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Questionnaire on Marine Safety and Vessel Traffic Services in Philippine Coastal Waters (Part 2)

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Abstract : *Part 2 of the Questionnaire Survey on Marine Safety and VTS in the Philippine Coastal Waters presents the alternatives to risk reduction, modifying the VTS, the qualification and competency of a VTS operator and effectiveness of the services and assistance rendered by VTS. This study finds that majority of respondents chose "Improved education and training of mariners" as the best alternative to risk reduction and the "Strict enforcement of ship safety regulations" as the best alternative based on the respondents' ranks last served onboard and areas of familiarity. In modifying the VTS, the areas with VTS chose to "Improve or upgrade" and for those without, is to "Implement" the system. The best VTS system is the "Port and Approaches" type and the PCG is selected to operate, maintain and supervise the system. As a VTS operator, the necessity of shipboard experience is considered "Essential" and the experiences include "Ship-handling and Communication", and "Management level" experiences. The effectiveness of the assistance and services rendered by VTS are considered "Very Important". Based on these findings, this study recommends improvement of education and training of mariners and users of the waterways including the training of VTS operators manning the VTS centers, strict enforcement of ship safety regulations along the busy and main ports of the country and installation of VTS system with the most appropriate type with the supervision of PCG.*

Key Words : *Marine safety, Vessel traffic services, Marine risk alternatives, VTS modification, VTS operator, Philippine regions, VTS services*

1. Introduction

This paper is the continuation of the questionnaire survey about the marine safety and vessel traffic services in the Philippine coastal waters. The first part, Part 1 of the Questionnaire Survey, deals with respondents' profiles (A) and their subjective risk perceptions (B) illustrated by risk factors and by familiar areas. This second part continues on with the Part C of the Questionnaire which deals with Risk Reduction where it presents the "Alternatives" and the "Modifications to VTS". Part D is about the VTS Operator's qualifications while the last part, Part E, is about the "Effectiveness of Vessel Traffic Services". This, like the Part 1, is patterned after a similar survey questionnaire (Philippine Ports Authority, 2012) amended to suit the present-day environment in the country. The data are compiled in a database where they are demonstrated by graphs and tables; and measured using statistical tools and Excel program.

This Part 2 of the study aims to have a model of risk reduction, and viability of an efficient VTS structure and system accepted to the local coastal areas. Thence, to establish a set of tools and techniques to be utilized as a guide in the improvement and development of maritime traffic safety in the country.

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2. Alternatives for Risk Reduction

Along with the increase in marine risk and the public perception of these risks have come new and sophisticated means of reducing risk. Each of us accepts a certain level of risk. Once this level is reached, or is expected to be reached, a counter-action is taken to reduce that risk(Kristiansen, 2005). This perception is most apparent on the bridge officers, however, a variety of perceptions is taken in this study to ensure a clear understanding of these risks and form effective alternatives to counter and/or mitigate those risks.

This paper offers ten (10) alternatives to reduce risk shown in Table 1. The respondents are asked to indicate the effect of the alternative methods and its level of effectiveness in improving marine safety. Number 1- "Very Seldom Increases Risk" is the best contributory to marine safety; number 2- "Seldom Increases

Risk" means better safety; number 3- serves as the neutral choice and the numbers 4 and 5 correspond to the most contributory to risk. A column for those who have no opinion is also offered. The "Alternatives" are each assigned with roman numerals shown at the first column.

Table 1. Alternatives for Risk Reduction

Alternatives for Risk Reduction		No Opinion Do Not Know 0	Very Seldom Increases Risk 1	Seldom Increases Risk 2	Sometimes Increases Risk 3	Often Increases Risk 4	Very Often Increases Risk 5
I	Improved weather information dissemination	3	38	33	36	41	31
II	Putting speed limits in more areas	5	36	51	40	33	17
III	Strict enforcement of ship safety regulations	2	48	16	28	41	46
IV	Additional dredging	11	45	34	45	21	21
V	Upgraded fixed and floating navigational aids	6	43	25	25	49	31
VI	Additional Traffic Separation Schemes (TSS)	8	40	30	31	42	25
VII	Additional Recommended Routes	8	41	27	38	38	18
VIII	Additional VTS	8	51	19	24	45	27
IX	Improved education and training of mariners	3	52	24	31	33	40
X	Strict enforcement of prohibition of fishing, incursions in fairways	6	42	25	30	32	47

Tables 2 and 3 are constructed to depict the best alternatives to reduce risk. Levels 1 and 2 - "Very Seldom Increases Risk" and "Seldom Increases Risk" respectively, show the best alternative to improve safety. Therefore, responses from these levels (1 and 2) are selected and used for further analysis compared with their last-served ranks onboard various types of ships (Table 2) and with the areas where they are operationally familiar (Table 3).

