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How to manage Silence? A large scale noise management system

R.G. (Richard) Schmidt Bsc

Affiliation: Softnoise Gmbh/DGMR Software B.V.
e-mail: sd@dgmr.nl

Abstract
Silence is the main noise management system for the Dutch highways and is used by the Dutch Ministry of Transport. The Silence system comprises IT infrastructure, environmental data, noise management software, an organisation, procedures and maintenance. Typical noise management system tasks involve data management, setup noise management software, software customisation, performing calculations and analyses and a proper maintenance cycle. In 2010 the new noise management system will become available and everything will be in place for (evaluation of) noise policy and the next round of EU noise mapping in 2012. This paper provides insight in the activities needed for setting up and maintaining large complex noise mapping systems including strategic tools e.g. noise emission ceilings, implementing noise policies and what-if analyses.

Keywords: tasks, noise management, mapping, Silence

1 Introduction

Silence 3 is a large-scale noise management system for the standardisation of noise mapping, development of noise policy and action planning around highways on national and regional scale. The system is used and has been continuously updated since 2000. Silence is used by the Dutch Ministry of Transport to support national scale noise policy and strategy.

Silence 3 aims to improve the manner in which government officials throughout the country produce and use noise mapping for policy related, strategic and trend studies. The application provides a means of standardisation by enhancing the use of the exact same input data, software environment and calculation standard. It introduces a new set of standard ways to estimate noise levels, which is suitable both on a national and on a regional scale.

The complexity of these kinds of systems should not be underestimated. Setting up a large scale noise management system is an extensive project. Preparation of the implementation requires thorough thinking about the requirements, structure, components and tasks.

This paper outlines a generic framework for setting up and maintaining large scale noise management systems (LSNMS).This framework is based on tasks needed to provide a noise management system to noise specialists and policy makers during its full life cycle. This framework should be interpreted as a 'thinking model' and can be used by organisations and bodies, responsible for noise management, to define their own approach for building and maintaining a LSNMS. The described tasks can be adapted to specific requirements, organisations and used technology. To make this generic framework more tangible, the Silence 3 system of the Dutch Ministry of Transport is used as an example implementation of this framework. This framework has proven its utility for Silence 3 over the past years.

The following topics will be handled to give more insight in this generic framework:
- definition: a general definition of a LSNMS
- Components within a LSNMS
- a task framework for building and maintaining a LSNMS
- case Silence 3

2 Definition LSNMS

What is a large scale noise management system?

There are several definitions possible for LSNMS and most of them just focus on the software part. LSNMS is not only software that allows us to manage noise but it is also the way it is organised. Besides that, a LSNMS is not a static system but a system that needs continuous adaption [1] to:
- new technology such as hardware, remote/distributed, new operating systems
- availability of new data and market demands for data
- demands for larger and more detailed (noise) information
- changing legislation: stricter national and EU legislation [2] (and support for more calculation standards)

A broader definition of an LSNMS system would be:

An LSNMS is the whole of software, hardware infrastructure, data, people and procedures that allow organisations to setup and maintain noise management in order to support noise policy and strategy.

To better understand a generic framework we need a more detailed description of the functions of a typical LSNMS. Below is a list of functions (in random order):
- management of large sets of data and insurance of the integrity and consistency
- management of meta-data
- tools for large-scale and detailed calculation
- scenario-based calculations
- monitoring of development on large time-scales
- publishing of noise results and maps
- tools that allow for statistics, impact-, what-if-, difference- and trend analysis

- report and presentation of both input data and results
- tools for publishing noise results and analysis results on several levels

3 Components

First step in the description of an LSNMS is to consider it as a composition of components. These components should enable us to build up, maintain, provide and use an LSNMS. The specification, selection and implementation of the components are driven by the requirements of the noise management system and the tasks. Some examples are:

- Local legislation may require specific software tools, localisation and skills in organisation.
- Short response times and widespread use of the system have effect on both the requirements for IT infrastructure and software.
- Effective use of the system requires enough resources and skills within the user organisation.
- The environmental data set must be in accordance with local available data and national implementation of INSPIRE [3].

