Integration of Geospatial Data to Serve the Industrial Risk Management

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BIOGRAPHY

Jean-Paul RINGLET, Manager of the Provincial Government of the Province of Luxemburg, and Manager of APS, with 28 years experience in civil security, and a solid expertise in emergency planning, is a partner of the European Interreg III "Crisis Management" programme. He is also member of different boards at federal and regional public service level.

Bernard STEVENOT, Senior Consultant, was graduated as Civil Engineer (Physics) in 1969 and has developed his career in the ICT sector for Business, Process Control and Aerospace Systems.
Since the creation of Spacebel in 1988 up to 2007, he was the Managing Director of the company. Currently, he is Consultant and acts as Advisor for the management of Spacebel, having a special contribution focused on the development of new opportunities in geospatial applications for Europe and for developing countries (South-East Asia and Africa).

INTRODUCTION

The integration of geospatial data to help in managing the industrial risk : the 3WSA project in Wallonia

The 3WSA (Wallonia World Wide Space Applications) project intends to provide to the stakeholders involved in the various phases of industrial risk management a comprehensive set of tools, which will help them improve their capacity to anticipate and prevent the occurrence of the hazards, as well as their effectiveness in the crisis situations.

The project started in November 2007 and will extend until December 2010. It is performed by a Consortium lead by Spacebel, under the umbrella of the "Aerospace" Pole of Competence of Wallonia and is co-funded by the Government of Wallonia.
The Consortium comprises Spacebel, Vitrociset, Walphot, Erdas, Creaction, CETIC, Centre Spatial de Liège (CSL, University of Liège), AMOS, Aquapôle (University of Liège) and Agence pour la Prévention et la Sécurité (APS).

The 3WSA project will deliver:
- A generic geospatial, web based platform for the provision of added-value services concerning the management of the Environment and the Security;
- A prototype for a future SEVESO risk management reference centre; the prototype will address the issues of the industrial risk in the framework of the SEVESO II Directive, i.e. the registry of the chemical substances, the industrial site mapping, the crisis scenarios, the atmospheric dispersion of pollutants, the impact assessment,.

The SEVESO Reference Centre will be operated and serviced by the APS (Agence pour la Prévention et la Sécurité), which is a Belgian organization servicing the Authorities at the different levels of responsibilities (Federal, Regional, Local), the Industry, the Security and Emergency Services and the Citizens in matters related to emergency planning, chemical products, pollution, SEVESO risk management. APS operates a Call Centre 24/24.

The following chapters will describe, successively, the main results of the 3WSA project.

THE REFERENCE CENTRE FOR SEVESO RISKS MANAGEMENT

The European Directives SEVESO (1982) and SEVESO II (1996) have been transposed into the national legislations to provide a framework for the control of industrial and technological risks. Authorities and industrial managers need today information and tools to support the implementation of the Directives and to make the correct decisions in case of industrial risk. APS will establish a reference centre with the infrastructure and competences required to deliver to the stakeholders concerned by industrial hazards the global information, in order to anticipate catastrophic events and to plan the reactions minimizing the consequences of the occurrence of the hazards.

The reference centre has a special focus on prevention, preparedness and mitigation and provides support in the early minutes of the crisis and beyond. To achieve its goal, the reference centre shall offer added value services, which are briefly described hereafter.

SEVESO site profiling: this service provides up-to-date information concerning the industrial site, with a condensed version as required by the emergency services in crisis situation; this information covers, among others, the detailed map of the site itself, the accessibility, the nature, volume, location and risks of the chemical products, the instructions for the emergency deployment, and alerting.

Chemical substance registry: this service provides detailed information for each chemical substance potentially used in industry; this information covers, among others, the danger code, the chemical code and their meanings, the transport and conditioning labels, and information related to procedures to be applied regarding environment and population protection, intervention and recovery actions.


