The Modeling Framework for the Need of Training Ship on Maritime Vocational Education

Rusnaedi Rusi, Suandar Baso, Syamsul Asri

Abstract: ***The seafarer's profession will be facing a few strong challenges today and future next. Correspondingly, the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) requires tightly the maritime vocational education that must produce graduates with appropriate and needed competences related with international trade perspective in the shipping sector. In order to improve student skill, a training ship is needed by maritime vocational education as real practice for student. This research describes a modeling framework of basic ship design for training ship of the maritime vocational education. The modeling framework was divided into three parts namely the model of training ship type selection, the capacity of the training ship, and the main dimensions of the training ship design. The modeling framework was applied to Maritime Polytechnic of AMI Makassar as a case study. The research results show the selected type ship was passenger-cargo ship type 37.20. The capacity of the training ship was about 150 students with cargo capacity 50 ton. The main dimensions of the training ship design were obtained where length between perpendiculars (Lbp), breadth (B), height (H), and draft (T) were 72.00 m, 12.00 m, 5.50 m, and 2.53 m respectively. The main dimensions of the training ship design were corrected as well by the parameters of main dimension ratio, geometric form coefficient, weight, and initial static stability.***

Keywords: ***Main dimensions, maritime vocational education, modeling framework, SCTW, ship capacity, ship type, training ship.***

I. INTRODUCTION

Every day, many commercial ships are traveling over the world where they are transporting goods and people. These ships have many skilled seafarers that handle ships safely at sea. However, the seafarer's profession will be facing a few challenges today and future where those are shortage in the supply of skilled seafarers and prediction of future skill needs. Therefore, the maritime vocational education or maritime education and training must pay attention deeply for high quality and visible attracting good student, producing graduates as seafarers with appropriate and needed competences the shipping sector.

As known, the Officer's Competency Convention in 1936 for international training of seafarers was coded by International Labor Organization (ILO) namely ILO C53. Then, Standards of Training, Certification and Watchkeeping for Seafarers (STCW) held international convention in 1978 to set minimum and specific standards for seafarers on an international level and it was adopted by International Maritime Organization [1]. Through these standards, the maritime vocational education or maritime education and training are also obliged to meet. Therefore, some researches had been done in investigating, improving, developing etc. on how maritime vocational education produce graduates who have competences suitable with minimum standards obligated by SCTW.

Several researchers have attempted to conduct some researches which were concerned on the development of maritime vocational education. These researches were focused several aspects on curriculum, competency, training process, and facility. The maritime vocational education should be having a training ship for support learning process to obtain learning out comes [2]. It also results learning outcome of extracurricular teachers have responsibility on safety, training process, and then ship operation. Knowledge about rules, training process, and maritime education in global industry and international across man power were offered to maritime vocational education, therefore, it was obligated to provide education and training in context framework of international regulation for shipping industry need [3]. The context framework consists of laboratory facility, simulation tool, teacher and instructor which qualified and experienced, infrastructure, and regulation for teacher and student.

Correspondingly, global perspectives of maritime education and training education (MET) in China were described [4]. Moreover, Dong redefined re-concept and reformation of MET into fund, strategy, education mode that effect on comprehensive development to be high quality. In addition, the special subjects teaching methods in marine engineer's vocational education system was discussed where a concept of practical simulation can simplify studying and understanding the algorithm and operational principle of automatic marine engineering control system [5]. Developing an effective maritime education and training system was discussed as well [6], commonly agreed principles in establishing an effective MET were considered. To achieve these missions, with international cooperation and support from European Union projects, the Turkish Maritime Education Foundation (TUDEV) and the Turkish Chamber of Shipping (TCS) initiated unlimited watch officer training.

The proficiency improvement method in maritime education was described a model for the curriculum development in scientific subjects for outcome-based maritime education [7].

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***** Correspondence Author
Rusnaedi Rusi*, Maritime Polytechnic of AMI Makassar, Indonesia. Email: rusnedi01@gmail.com
Suandar Baso, Naval Architecture Department, Engineering Faculty, Hasanuddin University. Email: s.baso@eng.unhas.co.id
Syamsul Asri, Naval Architecture Department, Engineering Faculty, Hasanuddin University. Email: sa_tanri_kapal83@yahoo.com _

The research result related with skill and competence achievement of seafarer was discussed where comparative analysis was done through training on bridge and engine simulator [8].

This training resulted significantly the good change of overall seafarer's skill. The technologies and approaches and Turkish experiment in maritime education and training was introduced that the discussions grouped and associated to formulate possible/probable solutions and then after testing suitability, reliability and acceptability of solutions, some applicable course of actions were analyzed [9]. Trends, challenges and opportunities of vocational and academic approaches to maritime education and training (MET) were discussed more detail. The global trend in maritime education and training is increasingly to link an essentially vocational education that provides specific and restricted competence outcomes. This trend has led to some dilemmas for curriculum development, for training legislation in a global industry, and for achieving desired learning outcomes in a professional setting [10].

