Evaluation of Slovak Waste Information System and Databases

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Abstract

Collection of environmental data of waste generators, collectors, transporters, operators of treatment and disposal facilities of the Slovak Republic started in 1992. Since 1993, all Slovak environmental departments of district/regional authorities are collected waste management data annually. There was developed the Slovak Waste Information System (SWIS) supported data management (collection, validation, editing, archiving, visualisation and processing) and it has been implemented and operated at all state environmental authorities since 1995. The Centre of Waste and Environmental Management of the Slovak Environmental Agency has been processed these annual data using the SWIS. The SWIS is now a part of the Partial Monitoring Systems WASTE, which is focused on monitoring, forecasting and decision-support services of waste management authorities of the Slovak Ministry of Environment. It will be presented, how the SWIS and its waste management databases help both national and international waste management information systems (SR, EEA, UNEP, OECD) for informing citizens, public administration and business together with the monitoring services for the identification, assessment, monitoring, transport and prevention of hazardous waste risks. Ten years experiences of waste data and information management and sharing knowledge on Slovak waste management using the SWIS are presented, too.

1. Introduction

The legislation of the Slovak Republic (SR) gave the background for the collection and processing environmental data of waste generators, collectors and transporters, operators of treatment and disposal facilities in 1992. Since 1993, all Slovak environmental departments of district/regional offices of the Ministry of Environment of the SR (MoE SR) are collected waste management data annually in the prescribed

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paper forms. Therefore, it was developed the Slovak Waste Information System (SWIS) during 1993-1994 under control of the MoE SR with the co-operation of the Czech company ECO-Management (Hřebíček 2001). One of the goal of the SWIS was to cover regional a national waste management (WM) data flow, see Fig. 1.

The SWIS has been implemented and operated at all environmental offices of the MoE SR since 1994. From this time WM annual data are processed electronically by the Centre of Waste and Environmental Management of the Slovak Environmental Agency (CWEM SEA) in Bratislava using the SWIS. The CWEM SEA has been controlling the development of the SWIS since 1995 with the MoE SR cooperation.

The essential method of local WM data entry into the SWIS was used the manual input of WM data from “annual reports” and “transport of hazardous waste reports” given by the Slovak legislation on waste for local level companies (waste generators, operators of waste recovery and disposal facilities, collectors and transporters of waste). Officers of the district/regional environmental authorities of the MoE SR were filled the SWIS by waste data after their verification from reports shipped out from companies of waste producers, hazardous waste transporters and operators of waste treatment facilities. The regional data from the SWIS were exported in standard transfer form to files, which were read into the central database of the SWIS implemented in the CWEM SEA in Bratislava (Hřebíček 2001).

<table>
<thead>
<tr>
<th>Level</th>
<th>Input data</th>
<th>Output data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local (generators, operators</td>
<td>local data</td>
<td>local output annual reports</td>
</tr>
<tr>
<td>of R and D facilities,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>collectors and transporters)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional (district/regional</td>
<td>regional data</td>
<td>aggr. regional data</td>
</tr>
<tr>
<td>offices, inspectorate of SEI)</td>
<td></td>
<td>reg. waste manag. planning and reports</td>
</tr>
<tr>
<td>National (CWEM SEA,</td>
<td>national data</td>
<td>aggr. national data</td>
</tr>
<tr>
<td>waste department of MoE,</td>
<td></td>
<td>Nat. waste manag. planning and reports</td>
</tr>
<tr>
<td>headquarters of SEI and SRF)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Annual waste management data flow in the SWIS

3 The users and functions of new version of SWIS (see Chapter 2.3) are written in italics.
It was also possible to input into the SWIS with waste data, which was read from files (on diskettes or sending by e-mails) produced by local (company) waste information systems using the prescribed Slovak waste data transfer standards (Hřebíček 2001), (Hřebíček/Pitner/Benko 2003).

Table 1 gives the number of companies sending annual waste report and the number of waste records from their annual reports, which were processed by the SWIS in the CWEM SEA during 1996-2000.

