IMPLEMENTATION OF SMARTE67 PROJECT

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Abstract. SmartE67 project is approved during the open call of the European Union's co-financing regional program, whereas SJSC "Latvian State Roads" and Estonian Road Administration have submitted their joint proposal of new service deployment in the field of Intelligent Transportation Systems. The project's main objective is improving traffic efficiency and safety on E67 road transport corridor Tallinn-Riga-Lithuanian border by introducing of the advanced and complex traffic management solutions, based on the mutually agreed technological approach and best-practice transfer. There is a broad list of activities to be implemented in 3 year period (2015.-2018.), such as: studies, rolling out new and modernisation of existing traffic control equipment, as well as adoption of the partners' Traffic Information Centres for the new functionality. The most visible outcome here will be the first massive implementation of variable message signs along the route in both Latvia and Estonia.

Keywords: adaptive traffic management, variable message sign, technology transfer, traffic information centre.

1. Introduction

Gradual development of Intelligent Transportation Systems (ITS) is one of European priorities in the field of transportation. For about 10 years ITS is a quite well-defined scope of services and supportive measures on the European Union (EU) level, which is aimed to improve all facets of mobility, including safety, network throughput and environmental impact. Proper approach to ITS allows to reach high-level synergy with road works. ITS is based on the extensive use of nowadays boosting information and communication technologies (ICT), where innovations change the traditional approach to network operations very rapidly. Some common things, directly related to ITS domain have already changed the transportation industry worldwide ("big data" use, car sharing, multifunctional traffic monitoring etc.) and will definitely make even bigger revolution in only some forthcoming decades, with an accent on autonomous vehicles and maximum multimodality of transport[1].

Practical use of ITS by road opertors mainly lies in the scope, defined by the EU Directive 2010/40/EU[2] (emergent support of critical traffic events and dissemination of traffic info) and European ITS action plan[3]. A set of supportive delegated acts was adopted to make such prescribed ITS services interoperable and seamless (between the EU member states) at least for the Trans European network (TEN). That is why national priorities and EU supportive measures provide opportunities for international ITS projects. Close cross-border co-operation allows to achieve even more than direct project deliverables only: knowledge transfer, harmonisation of technologies and co-operation procedures are the points of added value. Latvian and Estonian road administrations were able to form a succesfull partnership, aimed to reach these targets within the EU co-financed SmartE67 project.

2. General project indicators

All the Baltic States are relative newcomers in ITS field. There are still different priorities and tempo of ITS development in them. Some gaps exist also for proper decision making, such as lack of sectoral planning documents and institutional co-ordination. That is why the Baltic Road Association (BRA) is quite unique platform for discussion on regional co-operation and attraction of external funding to ITS sector. BRA ITS Technical Committee has examined a lot of opportunities, foreseen by the EU co-financing programmes for 2014 - 2020 period, which resulted in the idea of several joint proposals for target calls.

One of succesfull proposals, named SmartE67 was prepared by SJSC "Latvian State Roads" (LSR) as a lead partner and Estonian Road Administration (ERA) for the European Regional Development Fund (ERDF) Interreg Central Baltic Programme. Overall objective of the project is improving the efficiency and safety of cargo and passenger transport flow on a 394 km long section Tallinn-Riga-Bauska-Lithuanian border of the E67 transport corridor by introducing proper ITS pattern. According to proposal evaluation criteria, the main effect to be reached is a decrease of travel time for both passenger and cargo transportation within the whole section by at least 0.57%, comparatively to the present situation. Additionally, road safety is to be improved and CO_2 emissions reduced. It will have macroeconomical cost/effectiveness ratio for the planned investments of approximately 1/3 for the project estimated lifecycle of 15 years. The realistic traffic forecast for E67 for this period shows the annual growth of 1.5-2%. However, the biggest ever regional project *"Rail Baltica"* will result in alternative European type railway and should equate the transit by the

