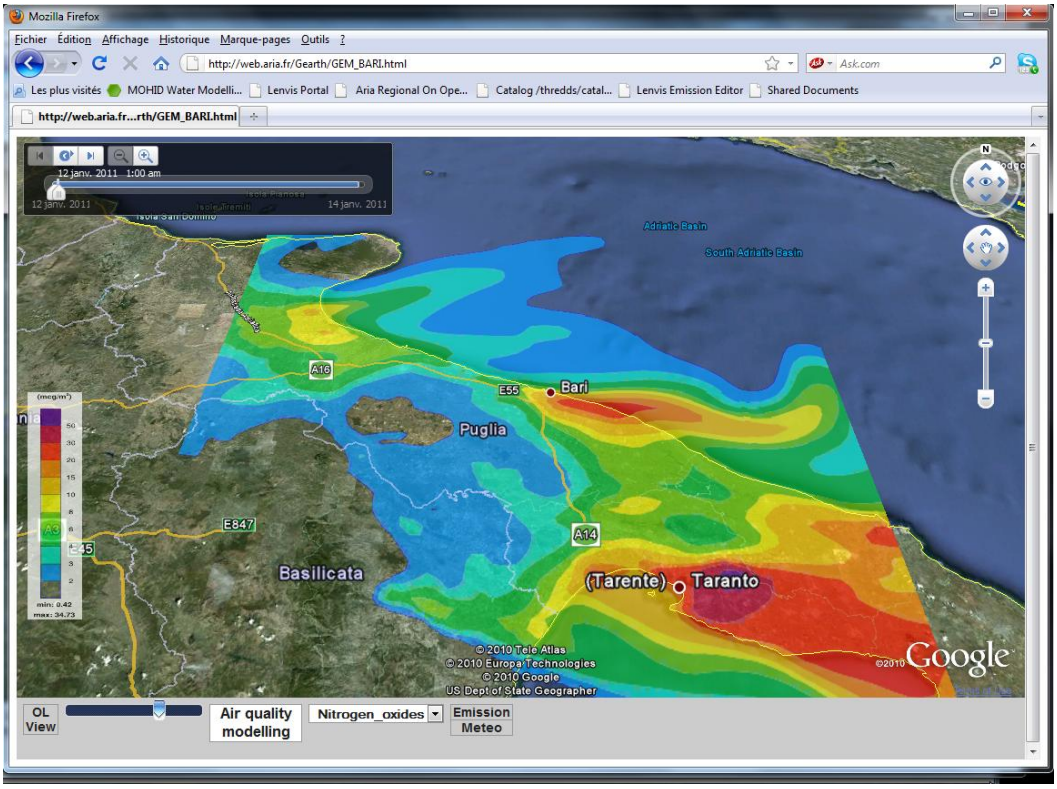


Fig. 13 Air quality modelling in the Bari area. Nitrogen Oxides (NOx) concentration. Google Earth feature (Only supported by Chrome, FireFox and Internet Explorer).

3.2.2. Health effect prediction

Unimib has developed HIDSS (Health Impact Decision Support System), a system for health decision support that through the use of a Data Access Component (DAC) provides an uniform

way to query heterogeneous data sources such DBMS (Data Base Management System), Web Services or structured text files processing environmental and hospital admissions time series making it possible to analyze them and assess their impact.

The influence of environmental factors on health risk has been the subject in the last years of intense research, in particular epidemiologic studies which pointed out estimations of the increased risk of morbidity/mortality according to daily pollution level or time of exposure. The WHO organization report points to a 0.11% increase in mortality (where cardiovascular or respiratory disease is the main cause of death) for a 10 μg/m3 increase in the daily average of PM10. While epidemiological studies are useful to support a posteriori evaluation over an extended period of time, Lenvis has a different aim: to fill the informational needs inherent with monitoring and forecasting very short term impact (1-5 days) measured in terms of hospital admissions. European directives mandate both structural and long terms improvements and short term decisions like temporary traffic limitations or warning some segments of the population.
The Health Impact Decision Support System within Lenvis can mine environmental and health data, in order to uncover patterns and correlations to use for providing health related forecasts and risk assessments. In particular a Markov-based Model have been trained from historical environmental and health data and then adopted to implement the forecasting. This model provides several advantages: supports environment agencies to design and evaluate emissions limitation policies, allows hospital managers to plan resources according to the predicted admissions trend (global intervention), help General Practitioners to predict adverse events and prevent patients hospitalization reducing costs while improving patient quality of life (local intervention).

A detailed description of the model has been provided in deliverable D6.4.

3.3. Service-oriented Business Intelligence applications

The HIDSS component has been integrated into the lenvis portal through two different gadgets: the HIDSS reporting gadget and the HIDSS forecast gadget, as it is described into the next sections.
In the first one, focalized on the visualization of historical time series data, permits the user to set online all the parameters for querying the system through dialog boxes, like those reported into D6.4.

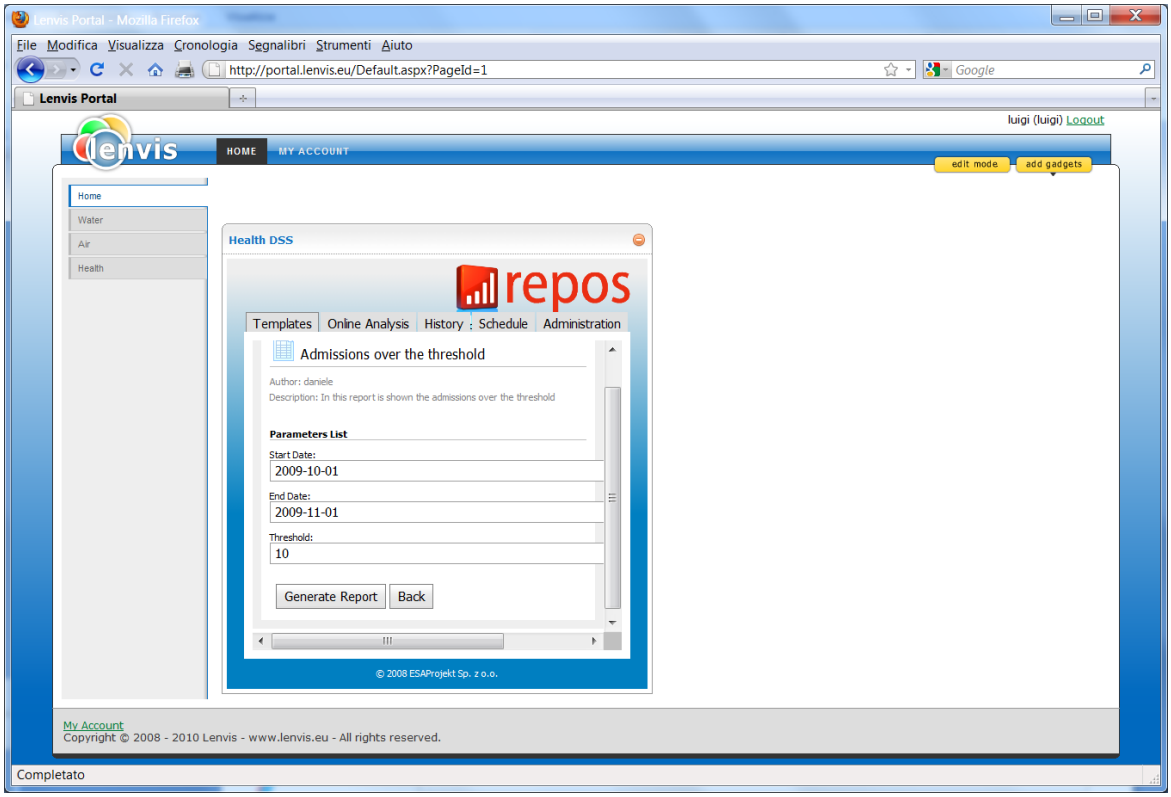


Fig. 14. Setting query parameters for the health modelling tools in the lenvis portal

Fig. 15 shows the output of the query, presented through a report that has been created dynamically extracting from the data services and modelling services the data that satisfy the query constraints.

Once a user introduces all the parameters in the relative boxes and submits his request to the system though the gadget, a results windows appears in to the gadget with the visualization of the data requested. An example is visible into the following figure.

