8.3.d Validation report: integration across case studies - intermediate report

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Short abstract	This intermediate report of WP8.3d - presents the overall conclusion of the lenvis case studies conducted in Italy, Portugal and The Netherlands. The user validation activities to date are presented in special parts of this report, 8.3. a, for Italy, 8.3.b for Portugal and 8.3.c for The Netherlands. This summary and integration report compares and discusses the validation and user feedback results across the three case study countries and draws overall conclusions for the lenvis evaluation and recommendations for further development and exploitation.		
Keywords	Case study, applications, lenvis portal, user validation		
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Glossary and acronyms

Glossary

Information System	Combination of hardware and software enabling one or more functions. An element of a system can be another system at the same time. Then, it is called subsystem which can be a controlling or controlled system or which can contain hardware, software and manual operations.
Validation	Validation checks and tests whether the system "does what it was designed for", or what users expect from it. In the context of this project, validation evaluates the impact of a developed information system on users' behaviour.
Verification	Test of a system/ function against the formal requirements specification, that is, whether it fulfils its requirements.

Accronyms

IS	Information System
ICT	Information and Communication Technologies

1.   Introduction

1.1.   Objective of this deliverable

The objective of this intermediate deliverable is to report on the work done in lenvis in Work Package 8 to develop and validate the three case studies of the project. Application products have been prepared and user validation has been carried out to receive feedback and evaluations in order to inter-actively develop and validate the lenvis products. The results of the user validation are presented in the previous parts of this 8.3 report (a, b, and c), separate for each case study. This section of the report, 8.3.d reports on the overall evaluation for the lenvis project, looking at the similarities and differences between the user validations in the three case studies, and should be considered only in conjunction with reports 8.3.a, 8.3.b and 8.3.c.
This report is a draft intermediate report which will be finalised at the end of 2011.

1.2.   Objective of user validation

The objectives of user validation are:
*   To evaluate the current products on user functionality, robustness, user-friendliness, and user usefulness and attractiveness;
*   To receive feedback to guide inter-active development during the lenvis project;
*   To raise interest and actively involve, build a relationship with, potential users of the lenvis products in dissemination and exploitation after the closure of the lenvis project.

1.3.   Outline of the report

The report explains in section two what is the theoretical base for developing the evaluation. Indicators and their selection is mentioned in this part. The results of the three case study validations are presented as spider diagrams, based on the selected indicators.

Section 3 makes an overall analysis of the obtained results. Section 4 looks at the similarities and differences in the evaluations coming from the three case studies. Last section is comprised of conclusions and reccomandations regarding the overall lenvis evaluation and the marketing strategy.

The questionnaire to which the report refers to, are annexes in the validation reports of each case study (8.3.a, 8.3.b and 8.3.c) and are not repetead here in order to avoid redundancy of report 8.3 as a whole..

2.   Overall lenvis validation results

The validation of lenvis products was carried out on two separate elements: water-health and air-health, based on the evaluation strategy proposed in Deliverable 8.2.
According to the evaluation strategy two types of validations were carried out:

- ***Technical performance (efficiency) of lenvis system.*** Tools produced in the project were assessed to assure that they are conform to the requirements set out in the specification document, Deliverable 2.1, and that the component s of the system interoperate as planned. Operability, reliability, robustness and flexibility of the lenvis system were evaluated in this step.
- ***Effectiveness of lenvis system*** was evaluated based on the quality of the results of the case studies carried out in Italy, Portugal and The Netherlands and were addressing the quality of the results and the acceptance by the end-user of the tools produced in the project. Information quality, individual impact, user satisfaction, system quality & information were assessed in order to evaluate the effectiveness of the lenvis system.

The list of indicators for evaluating the project was selected based on the questions that users answered. Each indicator was evaluated in a scale from 1 to 5, being the rate of a category computed as the average of one or more of its indicators.

2.1. Selected Indicators for evaluation

A list of indicators have been developed and identified during the elaboration of the evaluation plan.

These set of indicators are shown in Table 1.

