

A Study of Maritime Transportation Routes Enforced for Pilotage

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Abstract

This study aimed to develop and improve the pilotage in Thailand to increase efficiency and safety in navigation. The objectives of the study were 1) to study the attitude of pilots in six port areas in Thailand toward maritime transportation are that enforced for pilotage in three aspects: route, port, and personnel aspects, and 2) to compare the pilots' attitude from each port area by using one-way ANOVA, and 3) to study important physical characteristics of each port. Data were collected by using questionnaire that was validated by using the Index of Item – Objective Congruence method. The participants were 62 pilots. Another instrument was in-depth interviews that were completed with 21 participants. The results showed that the pilots agreed most on personnel aspect followed by port and route aspects, respectively. The pilots agreed that working experiences and working hours the most important factor for pilotage. The issues that should be improved the most were 'the consistency between working hours and resting hours of pilots' and 'the adequate number of pilots to the amount of ships receiving the pilotage service. The results of the comparison among pilots' attitude toward maritime transportation showed that the pilots from six ports had a similar attitude toward the issues in port aspect. However, they had significantly different attitude toward the issues in route and personnel aspects ($p < 0.05$). The results of the physical characteristics of each maritime transportation area showed that the Bangkok port area was the most difficult route for pilotage in Thailand.

Keywords: Pilotage, Pilot, One-way ANOVA

1. Introduction

World trading depends mostly on maritime transportation. More than 90% of international shipment depends on maritime transportation through ports (Cho & Yang, 2011). In 2017, there were about 50,155 ships shipped through ports all over the world with around 1,847,630,894 Deadweight Tons (UNCTAD, 2017). This number showed that nowadays there are lots of goods ships in international waters and domestic water territories in all regions of the world. Therefore, the effectiveness of maritime shipment is one of the most important factor in supply chain that can make shipment successful. The universal principle for international maritime transportation is that when a ship gets through any country territorial waters, there must be a pilotage officer of the country to pilot that ship to dock in the specific areas such as port or anchor drop point. The pilot, therefore, has the important role in maritime transportation in the area enforced for pilotage. The objectives of pilotage are for safety reason and the effective flow maritime traffic with the consideration to maintain environment and prevent water pollutions (Kraweechat, 1998).

Another objective of pilotage is it can help coordinate the ship who is getting in or out of the port areas to prevent accident (Pattarachai, 2010). The process of pilotage begins with the ship reaches channel front or the waiting point. Then when it is the time for the ship to get into port or dock as the ship owner or the representative had contacted for receiving pilotage service, the pilot will get the motor boat from the pilot station to the ship and pilot the ship to get into the destination port or dock.

After the ship finishes transferring all goods, customs formality, immigration, port clearance, and other involving process and it is a time for getting out of the port; the pilot will be responsible for piloting the ship out of the port or dock to the channel front or the waiting point. After they reach the end of pilotage territory, the pilot will get off the ship and took the motor boat back to the pilot station. The ship captain then takes the ship further to the destination.

For Thai Pilotage Law, there are six port areas that require pilotage process consisting of Bangkok Port, Sri Racha including Laem Chabang Ports, Sattahip Commercial Port, Phuket Deep Sea Port, Songkhla Port, and Maptaphut Industrial Port (Marine Department, 2014). Therefore, every time a ship reaches the six areas, it is required to receive pilotage service according to the law and regulation. A ship that does not follow the pilotage law will be announced as guilty. There are some cases that are exceptional especially when it is necessary or avoidable such as when the pilot clearly shows his inability in pilotage the particular ship safely (Sarin, 1987). There were many researchers studied about pilotage officers such as Pattarachai (2010) studied the satisfaction of pilotage officers toward pilot service of Marine Department by focusing on the factors affecting on satisfaction, the comparison between factors affecting on satisfaction, problems, difficulties, and solutions, and studied the service from pilotage office of Marine Department. Main and Chambers (2015) studied “Factors affecting maritime pilots’ health and well-being: a systematic review” with the aim to study factors affecting on pilots’ health and well-being.

