

# An Analysis of the Relative Importance of Modules for Vessel Traffic Services Operator Training

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**Abstract** : The International Association of Marine Aids to Navigation and Lighthouse Authorities(IALA) model course recommends specific aspects of basic curriculums for Vessel Traffic Services(VTS) operator education such as modules, course hours, contents, etc. Most domestic training programs for newly appointed VTS operators comply with such recommendations. The objective of this study is to determine whether such modules for VTS operator training recommended by the current IALA model course correspond to the actual opinions of VTS operators who are currently working in the field. To this end, the relative importance of basic modules for vessel traffic services operator training was analyzed using the Analytic Hierarchy Process(AHP) method. A questionnaire was designed to include 8 modules recommended by the IALA model course, and the survey results of 52 individuals working at 5 VTS centers were analyzed. The result showed that, unlike the assumption by the IALA, domestic VTS operators viewed Nautical Knowledge as the most important modules, followed by Emergency Situations, Traffic Management, Language, Equipment, VHF Radio, Communication Co-ordination, and Personal Attributes, in that order.

**Key words** : VTS operator, VTS training, IALA model course, Module, Relative importance, AHP

## 1. Introduction

International shipping operations need a common approach and universally agreed professional standards and competence for the delivery of Vessel Traffic Services (hereunder, VTS). The successful delivery of such services depends upon competent and experienced personnel to discharge the responsibilities of a VTS Authority. Recognizing that VTS personnel are members of a profession whose principle interaction is with mariners and maritime pilots for the safe management of maritime traffic, their competence needs to reflect that professional responsibility(IALA, 2013). The International Association of Marine Aids to Navigation and Lighthouse Authorities(hereunder, IALA) provides a guideline for Vessel Traffic Services Operator curriculums. In Korea, training and certification of VTS personnel has been conducted in accordance with IALA model course since 2005(MLTM, 2013).

In reality, however, there is a gap between such international standards and actual training in the field.

Besides, domestic VTS operators may have different views on the importance of each training item. Since the education for Vessel Traffic Services Operators focus on practical training, continued effort needs to be put forth into improving curriculums in reflection of hands-on staff's opinions.

Accordingly, this study aims to analyze the current situation of VTS operator training for Training and Certification of VTS Personnel, classify them into specific modules, collect existing employees' opinions, and evaluate the relative importance by means of the AHP method in order to provide a basis for Vessel Traffic Services Operator training curriculum development practical and appropriate for VTS operators currently in the field.

## 2. Current Conditions of Vessel Traffic Services Operator Training

### 2.1 Related Laws

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'Vessel Traffic Services Operator' is defined as an individual who has completed the Vessel Traffic Services Operator Training course and passed the examination process successfully in accordance with Article 36-2 of the Maritime Safety Act and Article 21 of the Act on the Entry and Departure, etc. of Ships. According to Article 5 of the Rules on Operation of Vessel Traffic Services, etc., "public officials who belong to the Ministry of Ocean and Fisheries(hereunder, MOF) or Ministry of Public Safety and Security(hereunder, MPSS) and intend to become a Vessel Traffic Services Operator shall complete the basic training program of 300 hours for Vessel Traffic Services Operator certification including practical education and then pass the examination successfully." The regulations on the Training and Certification of VTS Personnel, etc. of the MPSS(hereunder, regulations on VTS operator training) specify details of Vessel Traffic Services Operator (hereunder, VTS operator) education, education institutions, curriculums, and modules.

## 2.2 IALA Model Course

According to Article 5 of the regulations on VTS operator education, certification education shall "comply with recommendations of the International Maritime Organization (hereunder, IMO) and the IALA regarding curriculums, subjects, and education periods." The IALA recommends the model course regarding education for VTS operator certification, and particularly, the basic curriculums for newly appointed VTS operators specify the IALA Model Course V-103/1 on Vessel Traffic Services Operator Training (hereunder, IALA model course) (IALA, 2009). The IALA model course recommends curriculum systems, directions for instructors, curriculum, subjects, etc.

Table 1 below summarizes the modules recommended by the IALA model course and their contents, which are aspects that this study intends to focus on. Basically, the IALA model course consist of 8 modules - Language, Traffic Management, Equipment, Nautical Knowledge, Communication Co-ordination, VHF Radio, Personal Attributes, Emergency Situations, each of which includes basic knowledge necessary for vessel services and instructions for equipment operation.