The tables illustrate the alternatives in each corresponding roman numerals, the total responses from levels 1 and 2 calculated for standard scores (SC), averages and standard deviations (SD). This paper uses these statistical tools to remove any bias to the total numbers of responses per alternative. They are averaged according to the total population of responses and each SD is calculated to show the spread of the answers from the means. These calculations are done with the Excel program. Table 2 illustrates the alternatives in their corresponding roman numerals.

Table 2. Standard Scores of Responses to Alternatives according to Types of Ships last Served Onboard

Alternatives for Risk Reduction	Merchant Ships	Passengers	Tugs	PCG	Pilots	Marine Engineers	Radio Officer	Mean	Std Deviation
Number of Respondents	90	69	10	6	25	19	1		
III	1.4	1.6	-0.9	-0.5	0.1	-0.8	-0.9	10.7	10.9
X	1.6	1.4	-0.9	-0.6	0.0	-0.6	-1.0	11.4	11.7
IX	1.6	1.4	-0.9	-0.6	0.1	-0.7	-0.9	12.4	12.1
VIII	1.4	1.7	-0.9	-0.5	-0.3	-0.6	-0.8	11.1	12.5
V	1.7	1.3	-0.9	-0.5	0.0	-0.7	-0.9	11.3	12.7
I	1.7	1.4	-0.9	-0.5	-0.1	-0.6	-0.9	12.1	13.0
VII	1.8	1.3	-0.9	-0.5	-0.1	-0.8	-0.9	11.7	13.7
VI	1.8	1.3	-0.9	-0.5	-0.2	-0.7	-0.8	12.1	14.0
IV	1.8	1.3	-0.8	-0.6	-0.2	-0.6	-0.9	13.3	14.5
II	1.7	1.3	-0.8	-0.6	0.0	-0.7	-0.9	13.9	14.7

Table 3. SC of Alternatives based on Familiar Areas

Alternatives	Manila Bay	Batangas	Legaspi	Palawan	Cebu	Iloilo	Ormoc	Tacloban	Tagbilaran	Cag de Oro	Iligan	Ozamis	Davao	Zamboanga	Means	Std Dev
	NCR	**4A**	**4A**	**4B**	**7**	**5**	**8**	**8**	**7**	**10**	**10**	**10**	**11**	**9**	**Regions**	
	108	98	20	25	79	47	30	18	26	73	25	16	46	22	Responses	
III	1.9	2.3	-0.7	-0.3	1.0	0.5	-0.4	-1.1	-0.7	0.1	-0.3	-1.3	0.0	-0.9	16.9	9.2
VI	1.8	2.4	-1.0	-0.2	0.7	0.4	-0.5	-1.2	-0.5	0.5	-0.4	-1.3	-0.1	-0.7	17.6	9.7
X	1.7	2.3	-1.1	-0.4	0.6	0.7	-0.5	-1.0	-0.6	0.4	-0.4	-1.3	0.4	-0.9	17.8	9.7
I	2.0	1.9	-1.0	-0.4	1.1	0.4	-0.6	-1.2	-0.9	0.4	-0.3	-1.3	0.0	-0.6	18.6	10.0
VIII	1.9	2.4	-0.9	-0.3	0.8	0.3	-0.7	-1.1	-0.7	0.5	-0.4	-1.2	-0.1	-0.7	16.9	10.2
V	1.5	2.7	-1.1	-0.2	0.6	0.4	-0.4	-1.1	-0.5	0.3	-0.4	-1.1	0.0	-0.6	16.2	10.2
VII	2.0	2.3	-1.0	-0.2	0.7	0.3	-0.7	-1.2	-0.7	0.4	-0.3	-1.0	0.1	-0.5	17.6	10.3
IX	1.8	2.4	-0.8	-0.3	0.8	0.2	-0.4	-1.0	-0.7	0.7	-0.5	-1.3	-0.1	-0.8	19.9	11.3
IV	1.7	2.4	-1.2	-0.3	0.8	0.3	-0.6	-1.0	-0.7	0.8	-0.6	-1.1	0.2	-0.7	19.8	11.9
II	2.0	2.4	-0.9	-0.3	0.8	0.1	-0.6	-1.0	-0.8	0.4	-0.6	-0.9	0.1	-0.6	20.3	13.1

Table 3 is the tabulation of the respondents' familiar areas of operations and the alternatives in each assigned roman numerals of the combined responses from levels 1 and 2 shown in each SC and SD. The familiar areas are selected from the Philippine Ports Authority(Takahashi, 2011) and Cebu Port Authority 2011 Annual Statistics(Cebu Port Authority, 2012) with the highest number of ships' port-calls. The table is arranged according to the each alternatives' SD- from the smallest SD value down to the highest. This arrangement shows that the alternative with the least SD is the least widespread which means that it has the most reliable outcome.

Analysis of Table 1:

- In individual scoring, the highest number is attributed to

"Improved education and training of mariners" (IX) with 52 responses.

- The highest over-all sum of responses (436) is from the level 2- "Very Seldom Increases Risk" which is a positive alternative in mitigating risk.
- The combined totals of column 2 and 3 (720) is slightly higher at 40% than the combined sum of columns 4 and 5 (678), the negative side, which is at 38%. There are 1,786 total responses to this question.