modal shift in 2025 and even later. E67 in several sections will then probably be developed as the main access road for local traffic to railway stations and logistics facilities nearby.
The partners see a notable industrial multiplicator effect of the project, giving opportunity for pilot ITS implementations, transposable to the rest of the network later (especially VMS). SmartE67 aims to introduce new or to modernise the existing roadside ITS equipment and to ensure joint solutions for traffic information exchange between traffic information centres (TIC) of partner organisations, based on the Directive 2010/40/EU, joint technological approach and best-practice examples, available in the region (including EasyWay and CEDR guidlines). Finnish Transportation Agency (FTA) kindly agreed to be the project associated partner for initial expertise and knowledge transfer to LSR and ERA in the field of adaptive traffic management with VMS.
The total budget is almost 2.5 million EUR, where the EU will co-finance 85% of the eligible costs, with the following distribution between the partners: LSR – 1.4 million EUR; ERA – 1.1 million EUR. There are a lot of ambitious activities within the project, including specific studies, interventions in roadside ITS equipment, TIC adaptation, communication to road users and society, as well as, administrative costs. This is one of the first projects of this type for both partners, where target measures (studies and deployment) are combined with a broad list of supportive so called "soft" measures. The project started on November 31, 2015, and its completion was initially planned after 3 years, but the complexity of tasks probably will be the reason to prolong it for 1 year more (it is important also to replan the possible budget remainings to reach even better results).
Both partners see not only direct and measurable effect of SmartE67 to be reached, but also significant potential of multiplication, while the project results (traffic control paradigm, technical solutions, evaluation methodology, etc.) might be applicable for the rest of the road network, and to rise up ITS domain at well-interlocked level for both regional (cross-boarder) and local (interurban/urban) dimensions. Also the involved specialists of LSR and ERA will gain the professional competence in the field of adaptive traffic management and the related issues.

3. Project activities

According to project application form, there are 5 working packages with subsequent and parallel activities:

- consultations for ultimate and detailed decision making on the initially planned investments (feasibility study, technical design) and evaluation of project results (ex-ante/ex-post analysis);
- contracts for deployment of roadside ITS elements, including preparatory works (for instance, on-site wiring) and rolling out such installations;
- TIC adaptation foresees the improvements of existing data systems, providing complex central TIC software, data exchange hub between the partners and also training of TIC staff to be ready for the new functionality (scenarios applicable for traffic management);
- communication measures, which will not only cover general project PR issues and bring together the main stakeholders and target groups, but also will perform societal information campaign mainly aimed on VMS use (preparation of educational video, conference etc.);
- management package is provided by the project team as the main supportive effort to all above mentioned topics.

Technological harmonisation is one of the project key goals, as in reality the activities of partners are not absolutely equal due to their differencies in technical performance of E67 sections (e.g. number of lanes for some stretches), national traffic management priorities and existing ITS elements in the corridor. Due to these reasons, only some core activities are to be covered by joint procurement (project supportive studies and information campaign), while deployment tasks are to be solved separately, but still based on specific common principles. There are the following general differences:

- LSR develops various scattered spot ITS installations along the Latvian section of E67 and only some short stretches are to be lineary co-ordinated;
- ERA puts the effort mainly on variable speed limits for 13 km long motorway-type section near Tallinn and traffic signalling optimisation for Pärnu bypass.

This approach considers quite different roadside ITS elements planned by the partners, namely:

- LSR will have 2 incident management system (IMS) spots for real-time video monitoring of critical spots and in-depth technological integration (sharing of the elements) of warning type VMS with road weather station (RWS) on-site[4], which are to be operated mainly in automated (situation trigger → traffic management action) way;
- ERA will use more variable speed limits and text-type VMS, aimed for additional information to road users and re-routing, where various actions are to be manually approved by TIC dispatcher.

All technical details for roadside ITS installations are summarized in Table 1.
Public is to be well informed about the content and progress of the project. Press releases have been prepared at several project notable phases, information is disseminated through various media channels, including partners' webpages and social media. One of the key PR activities towards the end of the project will be an awareness campaign, making a series of information materials about SmartE67 and new developments introduced in road traffic. Educational video and in-depth instructions (in paper and electronic form) on how to react on VMS, while driving are to be issued and widely

broadcasted in mass media. Project final conference with focus on the main target groups of users and stakeholders is planned, as well. Some examples are shown in Figure 1.

