

A Survey and Analysis for VMS Standard Specification in Korea

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ABSTRACT

There is a problem of poor compatibility between VMS devices as requirements and specifications of VMS (Variable Message Signs) are various according to an ordering agency of a VMS project. Thus, the purpose of this study is to propose a guideline for design and construction of VMS through providing a consistent standard of requirements and specification for construction of VMS system. For this purpose, we performed a survey and an analysis on requirements and specifications of VMS and made a draft of VMS standard specification by drawing field requirements through questionnaire of experts. The proposed standard specification will serve as a guideline that is utilized in case a project operator such as regional construction management administration or local government prepares VMS specification for an ordered project. With utilizing the proposed standard specification we expect the compatibility and efficiency improvement of construction and maintenance.

Keywords: VMS, Standardization, Specification, ITS, Survey

1. INTRODUCTION

ITS (Intelligent Transportation Systems) are advanced applications which graft electronics, control and communication of advanced technology onto the components of the existing transportation system such as road, vehicle, and traffic signal, etc. As the modern society is increasingly digitalized and networked, customers' demands for ITS service are higher, especially requirements for the service promoting of VMS which is a means of directly providing traffic information service are increasing. To respond to the growing needs for VMS, an effort is being made to provide faster, more accurate traffic information to users through improving technology and developing a wide range of products.

However, as technical specifications for design and construction of VMS are diverse according to an ordering agency of a VMS project, a VMS project operator is going through a lot of confusion and it is not easy to efficiently construct VMS through improved technology and specification. Also, there is a problem of poor compatibility between VMS devices as requirements and specifications of VMS are various according to an ordering agency of a VMS project.

Therefore, the purpose of this study is to propose a guideline for design and construction of VMS through providing a consistent standard of requirements and specification for construction of VMS system. For this purpose, we performed a survey and an analysis on requirements and specifications of VMS and made a draft of VMS standard specification by drawing field requirements through questionnaire of experts.

2. VMS STATUS IN KOREA

In Korea, ITS were introduced in 1997 and have been pursued in earnest since 2004, starting with a pilot project of national highway-route 3 in 1998. With this

expansion of ITS construction projects, VMS has been widely installed like Table 1.

Table 1: VMS installation status (Korea Institute of Civil Engineering and Building Technology [1])

Road division	Built length(km)	The number of VMS
Freeway	2,804	350 (based on 2007 data)
National highway	2,567	580 (based on 2013 data)
Urban highway	3,435	660 (based on 2009 data)

Also, the market size of VMS grew significantly with an increase in the number of manufacturers of H/W and S/W related to VMS and the development of its own technology by related companies.

Generally VMS in Korea can be divided into three groups such as Character type, Diagram type, and Video type, according to the display type as shown in Fig 1.



(a) Character type

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(b) Diagram type



(c) Video type

Fig 1: VMS classification by display type (The Korea Transport Institute [2])

The character type of VMS is the most common in Korea. It can provide traffic information, special event information, ARS phone number, promotional information by character. The diagram type of VMS was designed to provide traffic information with displaying subject roads and sections using diagram in order to supplement the limitation of the character type. The video type of VMS additionally provides video screen besides character and diagram functions. This type of VMS provides a CCTV screen for traffic control and monitoring with displaying additional information by character.

By recent trends in research and development related to VMS in Korea, private companies, universities and government-funded research institutes are making efforts to develop techniques to expand purpose and function of VMS as well as to carrying out wide range of research activities like the performance enhancement of VMS through lighter, thinner, mobility, and its own power supply, etc.

Current guidelines of Ministry of Land, Infrastructure and Transport related to VMS present standard for the installation and management such as location and type of installation, message design criteria, operating method, etc. However, there are not any standard for H/W specification, message set, protocol, S/W specification, etc. and thus the installed VMS in Korea have several problems in terms of compatibility and maintenance.

Under this development of VMS, there is the need for the standard guide of VMS installing and the minimum standards of equipment for compatibility between the existing VMS and newly installed VMS, ease of equipment operation, and the link with the existing ITS systems.

3. SURVEY AND ANALYSIS FOR VMS STANDARDIZATION

3.1 Survey for ITS Equipment Standardization

We carried out a survey to investigate ITS experts' awareness for the need of standardization for ITS equipment and VMS like Table 2.

