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Speed Map Maintenance

experiences from the ISA project "Spar på Farten"

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SPEED MAP MAINTENANCE – EXPERIENCES FROM THE ISA PROJECT SPAR PAA FARTEN

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ABSTRACT

Spar paa Farten is a Danish Intelligent Speed Adaptation (ISA) project located in the Northern part of Jutland. It is based on Pay As You Drive principles and hence is the maintenance of the speed map crucial. This speed map is planned as shared with the municipalities. However, the updates from some of the municipalities have been sporadic and only 46 percent of the municipalities have made updates via a web application, which has been developed for this purpose. Hence the municipalities have not been a guarantee for an updated speed map.

BACKGROUND

The research project *Spar paa Farten* (SPF) is a continuation and up-scaling of the *INFATI* project in Aalborg, Denmark which The Traffic Research Group at Aalborg University carried out from 1998 to 2001 [1]. The overall goal of the *SPF* project is to test whether economic incentives, such as reduced car insurance based on the compliance with speed limits, will result in less speeding among the participants. The project was started in early 2004 and will continue until 2010. As part of the project a speed map has been developed. This paper describes the maintenance of the speed map and the challenges within this process.

The ISA equipment developed in SPF

The ISA equipment is an “On Board Unit” matching GPS positions with a digital speed map stored in a database in the car. The equipment also consists of a display showing the actual speed limits, a device using a female voice for warning the drivers when speeding and a function to log the speeding. The OBU uses GPRS communication for daily upload of the logs to a server as well as for the import of updates to the speed map. Finally the OBU has a security module to secure against cheating with the positions and the speeds. At the server side the participants have a web interface to look at their speeding logs.

Why is maintenance of the speed map crucial?

When map users find small errors in an ordinary map they can continue using it without problems just by abstracting from these errors. However it is evident that if major errors exist, the usefulness of the map is reduced. Concerning digital speed maps for ISA-projects the accuracy is crucial because the ISA user must have confidence in the system and wrong warnings are frustrating for the user. As an example the participants in an Australian ISA-project found that wrong speed warnings because of errors in the speed map were the largest frustration about the project [2]. In a project as *SPF* this is even more crucial since errors in the speed map may result in wrong discounts to the participants.

Experiences from digital map providers, authorities and other ISA projects

It seems that developing and maintaining digital speed maps causes troubles several places. In Norway, a common digital road database for all Norwegian municipalities and the national authorities was started in 1999. In 2003 a large part of the municipalities had still not contributed to the database [3]. Also English and Dutch governmental papers conclude that one of the largest challenges for a successful ISA project is the development and maintenance of the speed map [4], [5]. In addition also previous ISA projects have concluded that developing and maintaining the speed map is a major challenge. In a newly finished Swedish ISA project in Stockholm, problems with the speed map were one major reason why the project was delayed for one year [6]

Krak base their map on the Danish Address & Road database from whom they receive an annual update. Moreover the municipalities, the Counties and the Danish Road Directorate are contacted ad hoc. There is no standard procedure for these contacts which are based more on information on new projects for verifying the details. The map users also send a large number of corrections which also are verified by the authorities. Krak has no persons in the field to observe the changes. In general most of the update procedures are based on experiences and network with key persons [7]. De Gule Sider (The yellow pages) bases their maps on updated from KMS (National Survey and Cadastra) which is supplemented with user feedback [8].

TeleAtlas' digital map for Denmark was initiated with a version of DAV in the early 1990ers. With this as a basis, a number of employees in the field, and with feedback from the map users, updates are made. This is supplemented with information from municipalities, counties and the Danish Road Directorate. During the last few years, mobile mapping has been a central part of the updating procedure. The main roads are being driven through and recorded every year and the less important roads every fourth year. TeleAtlas does not use new updates from the authorities [9].

DEVELOPING THE SPEED MAP FOR SPAR PAA FARTEN

In general there are two ways to maintain a digital map. The first is to start from an existing map, followed by an independent updating procedure with no feedback to the initial map owner and vice versa. The second way also starts with an existing map but here relevant authorities and other stakeholders will contribute with continues updates. The first methodology is simple to administrate, but the digital map "grows away" from the original map. It is quite more complicated to administrate the second method, but in theory it will give a common map which always is updated because all stakeholders have an interest in order to keep their map updated. A large number of contributors are another difficulty in the second

way because it might be difficult to keep them all committed to the updating procedure. The latter procedure is selected for SPF.