Technical performance		Effectiveness of lenvis system		
System Quality	**Information Use**	**Information Quality**	**User Satisfaction**	**Individual Impact**
- 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	- Amount of use/duration of use - Number of inquiries - Amount of connect time - Number of functions used - Number of records accessed - Frequency of access - Frequency of report requests - Nature of use: - Use for intended purpose - Appropriate use - Type of information used - Purpose of use - Voluntariness of use - Motivation to use	- Importance - Relevance - Usefulness - Informativeness - Understandability - Clarity - Appearance - Accuracy - Timeliness	- Satisfaction with specifics - Overall satisfaction - Information satisfaction: - Difference between information needed and received - Enjoyment - Decision-making satisfaction	- Information understanding - Decision effectiveness: - Decision quality - Improved decision analysis - Correctness of decision - Time to make decision - Confidence in decision - Decision-making participation - Personal valuation of I/S - Willingness to pay for information

2.2. Indicators selection

For each evaluation questionnaires have been developed to complement the interviews, face-to-face user meetings, phone conferences, and e-mail feedback. (see annexes of reports 8.3a, 8.3.b, 8.3.c)

Out of these questionnaire the indicators have been evaluated, for each case study. The selection of each of these indicators, per case study and of their mapping with the questionnaires are as follows (please see Table 1, for the indicators list):

> ### 1. Technical performance (efficiency) of lenvis system
> -   System quality : all indicators can be evaluated for all case studies;
> -   Information use :
>   - Amount of use (Italy. The Netherlands)
>   - Voluntariness of use (Portugal, The Netherlands)
>   - Motivation of use (Portugal, Italy)
>
> 2. *Effectiveness of lenvis system*
> - For information quality
>   - relevance (Italy);
>   - usefulness (Italy, Portugal, NL)
>   - understandability (Italy)
>   - clarity (Italy, Portugal, NL);
>   - appeareance (Italy);
>   - acuracy;(Italy, Portugal, NL)
>   - timeliness (Italy, Portugal, NL)
> - For User satisfaction
>   - Satisfaction with specifics (Italy)
>   - Overall satisfaction (Italy)
>   - Information satisfaction (Portugal, NL)
>   - Enjoyment (Portugal, NL)
>
> - For individual Impact (see table 3, Evaluation report)
>   - Information understanding (Italy)
>   - Decision effectiveness (Portugal, NL)
>   - Personal valuation (Portugal)

The identified mapping on the questionnaires is:
> 1. For the Italian case study:
- 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

  2. Evaluation indicators used on portuguese case study evaluation:
- Indicators used on Web services: timeseriesclient, Services MapViewer, Particle Tracking model
  1-System quality (easy of use, usefull of system features and functions, system efficiency,
  2- Information use (voluntariness of use, nature of use
  3- Information quality (informativeness, understandability clarity
  4- User satisfaction (information satisfaction,
  5- Individual impact (decision effectiveness, Information use
- Indicators used on Surfers applications
  1- Information quality (usefulness, informativeness)
  2- User satisfaction (enjoyment, Overall satisfaction, satisfaction with specifics)
  3- Individual impact (personal valuation, decision quality)
  4-System quality (usefull of system features and functions)
  5- Information use (Nature of use, voluntariness of use)
- Indicators used on Portal evaluation
  1- Information 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)
  2- User satisfaction (Overall satisfaction, realization of users requirements
  3- Individual impact (Information use)
  4-System quality (easy of use, convenience of access)
  5- Information use (nature of use, Information understanding)
- Indicators used on Alert system and bathing water forecast evaluation
  1- Information quality (Usefulness, timeliness, Data accuracy, informativeness, understandability)
  2- User satisfaction (realization of users requirements, satisfaction with specifics)
  3- Individual impact (Information use, decision analysis, willingness to pay)
  4-System quality (usefull of system features and functions, data accuracy)
  5- Information use (nature of use, frequency of access, motivation to use)

  3. For the Dutch case study:
- Indicators used on Air quality application product web-based portal gadget:
  1-System quality (Eas of use, System flexibility)
  2- Information use (Motavation to use)
  3- Information quality (Accuracy)
  4- User satisfaction (Overall satisfaction)
  5- Individual impact (Information understanding)
- Indicators used on Air quality application product i-phone app:
  1-System quality (Eas of use, System flexibility)
  2- Information use (Motavation to use)
  3- Information quality (Accuracy)
  4- User satisfaction (Overall satisfaction)
  5- Individual impact (Information understanding)
- Indicators used on Bathing water qaulity website application product, professional users:
  1-System quality (Eas of use, System flexibility)
  2- Information use (Use for intended purpose)

