Monitoring public response and user ability in consulting and managing the Dynamap system

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ABSTRACT

The DYNAMAP project is a LIFE project aimed at developing a dynamic noise mapping system able to detect and represent in real time the acoustic impact of road infrastructures. To that end, the project has involved the design of a complex monitoring network and communication devices, as well as the implementation of an advanced management and reporting platform to update noise maps and inform the public on noise issues.

Public information on noise impacts is one of the most problematic objectives of the environmental noise directive 2002/49/EC that authorities responsible for providing strategic noise maps shall face. In order to facilitate public information, a web-GIS software application has been developed within the Dynamap project.

To guarantee the full effectiveness of this application, a group of selected users has been monitored to check their aptitude in managing the system and help developing a user-friendly interface for public information. Tests have been also administered to the general public to evaluate the system versatility and its contents comprehensibility.

In this paper a detailed description of the tests prepared to check recipients ability in managing and consulting the system, of the results achieved and of corrective actions undertaken to improve the web software application is reported.

Keywords: Dynamic noise mapping, Usability test
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1. INTRODUCTION

The DYNAMAP project (Dynamic Acoustic Mapping - Development of low cost sensors networks for real time noise mapping) is a LIFE project aimed to develop a

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dynamic noise mapping system able to detect and represent in real time the acoustic impact of road infrastructures.

Scope of the project is the European Directive 2002/49/EC relating to the assessment and management of environmental noise (END) [1-2], enforcing Member States to provide and update noise maps every five years in order to report about changes in environmental conditions (mainly traffic, mobility and urban development) that may have occurred over the reference period.

The Directive 90/313/EEC3 [3] enforces also public authorities to give free access to environmental information, setting out the basic terms and conditions on which such information should be made available. According to this directive, Member States shall ensure that public authorities make environmental information available to any natural or legal person at his request and without his having to prove an interest. They shall also define the practical arrangements under which such information is effectively made available and shall take the necessary steps to provide general information to the public on the state of environment by such means as the periodic publication of descriptive reports.

To that end, in the Dynamap project a user friendly interface and tools have been developed, so as to deploy the information gathered by the system on a large scale. In order to optimize the communication features of the software application, the project includes also a series of tests to assess users ability in accessing information and managing the system. To do so, a group of selected users has been monitored to check their aptitude in managing the system and help developing a user-friendly interface for public information. Tests have been also administered to the general public to evaluate the system versatility and its contents comprehensibility.

2. THE WEB GIS SOFTWARE APPLICATION

The core idea of the Dynamap project is based on the possibility of implementing dynamic noise maps by summing up several source related noise maps together, each one scaled by the system according to continuously measured noise data. Basic noise maps have been prepared using commercial calculation models as a function of some environmental parameters affecting noise propagation, such as meteorological conditions [5-6] and road traffic distribution. Dynamic noise maps are accomplished with a newly developed software application, whose main role is to scale the pre-computed partial noise maps as a function of the noise levels detected by the monitoring devices, sum them together to achieve the updated noise map and publish the results as coloured geo-referred noise maps in a user friendly format [7].

This new application has been integrated in the "Dynamic maps" page of the Dynamap website [8] where two buttons allow to select the Milan or Rome pilot areas (Figure 1). Clicking on buttons, the online tool opens showing the data related to the selected area.

The software platform implements a double access function with high and low privileges to protect sensitive information.
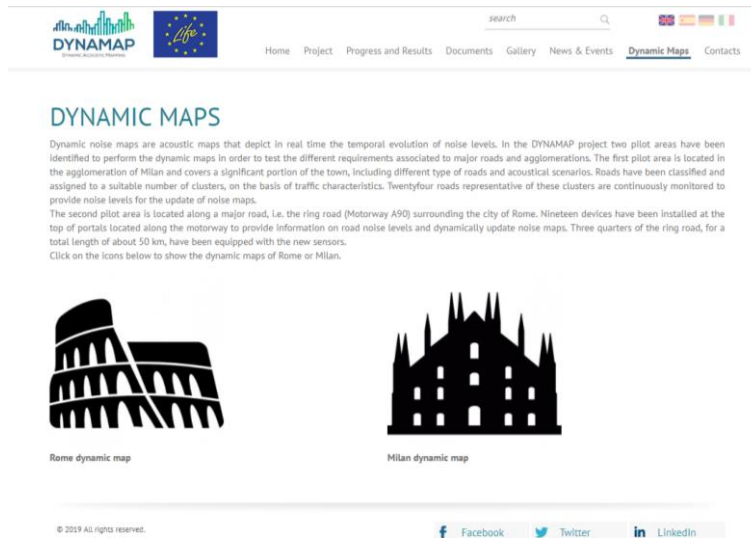
Figure 1. "Dynamic maps" page on the project website.

