Measurement of dimensions and calculation of Danish seine fishing vessel volume

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Abstract. Mark down is a Gross Tonnage (GT) written in a document that does not correspond to the actual physical condition of a ship. Mark down caused many losses both from the ship owner and the government. So that, the General Directorate of Sea Transportation issued regulation No. UM.003/47/16/DJPL.15 concerning re-verification of fishing vessels, to cope with the practice of mark down. The purpose of this study was to identify the suitability of ship GT data on documents by re-measuring physical checks of ships, calculate and compare ship GT with General Directorate of Sea Transportation (Perla) and Nomura formulas, calculate ship GT based on *LOA* and compare with the results of re-measurements. Data analysis used the GT ship suitability analysis and the GT ship measurement analysis. The results showed that, there were 15 Danish seine vessels measuring >30 GT which were evidenced in the initial documents not in accordance with the actual physical (mark down). The dimension ratio of Danish seine vessels to overall length (LOA) has a dimension ratio of length (L_{deck}) of 0.88, breadth (B) of 0.36, depth (D) of 0.15, as well as dimension ratio of ships of superstructure volume (Va) to volumes bottom deck (Vb) of 0.06. The results of the GT calculation based on the Perla and Nomura formulas on Danish seine ships have a GT difference based on L_{deck} with the equation $y=0.1845e^{0.22223x}$. The GT calculation based on *LOA* compared to the measurement of the harbourmaster has a GT difference with the equation $y=1.5871e^{0.1018x}$.

Key Words: gross tonnage (GT), overall length (LOA), mark down, Brondong fishing port, re-measurement.

Introduction. Initially the measurement and calculation of the dimensions of fishing vessels in each country is different. This causing problem for ships that have cross-country shipping routes. Based on these problems, in 1927 an agreement was made on the measurement of ships in Oslo, Norway, while the agreement was to enact a way to measure MOORSOM, this rule also applies to Indonesia, so the Ship Measurement Ordinance (Sceepmentie Ordonantie) 1927 was issued.

Because of the importance of an internationally accepted system, a conference was held on 27 May to 23 June 1969 in London, to formulate a convention on measurement which is internationally applicable. At the conference three recommendations were formulated, namely: 1) endorsement of the 1969 International Convention on Tonnage Measurement of Ship; 2) the use of gross contents (Gross Tonnage -GT) and net contents (Net Tonnage) as measurement parameters; and 3) there is a uniform interpretation of definitions and terms.

The Indonesian government then followed the results of the convention and stated in Presidential Decree No. 5/1990 concerning the International Convention on Tonnage Measurement of Ship. Then we are familiar with the term TMS 1969 for ship measurement.

The importance of measuring and calculating the volume of fishing vessels is to be able to know with certainty the capacity of the ship itself related to fish production and production data. This will be useful for estimating fish stocks, of course, for the sustainability of the fishing activity itself, in addition to the need for valid statistical data.

For the time being, perhaps what is more thought is related to non-tax state revenue through fisheries business licensing which is still based on the size of the GT.

The purpose of the present study was to determine how to measure dimensions and calculate the volume of ships that can be accepted by both the ship owner and other relevant agencies related to fishing vessels.

Material and Method

Ship GT compliance analysis. According to Mohammed & Bungin (2015), real conditions on the ground often make a difference. The ship GT conformity analysis in the present study is used to see the difference or gap between the GT of the recalculated results of the physical check of the ship and the GT listed on the document, so that from this it can be seen whether or not the GT data is listed by recalculation.

Measurement analysis of ships GT. Ship GT measurement analysis in this research was used to get the GT results from 2 measurement methods using the Nomura formula and Perla formula. Table 1 show the Nomura and Perla formulas. The measurement pattern of ship can be seen in Figures 1 and 2.

Table 1

Nomura and Perla formulas

Parameter	*Method of measurement*	
	Nomura (International)	*Perla (Indonesia)*
Formula	GT = K x V GT = K x (Vb + Va) GT = K x (L_{deck} x B x D x f) + (L x B x D)	GT = K x V GT = K x (Vb + Va) GT = K x (L_{deck} x B x D x f) + (L x B x D)
Constant	K = 0.353	K = 0.25
Coefficient block (Cb)	f = 0.5 to 0.8	f = 0.7

