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STABILITY, LOAD LINES AND FISHING VESSELS SAFETY

Short study on the 1969 TM Convention's impacts on crew well-being, vessel safety, limitation on innovation and competition distortion

Submitted by the International Transport Workers' Federation (ITF)

SUMMARY

Executive summary:	This document reviews the main issues involving the 1969 Tonnage Measurement Convention
Strategic direction:	2.0
High-level action:	2.0.1
Planned output:	2.0.1.8
Action to be taken:	Paragraph 2
Related document:	SLF 54/9/4

1 A short study on the 1969 TM Convention, conducted by the World Maritime University (WMU), is provided in the annex.

Action requested of the Committee

2 The Committee is invited to note the information provided and consider to refer it for further discussion within the Correspondence Group on the Development of Provisions to Ensure the Integrity and Uniform Implementation of the 1969 TM Convention, established at SLF 54.

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ANNEX

STUDY ON THE 1969 TM CONVENTION'S IMPACTS ON CREW WELL-BEING, VESSEL'S SAFETY, LIMITATION ON INNOVATION AND COMPETITION DISTORTION

Executive summary

- This study was commissioned by the International Transport Worker's Federation (ITF) to identify and review the impacts of the 1969 TM Convention on ships and shipping.

- The research reviews the existing documents on the topic using numerous sources including the IMO documents submitted to the Maritime Safety Committee and the SLF Sub-Committee. In addition, several interviews have been conducted with various stakeholders.

- An historical review of the tonnage measurement issue demonstrated that the flag States responded to the inherent flaws of the tonnage measurement by regularly updating their systems and by creating adequate deductions and exemptions. In addition, this historical review recalls the intention of the regulators in 1969.

- The principle of the 1969 TM Convention is briefly analyzed and its main weaknesses identified. The non-distinction between spaces for calculation purpose creates an incentive to reduce all enclosed areas. In addition, the Convention fails to encompass the current shipping changes and particularly the appearance of large deckloads. The lack of flexibility, mainly due to its amendment process, impedes the evolution of the 1969 TM Convention.

- The detrimental effects on the crew well-being are established through the shrinkage of individual and collective living and working areas. Because these areas are computed to determine the gross tonnage (GT), the reduction of such spaces in volume and numbers induces a GT reduction. Moreover, the disincentive to enlarge crew areas affects the availability of cabins for trainees and additional crew members.

- The effects on safety have earlier been demonstrated through various documents submitted to the IMO. In short, the analyses of several cases show that the trend of spaces optimization influences the overall ship's resilience.

- The designs made to satisfy tonnage reduction impact the ships ability to resist to pirate attacks. The resistance is affected because low freeboards are encouraged and the tonnage cost discourages the building of citadels, additional accommodation for security personnel and other defensive systems.

- While the shipping industry is entering a difficult economic and regulatory era and needs freedom of innovation, the 1969 TM Convention restricts the creativity of designers since they must consider the reduction of enclosed spaces. So, the 1969 TM Convention hinders innovations requiring extra volume. A small table reviews the upcoming regulation and their impact on tonnage.

- In another area, the study investigates the validity of collecting fees and establishing thresholds based on tonnage figures and provides alternative examples.

Foreword

This research project was commissioned by the International Transport Worker's Federation (ITF) from the World Maritime University (WMU), Sweden. Funding for this study comes from the ITF trust.

Acknowledgements

The World Maritime University (WMU) would like to express its gratitude to all those who were prepared to offer their assistance to this study.

Disclaimer

The elements expressed in this report are the author's views and may not necessarily reflect those of the World Maritime University, the International Transport Worker's Federation (ITF) and the ITF trust which funded this project.

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March 2012

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1 Introduction

Originally designed for wooden vessels deprived of deckload, the determination of ships' magnitude by computation of internal volumes was unified during the mid-19th century and thus, serves as an easy yardstick to establish fees and thresholds. So, in the basic principle of tonnage, operational expenditures are directly connected to ship's internal volumes.

Before 1969, each nation-flag adjusted tonnage measurement systems to preserve and protect their own fleets. Without an International regulatory body, such practices were easy to implement but lacked tonnage measurement uniformity.

Adopted in 1969, the International Convention on Tonnage Measurement of Ships (1969 TM Convention) was designed to harmonize and simplify the existing methods of ship measurement. Based on an adjusted volume calculation, the 1969 TM Convention distinguishes between two figures: Gross Tonnage (GT), and Net Tonnage (NT). These figures are recorded in the vessel's International Tonnage Certificate after being measured and verified by an Administration or an approved recognized organization.

GT aims to represent the overall magnitude of the ship and NT aims to establish its earning capacity. Because of their supposed meaning, numerous charges and thresholds are based on these features. Therefore, GT and NT directly impact ship expenditures. So, owners and operators strive to obtain the lowest figures for both Gross and Net Tonnage (permissible under existing regulations) but maximizing the ship's earning capacity.

In a highly competitive sector, to overcome their rivals, each shipping industry player struggles to acquire competitive advantages. So, the shrinkage of operational and assets costs constitutes common practices. Today, tonnage figures, and particularly Gross Tonnage, are strategic targets for shipowners because they serve to define several levies and establish regulatory thresholds. Therefore, the detrimental effects of the 1969 TM Convention have to be understood in relation to the highly competitive environment of the shipping industry and in the context of permanent quest to survive in a market inside which actors shrink costs and increases earning capacities.

In such a context, shipowners' willingness to reduce tonnage cannot end and, because of their business relationships, shipbuilders have to support their clients' desires to acquire additional competitive advantages using ship design tactics. This situation produces not only weird, uncomfortable and unsafe designs but also impacts fair competition and restricts design innovation. To address these issues, a revision and/or an in-depth modification of tonnage measurement is presently under examination[1].

The present context of shipping difficulties and the upcoming entry into force of several regulations which are likely to impact on ship design, it seems the appropriate time to analyse the impact of the 1969 TM Convention on ships and shipping.

2 Background and main problems

As a consequence of the constant development of local and international trade, it soon appeared necessary to construct a common "yardstick" to establish levies and thresholds. Tonnage measurements using enclosed space calculations were clearly confirmed as the yardstick of shipping in the mid-19th century.

[1] In this respect, it is worth noting that, in a recent past, several proposals to transform tonnage measurement were defeated since several member States expressed their wish to keep intact the current regulatory stability.

Because a link between tonnage and expenditures was established, the tonnage measurement became a major stake for shipowners and operators which realized the importance of playing with the yardstick.

2.1 Origins of tonnage measurement

Established in Europe, tonnage measurement using internal volume is an old method to assess vessel's capacity. This method is connected to the wooden shipping era and vessels without deck load.

2.1.1 Before the XIX century

Tonnage measurement emerged from practices developed to assess levy on sea transport. While trading grew, a common yardstick was found necessary to establish a transparent and fair referential system on which levies could be collected and freight rate calculated.

In medieval times, various systems co-existed. They were designed for commercial matters and to settle private agreements. Such ratings summed up various parameters including vessel's size and earning capacity. During this period it was established that both, size and earning capacity had relevance in determining a yardstick.

The origin of the word "tonnage" and the practice of collecting levies on volumes emerged in relation to wine cargoes. This transport required standard packages called tuns. Then, slowly, these tuns became the unit to measure the carrying capacity of vessels.

Consequently, the measurement of vessels' volumes became the reference to collect levies and to evaluate the vessel's capacity. Throughout the 18th century, volume-based evaluation of ships began to be a norm in Europe despite the existence of alternative methods based on "weight" measurement for example.

During the 17th and 18th centuries, European nations confirmed the dominance of tonnage by enacting national regulations.

The first act of tonnage measurement promulgated in the United Kingdom was in 1694. Soon after, in 1720, a serious revision of measurement was undertaken to compensate the effect of tonnage measurement on ship's seaworthiness (V. Nadienski, 1969). The main French maritime law during Louis XIV reign "Ordonnance touchant la Marine du mois d'août 1681" forced all new ship to hold a tonnage certificate. Such certificates required the calculation of the internal volume of the vessel. In 1789, the United States defined their own measurement system.

Despite the success of volume-based systems, tonnage measurement system failed to be harmonized among nations.

While calculating vessel's earning capacity and size on volume makes sense, a constant tendency to alter figures was reported because the implementation of taxes on volumes pushed shipbuilders and owners to design vessels able to combine a large earning capacity with a slight levy exposure.

The link between tonnage and expenditures created a clear weakness in the system because it built an incentive to curtail tonnage figures. This was the main embedded flaw in volume-based assessment of ships.

This flaw unfortunately affected ship's design which consequently had impacts on vessel's safety and comfort. To avoid such effects, the United Kingdom decided to review and clarify the tonnage measurement in the 19th century.

2.1.2 The Moorsom's system

From 1821 to 1849, several British commissions investigated the effects of tonnage measurement on ships. The latest commission launched the basic principles of today's tonnage measurement.

In 1849, George Moorsom's commission was assigned to review, once more, tonnage measurement. G. Moorsom underlined that: "(…) the internal capacity, on which the stowage of this merchandize entirely depends, must be the fair and proper basis for assessment". Moorsom's concept was to compute the total volume of enclosed spaces with some deductions and exemptions.