Table 1 Recommended course modules

Subject	Contents
Language	<ul style="list-style-type: none"> <li>• Language Structure</li> <li>• Specific VTS messages construction</li> <li>• Standard phrases</li> <li>• Collecting information</li> </ul>
Traffic Management	<ul style="list-style-type: none"> <li>• Regulatory requirements</li> <li>• Roles and responsibilities</li> <li>• VTS environment</li> <li>• Principles of waterway and traffic management</li> <li>• Traffic monitoring and organization</li> </ul>
Equipment	<ul style="list-style-type: none"> <li>• Telecommunications</li> <li>• Radar, audio, video and other sensors</li> <li>• VHF/Direction finding(VHF/DF)</li> <li>• Tracking systems</li> <li>• Information management</li> <li>• Equipment performance monitoring</li> <li>• Evolving technologies</li> </ul>
Nautical Knowledge	<ul style="list-style-type: none"> <li>• Chart work</li> <li>• Collision regulations</li> <li>• Aids to navigation</li> <li>• Navigational aids(ship borne)</li> <li>• Shipboard knowledge</li> <li>• Port operations and other allied services</li> </ul>
Communication Co-ordination	<ul style="list-style-type: none"> <li>• General communication skills</li> <li>• Communications</li> <li>• Log and record keeping</li> </ul>
VHF Radio	<ul style="list-style-type: none"> <li>• Radio operator practices and procedures</li> <li>• VHF radio systems and their use in VTS</li> <li>• Operation of radio equipment</li> <li>• Communication procedures, including SAR</li> </ul>
Personal Attributes	<ul style="list-style-type: none"> <li>• Interaction with others</li> <li>• Human relation skills</li> <li>• Responsibility and reliability</li> </ul>
Emergency Situations	<ul style="list-style-type: none"> <li>• International, national, regional, local regulations</li> <li>• Contingency plans</li> <li>• Prioritize and respond to situations</li> <li>• Record activities concerning emergencies</li> <li>• Maintain a safe waterway throughout emergency situations</li> <li>• Internal / external emergencies</li> </ul>

Source : IALA model course V-103/1(2009)

In addition, the IALA model course recommends class types and education hours of each module, and the details are presented in Table 2. The period of education is 547 hours in total, among which 307 hours are for theories and 240 hours for practical training with a higher weight on theory classes. All the modules except Language assume that new VTS operators have no knowledge of each module at all. The largest portion of the training hours is allotted to the module of Language, and then Nautical Knowledge, Traffic Management, VHF Radio, Equipment, Emergency Situations, Communication Co-ordination, and Personal Attributes in the order. The time allotted for Language was decided in line with Level 5 or the intermediate level of International English Language Testing System (hereunder, IELTS) conducted by Cambridge University, the U.K. This indicates that education on language, which is the most important factor for communication between a VTS operator and a navigation officer, is emphasized.

Table 2 Recommended course hours by IALA

Module	Recommended Duration in Hours		Total (hours)	Ratio (%)	Ranking
	Presentations/ Lectures	Exercises/ Simulation			
Language	91	75	166	30.4	1
Traffic Management	52	54	106	19.4	3
Equipment	39	6	45	8.2	5
Nautical Knowledge	85	38	123	22.5	2
Communication Co-ordination	7	11	18	3.3	6
VHF Radio	15	42	57	10.4	4
Personal Attributes	6	4	10	1.8	8
Emergency Situations	12	10	22	4.0	7
Total	307	240	547	100.0	

Source : IALA model course V-103/1(2009)

### 2.3 Current Domestic Conditions of Basic Education for VTS Operators

In Korea, the basic education for VTS operators is specified in the regulations on 'Training and Certification of VTS Personnel, etc. (Instruction No. 137 of the MPSS)'. Specifically, the total period, test criteria, test methods, and modules of the basic curriculums are presented. However, the hours for each module are not specified unlike the IALA model course.

Specific modules, education methods, education hours, etc. are presented in the basic education plans for vessel traffic VTS operator certification of the MPSS (hereunder, the basic education plan of the MPSS). Table 3 below shows the modules and education hours notified by an official document of the MPSS. The program consists of 8 modules, to which the test session is added. Marine Communication is a module that combines Communication Co-ordination and VTS Radio, the two modules in the IALA model course. Simulation training is included as a separate module. As in the VTS operator curriculum, the total education period is 300 hours: 136 hours for theories and 164 hours for practical training. More time is allotted to practical training. Among the modules, the largest portion of the education time was allotted to Language and simulation training, and then Equipment, Marine Communication, Traffic Management, Nautical Knowledge, Emergency Situations, and Personal Attributes in the order.