A speed map in the most basic form could be a road centre theme with a speed limit as attribute data. In Denmark there can be different speed limits in each direction of a road. Therefore the Speed map developed for SPF must contain a road centre, two speed limits, which may differ, and a unique road code for each piece of road. The collecting of the road data has been quite complicated because no central database exists. Furthermore the available data are seldom sufficiently updated. Therefore it was decided to develop a new speed theme for the project. The speed theme is a sign database which contains all the speed limit signs and signs for speed calming zones. The first task was to collect the position of every single speed sign in the County with about 9,300 km public roads and 22,000 km in total. Using a GPS unit and a customised keyboard we recorded 5,600 speed signs. See figure 1. The next step was to be sure that quality of data was as high as possible.



Figure 1 - The customised keyboard.

To create a speed map on the basis of registered speed signs there are some problems to be solved:

- Speed limit is often a zone where every single road that leads to that zone ideally should have a speed sign. However, in the real world this is often not the case.
- In the digital map we didn't have all the roadblocks and dead ends that could be a zone limit.
- Often in areas of for example summer cottages people put up private signs which is not in accordance with the law and regulation for that area.
- GPS is not so accurate that every registered sign is placed on the digital road map. So every sign needed to be snapped to the digital road map. This operation could lead to signs being placed on the wrong roads.

In order to find out where zones start and ends and the roads with private speed signs are, and if any speed sign were missed on the registration, the local authorities were contacted to help with correcting these errors.

As part of the speed map developing process, a web application was developed. On this application the municipalities, the county and other stakeholders have an easy and uncomplicated tool to maintaining the speed map. See figure 2.

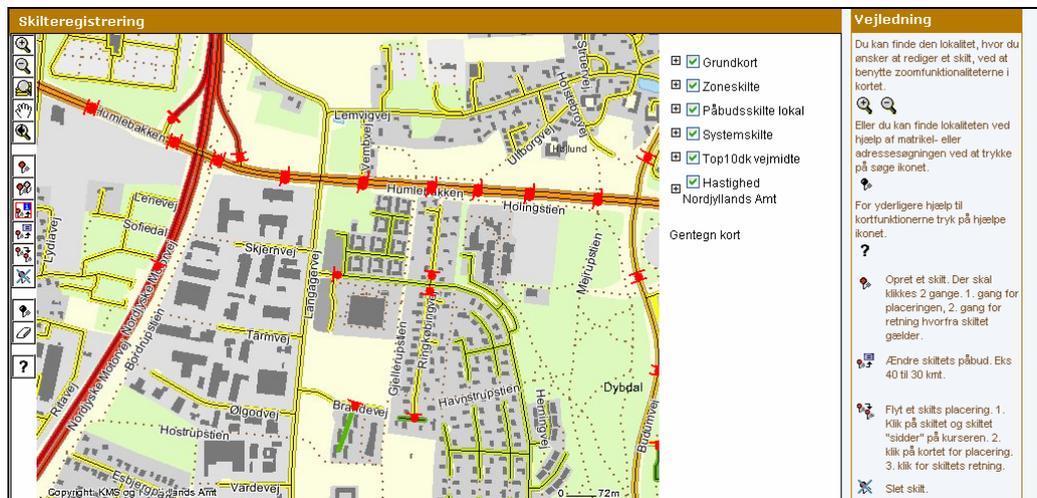


Figure 2 - Screen dump from the web application.

The updating procedures from the authorities are supplemented with feedback from the participants. However, this feedback might be biased since the interest in reporting speed limits which are too high might not be present.

This is a very short description of the speed map developing process. Besides being a speed map for the project, the map is also planned to be a unique tool for the municipalities in their daily work. They should just use the web application. For more about the developing of the speed map see [10].

EXPERIENCES WITH THE MAINTENANCE

The maintaining procedure has contained two methods. The first is the participant's feedback. It has mostly been done by e-mail and afterwards a project member has visited the location in order to verify the error and then update. The second methodology is the updates from the municipality which is the topic below.