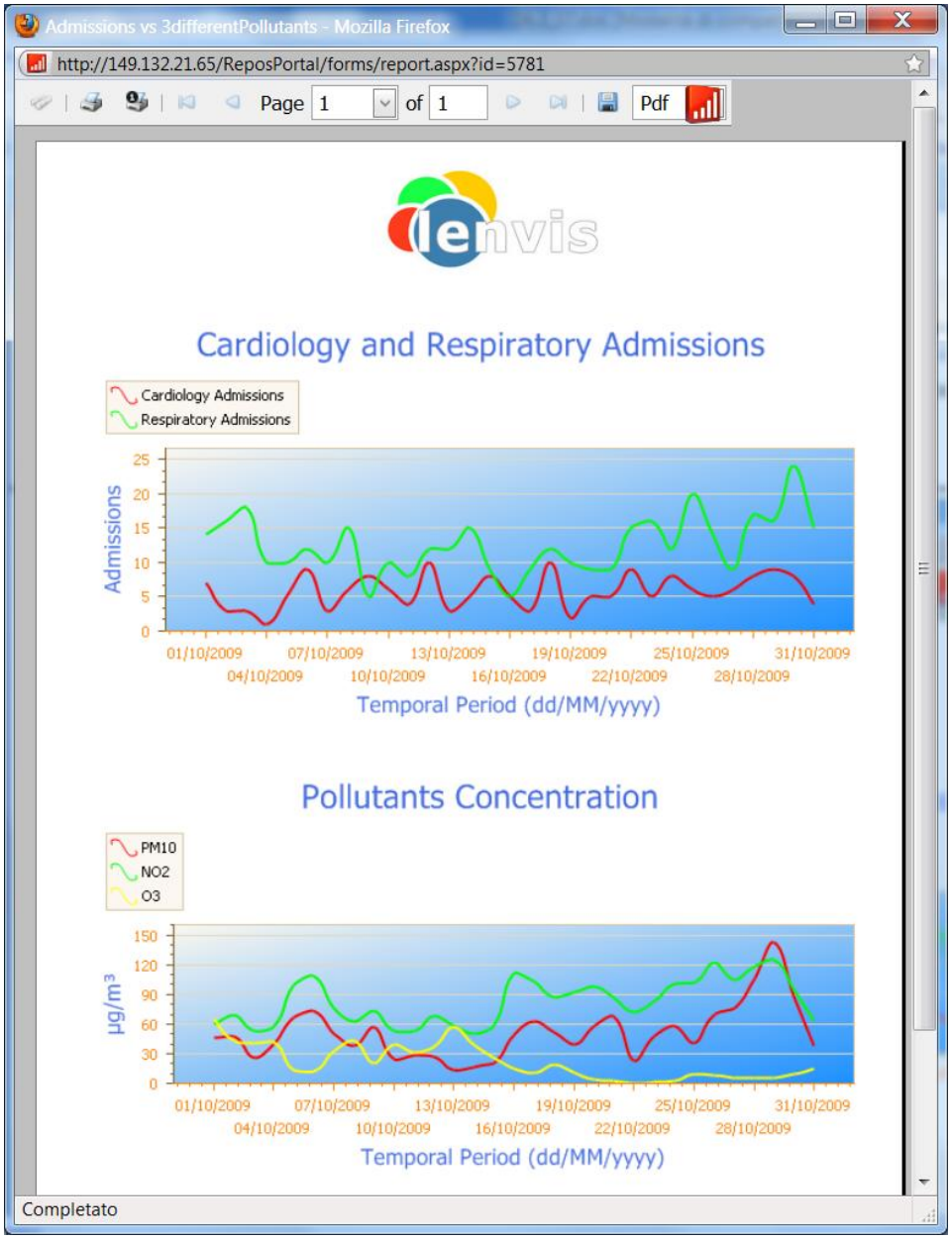


Fig. 15. Presentation of Query output

3.4. Mobile phone applications

Air quality

The air quality model prediction results can also be accessed by mobile phone. Simple dedicated menu have been developed in order to access to air forecast with Google Android and I-phone mobile platform.

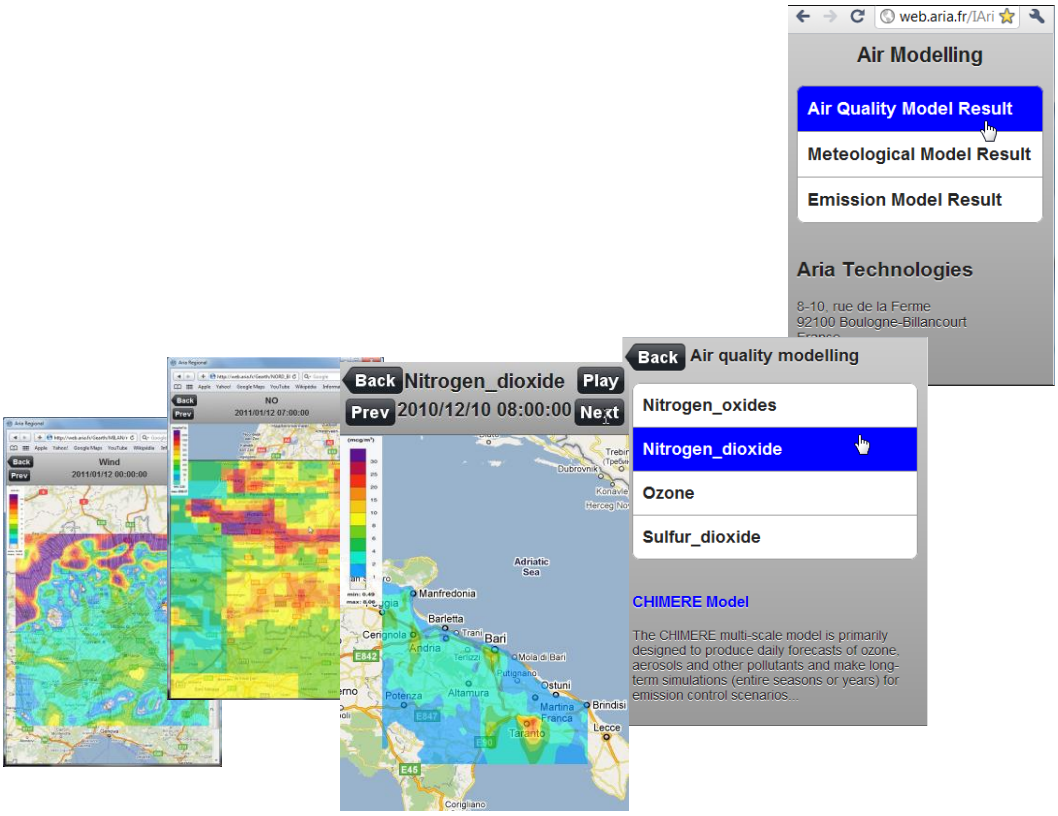


Fig. 16 Air quality model results

The figure above shows the air quality model results visualized on to the Lenvis mobile phone applications.

3.5. Lenvis portal

The lenvis portal (www.portal.lenvis.eu) represents a lightweight container of the services, which are presented as gadget, and it is accessible through HTTP, without requiring the installation of software on the user's client; this last requisite was expressed by the end users during the investigations performed in WP1 through the submission of questionnaires, as described in D2.1.

The following picture shows the integration of the health modelling services in the lenvis portal through two gadgets called *HIDSS gadget* and *HIDSS reporting gadget*.

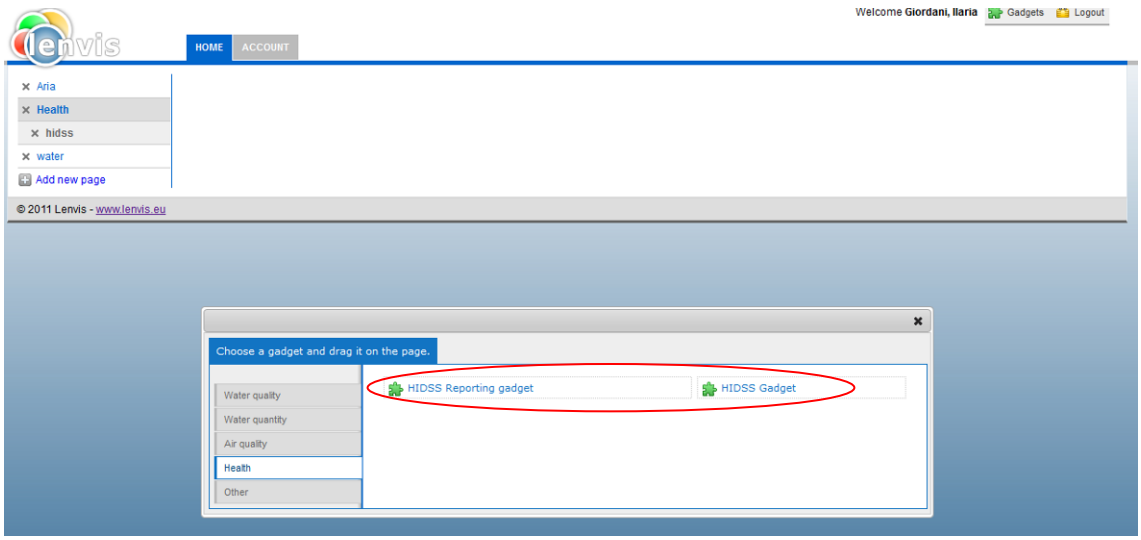


Fig. 17. Integration of health modelling in the lenvis portal as HIDSS gadgets (shown in the circle).

As shown in Fig. 18, the integration between the lenvis portal and the gadgets is implemented by an URL gadget, the gadget type that have been developed in lenvis for the easy integration of web applications.

Fig. 18. HIDSS Gadgets url in the lenvis portal

3.5.1. HIDSS Repos Gadget

REPOS is the reporting Business Intelligence tool used for visualizing data and it has been made by one of lenvis partner (ESA).
This BI tool consists of several components that cooperate to give the best results to the end user. The two main modules that a user can access trough a user interface are Template Editor and Repos Web Portal. The first one is a standalone application and provides a tool which enable users to create template in order to representing different time series. Instead, the Portal module is a .NET web application running on Microsoft IIS and allows users to publish the template created with the editor and share it with others members. The BI toolset can generate reports and analysis based on data stored in Warehouse or generated by Data Provider Services. External systems can communicate with BI trough an Export Service that provides possibility to generate all predefined reports stored in repository.
REPOS is used to provide the users with historical and forecasting data exposed by HIDSS' web services, through an easy-to-use graphical user interface.
In the figure below is depicted the Lenvis Portal (http://portal.lenvis.eu/).