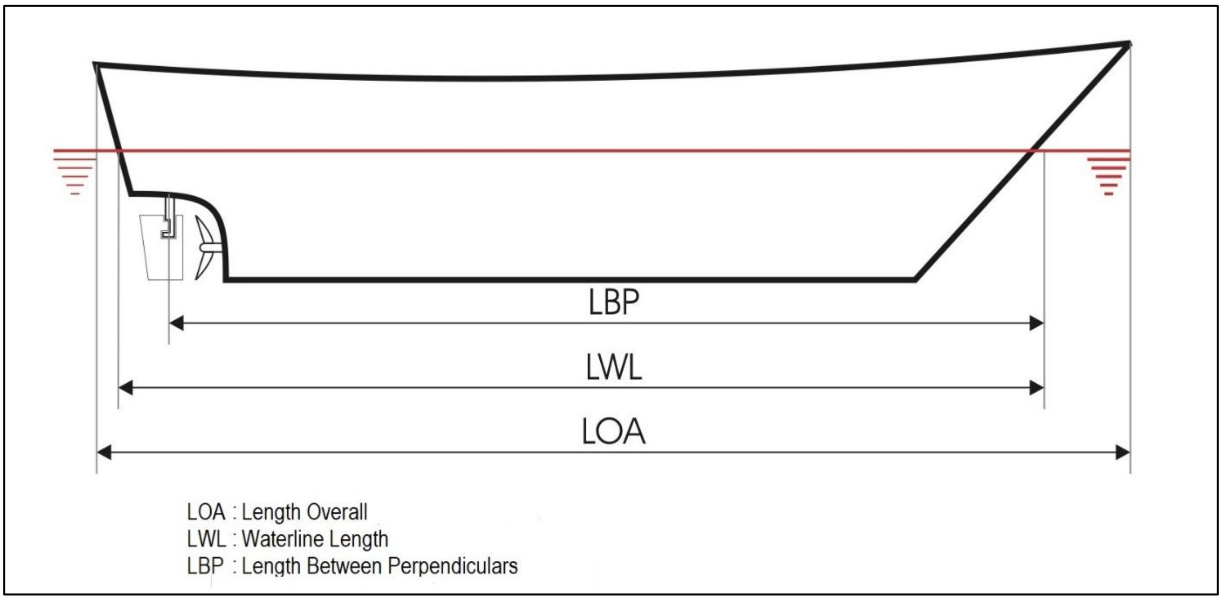

Figure 1. Ship length measurement pattern.

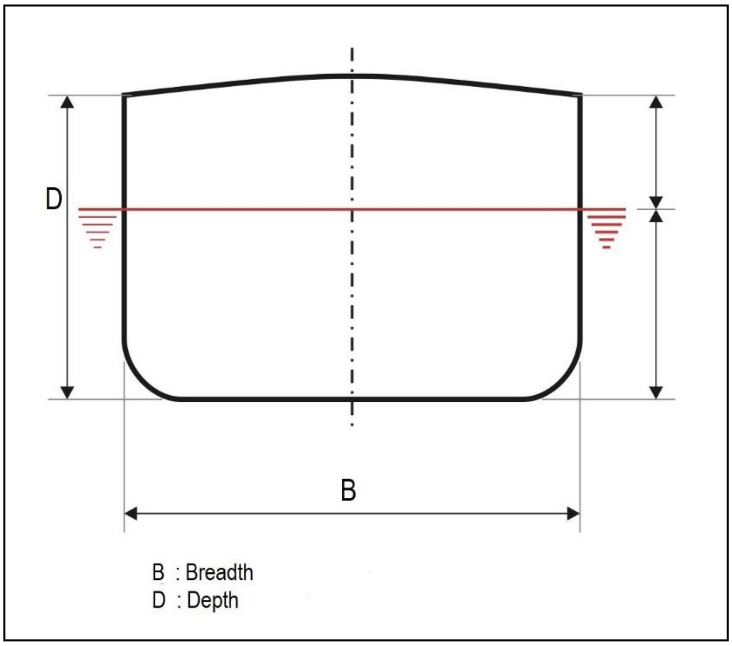

Figure 2. Ship depth and breadth measurement pattern.

In addition, measurements on cantrang vessel dimensions at the Brondong Fishing Port were carried out to obtain the ratio of vessel dimensions to facilitate the calculation of vessel GT. The ship dimensions ratio was obtained by using an alternative model equation calculation of GT ships according to Soeboer (2012), then the results of the ship dimensions ratio were multiplied by the LOA portion of the ship to find out the GT of the ship. The following alternative models for calculating GT based on LOA (Soeboer 2012) are equations developed from the Perla and Nomura formulas whose GT calculations are not based on LOA:

$$\frac{L1}{LOA1} + \frac{L2}{LOA2} + \cdots + \frac{Ln}{LOAn} = \frac{(\sum_n \frac{Ln}{LOAn})}{n}$$

$$\frac{B1}{LOA1} + \frac{B2}{LOA2} + \cdots + \frac{Bn}{LOAn} = \frac{(\sum_n \frac{Bn}{LOAn})}{n}$$

$$\frac{D1}{LOA1} + \frac{D2}{LOA2} + \cdots + \frac{Dn}{LOAn} = \frac{(\sum_n \frac{Dn}{LOAn})}{n}$$

Calculation of the average bottom deck volume (*Vb*) becomes:

$$Vb = LxBxDxf$$

$$Vb1 + Vb2 + \cdots Vbn = \frac{\sum_n Vbn}{n}$$

Calculation of upper deck volume *Va* (superstructure):

$$Va = p\ x\ l\ x\ t$$

$$Va1 + Va2 + \cdots Van = \frac{\sum_n Van}{n}$$

The ratio of *Va* to *Vb* becomes:

$$\frac{Va}{Vb} = \frac{(5)}{(4)}$$

Where:

LOA : Overall Length
L : Length
B : Breadth
D : Depth
Va : Upper Deck Volume

Vb : Bottom Deck Volume
n : Total Ship
f : Coefficient Block

Results and Discussion

Gross Tonnage (GT) Danish seine ship. Danish seine vessels in the Brondong Fishing Port comprises 695 ships with various GT sizes. The main dimension of the ship is an element to find out the GT of the ship. According to Irawan (2015), the dimensions of the ship affect the diversity of the volume of the ship or can be called GT. The size of GT of danish seine vessels can be divided into two groups according to data obtained from the Brondong Fishing Port: (1) 7-29 GT and (2): 30-100 GT. The division of the Danish seine ships concerning GT sizes can be seen in Table 2.