Despite some researches done well as stated previously, a research concerns on a training ship that is real practice for student in maritime vocational education is rarely discussed. The training ship owned by maritime vocational education could be covered and improved some skill for students. Therefore, this research has described a training ship need that supports real practice for student on board. The training ship that is needed should be suited properly with the current condition of the maritime vocational education. This could be done by ship design basically. Correspondingly, a framework was modeled for basic design works in order to obtain proper ship type, ship capacity, and main dimensions.

II. MODELING FRAMWORK AND METHODOLOGY

This section describes some methods that are used to be applied for obtaining properly training ship design for maritime vocational education. These some methods were schemed into three design works namely selecting ship type, analyzing ship capacity, and determining main dimensions. Correspondingly, the three-design works were systematically modeled and simplified into a framework.

A. The Modeling Framework of Training Ship Design

The modeling framework represented basic ship design flowcharts in every part and involved a lot of used methods in detail. Three design works that are the parts were considered for obtaining properly training ship design for maritime vocational education as shown in Fig. 1. The part of selecting ship type and the part of analyzing ship capacity were decided as the determination process of mission requirements. Then, the part of determining main dimensions involved analyzing main dimension and correcting ship parameter. Some methods that were used into three parts of the framework have been later discussed in next sub-sections.

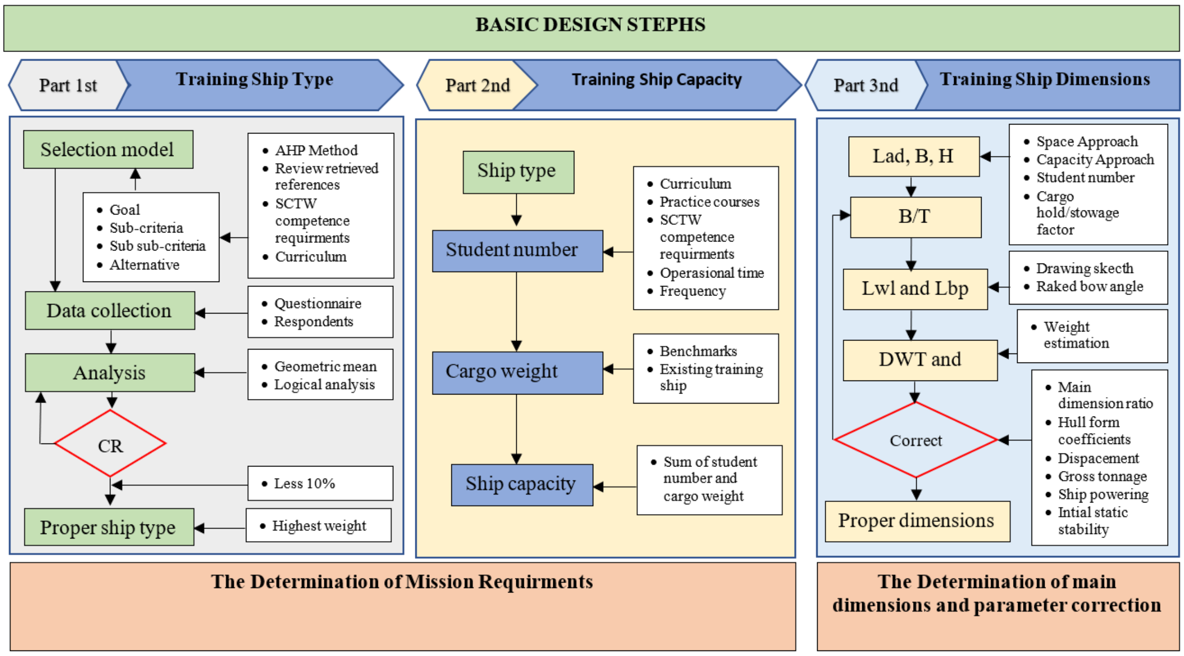

Fig. 1. The modeling framework of the basic design of training ship need for maritime vocational education

B. The Model of Training Ship Type Selection

The model, goal, criteria, sub-criteria, sub sub-criteria, and alternative, of training ship type selection was decomposed by using Analytical Hierarchy Process (AHP) [11]. The goal of the model was to select training ship type for maritime vocational education. The elements of criteria, sub-criteria, and sub sub-criteria were identified and formulated by reviewing retrieved references and open-ended question. The open-ended question was conducted and addressed to expert in ship design.

Meanwhile, the weights of criteria, sub-criteria, sub sub-criteria, and alternative were obtained by calculating the absolute value elements. The absolute values for matrix elements are 1, 3, 5, 7, and 9 and for the interest intensity representing five elements of the Likert Scale are strongly agree, agree, neutral, disagree, and strongly disagree.