The results found that there were 24 factors consisting of 9 physical factors, 8 mental factors, and 7 workplace factors. All factors involved pilots’ effective working in long term. Chauvin, Lardjane, Morel, Clostermann and Langard (2013) studied “Human and organisational factors in maritime accidents: Analysis of collisions at sea using the HFACS” with the aim to study ship crash accidents that were caused by the wrong decision making. The study was divided into various levels: level 1 concerning environment and personal factors, level 2 concerning leadership and safety management, and level 3 concerning the importance of bridge management.

The results showed that captain needs adequate ability of safety management and the ability of coping with emergency incidence. Ulusçu, Ozbaş, Altıok and Or (2009) studied “Risk analysis of the vessel traffic in the strait of Istanbul” with the aim to analyze the risks of the vessel traffic in the strait of Istanbul that was considered the most traffic and the most difficult area for pilotage in the world with more than 55,000 ship get through it every year, and about 20% of the ships loaded dangerous goods. The data were analyzed by using mathematics model that predicts from possibility, incidence, accident, effect, and previous records together with the opinions from experts. The results showed that the density of the traffic and the pilotage ability of the pilot were the two factors that mostly affected on the risks of the vessel traffic in the strait of Istanbul.

Finally, Fang and Hu (2008) studied “Study on risk control of ship pilotage in Shanghai harbor” with the aim to study and investigate accidents involved pilotage in Shanghai during the past 13 years. The data concerning dangerous factors involving pilotage were collected and analyzed to evaluate the risk on pilotage.

The results suggested the measurement for avoiding and controlling the risks of accidents in piloting ship to Shanghai port areas. In addition, Schermerhorn (2000) mentioned that attitude aspect consists of 3 components that are cognitive component, affective component, and behavioral component. The good attitude results in effective working (Veeraporn, 2014). Similar to the results of the study of Hsu (2010) titled “Ports’ service attributes for ship navigation safety” who found that the pilotage involvers including marine pilots, VTC

regulators, tugboat crews, and linemen need specific occupational profession. Those specific occupational profession together with the good attitude result in pilotage safety. Moreover, pilots have to work on shifts, so their physical and mental health can result in their work. Their tiredness that is the result from their bad health absolutely reduces the effectiveness in their work and further results in pilotage safety (Hetherington et al., 2006).

The researcher's previous study titled "Vessel Traffic Management System in Thailand: Sriracha Port and Map Ta Phut Industrial Port" in 2016 presented the suggestions and recommendations from the pilots for the further study. Additionally, according to the literature review related to pilotage and vessel traffic, they suggested many factors that take effects on pilotage. After data were analyzed and synthesized, it indicated that there are three main factors that take effects on pilotage consisting of factors in maritime route, port, and personnel aspects. This study, therefore, aimed to develop and improve the pilotage in Thailand to increase efficiency and safety in pilotage.

The objective of the study was to study the attitude of pilots in six port areas in Thailand toward maritime transportation that are enforced for pilotage in three aspects consisting of route, port, and personnel aspects. Another objective was to compare the pilots' attitude from each port and to study important physical characteristics of each port. The significances of the study were to develop and improve safety in maritime transportation and to enhance effectiveness of maritime transportation. Moreover, the results of the study were the useful data for other private and government involvers to use for their future development.

2. Objectives

1. To study the attitude of pilots in six port areas in Thailand toward maritime transportation routes that are enforced for pilots in three aspects: route, port, and personnel aspects
2. To compare the pilots' attitude from each port area by using One-way ANOVA and study important physical characteristics of each route