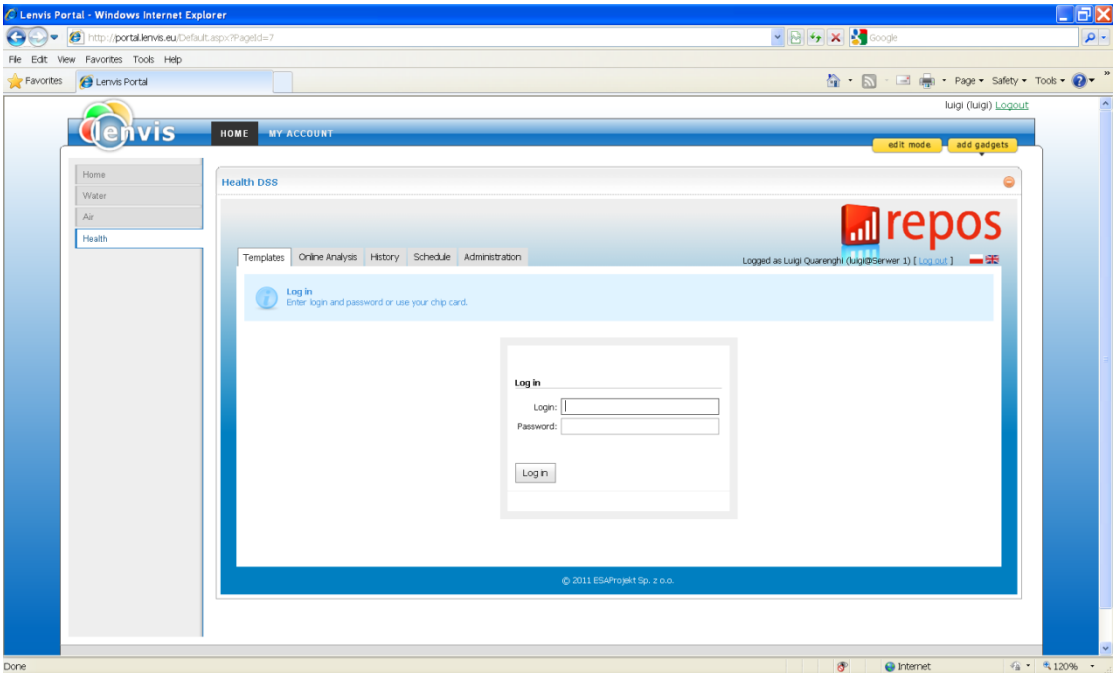
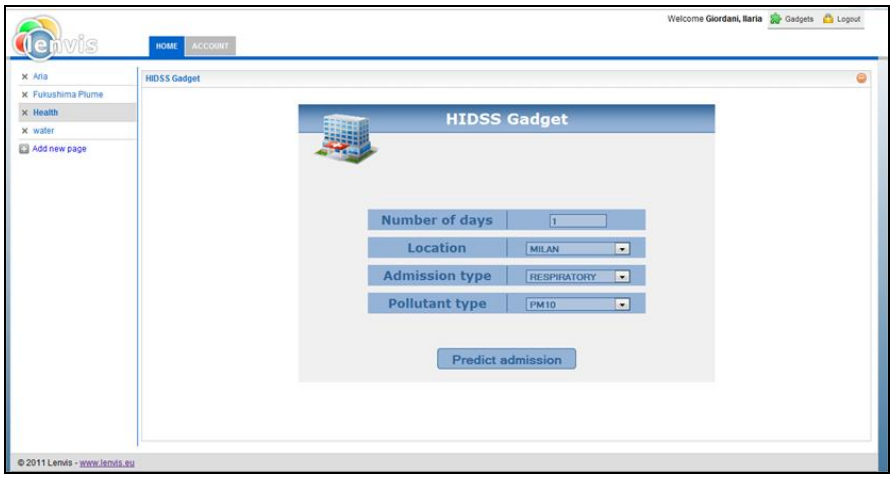


Fig. 19 HIDSS reporting gadget in the Lenvis Portal

3.5.2. HIDDS Gadget

HIDSS has been developed not only as a web services but also as a Gadget in order to be easy to be accessed by users via lenvis web portal. According to the HIDSS hospital admission forecasting service, user can be set the input parameter of the service through a very user-friendly web interface. In particular user can select the pollutant, the location, the type of admissions and the day on which perform the forecast.
The result of HIDSS consists of the probabilities associated to the three possible admissions trends for each day, computed according to the Markov-based Model detailed in Deliverable 6.4.



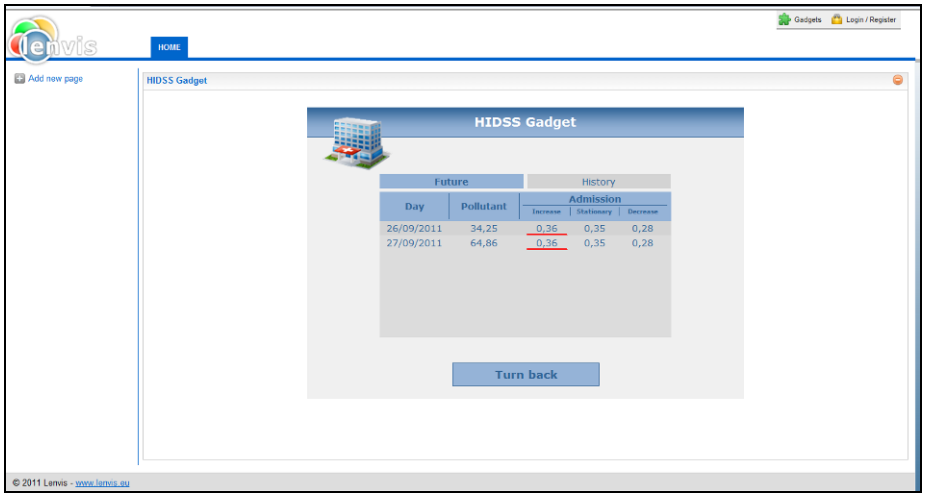


Fig. 20 HIDSS gadget's user interface

4. User validation

4.1. Evaluation strategy

The first phase in user validation, like for the other case studies, is the continuous user involvement and feedback analysis. In this phase many professional users form environmental organizations and health clinics/hospitals has been involved. Different face to face meetings have been organized in order to present and introduce the users to the lenvis system.

The evaluation is could be divided into two principal phases:

1. The first phase is focalized on ***Technical performance (efficiency) of lenvis system.***
   During this phase the gadgets produced by the project are assessed to assure that they are conform to the requirements set out in the specification document, Deliverable 2.1, and that the components of the system interoperate as planned.
   Operability, reliability, robustness and flexibility of the lenvis system, in the version applicable to Milan and to Bari, are evaluated in this step.
   In this phase many professional users form environmental organizations and health clinics/hospitals has been involved. Different face to face meetings have been organized in order to present and introduce the users to the lenvis system.
   First tests have been done in September 2010 before and during the mid-term seminar, and tests will continue in the first part of January 2011 in one or more sessions at the University of Milano - Bicocca with the contribute of the Bari Partner MB. Experts of the Department of Environment of the Milano - Bicocca University will be asked to attend the sessions as professional users.
2. The second phase is focalized on ***effectiveness of lenvis system.*** During these tests the lenvis system is evaluated considering: overall system quality, information use, information quality, individual impact of the results and user satisfaction. In this phase a questionnaire (Reported in Appendix A) has been submitted to all users.

In Italy the evaluation focus is on clinical users and environmental associations with the objective to have them using the system.

In Milano the validation is focused on medical users in two main classes:

1. Decision makers for public policy:
    a. ASL (Local health authority), in charge of assessing the effectiveness of risk mitigating measures
    b. Office for Environmental quality (Comune di Milano)

    Both groups remarked already their interest towards Lenvis as a Business Intelligence tool.

2. Medical doctors, in particular general practitioners (GP) and consultants in "Children Care" and "Elderly Care". Two uses were deemed particularly interesting:
    a. Visualization of health data to support clinical diagnosis (water related skin rashes, allergies related respiratory problems)
    b. Lenvis to support interaction among associations e.g. parents to mainly allow planning for outdoor recreational activities

In Bari, as well as in Milano, the focus of testing is aimed on clinical users and other subjects working on environmental issues. The objective is to have them using the system by end of October. These trials will go on in September and October with MB specialists involved in end-user testing.

In Bari area the validation is focused on users that deal with health and environmental quality issues that can be grouped in two main classes:

1. Decision makers for public policy:
    a. ASL (Local health authority), in charge of assessing the effectiveness of risk mitigating measures, visualization of health data to support clinical diagnosis (water related skin rashes, allergies related respiratory problems).
    b. Environmental Service of Bari Province.
2. Subjects with research and control responsibilities:
    a. University of Bari, Dept. of Chemistry
    b. Regional Environmental Protection Agency (ARPA Puglia);
    c. Acquedotto Pugliese (AQP).
3. Associations and public consultation groups:
    a. SIGEA Puglia;
    b. Legambiente Puglia;
    c. Consulta per l'Ambiente del Comune di Bari.

The detailed evaluation activities are reported in the next session.

4.2. User Evaluation activities

As already underlined ,the evaluation activities in Italy has can be classified in three principal types:

- Face to face interviews with professional users in order to depict the system and demonstrate its main functionalities. At the end of each interview a questionnaire has been submitted to the user.
- User meetings with group of professionals, physicians, general practitioners and researcher. At the end of each meeting a questionnaire has been submitted to the user.
- Short demo of the product and submission of questionnaires to non professional users, like students.

The principal face to face interviews and user meetings organized by Unimib and Municipality of Bari has been reported into the following table:

Tab. I Validation meetings

Meeting ID	Date	Place	Subject
1	28th January 2011	UNIMIB, Milan	First End user meeting
2	13th May 2011	ASL, Milan	Meeting with health decision makers
3	18th May 2011	CMR, Milan	Meeting with physician specialized in children
4	18th May 2011	CMR, Milan	Meeting with a researcher in statistical methods applied to health care
5	25th May 2011	UNIMIB, Milan	Seminar and meeting with managers and technicians of the Milano Municipality
6	26th May 2011	UNIMIB, Milano	Meeting with general practitioner
7	26th May 2011	UNIMIB, Milano	Meeting with environmental Science Master Students
8	30-31 May 2011	BARI	Meeting with end users BARI use case
9	27th June 2011	Policlinico di Milano, Milan	Meeting with medical students
10	8th July 2011	San Carlo hospital, Milan	Meeting with the head of pulmonology Department of San Carlo hospital, Milan
11	9th September 2011	UNIBS, University of Brescia	Meeting with computer sciences professors and phd students
12	27th September 2011	UNIMIB, Milan	Meeting with professor Carlo Maria Marino former president of ARPA Lombardia
13	18th October 2011	Università Bocconi, Milan	Meeting with professor Edoardo Croci, Director of the centre for research on energy and environmental economics and policy
14	26th October 2011	UNIMIB, Milan	Meeting with 7 general practitioners

4.2.1. Mid-term seminar in Delft, 22-23 March 2010

The mid-term seminar was planned, because half-way the project the pilot version of the lenvis portal and a number of data and modelling services are ready, and feedback to these intermediate products is useful for directing the further development in the second half of the project.
During the seminar the Italian test case was presented, the air quality models and the health decision support system components were shown and a preliminary evaluation feedback was received (by representatives of UNIMIB, CMR, MB, ESA, AT).
The main comments received from the audience (composed of internal to the project professional users) were:

- While lenvis should retain its innovative character through research and development towards a range of environmental and health information services, care should be taken that the products should remain sufficiently simple, self-explanatory, selectable and functioning reliably, for the users.
- Preferably every service that communicates to or with public users and may be of interest to international users, should be in the local language and in English to maximize the potential use of the service.

- The air-health information based BI tool should be expanded to allow for a wider range of queries.
- The output of health forecast should be integrated with alert services.
- The quality of environmental and health data should be taken in particular consideration. Lenvis should propose guidelines for health data collection with the aim of health modelling.