The weights of criteria, sub-criteria, sub sub-criteria, and alternative were calculated by dividing the number of rows of normalization matrix with the total of the sum result column. The weights of the elements that were input and calculated in pairwise comparison matrix are geometric mean.

Moreover, the absolute value elements were collected from respondents by using closed-ended questions. The questionnaire was addressed to respondents who are expert or top-level management from ship design consultant, shipyard, shipping industry, port authority, and academic staff. Nevertheless, the value elements of alternative were given separately based on data and logically analysis. This means that the value elements of sub-criteria and sub sub-criteria toward alternative did not addressed to respondents.

The ship types were determined based on the highest weight of alternative that was resulted. The value of the consistency ratio (CR) should be given smaller than 10% that signifies a consistent hierarchy and accuracy.

C. The Capacity of Training Ship Design

The capacity of the training ship was determined by an approach of passenger number and cargo weight. Here, passenger is assumed as student who conducts training on ship. The student number was identified from the several courses of curriculum of maritime vocational education. Besides, cargo weight was determined by benchmarking the existing training ship.

D. The Main Dimensions of Training Ship Design

The main dimensions of the training ship design were determined by using space or capacity approach and dead weight approach. The main dimensions of the training ship had been determined namely length of water line (Lwl), length between perpendiculars (Lbp), breadth (B), draft (T), and height (H). For the first, the length of the training ship design was measured by sum space need in accommodation deck plan and it was $L_{ad.}$ Correspondingly, the breadth (B) was measured by sum space need in accommodation deck plan as well. Moreover, draft T was assumed firstly by using the ratio B/T. Then, it would be considered after ship displacement (Δ) correction. Both of Lbp and Lwl were assumed less than L_{ad}. This means that the Lwl position is under L_{ad}. Therefore, the Lbp and Lwl were measured firstly by using the draft (T).

This must be noted that in order to consider properly, all main dimensions were corrected by using the ratio of L/B, L/H, B/T where L was Lwl. On the other hand, the ship displacement (Δ) by main dimensions was corrected with the sum of deadweight ton (DWT) and lightweight ton (LWT). For gross tonnage (GT) of the training ship, it was formulated by using benchmarks and then it was described by relation between cube root of L*B*H or $(L*B*H)^{1/3}$ and GT. Moreover, the horse power (HP) of the training ship was formulated by benchmarks as well in relation between $(L*B*H)^{1/3}$ and HP. Finally, the initial static stability was corrected as well.

III. RESULTS AND DISCUSSION

The modeling framework was implemented on the one of maritime vocational education as case study i.e. Maritime Polytechnic of AMI Makassar. The model of training ship type, the capacity of training ship, and the main dimensions of the training ship were analyzed to obtain properly its type, capacity, main dimensions for the need of Maritime Polytechnic of AMI Makassar. Despite being such the case study addressed to Maritime Polytechnic of AMI Makassar, the model framework that were implemented could be considered and used by any maritime vocational educations in order to design basically a training ship need. Furthermore, the research results are discussed and presented as follows.

A. The Model of Training Ship Type Selection and Its Decision

The selection model of training ship type was decomposed hierarchically into goal, criteria, sub-criteria, sub sub-criteria, and alternative respectively. Several references were reviewed to obtain criteria elements [12 to 19]. The review result the criteria elements that were payload, port, shipyard, and shipping route.

Thus, the elements of sub-criteria and sub sub-criteria were obtained by reviewing some references, [13, 15] and [20 to 26]. These sub-criteria elements consist of payload type, cargo packaging, ship service, cargo service, port type, types of ports, shipyard production capacity, shipyard production facility, raw materials, human resources, zone, and demand. Moreover, the elements of sub sub-criteria were passenger, cargo, wheeled cargo, sack, drum, pallet, quay, port berth, basin, tracking, loading-unloading facility, warehousing, terminal, general port, and particular port.

The above discussion highlighted criteria, sub-criteria, and sub sub-criteria, the selection model of the training ship type is shown in Fig. 2. Correspondingly, the decision of the training ship type has been explained. The results of questionnaire from respondents were calculated by geometric mean and then the geometric mean was input to pairwise comparison among criteria, sub-criteria, and sub sub-criteria as resulted shown in Table 1 to 3.

Table 1 expresses the weights of criteria elements where the payload has a highest weight about 57.20% with CR 5 %. The highest weights of sub-criteria under criteria are given payload type 83.30%, port ship service 64.90%, shipyard production capacity 55.50%, and zone 75% as shown in Table 2. Moreover, the highest weights of every sub sub-criteria under sub-criteria are contributed by passenger 60.00%, pallet 60.00%, quay 56.50%, loading-unloading facility 63.70%, and general port 75.00%.