The high privilege access (full access to the information stored in the platform) is reserved to authorized stakeholders and allows to plot Leq dynamic noise maps, historical data, some statistics and additional parameters linked to the sensors installed in each monitoring station (Figure 2).
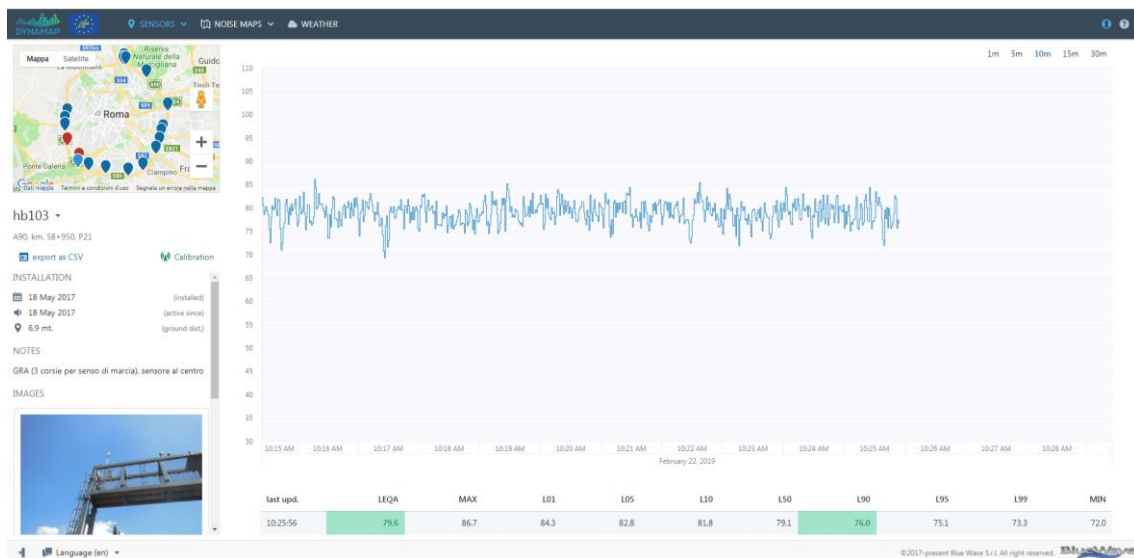

Figure 2. Sensors installed in Rome pilot area (reserved interface)

