Quality for Road Weather Information System - Applying ISO 9001

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INTRODUCTION

Road weather data quality has several characteristics. These include

- How exactly the data describes the road conditions (validity)?
- How well the data can be generalized?
- How comprehensively the data covers the road network?
- Is the data available all the time?

Validity of data is further affected by several factors, including:

- Properties of the road weather measuring device in use.
- Assembly of the device.
- Maintenance of the device.

The purpose of the project described in this paper is to ensure the quality of road weather information by developing a quality management system for the road weather information system in Finland. Road weather data is collected from about 320 road weather stations and about the same number of CCTV cameras. Weather forecasts and radar and satellite images as well are passed through the system from weather service providers to supplement data collected by FINNRA. The system was initially built up to provide data for the planning of winter maintenance operations, but nowadays data is also used to inform road users and to control variable message signs (for a more detailed description of the system see Toivonen and Kantonen, 2000).

The project was initiated by FINNRA and it started in autumn 2002. A project group was formed, members of which come from FINNRA, winter maintenance provider organizations, measuring equipment assembly and service providers, Finnish Meteorological Institute and the authors as quality experts. The group worked from autumn 2002 through spring 2003 to build a quality manual for the road weather information system.

MOTIVATION FOR THE PROJECT

The main purpose of road weather information is to facilitate optimization of performance and determining an acceptable level for risk. Drivers use information to find an optimal course or

timing for their trip. Variable message signs are used to control speed in challenging road weather conditions in such a way that risk is acceptable. Winter maintenance operators optimize their use of resources and for example their use of salt to prevent freezing.

To be useful for the intended purposes the quality of road weather data must be high enough. Otherwise optimization and risk management fails. Data quality has always been an important topic while developing the road weather system, but there are some factors why quality should be considered in a more systematic way than before.

Outsourcing winter maintenance and data use

Some years ago road administration in Finland was reorganized and as a result winter maintenance operations are now carried out by independent service providers. This outsourcing has changed the role of the road weather information system, which remained within FINNRA. Information is now used by independent organizations, whereas earlier it was mainly used within FINNRA itself. Moreover, one of the future goals in Finland and elsewhere is that commercial information services be built based on road weather data. So most of the users of data are outside FINNRA.

This outsourcing of data use means more formal relations between producers and users of data. As part of the formality, a need to define a quality level for the information becomes more explicit. At the moment, the winter maintenance contracts include a general statement of the availability of information. But particularly those looking for new business opportunities would also like to get more detailed information about accuracy of measurement and about possible breaks in the flow of data. Besides they would like to see some evidence, facts about quality of data.

Use in automated systems

There are several areas in Finland where speed limits and info signs are controlled by road weather data and the number of such areas is increasing. Data used in these systems must be highly accurate, so that speed limits and info signs reflect real driving conditions. Drivers seem to be sensitive to the justification for a speed limit; if they have the feeling that limits are often too low, they tend to disregard the limits.

Another example of automated systems is Internet pages: data from some road weather stations is shown on FINNRA's web pages. Here the requirement of accuracy is not exactly that high, but there is another common feature: data is used immediately. There is no possibility to human control until afterwards. This means that actions to ensure data quality must be mainly preventive in nature.

The VIKING guidelines

One of the long term goals in VIKING project is to achieve a harmonized and consistent level for road weather monitoring within Nordic countries. For that purpose, a set of guidelines has been prepared for monitoring (Kulmala R. and Luoma S., 2001). The guidelines include a set of common minimum quality requirements for monitoring road weather. The guidelines are an important step in assuring the quality of information. Still, it is only the first step: having defined a set of standards, we must also make sure that the whole system all the time (or most of the time) complies to the standard.

Quantity and quality

The overall coverage of road weather stations in Finland is quite good - at least on main roads - and the data collection applications are quite reliable. However, while the size of the system is increasing and at the same time the number of personnel responsible for monitoring and maintaining the system decreases, there is a risk of lowering quality. This stresses the need for preventive actions and also the need for straightforward routines for detecting and handling of problem situations, supported by automatic tools.

THE APPROACH

As a conclusion, there was a need to

a define a quality level for road weather data;
b ensure that the level is achieved;
c continuously monitor the level;
d collect evidence of quality.

From the very beginning, quality standard EN ISO 9001:2000 was taken as a frame of reference for the work, as it serves a generally accepted framework for quality and covers all the aspects (a-d) above. Moreover it has an explicit customer focus, which is one of the leading principles of FINNRA. Figure 1 shows the general outline of the project.