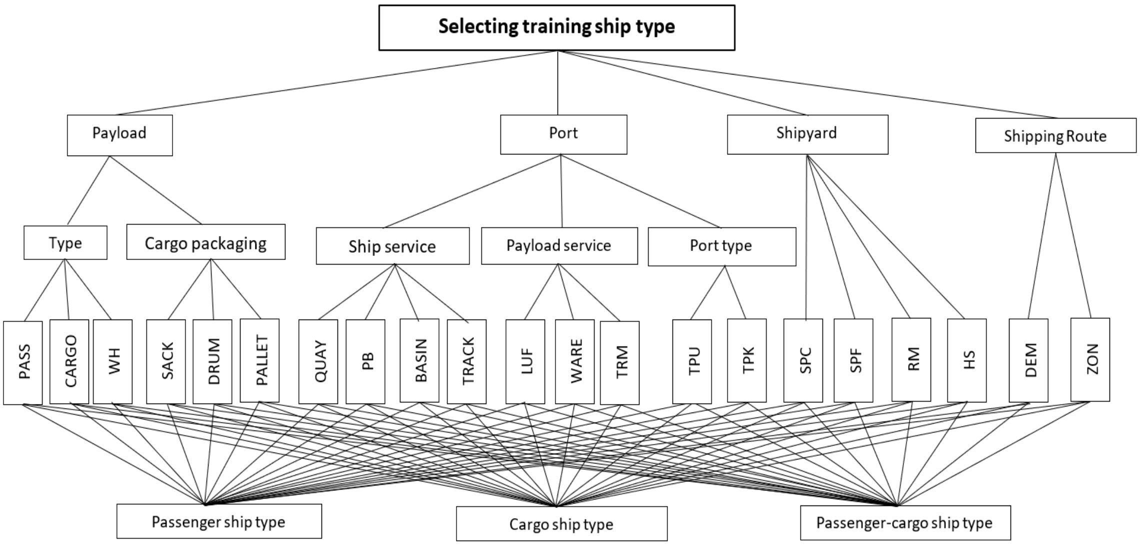

Fig. 2. The selection model of the training ship type using AHP method

Table 1. The weights of the criteria elements

No.	Criteria Element	Weight (%)
1.	Payload	57.20
2.	Port	30.20
3.	Shipyard	6.50
4.	Shipping route	6.10

Table 2. The weights of the sub-criteria elements under criteria element

Criteria and Sub-criteria	Weight (%)
Payload	
Payload type	83.30
Cargo packaging	16.70
Port	
Port ship service	64.90
Cargo service	27.90
Types of port	7.20
Shipyard	
Shipyard production capacity	55.50
Shipyard production facility	26.60
Raw materials	12.00
Human resources	5.90
Shipping route	
Demand	25.00
Zone	75.00

Table 3. The weights of the sub sub-criteria elements under sub-criteria element

Sub-criteria and Sub sub-criteria	Weight (%)
Payload type	
Passenger	60.00
Cargo	20.00
Wheeled cargo	20.00
Cargo packaging	
Sack	20.00
Drum	20.00
Pallet	60.00
Port ship service	
Quay	56.50
Port berth	26.20
Basin	11.80
Tracking	5.50
Cargo service	
Loading-unloading facility	63.70
Warehousing	25.80
Terminal	10.50
Types of port	
General port	75.00
Particular port	25.00

Table 4. The weights of the sub sub-criteria elements under sub-criteria element

Alternative element	Weight (%)	Alternative element	Weight (%)
Passenger (payload)		Warehousing	
Passenger-cargo ship type	47.40	Cargo ship type	63.90
Cargo (payload)		Terminal	
Cargo ship type	47.40	Passenger ship type	72.70
Wheeled cargo (payload)		Port type	
Cargo ship type	52.40	Passenger ship type	65.50
Sack		Particular port	

Cargo ship type	67.20	Cargo ship type	68.10
Drum		Shipyard production capacity	
Cargo ship type	68.10	Passenger-cargo ship type	33.30
Pallet		Shipyard production facility	
Cargo ship type	70.90	Passenger-cargo ship type	33.30
Quay		Raw materials	
Passenger-cargo ship type	33.30	Passenger-cargo ship type	33.30
Port berth		Human resources	
Cargo ship type	60.30	Passenger-cargo ship type	33.30
Basin		Demand	
Passenger-cargo ship type	33.30	Cargo ship type	58.20
Tracking		Zone	
Passenger-cargo ship type	33.30	Passenger ship type	66.90
Loading-unloading facility			
Cargo ship type	59.60		

On the other hand, the pairwise comparisons between sub-criteria and sub sub-criteria to alternatives were analyzed by using data, suitability, and logical mind toward the training ship need for Maritime Polytechnic of AMI Makassar. The pairwise comparisons or the weights of the alternatives under sub-criteria and sub sub-criteria are shown in Table 4 and this shows only the highest weight of alternative with the CR range 0% to 7%. Althought, the highest weights seem dominantly given by cargo type, however, the criteria, sub-criteria, and sub sub-criteria are highest weight are contributed by payload, payload type, and passenger respectively. Those elements directly affect on a selected ship type.