The low privilege access level is open to the general public, and allows to plot only noise maps in terms of a new disturbance index, specifically developed in the frame of the Dynamap project [9]. In Figure 3 a general view of the user interface designed for the general public is shown. On the right side the dynamic map in terms of disturbance index are reported, while on the left side information about the selected building is shown, such as the indicator hourly values. In this frame also information about Action Plans is reported to inform the public about planned mitigation measures in critical areas (Figure 4). Noise mitigation measures have been plot on the map and a popup shows the related main information. An educational area with information and advice to help reducing noise levels and descriptive documents are also published.
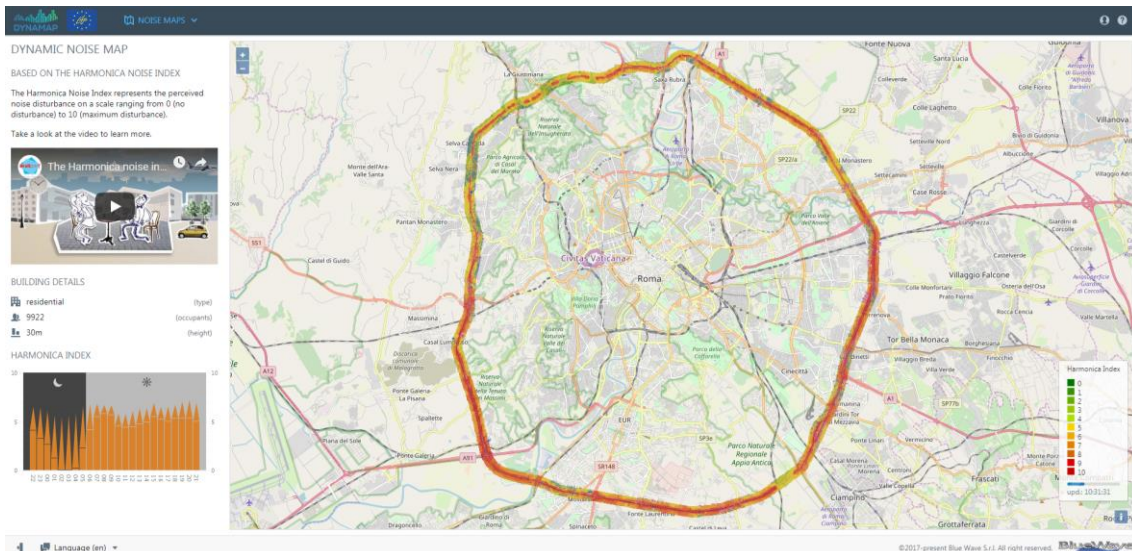
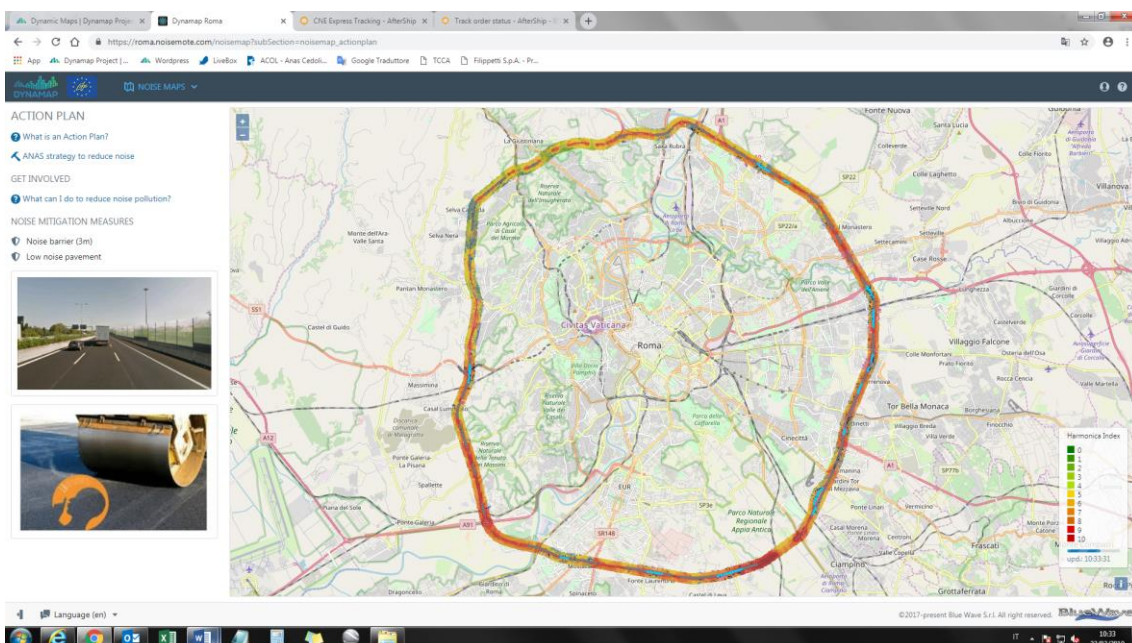*Figure 3. Rome dynamic map (general public interface)*

Figure 4. Rome Action Plan section (general public interface)

3. THE TEST PHASE

To guarantee the full effectiveness of this application, public response has been investigated as a function of two main objectives:

- to check the functionality and usability of the first level users interface addressed to system managers;
- to check users friendliness and accessibility of the second level interface addressed to stakeholders and the general public.