        3- Information quality (Accuracy)
        4- User satisfaction (Overall satisfaction)
        5- Individual impact (Information understanding)
- Indicators used on Bathing water qaulity website application product, public users:
        1-System quality (Eas of use)
        2- Information use (Voluntariness of use, Motivation of use)
        3- Information quality (Understandibility, clarity)
        4- User satisfaction (Overall satisfaction)
        5- Individual impact (Information understanding, Decission effectiveness)

3. Analysis and discussion

3.1. Intercomparison of case study user evaluations

In order to make the intercomparison on the validation of the results, the mapping of the indicators into a spider diagram, for each case study, are presented below, clustered on different criteria, such as area of application (water or air), or web services, or lenvis portal. The detailed description of the results is on each case study validation report. This section looks at similarities and differences in validation, across the three case studies.

3.1.1. Air quality gadgets

Air quality evaluation for the lenvis are presented in the following three figures, for the case studies where air quality was tested. Two tests for the air quality were in Italy (in Milan and inBari) and one in The Netherlands (in Eindhoven).

Though there seems to be overall good satisfaction in the case of the Italian case study, in case of The Netherlands the range between satisfaction and unsatisfaction is very small. The most pessimistic evaluation is the one on the i-Phone applications, regarding the individual impact. This could be due to the fact that users are not yet ready to use information coming on their phones, as compared with the information on a website. Culturally there is still a need to overcome the idea that all that internet can provide you as an information is available nowdays on the phone as well.

The portal gadget in the Netherlands is different evalutated than the overall evaluation in Italy, with the most feedback (lowest score) on information use. However the evaluation of the i-phone gadget in the Netherlands shows clear similarity with the evaluation in Italy, with both high values for User satisfaction. All applications were valued high for their information quality.

Overall the air quality application products have been well received in both Italy and the Netherlands.
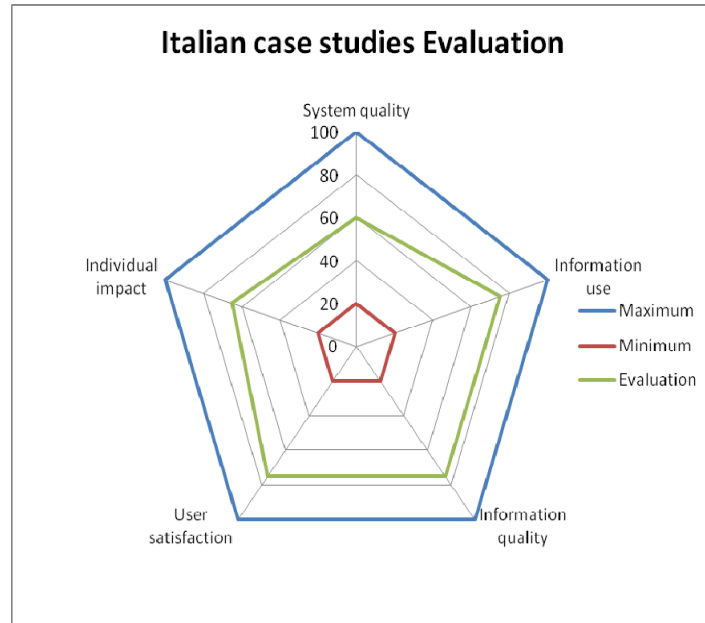
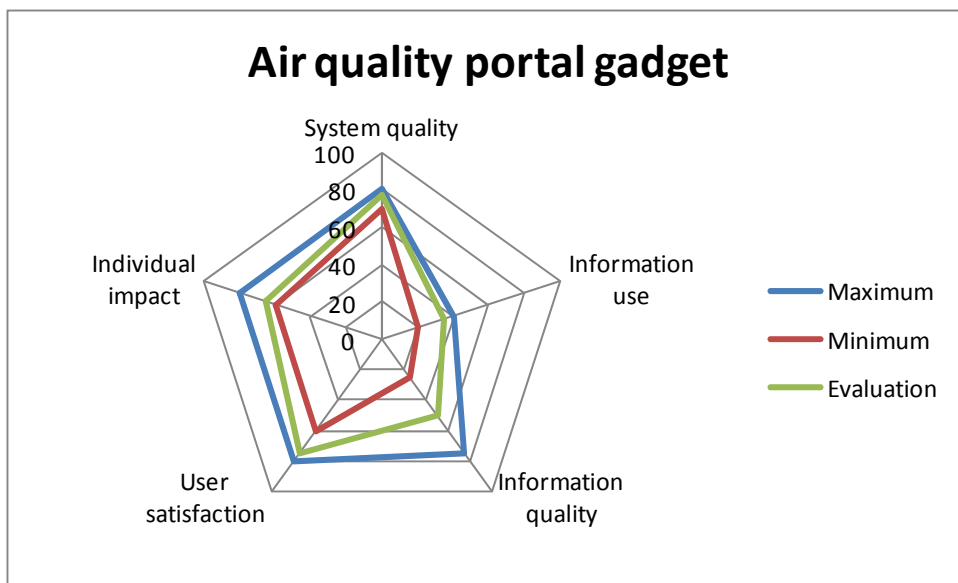Fig 1. Overall evaluation of Italian air case studies