Therefore, the overall weights of the alternatives are shown in Figure 3 where the weights of the passenger ship type are 31.20%, the passenger-cargo ship type 37.20%, and the general cargo ship type 31.60%, respectively. This is noted that the alternative of the training ship type was determined i.e. the passenger-cargo ship. The passenger-cargo type has a highest weight. And then, this means that the passenger cargo ship was decided as the training ship type for Maritime Polytechnic of AMI Makassar.

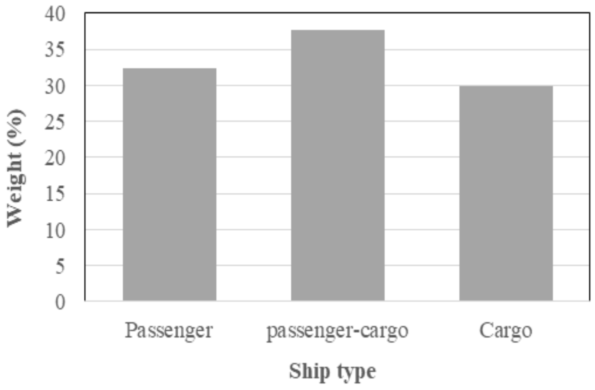

Fig. 3. The overall weights of the alternative ship type

B. The Capacity of Training Ship Design

The determination of the ship training capacity was basically derived from the mission requirements. A few mission requirements had been considered as follows:

a. Training ship type. This has been obtained in previous section i.e. passenger-cargo ship.
b. Standards of training, certifications and watchkeeping (STCW) for seafarers (2010) requirements. STCW has given a specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tonnages or more. Also, SCTW has given mandatory minimum requirements for certification of chief engineer officers and second engineer officers on ships powered by main propulsion machinery of between 750 kW and 3,000 kW propulsion power.
c. Curriculum demands of Maritime Polytechnic of AMI Makassar. Courses which have practice were identified.
d. Ship speed. Ship speed was determined based on allocated time for practice per shift and trip to and return destination port.

Here, the training ship capacity was formulated by approach of student number who conduct practice on ship annually. As known, there are two study programs in Maritime Polytechnic of AMI Makassar which has some courses to conduct practice on board namely Nautical Study Program and Technical Study Program. Figure 4 shows the schematic schedule of the practical courses that implement on semesters (odd and even). For semester I, II and III, several courses conduct introduction to real ship and basic practice on board. Then, the advanced practice is conducted on semester IV. This means that the students to be able to control a ship by themselves. The blue mark is denoted the introduction to real ship and basic practice on board and the red mark is denoted the advanced practice. Therefore, the advanced practice as achievement of the competence needs longer time for all shifts allocated 2 months (third and fourth) where one shift is about 14 days. Also, the service speed of training ship was considered 12.75 knot. In addition, two months later are used for assessment on students after practicing as a final semester.

A number of new students for two study programs per year are averaged 600 people. Then, they would conduct a practice in Semester IV. As explained previously, the allocated time for practice on board is about 2 months. Therefore, the frequencies of the training ship use are four times. For four times, the student would be 150 people on board. This is highlighted that the capacity of the training ship was about 150 students or people as passengers.

The capacity of the training ship based on weight cargo was considered by using benchmarks according to the existing of the training ship in Indonesia. Table 5 shows the existing of the training ship with its weight cargo capacity. By benchmarks, the capacity of the training ship design for Maritime Polytechnic of AMI Makassar is around 50 ton.

Fig. 4. The schematic implementation of the practical courses on odd and even semester in Maritime Polytechnic of AMI Makassar

Odd Semester (I and III)							Even Semester (II and IV)						
Monthly	I	II	III	IV	V	VI	I	II	III	IV	V	VI	Monthly
Semester I													Semester II
Semester III													Semester IV

Table 5. The existing of the training ship and its cargo weight capacity

No.	The name of training ship	Weight cargo capacity
1.	KL. Barombong	30 ton
2.	KL. Sultan Hasanuddin	50 ton
3.	KL. Laksamana Malahayati	50 ton
4.	KL. Laksamana J. Lee	50 ton
5.	KL. Bung Tomo	50 ton
6.	KL. Moh. Husni Tamrin	50 ton
7.	KL. Frans Kaisiepo	50 ton

C. The Main Dimension of Training Ship Design

As stated previously, the main dimensions of the training ship design were determined by using space or capacity approach and deadweight approach. Also, the type and capacity of the training ship design were determined previously as the ship design requirements. Here, the accommodation deck was firstly arranged based on space need of the training ship design in order to consider the main dimensions (length and width) and hereafter other main dimensions would be considered as well. A compartment which is needed in accommodation deck considered in the same with the existing training ship and the ship safety given by the regulation of safety of life at sea (SOLAS) [27].

