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Tonnage measurement of ships : historical evolution, current issues and proposals for the way forward

Aji Vasudevan
World Maritime University

WORLD MARITIME UNIVERSITY
Malmö, Sweden

TONNAGE MEASUREMENT OF SHIPS: HISTORICAL EVOLUTION, CURRENT ISSUES AND PROPOSALS FOR THE WAY FORWARD

By

AJI VASUDEVAN

India

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Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has been previously conferred on me.

The contents of this dissertation reflect my personal views, and are not necessarily endorsed by the University.

Signature : ....

Date : 30-AUG-2010. ....

Supervised by : Jan-Åke Jönsson,
Professor,
World Maritime University, Malmö.

Assessor : Dr.-Ing. Michael Baldauf,
Assistant Professor,
World Maritime University, Malmö.

Co-Assessor : Jan Frisk,
Principal Tonnage Surveyor (Retd.),
Swedish Maritime Administration.

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Abstract

Title of Dissertation : Tonnage Measurement Of Ships: Historical Evolution, Current Issues And Proposals For The Way Forward.

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'Tonnage' has been used for centuries to indicate the relative magnitude of ships. The term 'tonnage' originated during the days of wooden sailing vessels, when the costs for protection from incessant war and piracy were recovered from ships, and based on the number of wine-barrels, or *tuns*, it carried. This parameter was termed '*tunnage'*, which later became 'tonnage' and was mainly used as the basis for collecting ship's dues. Over a period of time, tonnage was found to be a convenient basis for various other purposes, such as shipping statistics, regulatory applications, manning and insurance.

In this research paper, a study about the historical evolution of different tonnage measurement methods is made, followed by a detailed analysis of the problems with the current measurement method, in the historical background. Thereafter, a number of recommendations are made for improvement based on sound justification.

The '*International Convention on Tonnage Measurement of Ships, 1969*', or (ITC-69), is the current international standard for tonnage measurement of ships. The ITC-69 has not yet been amended, despite significant changes in the type and design of ships during the last 40 years. Some flag States have reported to IMO that the ITC-69 has resulted in undesired effects such as economic disadvantages to specific type of ships, unilateral actions by States and unsafe designs. The reported problems and complaints about ITC-69 are consolidated and analyzed here in the historical perspective, to establish the root-causes and inadequacies of ITC-69.

Finally, various options are evaluated using qualitative and quantitative techniques, and a number of recommendations for long-term solutions are made to address the deficient aspects of ITC-69. Areas for further studies in this topic are also indicated.

Key Words: Tonnage, Maritime Real Estate, Moorsom, Toll-tonnage, Open-top, GT, NT, Tonnage Convention, Tonnage Measurement.

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List of Abbreviations

ACP	:	The Panama Canal Authority
AMSA	:	Australian Maritime Safety Authority
C_b	:	Block Coefficient
COLREG-72	:	Convention on the International Regulations for preventing collisions at Sea,1972.
ESCAP	:	United Nations Economic and Social Commission for Asia and the Pacific
EC	:	European Commission
EU	:	European Union
FAO	:	Food and Agricultural Organisation
GRT	:	Gross Register Tonnage, in tons
GT	:	Gross Tonnage, as per ITC-69
IAPH	:	International Association of Ports and Harbours
ICFTU	:	International Confederation of Free Trade Unions
ILO	:	International Labor Organization
IMCO	:	Inter-Governmental Maritime Consultative Organization
IMO	:	International Maritime Organization
ITC-69	:	International Convention on Tonnage Measurement of Ships,1969
LL-66	:	International Convention on Load Lines, 1966
LRS	:	Lloyds Register of Shipping
OECD	:	Organisation for Economic Co-operation and Development
UNCLOS	:	United nations convention on the Law of the Sea, 1982
MRE	:	Maritime Real Estate
MSC	:	Maritime Safety Committee
NIS	:	Norwegian International Ship Register
NRT	:	Net Register Tonnage, in tons
NT	:	Net Tonnage, as per ITC-69
OECD	:	Organization for Economic Co-operation and Development
OSV	:	Offshore Supply Vessels
PC-NT	:	Panama Canal Net Tonnage
PC-UMS	:	Panama Canal Universal Measurement System
PRC	:	Policy Research Corporation

PSC	:	Port State Control
SBT	:	Segregated Ballast Tanker
SC-NT	:	Suez Canal Net Tonnage
SLF	:	Sub-committee on Stability and Loadlines and on Fishing Vessels Safety (IMO)
SOLAS-60	:	International Convention on Safety of Life at Sea,1960
SOLAS-74	:	International Convention on Safety of Life at Sea,1974
STCW	:	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended
TEU	:	Twenty-foot Equivalent Unit
TT	;	Toll Tonnage
UK	:	United Kingdom
UN	:	United Nations
UNCTAD	:	United Nations Conference on Trade and Development.
US	:	United States of America

SECTION-I. INTRODUCTION

CHAPTER-1 . About this Thesis

1.1 Background and Aim of the study.

1.1.1 Background

Records of measurement of a ship's size can be traced back to the 13th century. According to French (1973), '*shipping tonnage was a useful indicator of a country's commercial (and military) strength especially during a century when countries concentrated so much of their energy in extending their commercial empires'*. It was also used for imposing taxes on ships, indicating physical carrying capacity of ships and comparison of trade and movement of goods.

The tonnage measurement methods in the 19th and 20th centuries were mostly based on 'Moorsom's System'[1], though the national rules varied widely across the world. In early 20th century, it was recognised that there is a great need for a single international system. It was one of the priorities when IMCO (now IMO) first met in 1959.

The current international standard for tonnage measurement, is the 'International Convention on Tonnage measurement of Ships, 1969' (ITC-69), adopted on 23rd June 1969. It entered into force on 18th July, 1982 and was progressively implemented to cover all merchant ships within the next 12 years.

ITC-69 was primarily aimed to establish an internationally acceptable system for measuring a ship's size. It was drafted in such a way that the gross and net tonnages, calculated through a relatively easier method, did not differ greatly from those calculated under previous methods. It resulted in a transition from traditionally used terms Gross Register Tons (GRT) and Net Register Tons (NRT) to Gross tonnage (GT) and Net tonnage (NT).

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[1] The method embodied in the British Merchant Shipping Act of 1854, developed by a Royal Commission headed by George Moorsom, universally known as 'Moorsom's System'.

From the medieval times, the ship-designers, shipbuilders and ship-owners made every effort to get the lowest possible tonnages for a given deadweight, even by compromising the safety or crew welfare aspects. This continued even under ITC-69.

After ITC-69 was adopted 40 years ago, substantial developments have taken place in the sizes and types of ships. Though the tonnage of every type of ship can be ascertained under ITC-69, it was reported that the regulations in ITC-69 are not consistent with the subsequent developments in design and operational aspects of ships, leading to commercial disadvantages for certain new type of ships.

In view of the above, a number of countries have urged IMO in recent years to make necessary changes and update the provisions of ITC-69 to address deficient areas. The problems highlighted were mainly related to safety issues connected with imaginative and flexible interpretation by designers/owners to reduce tonnage, penalization for safety measures such as higher freeboard, specific commercial disadvantage to some types of ships, and various thresholds for applicability of IMO conventions.

Although it was intended at the time of adoption of the ITC-69 that the regulations should not influence the shape and layout of ships, experience shows that this has not necessarily been achieved and that the trends have been against improvement of safety standards. The ITC-69 has not been amended since its adoption in 1969, though IMO has adopted resolutions and circulars as interim measures. The need for early amendments and updating of ITC-69, to remain as a uniform method to determine the ship's size, as intended originally, has become increasingly evident during the last few years.

