LAWIS – A COLLABORATIVE DATA COMMUNICATION PORTAL FOR AVALANCHE RISK MANAGEMENT AND PREVENTION

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ABSTRACT: LAWIS (lawis.at) is a portal for sustainable data retrieval, dissemination and communication of avalanche relevant information. The acronym stands for "**LA**winen**W**arndienst **I**nformations**S**ystem" (Avalanche Warning Service Information System) and comprises a freely accessible online information tool for avalanche related issues based on collaborative participation, open government data and applied research.

KEYWORDS: avalanche risk management and prevention, web-portal, geo-communication

1. INTRODUCTION

LAWIS started as a partnership project between the Tyrolean Avalanche Warning Service and the University of Vienna, Department of Geography and Regional Research shortly after the Galtür disaster of 1999. The goal of this collaboration was primarily to communicate alpine weather station data efficiently to experts within the internal workflow of the Tyrolean Avalanche Warning Service. However, over time, the focal point of this cooperation changed and the emphasis shifted. Storage and management of other avalanche relevant data such as snow profiles, avalanche incidents as well as targeted selection and data retrieval were heavily requested. The need to monitor, store as well as to disseminate aggregated information efficiently to experts as well as to the public thus became crucial. This demand triggered a broader interest within the community and boosted the further use of LAWIS beyond national boundaries towards an international setting leading to the design and implementation of appropriate extensions, which are at present a major asset of LAWIS.

Making resources available for avalanche warning is not an easy task and can be very sophisticated especially if deployed in remote mountainous regions. Such resources consist primarily of variable meteorological data and terrain related geo-data as well as information on snow stability and avalanche incidents. A collaborative participatory approach can satisfy this assumption if the quality of data can be guaranteed. This involves a method where people as actors affected by a range of activities with a common goal play an active and influential part in the decision and acquisition process. In other words, the actor collaborates and is not just beneficiary, but also has the opportunity to shape the outcome. The mutual aim is therefore to facilitate a representative cross section of avalanche relevant information focusing on the above described meteorological and terrain related information. The people affected by this common goal are experts and winter sports enthusiasts alike, who need profound information about the current avalanche situation in a specific area. The involvement of the affected people is realized through their participation acquiring geo-data, snow and avalanche information as well as weather data.

The current online application LAWIS is an example of an approach within the domain of avalanche prevention. This project exemplifies a successful realization of such a collaborative participatory approach referring to data acquisition for avalanche prevention. LAWIS communicates via an interactive topographic map portal information about the weather, snowpack and its stability, as well as facts about current and past avalanche incidents. Based on the participatory approach, everyone has the possibility to feed the system with relevant data. Consequently, the user is no longer consumer alone, but also participant within the production process. Volunteers participate in data acquisition at the same time as they use the gained information for their decision-making in the field. Hence, systems such as LAWIS are characterized as "bottom-up" systems.

2. STRUCTURE

The overall framework of LAWIS (see figure 1) consists of a data component as well as a technical backbone encompassing a backend module for data storage, manipulation and retrieval as well as a frontend module for external communication comprising a homepage portal (see figure 2) as well as reporting facilities. The data component is again subdivided in