- The accommodation deck length (L_{ad}) of the training ship design

  The ship length of the training ship design was primarily considered and measured from the edge of fore peak tank to the edge of after peak tank on accommodation deck, and then this is mentioned accommodation deck length (L_{ad}). The accommodation deck was placed in the second deck. In general, the spaces and compartments on accommodation deck include fore peak tank, cargo hold, accommodation room, office room, cadet messroom, cafeteria, kitchen, fresh water tank, steering gear room, after peak tank, toilet, and gang way and ladder space. The length need for spaces and compartments on accommodation deck is shown in Table 6. The sum of the length needs for spaces and compartments on accommodation deck (L_{ad}) was about 75.47 meters. The length of spaces and compartments on accommodation deck were arranged as shown in Fig. 5.

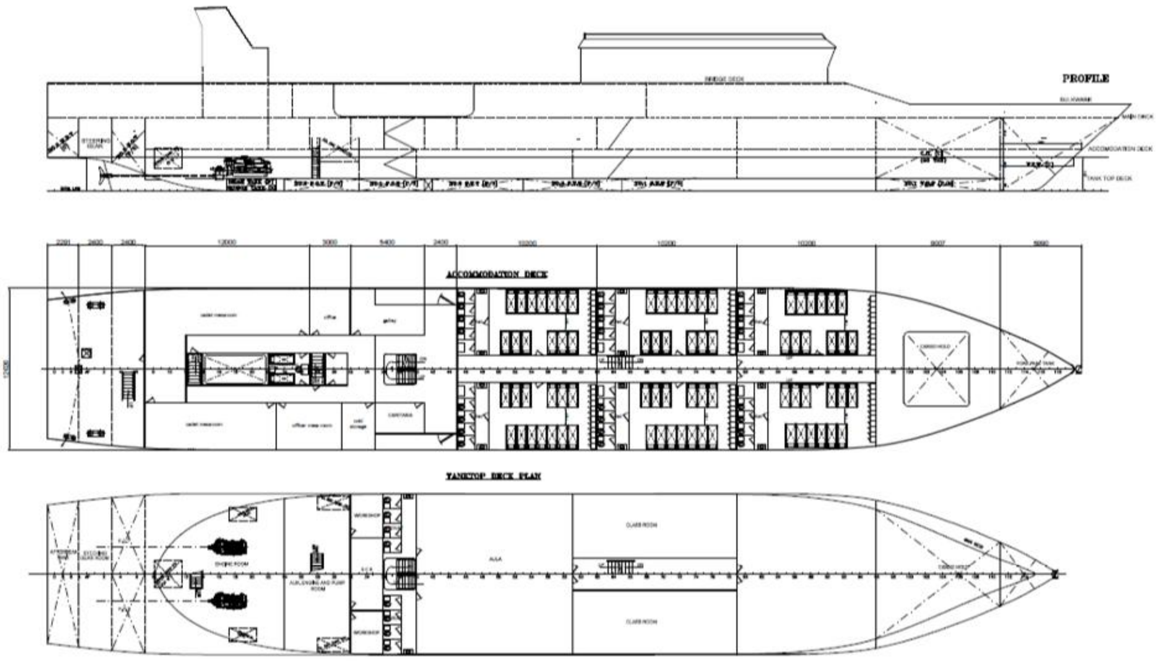

Fig. 5. The arrangement of accommodation deck by the length of space and compartment

Table 6. The length needs for spaces and compartments on accommodation deck of the training ship design

No.	Space or compartment	Length need (m)	Description
1.	Fore peak tank	5.99	Measuring from edge of FP to collision bulkhead or (0.05-0.08)Lbp
2.	Cargo hold	9.00	Cargo weight capacity 50-ton, stowage factor 3.3 m^3/ton or 165 m^3
3.	Accommodation room (include toilet and shower space)		Capacity 150 students or people
	a. Room 1st	10.20	52 students, bunk beds
	b. Room 2nd	10.20	52 students, bunk beds
	c. Room 3th	10.20	46 students, bunk beds
4.	Gang and ladder space	2.40	Access
5.	Kitchen	5.40	Cooking and storage
6.	Office room	3.00	Administrative staff
7.	Cadet mess room	12.00	Capacity 75 seats
8.	Cafeteria		Canteen
9.	Fresh water tank	2.40	Bathing, washing, cooking, etc.
10.	Steering gear room	2.40	Deck machinery
11.	After peak tank	2.28	Water ballast, from edge of APT to stern bulkhead
Total		75.47	