Table 3 VTSSO training hours in Republic of Korea

Module	Recommended Duration in Hours		Total (hours)	Ratio (%)	Ranking
	Presentations/ Lectures	Exercises/ Simulation			
Language	40	40	80	26.7	1
Traffic Management	17	3	20	6.7	5
Equipment	25	12	37	12.3	3
Nautical Knowledge	12	8	20	6.7	5
Marine Communication	9	21	30	10.0	4
Personal Attributes	6	3	9	3.0	8
Emergency Situations	6	9	15	5.0	7
Simulation Training	20	60	80	26.7	1
evaluation	1	8	9	2.9	9
Total	136	164	300	100.0	

Source : Ministry of public safety and security(2015)

### 2.4 Comparison of Basic Curriculums Modules

There are differences between the IALA model course and the education plan of the MPSS: First, the total education period of the IALA model course is 547 hours while that of the MPSS is 300 hours. Second, as for the ratio of theories and practical training in the class hours, the IALA model course gives more weight to theories while the course of the MPSS gives more weight to practical training. Third, both courses give the highest importance to Language, but the IALA model course gives the second importance to Nautical Knowledge while the course of the MPSS gives the second importance to Equipment. While the IALA model course assumes that the trainees have no knowledge of the module at all, those who have 1-year on board career after acquiring the 5th class navigation officer certificate or higher are qualified to apply for the VTS operator certification. Thus, it is assumed that trainees have a measure of knowledge in that area.

## 3. Study Method

### 3.1 Overview of the AHP

The Analytic Hierarchy Process (hereunder, AHP) is a survey method to assess and sequence the weights of various test factors and alternative preferences(Satty, 1990). The most outstanding characteristics of the AHP are as

follows: It classifies various test factors to major factors and specific sub-factors; it clarifies the relative importance of factors through pairwise comparison of stratified factors; and it improves the robustness of the decision-making process by verifying the consistency of determined weights(Kim, 2015).

The AHP may be divided into 5 steps of analysis as shown in Fig. 1. The first step is brainstorming to determine test items through a discussion of experts in the area. The second step is to explain how to structure the upper-level layer items and lower-level layer items that affect the upper-level layer. The third step is to determine weights of each factor through pairwise comparison of test items. The fourth step is to assess and verify the consistency in reference to the consistency ratio. The last step is the measure grades to determine the relative appropriateness of each alternative in reference to test items (Kim, 2015).

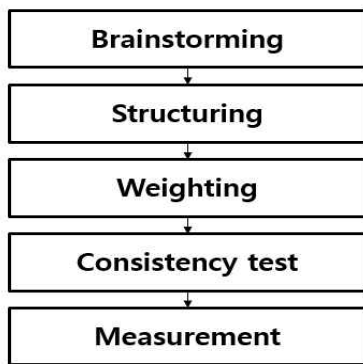


Fig. 1 Analysis process of AHP

To analyze the relative importance of basic curriculum modules for VTS operators, an expert survey was conducted by means of a questionnaire structured based on the AHP among existing VTS operators who had completed the basic education course and worked in the field. Because The AHP has unique advantages when important elements of the decision are difficult to quantify or compare, or where communication among team members is impeded by their different specializations, terminologies, or perspectives (WIKIPEDIA, 2016).

### 3.2 Test Items and Structuring

The most important step in AHP-based study of weights is to set a reasonable hierarchy for effective measurement

(Song et al., 2015). In order to analyze the relative priority of modules for Vessel Traffic Services Operator Training, this study forms a structured model consisting of 2 steps on the basis of the IALA model course and the Training and Certification of VTS Personnel that has been presented by the Ministry of Public Safety and Security. In the first step, the three basic upper-level variables are VTS Knowledge, VTS Operation, and VTS Facility. 8 variables are then selected as step-2 sub-factors. VTS Knowledge includes Language, Nautical Knowledge, and Personal Attributes; VTS Operation includes Traffic Management, Communication Co-ordination, and Emergency Situations; and VTS Facility includes Equipment, and VHF Radio. These 3 upper-level items and 8 lower-level items may be illustrated as in Fig. 2 below:

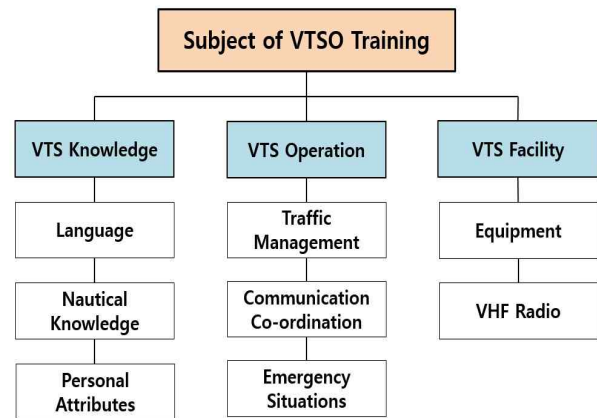


Fig. 2 Analytic model of AHP

### 3.3 Data Collection and Analysis Method

The questionnaire includes two major sections: general characteristics of subjects(workplace, age, license, VTS career, etc.) and relative importance of modules. The survey was conducted from May 14 to June 13, 2016. With 5 centers - Mokpo Port, Jindo Coast, Wando Port, Yeosu Port, and Yeosu Coast - as samples among 18 domestic vessel traffic control centers, 80 copies of the questionnaire were distributed. Among them 60 copies were collected, which indicates that the collection rate was about 75%. Among the collected copies, 8 copies whose non-consistency index exceeded 0.1 were excluded, and thus 52 copies in total were used in the final analysis. For the survey analysis, 'MakeIt,' which is a software program designed for AHP analysis, was adopted. Fig. 3 ~ Fig. 5 shows that the analyzed through 'MakeIt' program. Fig. 3

shows a example of data input to 'MakeIt' program. Fig. 4 shows a result of relative importance in a matrix. Fig. 5 shows the integrated results of this study.

Criteria A	Importance	Equal	Importance	Criteria B
VTS Knowledge			3	VTS Operaton
VTS Knowledge	3			VTS Facility
VTS Operaton	5			VTS Facility

Fig. 3 Example of questionnaire data input

	VTS Knowledge	VTS Operaton	VTS Facility	Relative Importance
VTS Knowledge		0.3333	3	25.83%
VTS Operaton			5	63.70%
VTS Facility				10.47%
Inconsistency Ratio	0.037			

Fig. 4 Example of questionnaire result

No.	Criteria of Evaluation	Local Priority	Combined Priority	Inconsistency Ratio	
				Criteria of Evaluation	Alternatives
	Objective	Relative Importance of VTSO Training Module		0.0004	
1	VTS Knowledge	40.51%	40.51%	0	
1-1	Language	34.80%	14.10%		0
1-2	Nautical Knowledge	51.68%	20.94%		0
1-3	Personal Attributes	13.52%	5.48%		0
2	VTS Operation	42.56%	42.56%	0.0047	
2-1	Traffic Management	39.20%	16.69%		0
2-2	Communication Co-ordiantion	14.38%	6.12%		0
2-3	Emergency Situations	46.42%	19.76%		0
3	VTS Facility	16.93%	16.93%	0	
3-1	Equipment	50.70%	8.58%		0
3-2	VHF Radio	49.30%	8.35%		0

Fig. 5 Result of this study AHP analysis

## 4. Survey Results

### 4.1 General Characteristics of Subjects

General characteristics of the survey Subjects are presented in Table 4. Workplaces (vessel traffic service centers) located in Jindo Coast accounted for the largest portion (32.7%), and then Yeosu Port, Yeosu Coast, Mokpo

Port, and Wando Port in the order. The number of Coastal VTS operators was (51.9%) and that of Port VTS operators was (48.31%), similar to each other. As for age, those in the 30s accounted for 63.5%, and then those in the 50s, 40s, and 20s in the order. As for acquired certificates, those with the Certificate of 3rd class navigation officer accounted for 38.5%, and then 2nd class navigation officer and 2nd class radio officer in the order. As for onboard and VTS experiences, those with experience of 5 years or less accounted for 57.7% and 48.1% respectively.