Table 1. SmartE67 project: road/traffic data and planned deliverables

Project deliverables	LSR data	ERA data	Cummulative data
Length of road section, km	202	192	394
Traffic flow (min/max) in 2015, vehicles per day	4399/22370	3220/31345	4399/31345
Number of spots (stretches) covered by ITS elements	26(3)	16(6)	42(9)
Overall number of road ITS installations	55	62	117
Number of new RWS	5	2	7
Number of modernized RWS	8	1	9
Number of IMS spots	2	-	2
Number of traffic lights adjusted to adaptive regime	10	9	19
Number of warning VMS	26	12	38
Number of speed limit VMS	2	30	32
Number of freely programmable VMS	2	-	2
Number of combined VMS (pictogram plus text)	-	8	8

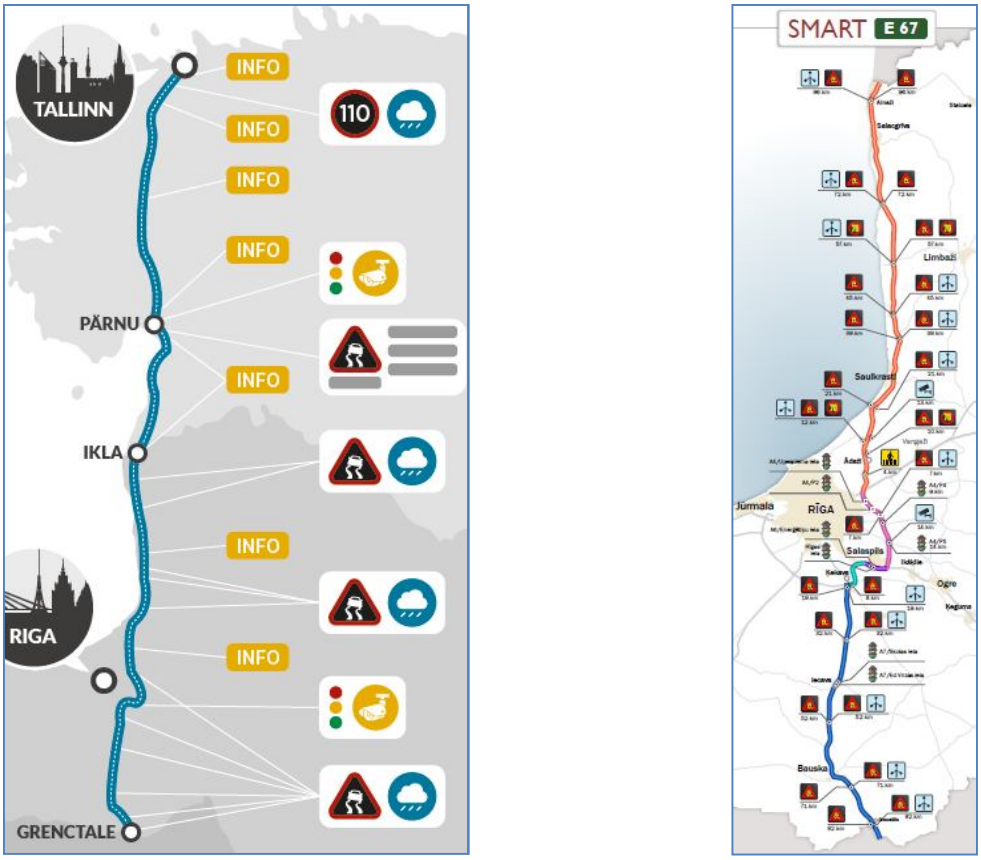

Fig. 1. Project infographics about planned road ITS installlations

4. Progress report

Since the commencement of project implementation a lot of activities are already accomplished or are on-going according to SmartE67 schedule. The main related organisational issues are, as follows:

- administrative efforts and preparations (which were quite new for the partners) to launch the project implementation (staff hiring, procedures, documents etc.);
- working meetings, that involve project management team and steering committee (kick-off meeting and one meeting per each project period of 6 months);
- reporting to the first level control institution and the Programme institution for each project period (2 reports are already approved);

- any other project related auditing activities (e.g. LSR has passed the Programme mid-term audit in May, 2017, and the revision of the State Control Bureau in 2016.);
- development and implementation of project communication plan (creation of project account in social media https://www.facebook.com/smarte67/?fref=ts, provision of project description for the web pages of partners and the Programme, preparing press releases according to the plan, etc.);
- preparation of project modification request, which is related on some formal (changes in the status of the partners, cost movement between the budget lines), as well as, content (deliverables, time schedule) issues, outlined below as an example of decision making, when the detailed latest data gives the opportunity to change or improve some of the initial considerations.