- The breadth (B) of the training ship design
  Similar to the determination of accommodation deck length, the width of the training ship design was determined by using space approach as well. Fig. 5 also shows the width of the spaces that were arranged. The width of the training ship design is the sum of the space's width. The capacity of second accommodation room is 52 students or 26 bunk beds. The second accommodation room was placed around the amidship. The length of the bunk bed was ordered by the width of ship and the bunk bed was four columns. Therefore, the space width of four bunk beds was needed 8.00 meters and a space among bunk bed transversely was 0.60 meters. In the 2nd accommodation deck, the gangway and ladder were also placed and they needed 2.20 meters. The space between bunk bed and shell was 30 cm. Finally, the width of the training ship design (B) was 12.00 meters.
- The Height (H) of the training ship design
  The height of the training ship design was measured from baseline to main deck where the training ship design consists of double bottom space, class room, and accommodation room vertically. The height of double bottom (Hdb) is 0.35+0.045B [28], therefore, Hdb is approximately 90 cm. The height of class room was assumed 2.20 meters and then the height of accommodation room was 2.40 meters. By the sum of the heights, the total height (H) was needed 5.50 meters.
- The draft (T) of the training ship design
  The draft of the training ship design was obtained by using the B/T ratio that is 3 to 5. Firstly, B/T was assumed 4.5 and then T was resulted approximately 2.67 meters. This would be corrected and considered hereafter the ship displacement (Δ) correction. After corection, the draft of ship was changed and then resulted 2.53 meters.
- The Lwl and Lbp of the training ship design
  The length of water line (Lwl) and length between perpendiculars (Lbp) of the training ship design were 75.03 meters and 72.15 meters respectively. These dimensions were considered under Lad position and the bow stem type was raked bow that the acute angle is less than 45 degree [29]. By the dimensions, the angle bow was calculated and it resulted 44.34 degree. After displacement correction, the Lwl and Lbp were revised and then resulted 74.88 m and 72.00 respectively.
- The weight estimation of the training ship design
  The weights of the training ship design were estimated and they consist of the component of light weight ton (LWT) and deadweight ton (DWT) [30]. Table 7 shows the weight of LWT and DWT. Then, the weights of LWT and DWT were totally 1444.59 ton.
- The gross tonnage and ship powering of the training ship design
  The gross tonnage of the training ship was obtained by using statistical analysis of the existing ship training. The number of the existing data was 89 passenger-cargo ships and they were group into four based on gross tonnage and ship power. The relation between nondimensional parameter of ship volume given by Lwl, B, and H (cube root of ship volume or $(LBH)^{1/3}$) and gross tonnage is shown in Fig. 6. Based on the relation, the gross tonnage of the training ship was 1587 GT. Therefore, the gross tonnage of the training ship design is more than 500 GT where the minimum requirement of STCW is 500 GT.

Table 7. The weight of LWT and DWT of the training ship design

LWT component	Weight (ton)
1. Hull steel (Wst)	504
2. Outfitting (Woa)	345.06
3. Engine and installation (Weng)	89.25
DWT component	
Supply and consumable	
1. Fuel oil	74.45
2. Lubrication oil	0.26
3. Fresh water	338.56
4. Crew	1.58
5. Provision	7.56
6. Diesel oil	14.89
Payload	
1. Cargo	50
2. Passenger including luggage	18.4
Total	**1444.59**

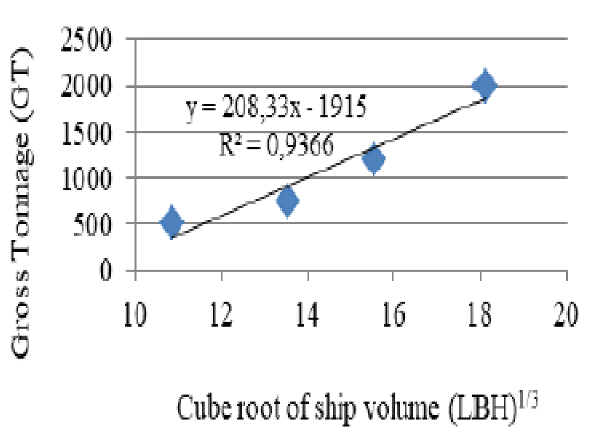

Fig. 6. The relation between nondimensional parameter of ship volume and gross tonnage

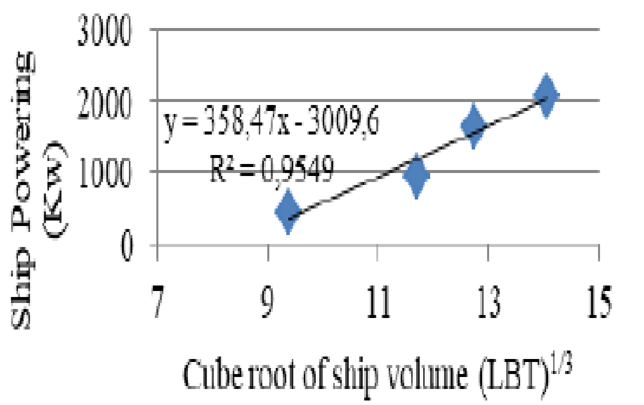

Fig. 7. The relation between nondimensional parameter of ship *volume and ship pwering*