Analysis of Table 2:

- The least dispersed from its means (Means 10.7, SD 10.9) is calculated from alternative III "Strict enforcement of ship safety regulations" This means that this alternative has the most reliable responses among all the alternatives and, thus, is the best to reduce risk based on the types of vessels last served onboard.
- This is followed by Alternative X "Strict enforcement of prohibition of fishing, incursions in fairways" (Means 11.4, SD 11.7), Alternative IX "Improved education and training of mariners" (12.4, 12.1) and Alternative VIII "Additional VTS" (11.1, 12.5) respectively.
- Officers from merchant ships top the list at 90 respondents, followed by 69 officers from passenger ships and ferries, and by the pilots at 25 respondents.

Analysis of Table 3:

- Following the same treatment of Table 2, the alternative with responses with the least dispersion from its means is the Alternative III "Strict enforcement of ship safety regulations" (Means 16.9, SD 9.2). This means that it has the best gathering of responses in reducing risk based on respondents' areas of familiarity.
- Of the 14 regions, Manila Bay (NCR) and Batangas Bay (4A) top the list with most respondents. Cebu (7) and Cagayan de Oro (10) followed next.

3. Modification to VTS

3.1 Area With VTS Service

The questionnaire requires the respondents to name their port of operation. There are 150 responses where 16 ports are named. Batangas Bay has been selected 45 times, 34 for Manila Bay area, Cebu has 27, 15 for Davao and 14 named Cagayan de Oro. The rest of the ports consist of 1x4s, 1x2s and 9x1s selection.

Respondents are asked, "If your area presently has VTS service", and are given four choices:: "Downgrade or Close"- no response; "Maintain at present level"- 16 responses; "Improve or upgrade"- is overwhelmingly chosen at 89; and those with "No opinion" has 7. Table 4 illustrates the number of preferences of those who chose "Improve or Upgrade" according to their experiences onboard various types of ships, the size in GT and other marine backgrounds.

Table 4. Respondents who chose "Improve or Upgrade" VTS in their area according to Type of ship last served, Size in GT and Other marine background

Type of ship last served onboard	Freq.	Size (GT)	Freq.	Other marine background	Freq.
Merchant ships	32	<100	1	Co/Agency	23
Passengers	39	100-500	10	Port Offr	0
Tugs	5	500-1K	17	Schools	6
PCG	6	1-5K	24	Govt Empl	8
Pilots	6	5-10K	7	PCG	10
Marine Engineer	5	10-30K	13	Mar. Org.	0
Radio Officer	0	>30K	20	Others	0

In the "Type" group, the top responses are from the merchant ship with 36% (32), and passenger ships 57% (39). The "Size" group has >30K with the maximum of 20 (35%), 1-5K 17 (71%) and 1-5K at 24 (57%) respectively for 1-3 places. In the "Other marine background" group, those who work in the agencies, maritime companies top the list at 23 and followed by PCG at 10.

3.2 Area Without VTS Service

For the area without VTS service, the respondents have three (3) choices: "Implement" which garners the highest with 99 responses, "Do not implement" at 3, and those with "No opinion" at 6. Table 5 illustrates the numbers of responses which chose the "Implement" according to the types of ships they last served, size in GT and other marine linkages. The top three in the "Types" group, merchant ship officers have 50 (56%), Passenger ships have 37 (54%), and 12 (63%). In the "Size" group, >30K, 10-30K, and 100-500 top the top-three respectively. In the "Other marine background", those from the agencies top at 20, and those engage in training and education has 15.

Table 5. Respondents who chose "Implement" based on Type of ship last served, Size in GT and Other marine background

Type of ship last served onboard	Freq.	Size (GT)	Freq.	Other marine background	Freq.
Merchant ships	50	<100	1	Co/Agency	20
Passengers	37	100-500	20	Port Offr	3
Tugs	6	500-1K	10	Schools	15
PCG	0	1-5K	12	Govt Emp	3
Pilots	8	5-10K	12	PCG	1
Marine Enginee	12	10-30K	24	Mar. Org.	0
Radio Officer	0	>30K	32	Others	2

Based on each familiar areas, Manila Bay has 57 responses out of 108 respondents, followed by Batangas at 41, Cebu at 79 and closely followed by Cagayan de Oro at 73 which occupy the top-four in this group.

3.3 VTS Level Appropriate in Area of Operation

With answers "Improve or upgrade" (Section 3.1) or "Implement" (Section 3.2), the respondents are asked what level of VTS is adequately appropriate in their area of operation. Table 6 shows that Level IV has the most number at 81 responses amongst all other levels. It also describes the characteristics and features of each level.