3. Methodology

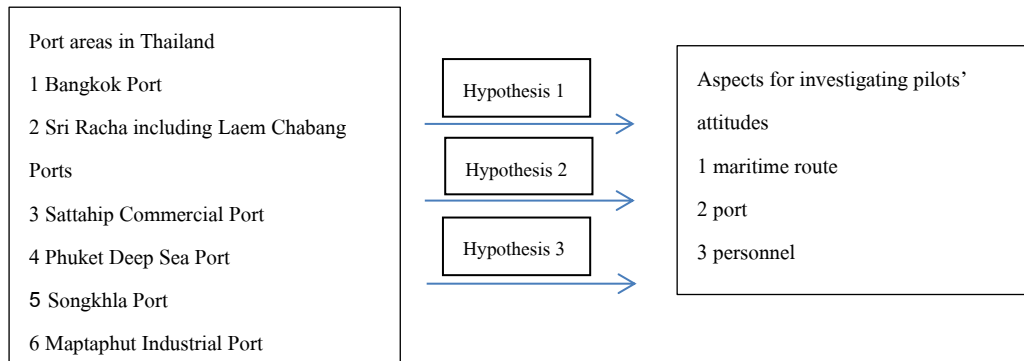
This research aimed to study the attitude of pilots in six port areas toward maritime transportation and compare the pilots' attitude from each port area and study important physical characteristics of each route. The procedure were as follows:

1. Information about the six port areas were retrieved and studied from international and national researches related to maritime transportation. The data were analyzed and used to create questionnaire and in-depth interview.
2. The questionnaire and in-depth interview questions were validated by expert to create the instruments that is consistent. The question framework was checked by expert to find out content validity to raise quality of the instrument and make it appropriate and consistent to the research objectives. The experts were from pilot field in Marine Department. IOC method (Index of Item – Objective Congruence) was used, and the items with 0.5 and higher IOC index were selected.
3. Pilots from six port areas answered questionnaire and participated in-depth interview. Data were collected and analyzed.
4. Statistical analyses were used following research methodology to achieve research objectives.

Scope of the study

The scope of the study was the six port areas that were enforced for pilotage in Thailand consisting of 1) Bangkok Port, 2) Sri Racha including Laem Chabang Ports, 3) Sattahip Commercial Port, 4) Phuket Deep Sea Port, 5) Songkhla Port, and 6) Maptaphut Industrial Port. The population of the study were 77 pilots (Marine Department, 2017). The samples of the study were 62 pilots (80.52% out of the whole population) selected by using non-probability sampling selection and convenience sampling method.

Research framework



Research hypotheses

Hypothesis 1

H0 = Different ports areas in Thailand do not have different attitude toward maritime transportation routes aspect

H1 = Different ports areas in Thailand have different attitude toward maritime transportation routes aspect

Hypothesis 2

H0 = Different ports areas in Thailand do not have different attitude toward ports aspect

H1 = Different ports areas in Thailand have different attitude toward ports aspect

Hypothesis 3

H0 = Different ports areas in Thailand do not have different attitude toward personnel aspect

H1 = Different ports areas in Thailand have different attitude toward personnel aspect

4. Results

This research was conducted on the topic of maritime transportation enforced for pilotage. The subjects were 62 pilots in six port areas in Thailand. The instruments were questionnaire and in-depth interview. The in-depth interview was done with 21 subjects. The statistics used in this research were percentage, mean, standard deviation, and F-test with the significant level at $p \leq 0.05$. The analyses consisted of:

1. Analyze the attitude of pilots in six port areas in Thailand toward maritime transportation in three aspects: route, port, and personnel aspects,
2. Compare the pilots' attitude from each port area in three aspects: route, port, and personnel aspects by using hypothesis testing,
3. Summarize the results of in-depth interview of the pilots in six port areas in Thailand.

Table 1: Number and percentage of pilots in each port area in Thailand

General information	Number	Percentage
1. Bangkok Port	30	48.4
2. Sri Racha including Laem Chabang Ports	15	24.2
3. Sattahip Commercial Port	5	8.1
4. Phuket Deep Sea Port	2	3.2
5. Songkhla Port	5	8.1
6. Maptaphut Industrial Port	5	8.1
Total	62	100

Table 1 shows general information of 62 pilots in six port areas in Thailand that are enforced by the pilotage law. The highest number was of Bangkok port consisting of 30 pilots accounted for 48.4%, and the lowest numbers number was of Phuket Deep Sea Port consisting of 2 pilots accounted for 3.2%.