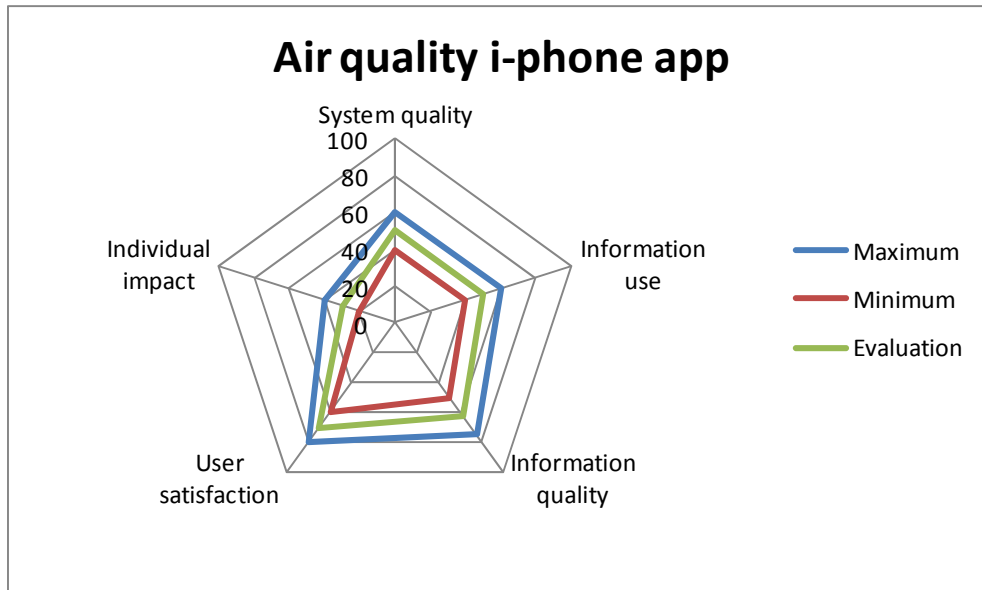Figure. 2 Spider diagram evaluation Dutch case study

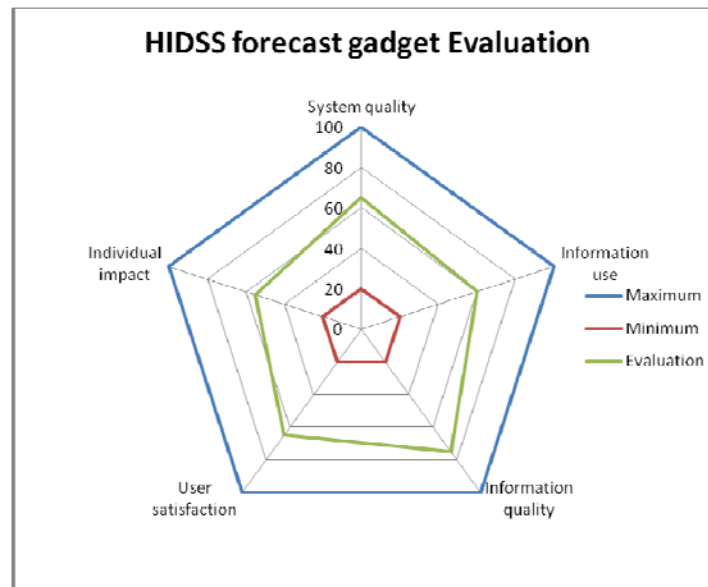Figure 3 .Spider diagram evaluation, Dutch case study

Figure 4.Spider diagram evaluation for the Italian case study

3.1.2. Bathing water quality website

The following three spider diagrams are looking at the quality of the bathing water in Portugal and The Netherlands. The services provided by lenvis are at the high stadards in both countries. The only indicator which is under the value of 40% is the Individual impact on professional users. This is expected to be like that because professional users have different sources of information, even from their own work, so a sitem, as lenvis is, which addresses the whole population will not have the same impact on them as their own information from trusted sources from work.