Table 6. VTS Level and Frequency of Responses

VTS Level	Freq.
Level I– VMRS (a Vessel Movement Reporting System consisting of VHF communication and other reporting equipment)	25
Level II– Basic Radar Surveillance (The VMRS of Level I coupled with basic Radar surveillance. The radar is assumed to be a standard ship-board radar without advanced features)	10
Level III– Advanced Radar Surveillance (This system includes complete communication plus an advanced state-of-the-art VTS Radar surveillance system including; automatic vessel track analysis; track and collision alarms; advanced rain and sea clutter; high resolution; over laid port chart system; provisions for vessel identifiers and particulars)	43
Level IV– Automatic Dependent Surveillance (Based on the use of differential GPS, AIS transmissions. This system consists of automated transponder installed on the participating vessel that determines the vessel's position via differential GPS, and transmits this information automatically, along with vessel identification and particulars to the VTS control center)	81

3.4 VTS Type Appropriate in Area of Operation

The next question: "What kind of VTS is adequate in your area?", respondents chose "Port and Approaches" with 122 (68%) out of 179 responses. Coastal VTS seconds with 32 (18%), Port VTS at 24 (13%) and one responded to "Others" without specifying VTS type. Fig. 1 graphs this outcome.

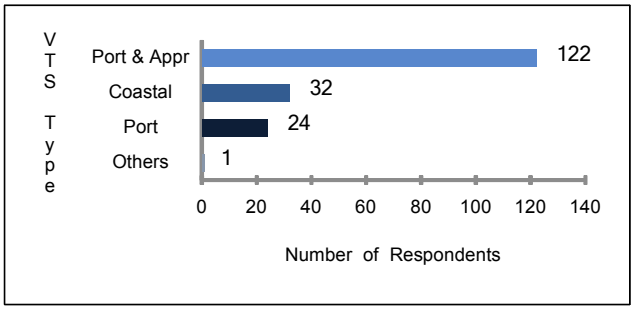

Fig. 1. Types of VTS Appropriate in Area of Operation.

Table 7, likewise, profiles those who selected "Port and Approaches" based to "Types last served", the average "Size" of these ships and those with "Other marine links"

Table 7. Respondents who chose "Port and Approaches" type of VTS as adequate in their area of operation

Type last served	Qtn Freq	Size (GT)	Qtn Freq	Mar Links Ashore	Qtn Freq
Merchant	56	<100	2	Co/Agency	20
Passenger	39	100-500	19	Port Offr	3
Tug	17	500-1K	15	Schools	12
PCG	10	1-5K	19	Govt Empl	7
Pilot	7	5-10K	10	PCG	10
Mar. Engr.	6	10-30K	30	Mar. Org.	1
Rad.Offr	1	>30K	37	Others	2

Respondents who believe that "Port and Approaches" type of VTS is adequate in their area of operation according to Familiar Area has chosen Manila Bay again with the highest at 80 responses. It is followed by the major ports of Cebu 56, Batangas 55, and CDO 44. The rest are in the 30s and below. Interestingly, Zamboanga and approaches has 91 in percentile, although, cumulatively, is only at 3.2%.

3.5 VTS Manager Appropriate in Area of Operation

"Who should operate, maintain and supervise VTS in your area?" is the last question in this section. Figure 2 graphs the respondents who chose the Philippine Coast Guard (PCG) with 75 responses amongst the other choices- Port Officer 59, Harbor Officer 49, Pilots 13 and the government agency for maritime affairs, Marina at 7 responses.

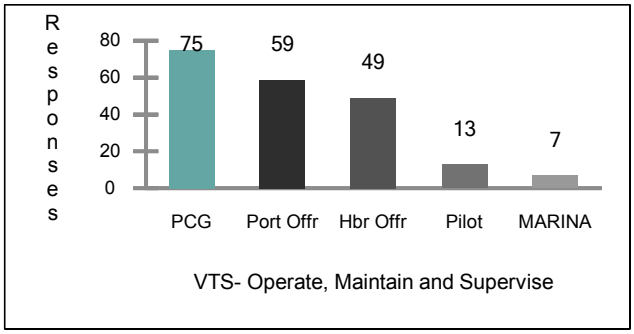

Fig. 2. Operators, Maintainers and Supervisor of VTS.

The preceding presentations shows that there are differences or correlation between those respondents who wish to improve or upgrade their VTS, those who wish to install VTS system in their area and what type of system to implement against the respondents' familiar areas of operation. To prove the degree of the correlation, Cramer's V or Independent coefficient tool is used Table 8 compiles the summations of the actual and expected data from each categories using equation (1) of areas with VTS and whose majority chose to "Improve or Upgrade"; those without VTS, majority selected the "Implement"; and 'Port and Approaches" type is chosen by the majority to install in their area of operation.

$$\text{Expected Freq.} = \frac{\sum regions \times \sum ranks}{\sum of values} \qquad (1)$$