Table 1 lists the components involved in a typical noise management system.

Table 1 – Components of an LSNMS.

Component	**Description**
Software	Noise management related tools. One or more software packages to perform all the required tasks related to noise mapping, noise policy and noise strategy. This software can either be standard software, customised standard software or custom software depending on the requirements.
Hardware IT infrastructure	Hardware to install software on and networking facilities to enable group wise use and remote use of the system.
Data	A unified dataset, used for noise calculations and performing analysis for noise policy and strategy. This dataset consists of several types of data: • spatial data • environmental related data (e.g. acoustic data) • demographic data • meta-data This data is delivered by responsible bodies or 3rd party vendors.
Organisation (people)	Group consisting of staff that supports and uses a LSNMS. Consists of IT specialists, application specialists, data specialists, noise specialists and policy makers. This organisation brings in the knowledge, skills and resources for all the noise management tasks.
Procedures	A well defined set of procedures for maintaining the system. The procedures specify the roles, tasks and results of all required activities to ensure the quality of the system such as availability, reliability, reproducibility and actuality. All procedures should be documented for clarity.
Development tools	Tools for the IT specialists and application specialist to build and maintain the LSNMS during its complete life cycle. This also includes documentation and reference material.

4 Task framework

Next step in the description of an LSNMS is to consider the process of noise management within the full life cycle of the system. There are many activities involved in building up, maintaining, providing and using this system. To reduce complexity and to get more insight in these activities we need to structure them by grouping them into tasks. Ideally, each task is identified by its comparable activities, applied tools, infrastructure, data, resources and procedures. The tasks are grouped into a coherent framework to demonstrate workflow, dependencies between the tasks and their place within the life cycle. An iterative approach can be used for repeating policy processes e.g. a yearly updated noise map which may require partial data processing and recalculation tasks. It should be noted that not all tasks and activities are mandatory to implement and carried out, this depends on the requirements of the organisation.

Figure 1 shows a schematic overview of the task framework.

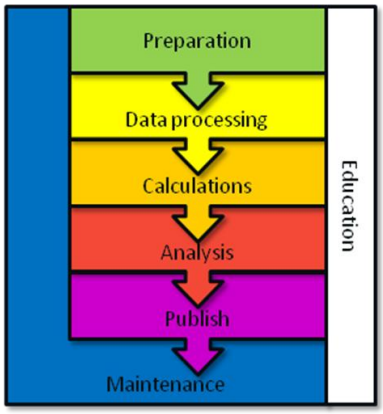

Figure 1 –Task Framework.

Table 2 shows the tasks in more detail, every task is broken down into activities.

Table 2 – Tasks within an LSNMS.

Task	**Activity**
Preparation, setup and customisation noise management system	• Definition of requirements for software, tools, infrastructure, data, organisation and procedures. • Implementation of requirements within the organisation. • Hosting of IT infrastructure. • Deployment of standard tools or custom(ised) tools. • Development by using accepted methods e.g. Agile or RAD.
Data processing	• Setup of (meta) data specifications. • Data acquisition. • Manual and automated tasks/spatial data processing. • Deployment of spatial tools, e.g. Geographic Information System (GIS). • Setup of a noise management database.
Calculations	• Verification of data to check completeness, correctness, consistency and compliancy with domain requirements.

Task	Activity
	• Perform large-scale calculations e.g. on dedicated computing facilities.
Analysis	• Processing derived data sets (addresses + noise levels or accumulated maps). • Carry out analysis based on requirements and legal demands. • Delivery of mandatory data (e.g. as required by the EC).
Reporting and publishing	• Publishing noise mapping results to the public. • Hosting website on infrastructure. • Adapting website to cooperate style.
Education	• Training on noise management tools, noise mapping task and legislation.
Maintenance	• Maintenance by using accepted methods (e.g. ITIL or ASL). Can have impact on all the components and tasks within the framework. • Incident management: helpdesk for noise management system and data. • Problem management: corrective actions components. • Change management: adaptive maintenance on components. • Configuration management.

