

**CLV Web- Platform:  
a new tool to support the management of local avalanche hazard.**

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**ABSTRACT:** The management of local avalanche hazard has always been one of the vital aspects in mountain areas. Besides being a job of great social commitment, it entails a deep knowledge on local territory and on avalanche dynamics, snowpack formation and micro-Alpine meteorology. For this reason, with the regional law n. 29/2010, the Aosta Valley (IT) has regulated the Avalanche Local Commissions (CLV), born to support the local authorities to manage the avalanche hazard. CLV are engaged in: (i) forecasting and monitoring of snow and weather conditions; (ii) evaluation of the snow cover stability; (iii) early warning, emergency management and intervention in case of avalanche hazard. So, the 3.260 km<sup>2</sup> of Aosta Valley Alpine region (with 70% exposed to avalanche hazard) has been subdivided into 17 zones (by grouping all 74 municipalities) in the urbanized territory, each under the supervision of one CLV. To facilitate the management of local avalanche situations on uniform criteria and methodologies, thanks to the Alpine Space project Start-It-Up, in collaboration with CELVA - Consortium of Local Authorities of Aosta Valley, the Region of Aosta Valley is starting the implementation of a platform for the visualization and data storage about snow, weather and avalanches as well as the verbalization of actions performed and suggested by CLV in avalanche emergency. Based on the experience of Austrian colleagues, the platform is developing through open source tools and frameworks to reduce the cost of software managing and the hardware architecture is supporting plugins to easily include future new deployments. The platform will be testing and used by the CLVs of Aosta Valley from winter 2014/15.

**KEYWORDS:** roads, avalanche hazard management, ski resort.

## 1 INTRODUCTION

At the Italian national level, the management of hydrological risks is regulated by the Law on Civil Protection which provides an advisory body expert in natural hazards headed by the Mayor.

In the field of avalanche risk, some Autonomous Regions and Provinces have a more specific legislation that provides for the possibility to establish, in the territories under risk, specific "Local Avalanche Committees" (CLV) with the technical advisory task to support the Mayor on the assessment of the state of local hazards and risk associated with the necessary countermeasures.

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The CLV organisms are historically present in the Italian Alps; the Alto Adige has the primacy of the first official establishment in 1976, revised in 2013, followed by Trentino (1982), Friuli Venezia Giulia (1988), Aosta Valley (1992) and Piedmont (1999). Among the Alpine Italian regions, the CLV have not been established, ruled by a law, however, in Lombardy and Veneto.

Although the activities and tasks of the CLV are clear and well-established their composition and nomination, management and coordination, as well as the remuneration are still today rarely comparable.

In the Aosta Valley Region, thanks to the pioneering regional law – L.R. 29/2010 "Provisions relating to Local Avalanche Committee" – were officially established in regional areas under risk, specific "Local Avalanche Committees" with the task of carrying out the following activities: *"the prediction and the assessment of the snow and weather conditions and the state of stability of the snow masses, the surveillance, the warning and the intervention in situations of risk and the*

*emergency management, in order to ensure local control of dangerous situations on the territory and provide technical advisory opinion in the framework of civil protection to the Mayor in charge of the public safety”.*

In order to join the technical interdisciplinarity with the perfect knowledge of the territory - both in geographical and snow & meteorological terms - the CLV of the Aosta Valley Region are composed by 1 to 3 local mountain guides, a manager of the ski resorts and a regional Forest Ranger of the territory of competence.

Thanks to this, the crucial role of the regional civil protection guaranteed by the CLV in avalanche risk is definitely operating, in institutional way, since winter 2011. The 3.260 kmq of regional territory are supervised by 17 CLVs (Fig. 1) thanks to a regional financial contribution equal to (maximum) 200.000 Euro per year [Segor et al. 2014].