The air quality modelling and representation services function well. Further development should focus on including time series handling and representation services (now only maps are presented), improving the emission inventories of the case studies to improve the predictions, and on coupling the model results to the health risk prediction model.

Other comments were:
– Focus on connection between pollution and hospital admissions
– Use forecasting to present danger situations
– Control quality of data
– Need to cooperate with authorities
– Increase health data collections
– More interactivity on charts
– More built-in queries (chose them with end users)

These comments were the result of a free discussion after the presentations and were summarised at the end of the day.

4.2.2. End user meeting #1

Meeting Place:	Milano, UNIMIB, 28th January
End users participants:	13 professionals
Lenvis participants:	• Francesco Archetti • Giampaolo Giuliani • Ilaria Giordani • Ezio Bolzacchini • Vincenzo Campanaro

A preliminary end user meeting was held at the University of Milano - Bicocca the 28th of January 2011.
The participants, 13 professionals carefully selected, are representative a wide range of expected Lenvis professional end users: public agencies, municipalities, health services, environment related software companies and research centres.

Fig. 21 Italian end user meeting January 2011

A general presentation of the project goals and some virtual images on how the system, ready to be released for real tests by users, will work, was done by Francesco Archetti. A more detailed explanation of the Lenvis architecture and on how the system works was given by Ilaria Giordani. Ezio Bolzacchini described the experimental monitoring station built near the University and equipped with a tethered balloon to measure the vertical concentration of the polluting particles and mentioned the main results obtained with special instruments on the chemical ionic composition of the particles. The knowledge of the particles chemical composition, characterized by a seasonal trend, is of paramount importance for the construction of a molecular model describing the effects of the pollutants on the epithelial tissues of the human airways. Vincenzo Campanaro presented the point of view of a professional responsible of the environment division of the Bari Municipality. Finally Giampaolo Giuliani described how the validation, through the end users tests, will be carried out in the next months.

The main point touched in the subsequent discussion, facilitated by the project coordinator F. Archetti, were:

- who will certify the quality of the input data ?
- when data from non professional users (for example in the framework of a social network) the quality is not controlled. What to do with these last data?
- how the heath data base shown in the presentation were selected and why ?
- who will manage the Lenvis system
- there is an Italian project looking for the correlation between IPA exposure and children health
- Lenvis basically helps to deal with the difficulty due to the fragmentary knowledge
- It of paramount importance the possibility to personalize the Lenvis reports to the individual needs.

At the end of the discussion all the participants stated they will be ready to test the Lenvis portal as soon as available.

4.2.3. End user meeting #2

Meeting Place:	Milano, ASL, via Statuto 5, 13th of May 2011, 10.00 - 12.00 a.m.
End users participants:	• Maurizio Tabiadon, manager of the Environmental Epidemiology Unit • M. Rampini, assistant
Lenvis participants:	• Francesco Archetti • Giampaolo Giuliani • Luca Cattelani

ASL performs strategic planning, coordination and monitoring of health care providers in Milano.
ASL is supporting decision making in all aspects of health related issues in Milano.
The two end users are physicians professionally concerned with the effects of environment (air quality) on the health of Milano citizens. The aim of the Unit is to develop a set of health risk indicators using historical data supplied by the Regional Health Authorities (ASL Lombardia) and by the Regional Environmental Agency (ARPA Lombardia). The evaluation supplied by the Unit is typically ex-post, performed on data even 2 years old which have been carefully cured (e.g. editing Electronic health records or Hospital Dismiss ion Sheets)useful for long term prevention policiesbut6 not for term prediction of admission loads.. They use the AirQ 2.2 software to perform calculations that allow the quantification of the health effects of exposure to air pollution, including estimates of the life expectancy reduction.
ASL is supporting Comune di Milano and Regione Lombardia in policy making about traffic restrictions and actions related to exceeding pollution thresholds like congestion charges a road pricing.

After a short presentation of the Lenvis project objectives the Lenvis Portal was shown and some of the available gadgets were illustrated with explanations and examples. The discussion was focused on the effect of air pollution on respiratory and cardiovascular disorders and on the difficulty to separate the effects of a lot of variables, one of which is the air pollution. As data source they use the so called hospital discharge data (SDO), collected by ASL Lombardia, with clinical information codified with an international code source (ICD9CM). Last year studied was 2009, 2010 data are not yet available.

The conclusions of the end users were:

- The hospital admission forecasting can be certainly useful to hospitals and emergency services but not so much to the Epidemiology Unit which is concerned with assessing long term health risks.
- The interest of ASL is more on the Business Intelligence methods helpful to prepare graphical reports by using data filtering systems;
- They are interested to start using the Lenvis Portal and they promised to fill, after some time of use, a supplied specific evaluation questionnaire.

4.2.4. End Users Meeting # 3

Meeting Place:	Milano, CMR, via Cozzi 53, 18th of may 2011
End users participants:	• Marco Sala, Ospedale di Tradate, Pediatric Department, Piazzale Angelo Zanaboni – 21049 TRADATE (marco.sala@unimi.it) • Marzia Mandelli (marzia.mandelli@unimin.it), Ospedale San Paolo di Milano, Children Clinic • Francesco Di Dio (francesco.didio@libero.it), Ospedale San Paolo di Milano, Children Clinic • Sabrina.Argirò (sabrina.argirò@libero.it), Ospedale San Paolo di Milano, Children Clinic
Lenvis participants:	• Francesco Archetti • Ilaria Giordani • Giampaolo Giuliani • Paolo Testa

The four end users are physicians professionally concerned with the treatment of children's Asthma, Allergies, & Other Respiratory Disorders (cardiovascular diseases not relevant for children).

After a short presentation of the Lenvis project objectives the Lenvis Portal was shown and some of the available gadgets were illustrated with explanations and examples. The discussion was focused on the effect of air pollution on respiratory disorders and on the difficulty to separate the seasonal effects, due to the weather conditions and to the spread of viral infections, from the seasonal effect due to the air pollution. Moreover, in the case of PM 10 or PM 2.5 particulate it was stressed that the chemical composition of the particles, not yet measured by the monitoring networks, is of paramount importance.

The conclusions of the end users were:

- The hospital admission forecasting is certainly of interest but, practically, the structure
- of hospital resources, in term of available doctors and nurses, being highly rigid it cannot be easily adapted to the changing conditions (excluding of course the case of dramatic events).
- Lenvis should be of great interest to the children parents living in highly urbanised regions, like Milano. Associations, like Genitoriantismog (http://www.genitoriantismog.it/) have been already contacted to show the Lenvis capabilities to give localised information on air and water quality and to contribute to better address the children outdoor activities.
- A decision these clinicians are often asked to support the parents about children outdoor activities
- They are very interested to start using the Lenvis Portal and they promised to fill a supplied specific questionnaire.

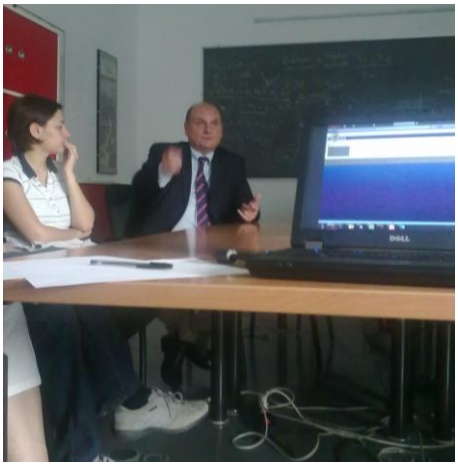


Fig. 22 end user meeting with physicians professionally concerned with the treatment of children'

4.2.5. End Users Meeting # 4

Meeting Place:	Milano, CMR via Cozzi 53; 18th of May 2011, 14.00 - 15.30 p.m.
End users participants:	Sara Conti (sara.conti@yahoo.it), Researcher, statistical methods in health care CESP (Research centre for public health services), Villa Serena, via Pergolesi 33, 20052, Monza, ITALIA, Tel: 039 2333097/8 Fax: 039365378, e-mail: cesp@unimib.it
Lenvis participants:	• Ilaria Giordani • Giampaolo Giuliani • Paolo Testa

The mission of CESP is to help and facilitate the development of studies and researches for the improvement of public health services. One of the projects that the Centre is actually running is the study of a correlation between drug consumption and air pollution. Assessing how much of this consumption is pollutant related allows a better definition of the social and economic costs of pollution and a better informed policy making in terms for instance of congestion charges and load pricing.

After a short presentation of the Lenvis project objectives the Lenvis Portal was shown and some of the available gadgets were illustrated with explanations and examples. The discussion was focused on data quality and methods to assess data significance.

CESP should be very interested in using the models and the forecasting algorithms developed in Lenvis and eventually in exchanging data and knowledge on raw data filtration methods. S. Conti will present this proposal to the CESP board. The end user is very interested to start using the Lenvis Portal and she filled, after some time of use, the supplied specific evaluation questionnaire.

4.2.6. End user Meeting # 5

Meeting Place:	UNIMIB, Department of Environmental Science
End users participants:	– Managers and technicians of the Milano Municipality (see the attached seminar programme) – professors, researchers and students of the Department of Sciences for Environment
Lenvis participants:	• Ilaria Giordani • Francesco Archetti • Giampaolo Giuliani • Paolo Testa • Luca Cattelani

This meeting has been held at the Department of Environmental Science at University Milano Bicocca. during the seminar "Sustainable development of urban areas" .

L'Università di Milano - Bicocca, il Centro di Ricerca Polaris, il Consorzio Milano Ricerche ed il Progetto Europeo LENVIS organizzano

Mercoledì 25 maggio 2011
ore 14.30, Aula Marchetti
Dipartimento di Scienze dell'Ambiente e del Territorio, Piazza della Scienza 1

il seminario:

"Governo sostenibile del territorio urbano"

con la partecipazione della dott.ssa Annalisa Gussoni
(dirigente responsabile del Settore Attuazione Politiche Ambientali, Comune di Milano)

Programma:

14.30
Dr. **Annalisa Gussoni**
Attività del Settore Attuazione Politiche Ambientali, normativa, particolarità e criticità del ruolo nell'ente pubblico.