Table 8. Compilation of Actual and Expected Frequencies

Area	With VTS Improve or Upgrade		Without VTS Implement		VTS Type Port & Appr. VTS		Sums
	Act	Exp	Act	Exp	Act	Exp	
Manila Bay	53	43	57	68	80	79	190
Batangas	52	33	41	53	55	62	148
Legaspi	6	7	12	10	11	12	29
Palawan	12	10	10	15	21	18	43
Cebu	29	32	58	51	56	59	143
Iloilo	13	17	31	27	32	32	76
Ormoc	11	12	22	19	20	22	53
Tacloban	5	7	13	11	13	13	31
Tagbilaran	8	10	21	16	16	19	45
Cag. De Oro	19	24	43	38	44	44	106
Iligan	7	9	14	15	20	17	41
Ozamis	1	5	11	9	12	10	24
Davao	12	17	30	27	33	31	75
Zamboanga	7	9	11	14	20	16	38
Sum	235		374		433		1,042

The calculation of each data Pearson's Chi-square test value, (χ_0^2), is done by equation (2) and shown in Table 9.

$$\frac{(Actual\,Frequency - \text{Expected}\,Frequency)^2}{\text{Expected}\,Frequency} \qquad (2)$$

Table 9. Pearson's Chi-square test value tabulated results

Area	Improve or Upgrade	Implement	Port and Approaches	Sum
Manila Bay	2.4	1.8	0.0	4.3
Batangas	10.4	2.8	0.7	13.8
Legaspi	0.0	0.2	0.1	0.4
Palawan	0.5	1.9	0.5	3.0
Cebu	0.3	0.9	0.2	1.4
Iloilo	1.0	0.5	0.0	1.5
Ormoc	0.1	0.5	0.2	0.7
Tacloban	0.6	0.3	0.0	0.9
Tagbilaran	0.5	1.5	0.4	2.3
Cagayan De Oro	1.0	0.6	0.0	1.7
Iligan	0.5	0.0	0.5	1.1
Ozamis	3.6	0.7	0.4	4.7
Davao	1.4	0.4	0.1	1.9
Zamboanga	0.3	0.5	1.1	1.9
Sum	22.7	12.6	4.3	**39.5**

Finally, the test is carried out by equation (3) and the coefficient found is 0.1376 which means that the relationship between the sets of data are poorly related.

$$\begin{aligned} &= \sqrt{\frac{\chi_0^2}{\sum values \times (\min\{r,c\}-1)}} \\ &= \sqrt{\frac{39.5}{1.042 \times (3-1)}} \\ &= 0.1376 \end{aligned} \qquad (3)$$

4. VTS Operator

This section deals with VTS operators' qualifications and competencies.

4.1 Necessity of Experience

The first question posed is: "Do you think that marine experience is essential for VTS operators to perform their tasks and duties?"

There are 186 responses to this question and Figure 3 graphs them where "(1) Essential" occupies the biggest slice at 173 (93%) and the rest are all to the minimum.

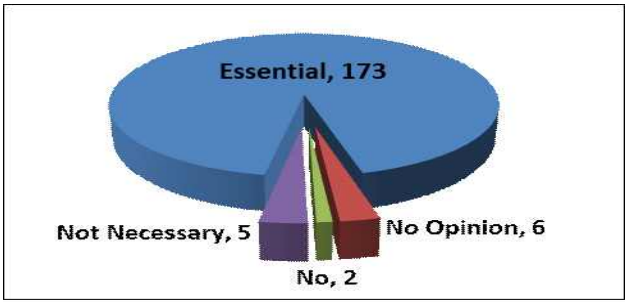

Fig. 3. Marine experience for VTS Operator.

4.2 Kind of Experience

If the majority chose "(1) Essential", what kind of previous experience is required? Among the selections, the majority chose "Ship-handling and Communication" with 155 (87%), next is "Communication" only at 19 (11%), "Ship-handling" alone with only 3 responses and 2 for "Others" without offering any specific qualification.

4.3 Level of Qualification

The last question on this section is- What level of qualification is necessary to perform the functions? The choices of the levels of qualification are graphed in Figure 4. 198 responded to this question where "Management level experience" tops the selection with 66, "Operational level experience" 50; "Management level certificate" 29; "Radio operator's certificate" at 21; "Pilots" 18; and lastly, the "Operational level certificate" at 14.

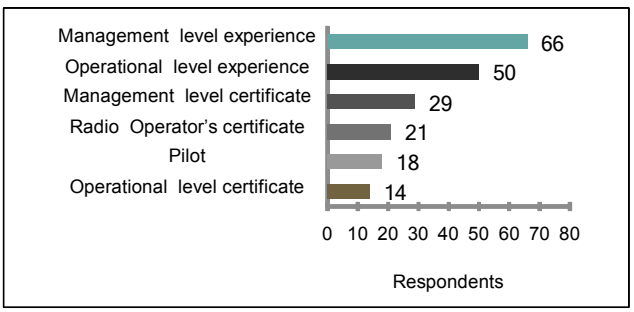

Fig. 4. Level of competency for VTS Operator.

5. Effectiveness of VTS

The last section deals with the level of effectiveness of the assistance and services commonly rendered by VTS.

Table 10 tabulates the coded services showing the level of effectiveness, and the responses according to their personal subjective perceptions. There is a total of 1,971 responses to these questions and all of them place the highest level of effectiveness at the 5th level- "Very Important" to all the offered services by VTS with 74%.