Table 2

Danish seine ships according to the GT

No	*GT Size*	*Number*	*Percentage*
1	7-29	352	50.6%
2	31-100	343	49.4%
	Total	695	100%

Table 2 shows the number of Danish seine vessels based on GT. Danish seine vessels with sizes from 7 to 29 GT dominate the overall Danish seine vessels located at the Brondong Fishing Port. The number of Danish seine vessels with sizes from 7 to 29 GT amounted to 352 ships with a percentage of 50.6%. Danish seine vessels with sizes from 31 to 100 GT total 343 ships with a percentage of 49.4%.

GT of the Danish seine ship is influenced by the main dimensions of the ship. Each GT group of ships has different L_{deck}, B, and D sizes. Danish seine ships with sizes from 7 to 29 GT have an average L_{deck}, B, and D of 13.04 m, 5.67 m and 2.04 m respectively. Danish seine ships with sizes from 30 to 100 GT have an average L_{deck}, B, and D of 15.43 m, 6.50 m and 2.51 m respectively. This proves that the larger the dimensions of the ship, the greater the size of the GT of each ship. The average specification of the size of ships concerning GT of Danish seine vessels is presented in Figure 3.

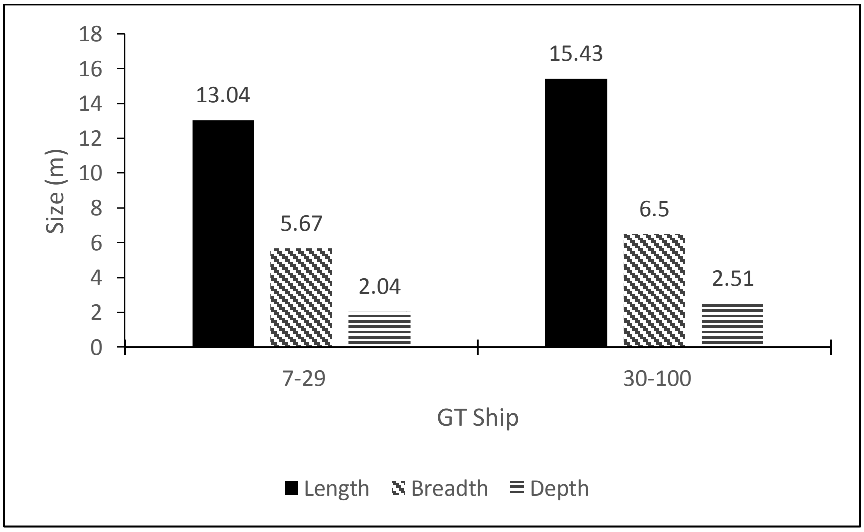

Figure 3. The average size of Danish seine vessel dimensions.

Danish seine vessels which are domiciled in the Brondong Fishing Port are generally made from wood. Wood-based shipbuilding has become a hereditary tradition that has many advantages. The advantages of shipbuilding with wood, namely the availability of wood in Indonesia is quite a lot and the price is economical and affordable (Kusumanti 2009).

Compliance concerning GT of Danish seine ship. Circular No. UM.003/47/16/DJPL.15 concerning re-verification of fishing vessels was officially issued by the Directorate General of Sea Transportation in 2015. This makes fishing vessel owners obliged to re-measure their vessels, as well as what happened at the Brondong Fishing Port. Ship owners at the Brondong Fishing Port are required to verify or re-measure their vessels. There are a total of 972 fishing vessels in the Brondong Fishing Port in 2018, which until 2019 have not all been verified.

Danish seine vessels in the Brondong Fishing Port in 2018 recorded 695 vessels. There were only 71 ships that had been re-measured by the harbourmaster and 15 ships were re-measured directly at the time of the study. The GT measurement results are displayed in Table 3.

Table 3

GT original document and re-measurement document

No	*Ship name*	*Ship GT*	
		Original document	*Re-measrument document*
1	Andi Jaya - 1	30	27
2	Andi Jaya - 2	30	27
3	Anugrah - 3	28	27
4	Asba	26	21
5	Binaria	29	28
6	Bintang Mustika	28	96
7	Brawijaya - 1	30	40
8	Bunga Mekar	29	42
9	Bunga Mekar - 2	29	46
10	Cahaya Bahari	30	40
11	Citra Buana	30	54
12	Insyaallah	30	54
13	Jati Kembar	30	47
14	Karya Jaya	30	55
15	Karya Mandiri 1	22	40

Based on Table 3, the ship that has been re-measured by harbourmaster produced the GT size of the ship which did not match the GT in the original document. This can be interpreted that 5 ships measuring <30 GT experienced mark up while 10 vessels measuring >30 GT experienced mark down practices.