15.15
Ing. **Alba De Salvia**, responsabile del Servizio Piani di Bonifica
Progetti europei INCORE e FOKS e Rete Civica di Controllo Acque di prima falda

15.30
Dr. **Paola Coppi**, AMAT (Agenzia Mobilità Ambiente Comune di Milano)
Piano di Classificazione Acustica e Mappa Acustica Strategica

15.45
Ing. **Caterina Padovani**, responsabile del Servizio Energia
Progetto LAIKA e Progetto Efficienza Energetica su stabili vincolati (Palazzo Cusani)

16.00
Dr. **Andrea Zelioli**, responsabile del Servizio Tutela Acque e Territorio
Valutazione Ambientale Strategica e Piani di Governo del Territorio

16.15
Dr. **Ilaria Giordani**, Consorzio Milano Ricerche
Il progetto europeo LENVIS per le aree urbane

16.30
Prof. **Marina Camatini**, Direttore del Centro di Ricerca Polaris
Ruolo della ricerca a supporto di interventi di governance in ambiente urbano

16.45 Discussione generale

Fig. 23 Program of End user meeting 25th May 2011

Fig. 24 End user meeting 25th May 2011

Users are mainly interested into the Lenvis Portal usability, several users has asked us all the information needed to register into the portal in order to try to use it.
During the discussion, particular attention has been focalized on the quality and security of the data.

4.2.7. End Users Meeting #6

Meeting Place:	Milano, UNIMIB; 26th of May 2011
End users participants:	Dr. Mauro Martini studio@mauromartini.it Family Doctor (General Practitioner) Via Monte Grappa 23, San Donato Mobile: +393498118452
Lenvis participants:	• Ilaria Giordani • Giampaolo Giuliani • Francesco Archetti

Mauro Martini (MM) is a General Practitioner (GP, in Italy "medicina di base") in S. Donato a neighbourhood of Milano. MM which has remarkable computer skills, way above the average GP, had already been using the portal having received upon request the access code to lenvis portal. The meeting started with a brief presentation of the project and the demonstration of all lenvis functionalities. MM pointed out two natural uses in his daily activity:

1. Related to water: checking during a medical visits the state of the body of water rivers or lakes which the patient had used (e.g., the previous week end).
2. Related to air (allergies): a short term forecast could allow the GP to start a mitigation therapy before the outbreak of pathological condition

MM explained how the PC of a GP is tightly connected with the GP network of Regione Lombardia. Everything which gets regional funding from drug prescription to lab examination, consultant's visit and access requests to health care providers, private and public, is entered into the system through interface and routers installed into Regione Lombardia already equipped with privacy and security software. As far as the Electronic Health Record is concerned the GP can choose between 26 software applications which are certified by Regione Lombardia, one more application will be the patient summary. In order to be in this system lenvis should be hosted as an

application on the system of Regione Lombardia and anyway requires computers skills above the average physicians': MM insisted on simplifying the interface making it more intuitive and immediate.
A GP can access only his own data which are loaded into SIS. Only patients can allow other medical physicians to access their data.
An interesting trend is that to reduce the number of hospitalization GPs are being supported into merging their operating infrastructure in multi–doctor practice focused on specific chronic conditions
Mr. Martini finally accepted to fill the Lenvis questionnaire (italian version).

4.2.8. End user Meeting # 7

Meeting Place:	UNIMIB, Bld. U1, Room 2, Milano 26th May 2011
End users participants:	25 students attending to the 1st year of a master course in Science and Technology for Environment and Territory
Lenvis participants:	• Luca Cattelani • Giampaolo Giuliani • Ezio Bolzacchini

After a short general introduction on the Lenvis European project done by E. Bolzacchini , G. Giuliani presented shortly the Lenvis objectives and L. Cattelani explained the project philosophy and showed to the students the Lenvis Portal on line and some of the available gadgets, illustrated with explanations and examples.
The students were asked to spend some time to explore the portal and to send back by e-mail to the Lenvis team comments and suggestions.

Fig. 25 end user meeting at UNIMIB, environmental science students

4.2.9. End user Meeting # 8

Meeting Place:	BARI, Villa Framarino, located in the Regional Natural Park of Lama Balice. 30-31 May 2011
End users participants:	– Managers and technicians – Professional users
Lenvis participants:	• Vincenzo Campanaro, MB • Francesco Archetti, UNIMIB • Ilaria Giordani, CMR • Schalk Jan van Andel, IHE • Ioana Popescu, IHE • Arnold Lobbrecht, HL • Sead Kolic, HL • Claude Derognat, ARIA • Jacques Moussafir, ARIA • Caludia Viegas, IST • Paulo Chambel Leitao, HID

As part of the project activities of the LENVIS Project, The Municipality of Bari has organized a series of technical/scientific meetings, which took place at the Villa Framarino, located in the Regional Natural Park of Lama Balice.
On May 30, 2011 there was a meeting between the project partners, with the objective to verify the operation of the informatics LENVIS system, in view of the test phase scheduled the next day, to which were invited a range of subjects. There have been developed reports and presentations for the next day.
Tuesday, May 31 starting at 9:00, in the presence of the person referred to in Tab. IV, took place the presentation about the report on the status of the project, with studies concerning the evaluation of environmental management strategies depending on health impacts.
In the afternoon took place a test phase during which participants were able to operate directly on the portal LENVIS. Those present showed great interest in the project itself as well the web portal functionalities. The same people, once the test phase, have expressed their willingness to do any testing witnessed by staff of the Municipality of Bari, at their respective offices. The results will be filled in the questionnaire.
This phase is being implemented, and the results will be released at the conclusion of the project.

4.2.10. End Users Meeting # 9

Meeting Place:	Milano, Policlinico; 27th June 2011
End users participants:	- Prof. Daniela Mari, UNIMI - 50 master course of health care students of UNIMI
Lenvis participants:	• Ilaria Giordani • Francesco Archetti • Paolo Testa

The meeting is focalized on the introduction of European Regulation laws in Lenvis System, principally behind HIDSS gadget. After a brief presentation of Lenvis project, a live demo of the portal and mobile applications.
The list of participant users is reported in Appendix B.

4.2.11. End Users Meeting # 10

Meeting Place:	Milano, San Carlo Hospital; 8th July 2011
End users participants:	Prof. Sandro Amaducci, Head of Pulmonology Department San Carlo Hospital, Milan
Lenvis participants:	• Ilaria Giordani • Francesco Archetti

Prof. Amaducci is the coordinator of POEMI (Pollution and Emergencies in Milan) study that has examined the correlation between pollution concentration and emergency admission over the 5 years of respiratory, cardiovascular and allergy diseases.
The interest of prof. Amaducci is twofold:

- As the president of Italian pneumology society which is running educational events for general practitioners and consultants
- For his clinical and research activity in order to correlate abnormal clinical events of his department with pollution concentration and visualize this data on Web.

In Milan, it is expected that the newly elected administration in Milano will perform a complete reassessment of its environmental policy and risk mitigation procedures related mainly to private traffic. Lenvis could participate in this process, along with prof. Amaducci, to show how the pollution severity year to year can be accessed thru HIDDS.

4.2.12. End Users Meeting # 11

Meeting Place:	UNIBS, University of Brescia; 9th September 2011
End users participants:	- About 10 Computer science professors - 5 phd students
Lenvis participants:	• Ilaria Giordani • Paolo Testa • Enza Messina

The meeting is focalized on the presentation of the main objective of HIDSS gadget: perform a short-term forecasting for cardio-vascular and respiratory hospital admissions based on pollutants levels prediction thorough Markov Model.
At the end of the presentation, a live-demo of the Lenvis portal has been done in order to illustrate to the users all the other gadgets present in it focalizing on those regarding the Italian case study.
Users were interested and did a lot of questions regarding the security of data and the pre-processing phase of health data.

Fig. 26 end user meeting at University of Brescia

4.2.13. End Users Meeting # 12

Meeting Place:	UNIMIB, Milano; 27th September 2011
End users participants:	Carlo Maria Marino Former president of ARPA Lombardia professor of geological sciences at the University of Milano
Lenvis participants:	• Ilaria Giordani • Giampaolo Giuliani

Carlo Maria Marino, professor of geological sciences at the University of Milano - Bicocca, Department of Environmental Sciences, was the President of ARPA Lombardia during the years 2008 - 2010. ARPA is the regional agency for the protection of the environment with the mission of supplying activities and services to support the environmental policies of the regional government and municipalities. He was highly interested in the Lenvis system as a tool to diffuse information and culture on the effects of a air and water polluted environment on the citizens health. He made the point that actually the information, supplied essentially by the mass media, is very often incorrect because trying to raise feelings of fear and excitement. The politicians, gathering these feelings, are driven towards wrong decisions.

4.2.14. End Users Meeting # 13

Meeting Place:	Università Bocconi, Milano; 18th October 2011
End users participants:	• Prof. Edoardo Croci, Research Director of the centre for research on energy and environmental economics and policy (IEFE) • Doctor Tania Molteni, IEFE junior Researcher
Lenvis participants:	• Ilaria Giordani • Francesco Archetti • Giampaolo Giuliani

Edoardo Croci, professor of environmental management and economics at the university Bocconi has been in charge of mobility and environment at Comune di Milano for 3 years.

His main accomplishment has been the introduction of ECOPASS which has been instrumental in reducing air pollution in the years 2007-2009.
Croci has shown a marked interest in Lenvis both as a tool to inform citizens and as a decision support system for local authorities. In particular it has been discussed how the computation of the probabilities of each state can contribute to the assessment of environmental policies.

4.2.15. End Users Meeting # 14

Meeting Place:	UNIMIB, Milano; 26th October 2011
End users participants:	• Dr. Mauro Martini, General practitioner • Dr. Gioacchino Graffagnino, General practitioner • Dr. Marco Zampieri, General practitioner • Dr. Danilo Cadarosti, General practitioner • Dr. Anna Forzati, General practitioner • Dr. Fay Vinicio, General practitioner • Dr. Noemi Bruna Eisera, General practitioner
Lenvis participants:	• Ilaria Giordani • Francesco Archetti • Giampaolo Giuliani • Gaia Arosio

The meeting consisted basically of a hands-on Lenvis session for the group of 7 practitioners.
After a brief introduction by Francesco Archetti and demonstration of the system by Ilaria Giordani, the participants analyzed the environmental- health status of Milan this October using the HIDSS gadget and Air quality gadget.
The participants have appreciated Lenvis functionalities as selective multichannel information and usage of simulation models. Two points where prominent in the discussion:

1- The integration of monitoring data and simulation to generate evaluation and forecasting.
2- The difficulties of collecting top quality health data, in particular about the admissions.