Table 10. Responses on the Effectiveness of VTS

Code	Effectiveness of Vessel Traffic Services	No Opinion 0	Least Important 1	Unimportant 2	Average 3	Important 4	Very Important 5
E1	Assistance in Reduced Visibility Conditions	0	1	0	4	29	162
E2	Assistance in Adversed Meteorological Conditions	0	2	0	7	27	161
E3	Assistance in Dense Traffic Areas	0	0	0	9	30	155
E4	Assistance in Areas congested with fishing or pleasure crafts	2	0	1	14	51	131
E5	Assistance in Restricted Waters	0	2	1	7	42	146
E6	Assistance in Areas with vessels acting contrary to rules	0	0	0	10	47	141
E7	Assistance rendered to vessels in emergency	0	0	2	5	33	158
E8	Assistance with foreign language, lack of experience or knowledge	0	0	1	17	50	130
E9	Assistance with communication problems	0	1	0	19	49	129
E10	Provisions of notices to shipping	0	0	1	11	42	141
	Sum	**2**	**6**	**6**	**103**	**400**	**1,45**
	%	**0%**	**0%**	**0%**	**5%**	**20%**	**74%**

This study tries to evaluate the degree of relationships, if any, amongst the personal factors of the respondents. The succeeding sub-sections 5.1-5.4 calculate the correlation between these factors using the Pearson's Chi-square to test the degree of relationships among these factors using equations 1-3, previously shown in Section 3.5. For these relationships, only the responses from the 5th level, the "Very Important" is used in all the calculations.

5.1 Relationship Between VTS Assistance and Group–years of experience

The respondent's average years of experience onboard ships are divided into 5 groups. The first column is the VTS coded services taken from Table 10. Tables 11 shows the actual and expected values of responses and Table 12 shows the Pearson's values.

Table 11 calculates the total values (1,384) while Table 12 calculates the Pearson's value, (χ_0^2), at 5.624.

Table 11. Respondents' actual and expected values of years of experience

Years	0-5		6-10		11-15		16-20		>20		Sum
Code	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	
E1	37	34	42	43	27	25	17	19	31	34	154
E2	35	34	41	43	26	26	19	19	35	34	156
E3	32	32	43	41	27	24	17	18	28	32	147
E4	29	27	34	35	16	21	16	15	30	27	125
E5	29	30	40	38	23	23	16	17	30	30	138
E6	25	30	38	37	23	22	17	16	32	29	135
E7	32	33	44	41	23	25	18	18	32	33	149
E8	27	27	33	34	20	20	16	15	28	27	124
E9	29	26	33	34	20	20	14	15	25	26	121
E10	28	30	36	37	23	22	17	16	31	29	135
Sum	303		384		228		167		302		1,384

Table 12. Pearson's values for Years of experience

Code	Average Years of Experience Onboard Ships					Sum
	0-5	6-10	11-15	16-20	>20	
E1	0.32	0.01	0.10	0.13	0.20	0.77
E2	0.02	0.12	0.00	0.00	0.03	0.17
E3	0.00	0.12	0.32	0.03	0.52	0.99
E4	0.10	0.01	1.02	0.06	0.27	1.46
E5	0.05	0.08	0.00	0.03	0.00	0.15
E6	0.70	0.01	0.03	0.03	0.22	0.99
E7	0.01	0.17	0.10	0.00	0.01	0.29
E8	0.00	0.06	0.01	0.07	0.03	0.17
E9	0.24	0.01	0.00	0.02	0.07	0.35
E10	0.08	0.06	0.03	0.03	0.08	0.28
Sum	1.5226	0.6455	1.6140	0.4069	1.4349	5.62

$$= \sqrt{\frac{5.624}{1{,}384 \times 4}}$$

$$= 0.03187 \quad \text{Independent coefficient} \qquad (4)$$

Independent coefficient (4) 0.03187 shows that there is very weak correlation between VTS assistance/services and respondents' group-years of experience onboard ship.

5.2 Relationship Between VTS Assistance and Ranks served onboard ships

This section illustrates the services offered by VTS against the respondents' last rank served onboard various types of ships.

Table 13. Actual and expected values for Ranks last served onboard various types of ships

Years	Mer		Pass		Tugs		PCG		Pilots		Engrs		RO		Sum
Code	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	
E1	73	73	57	52	9	9	6	7	13	16	17	18	1	1	176
E2	75	74	52	53	10	9	6	7	16	16	18	18	1	1	178
E3	69	70	54	50	9	8	6	6	13	15	15	17	1	1	167
E4	66	62	38	44	6	7	6	6	16	14	15	15	1	1	148
E5	65	65	44	47	10	8	6	6	14	14	17	16	1	1	157
E6	68	66	47	47	6	8	6	6	15	15	16	16	1	1	159
E7	70	71	53	51	9	9	6	6	16	16	16	17	1	1	171
E8	58	60	41	43	9	7	6	5	13	13	16	14	1	1	144
E9	55	58	44	42	7	7	6	5	12	13	15	14	1	1	140
E10	64	64	44	46	5	8	6	6	18	14	15	15	1	1	153
Sum	663		474		80		60		146		160		10		1,593