Table 1
Number of companies and waste records processed by SWIS

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of companies</th>
<th>Number of records</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>10 910</td>
<td>41 824</td>
</tr>
<tr>
<td>1997</td>
<td>12 603</td>
<td>46 523</td>
</tr>
<tr>
<td>1998</td>
<td>13 486</td>
<td>48 775</td>
</tr>
<tr>
<td>1999</td>
<td>14 827</td>
<td>52 179</td>
</tr>
<tr>
<td>2000</td>
<td>19 044</td>
<td>71 675</td>
</tr>
</tbody>
</table>

The new version of the SWIS has been developed by ECO-Management with respect to requests of the European Union (EU) waste legislation as a monitoring system of waste management and material flow since 2000, (Hřebíček 2001), (Frol et al 2002). Since 2003, further development of the SWIS has continued to fulfil the Regulation (EC) No 2150/2002 of the European parliament and of the Council on waste statistics. This new version of the SWIS and its databases is presented, follows (Hřebíček, 2003). New ways of environmental data collection, system of their validation, transfer safety and processing including WM information management using web information and communication technology, is presented, follows (Hřebíček/Jančárík/Lacuška, 2003).

2. Current state of the development of the SWIS
2.1 Slovak environmental monitoring systems

Basic information subsystems of the Environmental Information System of the SR (EIS SR) are Partial Monitoring Systems (PMSs) of the Slovak Environmental Monitoring System (http://www.iszp.sk), which process complex environmental monitoring of the SR. They are in full range provided by designed guarantees of the MoE SR. All PMSs have to ensure principal tasks of the future integrated EIS SR. Individual PMSs are built on the base of the authorized projects, e.g. PMS WASTE (ECO-Management 2000). The task of this project was, first of all, specifying the
subject of the concrete PMS and determining basic approaches and methods of monitoring appropriate area of environment.

Since 2000, the SWIS has been the part of the PMS WASTE. It has been concentrated on data collection related to waste origin (the place of origin, the type of waste due to the Slovak or European Waste Catalogue, the amount of waste), the way of waste treatment (the place of treatment, treatment facility) and monitoring waste disposal (the place of disposal, the company of disposing the waste, the way of waste disposal, monitoring environmental impacts, etc.). Hazardous waste transport within the territory of the SR is also partially registered (ECO-Management 2000).

The main goal of the PMS WASTE is processed waste management indicators with methodology of the European Environment Agency (EEA) from monitoring net of environmental authorities (district/regional) of the MoE SR. This is comparable to similar monitoring systems abroad, i.e. in EU and OECD countries.

PMS WASTE principal tasks relating to monitoring, inspection and enforcement are in the support of:

- monitoring and inspection of licensed waste management facilities;
- monitoring and control of movements of hazardous waste on national level;
- identification of unlicensed/illegal facilities or activities; and
- taking enforcement action in respect of breaches of waste licenses and related conditions, and/or other legal requirements/mandatory standards.

Further goal of the PMS WASTE is to provide citizen public access to environmental information and share knowledge from the waste management area. The PMS WASTE also loads public (state and municipal) administration authorities with relevant information concerning waste management (i.e. prevention of waste, its generation, collection, separation, reuse, recovery, transport and disposal, registration of waste disposal and recycling facilities, etc.) at local (municipal), regional (districts and regions) level. It also prepares aggregated information and waste indicators for waste management reporting on national and international (UNEP, OECD, EU) levels.

### 2.2 The role of the SWIS in PMS WASTE

The new information and communication technology (ICT), especially Internet, brought new possibilities in waste data and information management and sharing knowledge about waste management. This initiated a new development of the SWIS as the one of the most important part of PMS WASTE (ECO-Management, 2003).

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The new requests for the SWIS have been also brought by the new Act on Waste\(^5\) of the SR, fully in compliance with EU, which has been valid since 1\(^{st}\) July 2001. This act completely changed waste management control standards, annual reports, their forms and annual waste statistics of the SR to be in compliance with EU ones.

The new versions of SWIS as the part of PMS WASTE has been developed during last four years again by the Czech company ECO-Management (Hřebíček 2003), (ECO-Management 2003). The designers were able to design the SWIS as the unique object oriented open information system monitoring waste management and material flows of the SR with using a new ICT and also a new Slovak environmental legislation. Therefore, the development of the new SWIS has been planned as a central, global and spatial real-time environmental information system using the intranet network ZPNet (communication computer network of the MoE SR), (Hřebíček/Pitner/Benko 2003).