Table 2: Mean, standard deviation, and the comparison indices of the attitude of pilots in six port areas toward factors in route aspect

factors in route aspect	\bar{X}	S.D.	F	P
1. The physical characteristics of the channel is appropriate for the size of the ships get through this route.	3.94	0.86	3.64	0.006**
2. The physical characteristics of the channel is following Nautical Charts of the Hydrographic Department, Royal Thai Navy.	3.89	0.63	1.65	0.162
3. The physical characteristics of the channel is difficult for getting in-out of the port.	2.92	0.94	1.60	0.175
4. The speed and the direction of the wind in the route is the obstacle for getting in-out of the port.	2.79	1.05	8.46	0.000**
5. The speed and the direction of the current in the route is the obstacle for getting in-out of the port.	3.13	0.87	4.65	0.001**
6. The height and direction of the wave in the route is the obstacle for getting in-out of the port.	2.69	1.23	17.26	0.000**
7. The visibility in the route is the obstacle for getting in-out of the port.	2.60	1.03	1.59	0.177

factors in route aspect	\bar{X}	S.D.	F	P
8. Some barriers that cannot be seen by eyes (e.g. undersea objects, submerged rocks, sand bar, etc.) in the route are the obstacle for getting in-out of the port.	2.77	1.22	2.93	0.020*
9. Human-made objects (fish trap, coastal fisheries, etc.) are the obstacle for getting in-out of the port.	3.47	1.52	13.15	0.000**
10. Different seasons take effect on getting ship in-out of the port.	3.27	0.91	5.02	0.001**
11. The traffic in the route is crowded.	3.52	1.25	31.92	0.000**
12. The traffic signs in the channel are clear, enough, and not confusing.	3.55	0.88	3.70	0.006**
13. Other kinds of boats (fisheries boats, ferry, etc.) are the obstacle for getting in-out of the port.	3.44	1.53	29.31	0.000**
14. Communication materials and VHF signal system are effective for operation.	3.00	1.14	9.40	0.000**
Grand Total	3.21	0.46		

**significant at $p \leq 0.01$ *significant at $p \leq 0.05$

Table 2 showed that pilots had the attitude toward maritime transportation in route aspect at 3.21 average score (S.D. = 0.46). When considering each individual item, the item 'the visibility in the route is the obstacle for getting in-out of the port' got the lowest score, and the item 'the physical characteristics of the channel is appropriate with the size of the ship get through this route' got the highest score.

Hypothesis 1 Testing

F-test was done by using ANOVA with the significant level at $P \leq 0.05$. The results showed that the opinions toward the item 'the physical characteristics of the channel is following Nautical Charts of the Hydrographic Department, Royal Thai Navy' and the item 'the visibility in the route is the obstacle for getting in-out of the port' got p-value higher than 0.05 that can be inferred the pilots from the six port areas did not have different opinions toward these issues. However, the pilots had significantly different opinions toward other 11 items ($P \leq 0.05$).

Table 3: Mean, standard deviation, and the comparison indices of the attitude of pilots in six port areas toward factors in port aspect

factors in port aspect	\bar{X}	S.D.	F	P
1. Support materials such as pintle, cushion, life buoy, portable fire extinguisher, fire hose, etc. are adequate and ready to use.	3.16	0.81	1.15	0.346
2. Tug boat and rope receiving boat are ready when you get to the port.	3.31	0.82	1.58	0.182
3. Tug boat and rope receiving boat help you work more effectively.	3.74	0.78	0.53	0.754
4. The lights around the port front are adequate.	3.37	0.73	1.30	0.279
5. The size of the turnaround area is appropriate.	3.4	0.79	2.30	0.057
6. The traffic controlling around the port front is appropriate.	3.23	0.89	1.90	0.11
7. The management in receiving in and letting ship out of the port is appropriate.	3.26	0.82	0.88	0.503
8. The docks in the port are difficult for docking/leaving appropriately.	2.82	0.82	0.90	0.489
9. The port management takes effect on your work on receiving in and letting ship out of the port.	3.56	0.76	2.08	0.082
10. In overall, the port is ready for receiving in and letting ship out of the port.	3.47	0.78	1.86	0.116
Grand Total	3.33	0.43		

**significant at $p \leq 0.01$ *significant at $p \leq 0.05$

Table 3 showed that pilots had the attitude toward maritime transportation in port aspect at 3.33 average score (S.D. = 0.43). When considering each individual item, the item 'The dock in the port is difficult for docking/leaving appropriately' got the lowest score, and the item 'Tug boat and rope receiving boat help you work more effectively' got the highest score.