Based on the submissions from member countries to IMO, a work programme was approved by the 81st Session of Maritime Safety Committee on the 'development of options to improve effect on ship design and safety of the ITC-69'. At present, various proposals are under consideration by the 'Tonnage Correspondence Group' re-established at the 52nd session of SLF Sub-committee and targeted for completion by 2011 (IMO,2008a; IMO,2008b).

1.1.2 Aim of the study

This research aims to identify various issues/drawbacks of ITC-69, to analyse them in detail in the historical perspective, and to formulate solutions for a way forward.

1.2 Structure of dissertation, Methodology used and Constraints

1.2.1 Structure of dissertation

This dissertation is divided into 4 sections, with Chapters under each section. **Section-I** has two Chapters (1&2), containing the aim of this research, methodology used, background information about the topic and the terminology related to tonnage.

Section-II, (Chapters 3&4), covers the evolution of tonnage measurement before 1969. The historical aspects have significance in this thesis, to highlight the complexities in the subject and to illustrate the constraints faced while establishing an international agreement in 1969. The reasons which led to the development of a number of methods from 13th century are identified, based on research in maritime history literature. The findings in this section, especially regarding the developments between the 18th and 20th centuries, are correlated and analysed in Section-IV.

Section-III (Chapter-5) brings out various issues and drawbacks related to the current tonnage measurement system under ITC-69. The drawbacks, areas of non-uniform application, impediments to amendment, effect on safety and social aspects are discussed. This is based on the research data collected on issues raised at international level, industry afflictions, accident investigation reports and changes in ship-design.

Section-IV, (Chapters-6,7&8), covers the core part, analysing and synthesising the outcome of the research from Sections II and III. In addition to the analysis undertaken based on the research pertaining to past and current data, a futuristic view is also taken while evaluating different options. At the end of this section, recommendations, supported by arguments and viewpoints, are made to address the deficient aspects of ITC-69 and areas for further research are indicated.

1.2.2 Methodology followed

During the initial part of the research, various measurement systems used in the past are studied (Chapter-3&4). Thereafter, the evolution of ITC-69 and the current issues and practical problems are examined in detail (Chapter-5&6). Practical solutions are formulated after a detailed analysis of historical aspects and current issues of ITC-69 (Chapter-7). Based on this, recommendations are made in the final chapter (Chapter-8).

A combination of qualitative and quantitative methods has been used in this research. Qualitative techniques have been used to collate and analyse data on various tonnage measurement methods in the past and present. It includes historical data and literature about the conceptual evolution of tonnage since the 13th century, different methods used in the past (until ITC-69 came into force) and their problems. Thereafter, development of ITC-69 as a new method, and the current issues of ITC-69 are discussed and analysed using both methods.

While formulating the solutions, quantitative techniques have been used with sample data of 25,747 ships of 22 types, representing the world shipping fleet, as an aid to decision-making.

1.2.3 Constraints.

Tonnage measurement was more of an art than science, and hence it was not easy to find technical articles about the subject.

The articles or regulations of ITC-69 are neither discussed nor analysed in detail to the extent of those in SOLAS or MARPOL. Hence it was very difficult to locate literature about various technical and social issues concerning the existing system, and the evolution of tonnage measurement systems. Most of the articles available about this topic, cover areas related to economic aspects, such as trade growth, cargo movement and national fleet strength, but rarely discuss the technical aspect or the necessity for change.

Hence extensive research was necessary to obtain technical information about current and historical aspects of tonnage measurement. An extremely large number of publications and articles dating from the 1850's were to be collected and studied during the short period. There were considerable delays in getting some of the documents published in 19^{th} and early 20^{th} centuries, and a few of such documents could not be obtained. Notwithstanding these constraints, every effort was made to gather the maximum amount of information and to cover all possible areas of concern.

While formulating solutions, a sample database representing the world shipping fleet was chosen to study the impact of proposed changes. The data available was incomplete in many respects and extensive efforts were needed to validate the database, in order to make the sample size as large as possible.

The length of the thesis could have been reduced by pruning the initial chapters. In order to portray the right background for this thesis, the author felt it necessary to cover the essential historical aspects, at the expense of a few extra pages, since consolidated information on history of tonnage measurement is not available. This will also be very useful for further research in the topic.

CHAPTER-2 . Tonnage of Ships : A Prelude

2.1 Terminology.

According to Moorsom (1855a), the purpose of the term 'tonnage', as originally applied to vessels, is not unequivocally set forth in documents. It is not clearly distinguished whether 'tonnage' referred to the 'weight carrying capacity' or 'volume capacity' or 'cargo space'. The word has meanings[2] so different between them that the tonnage of a vessel measured in one kind of 'ton' significantly differs from the tonnage measured in a different kind of 'ton' (Lane,1964).

It is necessary to understand and differentiate between the following terms used to express the relative magnitude of ships for various purposes, both past and present[3].

(i). Freight tonnage;
(ii). Displacement tonnage;
(iii). Deadweight tonnage;
(iv). Measured tonnage;
(v). Registered tonnage;
(vi). Gross Register Tonnage(GRT);
(vii). Net Register Tonnage(NRT);
(viii). Panama Canal tonnage;
(ix). Suez Canal tonnage;
(x). Gross Tonnage(GT);
(xi). Net Tonnage(NT);
(xii). Compensated gross tonnage; and
(xiii). Maritime real estate.

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2 'Ton' as a unit of weight has three meanings, (i) the short ton of 2000 pounds; (ii) the long ton of 2240 pounds; and (iii) the metric ton of 1000 kilograms or 2204.6 pounds. As a unit of volume, there is no established standard value for ton. However, conversion factors of 40 ft^3 and 100 ft^3 have been used determining ship's tonnage, as seen in later Chapters.

3 Some terms, that are not covered in the standard terminology and used rarely, such as power tonnage, are not discussed here.

2.1.1 Freight tonnage

In ancient and medieval times, wine was the most important cargo and the capacity of a ship was mentioned in terms of the wine casks, or '***tuns'***, carried by it. A 100 'tun' vessel meant that it could load 100 casks. The volume of a cask (approximately 40 cubic-feet) was related to one 'tun' (or ton) and freight rates for all other cargoes were fixed using this as a base. The volume occupied by other cargoes, was divided by 40 to obtain the equivalent 'ton' called 'freight tonnage'. 40 cubic-feet of space was allotted when payment was made for one 'ton'. George Moorsom[4] called the freight tonnage the "*measurement cargo at 40 ft^3 to a ton which a ship can carry*"(Lane,1964).

Freight tonnage is dependant on the cargo volume, not the weight (*tonneau d'affretement, tonnellata di nolo).* For easy comparison, it can be considered analogous to current cubic capacity terms such as bale capacity or grain capacity.

2.1.2 Displacement tonnage

Displacement tonnage is the weight of seawater displaced by a vessel at a particular draft. Two kinds of displacement tonnage were in use, 'light displacement tonnage' (*deplacement lege, dislocamento leggiero)* and 'displacement tonnage loaded' (*deplacement en charge, dislocamento a pieno carico)*. The displacement tonnage was used mainly for construction estimates of battle ships, and apparently not used before the 19th century (Lane,1964;Kendall,1948). The term 'displacement' in current terminology is comparable to the 'displacement tonnage' (Rawson&Tupper,2001).