Moorsom's system was inserted inside the Merchant Shipping act, 1854, under "part II: British ships: their ownership, measurement and registry". Then, tonnage measurement turned into an important part of the registration procedure. At the end of each registration process, vessel's Register Tonnage was "deeply carved or otherwise permanently marked on her main beam" (#25, Merchant Shipping Act, 1854).

The Moorsom's system established a reference system in tonnage measurement. Domination and reputation of British trade and empire assisted to disseminate Moorsom's system among other countries. By 1885, European nations and Japan adopted Moorsom's principles[2].

Thereafter, this system became a quasi-international standard in Tonnage Measurement despite the absence of unified interpretation; and despite its embedded flaw which affects ship's design.

Recognizing the weaknesses of the system, States acted to address its detrimental effects and to promote better living conditions on board.

The United Kingdom amended several times their Tonnage Measurement methods, mainly by including additional exemptions and deductions.

As an example, section 9 of the 1867 Merchant Shipping Act introduced rules and deductions as an incentive to ameliorate crew accommodations and commented as "Place appropriated to seamen to have a certain space for each man, and to be properly constructed and kept clear".

[2] The British system has been adopted by the following countries at the dates named: – United States, 1865; Denmark, 1867; Austria-Hungary, 1871; Germany, 1873; France, 1873; Italy, 1873; Spain, 1874; Sweden, 1875; Netherlands, 1876; Norway, 1876; Greece, 1878; Russia, 1879; Finland, 1877; Haiti, 1882; Belgium, 1884; Japan, 1884.

9. The following Rules shall be observed with respect to Accommodation on board British Ships; (that is to say,)

(1.) Every Place in any Ship occupied by Seamen or Apprentices, and appropriated to their Use, shall have for every such Seaman or Apprentice a Space of not less than Seventy-two Cubic Feet, and of not less than Twelve Superficial Feet, measured on the Deck or Floor of such Place:

(2.) Every such Place shall be such as to make the Space aforesaid available for the proper Accommodation of the Men who are to occupy it, shall be securely constructed, properly lighted and ventilated, properly protected from weather and Sea, and as far as practicable properly shut off and protected from Effluvium which may be caused by Cargo or Bilge Water:

(3.) No such Place as aforesaid shall be deemed to be such as to authorize a Deduction from Registered Tonnage, under the Provisions herein-after contained, unless there is or are in the Ship One or more properly constructed Privy or Privies for the Use of the Crew ; such Privy or Privies to be of such Number and of such Construction as may be approved by the Surveyor herein-after mentioned:

(4.) Every such Place shall, whenever the Ship is registered or re-registered, be inspected by one of the Surveyors appointed by the Board of Trade under Part IV of the Principal Act, who shall, if satisfied that the same is in all respects such as is required by this Act, give to the Collector of Customs a Certificate to that Effect, and thereupon such Space shall be deducted from the Register Tonnage:

(5.) No such Deduction from Tonnage as aforesaid shall be authorized unless there is permanently cut in a Beam, and cut in or painted on or over the Doorway or Hatchway of every such Place, the Number of Men which it is constructed to accommodate, with the Words "Certified to accommodate _____ Seamen":

(6.) Every such Place shall be kept free from Stores or Goods of any kind, not being the personal Property of the Crew in use during the Voyage:

(7.) Upon any Complaint concerning any such Place as aforesaid, One of the Surveyors appointed by the Board of Trade may inspect such Place, and if he finds that any of the Provisions of this Act with respect to the same are not complied with he shall report the same to the Collector of Customs, at the Port where the Ship is registered, and thereupon the registered Tonnage shall be altered, and the Deduction aforesaid in respect of Space disallowed, unless and until it shall be certified by such Surveyor, or by some other Surveyor appointed by the Board of Trade, that the Provisions of the Act in respect of such Place are fully complied with:

(8.) If any such Place in any Ship is not kept free from Goods and Stores as aforesaid, the Master shall be deemed to be in fault, and shall for every such Failure to comply with the Provisions of this Section forfeit and pay to each Seaman lodged in such Place the Sum of One Shilling a Day for each Day after. Complaint made to him by any Two or more of such Seamen during which any Goods or Stores, not being the personal Property of the Crew, are stored or kept therein:

(9.) If in any other respect the Provisions of this Section are not observed with respect to any such Place in any Ship the Owner shall be deemed to be in fault, and shall for every Failure to comply with the Provisions of this Section incur a Penalty not exceeding Twenty Pounds.

This section of the Merchant Shipping Act, 1867, demonstrated that tonnage exemptions could represent a reliable incentive to enhance crew well-being.

The United Kingdom and the other countries – using levies and thresholds based on tonnage, amended regularly their systems to mitigate its adverse effects on safety – i.e. tonnage openings, and on crew living standards but also to integrate the evolution of shipping – i.e. propelling power and machinery systems.

Acting individually, each State adjusted their systems accordingly to the continuously reported effects of the tonnage measurement and also to promote internal policies.

However, these numerous modifications in measurement destabilized the Moorsom's system. They destroyed the system's unity because each flag introduced its own set of deductions and exemptions. Faced with this lack of consistency, more and more voices expressed their concern about the system and its interpretations.

Independent calculation methods emerged; Danube rules were created in 1871; Suez tonnage emerged in 1873 and Panama Canal designed its own systems in 1913. Thereafter, the same ship could have different tonnage values at different locations and, still today, the ship is required to carry at least three certificates –International tonnage certificate, Suez and Panama Tonnage Certificates.

In the late 1960s and after 110 years of existence, tonnage regulations based on Moorsom's works were incredibly complicated because of numerous exemptions and deductions added over the years. Thus, the calculation process became difficult, non-harmonized and open to interpretations.

The existence of numerous deductions highlighted the importance of having two tonnage figures to clearly distinguish the earning capacity of the ship (Net Registered Tonnage or Net Tonnage today) and the indication of ship's magnitude (Gross Registered Tonnage or present GT).

Appearance of multinational organization throughout the 20th century created a forum to discuss the harmonization of tonnage measurement. These talks on tonnage harmonization became an important issue during this period of international trade growth which clearly needed a common yardstick.

After the Second World War, the United Nations gave the impression to be the appropriate framework to develop such instruments.

2.1.3 Towards international harmonization

Although the tonnage measurement was based on the same Moorsom's principles, the diversity of regulations and interpretations created serious confusion. Thus, tonnage figures, and particularly Registered Tonnage, moved away from their original purpose which was to reflect the ship's size.

The League of Nations conducted the first efforts to harmonize tonnage. In 1925, the Permanent Committee for Ports and Maritime Navigation hosted the first meeting to unify tonnage calculation. In 1938, the drafts of the convention were discussed during the Oslo Conference. The final draft of an International Tonnage Measurement Convention was edited in 1939 and was circulated between nations. However, the process of adoption was interrupted by the Second World War.

Oslo hosted a second conference in June 1947 but only a limited number of nations were represented. Mutual recognition of certificates was granted. But the lack of uniform calculations and its failure to incorporate main shipping nations impeded the expansion of the Olso Convention.

In 1948, a United Nations conference decided to create the Inter-governmental Maritime Consultative Organization. Effective in 1958, IMCO took over the issue of tonnage measurement. In 1959, under the Maritime Safety Committee; the Sub-Committee on

Tonnage Measurement was formed and tasked with the following terms of reference: "To draw up recommendations for a system of tonnage measurement suitable for worldwide application, which would be just and equitable as between individual ships and groups of ships, which would not hamper good design or militate against seaworthiness and which would take into consideration the economics of shipping industries generally."

From the beginning, it was clear that the intention was to avoid a system that would have a significant influence on ships' design and "above all, should not encourage constructional features which detract from ships' safety or efficiency". (V.Nadeinski, 1969)

In addition, two other goals were: simplicity and no adverse effect on the economics of shipping.

In May-June 1969, London hosted the International Conference on Tonnage Measurement of Ships with an aim to define a universal tonnage measurement system. The Indian delegation summarized its goals:

> "(i) A simplified system of Tonnage Measurement should be evolved which is internationally acceptable.
>
> (ii) The safety of the vessel should always be considered of paramount importance.
>
> (iii) The new method of Tonnage Measurement should not allow different interpretations leading to manipulation of tonnage.
>
> (iv) The tonnage evolved by the new method should be as close as is reasonably possible to the existing tonnage figures so that existing ships do not have to pay additional port and harbour dues." (IMCO Plenary Documents, 1969).

The International Convention on Tonnage Measurement of Ships was adopted and came into force on July 1982 with a 12 year phase-in period ensuring a smooth transition.

In the 1969 TM Convention, Gross Tonnage and Net Tonnage are defined in article 2 as:

> "(4) "gross tonnage" means the measure of the overall size of a ship determined in accordance with the provisions of the present convention;
>
> (5) "net tonnage" means the measure of the useful capacity of a ship determined in accordance with the provisions of the present Convention;"

In other terms, Gross Tonnage aims to represent the vessel's magnitude and Net Tonnage its cargo capacity which is expected to reflect its earning possibilities.