The completed content oriented measures of the project are listed in chronological order:

- LSR and ERA project engineering staff visit to FTA in December, 2015, to study in-depth adaptive traffic control in Finland and acquire the related documentation;
- preparation, procurement, provision and evaluation of project feasibility study[5] for detailed planning of investments in roadside ITS and TIC adaptation packages;
- preparation, procurement, provision and evaluation of project ex-ante/ex-post analysis[6] to measure the impact of the implemented ITS solutions on travel time (general methodology and ex-ante part already completed);
- preparation and procurement of supportive and on-site preparatory services (design and provision of electricity connections for road ITS equipment a.o.);
- complex procurements (separately for each of the partners) of project road ITS equipment, which approaching its one year long execution phase (until August, 2018);
  in-depth preparation of TIC adaptation activities (Figure 2), where several alternatives are possible and one has to be chosen for service procurement (to be started on October, 2017).

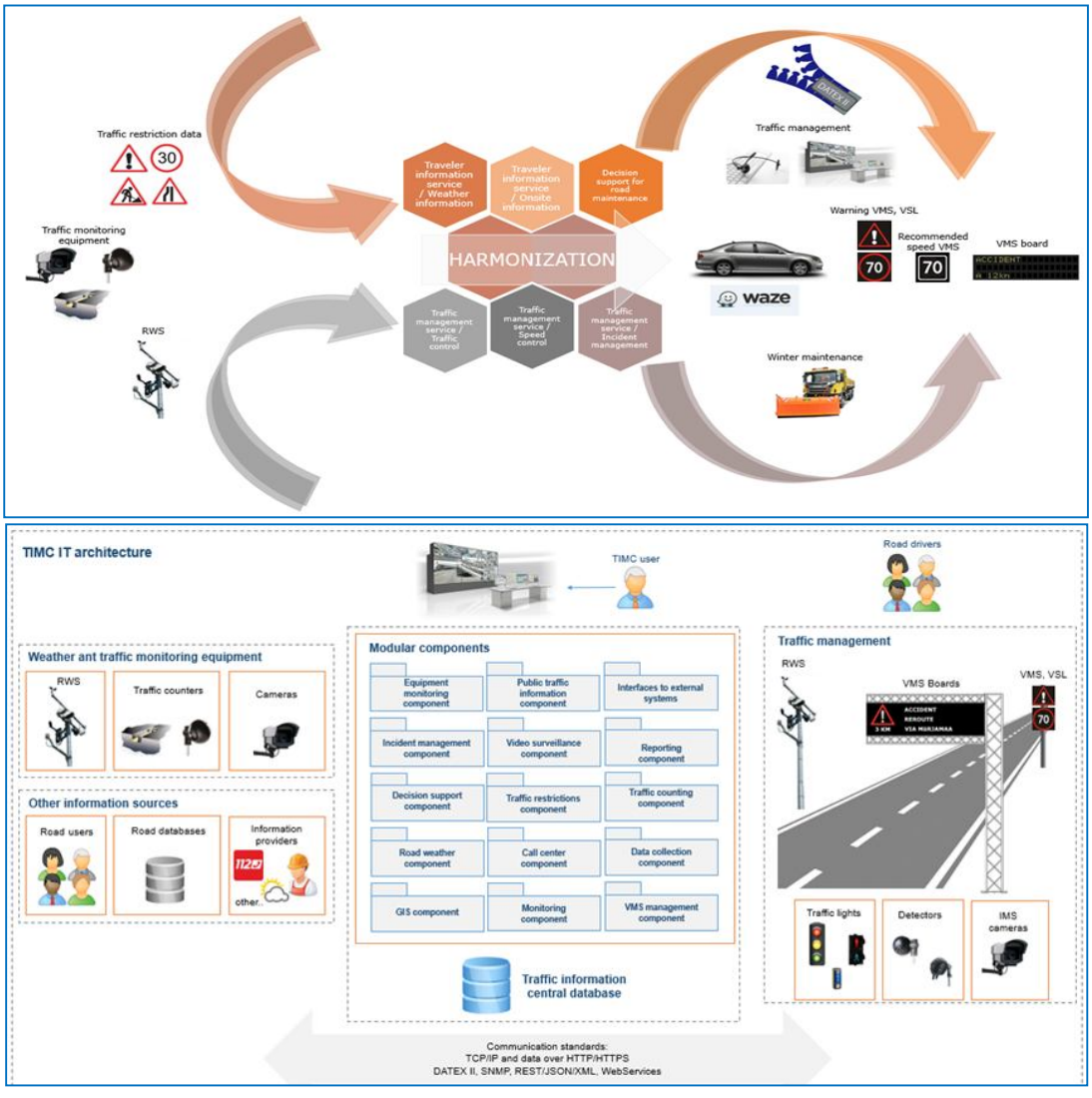