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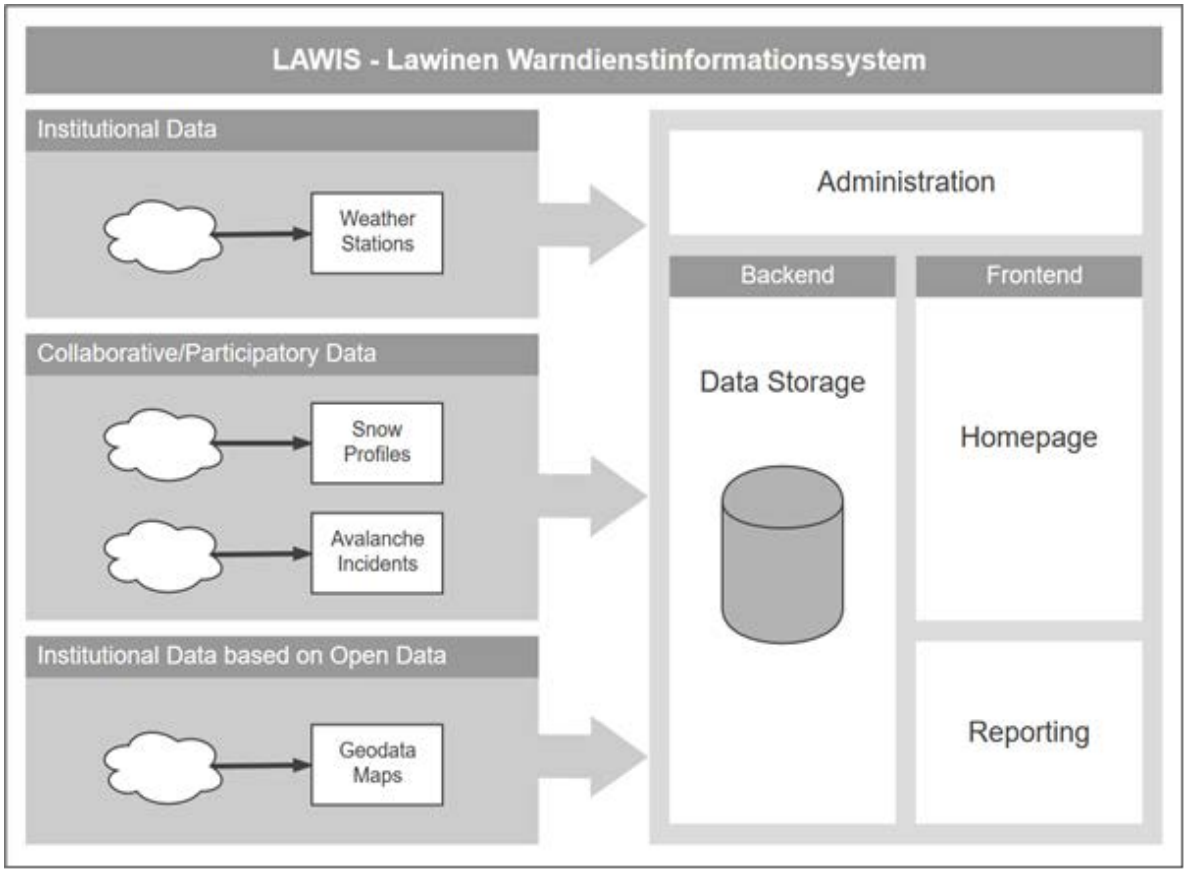