Table 2: Summary of a survey on ITS equipment standardization for ITS experts

Period	May 2013 to July 2013
Subject	Experts related to ITS (total 41 people)
Survey method	Email and Interview

Among selected ITS experts, 44% have more than 10 years of work experiences related to ITS as shown in Fig 2.

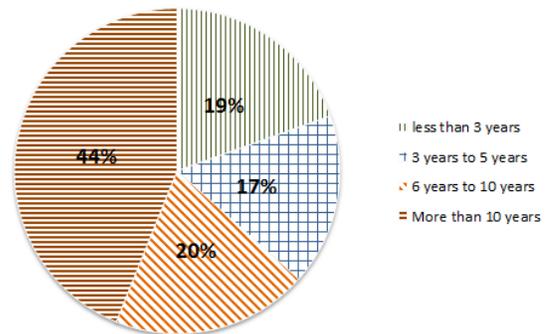
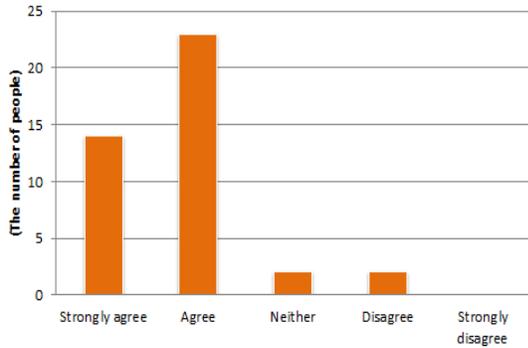


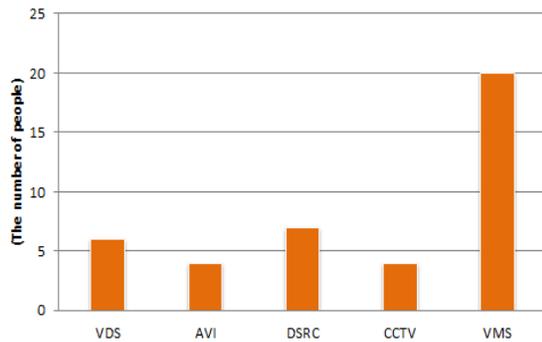
Fig 2: The work experiences related to ITS for subject (Korea Institute of Civil Engineering and Building Technology [1])

As the survey result of questions for ITS equipment standardization, it shows that more than 90 percent (Strongly agree: 14 people, 34% and Agree: 23 people, 56%) were in favor of standardization of ITS equipment and most experts have been recognized VMS among ITS equipment has the most urgent need for standardization.

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(a) Favor of standardization of ITS equipment



(b) The most urgent need for standardization among equipment

Fig 3: Opinions of standardization of ITS equipment and the most urgent need for standardization among equipment (Korea Institute of Civil Engineering and Building Technology [1])

Although ITS experts recognize that VMS is the most urgent need for standardization recognized VMS, They has the opinion that the standardization of VMS is not easy since standardization can inhibit the development of new technologies for VMS and there is the difficulty of establishing a standard for a variety of existing products.

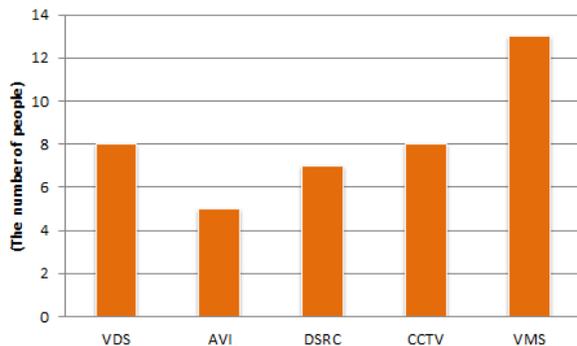


Fig 4: Answers about equipment having the difficulty of standardization (Korea Institute of Civil Engineering and Building Technology [1])

Also, as the survey result of the question about why standardization of ITS equipment is needed, most experts chose guarantee of interoperability between different systems, securement of compatibility between

different devices and decrease of maintenance difficulties as standardization purposes as shown in Fig 5.