For the very first time, a common tonnage measurement was adopted worldwide. The convention expressed two clear intentions:

- First, not impacting vessel's design that could jeopardize ship's safety and crew well-being;
- Secondly, creating a simple system not affecting shipping economics.

2.2 The 1969 Measurement principles and their weaknesses

Compared to Moorsom's system, the 1969 TM Convention is relatively simple. The determination of tonnage figures does not require vessel's completion and can be performed using ship's plans before the construction.

Simplicity has definitively been achieved and usage of K factors allows new tonnage measurement not to jostle shipping business. Two of the four goals identified by the Indian delegation were successfully achieved.

However, the two other goals did not perfectly reach the expectations of the conference members. Various interpretations have been noticed and the measurement system affects safety of certain ships.

Two major flaws of the present Convention are: its inability to hamper weird ship design and its lack of flexibility as a consequence of the amendment procedure.

2.2.1 Volume calculation and K factor

The principle to measure the vessel by internal volume calculation was maintained. Deductions or exemptions were suppressed.

To determine the Gross Tonnage, the entire enclosed volumes are considered. The Net Tonnage is proportional to the volume of the cargo spaces but not directly deducted from Gross Tonnage.

The 1969 TM Convention proposes a simple and non-dimensional formula to determine the Gross Tonnage. The formula presents two-elements and is visible in annex 1, regulation 3 of the 1969 TM Convention:

GT = K1V

where: V = Total of all enclosed spaces of the ship in cubic metres,
K1 = 0.2 + 0.2 log10V (or as tabulated in appendix 2)

This simple relation clearly demonstrates direct impacts of all enclosed spaces on GT because non-earning spaces are included in GT. The formula also introduces the idea of K factor to bring closer the old GRT and new GT. However, the introduction of K factor disconnects GT from its original volumetric unit.

The formula used for Net Tonnage calculation is also a non-dimensional formula – Annex 1, regulation 4. NT figures mainly depend on cargo capacity or passenger numbers.

$$NT = \underbrace{K2Vc\,(4d/3D)\,2}_{\text{Main parameter is total cargo space}} + \underbrace{K3\,(N1+N2/10)}_{\text{Main parameter is the number of passengers but remains proportional to GT } (K_3)}$$

NT figure does not include enclosed spaces which are not dedicated to cargo, except and indirectly for passenger ships.

NT clearly represents the "enclosed" earning capacity only. The deck load and non-enclosed cargo spaces are excluded from the formula.

In clear:

- K factor was introduced to bring closer figures established under the old system and the new system of measurement. Therefore, GT & NT became non-dimensional figures by mixing volumes with arbitrary coefficients (K). So, tonnage figures are unitless and have no relevance by themselves. These figures exist only when they are compared to other similar figures.

- GT measurement considers the total volume of all enclosed spaces. So, the larger the enclosed spaces are, larger the GT is. In other words, to reduce the GT figure, you have to reduce the enclosed spaces but if you want to maximize your earning capacity, you have to shrink the non-earning volumes only.

- NT is directly proportional to the "enclosed spaces" dedicated for cargo and/or to the total number of passengers. So, GT effects exist for ships carrying more than 13 passengers.

So, in short, if you wish to keep intact your cargo capacity but reduce you exposure to levies based on GT, you need to shrink all spaces not dedicated to cargo. And by storing cargo out of enclosed cargo spaces, namely on open decks, you may reduce both, GT and NT.

2.2.2 Main weaknesses

Finalized in 1969, the Convention responded to its present and past. Some problems of previous systems, identified before 1969, found an answer – i.e. tonnage openings. However, unexpected effects of the convention appeared after full implementation of the 1969 TM convention in 1994 after the 12-year phase-in period.

Two elements, embedded in the body of the convention, bear most of the responsibility of the convention's inability to address design issues and new ship types: the volume/expenditure link and amendment procedure.

The unification process that culminated in 1969 surfaced after a long gestation period which means this convention is deeply anchored in the past.

The tonnage convention received its final push in 1959 with the creation of IMCO but the discussions were initiated in 1925 and covered nearly half a century. Data, principles and analysis which underpinned the 1969 Tonnage Measurement Convention were developed before 1969. Moreover, the core elements of measurement did not change since the wooden ship era. So, expenditures and enclosed volumes remain irrevocably connected.

Adopted forty-two years ago on ideas settled 85 years ago with interested parties belonging to their own timeframe, the 1969 TM Convention fails to evolve because the Convention is trapped by its article 18 (Amendments procedures). The absence of a flexible amendment procedure unfortunately prevents the Convention from evolution to meet present shipping need.

Adapted to a previous shipping environment, the 1969 TM Convention has never evolved contrary to the shipping world the Convention was expected to embrace.

Forty-two years in ship design and landscape are ignored:

- New types of ships have emerged, like containership;

- New hull design and new motorization exist;
- Naval architecture and material properties have evolved and permit unexpected ships sizes and types.

Despite the variety of changes, the Convention never moved. So, naval architects have to work with the constraints generated by the tonnage measurement regulations.

Before tonnage measurement found an international agreement, flags possessed their own measurement and modified their systems to account for evolutions in shipping and notification of tonnage calculation impacts on their fleets. E.g. after the adoption of Moorsom's system in 1864, the United States regularly amended their regulations: in 1865, 1882, 1884, 1886, 1895, 1906, 1914, 1938 and 1966. The longest period without amendment was 28 years.

Calculated on total enclosed space, Gross Tonnage does not distinguish between various existing spaces.

Two categories exist: cargo spaces and non-cargo spaces. The non-cargo space category gathers a large variety of spaces having their own dedicated purpose like:

- Safety spaces for equipment, stability and other safety related needs;
- Security spaces (i.e. citadel);
- Living areas (i.e. cabins, recreational spaces…);
- Working areas and workshops;
- Storage places;
- Mechanical & equipment locations;
- Etc.

Nowadays, builders, which focus their efforts in satisfying their customers, acknowledge shipowners' demands to reduce operational costs by all means. So to remain competitive, builders have to propose attractive designs made to increase the cargo capacity while curtailing GT. In the process of reducing GT figures, the temptation is high to cut indistinctly all non-earning spaces.

The lack of distinction between the non-cargo spaces is becoming a serious weakness of the Convention. This flaw, previously compensated by a full set of exemptions and deductions, is no longer counterbalanced by any rule.

Despite various interpretations, clarifications and recommendation, the convention has never been amended. In short, the 1969 TM Convention has never been in line with shipping dynamics.

By weakening its link to shipping realities, the 1969 TM Convention slowly loses its consistency. The Convention spoils its ability to cope with present shipping while the detrimental effects of the tonnage measurement are becoming visible.

So, an important weakness of this Convention is its lacks of flexibility while our world is moving. This serious weakness is mainly due to the amendment process which does not consider the "tacit amendment" procedure.

The lack of consistency of the Convention leads to a situation in which the GT does not represent correctly the magnitude of the vessel nor the NT the earning capacity.

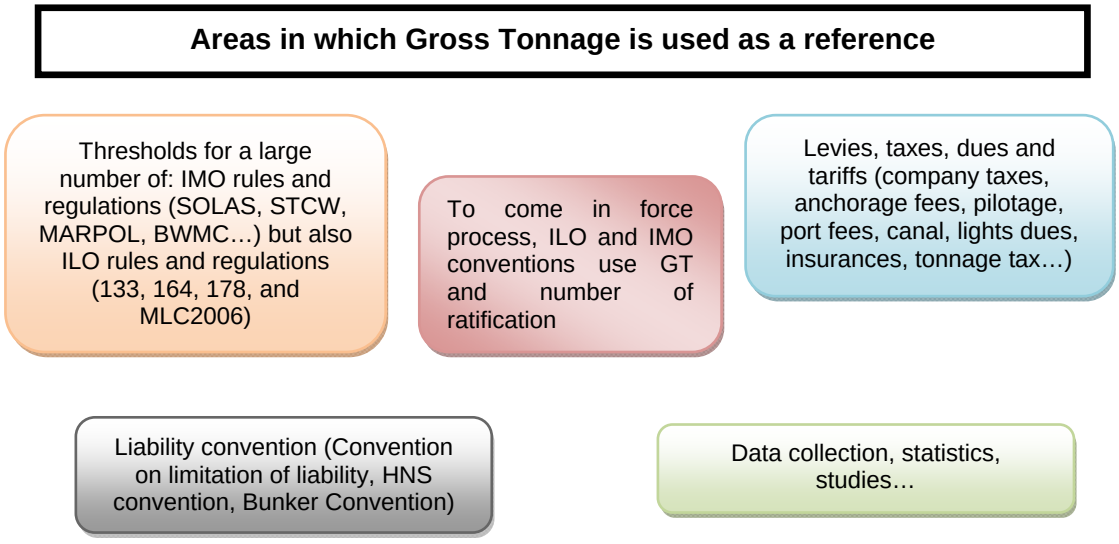
Today, while Net Tonnage unsuccessfully represents the whole cargo capacity of the ship, the Gross Tonnage failed to be a useful tool to assess and compare all ship sizes.

2.2.3 Implication of tonnage measurement on shipping economics

The purpose of the 1969 TM Convention is to provide a uniform calculation of GT and NT for ships, in order to establish a fair and transparent system of charges and thresholds.