The size of the GT that is incompatible with the previous document is caused by several aspects. Inappropriate size can occur due to additional dimensions such as length, breadth and depth of the ship. Inappropriate GT also occurs due to the addition of enclosed spaces above the deck whose volume exceeds 1 m^3 which was not previously listed on the original document (Nugraha 2018). In addition, measurement errors can also cause different GT results. Errors when measuring one of the causes such as wind that can interfere with the roll meter upright when stretched. In addition, there are waves that can change the position and balance of the ship, so that disturbing the balance of the gauge at the time of measurement of the ship leaning on the port can cause results that are not in accordance with the actual physical fact. Therefore for the ship to be re-measured it is recommended to be on land when the weather conditions are calm, in order to minimize errors that occur at the time of measurement. However, some of these aspects will not produce changes to the GT in the original document with the GT re-measurement if there is no significant difference, as is the case with some ships that have GT differences up to 30 to 40 GT (Nugraha 2018). The difference in GT is very significant due to fraud in manipulation of ship size data conducted by ship owners with harbourmaster or measuring experts who carry out measurements where the results of the ship GT are listed in the original document which is proven to be marked down. This is proven because according to the Minister of Transportation Regulation No. 8 of 2013 concerning Measurement of ships, only ship measurement experts or Government

Officials within the Directorate General of Sea Transportation has the authority to carry out vessel measurements.

Danish seine vessels that mark down are dominated by vessels that previously had GT on documents no more than 30 GT. The mark down is done so that ships can be easier in managing permits, they do not have to do a permit to the center as stated in the Regulation of the Ministry of Marine Affairs and Fisheries Number 27 of 2009. This is also done by fisheries businesses to save costs in obtaining ship permit because it is in accordance with the Regulations of Ministry of Marine Affairs and Fisheries Number 5 of 2008 (Arthatiani 2014). According to Firdaus et al (2017), the causes of mark downs carried out by business actors include the ease of licensing (central licensing should be regional) and avoiding taxes. In addition, the mark down was also carried out in order to minimize levies imposed by the Government on fishery entrepreneurs. According to Government Regulation Number 75 of 2015 concerning Types and Rates of Non-Tax State Revenues Applicable to the Ministry of Marine Affairs and Fisheries, the amount of fishery business levies is determined based on the formulation of tariffs per GT multiplied by the size of vessels GT according to the type of fishing gear on the Danish seine vessels of 19.66 USD GT^{-1}. Therefore, verification or re-measurement is very important to be implemented by the Government in order to overcome the mark down which is very detrimental.

Measurement and calculation of Danish seine ship dimensions. Since 2002, through the Decree of the Director General of Sea Transportation Number: PY.67/1/16-02 concerning changes to the Decree of the Director General of Sea Transportation Number: PY.67/1/13-90 regarding the implementation of the Decree of the Minister of Transportation Number 41 of 1990 concerning the Measurement of Indonesian Vessels, the Directorate General of Sea Transportation officially changed the formulation of the calculation of ships GT on the coefficient or the conversion of ships GT from 0.353 to 0.25. The Directorate General of Sea Transportation changed the coefficient in order that the method of domestic measurement was in accordance with the provisions of TMS 1969 and there were also demands from stakeholders that the coefficient of 0.353 be changed because it was too high (Nanda 2004). These changes will certainly cause different GT results in domestic measurements using the Perla formula when compared to international measurements that have a GT conversion of 0.353 in accordance with the provisions of the coefficient value applied by the Nomura formula. Table 4 show the results along with the GT difference of 15 Danish seine vessels measured at the time of the study and the graph to be displayed in Figure 4.

Table 4

GT comparison of Perla and Nomura

No	*LOA*	L_{deck}	*GT measurement results*		*Difference*
			Perla formula	*Nomura formula*	
1	13.82	12.10	27.77	30.81	3.04
2	14.87	13.10	27.05	30.01	2.96
3	14.64	13.00	27.71	30.74	3.03
4	13.53	11.80	21.37	23.71	2.34
5	15.04	13.40	28.14	31.22	3.08
6	20.71	18.60	100.54	112.81	12.27
7	18.97	16.80	43.10	48.59	5.48
8	17.38	15.30	45.92	51.88	5.96
9	18.66	16.50	50.38	56.94	6.56
10	17.98	15.80	43.33	48.83	5.50
11	19.66	17.60	57.63	64.83	7.20
12	19.37	17.20	57.43	64.52	7.09
13	18.15	16.00	49.93	56.18	6.25
14	17.85	15.70	58.53	65.77	7.24
15	16.42	14.30	43.22	48.79	5.57