- Guarantee of interoperability between different devices: Very important 48.6% and Important 45.9%
- Securement of compatibility between different devices: Very important 43.2% and Important 48.6%
- Decrease of maintenance difficulties: Very important 48.6% and Important 37.8%

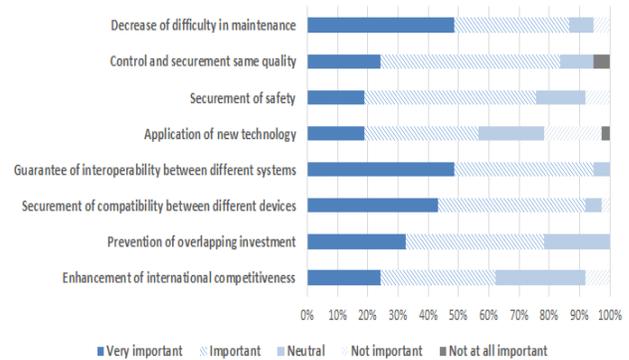


Fig 5: Answers about why standardization of ITS equipment is needed (Korea Institute of Civil Engineering and Building Technology [1])

As the survey result of the question about importance by component according to the standardization of VMS, most experts placed importance on communication method/ protocol and message set rather than test/evaluation of performance and physical specification as shown in Fig 6.

- Communication method and protocol: Very important 51% and Important 44%
- Test and evaluation of performance: Very important 22% and Important 49%
- Message set: Very important 29% and Important 29%

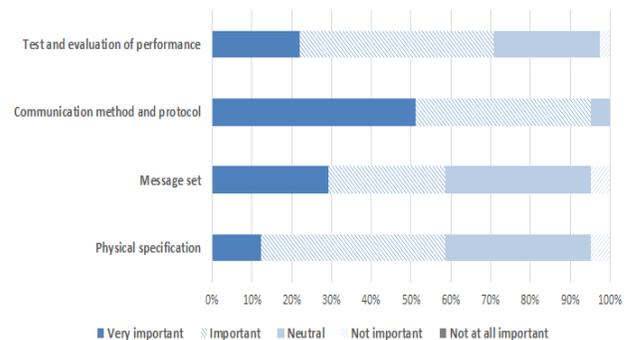


Fig 6: Importance by component according to the standardization of VMS (Korea Institute of Civil Engineering and Building Technology [1])

It shows that it is important to ensure the interoperability through standardization of communication method/protocol and message set rather than inhibiting the development of technique due to the standardization of physical specification.

3.2 The Component of VMS by Required Function

We can classify VMS systems by required function and implementing devices into three parts as shown in Table 3.

Table 3: The classification and configuration of the VMS system

Parts	Components	Functions
VMS Display part	VCU, VMS display module, Signs, SMPS	Message display and control
VMS Maintenance part	VMS management control division (MCU, EMU, Power supply), Power control division, Distribution board, Communication device, Housing	Message monitoring, Maintenance and management, Status report
Monitoring camera part	Monitoring camera	Monitoring message display

* Note: VCU (VMS Control Unit), MCU (Main Control Unit), EMU (Environment Monitoring Unit), SMPS (Switching Mode Power Supply)

VMS display part consists of VCU, display module, Signs, SMPS, etc. and has functions of message display and control. VMS Maintenance which is composed of VMS management control division, power control division, distribution board, communication device, and housing, has functions of message monitoring, maintenance, and status report. Also, monitoring camera part has a function of monitoring message display by a monitoring camera. Fig 7 shows the example of VMS component diagram.

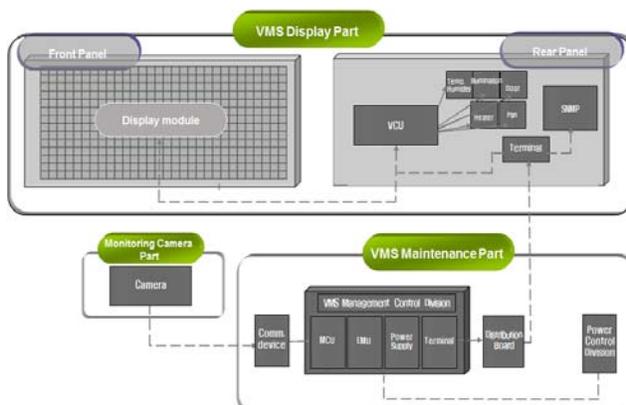


Fig 7: The example of VMS component diagram

3.3 Survey for VMS Equipment Specification

Next, we carried out a survey listed in Table 4 to investigate VMS experts' opinions for selection of items to be included in a standard specification as the minimum equipment specification which is necessary for implementing the basic function of VMS.