Consequently, two kind of tests have been prepared.

The first type of test has been addressed to ANAS and Milan Municipality/AMAT officials. The test included direct observation of users ability in managing the system and the compilation of a technical evaluation form.

The second type of test has been addressed to stakeholders and the general public. In this case, the test required a direct access to the system through the project website and the compilation of a short questionnaire to acquire information about users reactions. The

questionnaire included questions on project tools capability of raising people awareness on noise through freely accessible information and communication from the website.

3.1 Test to officials

The participants were selected among Anas, Amat and Milan Municipality officials, who are working in the environmental acoustics field or are generally interested in the Dynamap system. Among the selected people, there are also future potential users of the system.

Before the test session, a training course has been held to deliver to Dynamap system users the necessary skills to manage and maintain the system. Dynamap technical manual and user guide have been presented and distributed at the training course.

After the course, participants were asked to explore and test the Dynamap platform, assisted by software experts and developers, and to fill in a questionnaire. In particular, participants rated the site for the following major issues:

- Frequency of use;
- Site organization and ease of use;
- Content facilities exploration;
- Usefulness of site content.

The test was attended by 10 officials for Anas and 4 for Amat. From the data gathered, we discerned that our population sample was composed mainly of young adults in the range of 25 to 45 years old (Figure 5). The majority of our testers, 79%, were male (Figure 5), and 89% of testers possess a high educational level (Figure 6).
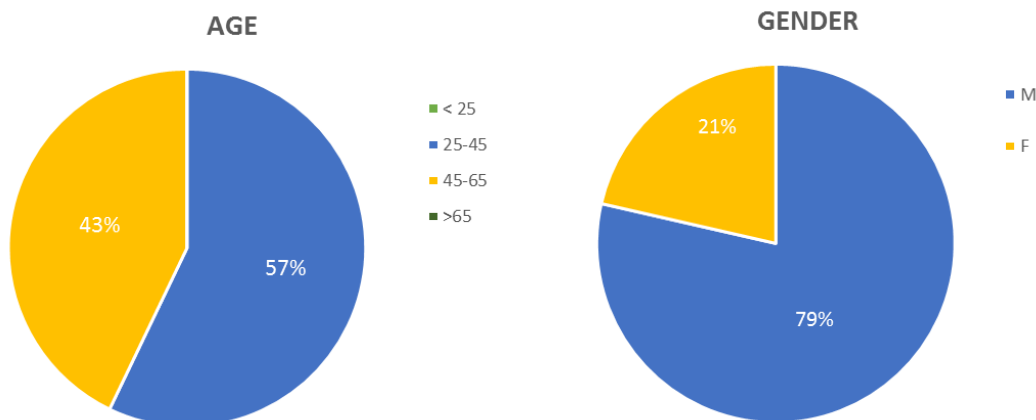

Figure 5 – Officials age (left) and gender (right)

Professionally, our testers are identified as follows (Figure 6):

- 8 engineers (57% of testers);
- 2 quantity surveyors (15% of testers);
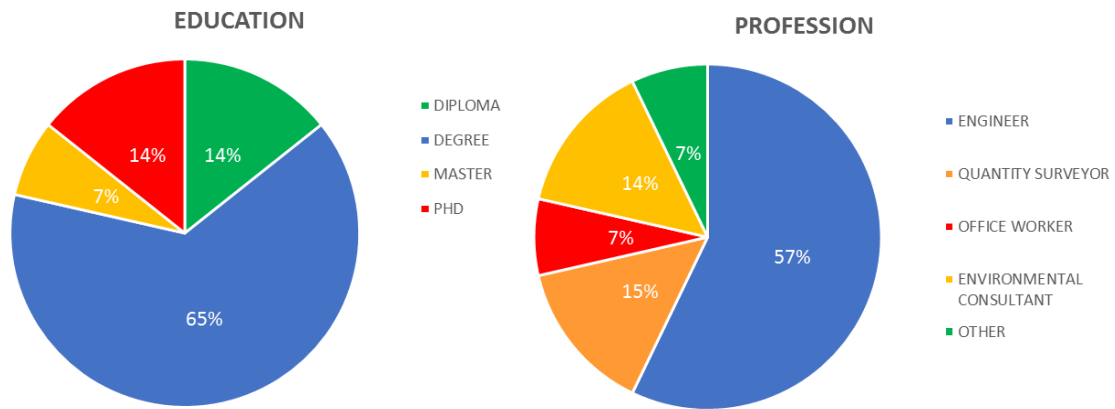- 2 environmental consultants (14%)
- 1 office worker (7%);
- Other (7%).