Surroundings: this service provides information about the population, assets and environmental protected areas in the vicinity of the SEVESO site: land use, properties, public buildings and destination, roads, rivers, concentration and profile of population.
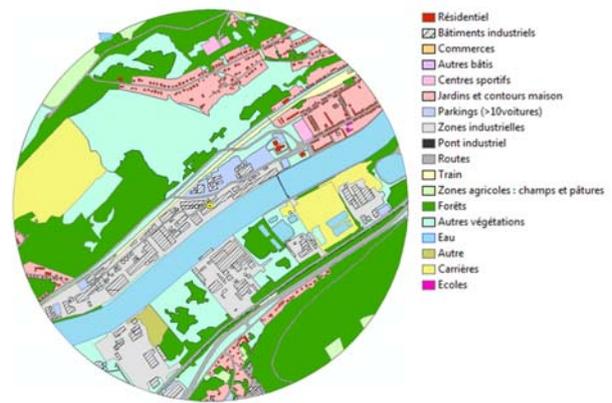
Source WALPHOT

Impact asessment: this service provides the modelling tools to forecast the consequences of a specific industrial accident on the surroundings, depending on various parameters, such as the nature of the chemical products, the dispersion form (gas, solid, liquid), the meteorological conditions, etc; currently, the prototype modelling facility is based on atmospheric dispersion models; modelling of liquid dispersion will be provided at a later stage.
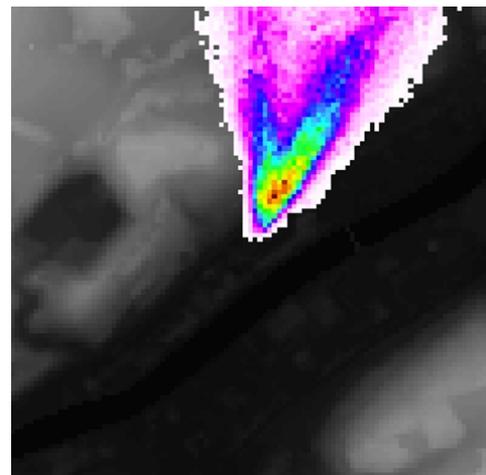
Crisis scenarios: this service allow each stakeholder to tailor the reference incident/accident scenarios (explosion, human error, fire, cracks in tanks or pipes) to the specific responsibilities of its discipline (for instance, the set-up of a security area around the site is the responsibility of the Police), including the development of the rescue plans: evacuation, confinement, alerting to the population.

Simulation for training and exercise: this service will provide the "engines" required to perform an efficient training of the stakeholders involved in the SEVESO risk management process and to support the multi-disciplinary exercises. Training and exercise adrress mainly:
- the evacuation in emergency situation;
- the deployment of the actors in crisis;
- the management of the industrial infrastructures (soft/crash shutdown of the production, switch-off of fluid circuits, energy flows)
- management of the socio-economic dimensions of the crisis.

The reference centre will connect the stakeholders with a network of experts and ensure the access to satellite images, in-situ sensors, geographic maps, socio-economic data and support decision making by integrating data concerning the chemical products used, the geography of the site (terrain, buildings, population), the dispersion of the pollutants (air, soil, water) and supply the actors with workplan comprising the various measures for prevention, mitigation and recovery. The reference centre provides the flexibility to adapt the level of details to the risk management phase: detailed information during the prevention phase and synthetic information for the emergency phase.

The figure below illustrates the overall logic of the SEVESO risk management system.
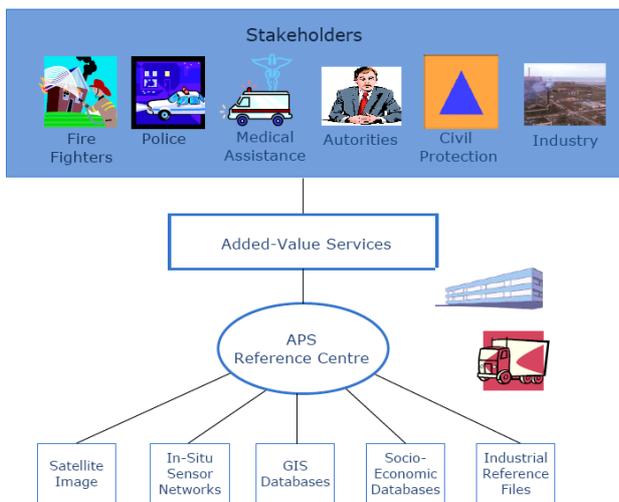
The main challenge of the reference centre is to collect reliable, up-to-date data from the multiple sources of information; the typical information sources are described hereafter and the access issues are briefly discussed.

Satellite imagery is used to get rapidly the up-to-date status and changes of an industrial site and its surroundings. To achieve this goal, the reference centre will search and acquire the earliest snapshots foreseen, taking into account the position, orbit and viewing programme of the satellites. The acquired images will be processed and compared with previous images to highlight the changes.