2.1.3 Deadweight tonnage

The difference between 'light displacement tonnage' and the 'displacement tonnage loaded' is called 'deadweight tonnage', i.e., the weight of additional water displaced due to cargo weight. In older days, the weight of cargo was determined by weighing and counting the loaded units individually. For ordinary wooden vessels, deadweight tonnage was about 50% of its

[4] Secretary, Board of Trade in Britain, who framed the 1854 British tonnage rules, by a system of measurement, universally known as Moorsom System(1854).

'displacement tonnage loaded' (Lane,1964;Salisbury,1968). This term is comparable to 'deadweight' in current terminology (Taggart,1980).

'Burthen' or 'Burden' was also used to indicate the cargo capacity (Keene,1978). According to Davis (1962), the term 'tons burden' was used in the 18th century to denote '*the number of tons which would lade an empty ship down to her minimum safe freeboard or loadline'*.

2.1.4 Measured tonnage (or 'Old registered tonnage')

In medieval times, ships were '***rated'*** for a particular voyage. The '***rating'*** depended on the cargo capacity, ship's age, length and circumstances of intended voyage (*i.e., expected weather conditions and operating sea-area*), space allotted for stores and arms (*piracy was prevalent those days*), and in addition, on the judgement of shipwrights, masters and officials based on the above factors. Hence, there was plenty of room for arguments and negotiations between ship-owners, charterers and tax authorities, and a ship could have entirely different '***rating'*** for different voyages or different purposes or by different persons.

This practice created confusion and difficulties, since the ship had to be 'rated' each time it sailed. Gradually, official estimate of the ship's 'rating' was determined from the principal dimensions[5] (French,1973;McCusker,1997). The '***rating***' so determined from measurement of dimensions, is called 'measured tonnage'.

In French and Italian terminology, they were termed ton '*de jauge' or 'di stazza'*. The 'measured tonnage' is also termed '*old registered tonnage*', after the introduction of 'registered tonnage' in 1786[6] (French,1973;Lane,1964).

2.1.5 Registered Tonnage (RT)

The formula for 'measured tonnage' was not widely enforced until 1786. Since the taxes and dues were based on tonnage, a lower tonnage was declared by ship-owners during registration, though the higher 'measured tonnage' was used for building, buying and selling of vessels. The tonnage

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5 i.e, from the length of keel, breadth and depth, by using ´94´ as divisor without reference to block coefficient. Details in Ch-3.2.

6 Registry Act of 1786 in Britain.

indicated on the ship's registration documents is called 'registered tonnage'. The 'registered tonnage' was roughly two-third of the 'measured tonnage', rounded down to the nearest whole number (McCusker,1966).

In 1786, the law required all vessels to indicate the 'measured tonnage' during registration. Thereafter the 'measured tonnage' is same as the 'registered tonnage' (French,1973).

2.1.6 Gross register tonnage(GRT)

The 'registered tonnage' was intended as an indicator of total 'weight' of a ship (Moorsom,1855a). The weight of cargo was assumed to be 50% of the 'registered tonnage'. As the carriage of lighter cargoes such as cotton became more frequent, more space was needed for stowage. Spaces other than cargo space were also utilised for cargo, and ships with higher volume had higher earning potential. Further, the formula-based method for 'registered tonnage' led to the construction of ill-formed vessels with low tonnage, and the 'registered tonnage' did not realistically represent the actual 'weight' of the ship.

Due to these reasons, a new term 'Gross register tonnage (GRT)' was introduced in the 1854 British Act[7]. GRT is determined from the total volume of enclosed spaces. Each 100 ft^3 (or 2.83 m^3) is counted as one ton, and GRT is obtained by dividing the total enclosed volume in ft^3 by 100 (or by 2.83 if in m^3). The GRT could have decimal values (Lane,1964;Moorsom, 1855c).

The changes in design, transition from wood to iron hull, and changes in propulsion method meant that the GRT alone could not signify the cargo capacity. Some part of the cargo space was allocated for propulsion machinery in steamships (Hughes&Reiter,1958). The traditional desire to relate tonnage to income yielding cargo capacity, led to the development of another registered tonnage, called the 'net register tonnage' (NRT).

2.1.7 Net register tonnage(NRT)

'Net register tonnage' was intended to represent the earning capacity. It is obtained by deducting the volume of spaces not available for cargo (such as

[7] Merchant Shipping Act of 1854, in Part-II, Measurement and Registration of British ships.

space for propulsion machinery and crew's quarters), from the volume for GRT, and dividing the resultant volume in ft^3 by 100 (or by 2.83 if in m^3). The NRT also could have decimal value (Lane,1964;Moorsom,1855c).

2.1.8 Suez Canal net tonnage (SC-NT)

This tonnage is used only for charging toll for ships transiting the Suez Canal. Special rules, recommended at an international conference held at Constantinople on 18th December, 1873, are used for determining SC-NT. Though these rules are based on Moorsom's System, they differ in some aspects such as deductions and exemptions. The 1873 rules are still followed for SC-NT (Abu-el-hassan,1974;Corkhill,1980).

2.1.9 Panama Canal net tonnage (PC-NT)

This tonnage is used only for charging toll for ships navigating through the Panama Canal. Separate rules, based on Moorsom's System and Suez Canal rules, were developed for PC-NT in 1913. The principles of ITC-69 were incorporated into the rules in 1994, and now it is called 'Panama Canal Universal Measurement System' net tonnage, PC/UMS-NT (Barnett&Ruben, 2005;Corkhill,1980).

2.1.10 Gross Tonnage (GT)

Gross tonnage is determined according to Regulation-3 of ITC-69. The calculation of GT is much easier than earlier methods. GT is determined by a mathematical formula from the total enclosed volume of the ship, including superstructure and deck houses. The final figure is rounded down without decimals to get GT (IMO,1983a;IMO,1994).

2.1.11 Net Tonnage (NT)

Net tonnage is determined according to Regulation-4 of ITC-69. It is dependent on the total volume of cargo spaces, number of passengers, depth, draft, and the GT of the vessel. It is also calculated by a formula and the final figure is rounded down without decimals to get NT (IMO,1983a;IMO,1994).

2.1.12 Compensated Gross Tonnage (CGT)

CGT is not an indicator of ship's size. It is a statistical tool developed in 1968, for economic evaluation of shipbuilding output worldwide. CGT reflects the work content and complexity in building different types and sizes of ships. For example, one GT of a passenger ship with its sophisticated accommodation and public spaces requires a significantly higher level of work content than one GT of a bulk carrier. One CGT of either ship roughly reflects the equivalent work content, and is hence recognised as a superior tool to GT for comparison of shipyard workload and output. CGT is determined from the GT by using two internationally agreed correction factors, A and B, depending on type and size of ship (Menezes&Flynn,2007;Lorenz,1991;OECD, 2007;Stopford,2009).

2.1.13 Maritime Real Estate (MRE)

This is the latest term proposed to be used as the basis for vessel based charges. In 2005, Australia mooted the concept of 'Maritime Real Estate,(MRE)' as a third tonnage measurement, in addition to GT and NT (IMO,2005b;IMO,2005c). MRE is proposed as the product of length, breadth and draft, with a suitable scaling factor. This is one of the topics currently being studied by the 'Tonnage Correspondence Group' under the SLF subcommittee at IMO (IMO,2009a;IMO,2010).