Hypothesis 2 Testing

F-test was done by using ANOVA with the significant level at $P \leq 0.05$. The results showed that the opinions toward all items got p-value higher than 0.05 that can be inferred that the pilots from the six port areas did not have different opinions toward these issues.

Table 4: Mean, standard deviation, and the comparison indices of the attitude of pilots in six port areas toward factors in personnel aspect

factors in port aspect	\bar{X}	S.D.	F	P
1. Your working hours and resting hours are consistent and appropriate.	2.5	0.95	3.60	0.007*
2. The stress from any situations before work results in pilotage.	3.21	0.89	3.03	0.017*
3. The stress during work results in pilotage.	3.68	0.93	7.29	0.000**
4. The tiredness of previous pilotage results in later pilotage.	3.76	0.9	7.42	0.000**
5. Your eye-sight problems are obstacle for pilotage.	2.63	1.04	2.07	0.083
6. Your health problems (e.g. illness or fever) take effect on pilotage.	2.92	1.11	1.09	0.378
7. The time table of pilot office is flexible and appropriate.	3.48	0.84	1.40	0.24
8. The pilot office that you work for has enough pilots and adequate for the service users.	2.47	0.84	4.26	0.002**
9. The boat for pilot is appropriate and punctual according to the appointment time for getting in-out of the port.	3.68	0.65	3.70	0.006**
10. The knowledge sharing from your senior officers can promote you to work more effectively.	3.98	0.86	1.15	0.346
11. You have the ability to share your knowledge to your junior.	3.87	0.97	0.94	0.464
12. Your accumulate skills and experiences from your working periods can promote you to work more effectively.	4.68	0.51	1.04	0.406
13. The ability to speak third language (local language) to cox officer results in effective pilotage.	3.23	1.15	2.10	0.079
14. The ability to speak third language (local language) to captain results in effective pilotage.	3	1.21	1.46	0.216
15. Goods ships make correct/complete pilotage card.	3.87	0.86	3.46	0.009**
16. Pilotage card helps you work more effectively.	4.08	0.82	3.11	0.015*
17. Performance and effectiveness of ships result in pilotage.	4.39	0.75	0.80	0.556
18. Captain's behavior results in pilotage of the pilot.	4.4	0.64	2.76	0.027**
Grand Total	3.54	0.28		

**significant at $p \leq 0.01$ *significant at $p \leq 0.05$

Table 4 showed that pilots had the attitude toward maritime transportation in personnel aspect at 3.54 average score (S.D. = 0.28). When considering each individual item, the item ‘the pilot office that you work for has enough pilots and adequate for the service users’ got the lowest score, and the item ‘your accumulate skills and experiences from your working periods can promote you to work more effectively’ got the highest score.

Hypothesis 3 Testing

F-test was done by using ANOVA with the significant level at $P \leq 0.05$. The results showed that the opinions toward 9 items got p-value higher than 0.05 consisting of the items ‘your eye-sight problems are obstacle in pilotage’, ‘your health problems (e.g. illness or fever) take effect on pilotage’, ‘the time table of pilot office is flexible and appropriate’, ‘the knowledge sharing from your senior officers can promote you to work more effectively’, ‘you have the ability to share your knowledge to your junior’, ‘your accumulate skills and experiences from your working periods can promote you to work more effectively’, ‘the ability to speak third language (local language) to cox officer results in effective pilotage’, ‘the ability to speak third language (local language) to captain results in effective pilotage’, and ‘performance and effectiveness of ships result in pilotage’. This indicated that the pilots from the six port areas did not have different opinions toward these issues. However, the pilots had significantly different opinions toward other 9 items ($P \leq 0.05$).