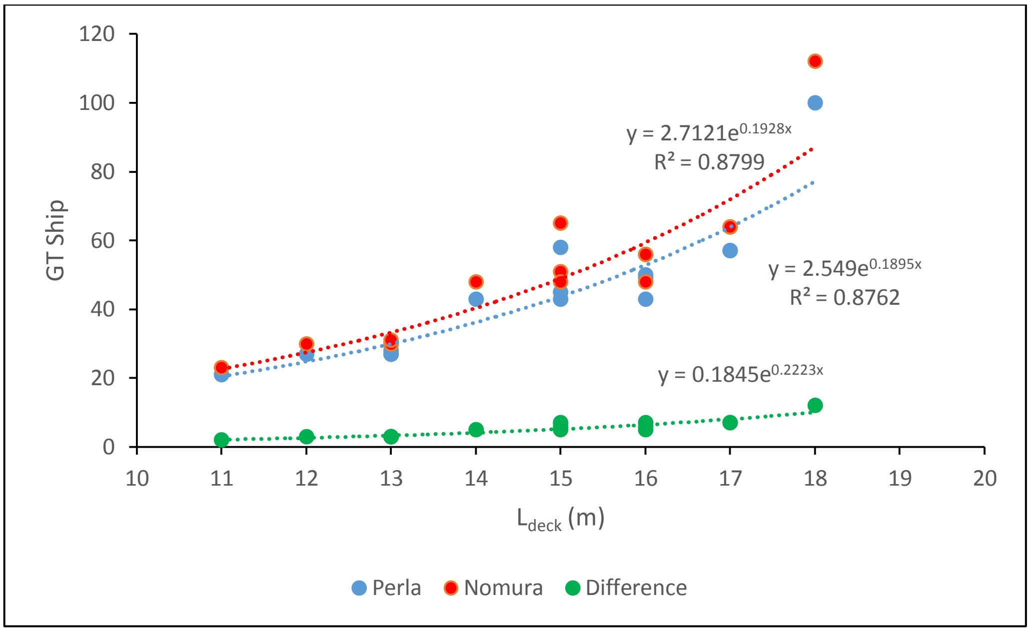

Figure 4. Comparison of Perla and Nomura GT.

Figure 4 shows an exponential graph. The graph on both the Perla and Nomura GT results shows the value of R^2 or determination value of 0.8762 and 0.8799. The R^2 value in the Perla formula shows the change in ship GT is influenced by L_{deck} vessels 87.62%, while 12.38% GT vessels are influenced by factors other than L_{deck}. The value of R^2 in the Nomura formula shows that the change in the GT of the ship is influenced by L_{deck} 87.99%, while 12.01% of the GT of the ship is influenced by factors other than L_{deck}. Other factors that influence the ship's other dimensions besides L_{deck} such as B, D, Va and Vb. The R^2 results are then square rooted and the correlation coefficient results obtained in the Perla and Nomura formulas are 0.9361 and 0.9380. The results of these values indicate the closeness of the correlation between GT ships with L_{deck} included in the category of a very strong correlation relationship. These categories can be seen in Table 5.

Table 5

Correlation coefficient relationship (Sugiyono 2010)

Correlation coefficient value	*Information*
0.00 – 0.199	Very low
0.20 – 0.399	Low
0.40 – 0.599	Enough
0.60 – 0.799	Strong
0.80 – 1.000	Very strong

Figure 4 shows the difference of each ship GT with the equation $y=0.1845e^{0.22223x}$. The equation shows that the greater L_{deck} will make the gap between the results of GT using these two formulas will be increasingly distant. The difference between the two GTs is due to the different GT multiplications especially in the GT conversion. This will be detrimental to the state and fisheries if the GT Perla is compared with the Nomura measurement results. Losses to the amount of GT experienced by the state in the form of non-tax state revenues that will not be in accordance with the conditions in the field as stated in Government Regulation No. 75/2015 concerning types and rates of types of non-tax state revenues that apply to the Ministry of Marine Affairs and Fisheries. Another case with losses experienced by fisheries or ship owners. The loss they experienced was in the form of assistance from the government. The government will provide assistance in accordance with the GT size of the ship, in other words the greater the GT, the greater the assistance received. In addition, losses will also be experienced when ship owners apply for insurance and make loans with the ship as collateral. The ship owner will get insurance and loans in accordance with the GT of the ship listed on the document. However, to date these two things have not been felt because there is still a lack of information and systems regarding insurance for ships and also borrowing with collateral ships even though ships are one of the collateral items in Bank Regulation Number 9/6/PBI/2007 recognized by the Bank Indonesia as collateral.

The re-measurement data on 10 cantrang vessels by harbourmaster were processed using the alternative model equation calculation of GT ships based on length overall (LOA) (Soeboer formula). The equation is an equation developed from the Perla and Nomura formulas. Based on the data obtained, the ship dimension ratio between L_{deck} and LOA is 0.88. The ratio of ship dimensions between B and LOA is 0.36. The ratio of ship dimensions between D to LOA is 0.15. After that, it is also obtained the calculation result of the dimension ratio of the vessel Va to Vb of 0.06. The results of these calculations are shown in Table 6.

The GT calculation in Table 6 is the results of different GT vessels. Different GTs are generated in GT based on LOA with GT re-measurement in which the GT results are both converted to 0.25 according to the formula (Perla). In addition, different GTs are also obtained for GT based on LOA with re-measurement GT whose GT results are both converted to 0.353 according to the provisions of the international formula (Nomura). These results can be seen in Table 7.

Based on Table 7, the deviation or GT difference obtained shows the GT results based on LOA adjacent to the GT results by means of the Perla calculation, but for Nomura calculations have a large gap. In addition there are also different GTs between repeated measurements using the Perla formula, GT calculation results based on LOA length, and GT document results. Gap or difference of the three GT results can be seen in Figure 5.