Table 4: Summary of a survey on VMS equipment specification for VMS experts

Period	June 2013 to July 2013
Subject	Experts related to VMS (total 17 people)
Survey method	Email and Interview

Before a survey on VMS equipment specification for VMS experts, we made a draft of VMS specification questionnaire including all specifications which are stated in the existing specifications and request for proposals on the basis of checking up specification and request for proposals by local government, regional construction and management administration, and Korea Expressway Corporation. Also, after review on a draft of VMS specification questionnaire by VMS manufacturers and research institutions, final version of VMS specification questionnaire was completed.

The subject consists of VMS manufactures (5 people), managers of regional construction management administration (4 people), traffic center managers of local government (4 people), private ordering agency (1 people), and researchers of dedicated organization for ITS standardization (3 people). All items chosen for being included in the standard specification of VMS were divided into two groups as follows:

- Required item: as a specification of an item that must be observed on the design and construction of VMS, the item should be included in a specification.
- Selection item: an item can be selectively included in a specification by Concession Company and ordering agency of a VMS project.

4. VMS STANDARD SPECIFICATION AND VMS STANDARD

Based on the survey on VMS equipment specification such as H/W, S/W and communication protocol, the selected items as the minimum standard to implement the basic function of VMS were chosen as the subject items of standard development. Also, the capacity and speed of processor, memory, storage, and operating system within MCU, VCU or EMU were not specified to consider a technique being developed continuously. By the survey result of VMS equipment specification, drafts of VMS standard specification and VMS standard were made like Fig 8.

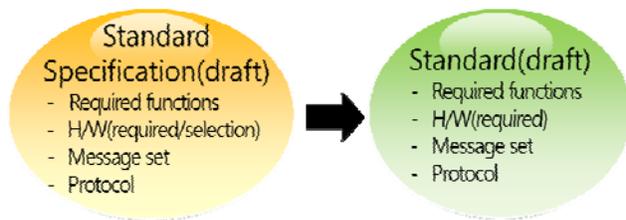


Fig 8: Comparison between VMS standard specification and VMS standard

All selected items among specifications of H/W, communication protocol and S/W are included in draft of VMS standard specification [3] and required items among all selected items are include in draft of VMS standard [4]. The detailed items are explained in [1].

Message set definition and protocol of information exchange between MCU and center are designed to comply with two kinds of the application layer such as DATEX-ASN (Data Exchange-Abstract Syntax Notation) and SNMP (Simple Network Management Protocol) by Technical Standard of VMS Data Exchange (Draft) [5] and VMS Data Exchange Standard [6]. Also, VMS have to comply with one of two application layers which is required by a center.

5. CONCLUSIONS

In this study, we performed a survey and an analysis on requirements and specifications of VMS and made a draft of VMS standard specification by drawing field requirements through questionnaire of experts. The purpose of this study is to propose a guideline for design and construction of VMS (Variable Message Signs) through providing a consistent standard of requirements and specification for construction of VMS system.

The proposed standard specification will serve as a guideline that is utilized in case a project operator such as regional construction management administration or local government prepares VMS specification for an ordered project. By utilizing the proposed standard specification we expect the compatibility and efficiency improvement of construction and maintenance for VMS.

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REFERENCES

- [1] Korea Institute of Civil Engineering and Building Technology, Report of 2012 ITS Standardization Project, 11-161300-000123-14 (2013).
- [2] The Korea Transport Institute, A Study on Installation and Operation of VMS, 11-1500000-001958-01 (2007).
- [3] Ministry of Land, Infrastructure and Transport, Korea, VMS Standard Specification (Draft) (2013).
- [4] Ministry of Land, Infrastructure and Transport, Korea, VMS Standard (Draft) (2013).
- [5] Ministry of Land, Infrastructure and Transport, Korea, Technical Standard of VMS Data Exchange (Draft), (2013).
- [6] ITS Korea, VMS System Standard – Part 6: VMS Data Exchange Standard, ITSK-WD-00087 (2013).

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