Figure 6 – Officials education (left) and profession (right)

As for frequency of use, Figure 7 shows that the Dynamap platform was seen for the first time by most of the test participants (57%) during the training course. On the other hand, all the participants have underlined that they will use the site in the future.
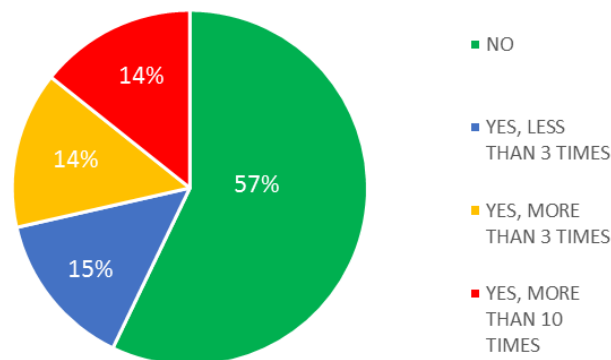

Figure 7 – Dynamap platform knowledge

The general organization of the site has obtained an excellent average score (4 on a scale of 1 – very bad - to 5 – great-) and the participants considered the content sufficiently clear (average score 3.7). However some suggestions to improve the communication aspect of the site have been given. The site has been also evaluated to be simple to use (average score 3.9), although many testers have highlighted the lack of a complete legend. The contents were generally assessed easy to be understood and well organized (average score 4). Some difficulties have been found in understanding the functionality to view buildings and mitigation actions details by clicking on them and in accessing the conflict maps.

The DYNAMIC MAPS section has been evaluated very useful by the officials (average score 4); a lower score was instead obtained by the ACTION PLAN section (3.4). In particular, the testers suggested to improve the Questionnaire on Action Plans, by geo-localizing citizens polls both by reverse geocoding and by direct entry to the buildings with the related mitigation measure.

The SENSORS section received excellent ratings from all the officials, who consider it complete with all the necessary information. A direct link to dynamic maps and possibility to add data of previous monitoring campaigns in other measuring points (creation of a monitoring database) have been suggested.

The STATIC MAPS section was considered useful and complete by all the testers. The possible suggested applications are:

- evaluation of the mitigation measures effects;
- design of noise mitigation measures;
- acoustic impact analysis of new works;
- evaluation of noise levels variability over time in order to identify the most critical periods in areas of interest.

Regarding the data to be downloaded, the officials considered them easy to be used and END compliant.

Finally, the METEO section received some observations on the clarity of the contents: officials highlighted that it is not clear if the data are in real time and they have also suggested the creation of weather maps.

Upon completion of the tasks, participants provided feedback for what they liked most and least about the website, and recommendations for improving the website. In particular:

- Liked Most: operational features, response times, easy to use, aesthetics, usefulness of the contents;
- Liked Least: communication skills, cartographic basis slightly updated.

3.2 Test to general public

For users testing session, a sample of participants was identified within a demographic target specified by the project team with the aim of involving the greatest number of people of different ages, cultural level and profession. Participants were recruited by email: a link was sent them to fill out the online form on Google Forms both for Rome and Milan pilot areas.

A total number of 46 people participated in the test. From the data gathered, we discerned that our sample of testers was comprised most of young adults in the range of 25 to 45 years old (Figure 8). The majority of our testers, 63%, were male (Figure 8), and 50% of testers possess a higher degree (Figure 9).