The access to in-situ measurements is foreseen through the existing sensor networks (air quality, water quality, meteorology) in order to improve the evaluation of the situation and the subsequent decision-making. The critical issues for accessing the sensor data through the networks in the operational context are the access rights, the security and the confidentiality of the collected data.

The access to existing GIS and non-GIS sources of information is of the utmost importance because it is the basis on which critical decisions are made in case of emergency. Many information is already available in various GIS systems, which are currently maintained by different entities in different locations, often duplicated. As the direct access to these geospatial data is not yet

possible in an integrated way, the reference centre will use intermediation processing services to collect all the information required and store them in a geo-database. Typical information collected are:
- GIS: cartographic maps, land use/ land cover, vulnerability zones (Natura 2000), population estimation day and night, points of interest (schools, hospitals, …), energy flows (gas, electricity).
- non-GIS: population statistics, assets value, factory profiles, dangerous products database, reflex sheets.

The relevant data concerning the industrial site is extracted by APS from the reference file submitted by the industry to the Authorities to obtain the operations license. It is subject to review and periodic updates by the Security and Emergency Services.

The simulation of the dispersion air pollutants in the ambient atmosphere are carried out thanks to a Lagrangian particle model, i.e. AUSTAL2000. This model was developed by Ing. Büro Janicke in Dunum, Germany under contract to the Federal Ministry for Environment, Nature Conservation and Nuclear Safety.

The AUSTAL2000 model allows a large panel of input parameters including:
- The description of the source(s),
- The description of the terrain,
- The description of the meteorological parameters.

In the framework of the 3WSA project, this model is included in a workflow allowing to collect all mandatory inputs for the simulation, to compute and to display the atmospheric dispersion of pollutant plume in a Web Map Service (WMS) according to the OGC standards. For the specific inputs like the terrain's description (Digital Elevation Model (DEM)) and the meteorological data, i.e. wind speed and direction, and according to the inputs provided by the expert, the workflow sends specific requests respectively to a Web Coverage Service (WCS) and to a Sensor Observation Service (SOS) in compliance with the OGC specifications. The workflow retrieves all required data and then launches a Web Processing Service (WPS) that executes pre-treatment, runs the model and performs post-treatment. The workflow finishes the process by publishing the result(s) of the model in a WMS, i.e. the dispersion plume.
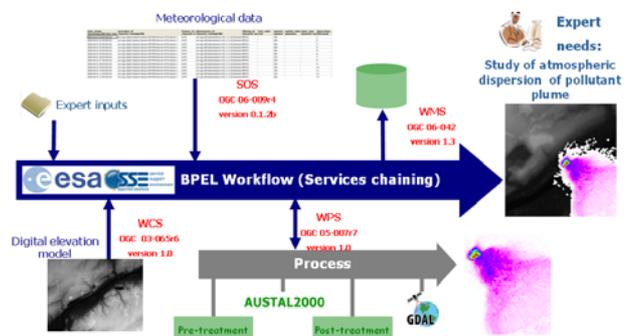
3WSA GENERIC GEOSPATIAL PLATFORM

The 3WSA platform is a technology Framework comprising a suite of generic Software services and associated tools for the easy deployment of a "Service Oriented Architecture" compliant system, which may be used for the provision of all sorts of services in the context of geospatial applications, including more specifically GMES. This 3WSA Platform will offer the features represented in the diagram below and further described hereafter
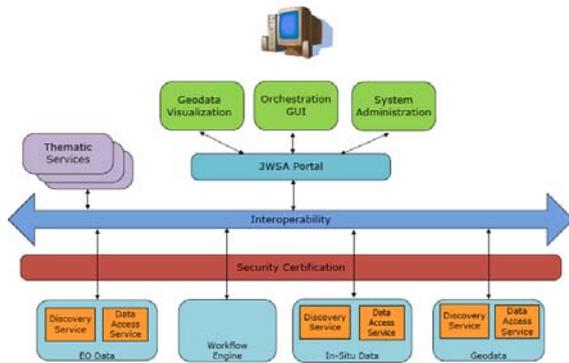
3WSA Portal

3WSA provides a Portal, compliant with the recognized international standards (ISO, OGC, W3C, OASIS), enabling a large number of users and service providers to share data, processing functions, know-how and results in the context of geospatial information management. It allows the easy discovery of services and information, including EO and in-situ data, the monitoring of geo-referenced parameters (environment, security), the alerting, the enhanced visualization of geospatial information, the execution of complex chaining of services, the combination of multiple heterogeneous sources of geospatial information, the exchange of information with local, national and international stakeholders.