When comparing the bathing water quality feedback for the Netherlands and Portugal simililarities are in the high appreciation of System Quality and Individual Impact.

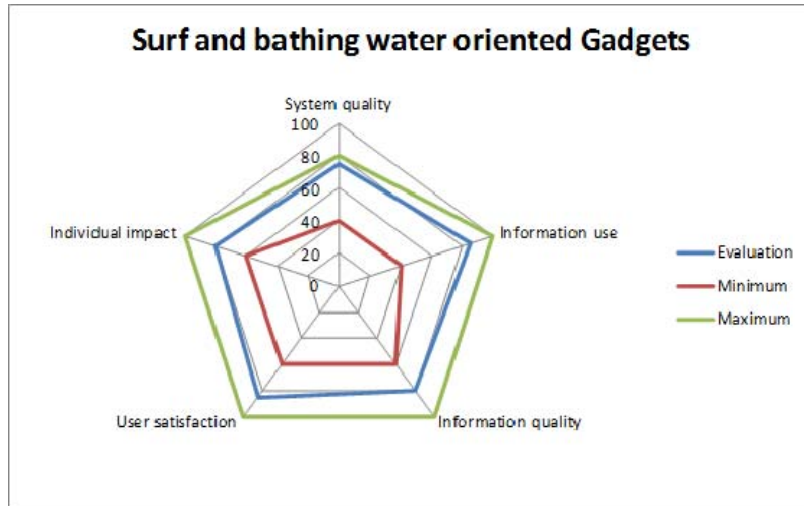However overall the appreciation for the services is very high.

Figure 5. Spider diagram of Surf and bathing water oriented Gadgets evaluation for Portuguese case study
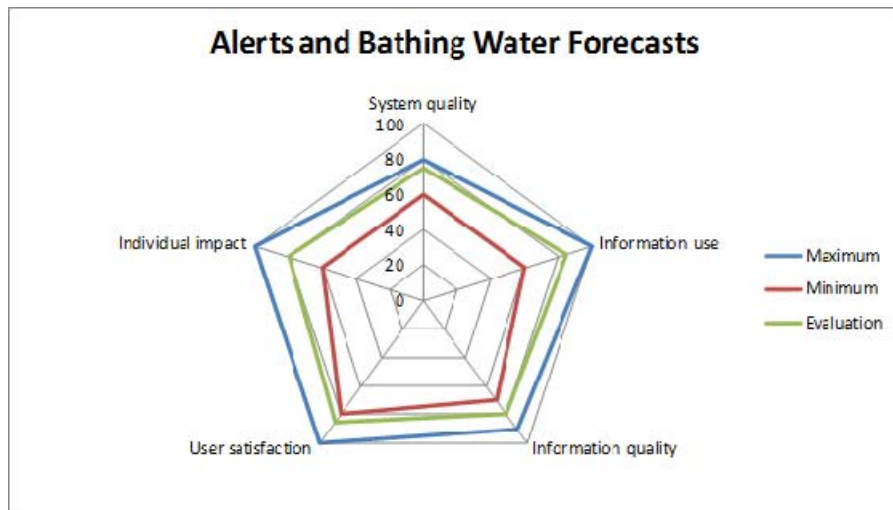