Table 8. The weight of LWT and DWT of the training ship design

No.	Parameter	Designed ship	Correction value
1.	L/B	6.24	6 to 8
2.	L/H	13.60	10 to 15
3.	B/T	4.74	3 to 5
	Fb/B		≥0.10
4.	Dwt/Displacement	0.35	0.35 to 0.40
5.	Block coefficient (cb)	0.62	0.58 to 0.62
6.	Midship coefficient (cm)	0.95	0.90 to 0.95
7.	Prismatic coefficient (cp)	0.65	0.60 to 0.67
8.	Ship displacement (L*B*T*cb*γ*C) vs (DWT+LWT)	0.008	≤0.05
9.	Metacentric height (GM)	0.68 (m)	MG>0.15
10.	Rolling period (T_r)	11.05 sec.	10 – 14.5 sec.

Similarly, the powering of the training ship was obtained by using statistical analysis as well. The relation between nondimensional parameter of ship volume given by Lwl, B, and T (cube root of ship volume or $(LBT)^{1/3}$) and ship powering is shown in Fig. 7. Then, the powering of the ship design was 1643 Kw and it is higher than the minimum requirement of STCW 750 Kw.

- The parameter correction of the training ship design

The main dimensions of the training ship design that were obtained are corrected by the parameters of main dimension ratio, geometric form coefficient, weight, and initial static stability. Table 8 shows the parameter corrections of the training ship design. These seem that overall parameters are acceptable.

IV. CONCLUSION

The framework of basic ship design for education and training of the maritime vocational education was modeled simply and systematically. The model is especially applied to maritime vocational education because it considers ship type, student number and cargo capacity that are derived from curriculum and practice courses of maritime vocational education, SCTW competences requirements as several mission requirement of basic ship design. The modeling framework was then applied to the need of training ship for Maritime Polytechnic of AMI Makassar as a case study. The modeling framework was divided into three parts namely the model of training ship type selection, the capacity of the training ship, and the main dimensions of the training ship design. The selection model of ship type and ship capacity formulated training ship requirements and then those were analyzed continuously to obtain training ship dimensions. The application of the modelling framework results as follows:

a. The model of training ship type selection had been made based on AHP method where the elements hierarchically was ordered according to level of importance i.e. criteria, sub-criteria, and sub sub-criteria. The elements were formulated by using some references that the criteria were payload, port, shipyard, and shipping route. The sub-criteria and sub sub-criteria were payload type, cargo packaging, port ship service, cargo service, types of port, shipyard production capacity, shipyard production facility, raw materials, human resources, demand, zone, passenger, cargo, wheeled cargo, sack, drum, pallet, quay, port berth, basin, tracking, loading-unloading facility, warehousing, terminal, general port, and particular port respectively.
b. The overall weights of the alternatives were the passenger ship type 31.20%, the passenger-cargo ship type 37.20%, and the cargo ship type 31.60%. The passenger cargo ship was decided as the training ship type for Maritime Polytechnic of AMI Makassar.
c. The capacity of the training ship was about 150 students or people as passengers and then the cargo capacity cargo was considered 50 ton based on benchmarks to the existing training ship in Indonesia.
d. The main dimensions were obtained and analyzed firstly by the space need on accommodation deck. Therefore, the length of accommodation deck (Lad) was about 75.47 m, Lbp 72.00 m, Lwl 74.88 m. Hereafter, the other dimensions breadth (B), height (H), and draft (T) were 12.00 meters, 5.50 meters, and 2.53 meters respectively.

The main dimensions of the training ship design were corrected by the parameters of main dimension ratio, geometric form coefficient, weight, and initial static stability. The overall parameters are acceptable.

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AUTHORS PROFILE

Rusnaedi Rusi is a lecturer at Maritime Polytechnic of AMI Makassar, Indonesia. His master degree was obtained in Naval Architecture Department, Engineering Faculty, Hasanuddin University. His research includes ship design, ship management, and ship transportation.

Suandar Baso is an Associate Proffessor at Naval Architecture Department, Faculty of Engineering, Hasanuddin University. He graduated in 2012 and obtained Doctor of Engineering (Dr.Eng) in Fluid Dynamics for Transportation and Environmental Systems, Hiroshima University. His research interests are ship seakeeping, ship hydrodynamic, ship desig, ship CFD.

Syamsul Asri is an Associate Professor at Naval Architecture Department, Engineering Faculty, Hasanuddin University. He graduated in 2018 and obtained Doctor degree in Civil Department, Engineering Faculty, Hasanuddin University. His researches include ship design, ship stability, and ferry transportation system.