2.2 Uses of tonnage

Tonnage is a term by which we form an idea of the magnitude of vessels (Moorsom,1855a). Tonnage measurement is ***the only statutory survey required to be completed*** before a ship is registered (Mansell,2007). From 1835, the manning scale of ships were decided based on the tonnage (Clapham,1910). The tonnage figures were used for statistics in maritime trade, and for charging taxes, levies and dues(North&Heston,1960). The customary measure of shipping or carrying capacity is the gross tonnage (Hughes&Reiter,1958).

Tonnage figures are used for comparison of national fleets, framing of policies on trade and shipping, granting of subsidies, comparison of shipbuilding/scrapping, regulatory applications, basis for manning, charging dues from ships, registration and survey charges, insurance premiums and limitation of liability in cases of pollution (ESCAP,1991;Taggart,1980).

SECTION-II. STUDY ON MEASUREMENT OF SHIPS BEFORE ITC-1969

CHAPTER-3 . Evolution of Tonnage Measurement

3.1 Origin of Tonnage

According to Owen (1907), *'there is no authentic record of the origin of the word 'tonnage', though it has been in use in connection with ships and imposts for centuries past'*. However, literature indicates that the term 'tonnage' originated in the 13^{th} century for imposing levy towards the cost of protection of ships, as they had to travel in convoy due to incessant war and piracy (Mansell,2007). George Moorsom,(1855a) discusses the declaration in 1422, during the reign of King Henry the Fifth, that '*keels that carry coals at Newcastle, shall be measured and marked*'.

In the 13^{th} century, wine was the major cargo and ships were levied according to the **'tuns'**[8] (wine-casks) they could carry. Subsequently this criterion became the norm by which all ships were levied, and was called '**tunnage'**, which later on became '**tonnage'** (Kendall,1948;Rawson&Tupper,2001). The term 'tonnage' as an indicator of ship's magnitude has survived for centuries, despite evolution of different measurement methods.

At that time, wine was carried in earthen jars of peculiar shape (Figure 1) called ***amphora*** or ***amphore*** (Lane,1964;Twede,2002).

Figure 1 : Amphora : unused space around it was also charged
(Picture Source: www.e-monsite.com/treasures/amphore-04-q3r16.jpg &
http://pedagogie.ac-amiens.fr/lettres/Latgrec/amphore.jpg)

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[8] *tun* in English, *tonneau* in French, is a wine-cask containing about 2000 lb (900kg) of wine (Lane,1964).

The 'tunnage' of a vessel was based on the maximum number of '***amphores'*** (or tuns) it could carry, and the freight rates and dues for a ship were based on its 'tunnage'. These earthen jars were heavy and increased the weight of cargo (wine) to be transported by about 65%, thereby submerging the vessel to permissible drafts even without filling up the available cargo space. In addition, there was unutilized space due to the ship's hull form and peculiar shape of amphores. To account for the loss of revenue from such empty spaces, the 'occupied space' for an amphore was calculated and related to its actual weight.

The introduction of wooden casks significantly reduced the weight of the containers from 65% to about 8%. This established a new average relationship between cargo(wine) weight and cargo space on ships. The same ship could carry more wooden casks, resulting in a higher 'tunnage'. A wine-cask measured about 40ft^3, but 'occupied' about 60 ft^3 due to its shape. However, only 40ft^3 (instead of 60) was allotted by ship-owners for payment of one 'tun', to earn more revenue. Further, 40 ft^3/ton was the average stowage factor of prominent cargoes. This measure of 40 ft^3 is termed as a '***freight ton***'. Subsequently 40 ft^3/ton was adopted as the volume-weight ratio for all cargoes other than wine (Davis,1956;Lane,1964;McCusker,1997). There were other units also in use for indicating the cargo capacity, such as the ***botta*** in Venice, ***tonneau*** in France, ***Salma*** in Sicily and ***läst*** in Scandinavia (McGowan,1981;Muller,2009;Lane,1977).

3.2 Shift to weight-based Tonnage

A review of the British enactments on tonnage measurement in 1695 and 1720[9] by Moorsom (1855a), clearly shows that 'the principle of displacement was entertained by the earlier projectors of the law'.

A description of the vessels designed by Fredrik Henrik Af Chapman in the 18th century indicates that tonnage represented displacement (Harris,1989; Schafullen,2002). Mendoza (2008) describes the Spanish methods[10] used in the 16th and 17th centuries for measuring tonnage in *toneladas* (i.e., tons) from the

[9] Smuggling Act of 1720.

[10] Different methods were used to determine tonnage in *toneles or toneledas* (units of weight) from the length of keel (*quilla*), breadth (*manga*) and depth (*puntal),* for which ordinances were issued in 1607 and 1613. Also refer Martin (1977).

principal dimensions. Records of 15th Century notes from Venetian shipwrights contain a formula[11] to determine the size of a ship in ***botte***. A similar formula[12] was used in England for estimating tonnage called 'Carpenter's formula' (or 'Builders' old measurement') (Hodson,1809;Lane,1964:Lyman,1968;Lyman,1977). These old formulae have similarities with the basic formula for ship's displacement, i.e., $LxBxTXC_b$, denoting that a weight based method was used for tonnage measurement during that period.

As mentioned in Para.2.1.5, ships were registered with a lower tonnage ('registered tonnage') to save port dues and expensive obligations, but owners desired a higher tonnage ('measured tonnage') while renting their ships to government for war or transport (Usher,1928). This conflict of interest originated in official measurement of tonnage (Salisbury,1966a).

The 'Carpenters formula' was adopted by the Royal Navy to assess the tonnage of hired private vessels in the late 16th century (Salisbury,1966b). Due to difficulties in measuring K (length of keel) and D (depth) of a laden vessel, the formula was simplified in 1695 as $\frac{(LB^2/2)}{94}$, by measuring the length on main deck (L) and assuming depth as B/2. According to Salisbury(1959), the divisor[13] '94' was obtained by experiment to get the 'burthen' (or 'cargo weight') and later used for statutory purposes. During most part of the 18th century, tonnage was calculated using this method (French,1973;Laughton,1958;Parsons,1831;Salisbury,1967; Salisbury,1969a). The carriage of guns was common on merchant ships and the spaces for guns on tween-deck were not measured. Salisbury(1969c), indicates that these gun ports might have become 'tonnage openings' subsequently.

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[11] Tonnage = $\frac{KBD}{6}$, K=length of keel, B=beam and D=depth

[12] Tonnage= $\frac{KBD}{100}$, K=length of keel, B=beam and D=depth; called Ship's Carpenters formula. Also called Mr.Baker's Rule, according to Salisbury (1969a).

[13] '100' was used as a divisor till 1646, and thereafter, '94' was used (details given in Salisbury,1966b). In 16th and 17th centuries, '95', '96' '100'and '110' were also used as divisors to calculate tonnage (Salisbury,1967).

3.3 British Tonnage Law of 1836

Tonnage as per the 1695 rule was not dependant on the actual depth, and the breadth had more influence, than the length, on tonnage. Hence, long, deep and narrow vessels of lower tonnage were built, and the tonnage diverged considerably from the real carrying capacity (French,1973;Lane,1964;Nadienski, 1969). Significant savings could be obtained by deepening the hold without increasing the breadth. This often meant dangerously unstable vessels, requiring a large amount of ballast to prevent capsizing. S.S Leviathan, an unstable and unmanageable ship, was constructed longer and deeper to reduce tonnage to the extent that it could defraud tax revenue by nearly 62% (Griffiths&Bates,1854). Though the above formula was slightly modified in 1773[14] and 1819[15], the main issues remained unresolved and the practice of tonnage evasion continued (Moorsom,1860).