NT, which seems much adapted to establish charges, is unfortunately scantly considered and lost its consistency with the appearance of large deckloads. And today, many systems consider GT, mainly because it is the largest figure available on the tonnage certificate.

The pattern below aims to highlight main areas in which GT is used.



All these domains impact shipping economics and affect shipowners' decision-making. This economics of tonnage embraces a large number of parameters. Consequently, reducing GT and NT has a great influence on operational costs.

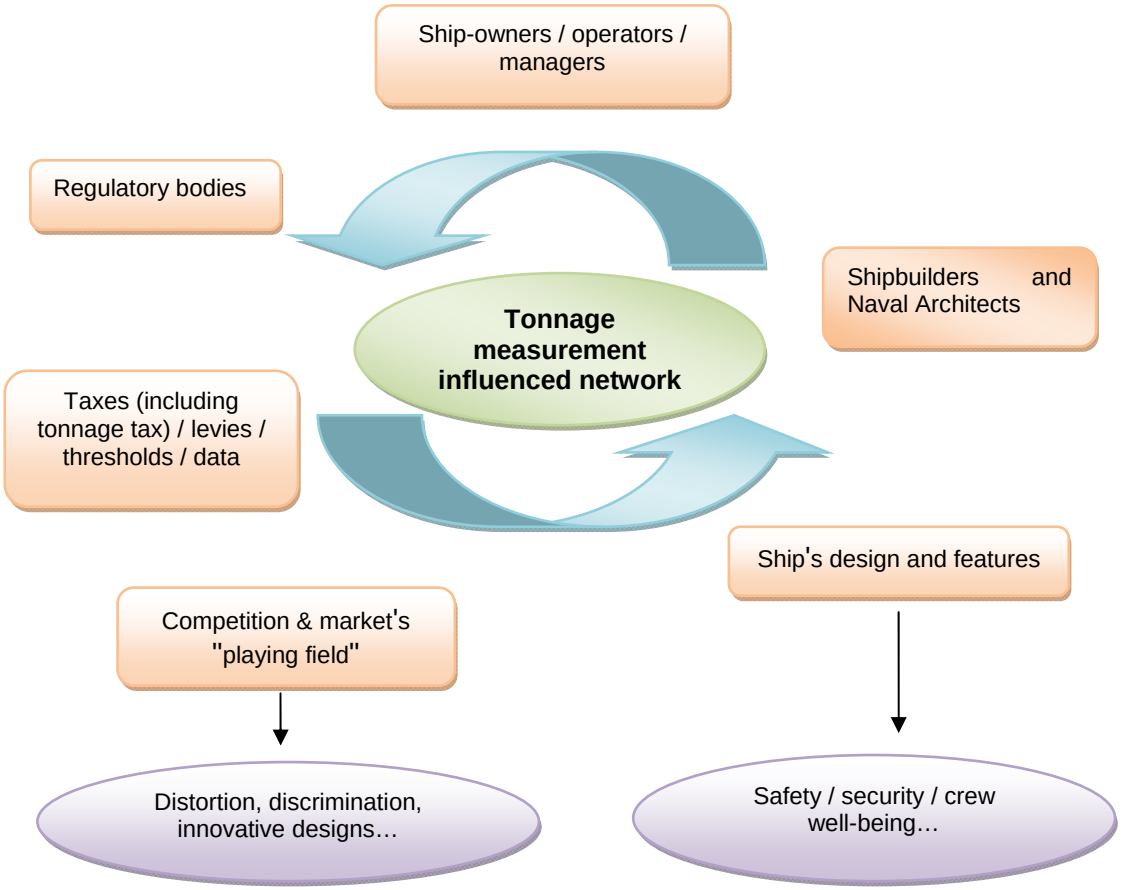
2.2.4 Origin of detrimental effects: the tonnage calculation "game"

For some stakeholders, tonnage figures reflect the expected ship's size and cargo capacity. But for another kind of stakeholders, like investors, owners or operators, tonnage equals money to waste or to spare. This second reality is obvious because levies and thresholds are based on tonnage figures.

Therefore, the 1969 TM Convention cannot be considered as a Convention that simply defines a neutral yardstick.

Tonnage measurement is located in the middle of a network. Tonnage affects and interacts with the whole shipping environment.

A small pattern clarifies this network of mutual influences – In order not to overload the pattern with interacting arrows; we limit their amount to the indirect ones which are important for us.



As soon as a measurement system emerges to collect levies and set thresholds, it begins to be integrated in the whole economics of the activity; and therefore, such a system is subject to be examined, scrutinized, discussed and contested.

So, as a matter of fact, tonnage measurement weaknesses have been discovered, explored and exploited in order to save some expenses. Each player involved in the shipping competition is now considering tonnage as a crucial cost to curtail.

An inventive "game" began. The aim of the whole "game" is:

- To dissect the texts of the convention;
- To find and explore its flaws;
- And to use them in order to improve competitive advantages.

Far from being unusual, such a "game" is part of the business and is established in every sector.

Integrated in the business-model, the industry gets accustomed to it and finds adjustment. So, any changes made to the 1969 TM Convention would have an echo in the business of shipping and in its economics. Changing basic rules in a competitive sector frightens stakeholders.

Tonnage measurement became a problem when the collateral effects of the "game" began to be seriously visible and affected safety, development and innovation.

This issue of tonnage exists because the manipulation of measurement leads to unsafe design, reduction of crew spaces, competition distortion and maladjustment to innovative designs.

As long as tonnage will be used to collect levies and set thresholds, the measurement system will continue to be a major target for shipping key players.

Tonnage is not a neutral yardstick detached from the socio-economic reality of shipping. This system possesses a clear impact on ship's design because numerous levies and thresholds are created on tonnage figures.

Tonnage measurement drives decision-makers to consider reduction of tonnage as an important competitive advantage. Ship design becomes an important stake and a "game" for owners and shipyards competing in their own respective markets.

This link to the economics of shipping makes the tonnage measurement a very sensitive topic, difficult to modify.

3 Detrimental effects of current tonnage measurement

The goals of this part are to detail the most visible effects of the tonnage "game" and highlight the influence of tonnage on ship design.

The detrimental effects of the 1969 TM Convention form the core of the argument to modify the tonnage measurement system in order to limit or eradicate them.

These effects clearly appeared with the production of five sets of unified interpretation from 1979 to 1994. The last one, the "Interpretations of the provisions of the International Convention on Tonnage Measurement of Ships, 1969" was edited in 1994 as TM.5/Circ.5 and identify various ship types affected by the 1969 TM Convention.

3.1 Crew area

Since 1994, the 1969 TM Convention is used to edit the International Tonnage Certificate. From this date; the crew area was reduced.

3.1.1 Accommodation not deducted

As we previously mentioned, the 1969 TM Convention does not accept deductions or exemptions and, in addition, does not make any distinction between spaces when calculating GT. So, all individual and collective crew areas are computed to determine the GT.

As part of GT, accommodations are therefore taxed. Consequently, the smaller crew areas are, the less GT-based exposure you have. The link between volume and expenses penalizes shipowners who want to provide large and comfortable crew and working areas.

Contrary to the evolution of tonnage measurement throughout XIX and XX centuries, neither deduction nor exemption was ever made to compensate the effect of tonnage measurement on crew well-being. No incentive has ever been established to encourage enlargement of crew spaces. So, policies made in the mid-19th century seem today unattainable!

Since the 1969 TM Convention came into force, one observes a global trend in shrinking non-earning spaces, including crew spaces. Despite the recognized importance of the human element, the 1969 TM Convention highlights the lack of willingness to address human issues related to tonnage.

Ship designs respecting human factors are sacrificed to tonnage reduction benefit and shipowner's competitiveness.

Overall external volume of today's accommodation is far smaller than thirty years ago, a short glimpse on VLCC, Capsize Bulk carriers or feeders are convincing. However, comprehensive studies should be made to precisely calculate and evaluate the volume reductions.

3.1.2 Reduced individual & collective areas

The overall reduction in the volume of accommodations is not the only issue affecting crew well-being. Tendencies to shrink individual spaces to their minimum have been noticed since the Convention came into force.

The cabin height rarely exceeds the minimum required by ILO regulations. ILO Convention No.133 requires 198 cm height on each crew space. This minimum height will increase to 203 cm when MLC2006 will enter into force. The same regulations prescribe minimum cabin size by defining a floor area.

As individual spaces are forced smaller, collective spaces, like galley, are reduced to their minimum and recreational spaces are also minimized.

This tendency has a detrimental effect on crew well-being, social life and willing to remain in the profession. The Report of the Task Force on Maritime Employment and Competitiveness and Policy Recommendation to the European Commission, released in 2011, stress that working and living conditions discourage Europeans from going and staying at sea: "The factors include […]; the increasingly limited availability of on-board facilities, which, because of an insufficient allocation of space on board, are much less attractive than twenty years ago, when fitness areas and even swimming-pools featured many cargo-ships, although at a time when seafarers spent much longer uninterrupted periods at sea." (2011, p9)

Crews face serious affection of their living conditions through the shrinkage of on board accommodations and living spaces.