Table 4 General characteristics of subjects

	Variable	Number	Ratio(%)
VTS Center	Yeosu	11	21.2
	Wando	5	9.6
	Mokpo	9	17.3
	Yeosu Coastal	10	19.2
	Jindo Coastal	17	32.7
Age Group	20s	1	1.9
	30s	33	63.5
	40s	8	15.4
	50s	10	19.2
Certificate	1st Class Navigation	2	3.8
	2nd Class Navigation	18	34.6
	3rd Class Navigation	20	38.5
	4th Class Navigation	2	3.8
	5th Class Navigation	1	1.9
	1st Class Radio	1	1.9
	2nd Class Radio	6	11.5
Onboard Career	3rd Class Radio	2	3.8
	< 5 years	30	57.7
	5~10 years	18	34.6
	10~15 years	2	3.8
	15~20 years	1	1.9
VTSO Career	≥ 20 years	1	1.9
	< 5 years	25	48.1
	5~10 years	16	30.8
	10~15 years	3	5.8
	15~20 years	0	0.0
	≥ 20 years	8	15.4

### 4.2 Step 1: Relative Importance Analysis

As shown in Fig. 2, Vessel Traffic Services Operator training items were divided to VTS Knowledge, VTS Operation, and VTS Facility, and the importance of each item were examined through pairwise comparison. It was

analyzed by separating the port VTSO and the coastal VTSO. Because the tasks of the port VTSO and the coastal VTSO are some different(IMO, 1997)<sup>1)</sup>. The result is presented in Table 5 below. The importance of VTS Operation was the highest up to 42.5%, and then VTS Knowledge 40.5%, and VTS Facility 17.0% respectively. There was a measure of difference in terms of importance between Port VTS operators and Coastal VTS operators: Port VTS operators were highly aware of the importance of VTS Operation while Coastal VTS operators were highly aware of the importance of VTS Knowledge. The importance of VTS Facility was recognized as low probably because the survey objects were all VTS operators.

Table 5 Result of 1st step importance analysis  
(Unit : %)

Classification	Importance		
	Total	Port VTSO	Coastal VTSO
VTS Knowledge	40.5	36.2	44.6
VTS Operation	42.5	47.6	38.0
VTS Facility	17.0	16.2	17.4

#### 4.3 Step 2: Module Relative Importance Analysis

##### 1) VTS Knowledge

Importance analysis was conducted for lower-level variables related to VTS Knowledge, and the result is presented in Table 6 below. The highest priority was given to Nautical Knowledge whose importance index was 51.7%, and then Language(34.8%) and Personal Attributes(13.5%) in the order. The result was similar when port and coastal VTS operators were compared. This result does not correspond to the education plans of the IALA model course and the MPSS. As shown in Tables 2 and 3, more time was allotted to Language than other modules. In this study, however, existing VTS operators regarded Nautical Knowledge as more important than Language.

Table 6 Result of importance analysis in VTS knowledge  
(Unit : %)

Classification	Importance		
	Total	Port VTSO	Coastal VTSO
Language	34.8	31.8	37.7
Nautical Knowledge	51.7	55.3	48.3
Personal Attributes	13.5	12.9	14.0

##### 2) VTS Operation

Importance analysis was conducted on lower-level variables related to VTS Operation as well, and the result is presented in Table 7. The importance of Emergency Situations was the highest up to 46.4%, and then Traffic Management(39.2%) and Communication Co-ordination (14.4%) in the order. In comparison of port and coastal VTS operators, it turned out that port VTS operators regarded Traffic Management as the most important while coastal VTS operators regarded Emergency Situations as the most important.

Table 7 Result of importance analysis in VTS Operation  
(Unit : %)

Classification	Importance		
	Total	Port VTSO	Coastal VTSO
Traffic Management	39.2	42.8	35.5
Communication Co-ordination	14.4	17.7	11.7
Emergency Situations	46.4	39.5	52.8

##### 3) VTS Facility

The result of analyzing importance of lower-level variables related to VTS Facility is presented in Table 8. The importance indexes of Equipment and VHF were 50.7% and 49.3% respectively, similar to each other. As Equipment is a module about almost all devices such as radar, audio, video, etc. except VHF, it indicates that VHF Radio is of greater importance.

1) A clear distinction may need to be made between a Port or Harbour VTS and a Coastal VTS. A Port VTS is mainly concerned with vessel traffic to and from a port or harbour or harbours, while a Coastal VTS is mainly concerned with vessel traffic passing through the area. A VTS could also be a combination of both types. The type and level of service or services rendered could differ between both types of VTS: in a Port or Harbour VTS a navigational assistance service and/or a traffic organization service is usually provided for, while in a Coastal VTS usually only an information service is rendered.