4.1 Services

But who is responsible for carrying out the tasks in this framework? That depends on the decision if those tasks are carried out by the noise management organisation itself or outsourced to external (commercial) parties. Outsourcing can be relevant if the organisation wants to

- overcome undercapacity (in both knowledge and resources);
- minimise the risk for a specific task because of certain uncertainties.

From a commercial perspective, external parties can deliver tasks to the noise management organisation as services [4]. This calls for establishing clear agreements between the organisation and external parties by using a formal Service Level Agreement (SLA).

5 Case Silence 3

The previous chapters describe a general outline for components and tasks involved in noise management. In this section the Silence 3 [5] noise mapping system is used as an example to demonstrate the implemented components and tasks. Silence 3 is in all respects a large noise management system if we look at the scale, size of data, computation facilities and well defined organisation and tasks.

5.1 Background information Silence 3

Silence 3 provides a filled noise management database and calculation core in a user friendly GIS environment. It presents, for example, noise contours geographically and estimates the amount and type of surface area, number of houses and inhabitants above a certain noise level. Silence 3 allows for complex detailed calculations in large areas. The application uses a large amount of data from different sources. Information on hectometre signs, traffic flow, road surface, noise barriers is added to the road network.

Other information, such as geographical information from residential areas, industrial areas, nature areas and the so-called “silent areas” is combined to get the complete model for noise calculations. The Dutch Ministry of Transport, Public works and Water management's Road and Hydraulic Engineering Institute has been collecting data for the complete network, which consists of ca. 7000 km of highways. These data are combined for the last 15 years.

5.2 Strategic tools

Silence 3 contains a large set of operational functions for data management and carrying out noise calculations as described in chapter 2. In addition, Silence 3 also provides functions related to noise policy and strategy. Some examples:

- Noise Emission Ceilings methodology, an emission based register to control and manage noise.
- Noise Measure Module, methodology for automatic determination of measures on national scale and analysis of the impact on nuisance and national budgets.

Figure 2 and 3 show examples of the Silence 3 system.

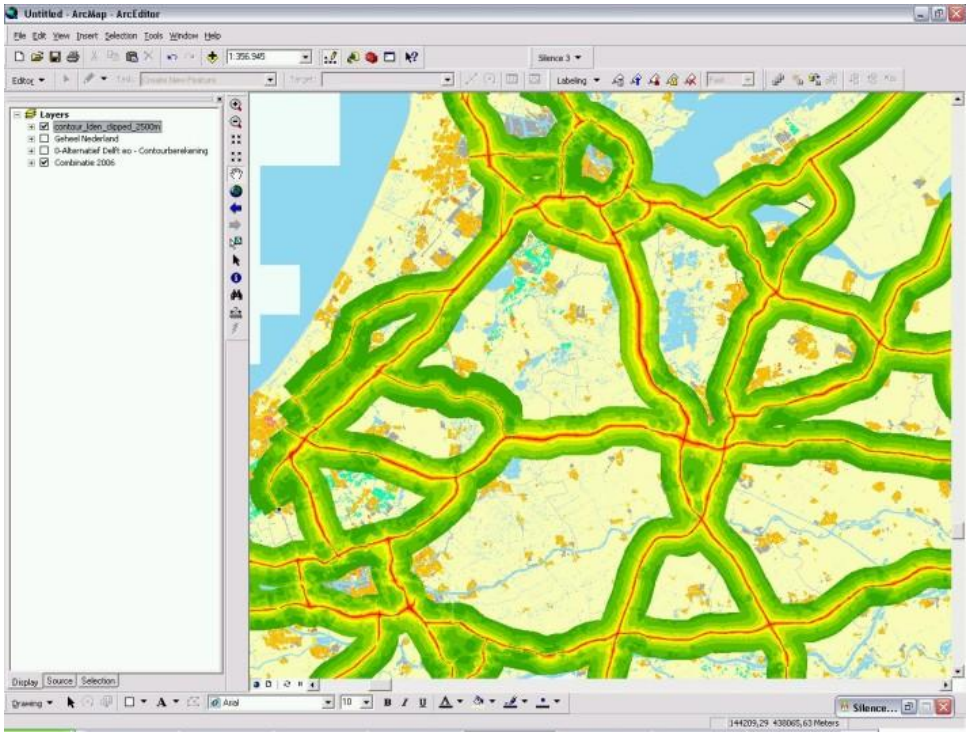

Figure 2 – Example, part of national scale noise map on highways.