3.1.3 Lack of extra cabins

In consideration to shortage of qualified seafarers, there is an obvious need to train more people and to retain present seafarers (ratings and officers). Therefore, India submitted, in 2008 at MSC 85, two documents highlighting the urgent need to consider extra cabins on board ships, particularly to provide available berth for trainees. The documents intended to push IMO to define binding rules in order to oblige shipowners and operators to provide adequate number of berth, paying heed to newcomers' handover and training needs. By offering available berth on board, cadets and trainees could take over a part of the workload and could become the next generation of seafarers.

The accommodation issue for trainees is not restricted to India. Swedish shipowners' association identified the same issue under Swedish-flagged ships.

In addition to the renewal of seafarer's generation, extra berths offer important benefit and flexibility to ship's management and for safety purpose:

- Additional permanent crew can work on board;
- Special and supplementary workforce (i.e. engine repair teams or security guard) can be hosted in a decent way;
- Long handovers can be encouraged. Such periods assist newcomers to get familiarized with vessel's specificities;
- Short handover of a day or more could help sign on persons to recover after a long journey of travel and therefore avoiding fatigue personnel taking over operational tasks immediately.

Therefore, smaller spaces for crew and limited number of available berths generate indirectly safety problems by affecting human element which is deemed responsible for around 80% of incidents and accidents and, certainly have an impact on crew moral.

By negatively impacting the human element, overall vessel safety is affected. Discomfort and discontent possess immediate and long term effects on the crew performance and increase human error rate.

Moreover, general discomfort of ships and its perception demotivate and discourage qualified seafarers to pursue long careers at sea (turnover in the profession is expected to be around 7 years identical as in the 18th century). Finally, knowing that the rate of suicide by seafarers is much higher than for any industry, the shipping community should consider the impact of crew accommodation quality on seafarers' minds.

3.2 Safety & security of ships

In the Lloyds List of 26 October 2006, Michael Grey condensed nearly all adverse effects of the 1969 TM Convention related designs:

> "From inadequate bow heights, which encouraged green seas to crush bulk carrier hatches, to freeboards that would immerse the deck edge at surprisingly low heel angles, along with poopless ships that asked to be pooped, he inveighed against these designs, which were forced on the designer by the '69 Convention. And it was containerships, with up to two-thirds of their cargo carried on deck to minimize their gt, which attracted increasing expenditure of Vossnack ammunition."

3.2.1 Spaces reduction and forecastle suppression

A global GT reduction strategy implies to investigate and assess all spaces by checking their usefulness in terms of cost and benefits. In case the value of a space is not clearly established, this area can either be restricted or suppressed.

It has been established that the "game" on GT impacts the following areas:

- Crew accommodation (as discussed previously) on all vessels but tend to be a serious threat for crew well-being, particularly on smaller ships;

- Engine-room spaces are reduced. Again; this is particularly noticeable on smaller vessels. This makes maintenance and repairs uneasy and unsafe. In addition, in case of emergency or fire, engine-room evacuation is becoming complicated and fire-fighting techniques are more difficult and dangerous to apply. Also, the concentration of material with high fire-prone in a small space increase the risk of fire;

- Stores and workshop volumes are limited. Such spaces can accept a limited number of spare parts, equipment and tools. This situation limits the ability of the ship to remain an autonomous system at sea and makes it more dependent on shore support for supply;

- Void spaces providing extra buoyancy are reduced. In case of water intake, the ship's stability could be affected faster;

- Forecastle disappearance caused such serious troubles that new ships consider forecastle again;

- Protection of piping on deck, in order to secure and maintain pipes, automation and valves, cannot be achieved by a trunk from fore to aft – for tankership, because it increase the GT;

- Freeboard reduction affects vessel's seaworthiness and will be investigated later.

Enhancing beyond regulatory limits safety, security and crew welfare did not motivate builders because their designs remain trapped in tonnage constraints. Builders work for their customers who try to establish tight business plans and ensure favorable competition. Ship operator financial risk management differs from ship's safety management needs.

One of the worst trends in reducing GT was the suppression of the forecastle and sheers. By practical reason, shipbuilders began to eradicate sheers and, when, the 1969 TM Convention came into force, it created another incentive to eliminate sheers. Many ships encountered casualties because of low bow height. One of the worst was the sinking of the MV **Debyshire** in September 1980.

This ship's designs provoked disasters because the first hold is insufficiently protected, therefore, water can easily flood during heavy weather and cause serious structural failures.

Finally, the International Load Line Convention was amended in 2005 to tackle this issue.

3.2.2 Reduced resilience: buoyancy, freeboard, stability and loss of deck cargo

By reducing the amount of empty volumes, the whole buoyancy of the ship and its resistance to sea hazards became a risk.

Reduced to the minimum permitted by regulations, buoyancy and stability reserves lack during unexpected situations. The "on the edge" ship designs clearly jeopardize resiliency[3] of ships, because such ships do tolerate neither breaches nor miscalculation.

[3] Resilience: it is the property of a system to absorb expected and unexpected situations which endanger the system.

The case of M.V. **Dongedijk** underlines this lack of resilience even in perfect weather condition.

> "The combination of overloading, trim and changing course caused the water to flow on deck with only five degrees of heel; this reduced the stability of the ship significantly. Next to this, water accumulated on the aft part of the main deck due to the speed of the vessel. Both effects were sufficient for the ship to heel more than 20 degrees. Containers were submerged and started being filled with water. Water also flowed into the engine-room through the vent openings." (Marin Research Group NL, 2003)

Unintended extra load on such a low freeboard vessel had huge impact stability.

A single unexpected piece fails and the whole structure collapses. The design of the ship and her small freeboard contributed to the disaster according to Mr. Vossnack (a member of a panel of Dutch experts investigating the case) who asserts that M.V. **Dongedijk** was "a victim of the Gross Tonnage Rules". This statement is underpinned by the following comment reported in Lloyd's List (10 December 2001):

> "A much safer design would have one extra tier of containers below deck, with the freeboard thus substantially increased. The reality, however is that such a design change would increase the gross tonnage from 2,926 gt to 3,800 gt. No shipyard could possibly sell such a design."

Naval architects' respond "to the demand from their customers and their interpretation of the regulations and classification society rules" (M.Grey, 2002).

So, incentive to reduce tonnage combined with beliefs that this reduction can be achieved without jeopardizing the ship's safety lead shipbuilders to tighten safety margins.

Safety limits are computed in offices by using simulation models which are simplification of ship's life. So, by drawing a model of a ship's life, safety margins can be mathematically pressurized, without considering the complex reality of shipping and the multiples interactions involved in vessel's operations, and justified by statistical models. All ship constructions "on the limits" are subject to be destabilized by all kind of unexpected or ignored disturbance. Low freeboard risks are pertinent with small ships.

In an effort to "optimize" safety margins, ships lose their resilience; therefore, they can hardly endure slight flaws on stability calculations or unexpected impairment. So, the occasional (but not unusual) wrong cargo weight distribution and/or erroneous cargo declaration[4] can seriously threaten ships' safety.

Cargo shifting on deck is identified as a major threat to a ship's stability and marine environment. The amount of harmful shifting results from the generalization of carriage of cargo on open decks to reduce both GT and NT. The loss of deck load exists in all shipping businesses but prevails in the container trade.

Large deck loads were boosted through containerization process. These boxes are supposed to be watertight enough to stay on open deck without requiring extra protection. Consequently, they are stacked high on deck. As a mainstream of container business,

[4] MSC Napoly accident gave to the investigators the opportunity to compare real weights with declarations. The findings showed that 20% of containers on deck differed from declared figures by more than 3 tons.

economies of scale pushes for an increasing size of containership and the growing height[5] of deck stacks of containers.

Recognized as a major issue, containers overboard are indirectly related to tonnage measurement for a least three reasons:

- Deck load benefit from not being transcript and recorded on tonnage figures (out of the scope of GT and NT);
- Large deck load and high stacks stress lashing systems;
- Despite their positive safety records, vessels offering a good protection to containers, like open-top containerships, are penalized by present tonnage measurement system.

3.2.3 Piracy: reduced freeboard & Citadel principle

Low freeboard facilitates piracy exposure. It is well established that low freeboard ships are very vulnerable. Container feeders, tugs, coasters and small ships are permanently threatened but also loaded tankers and bulk carriers of medium size are vulnerable.

We have to recall that the low freeboard strategy is a direct effect of the 1969 TM Convention.

In addition, the 1969 TM Convention hampered new developments of anti-piracy measures.

Embedment of well-designed and protected citadels inside the ship and other defensive systems require large volumes to shelter crew and provide them a minimum of survival devices and equipment.

Finally, the reduced amount of berth available on board impedes the ability of security guards able to protect the ship.

3.3 Impact on vessel types and innovation in shipping

This section intends to describe the impact of the TM Convention on ship types and innovative design.

Inflexibility of the 1969 TM Convention makes it unsuitable to cope with new designs which could impact safety and fair competition. I.e., containerships hold a particular advantage on this respect because deck load is neither considered in GT nor NT.

So, containerships are at an advantage over ships having large superstructures and those unable to load on deck like RoRo ships.