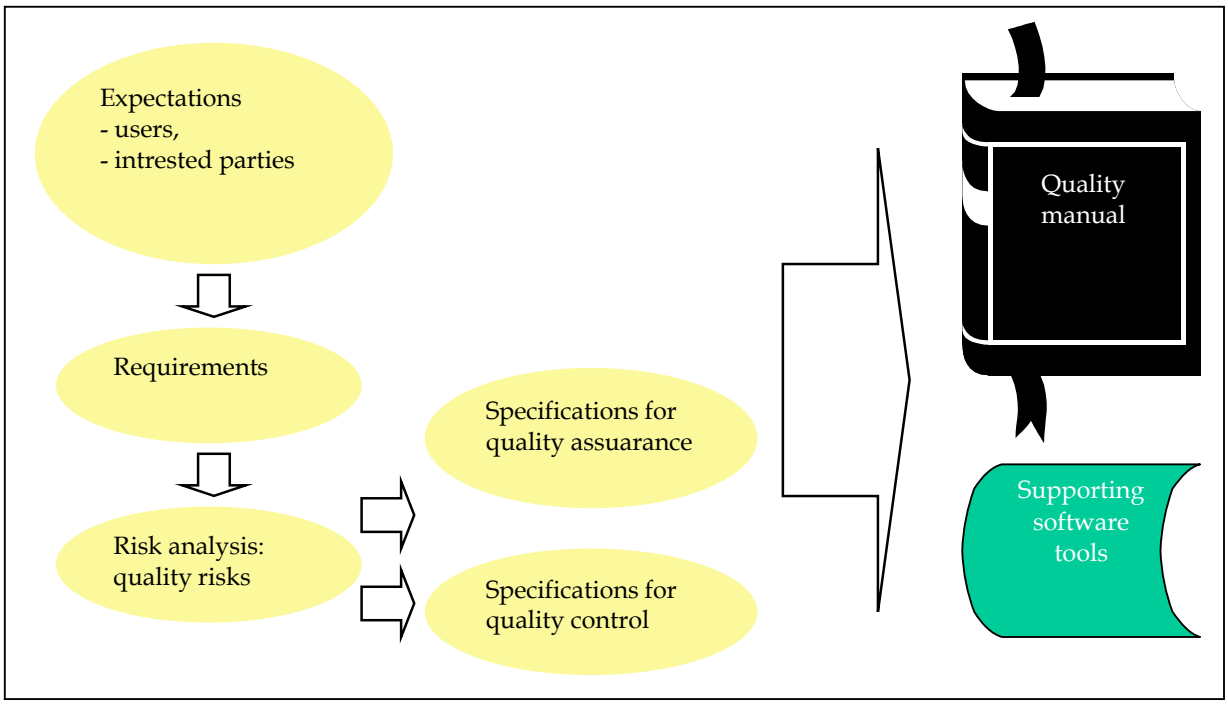

Figure 1. Project tasks

In the quality standard, quality is not considered in absolute terms. Quality is defined as "degree to which a set of inherent characteristics fulfils requirements". Thus the first task in the project was to define the requirements. Interviews were used to determine needs and expectations of data users and other interested parties. Invaluable information was also received from a concurrent project on future visions of road weather system (Lähesmaa and Levo, 2003). The needs and expectations were then analyzed to establish a set of

requirements for road weather data quality. The resources available for road weather information system were taken into account, so that unrealistic expectations were not accepted in the set of requirements.

The requirements include

- density and placement of stations and camera installations
- accuracy of measurements,
- availability of data and video images.

The VIKING monitoring guidelines where accepted were applicable.

Next task was to consider how to fulfil quality requirements. It is evident, that data quality is determined, when the measurement is done. Afterwards one can search and filter out clearly incorrect data, but the accuracy of an individual measurement cannot be increased. Thus actions to ensure data quality must be mostly taken before the measurement.

The method used to find the actions needed to ensure data quality was risk analysis. The whole process of producing road weather data was analysed step by step. At each step it was consider, what factors might risk the ability to produce and deliver high quality data. Actions were then planned to eliminate the risks. The actions include:

- careful planning while selecting a place for a station or camera,
- careful assembly of devices,
- maintenance operations accomplished according to a plan before the start of season,
- etc.

In the quality standard this approach is referred as quality assurance. In principle, road weather data can be validated by conducting an independent measurement and comparing the results. Unfortunately this is only seldom possible and we must mostly rely on quality assurance. Quality assurance aims at preventing any problems from happening. Of course, it is not a hundred percent guarantee of quality. It is a way to provide reasonable confidence that the requirements will be met.

Quality assurance is also related to quality control. The main difference is that quality control is reactive in nature whereas quality assurance is preventive. Quality control uses techniques such as inspections and monitoring to assess quality.

Quality control is used in road weather information system to find device malfunctions and to assess the effectiveness of quality assurance. For that purpose data can be verified against older data from same point or against current data originating from neighboring stations. However, this method reveals only considerable deviations. To find minor deviations we must rely on human judgement: the user of data may detect even small deficiencies by comparing road weather data to information from other sources and by monitoring data for a longer period of time. Results from calibrations are used to assess the effectiveness of preventive maintenance.

Collecting data describing quality achieved or activities performed is an important part of quality management. To be able to improve quality, one must have facts about current state. Collected data is also used as evidence while showing the quality.

PROJECT RESULTS

Evidently, the most important result of the project is better quality. However, it is still too early to make an assessment whether this was achieved. In a project like this, the general competence building is another, yet hard to measure result. The competence of the personnel was increased by arranging several courses on quality issues; some members of the project group even passed a quality auditor exam during the project.

The first visible outcome from the project was the Quality manual, first version of which was accepted in May 2003. In autumn 2003, several software tools were implemented both to road weather data users and to the personnel.

The most important goal while designing new tools for road weather data users was that of adding the overall transparency of the system. New features were integrated into the existing viewing tools to show the users as much background knowledge of each station and camera installation as possible. The motivation for this was that the background knowledge helps the user in interpreting the measurement results correctly; clearly a quality goal in itself.

With the aid of new tools supporting personnel detects problem situations more quickly. The system itself records data about problem situations in the data base. Moreover, the system collects feedback from the users. All this data can be viewed by the supporting personnel as well as by the user. The system makes it easier for the supporting personnel to send maintenance requests for device maintenance service providers, helping to shorten the time while data is not available.

Frequently done maintenance operations on stations and camera installations are a key in maintaining the accuracy of data. By new tools the personnel can track that the maintenance operations are carried out as intended making their management easier. Data recorded can also be used for auditing purposes.

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