Based on Figure 5, we can see three exponential graphs from the three GT calculations. The resulting R^2 on the three graphs shows different results. R^2 on the GT results graph that uses the Soeboer formula, the results of re-measurements, and documents have R^2 of, 0.935, 0.5862, and 0.207 respectively. The R^2 results show that the ship GT affected by LOA on the GT results uses the Soeboer formula of 93.50%, the GT results on the re-measurements use the Perla formula of 58.62%, and the GT results listed on the document are 20.70%. GT results that use the formula and the results of repeated measurements have a correlation coefficient of 0.9669 and 0.7656. The results of these values indicate the closeness of the correlation between GT ships with LOA included in the category of a very strong and strong correlation relationship (Table 5). As with the GT listed in the document has a correlation coefficient of 0.4549. This value shows the closeness of the correlation between GT ships with LOA included in the sufficient category (Table 5). The results of GT calculation are based on LOA with the results of repeated measurements using the graph Perla formula or the results are close together. This shows the results that have a slight difference. Whereas GT document results on the graph look very different from the other two GT calculation results. This shows that the GT listed in the document shows non-adequate GT data. Unlike the case with GT generated by repeated measurements and GT uses the ratio of ship dimensions to LOA.

The ship dimension ratio results was obtained from measurements using the Soeboer formula which has a L_{deck} vessel dimension ratio of 0.88, B of 0.36, and D of 0.15 (Table 6). And the Va dimension of the ship is 0.06. The results were tested with ships that have been re-measured by the local harbourmaster, by way of this ratio multiplied by the LOA portion of the ship to determine the GT of the ship. There are 5 ships in this study that have been measured only in the LOA section of the ship. The results of the GT can be seen in Table 8.

Table 6

GT calculation based on LOA

LOA	*Ratio*			*Vol. Coefficient Block*	*Ratio Vol. Superstructure*	*Gross tonnage*			
						GT conversion			
						Indonesia (Perla)		*International (Nomura)*	
	L	*B*	*D*	*m^3*	*m^3*	*Ratio*	*Re-Measurement*	*Ratio*	*Re-Measurement*
	0.88	*0.36*	*0.15*	*0.70*	*0.06*	*0.25*		*0.353*	
20.71	18.31	7.41	3.01	285.94	16.22	75.54	100.54	106.66	112.81
18.97	16.77	6.78	2.76	219.76	12.47	58.06	43.10	81.97	48.59
17.38	15.37	6.22	2.53	169.00	9.59	44.65	45.92	63.04	51.88
18.66	16.50	6.67	2.71	209.16	11.87	55.26	50.38	78.02	56.94
17.98	15.90	6.43	2.61	187.12	10.61	49.43	43.33	69.80	48.83
19.66	17.38	7.03	2.86	244.62	13.88	64.62	57.63	91.25	64.83
19.37	17.13	6.93	2.82	233.95	13.27	61.81	57.43	87.27	64.52
18.15	16.05	6.49	2.64	192.47	10.92	50.85	49.93	71.80	56.18
17.85	15.78	6.38	2.60	183.09	10.39	48.37	58.53	68.30	65.77
16.42	14.52	5.87	2.39	142.51	8.08	37.65	43.22	53.16	48.79

Table 7

GT deviation aboard the Soeboer, Perla and Nomura formula

Ship gross tonnage (GT)		*Average GT result*	*Difference*		
			Lowest	*Highest*	*Average*
Conversion (0.25)	GT LOA Result	54.62	0.92	25.00	8.02
	Perla	55.00			
Conversion (0.353)	GT LOA Result	77.13	2.53	33.38	16.44
	Nomura	61.91			

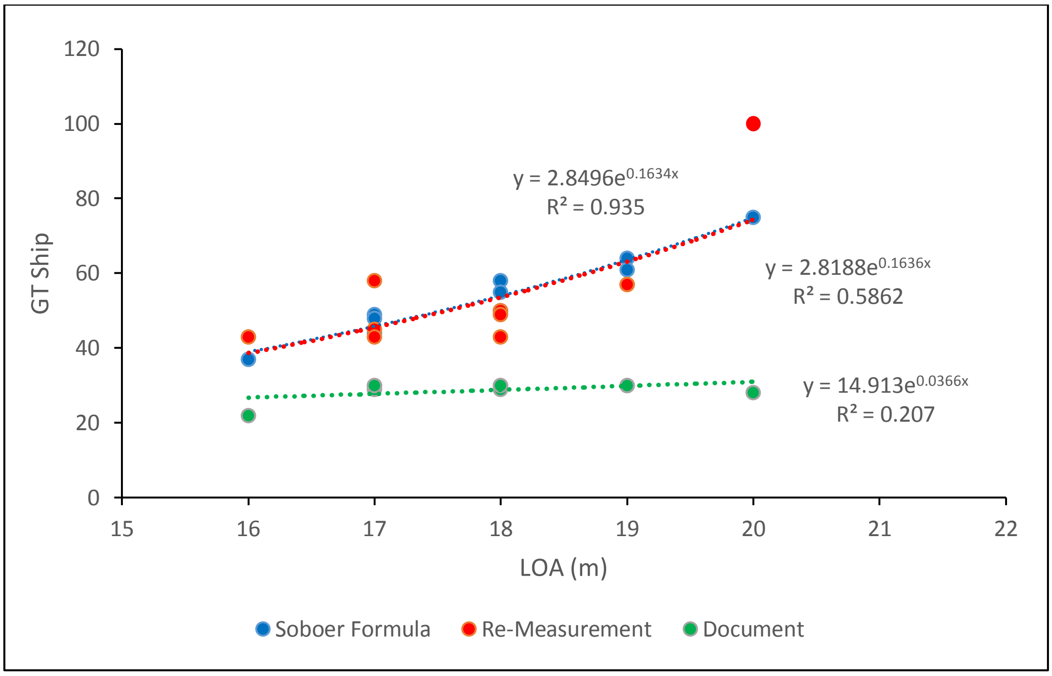

Figure 5. Comparison between GT using the Soeboer formula, re-measurement results and GT documents.