According to Moorsom (1855a), no steps had been taken to improve or amend the rule, until the 'injurious effects of the law were realised' in 1821 when the British Government appointed a Commission of Inquiry.

The 1821 Commission reported that the measurement of draft would also be necessary in the weight-based approach, but it is '*considered as liable to insuperable objections, on account of the impossibilities of ascertaining the position of these lines in a satisfactory manner*' (Moorsom,1855a,p.179). The report therefore recommended a simpler method consisting of only a few internal[16] measurements, but no legislative action was taken.

A second commission, appointed in 1833, recommended that the 'internal capacity' of a vessel was the fairest standard of measurement. The rules constructed on the above principles were established by the Act of British Parliament in 1836. Though the new rules corrected some of the worst features of its predecessor, they were found to be '*greatly open to evasion*', '*as obnoxious to complaints as the old law*', and were subjected to abrogation (Moorsom,1855b;Graham,1956;Greenhill, 1980).

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[14] Registered Tonnage was introduced.
[15] For steam vessels, length of engine room was deducted from the full length of vessel, while calculating tonnage.
[16] Internal measurement done between the inside of frames or structural members.

3.4 Moorsom's System (1854)

Based on numerous complaints concerning the 1836 tonnage regulations, the British Government appointed a third commission in 1849, with George Moorsom as the Secretary, to secure greater uniformity in the measurement and registration of ships (Kendall,1948;Moorsom,1855b).

It is interesting to note that the 1849 Commission initially reported '*external measurement of cubic capacity*' as the equitable basis for charging ships, and recommended a highly scientific system of '*external mensuration'*. But this proposal was unfavourably received by the industry and was not adopted by the Government. Based upon the repudiation of external measurement by ship-owners and adoption of internal cubature as an incontrovertible condition, the issue was reconsidered to formulate an acceptable method (Moorsom,1855b).

According to Salisbury(1969c), while amending tonnage rules, it was a principal objective to maintain the total tonnage nearly the same under both the old and new rules. The 1849 Commission observed that the British merchant fleet had 3,700,000 'registered tons' and a total internal volume of 363,412,000 cubic feet, or 98.22 ft^3/registered ton. This figure was rounded-up as 100 ft^3/registered ton for the purposes of easier calculation and proposed that the gross register tonnage (GRT) may be obtained by dividing the total internal volume of ships by 100 (Johnson,1906; Kendall,1948;Taggart,1980). This method of tonnage measurement was accepted by the commercial community and enacted by British Parliament in 1854[17]. Since May 1855, the GRT of ships was ascertained from the total volume of its enclosed spaces in ft^3 by dividing it by 100 (Moorsom,1860;Nadienski,1969; Wilson,1970). According to Van-Driel(1925), the 1854 Act brought a new order to sea-borne commerce.

As per the above concept and the description given in the Bible, the estimated GRT of 'Noah's Ark', the first ship recorded in history or legend, would be around 15,000 tons (Kendall,1948).

Traditionally tonnage was related to the carrying capacity of the ship. However, Moorsom's concept related tonnage to the total volume of enclosed

[17] Merchant Shipping Act,1854. In later discussions, this method is referred as 'Moorsom's System'.

spaces. The traditional desire to relate tonnage to income yielding cargo capacity resulted in the development of a second kind of tonnage, called NRT[18] (Graham,1956; Lane,1964). NRT is derived by deducting the tonnage of spaces not available for cargo, such as machinery and boiler spaces, from the GRT.

Being the colonial power, the British maritime legislation had a profound influence on the development of maritime legislation throughout the world (Mukherjee,2002). During the second half of the 19th century, Moorsom's System was the basis for tonnage measurement around the world, though the rules varied from one jurisdiction to another (Lane,1964).

Though NRT was introduced, sailing ships had only one tonnage, i.e, GRT. In 1867 the law was changed with the intention to encourage better living quarters for the crew, and allowed deduction of seamen's living spaces from the GRT, which initiated a system of net tonnage for sailing ships also (Graham,1956).

Moorsom's System was amended later based on a decision by the House of Lords in 1875, in the case of S.S.Bear. Certain spaces provided with *'tonnage openings'* were considered open and hence exempted from measurement, though these could be used for carriage of cargo and made 'sea-proof' when necessary (Comstock,1967;Lyman,1945). This interpretation was exploited by designers, to design ships with ridiculously low tonnage values. The exemption of shelter-deck spaces in Moorsom's System was one of the reasons which prompted the Suez and Panama Canal authorities to have separate rules. The US did not accept this concept of exemption until 1915 (Johnson et al,1940).The tonnage measurement law promulgated in the United States in 1865 was based on Moorsom's System and the rules provided a detailed method for calculation (Butts,1865).

According to Kendall (1948), GRT was a statutory figure in Britain required for registration of ships, comparative statistics in shipping and shipbuilding, and as a basis for subsidy, while NRT was used for the calculation of port dues and charges, light dues, and time-charter rates of hire.

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[18] Net Register Tonnage. Referred earlier at Para. 2.1.7.

3.5 ‘Danube’ rules (1871)

In order to improve the navigation facilities on the Danube River and to collect tolls from ships, the ‘European Commission of Danube’ was formed in 1856. From 1860 onwards, the toll on vessels navigating in Danube river was based on the tonnage under Moorsom’s System. But the lack of worldwide uniformity in tonnage rules resulted in a complicated charging system for tolls on the Danube. The efforts to bring about uniform tonnage laws between maritime nations in Europe were also unsuccessful (Corkhill,1980;Johnson,1906).

Therefore, the commission framed new tonnage rules called ‘Danube’ rules in 1871 (revoked in 1876), rectifying the contentious provisions in Moorsom’s System regarding shelter-deck spaces and allowance for propelling power. In the Suez Canal tonnage rules of 1873, the allowance for propelling power was based on the 1871 ‘Danube’ rules. From 1876, the Suez Canal net tonnage was adopted for tolls in Danube (Johnson,1906 & 1913).

3.6 Suez and Panama and Canal Tonnage

Initially, the NRT was used as a basis for Suez Canal tolls. Since the revenue was inadequate to meet the expenses and owing to the questionable propelling power deductions for steamers (Lindsay,1876), GRT was adopted as the basis from July 1872, leading to higher charges. The shipping companies and ship-owners opposed this change. The ‘International Tonnage Commission’, formed to resolve the issue, adopted separate rules for Suez Canal tonnage in 1873 at Constantinople. It was expected that the 1873 rules would be adopted by the countries represented at Constantinople as well, leading to a universal system. However, British law could not be amended due to heavy opposition from British ship-owners, as the resulting net tonnage under Suez Canal rules was higher than existing NRT. Britain was a major maritime power and most of the maritime nations were based on the British rules. Thus separate rules for Suez Canal tonnage came into existence (Johnson,1913; Wilson,1935).

The Suez Canal tonnage rules are based on Moorsom’s System, with some differences in the deduction of propelling power allowance and crew accommodation spaces. The shelter-deck exemptions under British rules are not granted in the Suez Canal tonnage rules. Consequently, the Suez Canal tonnages are higher than British tonnages by 10%-20% ("Computation of tonnage",n.d;Johnson,1913).