Figure 6 . Spider diagram of alerts and bathing water forecast evaluation for Portuguese case
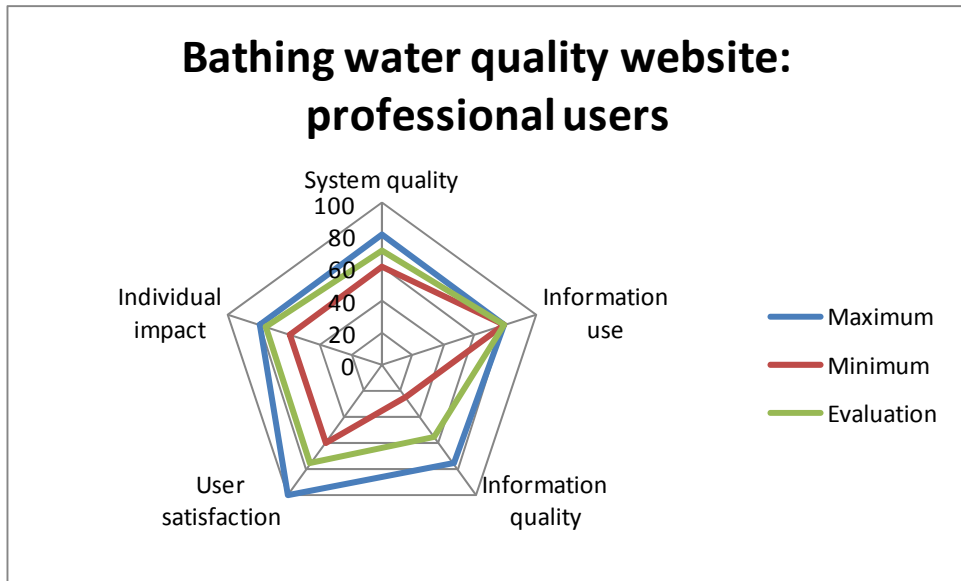
Bathing water quality website: professional users

Figure 7.Spider diagram evaluation for Dutch case study

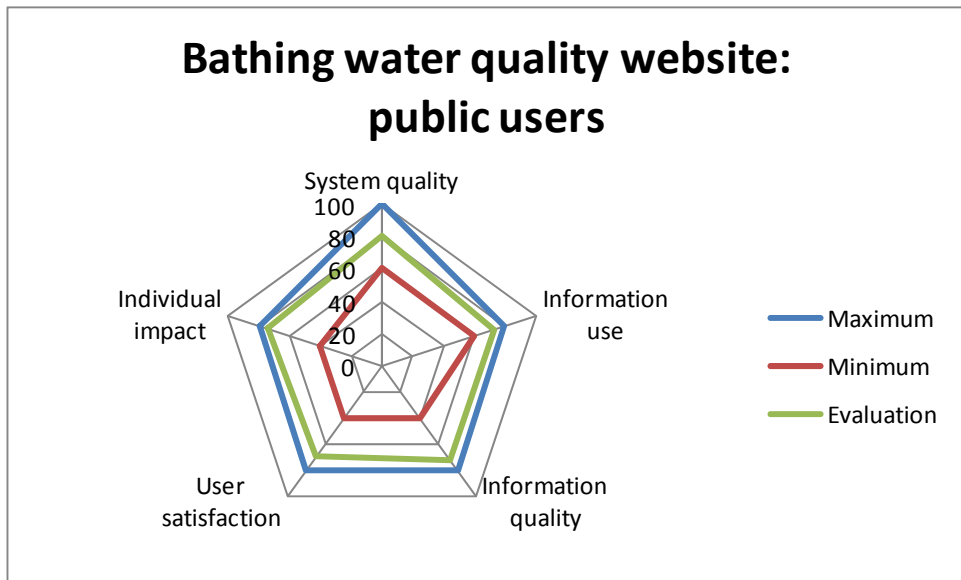**Bathing water quality website: public users**