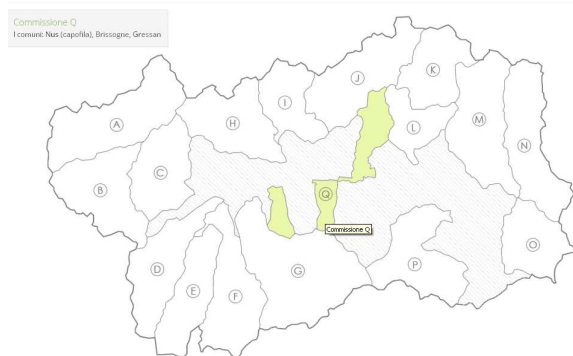


Figure 1. Aosta Valley Alpine region (3.260 kmq) subdivided into 17 areas managed by CLVs. Figure puts into evidence the district under the supervision of CLV Q that groups the municipalities of Nus, Brissogne and Gressan – AO, Italy.

For your information, the winter 2013/14, not particularly intensive from the avalanche risk point of view, has seen a significant increase in the avalanche hazard in the months of February and March in which 15 regional roads and a national highway were forbidden to transit (8 of which were closed for prevention and 7 after the successive occurrence of avalanches; the regional roads were closed for a maximum of 36 hours); 5 municipal roads were precautionary closed and consequently having 2 entire valleys unreachable, by land, for 8 days, with a total of 35 people needed to be evacuated and 15 left isolated [Source: ANSA and CLV]. The related documented CLV activities, for the season, saw about 40 in-situ surveys of snowpack conditions, 110 meetings and in-situ

monitoring activities, plus 17 monthly registers of the CLV activities - one for every CLV - from December to April for a total cost of about 110.000 Euro including insurance charges, training and maintenance of own material (including snow measuring poles).

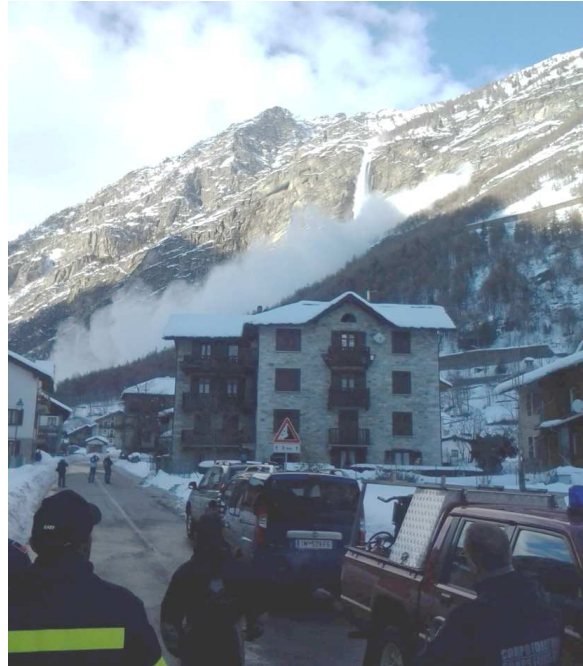


Figure 2. The “Bounitzon” avalanche in Gaby - Gressoney Valley (Valle d'Aosta). This avalanche basin is one of those included in the P.A.V. by the local CLV for the interference between avalanche and the main roads and, for this reason, it is always monitored. The event of March 2<sup>nd</sup>, 2014 reaches the bottom of the Gressoney valley without causing damage to structures and roads [Photo Regional Forestry Rangers].

These articulated and delicate tasks and activities carried out by CLVs have seen a big effort in terms of time, energy, commitment and technical comparison between the CLV components and the regional technical body responsible – the Avalanche Warning Service (AWS) of the Aosta Valley Region. Thanks to an intensive schedule of monitoring (definition of the PAV - "Plan of Activities in the case of Avalanche danger: identification, in the territory of competence, of the critical areas exposed to avalanches who interfere with strongly vulnerable elements [Chiambretti, 2009] and the laying of snow measurement poles at representative or critical sites ) and the related interventions, these last three winters have seen a growth in terms of professionalism, experience and

operation of CLV (and AWS) together with a greater awareness of the real and potential avalanche hazard by the Mayors. From this and from the constructive dialogue between the different actors involved, a homogeneous instrument of the storage, transparency, accountability and traceability of the CLV activities made during the forecasting, under avalanche danger and when the event occurs, was necessary.