In the case of the Panama Canal, separate rules were adopted in 1913[19], after a detailed comparative study[20] of British, US, German and Suez Canal rules (ASIL,1914;Johnson,1913). Moorsom's System and the Suez Canal rules were used as the basis while framing the rules (Nadienski,1969). The deck cargo could be charged for light dues, on actual measurement, but this was discontinued in 1914 (Brown,1920;Johnson,1938). From 1976 onwards, deck cargo was considered for charges by including the corresponding volume for PC-NT. In 1994, new regulations based on ITC-69 were introduced to calculate the net tonnage under Panama Canal Universal Measurement System (PC/UMS-NT). In October-2002, the Panama Canal authorities decided to charge containerships under a new method based on TEU, since the PC-UMS NT was not representing the earning or economic capacity of container vessels (Barnett&Ruben,2005;Llacer,2005;Moloney,1997).

3.7 Efforts for uniformity

3.7.1 Efforts in Europe

In 1860, the British Board of Trade issued a memorandum about the contentious percentage rule for propelling power allowance in Moorsom's System, stating that deductions may be made on actual volume of spaces instead of flat rates. The Danube commission also made a recommendation in 1861 for a unified measurement system. In order to encourage other nations to adopt Moorsom's System, reciprocal arrangements were made with other nations for dispensing with re-measurement at British ports if the official tonnage figures on ship's documents were based on Moorsom's System. France appointed a commission in 1863 to study this matter and the commission recommended adoption of Moorsom's System. US and Denmark adopted the system in 1865 and 1867 respectively. By 1885, all the maritime nations of Europe, Russia and Japan had adopted rules based on the British system. (Barnett,1905;Johnson,1913)

[19] Panama Canal was opened in August, 1914 & Tonnage rules framed in November,1913.

[20] Study made in 1913 by Dr.E.R.Johnson (Professor Emeritus,University of Pennsylvania) as Special Commissioner on Panama Canal Traffic and tolls.

3.7.2 Efforts from League of Nations

Though many nations based their rules on Moorsom's System, local changes were incorporated in the rules and a ship could have different GRT & NRT values at different ports around the world. Due to various exemptions, the tonnage was not serving its original purpose, as an indicator of the vessel's size (Comstock,1967;McIntyre,1960). For example, the US method was based on Moorsom's System, but was interpreted and applied to favour passenger vessels under the American flag. This resulted in many passenger vessels under foreign flags having much lesser tonnage values when measured under US rules (Johnson et al,1940; Lyman,1945).

Though the Suez and Panama Canal tonnages were based on Moorsom's System, these resulted in different tonnages considerably larger than their registered tonnages (Johnson,1913). According to him, Moorsom's System favoured the British ship-owners with excessive allowance for propulsion space and resulted in unequal treatment of ships. The Danube rules and Suez rules corrected these anomalies, but were not universally accepted. Since Panama Canal authorities also decided to have a separate set of rules, ships had to carry at least 3 tonnage certificates (McIntyre,1960). As international shipping grew, the matter became very complex and the computation methods were only understood by specialists (Comstock,1967;Corkhill,1981).

Under the League of nations, efforts were made standardise the rules for tonnage measurement (League of Nations,1928&1931). In 1924, a committee was formed to examine a unified tonnage measurement system, and continued its work until 1939. The urgency for a uniform system was highlighted in 1931 by the substantial variations in tonnage of *S.S.Leviathan*[21] under the British and US regulations (Mansell,2007;Singh,1983).

Sweden and Norway took the initiative in resolving the problems of tonnage measurement and in 1938 hosted a conference in Oslo, where the draft regulations and reports made by the League of Nations were discussed. The outcome of the conference prompted the League of Nations to set up a second drafting committee in 1939. The parties to the Oslo Conference held

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[21] Details given in Chapter 5.1

another conference in 1939 June at Paris, but the Second World War prevented further developments until a conference was held in June 1947 at Oslo in participation with eight countries, and finalised the regulations known as the 'Oslo Convention'. The 'Oslo Convention' came into force on 30th of December 1954 between Norway, Iceland, the Netherlands, Denmark and Sweden. Though 10 more countries ratified this convention subsequently, major shipping nations of that time such as UK, US, Japan and Greece continued to use Moorsom's System, and since the 'Oslo Convention' needed unanimous acceptance for amendments, it was not universally adopted (Cunningham,1970;Taggart,1980).

3.8 Tonnage Mark Scheme

During the preparation of the 1960 SOLAS conference, it was acknowledged that the tonnage openings, provided on the tween-deck for tonnage exemption purposes, could substantially affect the safety of the vessel by its inability to prevent the spread of fire or by the reduced degree of subdivision when flooded. Therefore, a recommendation was made during the 1960 SOLAS conference, to devise a system to dispense with the tonnage openings while retaining the exemption of space. As a solution to this problem, a scheme was adopted by the IMCO Assembly in 1963 relating to the treatment of spaces with tonnage openings. This scheme is known as the 'Tonnage Mark Scheme' (Corkhill,1981;IMCO,1963; IMCO,1972;Wilson,1970).

The 'Tonnage Mark Scheme' allowed two sets of tonnage values and the owners could choose the tonnage for port dues depending on whether the tonnage mark on a ship's side was submerged or not. However, the 'tonnage mark' appeared irrelevant for the port authorities, pilotage and towage agencies, as the ship was the same whether the mark was submerged or not. It was ridiculous when the same ship declared a different tonnage and paid considerably lower charges after a few hours. Further, Ro-Ro ships with huge cargo spaces exempted from measurement in the tween-deck, have exploited this provision to absurd limits. The 'Tonnage Mark Scheme' was unsuccessful as many port authorities adopted other measures as a basis for charging (Corkhill,1980; Mankabady,1986).

CHAPTER-4 . Why Different Methods?- An Analysis

The evolution of various measurement methods before ITC-69, briefly discussed in Chapter-3 are analysed here to provide a background to the forthcoming discussions on ITC-69. The primary reasons leading to the developments in different measurement systems in the past are discussed for this purpose. An analysis of the various tonnage measurement methods used from the 13^{th} century shows that different methods evolved due to:

(i) Technological changes,

(ii) Response from disadvantaged stakeholders,

(iii) Delay in timely action to change the regulations,

(iv) Dominance of some maritime nations and ship-owners, and

(v) Concerns about safety and crew living conditions.

Moorsom's System was the basis for most of the national rules, but one or more of these reasons led to nations adopting regulations favourable to them, thus leading to wide variations in the tonnage of identical ships. Due to the flaws in the rules, the tonnage figures were no longer representing the size of the vessel or its earning capacity as originally intended (Comstock,1967).

4.1 Technological changes

The technological developments in ship construction have resulted in adoption of new measurement methods, as seen in Chapter-3. Steam was used at sea for the first time in the early 19^{th} century, and by the end of 19^{th} century steel ships were increasingly constructed. The machinery space on steam ships occupied a part of the cargo space and the lightship weight was higher due to propulsion machinery. Due to these technological changes and to give fair treatment to new generation vessels, internal volume was considered a better choice than weight to assess the earning capacity. The internal measurement also gave a much lower tonnage (Henderson,1854). While framing Moorsom's System, heavy or deadweight cargoes were not the predominant cargoes of commerce, and it was also feared that external measurement would lead to building of weak and thin-sided vessels (Butts,1865). This shift in approach meant that the GRT did not any more signify the cargo weight and a new measure NRT was needed to meet changing demands.