Figure 8 .Spider diagram evaluation for Dutch case study

3.2.   Lenvis portal

With the portal evaluation the result shows remarkable similarity in Portugal and Italy, with overall high valuation, in particular for Information Quality and User Satisfaction. This can be seen as a succes for the portal to be genericly applicable in different countries.
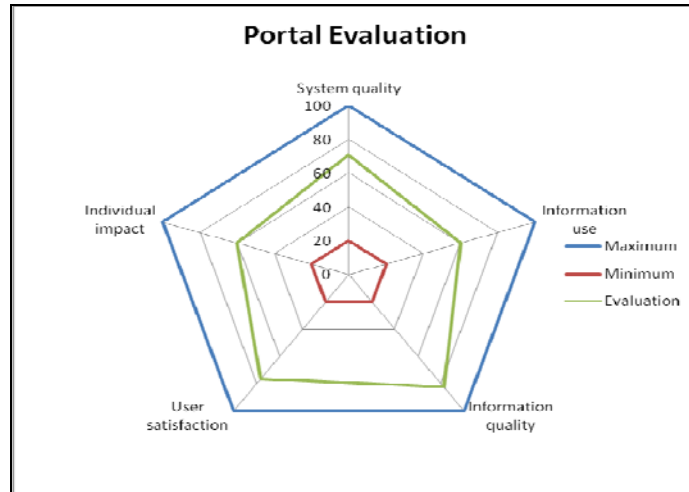
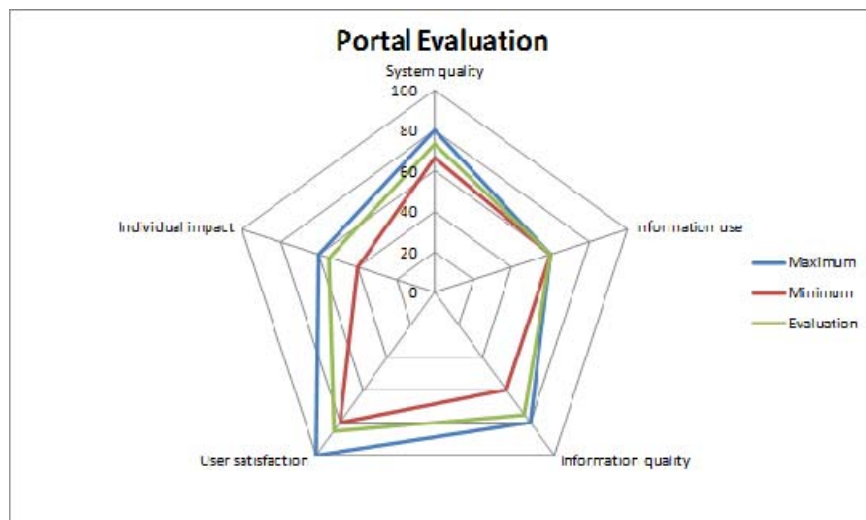Figure 9. Spider diagram evaluation for the Italian case study

Figure 10 .Spider diagram evaluation for the lenvis portal in Portuguese case study

3.3.   Discussion

An interesting observation is that in Italy and Portugal the difference between minimum and maximum scores is large, while in the Netherlands this is usually small. This could be the result of cultural differences where it seams that Italian users are more open / expressive in expressing their feedback.

- After analysing the results it is interesting to see that users acrros Europe are validating lenvis products in a similar manner.
- Discussion of the user validation strategy and activities (difficulties, successes, suggestions of other activities or planning or what strategy to follow for user validation/involvement in continuation activities after lenvis)

4. Overall lenvis conclusion and recommendations

4.1. Differences in case study evaluations

In Milano there is more interest in the health implications due to the criticality of winter months of the air pollution problem and the debate of the last five years, at least, about the interactions among traffic, residential heating, air pollution and health impact. Bari users have been more interested and particularly appreciated the forecasting and simulation facility of Lenvis and how close they take into account meteorological conditions mostly wind and temperature.

In Portuguese case study the services developed on lenvis focus on bathing water quality. Lenvis users were available and participated actively on lenvis sessions with the participation of more than 20 users from more than 10 entities. During these meetings the comments and feedback obtained were very useful for lenvis progress and development. One big limitation was the fulfilling of questionnaires, because the professional users prefer to give their feedback by comments during the meetings. The main evaluations activities had to occur during the bathing season (May-September 2011) in order to validate the bathing water forecast and the alert system.

4.2. Similarities in case study evaluations

In both use cases the mobile applications of Lenvis were very appreciated. There is indeed a growing awareness among public officers and elected officials of the potential of new ICTs, including social network, to distribute alerts to the population at large and to selected groups. This is compounded by the greying of the Italian population whose fastest growing segment is 80+ which are prone to develop a critical medical condition once information and alert thresholds are observed.

4.3. Lenvis overall user evaluation

The overall evaluation is positive. Members of all users groups have expressed a unqualified approval of applications in particular mobile applications. As far as, the portal is concerned the overall feeling that a further simplification of user interface could go a long way towards a larger acceptance.

The overall evaluation is very positive. Portuguese professional users were very satisfied with the information system developed by Lenvis, once that is helps to share information between different professional users. Members of all users groups have expressed a qualified approval of lenvis applications in particular the ones that allowed to sea bathing water data.
Also the surfers, Portuguese non-professional users were also satisfied with lenvis portal and the gadgets related with waves forecasts.
Both professional and non-professional lenvis end users would like to see lenvis information system expanded to other bathing waters in Portugal, what reveals their satisfaction on lenvis results.