In order to support the CLV with innovative technology, the Aosta Valley administration, thanks to the Alpine Space Project Start-It-Up - "State of the Art Technology in Risk Management: Implementation and Trial for Usability in Engineering Practice and Policy - in collaboration with CELVA - Consortium of Local Authorities in Aosta Valley - is developing a web-based platform for the rapid visualization and storage of snow, weather, avalanches data; the transcription of manual measurements and in-situ surveys carried on; and the traceability and verbalization of the operations performed and the recommended actions to protect the territory.

Below, the architecture of the web platform is presented. It will be available to CLV members of the Valle d'Aosta from the winter 2014/15.

## 2 THE NEEDS ASSESSMENT

The first step towards the design of the platform and its development was to identify the needs and requirements. The platform must necessarily be a technical tool, easy to use at any time by any member of the CLV that access to an autonomous and independent way with consequent responsibility for activities and contents.

The analysis of needs led to the identification of three main requirements:

1. an easy and quick consultation of snow and weather local data (e.g.; provided by AWS and Centro Funzionale of Aosta Valley) and not (e.g., areas over the regional and national borders);
2. reporting and archiving of activities carried out during the forecast of avalanche risk, during the event or when the avalanche occurred, to support the municipal administration in case of avalanche danger;
3. transparency and traceability of activities done as technical support about the Mayor's decisions regarding Civil Protection (Fig. 2).

In recent months, the Avalanche Warning Service of Aosta Valley together with a software company - Ecometer snc – and the support of some CLV members designed and built the CLV platform tool. The website is now in the testing phase.

## 3 THE ARCHITECTURE OF CLV PLATFORM

### 3.1 Concept design

Following the example of Tyrol that has a similar tool operating since 2005 and used by about 230 CLVs (1200 people), AWS of Aosta Valley decided to structure the CLV website in several interactive sections described below (Fig. 3 ).

The first section. The only static one, picks up the two home pages to present and access in the platform:

Public home page. It is the institutional page and the only public one of the website. It presents a map of the Aosta Valley area divided into zones under the responsibility of each CLV (Fig. 1) with basic information (e.g.; municipalities underlying and the municipality leader of single CLV and the CLV President) together with the relevant legislation (e.g., LR 29/2010, DGR 2774 / 2010, etc ...). From this page, each CLV component can login to his private access of his CLV.

CLV home page. Accessible only after the login at Public home page, the CLV home page is common and visible to all the CLVs and it is similar to the previous one. It includes the lists of the 17 CLVs (e.g., contacts, role, status (active or not) of each component, etc ...) and useful phone numbers (e.g., Mayors, fax numbers, regional AWS Office, etc ...). Very similar to an address book, the page is not directly editable in this section.

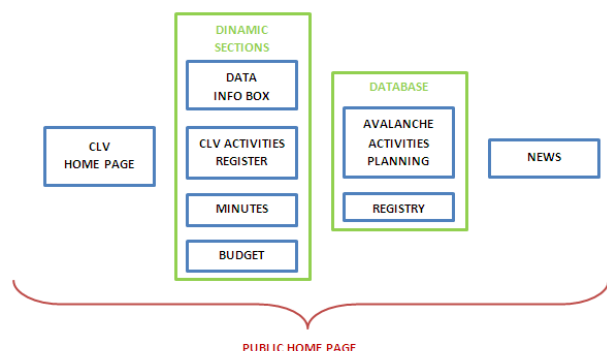


Figure 3. Scheme of the CLV website with the contents of its interactive sections.