Table 14. Pearson's values for last rank served onboard

Code	Ranks Last Served Onboard Various Types of Ships							Sum
	Mer	Pass	Tug	PCG	Pilot	Engrs	RO	
E1	0.00	0.41	0.00	0.06	0.61	0.03	0.01	1.12
E2	0.01	0.02	0.13	0.07	0.01	0.00	0.01	0.25
E3	0.00	0.37	0.04	0.01	0.35	0.19	0.00	0.97
E4	0.31	0.83	0.28	0.03	0.44	0.00	0.01	1.90
E5	0.00	0.16	0.57	0.00	0.01	0.10	0.01	0.85
E6	0.05	0.00	0.49	0.00	0.01	0.00	0.01	0.57
E7	0.02	0.09	0.02	0.03	0.01	0.08	0.01	0.25
E8	0.06	0.08	0.43	0.06	0.00	0.16	0.01	0.81
E9	0.18	0.13	0.00	0.10	0.05	0.06	0.02	0.55
E10	0.00	0.05	0.94	0.01	1.13	0.01	0.00	2.14
Sum	0.65	2.14	2.90	0.38	2.61	0.63	0.09	**9.3988**

$$= \sqrt{\frac{9.3988}{1{,}593 \times 6}}$$

$$= 0.03135 \quad \text{Independent coefficient} \qquad (5)$$

Table 13 sums the total values of the last rank served onboard (1,593) while Table 14 calculates the Pearson's values, (χ_0^2), (9.3988). Independent coefficient (5) 0.03135 shows that there is very weak correlation between VTS assistance/services and ranks last served onboard.

5.3 Relationship Between VTS Assistance and Familiar areas of operation

The 14 regions/ports are compared with the assistance rendered by VTS to prove any degree of relationship. Due to space constraints, the actual and expected values are separately

tabulated. Table 15 shows the first 7 ports and the Table 16 shows the 2nd half with the total values.

Table 15. First half (7 ports) actual and expected values

Code	Familiar Areas Per Regions (1st Half)													
	NCR		Bats		Legaspi		Palawan		Cebu		Iloilo		Ormoc	
	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp
E1	93	93	78	77	17	15	23	24	67	66	40	42	24	23
E2	91	96	77	79	17	15	23	25	68	68	42	43	26	24
E3	88	87	74	72	14	14	22	23	62	62	38	39	22	22
E4	79	74	58	61	9	12	20	19	54	52	35	33	19	18
E5	89	82	68	68	11	13	22	21	57	58	37	37	19	21
E6	83	85	67	71	13	13	22	22	62	61	39	39	22	21
E7	88	88	76	73	14	14	22	23	62	63	39	40	23	22
E8	73	74	58	61	11	12	18	19	51	52	34	33	17	18
E9	72	75	64	62	11	12	21	19	50	53	36	34	19	19
E10	76	78	70	64	13	12	22	20	56	55	36	35	17	19
Sum	832		690		130		215		589		376		208	

Table 16. Second half (7 ports) actual and expected values

Code	Familiar Areas Per Regions (2nd/Last Half)														Sum Overall
	Tacloban		Tagbilaran		CDO		Iligan		Ozamiz		Davao		Zambo		
	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	
E1	14	15	21	19	53	54	20	20	13	13	36	37	19	21	518
E2	17	15	22	19	56	56	22	21	15	14	36	38	20	21	532
E3	14	14	17	18	50	51	19	19	13	12	34	35	19	19	486
E4	11	12	15	15	44	43	14	16	10	10	27	29	17	16	412
E5	12	13	14	17	49	48	16	18	11	12	34	33	19	18	458
E6	15	14	17	17	51	50	19	18	14	12	33	34	19	19	476
E7	14	14	18	18	50	51	20	19	13	13	34	35	19	20	492
E8	10	12	14	15	47	43	17	16	9	10	33	29	18	16	410
E9	12	12	15	15	43	44	16	16	10	11	31	30	17	17	417
E10	13	12	14	16	42	45	16	17	10	11	31	31	17	17	433
Sum	132		167		485		179		118		329		184		4,634

The total values calculated shown in Tables 15 and 16 is 4,634. Using equation (2), Section 3.5, the Pearson's Chi-square values (χ_0^2) is taken at 12.55372. Calculating the degree of relationship between the offered "Assistance" rendered by VTS and "Familiar Areas" using equation (3) (Sec 3.5):

$$= \sqrt{\frac{12.55372}{4{,}634 \times 9}}$$

$$= 0.00030 \quad \text{Independent coefficient} \qquad (6)$$

Independent coefficient (6) 0.00030 shows that almost zero relationship between the two groups of data.