Table 8

GT comparison of original documents, re-measurements and ship dimension ratio (Soeboer formula)

LOA	*GT result*		
	Original document	*Re-measurement*	*Ship dimension ratio*
16.13	27	30	36
21.84	28	80	91
17.41	28	38	46
21.96	28	80	93
18.39	30	35	54

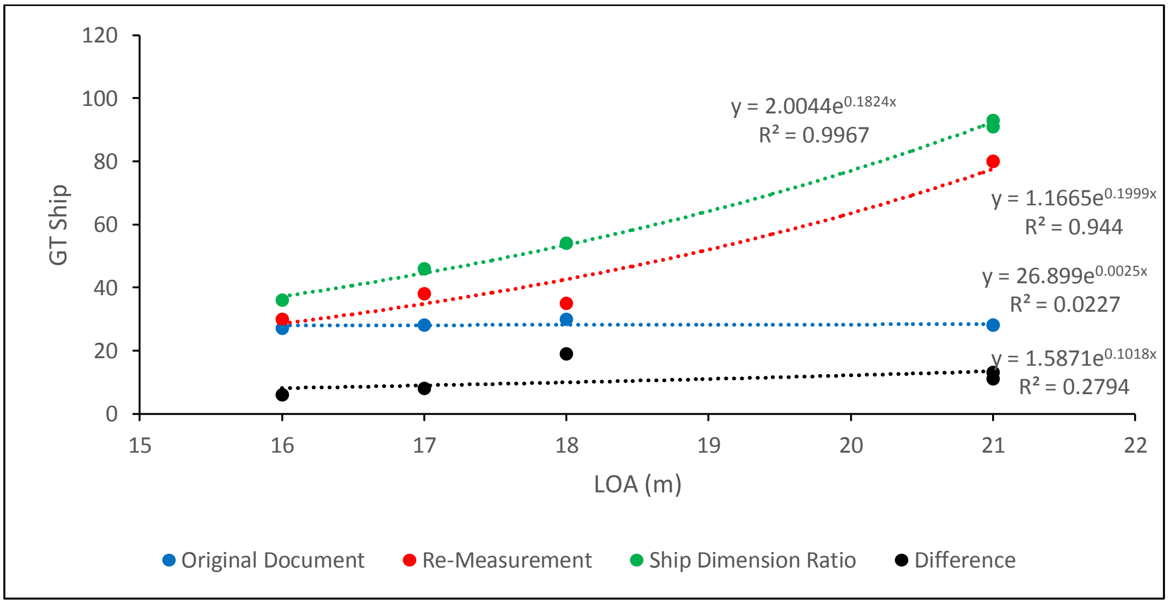

Figure 6. GT comparison of original documents, re-measurements and ship dimension ratio (Soeboer formula).

The final results of the GT calculation in Table 8, do not appear to use decimals because if there are decimals on the GT results of the ship, the GT results will always be rounded down (round down). This is contrary to the way of writing net tonnage or Net Tonnage (NT) which if there is a decimal in the NT calculation results, then the NT results will always be rounded up (round up). Such matter as stated in the Minister of Transportation Regulation No. 8 of 2013 concerning Measurement of Vessels containing GT and NT vessels which are listed in the measurement list and measuring letters is the result of rounding off by ignoring the numbers behind the comma.

Based on Figure 6, R^2 generated on the three graphs shows different results. R^2 on GT results using ship dimension ratio, re-measurement documents, and initial documents have R^2 0.9967, 0.944, and 0.0227 respectively. The R^2 results show that the GT of the ship affected by LOA on the GT results uses the formula of the ship dimension ratio of 99.67%, the GT results of the re-measurement documents use the Perla formula of 94.40%, and the GT results contained in the initial documents are 2.27%. The results of GT using ship dimension ratios and re-measurement documents have a correlation coefficient of 0.9983 and 0.9715 respectively. The results of these values indicate the closeness of the correlation between GT ships with LOA included in the category of very strong correlation (Table 5). As with the GT listed in the initial document has a correlation coefficient of 0.1506. This value shows the closeness of the correlation between GT ships with LOA included in the very low category (Table 5). GT graph between the results of the re-measurement document and the results of GT using the multiplication ratio of the ship's dimensions having an adjacent graph. That is because the GT difference between the two results is not high with the difference expressed in equation $y=1.5871e^{0.1018x}$. As with the GT graph obtained from the initial document before repeated measurements. In Figure 6, the graph looks very far apart from the two GT results, both the re-measurement documents and the GT results using the ship's dimension ratio. The difference can be seen in Table 9.