The Convention cannot absorb such unexpected design.

[5] High stack -> higher acceleration -> higher forces -> higher risk to damage lashing equipment -> high risk to have container overboard which is dangerous for the vessel itself (shift of cargo) and other ships (collision).

3.3.1 Containerships (feeders / deck load / open top)

The 1969 TM Convention was "under construction" while the first containers were transported by sea in the 1950s and the first container line opened in 1966. By providing a standard unit, containerships can load these boxes on deck or below deck. Despite some discussion during the conference, deck cargo was not included in the tonnage formula.

With containerization, a full generation of ships escapes from the 1969 TM Convention definition of enclosed spaces by piling up cargo on deck which is obviously not enclosed. Facing this situation of undeclared cargo, Panama Canal Authority decided to include deckload in the calculation of transit fee.

At the beginning, containerships benefitted from being newcomers. Their large deck cargo not included in tonnage provided to these ships a serious competitive advantage. While containerization expanded, the traditional cargo ships are slowly disappearing, unable to resist against the high productivity of containerships and their reduced operational costs. Container markets soared and dominated the dry cargo market.

In the containership world, the 1969 TM Convention seriously affects the design of small container feeders because the ratio between deck and hold is dangerously growing.

Other vessels

As previously mentioned, the 1969 TM Convention affects all ships and more specifically all crew spaces. However, each ship's category inherits its own impacts.

RoRo ships having large enclosed spaces cannot compete with containerships. The era of large RoRo & RoRo/LoLo ships carrying containers is over. RoRo will never succeed leaving their restricted market (car/truck/ferry…). There is a clear distortion of competition linked to tonnage measurement principles.

Bulk carriers do often have safety related issues like forecastle design. Absence of forecastle and sheers can hamper seaworthiness by removing deck protection against seas.

Introduction of double hull for tankers required a specific resolution (resolution A.747(18)) which addresses incompletely the issue at that time. Since double hull became mandatory, the competition distortion found a solution.

Small ships and small containerships are particularly vulnerable to tonnage influence. The main characteristic of small ship design is the freeboard height and ratio deck/hold cargo load. But, it is worthwhile to remember the impact on crew spaces and working spaces, particularly engine-rooms.

Livestock carriers have very large GT because corrals used to contain the animals are consider enclosed even when they are largely open to the sea.

Dockships and heavy lift can be affected by tonnage measurement.

3.3.3 Inability to cope with innovative design

Only by looking at today's tonnage issues, we can assert that the ability of the 1969 TM Convention to deal with innovative designs is and will be inadequate.

In line with containerization, the generalization of deck cargo is probably one of the main flaws of present convention because the 1969 TM Convention never envisaged such a situation.

The formula clearly does not encompass present ships carrying deckload. Builders and operators understood immediately the benefit and competitive advantage of stacking on decks to escape tonnage levies. More cargo on deck means less NT and GT for an increasing total cargo capacity!

So, the temptation is high to permanently raise the volume of cargo transported on deck and reduce the volume carried inside holds. This sole example demonstrates the inability to cope with one of the main reality of shipping business today: the container industry.

While it is always difficult to forecast, we need to foresee and draw some future trends.
Though safety issues are not ignored, the immediate shipping agenda items are piracy and environment, with policy and technical advances which should seriously influence ship's design.

While possession and use of weapons on board ships are widely discussed, new anti-piracy measures break through, like citadels and other measures. Whether it is active measures or passive measures, these solutions will require additional spaces. However, in line with the present tonnage measurement, these non-earning spaces will have to be integrated in the GT and levied accordingly. The non-distinction between spaces create a disincentive to build areas which helps to resist and/or combat pirates. Therefore, ships without anti-piracy spaces will benefit from a competitive advantage to the detriment of security of the ship and its crew.

Since the Rio Declaration in 1992, the UN agencies and governments focus on environmental issues. Far from being an episodic trend, this agenda mobilizes a serious part of social structures and will last a long time.

Often considered to be a resource for growth, some players assert that green agenda would push our world towards a new era. Whatever is the accuracy of these predictions, the outcome of global care on the environment is materialized through an increasing number of regulations.

Shipping industry adheres to this tendency. More and more regulations are adopted and entered into force. Some of these requirements will have serious impacts on GT. The table below highlights some potential effects the Convention could have on a ships' GT.

Convention	**Issue**	**Expected technology**	**GT impact**
Marpol Annexes I-5	Marine pollution by ship waste	1 Extension of sensitive and protected areas will require large on-board space to keep wastes (annex 5) 2 If all categories of wastes are to be retained on board and only discharge in shore facilities, additional storage spaces would be required.	Increase of GT

Convention	Issue	Expected technology	GT impact
Marpol Annex 6	Marine & air pollution	1 Vessel's design to improve EEDI 2 Engine and machinery spaces modifications 3 New equipment requiring spaces – i.e. scrubbers 4 New types of storage spaces 5 Alternative Fuel – LNG, Hydrogen, etc., & retrofitting or conversion will require additional space 6 Modular ship concept 7 Use of solar panel (i.e. Projects of containership covered by solar panels)	Impact on GT (And in case of new equipment, retrofitting or conversion could require GT increase and NT decrease for existing vessels and additional constraints for newbuildings)
Anti-Fouling System Convention	Protection of the ecosystem – biocides and HAOP	New types of anti-fouling	No impact
Ballast Water Management Convention	Protection of the ecosystem – Transport of Harmful Aquatic lien Organisms and Pathogens (HAOP)	1 Required treatment equipment and spaces to install them 2 New vessel's design (i.e. new ships projects without ballast)	Increase of GT with equipment size (will affect exiting ship and newbuilding) Undetermined impact of new design
Shiprecycling Convention	Coastal and marine environment protection & Labour issues	1 Issuance of Inventory of Hazardous Material 2 Cradle to Grave principle	Unknown effect but these two elements would certainly require modification of present vessel's design
Goal-based standard	Renew construction rules and regulation	New design and new internal structures	Unknown effect. However, to preserve their interests and reputation asset, selected rule makers will probably increase their safety margins and therefore increase GT

Most of these conventions will have an unknown or increasing effect on GT. It means builders and architects will have to consider tonnage measurement while finding inventive solutions to cope with new regulation. The 1969 TM Convention constraint may have serious detrimental effects on innovative design and choices.

Because the 1969 TM Convention does not differentiate between enclosed spaces, the Convention may penalize innovative designs demanding extra enclosed space to better achieve regulation requirements.

While no deduction or incentive can be achieved, there is high risk that the 1969 TM Convention blocks innovation.

The 1969 TM Convention restricts the freedom needed to develop innovative ships and constrain the builder to be obsessed by tonnage's impact on innovations.

Large companies are working on novel vessels designs:

- Shipyards: in Europe, some works are initiated on a 5-hull cruise ship with sails
- Shipping companies: several Asian shipping companies invent new project using solar cell panels and other techniques
- Classification societies: some classification societies unveiled several projects – i.e. reduced ballast quantity and without ballast tanks

All these projects are publicly visible on internet but it would be interesting to investigate more in-depth. Innovative design impediment is a serious argument to review and amend the 1969 TM Convention.

4 Fees and thresholds: sources of the issue

The use of tonnage figures as criterions to establish fees and thresholds makes the tonnage measurement a serious issue.

As detailed previously, tonnage builds a link between internal volumes and expenses. Because tonnage was part of the registry process, it became a commonly used yardstick to distinguish ships' sizes and establish levies.

An outcome of the 1969 Tonnage Measurement Convention was the creation of an International Tonnage Certificate which includes in its front page GT and NT. Therefore, these two "easy to extract" figures became multipurpose tools.

The simplicity to extract these figures generalized their indistinct utilization without questioning the relevance of using them.

This question of the relevance is particularly important because we had established that present calculation improperly represents ship's magnitude and earning capacity.

4.1 Quasi-universal Criterion

Largely used because easily identified, GT and NT are particularly difficult to contest and to renew.

4.1.1 Fees based on GT & NT

A large variety of fees are established, based on GT and NT. Ports collect numerous charges related to the service provided: light & fairway dues, port dues & wharfage, pilotage, towage, cargo handling, berthing/unberthing, waste disposal… These fees vary according to each port in numbers, types and foundations. Among them, port authorities often collect "tonnage dues" adjusted on GT:

> "The calculation of the tonnage dues is exclusively based on the gross tonnage unit stipulated in the submitted tonnage certificate, in accordance with the definitions of the 1969 International Treaty on the measurement of seagoing vessels. For open-top containerships, the reduced gross tonnage is taken into account." (Port of Antwerpen, Tariff regulations for sea-going vessels, 2011)

Acknowledging GT's lack of consistency, port authorities define their charges according to various parameters including ship's type, trade, size … Ports define scales of tariffs to counterbalance tonnage effects, inter alia, the effect of GT on some ships.

In Antwerp, Ro-Ro ships pay 0.4579 (EUR/GT) whereas Containerships pay 0.5592 or 0.5923 (from 18% to 23% difference) and reefer 0.5592 (18%). In Gdynia, Ro-Ro ships pay 0.18 whereas Containerships pay 0.22 (18%) and reefers 0.49 (63%).