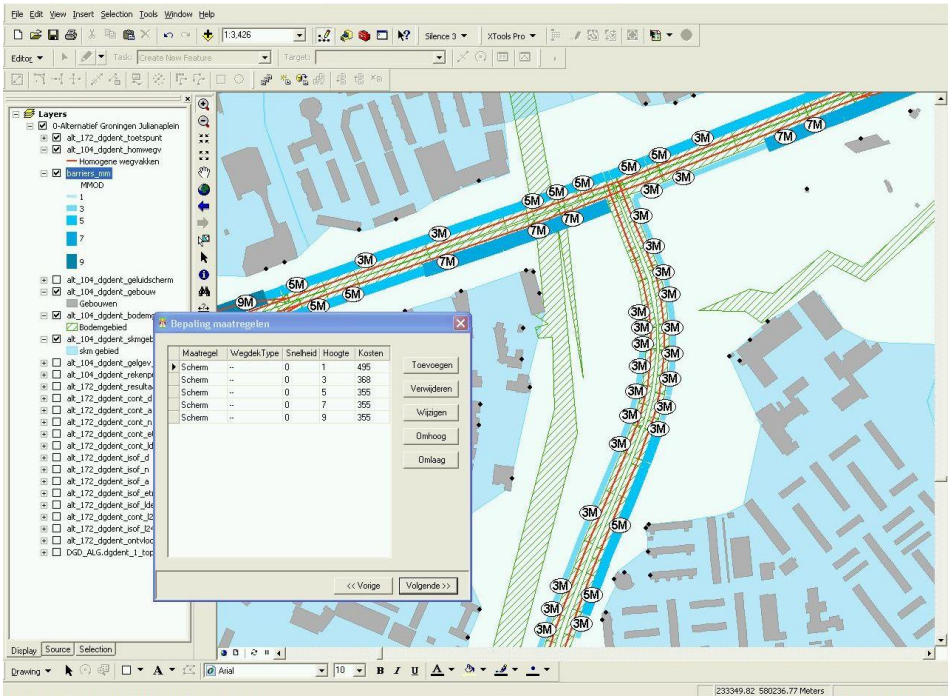

Figure 3 – Example noise measure model, automatically determined barrier heights.

5.3 Used components for Silence 3

The process of design and development of the Silence 3 system was based on the components as identified. Over the years all the components have evolved to meet new requirements in the area of local legislations, technology and organisation changes. Table 3 shows how the components are implemented within the Silence 3 system.

Table 3 – Components Silence 3.

Component	Description
Software	Standard noise calculation software Predictor/Geomilieu from Softnoise/DGMR tightly integrated within a GIS environment from ESRI. These tools support spatial data processing, noise modelling, extensive scenario/data management, calculations and analysis tasks. Standard software tools are combined with custom software development in GIS to support evolving datasets and supporting policy and strategy tasks. The suite of tools is fully documented.
Hardware IT infrastructure	A virtualised hardware environment is provided by the data centre of the Data-ICT Service of the Dutch Ministry. This environment allows remote access to Silence 3 for the user organisation. For large scale calculations a cluster of 20 machines is available to allow for distributed parallel calculations. The environmental data is stored within the virtualised environment on database servers.
Data	All data for noise management is stored in one single national scale database. This ‘digital noise database’ contains all the information in high detail: • noise sources • environment

Component	Description
	• population data • results of calculations, maps and analysis • measures • immission relevant locations • meta data
Organisation (people)	Two organisational units are involved in this noise management system: • User group: noise specialists and policy makers from the Dutch Ministry (15 users). • Development and maintenance group: IT specialists, developers, GIS specialists, data specialists and noise experts from organisations such as the Dutch Ministry of Transport, Public works and Water management, external consultants and Data-ICT Service (10-20 people).
Procedures	All procedures for use and maintenance of the system are prescribed in the Silence 3 documentation set and yearly updated according to system changes and changing requirements.
Development tools	Suite of state-of-the-art development and documentation tools is used to build and extent the noise management software.