Table 9

Difference between original GT document, re-measurement document, and GT using ship dimension ratio (Soeboer formula)

GT Ship	*GT difference*		
	Lowest	*Highest*	*Average*
Original document with re-measurement	3	52	24.40
Original document with ship dimension ratio	9	65	35.80
Re-measurement with ship dimension ratio	6	19	11.40

Based on Table 9, of the three GT results compared only the GT results on the re-measurement documents were compared with the GT results using the dimension ratio of ships that have a GT difference not too high compared to the other two comparisons. These results can be interpreted that the calculation of GT based on the length overall of the LOA using the ship dimension ratio (Soeboer formula) is a formula that can be applied in calculating GT and can be a solution for the government in re-measuring fishing vessels in Indonesia. GT calculation using the Soeboer formula can save time and energy because if a ship's dimension ratio has been obtained from a sample of ships in the location, then only by measuring the ship's LOA will the GT ship be obtained without having to measure other ship dimensions. However, the results of the dimension ratio of LOA ships to L, B, and D, as well as Va to Vb in the present study, cannot be applied elsewhere or in other fishing vessels. That is because fishing vessels in each region as well as in each type of fishing gear used in general has different specifications. According to Soeboer (2012), each region has different ship specifications. The design and construction of ships are made differently by taking into account the technical requirements for the operation of each type of ship based on the fishing gear operated (Farhum 2010). Therefore if you want to use the Soeboer formula equation you are required to take a sample first from the population of ships that are in the location in order to get the dimension ratio of the ship to be multiplied by the LOA of other ships to find out the actual GT size of the ship.

Conclusions. From a total of 20 Danish seine vessels, 15 vessels >30 GT that have been re-measured are proven to be GT vessels which in the original document was not in accordance with the actual physical state (mark down), 5 Danish seine vessels <30 GT indicated mark up. The results of the GT calculation was based on the Perla and Nomura formulas on Danish seine vessels having a GT difference based on L_{deck} with the equation $y=0.1845e^{0.22223x}$. Danish seine ship dimensions ratio to LOA obtained length (L_{deck}) 0.88, breadth (B) 0.36, depth (D) 0.15, and dimension ratio of ship volume superstructure (Va) to volume bottom deck (Vb) of 0.06, then the results of GT based on LOA (Soeboer formula) compared to GT re-measurement results have the difference in GT with the equation $y=1.5871e^{0.1018x}$. Measuring as well as calculating the amount of GT will be easier and faster by using the length dimension; anyone can measure the length of the ship and is very visible. Measuring and calculating using the formula used by Perla is very unprofitable, both for ship owners and for the government.

References

Arthatiani F. Y., 2014 The role of fisheries civil servants in the law enforcement process of the IUU fishing case in Indonesia. Widyariset 17(1):1-12.

Farhum S. A., 2010 Stability study of four types of Kasko ship pole and line. Journal of Tropical Marine Science and Technology 2(2):53-61.

Firdaus M., Dewitasari Y., Pramoda R., Koeshendrajana S., 2017 Fish resource losses due to mark down practices of fishing vessels in Indonesia. Journal of Marine Economics and Fisheries 12(2):133-141.

Irawan F., 2015 Contribution of fishing vessels based at Pelabuhanratu Fishing Port to Sea Pollution. Thesis, Bogor Agricultural University, Bogor, Indonesia.

Kusumanti I., 2009 Level of utilization of wood material in the making of frames in the shipyard of the people's trade business Semangat Untung, Tanah Beru Village, Bulukumba, South Sulawesi. Thesis, Bogor Agricultural University, Bogor, Indonesia.

Mohammed R., Bungin B., 2015 Audit communication approaches and methods of assessment of information and communication systems in an organization.. Prenadamedia Group, Jakarta, Indonesia.

Nanda A., 2004 Measurement and use of fishing vessels GT in Indonesia. Thesis, Bogor Agricultural University, Bogor, Indonesia.

Nugraha F. R., 2018 Conformity of ship size with documents on longline vessels in Pelabuhanratu. Thesis, Bogor Agricultural University, Bogor, Indonesia.

Soeboer D. A., 2012 Effective vessel registration system in managing fishing vessels in Aceh Province. Dissertation, Bogor Agricultural University, Bogor, Indonesia.

Sugiyono, 2010 Statistics for research. Bandung, Alfabeta.

*** Indonesia Bank Regulation Number 9/6/PBI/2007 concerning Asset Quality Rating for Commercial Banks.

*** Circular of the Directorate General of Sea Transportation Number UM.003/47/16/DJPL.15 concerning re-verification of fishing vessels.

*** Decree of the Directorate General of Sea Transportation Number PY.67/1/16-02 concerning domestic measurements for calculating ship GT.

*** Decree of the Directorate General of Sea Transportation Number PY.67/1/13-90 concerning the measurement of Indonesian vessels.

*** Decree of the Ministry of Transportation No. 41/1990 concerning measurement of Indonesian ships.

*** Government Regulation Number 75 Year 2015 concerning types and rates of non-tax state revenues applicable to the Ministry of Marine Affairs and Fisheries.

*** Ministry of Marine Affairs and Fisheries Regulation No. 27/2009 concerning registration and marking of fishing vessels.

*** Ministry of Marine Affairs and Fisheries Regulation No. 5/2008 concerning registration and marking of fishing vessels.
*** Ministry of Transportation Regulation No. 8/2013 concerning ship measurement.
*** Presidential Decree Number 5/1990 concerning the international convention on tonnage measurement of ship.

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