The second section brings together the dynamic and interactive pages of the portal, obviously reserved for the members of each CLV:

Data – info box. It contains a list of dynamic and customizable links (e.g., favourites and it permits the free insertion and deletion of one link) to monitor the current snow and weather conditions (e.g., data from automatic weather stations and / or radar data, database of in-situ survey performed by mountain guides, etc ...) and prediction (e.g., sites of regional and surrounding areas weather forecasting, etc ...), the snowcover stability (e.g., regional and surrounding areas - Piedmont, France, Switzerland - avalanche bulletins).

CLV Activities Register. It contains the history of the daily monitoring carried out during the winter (e.g., the danger degree of avalanche bulletins, the Hs from automatic weather stations and snow-poles indicated in the PAV, any in-situ surveys (Fig. 4), overflights, any avalanche observations in no PAV areas, updating activities, etc ...). Here, in addition to the simple transcription of the activities, there is also the opportunity to up-load photographic and video documentation, etc. ...



Figure 4. In situ surveys done by CLV.

Minutes. This is the page to support the CLV to prepare, thanks to predefined masks, reports of activities and technical support to the Mayor, especially in the case of critical situations. The minute will be digitally signed (if on-line) by the Secretary (who write it) and by the CLV components present at the meeting. Besides, the minute will be turned into a non-editable pdf (with any chosen attachments – e.g., photos, etc...) and directly sent via e-mail from the website to the municipality and to the relevant departments (e.g., regional AWS). This section also includes an archive of minutes drawn up in order to create

an historic and accessible database, available to all CLV members of the CLV, on activities and technical choices made

Budget. Starting from the annual funding available for each CLV, in this page the CLV members can update the budget reporting the expenses incurred by each CLV (as defined by DGR n.2774/2010). In this way, in addition to monitoring the economic situation of the CLV, the annual economic reporting will be easier and uniform.

The third section presents the quasi-static pages of the site that, however, may be modified only by the members of each CLV:

Avalanche Activities Planning. It contains the PAV (as defined in the DGR n.2774/2010) directly connected to regional Web Avalanche Cadastre on regional platform "Partout" (Debernardi and Segor, 2013).

Registry. It is the CLV register containing the information of its components (e.g., name, role, phone number, status (active from - to), taken courses, etc ...) together with a backup of the activities carried out in past winters - CLV Activities Register - archived in .rar format and that may be downloaded.

At the end, the News section in which the information for the CLV will be published (e.g., communications by regional AWS or CELVA, meetings, training courses, news on equipment, etc ...), but also thought of as a real time communication system between different components of CLV.

### 3.2 Access and transparency management

The access management to the website has been designed with a control panel for managing users, creating a multi-level structure of access to the site itself. In order to ensure the necessary transparency and traceability of activities in the platform, each CLV component will have an identification code and every log will be recorded on a not-editable file, encrypted and stored on institutional servers.

### 3.3 Off-line mode

Some sections of the platform will also be available remotely in case of a lack of connection to the network. For example, each CLV will be able to download a facsimile minute (in pdf format) to fill. This activity is followed by the one that updates the activities carried out on the portal in off-line

mode once again on-line, including the up-load of any minutes written by hand.

### 3.4 Hardware and Software Design

After the assessment of the needs, an approach "responsive" to the design of the platform is chosen in order to have a website receptive, responsive and relevant to the dynamic behaviour of the user and used device. On this basis, the pages of the application have been constructed to ensure optimal viewing for different environments where they can be displayed (on desktop pc with different resolutions, tablet, smartphone) giving to the user a better use of the content and minimizing the need for resizing and scrolling.

For the design, construction and the production of the application, the choice fell on tools and frameworks exclusively Open Source, in order to optimize the initial costs of development that reduce future operating costs of the hardware and software supports - Table 1.

Table 1. Web CLV Platform technical data: only open source software are employed.