As far as the Lenvis system is concerned it must be said that while younger practitioners have a good web experience and using regularly smart phones, the senior GP had really no experience behind the use of the regional prescribing and billing system. So they have been able to exploit only a relatively small number of Lenvis features. Their reaction suggests that to overcome the weak points as perceived by General practitioners during their own activities with the portal, the actions to be undertaken should be:

- Add a textual explanation to each gadget, for example with a help button.
- Explain better how each user could personalize his portal, for example adding a default explanation in the portal home page.

Fig. 27 Brochure (in Italian) prepared and distributed for the organization of the Lenvis end user meeting with General Practitioners

Fig. 28 end user meeting with General Practitioners

5. User validation results

The user feedbacks has been gathered up through the methods described in D8.2 using questionnaires (as that reported in Appendix A) and interviews. Results obtained from these investigations are analysed based on the following 5 important indicators already reported in D8.2.

In order to give a better and clear interpretation of the results obtained by the Lenvis questionnaires (Appendix A), we have tried to map the previous indices with the question presented in them (Appendix C).
Different groups of indicators has been evaluated based on the different applications under analysis:

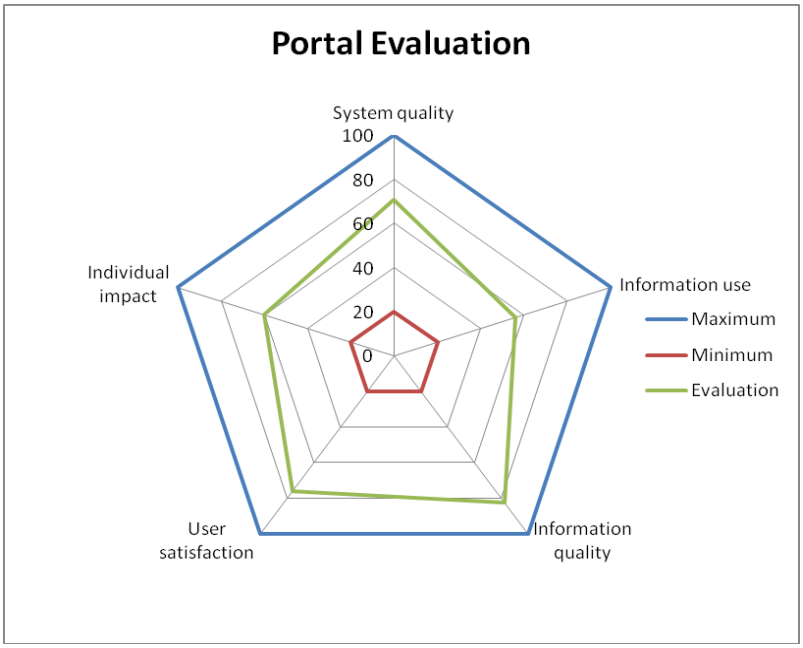
- Indicators used for ***Italian case study***:
  - *System quality*: Convenience of access, Realization of user requirements, Usefulness of system features and functions, System flexibility, System reliability, System efficiency,
  - *Information use*: amount of use, motivation of use
  - *Information quality*: relevance, usefulness, understandability, Clarity, Timeliness
  - *User satisfaction* : Overall satisfaction, Satisfaction with specifics, readiness to pay
  - *Individual impact:* Information understanding

- Indicators used for ***Lenvis Portal evaluation***:
  - *System quality*: Data accuracy, Ease of use, Convenience of access, Realization of user requirements, Usefulness of system features and functions, System flexibility, System reliability, Integration of systems, System efficiency,
  - *Information use*: amount of use, motivation of use
  - *Information quality*: usefulness, Appearance, Clarity

- *User satisfaction* : Overall satisfaction, Satisfaction with specifics
- *Individual impact:* Information understanding

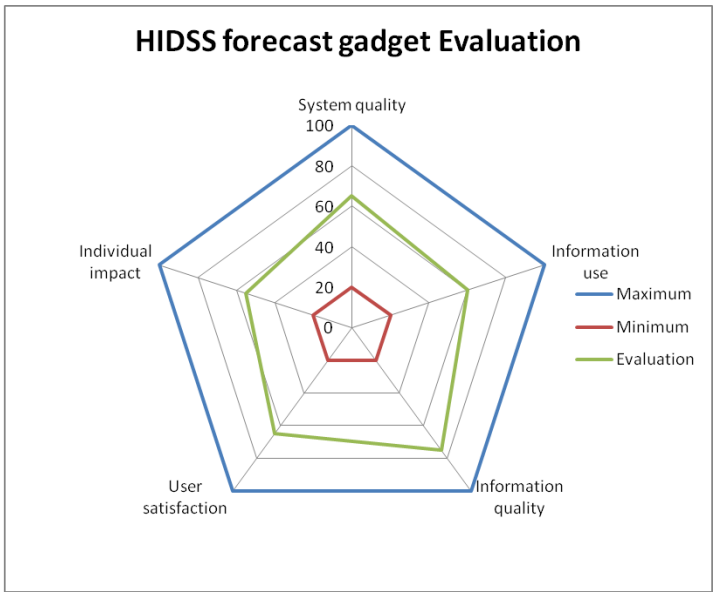
- Indicators used for ***HIDSS gadget evaluation***:
  - *System quality*: Data accuracy, Ease of use, Realization of user requirements, Usefulness of system features and functions
  - *Information use*: motivation of use
  - *Information quality*: usefulness, Clarity, understandability
  - *User satisfaction* : Satisfaction with specifics
  - *Individual impact:* Information understanding, Decision effectiveness

5.1. Lenvis portal evaluation



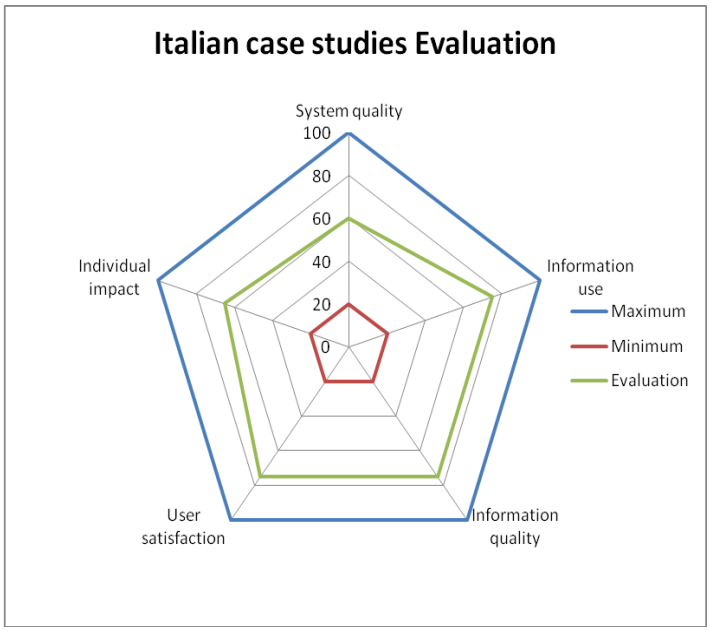
During the evaluation period lenvis portal faces some developments, mainly on technical performance. After the first users evaluation, where the users notice that gadgets names should appear on the first lenvis portal page or the possibility of adding gadgets should be more evident, some improvements were done.
The overall view of gadgets lists as improved considering user's recommendations.
In the first meetings, especially during Milan meeting of January 2010, we have collected different comments regarding the output of HIDSS module. In particular users suggest us to provide a new gadget with which they could see in a simple way the forecast of admissions trends.
Following this suggestions Unimib develop the gadget HIDSS gadget using which a user could ask the system the admission trend choosing a particular time period, a city and a pollutant. User comments about the gadget are reported in the next subsection.
Generally users express good observations about the usability of the portal and they are generally satisfied. During the meetings users were interested in the topic " data quality and security".
Users, and in particular General practitioners, have appreciated the possibility of creating a personalized portal, but stressed at same time the need of a more detailed Lenvis user guide to exploit this possibility.

5.2. HIDSS forecast gadget



As already explain, during the first meetings with clinical end users some specific requirements about data analysis have been occurred.
The most suitable statistical tests have been identified and performed "off-line" and different solutions have been taken into account. In particular, respect to the adopted statistical tests, integration at Wrap Level, through Matlab, seems to be the best and quickest one.
All these features are available both through the HIDSS web service and through the gadget on lenvis Portal. The gadget contains an embedded web application that, with a simple point and click user interface, allows the user to get a graphical representation of the admission trends, with trends highlighted.
The results visualized by the gadget were generally considered to be easy to obtain and useful to give an evaluation of the trend of the effect of the environment on the citizens health. The comment of Health Service Organizations, like ASL and Hospital, was that the assistance organisation is not flexible and cannot be tuned to the forecast trend of the hospital admissions but that the indicator should be of high interest for citizens, particularly elderly people and families with small children.
General practitioners have appreciated how retrieving quality indices of air and water can be a valuable informational contribution for their daily activities.GP were concerned about the clinical quality of data, meaning the reconciliation of the classification of conditions at the moment of emergency admission and the final diagnosis contained in SDO (hospital dimission form).

5.3. General considerations of Italian case studies: Milan and Bari



In Italy the General Practitioners seem to be professional category more interested to the Lenvis system, as an aid to the hilliness diagnosis and as the base of a warning messages system. They have asked, in addition, to integrate in to the Lenvis health system information and forecasts on atmospheric allergenic agents . Some managers of health and environment agencies told us they would like to see a diffusion of a system like Lenvis within the people communities to help the growth of a better understanding of the health/pollution problem and to push public authorities to more factual decision.
During the meetings different students and young users asked a lot of information regarding Lenvis mobile applications for Italian case study. They tested both the Lenvis portal and applications on their mobile phones and are satisfy of them.
The Milan case has been analyzed in particular detail in the GP meeting October 26th the quality of environmental and health data has emerged as an issue of particular concern. There is an agreement that air pollution control will be in Milan the single most important issue for the local government and that Lenvis is an unique tool in allowing both selective information and the fusion of point estimates by sensors and space and time distributed estimates provided by modeling.