Figure 1: LAWIS framework

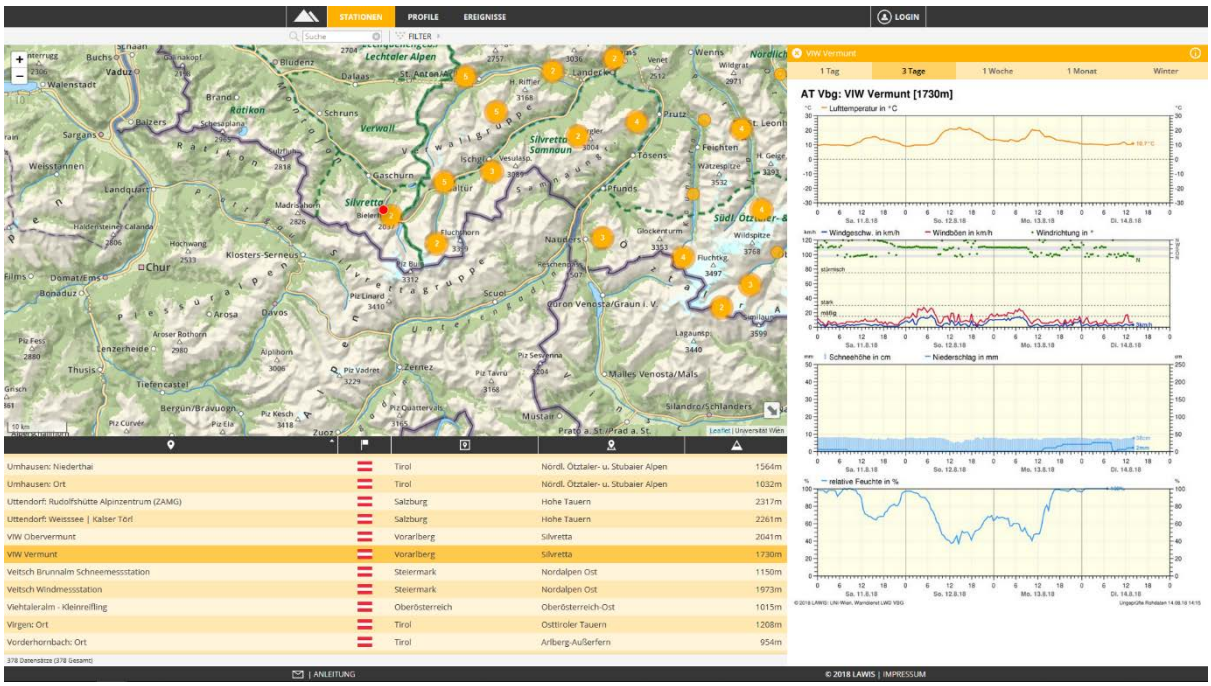

Figure 2: LAWIS homepage layout (weather stations)

thematic data as well as spatial data. Both data pools have different sources that define the quality of input.

The sources consist of institutional data, collaborative participatory data as well as institutional data based on OpenData. Institutional data includes

mainly meteorological data coming from official bodies guaranteeing up-to-date information. The collaborative participatory data encompasses essentially snow profiles and avalanche incident information inputted by domain experts and/or interested users. The institutional data based on OpenData includes all terrain related information within the system. This data is used under the principles of the OpenData movement and VGI in contrast to the employment of proprietary data. The OpenData and VGI approach, guarantees free use, access and distribution; hence, the participation is given high priority. Spatial data and the derived products within LAWIS follow the subsequent principles:

- Evaluation and preparation of base maps based on OGD data, as well as public domain geodata
- Spatial-temporal dependent processing of a heterogenic data basis
- Evaluation of cartographic visualization methods of avalanche relevant issues
- Aspects of geo-communication in a public environment

The basic principles of participatory data acquisition as described and exercised in LAWIS forms the basis for an avalanche warning assessment framework for remote mountainous areas. Two essential principles are crucial within this procedure. At first, the acquired data has to be applicable under the terms of the OpenData-movement. Secondly, data acquisition must follow the VGI approach (Volunteered Geographic Information) in other words collected by volunteers disseminating geographic data to create user-generated content.

LAWIS currently encompasses three thematic levels of information that communicate and depict selected parameters within a fixed spatial-temporal framework: alpine weather station data, snow profiles and avalanche incidents. The spatial component comprises customized topographic maps that include avalanche relevant terrain features, such as slope, optimized spot height and place name information.

3. TECHNICAL BACKBONE

The system has an automated data interface that can manage and process raw data for creating charts and tables as well as accessing ready-made diagrams. Opposed to the meteorological data that is regularly uploaded to LAWIS via a time-based job scheduler the integration of snow profiles and incidents pursue a direct collaborative approach. The input is triggered through an open accessible however semi-personalized user-interface that allows the user to upload and modify snow profiles (see figure 3) and incidents. This procedure is user-driven and monitored by domain experts in case of uncertainties or inconsistencies. Furthermore, a tailored user-interface based on spatial-temporal queries is available to enhance geo-communication within the field of risk assessment.

LAWIS is an efficient Online-System for storing and managing relevant avalanche warning information. These layers are viable for the preparation of avalanche warning bulletins, as well as for documentation and archiving. All of the information stored within LAWIS is made public and free-to-use. LAWIS members have access to the administration interface, which allows for maintenance and editing of content within the respective geographic region.