When the carriage of lighter cargoes became more common, bigger and more spacious ships were needed to carry the same weight of cargo (Davis,1956). Ships were specifically designed to carry 'bulky' cargo (lighter cargo) and 'weight' cargo (or heavier cargo). The 'tunnage' (or the number of casks) was no longer suitable to indicate the size of a ship. This change in transport need generated the idea of measuring the ship by **both weight as well as volume** for registration purposes in the 19th century, since evasive methods, by ingenious builders or saving owners, would only be possible if the law or its application was defective to render such evasion practicable (Bates,1858).

The Moorsom Commission recommended a method based on the internal volume of the ship, though the original proposal was for external measurement. Passenger ships were growing bigger in size during that period. After consulting the shipbuilders, ship-owners and trade representatives, the British government decided to follow the internal measurement method, as it suited national interests and was considered adequate for all the purposes (Moorsom,1855a). This indicates that the prevailing technical and commercial factors also played a role in formulating the new rules. The new regulations were so framed that they did not upset the existing statistical information on shipping and trade (Graham,1956).

The steam ships required higher capital investments when compared to sailing vessels. To promote the use of steam ships, deductions[22] higher than the actual tonnage of machinery space were permitted in Moorsom's System to achieve a lower net tonnage (BoT,1894). Most of the vessels had a machinery space tonnage of around 13% and, therefore, benefited from a lower net tonnage and dues (Biles,1908). This also shows how the rules were formulated according to

[22] When the actual tonnage of machinery space is between 13% and 20% of GRT, a deduction of 32% of GRT was given to arrive at the NRT. For vessels with larger machinery space, 175% of the tonnage of machinery space was deducted.

development in ship design and construction, though the primary aim was to modernise the merchant fleet.

Faster technological changes in late 1800's in ship design and construction, created new complaints about Moorsom's System that the size and earning capacity of a ship was not truly represented by its tonnage. Another Royal commission was appointed in 1881 and amendments were made in 1889, followed by further amendments in 1894, 1906, 1907, 1948, 1950, 1954 and 1965 (Wilson, 1970). These developments clearly illustrate the influence of technological developments in ship design and construction on the tonnage rules.

One of the reasons for adopting separate rules for Panama Canal was that the existing rules were not sufficiently applicable to modern designs and all ships were not charged on an equal basis (Johnson,1913). The advantage in having separate rules are evident, when the rules were amended in 1938 to incorporate modifications made desirable by changes in the design of vessels and the substitution of fuel oil for coal (Johnson,1938).

Until the 1970's, deck cargo was not so common, nor were ships specifically designed for carrying deck cargo. Further, carriage of cargo on deck was not permitted under British rules (Bates,1858). As deck cargo became more common, suitable amendments were made in the Suez and Panama Canal rules.

The technological changes, such as carriage of new types of cargo, use of steel for ship construction, introduction of self-propelled ships and design of bigger and modern ships, have influenced the regulatory changes in tonnage measurement system, as evident from the above discussion.

4.2 Response from disadvantaged stakeholders

It is seen in Chapter-3 that the basis for assessing the tonnage of a ship, was either its total volume or its displacement. The measurement of volume could be done externally or internally, i.e., measuring the moulded dimensions or the dimensions between the inside of the frames. The latter would provide a lower volume than external measurement. The internal measurement was beneficial to wooden ships, as the frames were deeper. But the scantlings were much less for steel ships, and steel ships had about 13% higher tonnage than wooden ships of the same displacement (Bates,1858). This anomaly was corrected by introducing NRT, by allowing certain deductions from GRT , and using NRT as a basis for charging.

According to Johnson (1913), the net tonnages of British ships were less than those under other national rules. The ship-owners benefitted from this by saving on port dues. This prompted other nations to also adopt rules beneficial to their ships. In the case of the Suez Canal, when the revenue from NRT-based toll system was inadequate to meet expenses, a GRT-based system was adopted. But opposition from British ship-owners, who controlled 80% of the ships passing through the Suez Canal persuaded authorities to adopt separate rules for the Suez Canal, and the Suez Canal tonnage rules were adopted in 1873 at Constantinople (Wilson,1935). In 1871, the Danube rules were formulated in a similar manner since the propelling power allowance of 32% (instead of the actual tonnage) was considered too high, thereby treating sailing vessels unfavourably. Panama Canal framed separate rules in 1913, after finding that larger modern ships were not treated equally under other measurement rules. The decision by the House of Lords in 1875, in the case of S.S. Bear, legitimised the shelter-deck concept. The purpose of tonnage as an indicator was conveniently discarded, and 'monster' ships without any proportionate increase in tonnage were constructed. The ports and canals were the losers, as they had to handle bigger ships without extra earnings. The tonnage mark scheme introduced in the 1960's had the same fate, since the owner could choose the tonnage for paying dues and the ports were not earning revenue proportionate to their expenses. The IAPH made a resolution indicating the unsuitability of the tonnage mark scheme for charging purposes and it was an important consideration during the ITC-69 Conference.

It can be seen that in many cases different measurement systems evolved out of compulsion and disadvantages to stakeholders. To a certain extent, this was also responsible for the failure to achieve worldwide uniformity.

4.3 Delay in timely action to change the regulations

During the mid-1800's, long and deep ships were built to reduce tonnage, since the 'measured tonnage' was not dependant on all principal parameters equally. This shows how the loopholes in regulations were exploited at the expense of safety, and highlights the need to formulate measurement methods carefully. The propelling power allowance in Moorsom's System was higher than the actual machinery volume. Repeated attempts to amend this provision failed in the British parliament due to objection from ship-owners, as it would result in a higher NRT. But the inability to amend the law led to the development of the Danube rules, Suez Canal Rules and Panama Canal rules (Johnson,1913). The canal tonnages are greater than national tonnages due to limited exemptions under their separate rules (Pearson,1969). Similarly, commercial interests prevailed over commonsense for amending the definition of shelter-deck, and ships of larger size without proportionate increase in tonnage could be built, after the S.S.Bear judgement (Lyman,1945). Consequently, the determination of tonnage became a complicated calculation and needed expertise (Comstock,1967). The British rules did not permit carriage of cargo on deck, and hence the tonnage rules did not include deck cargo. Later on, ships were specifically designed for carrying deck cargo, but rules were not amended and ships operated without any increase in tonnage. The Panama and Suez Canal authorities benefited from having their own rules because they could amend the rules according to changes in the industry.

These examples show how the inadequate regulatory provisions and the delay in making timely amendments to the regulations contributed to the development of different measurement methods.

4.4 Dominance of some maritime nations and ship-owners

In the 18th century, the tonnage declared during registration was on average 32% less than the 'measured tonnage' to save on tonnage based expenses (French,1973). This led to the development of 'registered tonnage' in 1773. In the late 1880's, Britain owned 80% of world tonnage (Fletcher,1958) and maritime trade was growing rapidly(Davis,1956, North,1958).

Though the 1849 Commission led by George Moorsom recommended a 'highly scientific' external measurement system in 1850, the shipping industry was so powerful that neither they nor the government accepted the recommendation. Subsequently the same commission had to formulate a volume-based internal measurement method, as desired by the industry, which was implemented through

Moorsom's System (Moorsom,1855b). The choice of 100 as the divisor[23], was merely coincidental, as seen earlier, based on the volume and tonnage of British ships alone. The inclusion of American or German or the world's shipping tonnage while establishing divisor may have resulted an entirely different divisor.