Fig. 2. Approach to traffic management and information dissemination (above) and modularity of TIC (below)

Ex/ante analisys was based on hybrid-type travel time measurements, where data from the partners' traffic counting units was combined with *Waze* input (Waze-o-meter module is available to LSR and ERA) and direct measurements, made by probe vehicles (carriers). 25 subsections of internally homogenous traffic were extracted for the modelling on the route. It was considered that peak hours (carrying about 20% of all traffic) occur for up to 800 hours, but busy flow – 56% for up to 3360 hours annually, which are to be primarily treated by additional traffic management measures of SmartE67 (see Figure 3).

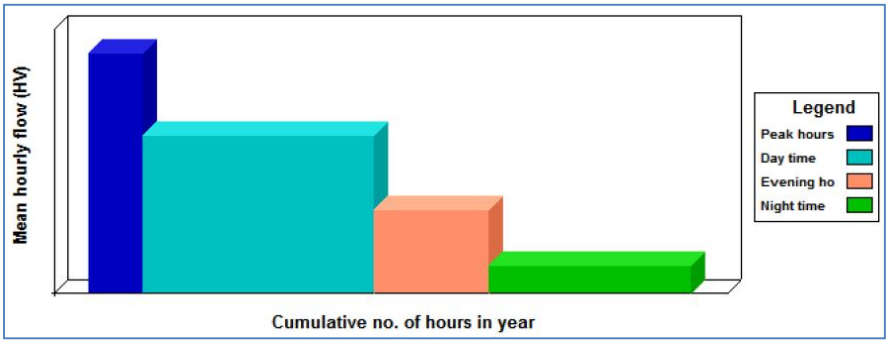

Fig. 3. General traffic flow distribution throughout the route

If the monitored average speed within the route is considered, weekly cycle is the most descriptive, where Friday evenings in the Latvian section are usually characterised by heavy rush. Road section near the Riga city is the main bottleneck. However, decade ago it was constructed as a compromise solution (14 m wide carriageway with the proposed hard shoulder use by slower vehicles, when overtaking takes place). At present it is not feasible anymore (see Figure 4.).