Professionally, our testers are identified as follows (Figure 9):

- 11 engineers (24% of testers);
- 10 office workers (22% of testers);
- 6 environmental consultants (13% of testers);
- 7 technicians (15%);
- 3 researchers (7%);
- 2 professors (4%);
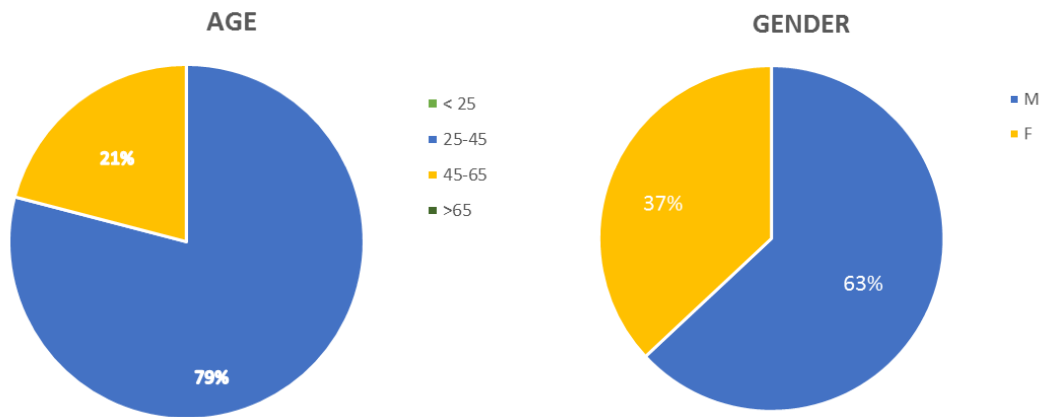- 7 other professions (15%).

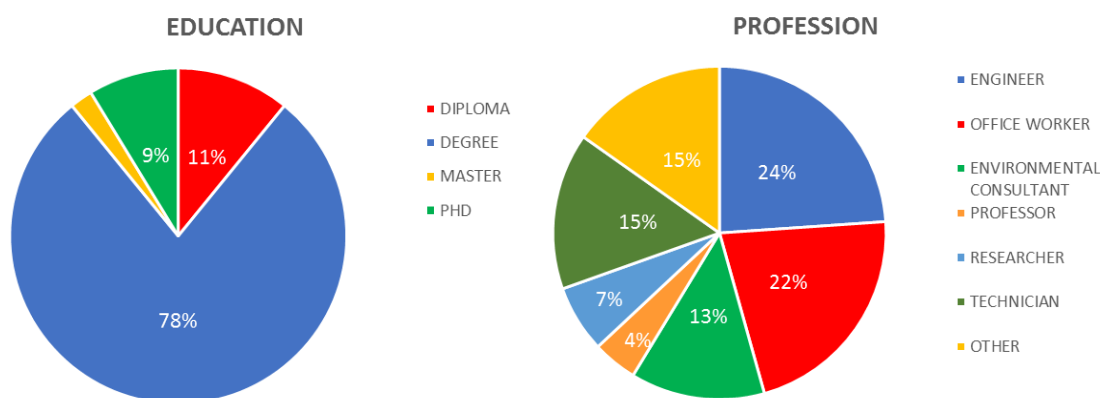*Figure 8 – General public age (left) and gender (right)*

Figure 9 – General public education (left) and profession (right)

We first used the questionnaire to investigate whether our participants are able to use internet and/or are expert in the acoustic field, in order to understand their ability in browsing websites and testing new applications.