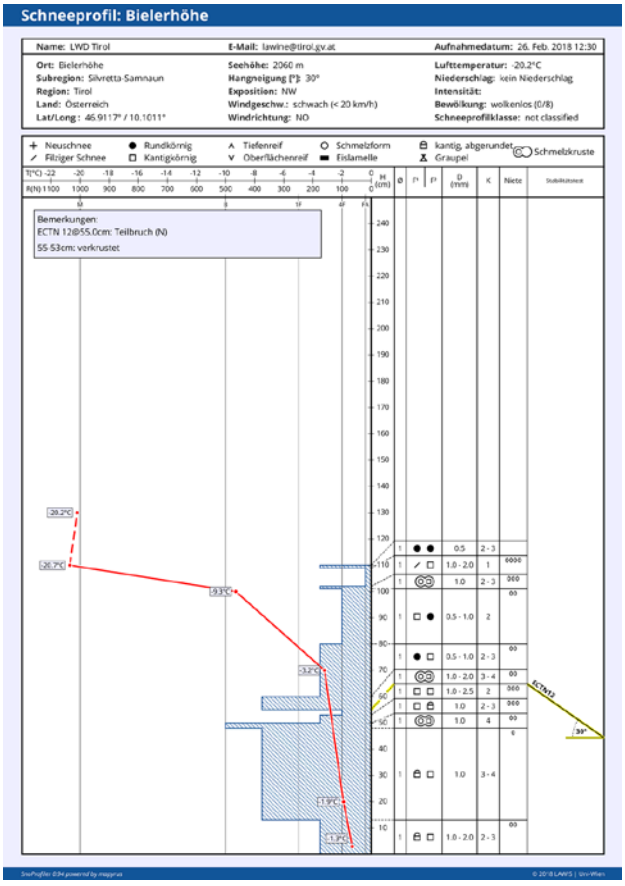

Figure 3: Example of a snow profile in LAWIS

LAWIS' structure is based on a 3-layer model. An efficient DBMS (Data Base Management System) forms the core of the service. It enables the possibility for structural storage of avalanche relevant information. The middleware consists of program modules for processing data. Their functionalities deal with the automated harmonization and storage of weather data (weather stations), the processing of user generated information (snow profiles and avalanche incidents), as well as cartographic processes in the form of diagram and map creation. Through a system defined interface it is possible to import and export data. Processes to revise the data that guarantee consistent data management are integrated.

Improper use of the system can therefore be prevented. Appropriate backup mechanisms are in place and ensure the smooth operation of LAWIS.

LAWIS was originally developed for the regional usage in Tyrol, Austria. It was therefore adapted to the needs and requirements of the avalanche warning service Tyrol. The further usage of LAWIS across regional borders and in a national and international context led to the development of expansions of the system. In this context, the following important development issues were defined:

- Standardization of avalanche relevant issues
- Development of mutual and international platforms
- Internationalization, multilingualism
- Standardization (CAAML)
- Targeted information system for domain experts and winter sports enthusiasts alike

4. STRATEGY

The common strategy of LAWIS is thus to propose a mutual, cross-border, harmonized and standardized daily service for experts and the public. At present, seven active contributing LAWIS members namely the AWS Tyrol, Styria, Salzburg, Vorarlberg, Upper Austria, Lower Austria and Carinthia (as of 2018) are actively contributing to the system guarantying continuity and further development. A major goal of LAWIS is therefore to harmonize and standardize internal workflows in order to offer significant opportunities for quality assurance in avalanche warning and thus, consequently, enhance risk management and risk prevention.

5. CONCLUSION

LAWIS consists of a nationwide collection of continuously updated data for weather stations, snow profiles and avalanche incidents. The cooperation of avalanche warning services and the University of Vienna has proven to be highly productive and sustainable. A national as well as an international expansion of LAWIS is desirable due to the fact that the standardization of working processes and the visualization as well as communication of avalanche relevant information needs to be further pursued.

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