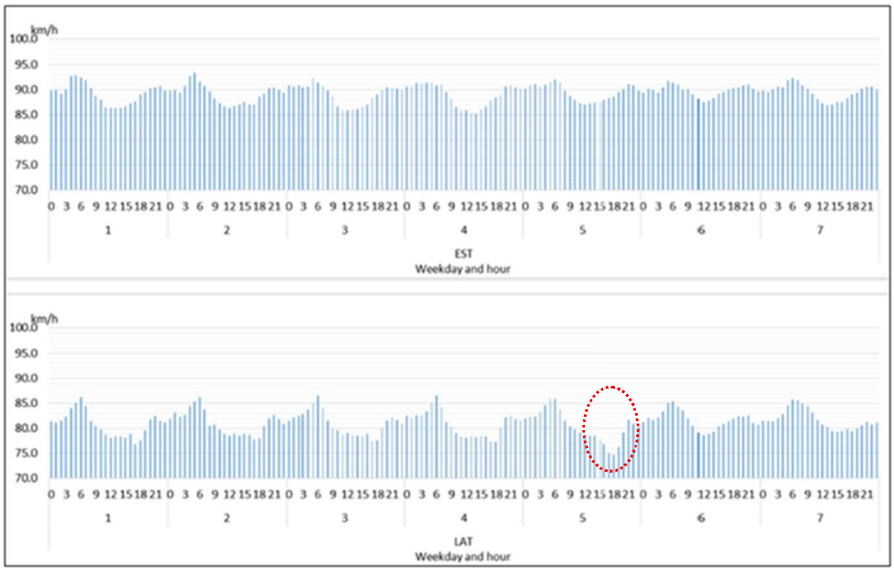

Fig. 4. Weekly distribution of average traffic speed for LV and EE sections

Monetary analysis for potential project benefits was made based on HDM-4 methodology, where existing cummulative road user costs (vehicle operation, travel time, accidents and emissions) are determined in order to be compared afterwards with the same data for ex-post study (when SmartE67 will be implemented). According to such approach, the Estonian section of E67 already generates almost twice lower road user costs due to actual traffic distribution, general traffic safety level and technical performance of the existing infrastructure (better road for smaller traffic flow). This potentially provides the opportunity for LSR to reach higher cost/effectiveness ratio for the Latvian section.

As it was mentioned before, one of project features is dealing within the previously unexperienced long-term ITS concept, and therefore a variety of parallel processes are taking place with direct effect on the project. In fact, such measures should be mutually agreed as far as possible, in order to build up coherent and sustainable nationwide ITS architecture from different blocks. For LSR such actual topics are:

- developing of the national strategy of ITS, where study, conceptual approach and action plan for 5 years will be introduced (October, 2017);
- feasibility study of TIC complex modernisation, analysing existing performance and setting up new functionality and defining the related investments, moving towards adaptive traffic management and maximum process automation;
- preparing of the national recomendations for VMS design and installation, which will make local add-ons (VMS visual performance, placing criteria, operational principles, algorithms a.o.) to intenational standard EN12966[7] (September, 2017).

5. Decision making process

A number of objective assumptions and uncertainties of project application form made consequent decision-making very important. That was the reason why the implementation phase was segmented in the following manner: idea → external expertise → internal expertise and decision → deployment → evaluation. In parallel to project studies, LSR and ERA are trying to raise their awareness by in-depth learning of the alternative technical solutions and communicate with the market on ITS performance and integration issues. These efforts resulted in the following project changes proposed to the Programe which were aimed at:

- rejection of some sub-deliverables in TIC adaptation package (hardware will be provided within partners' own budgets, when complex TIC modernisation will take place in the nearest 3 years, and data exchange hub is to be implemented by in-house production), to give the priority with all the saved funds to the implementation of complex TIC software aimed to organise the working environment for TIC operators and all related processes better (fast response on traffic events, co-operation etc.);
- non principal re-arrangements (costs and deliverables) between the initially planned road ITS implementation items due to detailed insight within the existing project framework (overall budget and targets);
- extension of project time schedule for 1 year (extremely feasible, due to the previously mentioned considerations and the whole Programme working cycle).

The feasibility study was elaborated, taking into account partners's common and individual needs, which resulted in a set of technical data and functionality details for the proposed solutions (see Figure 3).