GT-charges mean taxation of the whole internal volumes of the ship which include crew spaces, working spaces and all non-earning spaces.

Few ports use NT to charge ships:

"The basis for this charge is the net tonnage of the vessel. The vessel charge is calculated by multiplying the charge with the net tonnage." (Port of Helsinki, Price list, 2011)

In such a case, charges are collected on the earning capacity of the vessel, so crew space and other volumes are free of charge.

Generalized, this method of taxation should certainly not affect crew spaces and safety because these items remain out of the scope of taxation. However, the present tonnage measurement still does not encompass ships with deckloads and solves only half of the problem.

4.1.2 Tonnage Tax issue

Tonnage tax is often an optional alternative to Corporation Tax to which certain shipping companies may elect to have their profits charged.

In short, the company pays taxes according to the tonnage of their fleet. The levy disregards the company's profits. The tax burden is known in advance which reduce the financial risk in a competitive environment, and this levy is neutral to the performance of the company.

In the context of the generalization of this method of taxation in the shipping world, GT is a serious target for shipowners and another serious incentive to reduce GT and minimalizing the earning capacity.

The assessment of tonnage is becoming a serious stake for State which establish their levy on Tonnage and not corporate. Some of them could be sensible to tonnage measurement able to encompass all situations and particularly the issue of deckload.

4.1.3 Thresholds

Numerous IMO and ILO conventions set thresholds on GT. The rationality to use GT for anything is subject to questioning. And, as demonstrate by various documents, in many cases, alternatives to GT ought to be found.

The document "Consequences of the gross tonnage measurement", developed by the Dutch Ministry of Transport and presented during SLF 48, presents a review of the thresholds that should be re-evaluated and re-adjusted:

> ***Lack of causal link***
>
> Apart from the argument whether GT has implications on the safety and the stability of a vessel, it is obvious that in several instances the reference to the GT measure is rather irrational because of the lack of causal link between the specific aim that is pursued in setting the threshold and the GT measure itself:
>
> – The requirements for navigational equipment shouldn't be a function of the vessel's GT but of the needs for safe navigation and communication in the shipping lanes in which she operates as well as in her ports of call;
>
> – Whether lifeboats or rafts should be provided is not a matter that should be decided on GT (SOLAS Chapter III states a threshold of 500 GT or less than 200 passengers) but exclusively on the maximum number of people that are allowed on board (size of the crew plus complement of passengers);
>
> – Crew certification requirements should be dictated by the tasks that have to be carried out in order to ensure a vessel's safe and sustainable running;
>
> – Minimum accommodation standards ought to be decided so as to optimally motivate the crew and ensure its fullest commitment to the effective and efficient execution of the tasks at hand;
>
> – Setting port dues on the basis of the GT of a vessel doesn't allow taking into account the demand that a vessel makes on a port's infra and superstructures. There is no direct and realistic relationship between GT and the depth and width of the entrance channel needed by a vessel, the type and scale of the general civil works that have to be provided to accommodate the vessel or the amount of dredging that needs to be carried out alongside the berths;
>
> – GT is not the proper yardstick for determining fish catching capacity. More significant in this respect are the ability of the shipper, availability of electronic instruments, net size, fishing method, fish pump capacity, distance to the shore, freezing capacity and days effectively spent on the fishing grounds.
>
> The widespread use in International Conventions or subsequently in national laws of GT as a reference unit to define requirements, mandatory or otherwise, generates directly or indirectly additional costs for operators of vessels with relative higher GTs. But other costs

In addition, one can mention provisions related to MLC 2006 and to Ballast Water Management Convention. In the later Convention, threshold should be based on ballast water capacity rather than on GT.

Using GT as a common norm to settle all kinds of thresholds should be re-evaluated. Alternatives already exist like: number of persons, length…

When the stakes are high, like in shipyards and canals, other methods of calculation prevail:

- Suez Canal and Panama Canal possess their own methods which tend to integrate shipping evolutions in order to encompass, with fairness, all situations.

- Shipyards use a particular tonnage measurement method which combines various data in order to convey a better picture of the cost to build vessels of different types (= compensated gross tonnage).

Even if these tonnages are specific, this shows that tonnage should not be considered as an untouchable universal tool – canal authorities and builders consider for themselves more accurate systems of measurement.

Gross tonnage is also frequently used by governments and officials for statistical use.

4.2 Existing alternative for port dues

Ports and countries can enact their own regulations to implement port dues at their convenience. In this respect, the European study "Tonnage Measurement Study" issued in November 2006 highlighted and discussed alternative practices existing in the European Union.

4.2.1 The French and Polish system

France determines port dues "according to the geometric volume V of the vessel calculated as shown in article R-212-3 of the French Code of Maritime Port Law, by application of the rates shown in the table below in € per cubic metre."

Volume V is determined to the following formula:
V = L x b x D

where V is expressed in cubic metres, L, b and D mean respectively the vessel's overall length, breadth extreme and maximum summer draught expressed in metres and decimeters.

In the port of Gdynia, Poland, pilotage fee is calculated using the same method:

The pilotage charges are levied on the volume (V) in cubic meters using the following formula: ***V = L x B x T*** where:

- for ship: L = maximum length, B = maximum breadth, T= summer draft,
- for towing train (''push train'' or ''tug alongside the ship''): L = train's maximum length, B = train's maximum breadth, T = tug's or ship's extreme summer draft ,
- for towing train (''tug afore the ship''): L = tug's maximum length + ship's maximum length, B = train's maximum breadth, T = tug's or ship's extreme summer draft ,

expressed in meters and centimeters as contained in Lloyd's Register of Ships

Such methods possess the advantage of being easy to implement and verify because, ship's dimensions are extracted from existing mandatory certificates –International Tonnage Certificate and International Load Line Certificate.

The principle is to assess the overall volume of the vessel in order to identify the volume of port occupied by ships and charge them accordingly. The ship pays according to the space – port service, used and not according to the ship's internal volume -ship's data.

This is another approach in port dues because the levy is based on the port's infrastructures mobilized to operate the ship and not on ship's capacity – size or earning capacity. Therefore, vessels pay according to their overall dimensions and not to their enclosed volumes.

It is a change of mind set because fees are related to ports' interests and not ships' interests. This method makes sense because ports need to dredge, construct and maintain costly infrastructures to welcome ships.

Used for several years in many locations, this method never jeopardizes funds collected by ports and never caused particular disturbance neither to local authorities nor shipping.

A very similar method was unsuccessfully promoted by Australia in the IMO during the 2000s. Unfortunately, the Australian proposal was dismissed by the correspondence group. The proposal was considered unclear in its ability to modify the present situation. Another argument against was the willingness of many States not to jostle the present business status quo.

These methods, based on dimensions of ships, should not promote enclosed space reductions and, in addition, should little or no hamper ship's design. However, the marginality of these methods cannot presume for their impact.

4.2.2 The Croatian and Slovenian systems

Croatia and Slovenia do not considered it relevant to charge the ship using GT. The port fees are adjusted according to the cargo.

In short, the value and quantity of goods loaded and discharged in the port are used as a basis for charges. Quantity and type of cargo determine the port's expenditure.

This method has no impact on ships at all and is directly related to the sole earning capacity of the vessel.

The Croatian, Slovenian, French and Polish systems commonly share the idea to shift levy from the ship's characteristics to port needs. The ship capacities does not matter so much, what matters is the resources mobilized by the port to serve the ship because, most probably, ports represent national interests.

4.2.3 Compensated gross tonnage Shipyard measurement

As mentioned previously, the shipbuilding industry uses its own tonnage measurement which includes additional parameters like manpower …" The cgt-system is a statistical tool developed in order to enable a more accurate macro-economic evaluation of shipbuilding workload than is possible on a pure deadweight tons (dwt) or gross tons (gt) basis."(OECD, 2007)

This example shows the importance to define a precise and purpose based tonnage to match with requirements of a sector which requires measuring the accuracy of the activity involved in the shipbuilding operation.

Alternatives presented to the IMO

Discussions in the IMO were numerous during the last decade and several directions were pointed by the Parties.

Limited amount of alternatives

Among the discussions on the 1969 TM Convention, correspondence groups worked on various options to address the issue. Three main directions (among many proposals) were:

Maritime Real Estate concept (MRE):	**Promotion of NT:**	**Deductions and exemptions:**
Proposal to insert an additional figure on the International Tonnage Certificate MRE = L x b x D (k)	At the origin, an aim of the 1969 TM convention was to establish most of fees on NT which is expected to represent the ship's earning capacity Several proposition wished to promote NT	Reduced GT exist for open-top containership and tanker using segregated ballast New proposals aim to record an adjusted GT excluding crew accommodation

As previously mentioned, NT is not addressing the whole issue but have the advantage of not having any impact on non-earning spaces.

Deduction and exemptions as proposed today should be recorded as a "remark" on the certificate and non-binding for levy.

4.3.2 Total ship's volume & k factor

The Australian proposal of creating a MRE sought to address the entire issue. This method was similar to previously described cases of France and Poland.

In addition, Australian proposal intended to insert the result of the calculation of L x b x D (k) inside the International Tonnage certificate as Maritime Real Estate. The k factor seek to close MRE to existing GT.