The municipalities, who are the owners of the major part of the road network in the county, have promised to contribute to the speed map with continuous updates about changes in their speed limits. A significant part of the municipalities have contributed with changes as promised, while others have been less enthusiastic to contribute. During the project period the municipalities have been contacted several times with the purpose to commit them to contribute to the maintenance of the speed map.

The web application was introduced to all 27 municipalities in the county in the autumn of 2004. A member of the project staff visited all the municipalities again in the beginning of 2005 asking them to supply information for some of the roads and to offer the municipalities

help for the use of the web application. The experience from the visit at the municipalities was that the municipalities had quite varied attitudes to the speed map. A minority of municipalities told, that they didn't have resources for the updating procedure. Other contact persons were not familiar with IT and hence they would not use the web application for updates [11]. In the early 2005 the situation was:

- Approximately 15% of the municipalities didn't update the speed map for resource reasons
- About 50% were very positive and helpful concerning the speed map
- Approximately a third part had never tried the web application
- Another third part had tried the application, but had never used it
- The last third part used the application when updates were registered
- It seems that the contact persons in the largest municipalities were a little more used in IT, and they had a little more resources for updating the speed map

The largest challenges against getting a continuously updated speed map were unwillingness against IT and lack of resources for handling the task. It seems that the largest municipalities had most resources and were most used to IT. In general the municipalities had a positive attitude to the speed map as well as to the SPF project. Only one municipality didn't want to take part of the project. [11]

In September 2006 a short phone interview with the 26 positive municipalities was carried out [12]. During these conversations they were asked about; Use of the web application, Ease of use, Use, Updating routines if any, Reasons for not using the web application and How they registered their speed signs.

In two municipalities the original contact person had quitted the job and in two other municipalities the updating task was hand over to another member of the staff. The knowledge about the project and the web application was not handed over, and therefore some of the contact persons only had sporadic knowledge about the SPF project. The majority had a very positive attitude to SPF, but one of the contact persons stated dissatisfaction with the updating procedure.

Use of the web application

Since the last visit in the municipalities in early 2005, when the web application was introduced, 54% have not used it. 46% have visited it but only 38% have used it for the updating. See figure 4.

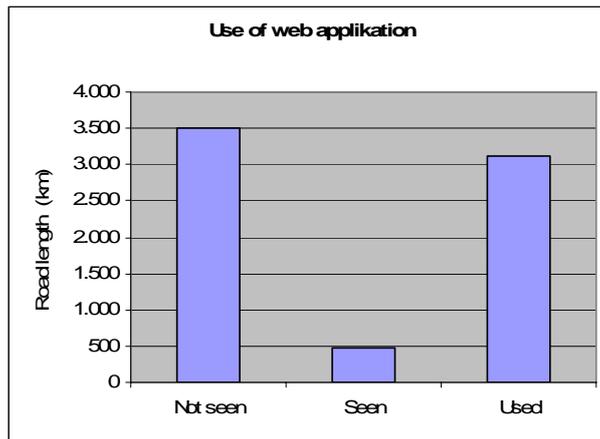


Figure 4 - Length of municipal roads in the County of North Jutland distributed by the responsible authorities' use of web application for updates.

The result is that no updates via the application were received from authorities who administrate some 4,000 km of 7,800 km public roads. Among municipalities who have made no updates, 28% states that they have forgotten the application. 21% have lack of resources, and 36% states that no changes have been made on their roads¹. Only 14% states that poor IT-knowledge has resulted in no updates via the web application. See figure 5.

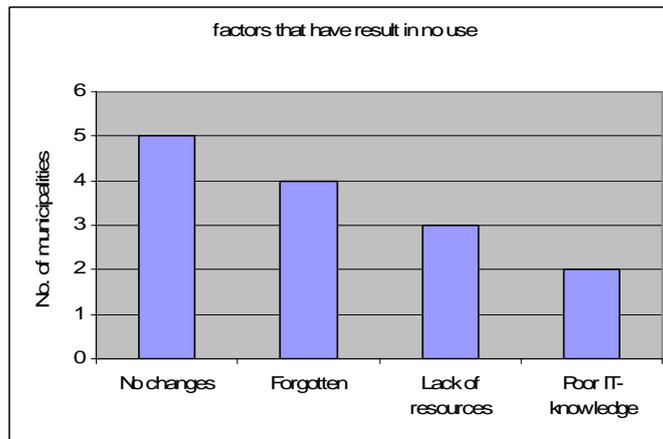


Figure 5 - Factors that have resulted in no use of the web application.