\(^5\) Act No. 223/2001 SR of 15 May 2001 „On waste“.
2.3 The structure and functions of the new SWIS

Since January 1st, 2003, is valid the new structure of environmental regional authorities of the MoE SR, which consists from 8 regional and 128 district administrative offices. It has been followed from the new Slovak waste legislation that the new version of the SWIS has to operate at every district/regional authority of the MoE SR, which has got the responsibility for waste administration and regulation. The waste department of the MoE SR (WD MoE) controls all regional authorities; regional authorities control their inferior district authorities.

The Slovak Environmental Inspection (SEI) consists of its Headquarter and 8 inspectorates. The SEI is responded for waste legislation enforcement and waste management inspection of the SR. It was also decided that the SWIS will have to operate at all offices of the SEI.

The new SWIS has been also proposed to play the important role as the decision support tool for strategic waste management planning, recycling and forecasting in the SR. Therefore, it has to be used by the WD MoE and the Slovak Recycling Fund (SRF), which control recycling waste streams of the SR.

The current version of the SWIS (http://riso.sazp.sk) is implemented as intranet information system using the network ZPNet. The ZPNet has been built as an all-purpose communication system. It links the MoE SR with its district/regional offices and research organizations, the Headquarter of the SEI and its inspectorates and the Headquarter of the SRF into private net covering the whole SR. It serves for opera-
tion of distributed resort and gradually also internal environmental information systems (Hřebíček/Pitner/Benko, 2003) with common ICT standards.

The ZPNet is connected with other resort intranets within the SR, especially with the intranet of government bodies of state administration (GOVNET). It is also connected to the European Environment Information and Observation Network (EIONET) of the EEA and its Environmental Topic Centre/Waste and Material Flows (ETC/WMF).

The new SWIS is working on a special web application server and database servers of the ZPNet, which are operating under Linux operation system. Users of the SWIS are connected to the web (http://riso.sazp.sk), see Fig. 2, using standard web browsers like MS Internet Explorer, Mozilla or Opera, etc.

The SWIS and its database were designed to keep hierarchy of state environmental authorities of the SR in data flow management. There are several basic principles of data management implemented in the SWIS:

- Generator of origin data (in annual or another reports) is responded to their correctness (data validity);
- Officer making data entry from generators reports or their electronic files to the SWIS is responded for correctness input data (data verification);
- Officer is able to read data and do permitted data processing in the regional area of his authority (superior is able to read data of its inferior);
- Public is able to obtain requested information only from aggregated data.

Waste management databases of the SWIS were split into two data sets, see Fig. 4:

- **Static databases**, which were created by standardised registers, which are possible to input and change only by the authorised administrator of the SWIS from official institutes responded for standardised registers (Hřebíček/Pitner/Benko, 2003).

- **Dynamic databases**, which were created by authors of the SWIS and fulfilled by authorized users of system.
There are following authorized users of the SWIS:

- **System administrator** – It is responded for standard system administration services (e.g. assignment authorised rights to users, system security, archiving system and its databases, etc.);

- **National waste managers** – they are able to read WM data of any generators from any district or region of the SR or the whole area of the SR and make prescribed queries, prognosis, graphs and tables and print them and visualized those using GIS (i.e. employees of the MoE SR, headquarters of SEI and SRF);

- **Regional waste managers** – they are able to read WM data of any generator from their region or district of their SEI inspectorate, regional managers are able to input data of transport of hazardous waste among their region and different regions; all managers are able to make prescribed queries, graphs and tables, print them and visualized those using GIS (i.e. employees of regional offices and SEI inspectorates responsible for WM);

- **District waste managers** – they are able to input, read, edit and delete WM data of any generator of their district from annual local reports, to input data of transport of hazardous waste among different districts of region and make prescribed queries, graph and tables and print them and visualized those using GIS (i.e. employees of district offices responsible for WM);
Public – anybody is able to read aggregated WM data for chosen regional area (district/region/the SR), graphs and tables and download or print them.

The SWIS modules have been programmed in scripting language (PHP version 4 with using XML, HTML, DHTML, JavaScript), SQL and the Borland Interbase database engine version 7.1 (according to quantity of records, special clients for Interbase administration have been developed).

The kernel of the SWIS is provided by a web server Apache, which acts as data transformation and distribution system for input and output data streams. Connectivity to information and data resources is ensured through a resource locator database and an intelligent advanced querying information system (i.e. SQL).