Table 5: The summary of in-depth interviews with 21 pilots in six port areas in Thailand

Thai Port Areas	Physical Characteristics/ Dangerous Pilotage Zone	Important Issues
1. Bangkok Port (3 informants)	Phra Pradaeng curve is dangerous because it is sharp and narrow curve. There are also deep and shallow area that cannot be seen by eyes.	Bangkok port is the most difficult area for pilotage because of the crowded traffic, the narrow and shallow channel, the long distance, lots of boats and lighters that are the obstacle for the big ship.
	Bang Hua Suea Slot is difficult for pilotage because there are new ports that make the sea lane narrower.	
	The channel is narrower above Non- see curve. The boats are crowded and are the cause of accidents. The pilotage service for goods ship should be inhibited at night.	
	Sathu Pradit Anchor drop area got lots of foreign goods ships that against the law. The current there is strong. And there is no turnaround point there.	

Thai Port Areas	Physical Characteristics/ Dangerous Pilotage Zone	Important Issues
2. Sri Racha including Laem Chabang Ports (2 informants)	The channel is wide and standard.	The wind is strong in monsoon season.
	Siam Sea port has too narrow dock that causes difficulties in docking. The wind and current are strong that makes it difficult to control ship.	There are crowded ships in the anchor area.
	Sichang Island port get strong current and wave. There was limited space for anchor drop, but there are lots of goods ships there.	While waiting for pilotage boat, there is sometimes goods transferring; therefore, the area for anchor drop that has win-screen is needed.
3. Sattahip Commercial Port (5 informants)	Sattahip Commercial Port is natural channel that makes it more difficult for pilotage than other manmade channels.	When the ships are passing, the smaller ship or the ship that is not in the routine route must stop. Therefore, good communication method between the two ships is needed.
	Sattahip Commercial port area is open sea that causes strong current and result in the unclear position of float light leading to the channel front. This problem results in the decision not to pilot the ships in- out of port area at night.	Most of the ships got in Sattahip Commercial port areas are navy ships and medium size ships that make pilotage in this area easier than other areas with big ships.
4. Phuket Deep Sea Port (2 informants)	The port get strong wind and current that are influenced by South- west Monsoon, Indian Ocean.	Pilotage ship through this area must take really careful because it is open sea that causes fluctuating strong wind and current. Piloting ships in- out of the area must really be careful.
	The current is really strong, so the pilot must take really careful of it.	There are lots of coastal fisheries and small boats there. And the fisheries boats also use the same channel for their traffic similar to goods ships that cause the obstacle in pilotage in this area.
	The visibility is limited especially in monsoon seasons, so the pilot must take really careful of it.	There are lots of manmade objects there (e.g. fish trap, fisheries, etc) that are obstacle for pilotage.
	There is a dangerous point on the east side of Tapaoyai Island where east cardinal mark is located. Therefore, pilotage ship through this area must take really careful	

Thai Port Areas	Physical Characteristics/ Dangerous Pilotage Zone	Important Issues
	because the sea is shallow, and also the area is open sea that causes fluctuating strong wind and current.	
5. Songkhla Port (4 informants)	The current gets influenced by Songkhla Lake so the pilot must take really careful of the strong current.	Wind and current become stronger during August to January. It is raining during East-north monsoon and South-west Monsoon Seasons.
	The visibility is limited especially in monsoon seasons, so the pilot must take really careful of it.	Pilotage is done by day not at night because of the more comfortability.
	There is a difficult pilotage point at the front to Songkhla deep sea port because the current there always changes.	There are lots of coastal fisheries and small boats. And the fisheries boats also use the same channel for their traffic similar to goods ships that cause the obstacle in pilotage in this area.
6. Maptaphut Industrial Port (5 informants)	Current is stronger and takes more effect than wind.	Different types of ships result in pilotage. There are different types of ships such as goods ships or oil and petrochemical ships that are also different in the difficulty of pilotage.
	The ships use right lane. There is a red light to show signal for other ships passing, and the ship on the side that the red light is shown must stop. However, the light is not clear and makes confusion sometimes.	The different weight load results in the different pilotage. The heavy load causes the ships difficult to control. However, if it is too light load, it is also difficult to control as well because the light load causes the ship float high and reduces the visibility.
	90% of the ship are oil and petrochemical products ships including natural gases and coal that are categorized as dangerous goods.	The size of ships results in pilotage. The bigger ships are more difficult to pilot than the smaller ones.