Poor IT-knowledge has been a decreased problem since 2005. This is probably a result of the general increase in IT knowledge in the society. Whether or not lack of resources or no changes in the municipal roads can explain the forgotten application is not clear, but it is obvious that the staffs from the municipalities last autumn (2006) has been very busy because of an upcoming reform of municipal structures in Denmark.

Registration of speed signs in the municipalities

¹ It is a rather long period, and at least twice, the project staffs have observed in the field that there have been changes in the roads although the responsible municipality said there have not.

In 2000 the municipalities in the County of North Jutland were responsible for 7,829 km municipality roads. The state and the county have further 1,448 km roads in the county. Hence the municipalities are responsible for 85% of the public administrated roads. Figure 6 below shows, how the municipalities administrate the speed signing on their roads.

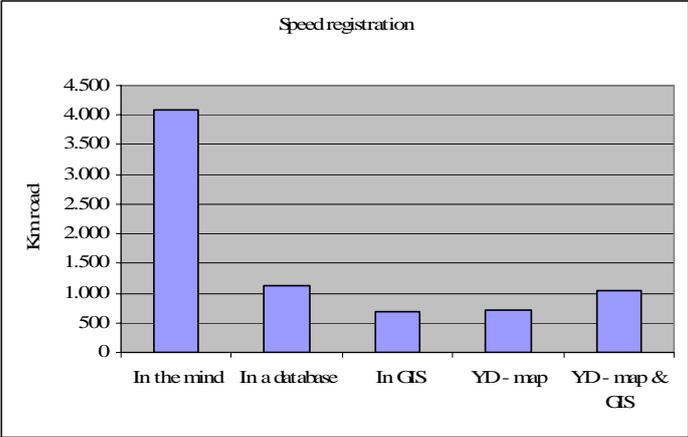


Figure 6 - The speed limit administration for the municipal roads distributed on km.

In the small municipalities the speed signs are just registered in the mind of the responsible person(s). If any doubt about the speed signs occurs, a visit on the site solves the problem. A few small municipalities use the SPF-map in addition as a reference - which were one of the main purpose with the map. In most of the larger municipalities a central database is established. Some have only a part of their signs in the database, while other municipalities have a GIS-theme with speed limits. One of the municipalities supports their GIS theme with the SPF map.

The situation mentioned above means that at 53% of the municipal roads (4,000 km) the municipality did not have the speed sign in any register. Only for app. 23% or 1,800 km roads the speed limits are available in a GIS-theme and hence in a map. This picture shows that if no special action is taken there is a long way to a situation where an updated digital speed map is available in all municipalities.

Future problem solving

As mention above, the speed map maintaining has not worked as well as expected. Many of the municipalities have no resources for the updating task at the moment which has resulted in a defective updating. No doubt some of this problem is a result of the ongoing reform of municipal structures finishing by the end of December 2006. Another condition is the size of the municipalities. In the small municipalities in the county there is only a little technical staff, with a wide range of tasks in which the updating procedure for the speed map may disappear. When the reform of municipal structures has finished, the municipalities will be bigger (from 27 to 9 municipalities) and hence they will get more specialised staff. A number of municipalities predict that a better registration and updating of the speed map will happen when the large municipalities are in operation.

CONCLUSIONS AND DISCUSSIONS

Our experience with speed map in the SPF project shows, that it is relative easy and economic manageable to make a digital speed map. The real challenge is to maintain the map. We developed a common web application, to be used by all road authorities. We made a voluntary update procedure - we had no other possibilities. We tried to convince the municipalities of the importance of the update, but our investigation shows, that only a few municipalities make a reliable update of the speed map. Our conclusion is that you can't get a high quality speed map based on voluntary maintaining in the municipalities.

Section 10 in the Danish road law says that the road authorities are obligated to keep the road in a condition that the traffic requires. Our recommendation is that the Danish parliament changes the road law, so it also is obligatory for the road authorities to make a digital map of the roads – including speed limits - available for the public. Only in that way, we can develop reliable controlling ISA systems in large scale.

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