6. Conclusions and discussion

6.1. Commonalities and differences in user evaluation results amongst the products

The products regarding:

- "*warnings/alerts when a pollutant concentration is over the limit value mandated by law (according to DIRECTIVE 2008/50/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, of 21 May 2008, on ambient air quality and cleaner air for Europe, 2008)"* has been evaluated in positive way by both Italian case studies.
    - Environmental authorities have the need either to develop additional modules of the legacy environmental information systems to make them compliant with the directive or to develop completely new systems is clearly perceived and Lenvis is

appreciated as an enabling technology, for both strategies, with the potential to reduce costs and time of development.
    - General practitioners, both from Bari and Milano have appreciated the possibility of linking specific medical conditions with pollution levels, for water (e.g., skin problems or infections) and air (e.g., respiratory or allergies).
- *"evaluation of the effectiveness of pollution limitation policies (through Markov-based Models)"*
    - This product fits more closely in the perceived needs of Milano, where there has been the Ecopass experience, the urban conurbation is large and different stakeholders have been more active in the debate about long term objectives.
- *health risk map obtained by calculating the impact on health based on pollution level,*
    - This product is equal important in meeting the needs of Milano and Bari. There are anyway substantial difference between the two cities: Bari has a major ozone problem while the meteorological conditions are better than in Milano which is cursed in the winter period by the mixing layer.
- *hospital admissions forecasting, in the short term, depending on predictions of pollutant concentrations*.
    - This product fits more closely in the perceived needs of Milano, where the Ecopass has spawned a debate both on long term increasing morbidity and short term effects. Indeed, the city of Milano has supported a large data collection and analysis exercise on emergency admission data.

6.2. Discussion of the user validation strategy and activities

A substantial difficulty is due to the fact the resources devoted to environmental control are relatively scarce, bent mostly to monitoring for administrative purposes rather than to support decisions both at operative and strategic level. Expertise in ICT is also less than necessary and distributed into many departments. The main positive result is the positive response by young officers which can understand the potential leveraging Lenvis technology into their daily activities. Continuation activities will be two folds:

1) continuing workshops to the users groups
2) monitoring the evolution of information systems towards compliant with thje requirements mandated by law discussing the issues with end users and ICT suppliers.

6.3. Overall Conclusion

This intermediate report provides an overview of the results in WP8 case studies in Italy to date.
Local authorities are interested in retrieving and sharing health and environmental information in order to compliant with the European directive. Healthcare providers consider relevant the analytical and forecasting functionalities in order to improve people quality of life while reducing costs. Lenvis (and HIDSS) usefulness appears clear and positive feedbacks have been received from preliminary users validation sessions. In particular, results turned out by using HIDSS service for short-term admissions forecasting, based on pollutant prediction, have been considered interesting by the clinical stakeholders and the approach proved to be useful also for evaluating the effectiveness of local authorities' actions for pollutant concentration control.

Appendix A

LENVIS QUESTIONNAIRE

SECTION 1: QUESTIONS ABOUT THE OVERALL LENVIS SYSTEM

1) Information quality for lenvis services:

	High	Medium	Low
1.1 Meteo Modelling			
• Temperature			
• Wind			
1.2 Air quality monitoring and forecasting			
• NO			
• CO			
• OZONO			
• PM10			
• PM2.5			
• SO2			
1.3 Health Decision Support System (hospital admission forecasting)			

2) The LENVIS System is useful for…

	High	Medium	Low
2.1 Accessing information everywhere			
2.2 Accessing information in real time			
2.3 Customizing tha data presentation			
2.4 Using business intelligence tools			
2.5 Supporting your decision process			

3) What will be the impact on your daily job if you will use LENVIS ?

☐ High ☐ Medium ☐ Low

4) What is your global satisfaction?

☐ High ☐ Medium ☐ Low

If moderately or unsatisfied, what didn't meet your need or expectation?

5) Which functionalities do you think are really useful for your job?

	High	Medium	Low
5.1 Meteo Modelling			
• Temperature			
• Wind			
5.2 Air quality monitoring and forecasting			
• NO			
• CO			
• OZONO			
• PM10			
• PM2.5			
• SO2			
5.3 Health Decision Support System (hospital admission forecasting)			
5.4 Business Intelligence tool (REPOS)			
5.5 Web Portal			

6) Which functionalities would you like to improve?

	High	Medium	Low
6.1 Meteo Modelling			
• Temperature			
• Wind			
6.2 Air quality monitoring and forecasting			
• NO			
• CO			
• OZONO			
• PM10			
• PM2.5			
• SO2			
6.3 Health Decision Support System (hospital admission forecasting)			
6.4 Business Intelligence tool (REPOS)			
6.5 Web Portal			

8) Lenvis Web Portal Usability

	Strongly Agree				Strongly Disagree
I think I would like to use this web site frequently	○	○	○	○	○
I found the Portal unnecessarily complex	○	○	○	○	○
I thought the web site was easy to use	○	○	○	○	○
I think I would need Tech Support to be able to use the Portal	○	○	○	○	○
I found the various functions well integrated	○	○	○	○	○
I thought there was too much inconsistency in the Portal	○	○	○	○	○
I would imagine that most people would learn to use the Portal very quickly	○	○	○	○	○

I found the website very cumbersome to use					
I felt very confident using the web site					
I need to learn a lot about the Portal before I could effectively use it.					

9) Overall Reaction to the Lenvis Portal

	0	1	2	3	4	5	6	7	8	9		NA
Terrible											Wonderful	
Difficult											Easy	
Frustrating											Satisfying	
Dull											Stimulating	
Rigid											Flexible	

10) Web Pages

		0	1	2	3	4	5	6	7	8	9		NA
Reading characters on the page	Hard											Easy	
Organization of information	Confusing											Very clear	
Sequence of pages	Confusing											Very clear	

11) Terminology and website information

		0	1	2	3	4	5	6	7	8	9		NA
Use of terms throughout website	Inconsistent											Consistent	
Terminology is intuitive	Never											Always	
Position of messages on screen	Inconsistent											Consistent	
Website informs about its progress	Never											Always	
Error messages	Unhelpful											Helpful	

12) Learning

		0	1	2	3	4	5	6	7	8	9		NA
Learning to use the portal	Inconsistent											Consistent	
Performing tasks is straightforward	Never											Always	

13) Website capabilities

		0	1	2	3	4	5	6	7	8	9		NA
Speed	Too slow	○	○	○	○	○	○	○	○	○	○	Fast enough	○
Reliability	Unreliable	○	○	○	○	○	○	○	○	○	○	Reliable	○
Designed for all levels of users	Never	○	○	○	○	○	○	○	○	○	○	Always	○

14) Overall Reaction to the Lenvis Portal

	Strongly Agree				Strongly Disagree
I'm satisfied with how easy is to use the Portal	○	○	○	○	○
It was simple to use	○	○	○	○	○
I can effectively complete my work using this website	○	○	○	○	○
I'm able to complete my work quickly	○	○	○	○	○
I'm able to effectively complete my work	○	○	○	○	○
I feel comfortable using the Portal	○	○	○	○	○
Whenever I make a mistake using the portal, I recover easily and quickly	○	○	○	○	○
It's easy to find the information I need	○	○	○	○	○
The information provided by the website is easy to understand	○	○	○	○	○
The information is effective in helping me to complete my tasks	○	○	○	○	○
The organization of information on the web pages is clear	○	○	○	○	○
The web interface is pleasant	○	○	○	○	○
The portal has all the functionalities and capabilities I expect it to have	○	○	○	○	○
Overall, I'm satisfied with this web site	○	○	○	○	○

15) Keywords to describe the Lenvis Portal

☐ Convenient	☐ Familiar	☐ Slow	☐ Friendly	☐ Straightforward
☐ Personal	☐ Confusing	☐ Stressful	☐ Fun	☐ Boring
☐ Innovative	☐ Helpful	☐ Simplistic	☐ Empowering	☐ Usable
☐ Old	☐ Complex	☐ Irrelevant	☐ Dated	☐ Advanced
☐ Meaningful	☐ Clear	☐ Flexible	☐ Sophisticated	☐ Effective
☐ Difficult	☐ Accessible	☐ Time saving	☐ Too technical	☐ Intuitive
☐ Organized	☐ Calm	☐ Disruptive	☐ Fast	☐ Consistent
☐ Controllable	☐ Annoying	☐ Easy to use	☐ Comfortable	☐ Approachable
☐ Collaborative	☐ Distracting	☐ Frustrating	☐ Attractive	☐ Efficient
☐ High quality	☐ Valuable	☐ Fragile	☐ Sterile	☐ Exciting
☐ Secure	☐ Predictable	☐ Intimidating	☐ Appealing	☐ Clean
☐ Understandable	☐ Low Maintenance	☐ Comprehensive	☐ Unconventional	☐ Effortless
☐ Customizable	☐ Time consuming	☐ Stable	☐ Unattractive	☐ Stimulating
☐ Not valuable	☐ Relevant	☐ Inconsistent	☐ Professional	☐ Compatible
☐ Incompressible	☐ Useful	☐ Not secure	☐ Trustworthy	☐ Integrated
☐ Disconnected	☐ Motivating	☐ Poor quality	☐ Impressive	☐ Hard to use
☐ Essential	☐ Creative	☐ Fresh	☐ Satisfying	☐ Exceptional

SECTION 2: QUESTIONS ABOUT LENVIS FUNCTIONALITIES

16) Meteo modelling:

	Strongly Agree				Strongly Disagree
It is easy to use	○	○	○	○	○
Realize the user requirements	○	○	○	○	○
System features and function are useful	○	○	○	○	○
System is reliable	○	○	○	○	○

17) Air quality monitoring and forecasting:

	Strongly Agree				Strongly Disagree
It is easy to use	○	○	○	○	○
It realizes the user requirements	○	○	○	○	○
System features and function are useful	○	○	○	○	○
System is reliable					

18) Health Decision Support System (hospital admission forecasting)

	Strongly Agree				Strongly Disagree
It is easy to use	○	○	○	○	○
Realize the user requirements	○	○	○	○	○
Sstem features and function are usefull					
System is reliable	○	○	○	○	○

SECTION 3: QUESTIONS ABOUT LENVIS INFORMATION USE

19) Information use:

	Agree	Don't know	Disagree
Can the lenvis's data, models and materials transform the working habits of professionals?	○	○	○
Is the information given by Lenvis transforming the way citizens look for information?	○	○	○
Is implementation leading to higher expectation of professionals about citizens understanding of the system?	○	○	○
To what extent is the implementation depending on the capacity of individual to provide information?	○	○	○

SECTION 4: QUESTION ABOUT LENVIS COMMERCIAL VALUE

20) Readiness to pay:

	Yes	Don't know	No
Will the professional user be ready to pay a fee for the Lenvis services?	○	○	○
Will the citizen user be ready to pay a fee for the Lenvis services?	○	○	○

Appendix B

In the following tables are reported all the Lenvis users of Milan and Bari end user meetings.