Products	Description
Ubuntu Server 14.04 LTS	Linux-based computer operating system
Perlbrew 0.67	Free perl installation management tool
Perl 5.18	Highly capable, feature-rich programming language
Mojolicious 4.9	An amazing real-time web framework
Nginx 1.5.12	Open source reverse proxy server for HTTP
PostgreSQL 9.2 / 9.3	Powerful, open source object-relational database system
PostGIS 2.1.0	Provides spatial objects for the PostgreSQL database
PgBouncer 1.5.4	Lightweight connection pooler for PostgreSQL
Munin 2.1.6	Networked resource monitoring tool
PgBarman 1.3.0	Backup and Recovery Manager for PostgreSQL databases
LaTeX - MiKTeX 2.9	High-quality typesetting system designed for the production of technical and scientific documentation
Python 3.4.0	Highly capable, feature-rich programming language
R 3.1.0	Strongly functional language and environment to statistically explore data sets
Geoserver 2.5.0	Software server that allows users to share and edit geospatial data

For the development of the web application, different technologies and standard languages are using, among which there are HTML 5, CSS 3, JavaScript, jQuery, AJAX, JSON.

To maximize the potential of Open Source products, Mojolicious - an MVC framework for web development written in Perl including a variety of

features such as plugins, control and management of sessions and cookies, is using.

The operation of the web application is ensured by the PostgreSQL database together with the http server Nginx, the Mojolicious framework and any supporting libraries needed to run the server itself.

About the deployment of the application, it comes with a medium-performance server with the Linux operating system Ubuntu 04.14 LTS.

For storage of the data collected during the CLV activities, an open source database (database server PostgreSQL 9.2) is using. It provides a set of advanced features in addition to supporting various extensions such as PostGIS, which enables the database to use of spatial queries for the treatment of geographic data. In order to this, the site will be programmed to provide backup procedures both the database and the documents produced and/or attachments during the operating sessions of the CLVs.

To allow the basic use of the website in off-line mode, the tool exploits the latest technologies available by HTML 5, as LocalStorage and Web SQL Database to save the main information in local environment and sync them when back to on-line mode.

### 3.5 Management and maintenance

The launch of the platform at the end of 2014 will be followed by a first phase of management and maintenance of its tools for two years. This management involves the software update, the check of the log, the security updates, and all activities required to make the product more accessible to the CLV components.

Another essential product to support the use of CLV platform will be the User's Guide, available in PDF format and on the web site, in the form of on-line help.

### 3.6 Future implementations

The Website has been designed and built to be as possible intuitive thanks to the strongly presence of icons and little text, in order to be able to translate it in other languages – English, French, German, etc ... - reducing the effort of translation.

Furthermore, the structure of the platform is designed by plugins to easy manage any new implementations, such as, for example, the critical avalanche scenarios obtained by statistical way [Barbolini et al. 2013] or the link with the unified regional warning system for meteorological risk, hydrological, hydraulic and avalanche danger for Civil Protection (DGR n.2614 / 2014).

#### 4 CONCLUSIONS

Born from the need to simplify and standardize the CLV activities to support the Mayor in relation to monitoring, forecasting and management of the local avalanche danger and risk, a web platform has been designed and constructed to access snow and weather data, reporting and archiving, as well as transparency and traceability of all activities.

Now under testing by some CLV components, the website will be operational for all 17 CLV operating in Aosta Valley from winter 2014/15.

Based on the Tyrolean experience, the web platform has the ambition to be the basis of an indispensable tool for the CLV, shared and implemented by all the Italian and European AWS.

#### 5 ACKNOWLEDGMENTS

The financial support provided by Alpine Space project Start-It-Up – “State of the Art in Risk Management Technology: Implementation and Trial for Usability in Engineering Practice and Policy and CELVA – Consorzio degli Enti Locali of Valle d’Aosta – are gratefully acknowledged.

CLV are sponsored by CELVA.

The authors wish to gratefully thank S. Pinet (CELVA) and A. Debernardi (Regione autonoma Valle d’Aosta – Avalanche Warning Service).

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