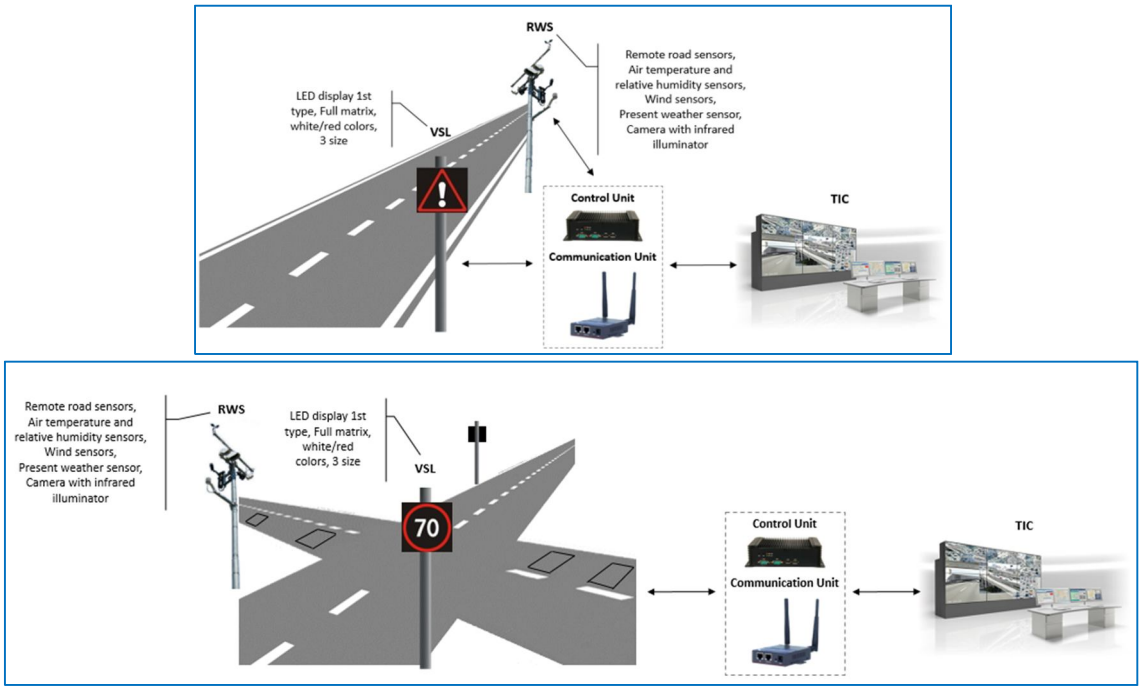

Fig. 3. Examples of VMS system subtypes, approved for LSR: VMS/RWS combined installation (above) and traffic calming VMS for crossing at grade (below)

TIC central software to monitor and run the planned road ITS installations is at present the focus of decision making. Taking into account the principles of modularity and interoperability on ICT level (also potential integration with future systems), as well as, modern type of service (cloud based, etc.), 3 principal alternatives were identified which were quite different in pricing and expected performance:

- fully customised product (service), developed exactly for the needs of a certain client, that gives the opportunity to have exactly what is asked for, but probably expensive in development and could not be specified enough by an unexperienced client;
- adjustable software, which has the main building blocks (data modules, templates for graphical user interfaces, etc.), but the executive version (variabilities of interface etc.) is to be additionally modified;
- ready to use software, made and marketed uniformly for wide range of customers.

Actually the partners decided to ask minimum user software for road ITS installation tender, which will help to exclude completely no-name solutions, which are not covered by typical operating programmes. That seems to be necessary on the basic level, but is absolutely not sufficient for TIC effective operation. Such advanced need is to be covered by the highest level products where functional integration between different types of road equipment and seamless data flow (also to the external feeds) is necessary. TIC operators should have direct trigger based notifications to react to (real-time road and traffic conditions) and support of their actions by the embedded set of applicable traffic management scenarios. In fact, this will require technological integration with GIS and SCADA platforms. The related data communication is to be solved internally within the system (NTCIP protocol for VMS) and by the outer transmission hub (XML protocol by DatexII specification and JSON proprietary coded dataset for light data exchange applications).

6. Conclusions

1. ITS sector need to be continuously structurized by legislative and organisational level in both Latvia and Estonia;
2. EU funds currently support investments in innovations, whereas proposals on ITS projects might be highly feasible;
3. LSR and ERA planned actions within SmartE67 are quite ambitious, pointing out new complex approach for corridor based adaptive traffic management;
4. some changes are planed in the initial application form due to the project's complexity and data from the preliminary studies;
5. harmonized ITS services doesn't mean deployment fully the same equipment, which is to be made on very complex site-specific considerations;
6. investments in ITS road equipment, let to reach not only target goals of certain project, but also bring new functionality and coverage of the existing services (f.i., RWS is not to be used for triggering VMS, but also for needs of road winter maintenance);
7. VMS case reflects very broad involvement of public and the key stakeholders, to be calibrated in practice (operational scenarios, road users' tolerance, enforcement methods etc.);
8. general approach to SmartE67 and parallel activities build up the framework for expertise and technology transfer to the rest of the road network.

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