Tab. II Lenvis users present on Lenvis meetings in Milano

User Type	Institution	Person	contact	Web site
Physicians	Clinica Pediatrica San Paolo	Marco Sala	marco.sala@unimi.it	www.unimi.it
		Marzia Mandelli	marzia.mandelli@unimi.it	
		Francesco Di Dio	francesco.didio@libero.it	
		Sabrina Argirò	sabrina.argirò@libero.it	
	ASL Milano	Maurizio Tabiadon	mtabiadon@asl.milano.it	www.asl.milano.it
		M. Rampinini	mrampinini@asl.milano.it	
	San Carlo Hospital	Sandro Amaducci	amaducci.Sandro@sancarlo.mi.it	www. sancarlo.mi.it
	Policlinico of Milan	Daniela Mari	daniela.mari@unimi.it	www.unimi.it
	CESP- research centre on public health	Sara Conti	sara.conti@yahoo.it	www.centrosanitapubblica.it
General practitioners	General Practitioner	Gioacchino Graffagnino	ggraffagnino@alice.it	
		Marco Zampieri	marco.zampieri@fastwebnet.it	
		Danilo Cadarosti	dcadarosti@alice.it	
		Anna Forzati	Annaforza4@alice.it	
		Vinicio Fay	vinfay@libero.it	
		Noemi Bruna Eisera	eiseranoemi@fastwebnet.it	
		Mauro Martini	studio@mauromartini.it	www.mauromartini.it
Environmental agency	ARPA Lombardia	Carlo Maria Marino	carlo.marino@unimib.it	www.arpa.it
	Amat-Milano	Marco Bedogni	marco.bedogni@amat-mi.it	www.amat-mi.it
Enviromental Research centres	Centro Polaris -Particulate Matter and Health Risks-	Marina Camatini	marina.camatini@unimib.it	www.polaris.unimib.it
ICT companies	GESP	Alberto Malacrida	alberto.malacrida@gesp.it	www.gesp.it
		Massimo Borlo	borlo@gesp.it	
	Contec Engineering	Giglioni Carlo	info@contec.it	www.contec.it
	Project Automation	Emanuela Seregni	emanuela.seregni@p-a.it	www.p-a.it
	BV Tech	Roberto Mazzilli	r.mazzilli@bv-tech.it	www.bv-tech.it
		Mauro Cislaghi	m.cislaghi@bv-tech.it	

	Present	Claudio Filippi	claudio.filippi@it-present.com	www.it-present.com
	Italdata	Edmondo Gnerre	edmondo.gnerre@italdata.it	www.italdata.it
		Paolo Martini	Paolo.martini@italdata.it	
Environmental companies	Arianet	Camillo Silibello	c.silibello@aria-net.it	www.aria-net.it
	EPSON	Maria Grazia Morselli	m.morselli@aria-net.it	www.epson.it
		Mario Giuliacci	giuliacci.mario@yahoo.it	
Lenvis Partners	Municipality of Bari	Vincenzo Campanaro	v.campanaro@comune.bari.it	www.comune.bari.it

Tab. III Participants to master course of health care students of UNIMI meeting 27/06/2011

DX9 71818 ANNIBALE ALESSANDRO	DX6 771970 MASCI FEDERICA
DX5 790316 BACCHETTA PATRIZIA	DX9 790271 MAZZOLENI CLAUDIA
DX7 790248 BAGNI ELENA	DX8 790202 MELERI ANNAMARIA
DX7 790165 BARRICELLA NIETTA	DX7 771768 MORANDI DONATELLA
DX8 790389 BERNARDINI VALERIA	DX 6771965 MORONE MARCO
DX7 790170 BERTOLI ELENA	DX7 790168 MUSIO FRANCESCA
DX7 790169 BONFITTO GIUSEPPE ROBERTO	DX6 771936 PIANGERELLI ALESSANDRO
DX6 790283 BONTACCHIO PAOLA	DX8 771908 PRIVITERA EMILIA
DX7 790163 CABIDDU GISELLA	DX8 790211 PUNTIERI CATERINA
DX8 790356 CAVENAGO ILARIA	DX9 771819 ROCI ELONA
DX9 771816 CENTRA MIRELLA	DX9 790219 SINNI MARIA FRANCESCA
DX8 771863 CORTI GUSTAVO	DX7 790148 TESTA PAOLA
DX8 772049 COSTANZA MIRKO	790246 BOSCHERINO GIOVANNI
DX9 772056 COZZULA PIERO	DX7 790208 DE CARO ANGELO
DX6 790289 D'AGOSTINO ENRICA	DX7 790167 RAIMONDI GABRIELE
DX9 790458 DE ANGELIS ROSELLA	DX7 7900300 FIRINU FABRIZIO
DX7 790161 DE MARCO ROBERTO	DX7 790299 PIRRO ERMINIO
DX9 790353 DONGHI CAMILLA	790277 MANDELLI NATALINA
DX6 771987 GALBIATI MARCO	DX9 790458 DE ANGELIS ROSSELLA
DX9 771815 GNECCHI LAURA	DX7 790395 LANZILOTTI LUCA
DX8 790392 LAZZARI GRETA	DX6 771988 GHILLANI MARIO
DX5 790397 LOGUERCIO ELENA	DX7 790158 PULIMENO LEONARDO
DX9 771821 LUCA ALESSIA MARZIA	771992 MUTTI ALESSANDRA
DX7 771786 LUPO ELEONORA NORMA	DX7 790160 PALIMBELLI MAURIZIO
DX8 771891 MAGISTRO MANUELA	772021 MAURO COLOSIO

Tab. IV End users at Lenvis meeting at BARI

User Type	Institution	Person	contact	Web Site
Environmental company	AQP SPA	Panunzio Marialaura	m.panunzio@aqp.it	www. aqp.it
		Abis Pier Paolo	p.abis@aqp.it	
		Portincasa Francesca	f.portincasa@aqp.it	
	Barisera	Fazio Antonella	antonellatog@hotmail.it	
	Planetek Italia	Barbieri Vincenzo	barbieri@planetek.it	www. planetek.it
Environmental agency	ARPA Puglia	Assennato Giorgio	dg@arpa.puglia.it	www.arpa.puglia.it
		Angiuli Lorenzo	l.angiuli@arpa.puglia.it	
Regional environmental	Provincia di Bari	Campanile Giovanni	g.campanile@provincia.ba.it	www. provincia.ba.it
		Latrofa Carlo	c.latrofa@provincia.ba.it	
	Regione Puglia	Ruggiero Simona	s.ruggiero@regione.puglia.it	www.regione.puglia.it
	SIGEA SEZ. Puglia	Valletta Salvatore	puglia@sigeaweb.it	www.sigeaweb.it
University and research Institutes	University of Bari Chemistry department	De Gennaro Gianluigi	Gianluigi.degennaro@uniba.it	www.uniba.it
		Demarinis Annamaria	annamaria.demarinis@uniba.it	
		Trizio Livia	livia.trizio@uniba.it	
	Università di Veterinaria	Tarsitano Elvira	e.tarsitano@veterinaria.uniba.it	
	Politecnico di Bari	Ranieri Ezio	e.ranieri@poliba.it	www.poliba.it
	Dip. Medicina del Lavoro	Massaro Tommaso	massaro.tom@libero.it	
	Research Director of the centre for research on energy and environmental economics and policy (IEFE)	Edoardo Croci	edoardo.croci@unibocconi.it	www.unibocconi.it
	IEFE junior Researcher	Tania Molteni,	tania.molteni@unibocconi.it	www.unibocconi.it
Press	RAI	Besostri Nanni	e.besostri@rai.it	www.rai.it
	Quotidiano di Bari	De Crescenzio Lucia	quotidiano@redazionepuglia.it	www.redazionepuglia.it
	Antenna Sud	Denignis Mauro	denignis@antennasud.com	www.antennasud.com
	Luca Turi (gazzetta del Mezzogiorno)	Lorusso Francesco	info@lucaturi.it	www.lucaturi.it

Appendix C

In the following table we report a mapping between all the indicators used in order to evaluate all the Lenvis products, and the different questions reported into questionnaires.

INDICATOR	*FEATURE*	*QUESTION N.*
Information quality	relevance	Section 1-question1
	usefulness	Section 1-question 2
	understandability	Section 1-question 11
	Clarity	Section 1-question 11 Section 1-question 14
	Appearance	Section 1-question 10
	Accuracy	Section 1-question1
	Timeliness	Section 1-question10
User satisfaction	Satisfaction with specifics	Section 1-question 5 Section 2-question 16 Section 2-question 17 Section 2-question 18
	Overall satisfaction	Section 1-question 4
	Information satisfaction	Section 1-question 1
	Enjoyment	Section 1-question 9
	Readiness to pay	Section 1-question 20
Individual Impact	Information understanding	Section 1-question 8
	Decision effectiveness	Section 1-question 3
System quality	Data accuracy	Section 1-question 1
	Ease of use	Section 1-question 8 Section 1-question 11 Section 1-question 12 Section 1-question 14
	Convenience of access	Section 1-question 3 Section 1-question 8
	Realization of user requirements	Section 2-question 16 Section 2-question 17 Section 2-question 18
	Usefulness of system features and functions	Section 1-question 3 Section 1-question 4
	System flexibility	Section 1-question 9
	System reliability	Section 1-question 9
	Integration of systems	Section 1-question 8
	System efficiency	Section 1-question 9
Information use	Amount of use	Section 1-question 8 Section 3- question 19
	Motivation of use	Section 3- question 19 Section 4- question 20