Table 8 Result of importance analysis in VTS facility  
(Unit : %)

Classification	Importance		
	Total	Port VTSO	Coastal VTSO
Equipment	50.7	55.5	46.2
VHF Radio	49.3	44.5	53.8

#### 4.4 Importance Analysis of Entire Modules

To examine the relative priorities in comprehensive consideration of relative weights of elements that were examined in Steps 1 and 2, relative weights in each step were multiplied by one another to determine the general priorities. The result is presented in Table 9.

It turned out that the weight of Nautical Knowledge was the highest up to 20.9%, and then Emergency Situations(19.8%), Traffic Management(16.7%), Language(14.1%), Equipment, VHF Radio, Communication Co-ordination, and Personal Attributes in the order. In comparison of port and coastal VTS operators, Port VTS operators regarded Traffic Management as the most important and then Nautical Knowledge and Emergency Situations in the order while Coastal VTS operators regarded Nautical Knowledge as the most important, and then Emergency Situations and Language in the order.

Table 9 Result of total importance analysis  
(Unit : %)

Module	Total		Port VTS		Coastal VTS	
	Importance	Rank	Importance	Rank	Importance	Rank
Language	14.1	4	11.5	4	16.8	3
Nautical Knowledge	20.9	1	20.0	2	21.6	1
Personal Attributes	5.5	8	4.7	8	6.2	7
Traffic Management	16.7	3	20.4	1	13.5	4
Communication Co-ordination	6.1	7	8.4	6	4.4	8
Emergency Situations	19.8	2	18.8	3	20.1	2
Equipment	8.6	5	9.0	5	8.1	6
VHF Radio	8.3	6	7.2	7	9.3	5

#### 4.5 Comparative Analysis of Relative Priorities

Table 10 below shows the ranks of VTS operator training modules determined based on the IALA model course, MPSS, and the result of this study.

Table 10 Comparative Table of VTS Operator Module Priority

Ranking	IALA	MPSS	Result of this study
1	Language	Language	Nautical Knowledge
2	Nautical Knowledge	Simulation Training	Emergency Situation
3	Traffic Management	Equipment	Traffic Management
4	VHF Radio	Marine Communication	Language
5	Equipment	Nautical Knowledge	Equipment
6	Emergency Situation	Traffic Management	VHF Radio
7	Communication Co-ordination	Emergency Situation	Communication Co-ordination
8	Personal Attributes	Personal Attributes	Personal Attributes

The IALA model course puts the highest priority to Language, and then Nautical Knowledge, and Traffic Management in the order. The curriculum of the MPSS puts the highest priorities to Language and simulation practice, and then Equipment and Marine Communication in the order. According to the result of this study, the highest priority was put to Nautical Knowledge, and then Emergency Situations, Traffic Management, and Language in the order.

### 5. Conclusion

This study aims to examine if modules of the basic curriculums for Vessel Traffic Services Operator training recommended by the current IALA model course correspond to opinions of VTS operators who are currently working in the field. To this end, the AHP method is adopted and the result of a survey conducted among 52 VTS operators working at port and coastal VTS systems was analyzed. 8 modules recommended by the IALA model course, including Language, were categorized to VTS Operation, VTS Knowledge, and VTS Facility in the questionnaire.

The survey result shows that in Step 1, the importance

of VTS Operation was the highest, and then VTS Knowledge and VTS Facility in the order. In Step 2, the importance of Nautical Knowledge was the highest among 8 sub-factors, and then Emergency Situations, Traffic Management, Language, Equipment, VHF Radio, Communication Co-ordination, and Personal Attributes in the order. This result is somewhat different from the basic assumptions of the IALA model course and the education programs of the MPSS. Existing VTS operators regarded Nautical Knowledge, which includes chart work, collision regulations, aids to navigation, shipboard knowledge, etc., as the most important in actual VTS. Additionally, they regarded Emergency Situations, which specifies how to prioritize tasks in internal and external emergency situations, as important.

This study is of significance in that it examines priorities of modules necessary for newly appointed VTS operator education based on opinions of VTS operators who have completed basic training courses and currently work in the field. The future study needs to reflect opinions of more various groups (professors, vessel operators, etc.).

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