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Implementing noise prediction standards in software, a team effort

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Most noise prediction standards are too complicated to put into a general purpose spreadsheet application. For this reason many prediction standards have been implemented in special purpose software. As legislation became more strict from the start of the 80's commercial noise consultants with some software knowledge have been addressing this growing market. Although most calculation standards still originate from the 80's there is a growing demand for additional functionality on the field of user friendliness, use of spatial data, data management, web enabled use, reporting options etc. The new harmonized calculation method for Europe will also have a big impact on the software development. At the start of the 80's the software could be written by a single acoustician with some software knowledge. Nowadays the development of such specialized software requires a team of specialists consisting of Acousticians, GIS specialists, Mathematicians, Help writers, Translators and Software developers. One of the many challenges of the team is the unclear paper documentation of a prediction standard. Another important issue is the absence of software certification procedures as well as software implementation guidelines by official assigned national or international committees. The software development team will therefore also have to interpret the calculation standard themselves and make choices for implementation. This paper gives insight in the tools, the process, disciplines and the skills needed for implementation of noise prediction standards into software.

1 Introduction

As noise legislation became more strict from the start of the 80's, noise consultants with some software knowledge have been addressing a growing local market for noise calculation software. They started developing software for their own consultancy use and later on also started selling software licenses. This stand alone and mostly DOS based software could calculate simple models and did not need much additional development. Data was entered manually in ASCII files or by using a paper map on a digitizer. New DOS versions and new PC's did not had a big impact on the software development and maintenance.

In the mid 90's software requirements started changing rapidly making software development a more complex and challenging task. The drivers for these requirements were:

- Windows : Compliance with the latest Windows versions (every 2 years)
- Systems: Compliance with networks, multi-core PC's, remote access and system integration
- Data import: Market demands for using digital data from traffic, GIS and CAD systems
- Larger models: Market demands for larger and more detailed models (complete cities)
- Legislation: More strict National and European legislation (also more calculation standards)
- Internet: Web publishing and web enabled software (noise maps, noise exposure)
- Competition: International competition between the software packages (more features)

Nowadays the development of such specialized software for an international market requires a team of specialists consisting of Product managers, Subject experts (Acousticians and Mathematicians), Software engineers, GUI designers, Data (GIS) specialists, Technical writers and Translators.

After the development and validation is done the marketing can start. This involves a complete new team of specialist like Graphic designers, Web developers, Sales engineers and Support engineers.

Changing market demands driven by user expectations and new legislation will result in new requirements. This makes the circle round again and a new development can start.

2 The software requirements

Most commercial noise calculation software nowadays offer not only the calculation itself but also many additional options like importing and exporting spatial and acoustic data, 3D modeling tools, what if analysis tools and web publication. An overview of the basic requirements for a complete noise calculation project is shown in figure 1.

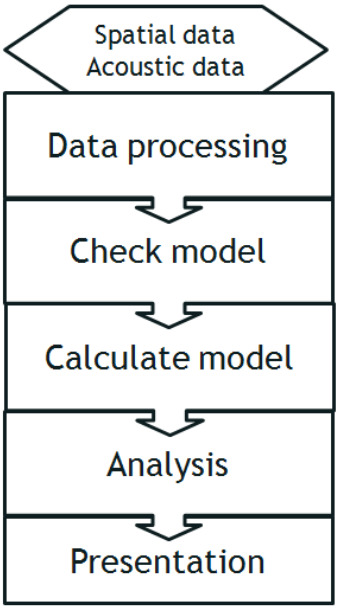

Figure 1: Basic requirements noise calculation project

The requirements for a noise calculation software seen from the users point of view will depend on the skills and tools already available within their organisation. For larger organisations that have their own GIS system like ArcGIS, the requirements for Data processing, Analysis and Presentation might not be needed. Smaller organisations however that do not have a GIS system need all requirements.

3 The development methodology

Software development projects are difficult to plan. Especially when the project takes a long time, new requirements are most likely to pop up and existing requirements will be changed. The ‘waterfall’ method that implies design of all requirements first, then implement them, then test them and then release is not successful in cases where there are uncertainties in requirements and release dates are fixed. A better method is a more iterative or ‘Agile’ development method. This can be achieved by ranking the requirements on importance and then design, implement and test them in that order. This makes the process more flexible when new requirements pop up or when time runs out. After each cycle it is possible to release a new version.

4 The development process

Software development is mostly associated with 1 software engineer using 1 development tool for writing code in a programming language like C++, Delphi, Fortran or Basic. However writing code is only one of the aspects when developing commercial software for noise calculations. The actual number of team members and tools will depend on the extend of the requirements and the skills of the team members. A small update will involve a Product manager, Software engineer and Tester. For a major upgrade a Subject expert, a Technical writer and a Translator will be added to the team. For a new development starting from scratch also a GUI designer and a Data specialist might be needed.

The product manager is responsible to setup the project plan with the specification, the forecasted costs and the forecasted earnings. After the management has agreed with the plan the development can start. In Table 1 a general overview is given of the phases in the development process. Per phase the possible team members, tools and deliverables are shown.