3. Data management of WM data

WM data are collected in the SR annually from any company, which treats with more than 50 kg of hazardous waste or 1 ton of other waste. WM data have to be recorded in legislation prescribed annual report form, see Chapter 1. Further set of WM data are collected from annual reports of every waste recovery or waste disposal facility and waste transport company. Only data from the process of hazardous waste transport are collected continuously.

The Slovak WM legislation specifies WM data management process and waste data flow, see Fig. 1. Annual WM data reports are collected from obliged persons (waste generators, collectors, transporters, operators of recovery and disposal facilities) by district offices to the end of January of following year or to the end of month of following quarter. The obliged persons are responded for data validation.

3.1 Verification process of WM data using the SWIS

Primary WM data collected by district offices from annual reports of obliged persons are verified in two steps:

1. The syntax and the content of company records of annual reports are verified by the SWIS. Input forms include company’s business identification data (i.e. business identification number, address of the company, address of its organizational unit, NACE code, spatial code, contact person, etc.), identification data on activities carried out by the company (generator, collector, transporter, operator of recovery or disposal facility). The SWIS uses the Slovak national register of organizations (maintained and delivered by the Slovak Statistical Office, http://www.so.sk) to verify these data. Annual report of company obtains for each waste: the identification data on wastes (waste code under the European waste catalogue, waste category, its amount in tons and Y code according to the
Basel Convention), the way of waste treatment (R and D code) and the identification of organization to/from which waste is given/taken or transported.

2. Verified data from the first step are processed by the SWIS with respect to standardized items following the legislation and amount of waste is compared with the amount from previous year. Incorrect or “potentially incorrect” (with the change of amount is larger than 100 %) data are repaired by officers of district authorities in cooperation with responsible contact persons of companies.

The above verification process of WM data input from obliged persons lasted with previous version of the SWIS usually six or more months.

3.2 Overview of processed WM data by the SWIS

Table 2 shows number of companies and waste records processed by the new SWIS during 2002-2003.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of companies</th>
<th>Number of records</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>12 881</td>
<td>82 605</td>
</tr>
<tr>
<td>2003</td>
<td>13 156</td>
<td>89 973</td>
</tr>
</tbody>
</table>

The new SWIS has shorted verification process to three months on CWEM SEA, increased quality of processed WM data and shorted upgrade of registers. The Fig. 5 shows GIS output of the SWIS, where is presented the amount (ton/year) of hazardous waste generation (degree of shadows) and its way of treatment (land filling, incinerating, recovering and other way of treatment) of all counties of the SR in the year 2003.

The SWIS enables also to fulfil Regulation (EC) No 2150/2002 of the European parliament and of the Council on waste statistics and automatically produces its required reports and tables. It issues from waste annual reports, where waste is evaluated using European waste catalogue and it uses the first version of the transducer (http://eea.eu.int) between European waste catalogue and Statistics waste catalogue, which are stored in its registers.

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4. Conclusion

Many countries of EU have been developed their own waste information or management systems (Frol 2002). This paper presented the Slovak waste information system and ten years experience in data and information management in the area of waste management of the SR. It presents the first solution concepts of Partial Monitoring System WASTE and its implementation with using the SWIS. They make first experiences in standardization.

The present time brings the new opportunity to standardize national waste information systems of EU or OECD countries. The main objectives of the proposed standards could be to establish an information system on waste generation and treatment (waste collection, transport, recovery and disposal), planning and reporting in compliance with the UNEP, OECD and EU legislation and standards. These standards will have to fulfil the new requests of OECD, UNEP or EU (e.g. Regulation on waste statistics).

These standards could help to develop a new general multilingual waste management information system. It will be focused on monitoring, forecasting and decision-support waste management systems and services, addressing both national and international waste management advanced system. Using Internet it will support waste management e-government tools for citizens, waste generators, transporters,
and operators of facilities with the services for the identification, assessment, monitoring, transport and prevention of risks as other as hazardous waste.

It will provide as data for the monitoring for the national and regional waste management policy, as fulfil public access to the environmental information for public (citizens, businessmen, scientists, industry associations, NGOs, etc.).

In particular, it will enable possibility to detect in detail the generated waste types together with the economic actors responsible for the generation and the destination of these wastes. Disparities regarding different relative waste amounts is permit the formulation of concrete regional and national waste management policy aims to ensure basic environmental conditions in the given country and to support fulfilling the UNEP, OECD or EU waste management objectives.

**Bibliography**