5.4 Implemented tasks

The Dutch Ministry of Transport, Public works and Water management is the owner organisation of the Silence 3 system and most of the tasks are outsourced to external consultants, IT partners and developers. Main reason for outsourcing tasks is the complexity of the system, the required IT infrastructure and the necessary expertise and skills in the noise software area.

Table 4 – Implemented tasks Silence 3.

Task	Activity	Outsourcing/delivered services
Preparation, setup and customisation noise management system	At start-up, the system is fully specified for software, IT infrastructure, data, organisation and procedures.	Development is outsourced to an external noise consultant and GIS consultant. The system is hosted by 'internal' provider (Data-ICT Service) at the Dutch Ministry.
Data processing	A yearly update is done on the complete dataset. Activities are in place for data acquisition, data processing and bringing up to date of the data. If needed the conversion tools are adapted to new developments in data.	Data is collected and delivered by the Dutch Ministry. All data processing and related automation is outsourced to an external noise consultant and GIS consultant.
Calculations	Model integrity and consistency is ensured by the Silence 3 system itself. Scenario management and performing calculations are done by the user organisation.	Calculations are hosted by the Data-ICT service of the Dutch Ministry. Occasionally specific scenarios and calculations are outsourced to external noise consultants.

Task	Activity	Outsourcing/delivered services
Analysis	Analysis for support of policy and strategy are done by using the built-in tools of Silence 3. • noise emission ceilings • effect of Implemented policies; • what-if analysis The output of analyses is adapted to EC requirements for noise mapping.	Occasionally, complex and custom-made analyses are outsourced to the external noise consultant and data specialist due to insufficient capacity.
Reporting and publishing	Results from the noise management system such as reports and noise maps are published by the Dutch Ministry on the internet.	Publications are hosted by the Data-ICT Service of the Dutch Ministry. Preparation of the maps itself is outsourced to an external noise consultant and GIS consultant.
Education	Regular training on the Silence 3 system is organised yearly by the Dutch Ministry with topics on using the Silence 3 system, new features, maintenance and changed procedures. Introduction of new versions.	
Maintenance	Maintenance is done by using the best practices from the ITIL methodology. A maintenance organisation is in place to provide a helpdesk, 2nd/3rd line problem management and to handle requests for changes. Configuration management is carried out to ensure traceability.	SLA between Dutch Ministry and noise consultant and GIS consultant. All maintenance tasks are provided as services. SLA between Dutch Ministry and Data-ICT Service for hosting and technical management.

6 Conclusion

Building and maintaining a large scale noise management system is a complex task and should not be underestimated. Experience has learned that a LSNMS is more than software only and requirements on noise management should be translated to required components, tasks and activities. Demands, requirements and legislations also evolve over time and this calls for well-defined maintenance tasks to keep the LSNMS up-to-date.

Organisations may decide to outsource tasks to external parties in order to expand resources, buy-in knowledge or limit project risks. External parties can offer these tasks as one or more services under an SLA.

This framework should not be followed rigidly but can be used as a guidance to define and describe a noise management system by identifying the best suitable components and tasks.

References

[1] Hartog van Banda, S.E.; *Implementing noise prediction standards in software, a team effort*, Paper BNAM 2010, May 2010

[2] European Union; the assessment and management of environmental noise, Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002

[3] European Union; implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions, publication COMMISSION REGULATION (EU) No 268/2010 of 29 March 2010

[4] Noise Mapping Services: http://www/softnoise.com

[5] Silence 3 website: http://www.silence.nl