Table 1: The development process

Project phase	Team members	Tools	Deliverables
Specification	Product manager	Office tool	Requirements
Design (per cycle)	GUI designer Subject expert Software engineer	Development Optimization Office tool	Functional design Prototype software
Implementation (per cycle)	Software engineer Data specialist Subject expert	Development Version control Setup	Setup software (beta version)
Documentation (per cycle)	Technical writer Translator Software Engineer Subject expert	Translation Help editing Manual editing	Translated software Help file Manual
Test (per cycle)	Tester Subject expert	Automated test	Test plan Test sets
Final release	Software engineer	Setup Version control	Setup software (final version)
Acceptance	Product manager		Accepted product

5 Uncertainties in the prediction standards

Prediction standards should give reproducible results. However there are significant differences between software products based on the same standard using the same input data and using the same calculation settings. This is not due to a ‘bug’ in the software, or due to the accuracy of the method, but a direct result of the unclear documentation of the standard itself leading to different interpretations. Most prediction standards contain ambiguous algorithms and unclear text. Examples of uncertainties in the currently used methods, like ISO 9613 [1], as well as uncertainties in the draft European Harmonoise-Imagine method [2] have been addressed in several papers over the last years. In cases of such

uncertainties the acoustic engineer will assist the software engineer on interpreting the ambiguous algorithms. However sometimes it is not clear to the acoustic engineer either. In those cases a call upon the writers of the method must be made. This proofs not to be an easy task. In practice there is very little to non support on prediction methods provided by the authorities or research institutes who developed the method.

6 Validation and quality of results

For validation of the calculated results, test cases will be defined. In most cases calculation standards do not include a standardized test set, or include only 1 situation. So more test sets will be defined by the development team. These test cases will be calculated by hand using a spreadsheet program and compared with the software results.

One important aspect in the quality of results are the possible effects of optimization settings in the software [3]. An evaluation of the impact can be done by statistically comparing levels obtained from calculations with no calculation optimization settings (giving the highest accuracy) to those obtained with calculation optimization settings used over a set of randomly selected receivers. This method, implemented in DIN 45687 [6], requires a minimum of 20 calculation points.

A problem is the absence of an official certification procedure for the implementation of noise prediction standard in software. However for prediction standards that include official test cases the Nordtest ACOU107 Verification Method [5] could be used. The Nordtest Method is an important development in ensuring the quality of independent implementations of methods by verifying that the software conforms with calculation methods. As the method states, *"In their effort to ensure high quality and reliability in noise level calculation the authorities should have test examples developed – with certified results and accepted tolerances – in parallel with or subsequent to calculation method development.*"

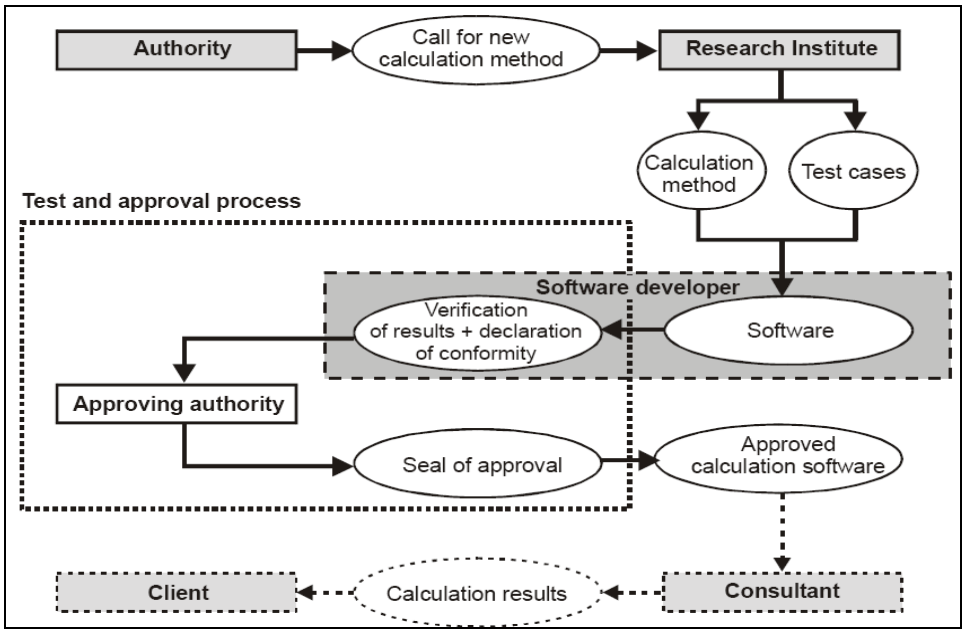

Figure 2: Nordtest Verification Method ACOU107

The overall quality of the software is very much depending on the clearness of the user interface, the clearness of the user documentation and the guidance of the user for avoiding mistakes. This issue was also addressed in the paper 'Good practice in the use of noise mapping software' [4].

7 The marketing process

After the final release and acceptance by the Product manager the marketing can start. In Table 2 an overview is given of the phases in the marketing process. Per phase the possible team members, tools and deliverables are shown.

Table 2: The marketing process

Phase	Team member	Tools used for	Deliverables
Promotion	Product manager Graphic designer Web developer	Desktop publishing Web development	Product brochure Website
Sales	Sales engineer	Video rendering tool Online presentation tool Office tool	Videos Presentation Email campaigns
Training	Subject expert	Online presentation Office tool	Training material
Support	Support engineer	Helpdesk Change management On line support	Bug list Wish list
New version	Product manager		Requirements

8 Conclusion

Implementation of a noise calculation standard into a software is a complex task involving a team of specialists. After the software has been developed the marketing of the software involves a new team of specialists. Changing market demands driven by user expectations and new legislation will result in requirements for a new version. This makes the circle round again and a new development can start.

A major issue for the development is the quality and extent of documentation of the standard itself. The software development community has for some time requested sufficient documentation, test cases and software certification procedures to be developed together with new calculation standards. As a result of this a software developers platform was recently created to support and advise the EU in developing the new European CNOSSOS method.

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