The 3WSA Portal will provide to the users, the Web Clients to:
- register users;
- visualize geodata;
- discovery services from Service Providers;
- manage users (authentication and authorization)
- notify event (alerts, etc);
- enquire and order services from Service providers.

Using the 3WSA Portal, the Service Providers, who are users with special rights, may offer services that they have implemented on their own computers and can perform the following operations:
- expose/publish the service;
- define the access rules to the service;
- orchestrate with other services (synchronously or asynchronously, on-line or off-line)
- process requests for quotation, orders;
- define conditions for use (level of service, financial terms)

Access to EO Data

3WSA provides the access to the discovery services and data access services for EO data, stored locally or available through the European EO Data Sets.
3WSA provides a user interface compliant with OGC HMA standard and providing the following capabilities: discovery of EO collections, sensors and associated services, programming and ordering EO data, on-line EO data access, orchestration of a seamless integration of data access with the processing chains and, finally, user management.

3WSA also provides access to Sensor Planning Services for EO Data (OGC SPS EO) allowing scheduling the acquisition of EO sensor products, i.e. optical and radar images, for a specified geographic location. This functionality will allow 3WSA users (experts) to order images (sensor products) that reflect the situation after the disaster for post-crisis analysis.

Access to In-Situ Sensors

Data collected by in-situ sensors can be accessed by authorized users, thus providing measurements of physical parameters geographically located (wind speed, river flow, air temperature, pollutant concentration). Sensors are usually organized in measurement networks, each network being owned and operated by defined organizations (enterprises, Meteo Offices, Ministries, etc); the sensors can be fixed or mobile, permanent or temporary, reconfigurable or not; they can communicate by wire or wireless and they can show various network topologies.

3WSA provides:

- services to search for measurements based on well defined criteria, such as type of measurement (temperature, flow), type of sensor (measurement process, precision), geographical area of interest, time period.
- services to handle, combine, and transform measurements collected in-situ; these services may be called, for example, for the interpolation of chronological series of measurements, calculate derived parameters, not directly measured.

In the context of 3WSA, Web clients will be made available for OGC Sensor Web Enablement services Sensor Observation Service, Sensor Planning Service, Web Processing Service, ensuring the compliance with the standards OGC SWE 1.0.

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3WSA-In-Situ Data Access
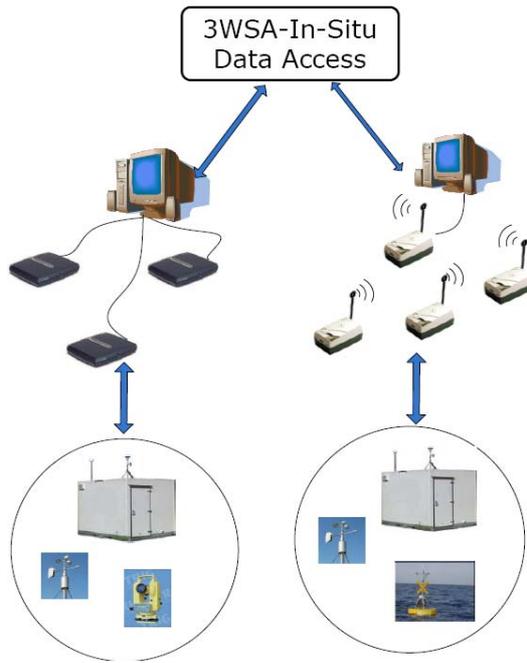
3WSA IN PERSPECTIVE:

3WSA is the result of several research and development programmes, in which Spacebel was and is still involved with key partners, aiming to the interoperability and inter-communications of numerous existing proprietary systems. A large number of applications directly concerning the citizens will then be feasible, technically and economically.

3WSA intends to pursue the development of a technological platform enabling the e-marketplace, where many providers (data owners, experts) can offer new added-value services/products to many users, ranging from the Authorities to the Citizens.

Access to Geodata

Many geospatial information is already available in various GIS systems, which are currently maintained by different entities in different locations. These geospatial data are not directly accessible from the 3WSA Portal, but intermediation processing services collect all the information required for visualization and store them in a geo-database.

This geo-database is accessed by the Portal, through Web services compliant with the OGC WFS, WCS standards.

3WSA-Geodata Access