Thai Port Areas	Physical Characteristics/ Dangerous Pilotage Zone	Important Issues
	Other goods ships are also big ships. Therefore, pilots who works in this area need experiences and expertise to make sure that the pilotage is safe and assure the ship owner and also the entrepreneur for the safety.	

5. Conclusions

This research studied the attitude of pilots in six port areas in Thailand toward maritime transportation that are enforced for pilotage in three aspects: route, port, and personnel aspects, and compared the pilots' attitude from each port area and study important physical characteristics of each route. The results showed that the pilots rated personnel aspect the highest because pilot is responsible to make decision to pilot ships safely in the channel without any accidents or dangers. The pilots considered the 'accumulate skills and experiences from their working periods' as the most important issue for promoting their work more effectively. The issue that should be improved the most was 'the consistency between working hours and resting hours of pilot' and 'the adequate pilots to the amount of ships receiving the pilotage service'.

This results can be inferred that their working hours and their resting time were not appropriate, and there were inadequate pilots for the ships receiving the pilotage service. The results of the hypotheses testing of the pilots' attitudes in three aspects (i.e. route, port, and personnel aspects) showed that pilots in the six port areas had the similar attitudes toward port aspect in all issues. That can be inferred that the six ports had the same standard. (Infrastructure, equipment, equipment used in docking of ships, as well as operations in docking.) However, the pilots got the significantly different towards the route and personnel aspects.

The results of in-depth interview with 21 pilots in six port areas showed the physical characteristics of the ports that Bangkok port is the most difficult area for pilotage because of the crowded traffic, the narrow and shallow channel, the long distance, lots of boats and lighters that are the obstacle for the big ships. Sri Racha including Laem Chabang ports area got the problems of strong current and wave around Sichang Island. Moreover, there was limited space for anchor drop, but there were lots of goods ships there. Sattahip Commercial port area was open sea that caused strong current and resulted in the unclear position of float light leading to the channel front. This problem results in the decision not to pilot ships in-out port area at night. However, most of the ships got in Sattahip Commercial port areas were navy ships and medium size ships that made pilotage in this area easier than other areas with big ships.

Phuket Deep Sea port got a dangerous point on the east side of Tapaoyai Island where there east cardinal mark is located. Therefore, pilotage ship through this area must take really careful because the sea is shallow, and also the area is open sea that caused fluctuating strong wind and current. Songkhla port had the difficult pilotage point at the front to Songkhla deep sea port because the current there always changes. Moreover, the pilotage there was difficult because of other obstacles such as tidal waves, coastal fisheries, fisheries boats, and small boats in the area. The fisheries boats also used the same channel for their traffic similar to goods ships that cause the obstacle in pilotage in this area.

Finally, Maptaphut Industrial Port got 90% of oil and petrochemical products ships including natural gases and coal that were categorized as dangerous goods. Other goods ships were also big ships. Therefore, pilots who works in this area need experiences and expertise to make sure that the pilotage is safe and assure the ship owner and also the entrepreneur. The results of the study showed that the physical characteristics of the six port areas in Thailand were different (e.g. characteristics of channel, current direction, and wind direction). Therefore, Pilot Bureau, Marine Department, Ministry of Transport who is directly responsible for pilotage should continuously provide pilot training in each port area to prevent any accidents or damages that might be occurred.

The pilots who have got much experiences and have been responsible for piloting for long working period with high potential in pilotage should be transferred to Bangkok Port because it is the most difficult area for pilotage in Thailand. The factors that caused the difficulty included crowded vessel traffic, narrow channel, long distance, and the working hours of pilots that were not consistent to resting hours. Additionally, there are inadequate pilots to the amount of vessels receiving the pilotage service nowadays, and the numbers of vessels tend to increase in the future. Marine Department should coordinate with other involvers to train more pilots for vessel pilotage in order to solve the insufficiency problems that occurs nowadays.

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