4.4. Recommendations for further development of lenvis

Based on the validation following are the recommendation that can be made:

- The meteorological information data services are now more localised such that users can select meteo-stations for their area of interest and display monitoring data, and predictions for that station.

- For the air quality case study the focus of the feedback from professional users on the relationship with health impacts and communication with public users, re-assured the focus

in development on a pilot air quality prediction system with customisable, both in localisation and forecast horizon, viewing of results. The detailed feedback concerning the maps, has already been incorporated by including a scale bar and by including the 3-D effect through the use of the Google Earth API. For the health impact the coupled modelling results of the air quality and health model for the Italian case study will be closely followed, and potential for adoption in the Netherlands will be analysed. Next to this, in response to the feedback on the level of detail of the predictions, the 5 by 5 km spatial resolution emission inventory is being included in the prediction model.

- Because of the difficulty of retrieving detailed (high spatial and temporal resolution) emission inventory data for the Dutch case study, the web-application for updating the emission inventory was developed for air-quality professionals of the Province of Noord-Brabant. This allows further improvement of the air quality model, and it allows for analysing the effect of management action to reduce emissions on the air quality predictions through scenario calculations.

- For the water case studies the focus of the professional users of the Province of Noord Brabant, the Water Boards, and the national Directorate for Water Resources, on communication of the up-to-date bathing water quality of fresh water lakes to the public users according to the EU bathing water directive, directed the developments to a dedicated website. Where in the beginning the pilot web-site consisted of many technical functionalities from the start of the home-page, in later versions the home-page was simplified to make it easier to understand and to see the overview by public users. Through inter-active development with monthly meetings with the technical and communication professional users a layered website was built that primarily allows easy localisation of the lakes and their present water quality status.

- To preserve consistency with EU bathing water directive and forthcoming Dutch national agreements on design of physical information boards at the bathing water location, similar design was applied to pop-up tabs on Google-maps api.

- With respect to the mobile phone applications feedback that these should make use of functionalities unique to mobile phones, layer applications are currently probably the best examples. Layer applications make user of both the GPS and Compass functionalities of the newest smart phones. The positive feedback on the layer application for bathing water quality leads to a focus on improving that application and where possible integrating it in the testing activities in 2011.

- The work on bathing water forecast validation should continue in order to have at the end of 2011 a validated methodology, in order to use it in 2012. This validation is very important because water management professional users cannot send false alerts on bathing waters because a false alert on bathing water can have an enormous negative impact on general public, and even on Portuguese media

- SurfersOracle and surfers and bathing water lenvis products, should be shared on more populated web sites, in order for achieve more end users. IST and HID are making efforts to use bigger Portuguese web sites to share this lenvis surfer developments.

- Lenvis portal could be more visible on internet, in order to achieve more public users.

- Also the system quality of some gadgets should be enhanced in terms of reliability and usability.

- The system quality should be enhanced in terms of reliability and usability. While specific applications, particular those delivered on mobile channels, can be quickly accepted,

navigating through the portal and learning how to orchestrate individual service in a complex one still requires specific skills considerable enthusiasm and substantial time. All these requirements would have to be reduced in any further Lenvis development.

4.5.   Recommendations for further exploitation and marketing of lenvis

Should be done enforces in order to make Lenvis portal more visible on internet, in order to achieve more public users. Also the SurfersOracle and surfers and bathing water lenvis products, should be shared on more populated web sites, in order for achieve more end users. IST and HID are making efforts to use bigger Portuguese web sites to share this lenvis surfer developments. Portuguese professional users demonstrate their will to expand the implemented information system and alert system to other bathing waters. Once that bathing water quality is an important issue and touristic and economic sector in Portugal, this tool could have a good acceptation.

In Italy, both environment and health are demanded to the Regions, so the defining event will be how the different Regions develop their systems to make them compliant to the European Directive. So, any exploitation and marketing activities have to be timed accordingly and addressed from one side to increase in the decision makers the awareness of the potential of new ICTs and from the other to demonstrate how Lenvis prototype can result in lowering time, costs and complexities in the development and deployment of the next generation environmental information systems.

References

- Lenvis report D1.2
- Lenvis report D5.1
- Lenvis report D5.2
- Lenvis report D8.1
- Lenvis report D8.2
- Lenvis report D9.5