Most of the testers showed a medium-good knowledge in the field of acoustics and a very comfortable attitude to the internet use (Figure 10). As shown in Figure 11, the Dynamap platform was seen less than 3 times before the test by most of the participants (56.5%).
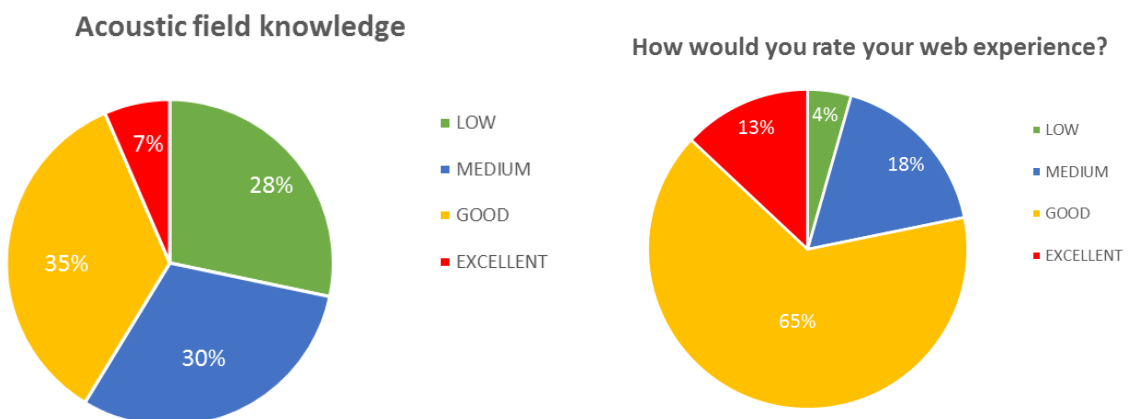

Figure 10 – General public acoustics knowledge and attitude to use internet

The testers who have already seen the application basically visited the website to read the Dynamap project contents and documents and to consult the dynamic maps.
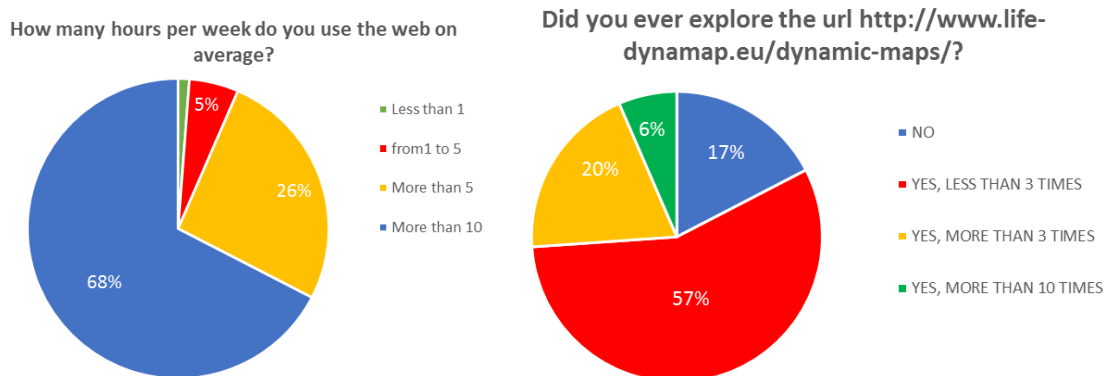
Figure 11 – Weekly hours spent on the web by testers and Dynamap platform knowledge

The general organization of the site has obtained a good average score (3.6 on a scale of 1 – very bad - to 5 – great-) and the participants considered the content sufficiently clear (average score 3.8). Nevertheless, the less experienced participants in the acoustics field have highlighted the website overly technical nature and the difficulty to understand what is displayed without reading explanations.

The site has been also evaluated to be simple to use (average score 3.7), although also in this case many testers have highlighted the lack of a complete legend.

The contents were generally assessed easy to be understood and well organized (average score 3.8). Some difficulties have been found in understanding the interactive features to view buildings and details on mitigation actions. It doesn't seem always clear how to switch from Rome to Milan pilot areas and vice versa. In addition the need to have an Italian version of the Harmonica Index has been underlined.

The MAPS LIVE section has been evaluated very useful and funny by the general public (average score 3.8). In particular, according to the participants, dynamic maps can be very useful to understand and visualize the noise pollution impacting the city. An interesting dynamic maps use proposed by the general public is to search less noisy areas where living for.

A lower score was instead obtained by the ACTION PLAN section (3.5): some doubts have been expressed on the general public judgments account in the mitigation measures design phase.

Upon completion of the tasks, participants provided feedback for what they liked most and least about the website, and recommendations for improving the website. In particular:

- Liked Most: operational features, response times, easy to use, aesthetics, usefulness of the contents;
- Liked Least: too technical, some parts are a little bit confusing.