5.4 Relationship between VTS Assistance and Average size of vessels' served

This section finds the relationship between the assistance offered by VTS and the respondents average size of vessels served.

Table 17. Actual and expected values of average size (GT)

Code	Average Size of Vessels Served														Sum
	<100		100-500		500-1K		1-5K		5-10K		10-30K		>30K		
	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	Act	Exp	
E1	3	2	26	26	20	19	30	30	16	16	39	39	45	48	179
E2	3	2	26	25	19	19	30	29	15	16	38	38	45	47	176
E3	2	2	25	24	17	18	28	27	15	15	36	36	43	44	166
E4	1	2	15	21	15	15	25	24	14	13	34	32	42	39	146
E5	2	2	24	23	16	17	25	26	14	14	37	35	41	42	159
E6	1	2	22	23	15	17	27	26	15	14	36	35	43	42	159
E7	1	2	26	25	17	18	30	28	16	15	35	37	45	45	170
E8	2	2	19	21	16	15	22	24	14	13	33	32	40	39	146
E9	1	2	24	21	17	15	21	24	14	13	31	31	36	38	144
E10	2	2	24	23	17	16	26	26	11	14	31	34	45	41	156
Sum	18		231		169		264		144		350		425		1,601

Table 18. Pearson's values for average size of vessel served

Code	Average Size of Vessels Served							Sum
	<100	100-500	500-1K	1-5K	5-10K	10-30K	>30K	
E1	0.48	0	0.06	0.01	0	0	0.13	0.693
E2	0.53	0.01	0.01	0.03	0.04	0.01	0.06	0.697
E3	0.01	0.05	0.02	0.01	0	0	0.03	0.114
E4	0.25	1.75	0.01	0.04	0.06	0.14	0.27	2.508
E5	0.03	0.05	0.04	0.06	0.01	0.14	0.03	0.353
E6	0.35	0.04	0.19	0.02	0.03	0.04	0.01	0.692
E7	0.43	0.09	0.05	0.14	0.03	0.13	0	0.87
E8	0.08	0.2	0.02	0.18	0.06	0.04	0.04	0.616
E9	0.24	0.5	0.21	0.32	0.08	0.01	0.13	1.489
E10	0.03	0.1	0.02	0	0.65	0.28	0.31	1.402
Sum	2.43	2.79	0.63	0.81	0.97	0.79	1.02	**9.4330**

In this last group, "Average size of vessels' served", the sum of the actual and expected values is 1,601 and the calculated Pearson's value, (χ_0^2), is 9.4330 (Table 18), hence, the degree of relationship is again found by equation (3) to be:

$$= \sqrt{\frac{9.4330}{1{,}606 \times 6}}$$

$$= 0.03133 \quad \text{Independent coefficient} \qquad (7)$$

which, likewise, declares a very weak relationship between the two categorical groups of data.

Analysis of Section 5:

- A total of 1,971 responded to these questions and all of them place the highest level with 74% at the 5th level- "Very Important" to all the offered services by VTS.
- Using the highest 5th level values, the calculated degree of correlation using Pearson's chi-square test between (4) average years served onboard 0.03187; (5) ranks served onboard 0.03135; (6) familiar areas of operation 0.00030; and (7) average size of vessels' served 0.03133 and the services and assistance by VTS show very weak relationship.
- This non-relationship signifies that the choice of the 5th level "Very important" is independently selected without any influence from respondents' personal factors.

6. Summary

This Part 2 study of the questionnaire finds that:

- In the individual number of responses, majority chose "Improved education and training of mariners" as the best alternative to risk reduction.
- Confined to the responses of those who favor the best alternative levels, "Strict enforcement of ship safety regulations" is calculated to be the best alternative to reduce risk based on the respondents subjective experiences according to types of vessels last served onboard and areas of familiarity.
- In modifying the VTS, the areas with VTS installed chose to "Improve or upgrade" and for those areas without VTS, their desire is to "Implement" the system. To improve or to install a system, the most advanced level is chosen (Level IV) which uses the Automatic Dependent Surveillance features. The best type of VTS system is the "Port and Approaches" type and the PCG is elected to operate, maintain and supervise the system.
- To qualify as a VTS operator, the necessity of shipboard experience is considered "Essential". The experiences include "Ship-handling and Communication", and "Management level" experiences.
- The effectiveness of the assistance and services rendered by VTS are considered "Very Important" and this is found to have no relationship and reached without any influence from respondents' personal factors based on their years served onboard, familiar areas of operation, and size of vessels' served.

7. Recommendation

This Part 2 of the study recommends:

- Improved the education and training of mariners and users of the waterways including the training of VTS operators manning the VTS centers presently installed only at the Manila Bay and Batangas Bay.
- Strict enforcement of ship safety regulations along the busy and main ports of the country.
- Install VTS system to those areas without and upgrade the system where it is already fitted. The most advanced type is desired, however due to economic constraints, a lesser level is presently appropriate to be fitted and assign the responsibilities in managing the system to the PCG for a simplified and effective policing and enforcement of rules and regulations.

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