This method was refused. The main arguments against are found in document SLF 53/5:

Option D – Establish a new tonnage parameter: maritime real estate gross tonnage (GT_{MRE}) This option seeks to establish an alternative parameter to GT or NT for use in assessing fees. The alternate parameter, referred to as GT_{MRE}, is based on the ship's actual maritime real estate (i.e., volume of length x breadth x draught), modified by a factor such that the total aggregate GT_{MRE} tonnage of the world's shipping approximately equals the total aggregate GT of the world's shipping. GT_{MRE} effectively excludes the volume of all parts of the ship (freeboard, superstructures, deckhouses, hatches, sheer, etc.) above the summer waterline that are included in GT.	
Benefits	***Disadvantages***
1 Facilitates the incorporation of larger enclosed cargo spaces, thereby avoiding undesirable design features such as reduced freeboards and excess deck cargo that are driven by the desire to avoid high fees based on GT. 2 Facilitates the incorporation of larger crew accommodation spaces and other beneficial non-revenue spaces (such as pollution control spaces).	1 Relies on voluntary implementation of GT_{MRE} as a basis for assessing fees, over which IMO has no control. 2 Encourages high block coefficients and ungainly ship proportions that may be detrimental to safety in terms of maneuverability, seakeeping, efficiency, and crew comfort/fatigue. 3 Disfavours multi-hull ships and similar craft with large breadth measurements. 4 Provides an incentive to minimize full load displacement (draught), which could lead to reduced scantlings, removal of ballast, and otherwise adversely affect ship design and safety (including crew comfort/fatigue).

Another proposal was submitted to address the issue of high block coefficients but was disregarded.

Variant D2 – Establish a new tonnage parameter: block coefficient maritime real estate gross tonnage GT_{CbMRE}

This option seeks to establish an alternative parameter to gross or net tonnage for use in assessing fees. The alternate parameter, referred to as GT_{CbMRE}, is based on the ship's actual maritime real estate (i.e., volume of length x breadth x draught) modified by both the ship's block coefficient (C_b) and a conversion factor calculated using maritime real estate values, block coefficients and gross tonnages for existing ships of a similar type. It would be assigned to new ships as an alternate for the GT parameter: current ships would not be assigned GT_{CbMRE}. Use of this parameter for assessing fees would lessen the gross tonnage "penalty" for the volume associated with larger crew accommodation spaces and enclosed cargo spaces (which in turn drive designs to favour larger deck cargo loads).

Benefits	*Disadvantages*
1 Facilitates the incorporation of larger enclosed cargo spaces, thereby avoiding undesirable design features such as reduced freeboards and excess deck cargo that are driven by the desire to avoid high fees based on GT.	1 Relies on voluntary implementation of GT_{CbMRE} as a basis for assessing fees, over which IMO has no control.
2 Facilitates the incorporation of larger crew accommodation spaces and other beneficial non-revenue spaces (such as pollution control spaces).	2 Discourages certain novel designs (e.g., some high speed craft designs with large breadth measurements).
	3 Provides an incentive to minimize full load displacement (draught), which could lead to reduced scantlings, removal of ballast, and otherwise adversely affect ship design and safety (including crew comfort/fatigue).
	4 Involves classification of ships by type, which is inherently problematic (e.g., must establish precise definitions of ship type, difficult to categorize multi-service ships, change of ship service could lead to large tonnage change).
	5 Introduces constraints on future ship designs by "locking-in" tonnage conversion factors based on drafts and other characteristics of existing ship designs.

4.3.3 Promotion of NT

Establishing fees on NT was the initial philosophy of the tonnage measurement because the levy is collected according to the earning capacity of the ship.

Unfortunately, by habit and because it is the largest figure on the certificate, ports are collecting taxes on GT.

Promotion of NT failed to gather IMO delegates and was rejected by the last report of the correspondence group (SLF 53/5).

Option B – Promote use of the existing net tonnage (NT) parameter
This option seeks to promote use of the existing NT parameter, *in lieu* of gross tonnage (GT), as the basis for assessing fees. NT is calculated using the ship's cargo space volume, number of passengers, and the ship's draft to depth ratio, but in no case may NT be less than 0.3 GT. Implementation of this option can be accomplished through issuance of an IMO circular or resolution at the appropriate level.

Benefits	***Disadvantages***
1 Facilitates the incorporation of larger crew accommodation spaces and other beneficial non-revenue spaces (such as pollution control spaces) for many cargo ship designs. 2 Encourages the design of ships of all kinds with greater freeboards (higher depth to draft ratios) that are, arguably, safer, due to favourable treatment under the NT formula.	1 Relies on voluntary implementation of NT as the basis for assessing fees, over which IMO has no control. 2 Could drive designs in the direction of excessively high freeboards, leading to ungainly ships with excessive wind profiles that are difficult to steer. 3 Does not remove the incentive to minimize the size of crew accommodation spaces for some ship types (e.g., towing vessels), where the NT is "capped" at 0.3 GT.

NT promotion is probably an interesting direction to investigate and support because it has the advantage of not modifying the concept of tonnage, so it should not frighten the opponents; it is extremely simple to implement; and, it is easy to defend and implement.

4.3.4 Deductions and exemptions

This option is the latest development of the talks about the 1969 TM Convention. Deduction for accommodation was proposed during MSC 89 by Germany and supported by ILO.

The principle is positive because it indicates a need for flexibility to evolving shipping industry. However, the proposal remains non-binding because it has not passed through an amendment process.

There is no ideal solution to replace a system that failed to achieve its intended goals. Each proposal possesses its own risks.

In other words, the complete renewal of the method of measurement should probably not be the objectives of the review. The target of the review should be to open the tonnage measurement to shipping changes in order to provide flexibility and encompass properly all situations. Therefore, the modification of the amendment procedure system (article 18) is paramount.

5 Conclusion

Acknowledging the economic impact of enclosed spaces, shipbuilders and designers focus on volume reduction and come up with solutions to downscale tonnage figures while keeping intact the earning capacity of the ship. Indeed, such designs minimize ships' tonnage (particularly GT) but affect ships' safety, crew well-being and penalize innovative designs involving enlargement of enclosed spaces. Not surprisingly, weird designs emerge hampering ship's resilience.

Because Gross Tonnage calculations account for absorb all enclosed spaces without distinction, the present system dissuades large enclosed spaces including accommodation as well as occupational spaces. While shipping industry is facing serious difficulties in recruiting and retaining officers and crew, incentive to promote crew well-being should be embraced enthusiastically. Seafarers expect shipping community to act and demonstrate

respect to their human and social needs which have a serious impact on human element performance.

In addition, numerous documents submitted to IMO listed the detrimental impacts of tonnage measurement on the safety; some are particularly noticeable: freeboard height, lack of buoyancy, low forecastle, poop design, high stress on deckload lashing, etc.

Despite its wide acceptance, the 1969 TM Convention is becoming, year after year, less capable to encompass ships' diversity which is slowly destabilizing the level-playing field. The origin of this inconsistency relies on inability to integrate major innovations (like containerization) and its lack of consistence in assessing ship's size.

Ultimately, if tonnage measurement constraints are neglected; any innovation implying enclosed space enlargement will not be considered. Such an observation is particularly alarming because the shipping industry is confronted with serious regulatory challenges.

Whereas, the detrimental effects of the 1969 TM Convention are indisputable and well-demonstrated, a lot of delegations are reluctant to approach this issue because they are afraid to open what they consider as "Pandora's box". The original fear is related to the history of tonnage measurement. The non-harmonization, complexity and chaos which characterized non-harmonized tonnage measurement principles prior the 1969 TM Convention, is still in the memories. However, such a fear is presently irrelevant because, the IMO secures a single internationally recognized instrument to deal with tonnage. So the harmonization of International Tonnage Measurement should remain, even if the current convention evolved.

The main concerns are somewhere elsewhere. They are related to business stability and adequate fund collection. These two categories aggregate three significant concerns:

- Firstly, as general rule, shipping business requires regulatory stability. So, for some delegations, modifying the 1969 TM Convention means jostling the current business conditions and unbalancing the competition.

- Secondly, the fear to implement a system which could be worse than the previous one.

- Thirdly, the changes in tonnage figures are often supposed to disrupt levy collection by ports. If it is likely that changes in the 1969 TM Convention may affect competition, such changes will not affect ports because they have the ability to counterbalance the modifications by adjusting their levy system.

Despite the numerous concerns described in the study, the shipping community remains uncomfortable in modifying present business stability. This stance tends to overlook the core of the issue: the detrimental effects of the 1969 TM Convention which presently jeopardize the human element, fair competition, and safety as well as impede the development of innovative designs. Unfortunately, the current regulatory status quo seems to justify identified risks to remain uncorrected.

However, numerous documents form the MSC and the SLF Sub-Committee have demonstrated a willingness to address the detrimental effects of the 1969 TM Convention. Before any agreement on the necessary modification of the 1969 TM Convention, a serious issue has to be overcome: the amendment process. Only a modification of the amendment procedures will allow sufficient flexibility to the 1969 TM Convention to be adjusted to shipping current needs.

6 Selected bibliography

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