4. RECOMMENDATIONS AND CORRECTIVE ACTIONS

Questionnaires results have been then used to identify corrective actions in order to meet user needs and fine-tune the web-GIS application to make its use simple and at the same time effective in relation to the project objectives. Table 1 shows the recommended changes driven by the participant observations, behaviours, and comments. Each recommendation includes a priority index given on the basis of the received observations number and according to Dynamap team judgement on the relevancy with

the aims of the project. The suggestions highlighted in light gray have been not accepted by the Dynamap team, after an analysis on their feasibility and usefulness to the project.

Table 1 - Suggested corrective actions

PUBLIC AREA		
SECTION	**CORRECTIVE ACTION**	**PRIORITY**
GENERAL	Improve communication aspect	LOW
	Add an help	HIGH
MAPS LIVE	Add a complete legend	HIGH
	Clarify that you can click on the buildings to view details	HIGH
	Highlight sensitive receivers with a different color	HIGH
	Emphasize this section on the web site	NA
	Insert subtitles in Italian language in the harmonica index video	LOW
	Make the language selection key most evident	na
	Insert a switching function between the maps of Rome and Milan	MEDIUM
ACTION PLAN	Add a complete legend	HIGH
	Clarify that you can click on the mitigation measures to view details	HIGH
	Make the mitigation measures more visible on the screen	HIGH
	Highlight sensitive receivers with a different color	HIGH
	Clarify that mitigation measures are only planned and not realized	HIGH
	Shorten the popup text	na
	Add detailed information about Anas strategy	na
	Add information on the mitigation measures effectiveness	LOW
	Review the questionnaire on action plans	LOW
	Link the questionnaire on the action plans to the related measure / building	LOW
RESERVED AREA		
SECTION	**CORRECTIVE ACTIONS**	**PRIORITY**
SENSORS	Link maps/sensors	na
	Improve aned detection on screen	HIGH
METEO	Clarify that weather data are in real time	HIGH
CONFLICT MAPS	Improve accessibility	HIGH
	Change the Leq night limit for schools from 100 dB to na	HIGH
SENSORS	Possibility to add previous monitoring data	na
MAPS	Add a scale factor and ruler	MEDIUM
NEW	Add weather data maps	na

Corrective actions have been than implemented according to the assigned priority index and the final assessment of the Dynamap system interface have been provided. The applied changes improve the overall ease of use and address the areas where participants experienced problems or found the interface and information architecture unclear.

Anyway the changes effectiveness will be tested informally: a questionnaire will be published on the project website and on social networks to collect new feedbacks. Any further changes will be implemented, if necessary.

4. CONCLUSIONS

The DYNAMAP project is a LIFE project aiming at developing a dynamic noise mapping system able to detect and represent in real time the acoustic impact due to road infrastructures (dynamic noise maps). Dynamic noise maps are achieved by updating pre-calculated basic noise maps as a function of sound pressure levels and weather conditions, provided by an automatic monitoring system, made of customized low-cost sensors and of a software tool implemented in a general purpose GIS platform. The web-GIS platform is able to read data coming from the system and depict noise values as coloured geo-referred noise maps in a user-friendly format.

In this paper a detailed description of the tests prepared to check recipients ability in managing and consulting the system, of the results achieved and corrective actions undertaken to improve the web software application has been given.

Tests have been administered to both the general public and selected stakeholders to evaluate the system versatility and its contents comprehensibility. The general public was able to view noise maps in real time and query the system to depict, in graphical mode, the environmental data stored in the system, while stakeholders were able to see additional information, such as real time, historical and statistical data, as well as accessing the system configuration parameters.

Test results show that participants liked most the application operational features, response times, easy to use and usefulness of the contents. Also the aesthetic aspect received very good feedbacks. Otherwise the platform communication skills have been considered poor and some practical suggestion to improve them has been given.

The collected recommendations have been used to improve the overall ease of use and address the areas where participants experienced problems or found the interface and information architecture unclear. Corrective actions have been then implemented according to the assigned priority index. The effectiveness of changes will be tested informally: a questionnaire will be published on the project website and on social networks to collect new feedbacks.

5. ACKNOWLEDGEMENTS

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