The Moorsom's System was beneficial to the British ships which constituted 75% of the Suez Canal traffic, especially for steamships which accounted for 96% of the traffic (Fletcher,1958;Lindsay,1876). The 'artificialities' of measurement system were such that there was little correlation between carrying capacity and NRT which benefited the British ships and other nations allowed similar exemption to their ships to avoid commercial disadvantages(McIntyre,1960). NRT was the basis for charging dues and a liberal propelling power allowance under the British rules, resulting in a lower NRT, encouraged a transition from sailing ships to steamships (Comstock,1967). The practice of declaring a lower tonnage during registration was operative in the late 18th century, and the 'registered tonnage' of colonial-owned vessels was about one-third less than 'computed tonnage' (French,1973;McCusker,1967). But these measures resulted in revenue loss to the ports and canal authorities, and the Suez Canal adopted separate rules in 1873 (Wilson,1935). Though Britain was present in the European Commission of Danube for framing the Danube rules, corresponding amendments could not be incorporated into the Moorsom's System. When the US adopted Moorsom's System, passenger spaces above the first deck were exempted from measurement to reduce the impact of the new system on passenger vessels. Hence, a foreign passenger vessel had a much lower tonnage under the US measurement system. According to Kendall (1948), the threshold of 500 GRT originated in Britain as a measure to exclude small coasting vessels and non-trading vessels, which was later included for application of major maritime conventions. Other thresholds (such as 1600GRT and 3000GRT) were originally made to distinguish between geographical areas of employment of British ships. The manning scale depending on a ship's tonnage was introduced in 1835 in Britain (Clapham,1910). These are some of the examples related to tonnage aspects where the maritime powers took measures to protect their commercial interests, which later became internationally accepted standards.

[23] In Moorsom's System, measured volume in cubic-feet is divided by 100, to get tonnage. Volume-tonnage ratio of British ships, 98.22, was rounded up to 100, as seen in Chapter-3.

4.5 Concerns on safety and crew living conditions

The changes to measurement systems were prompted by safety concerns and crew aspects. One of the reasons for opting the internal measurement, (i.e., between the inside of frames) was that it would encourage the owners to provide deeper floors, stronger frames and thicker wooden planks, since they would not be penalised for constructing a safer and stronger vessel (Butts,1865;Eriksson, as cited in Wilson,1970). Sailing ships did not have propulsion machinery and had only one tonnage, i.e., GRT. In order to promote the living conditions for crew, the NRT was introduced for the sailing vessels also, by allowing deduction proportionate to the crew spaces from the GRT (Graham,1956). Since the 'measured tonnage' was dependant only on length and breadth, it led to construction of deep and narrow vessels which were unsafe with poor seakeeping qualities (Henderson,1854). Due to this reason, the tonnage rules were modified subsequently to avoid undue influence of any single parameter on tonnage (French,1973;Graham.1956). After safety issues (such as the inability to prevent spread of fire or progressive flooding) due to the presence of tonnage openings were identified, the tonnage mark scheme was introduced in 1963 (Corkhill,1981; Wilson,1970).

The negative influence of safety and crew living conditions on tonnage measurement is clear from the above developments.

4.6 Summary

It can be seen from discussion that there are a number of factors which contributed to the evolution of new measurement methods, from time to time. Some of these factors contributed to the lack of worldwide uniformity in measurement systems. This brief analysis is intended to provide a background while evaluating various options to resolve the current issues of ITC-69, in Chapters 7 and 8.

SECTION-III. STUDY OF ITC-69

CHAPTER-5 . Current System of Tonnage Measurement

5.1 How it evolved

Though most countries followed the principles of Moorsom's System for measurement, tonnages of similar ships under different flags varied significantly due to the variations in the rules (Morgan,1943; Wilson,1970). According to Nadienski (1969), the diversity in regulations and differing - even contradictory – interpretations caused great concern among nations.

Efforts were made under the 'Permanent Committee for Ports and Maritime Navigation' of the 'League of Nations', between 1924 and 1939 for drafting regulations and uniform measurement methods (League of nations,1928&1931). 'Draft Regulations for Tonnage Measurement of Ships' published in 1931 were studied by various governments and a report was made in 1934. The case of S.S.Leviathan[24] in 1931 highlighted the extent of loopholes in the rules and the urgent need for a universal system.

Pursuit of a unified method of measurement continued under the 'United Maritime Authority' (1945), 'United Maritime Consultative Council' (1946), 'Provisional Maritime Consultative Council' (1947) and later on under 'International Maritime Consultative Organisation', IMCO (1958). The 'Oslo Convention', adopted in 1947, was not followed universally. During the inaugural meeting of IMCO (now IMO) in January 1959, one of the first tasks assumed was the establishment of a uniform tonnage measurement system. The Sub-committee on 'Tonnage Measurement' was the first subsidiary body established by the Maritime Safety

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[24] S.S Leviathan was a German passenger vessel with 54,282 GRT & 23,500 NRT under the Moorsom's System. In 1923, under American ownership, she was touted as the world's largest ship with 59,956 GRT & 27,696 NRT (revised tonnage under the US tonnage rules) just ahead of rival ships. The financial crisis in 1929 forced the owners to save on port dues and in 1931 her GRT & NRT were reduced to 48,932 & 15,800 respectively through manipulation, under the same rules (Mansell,2007;Singh,1983).

Committee (MSC) of IMCO. A 'group of experts' was formed in June 1959 to consider the unification of tonnage measurement systems, a problem that vexed the shipping industry for a long time (Cunningham,1970;Wilson,1970;www.imo.org).

As stated earlier in Para-3.9, the 'Tonnage Mark Scheme' was introduced in 1963 as an interim measure. But it was not widely accepted by port authorities since ships could declare a different tonnage within a few hours, causing a significant reduction in port dues for the same services. It was clear from the unsuccessful 'Tonnage Mark Scheme' that a comprehensive overhaul of the whole tonnage measurement system was needed (Mankabady,1986).

5.2 International Conference in 1969 on Tonnage Measurement

The efforts for a uniform method materialised when the 'Convention on Tonnage Measurement of Ships', (ITC-69) was adopted at an international Conference held in London from 27th May to 23rd June, 1969. It was the first successful attempt to introduce a universal tonnage measurement system. After deliberation on different proposals, based on both existing and new concepts, the final text adopted during the conference provided a sound and practical basis for a universal measurement system (Wilson,1970).

Though the Suez Canal Authority and Panama Canal Company attended ITC-69 as observers, they continued with their separate methods for tonnage measurement even after adopting ITC-69.

ITC-69 applies to ships above 24 metres in length[25] and came into force on 18th July 1982 (Text of ITC-69 at Appendix-7). A phase-in period was given for the ships built before that date to retain the existing tonnage figures up to 18th July 1994, for a smooth transition to the new system. 150 States amounting to 98.99% of world tonnage have ratified the Convention, as of 31st July, 2010 (IMO,1977; IMO,1982a;www.imo.org).

Under ITC-69, the overall size and useful capacity of a ship are indicated by dimensionless figures, GT and NT respectively (*instead of GRT&NRT under Moorsom's System*), calculated based on the total moulded volume of enclosed spaces and volume of cargo spaces (IMO,1982b).

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[25] other than ships of war and ships navigating in certain areas specified in Art.4 of ITC-69.

5.2.1 Comparison with earlier method

When compared to the earlier system, tonnage measurement under ITC-69 is relatively simple. Tonnages are no longer expressed in 'tons'. The tonnage could be ascertained during early design stages, obviating complicated measurement between internal structural members after construction. The 'tonnage mark scheme' was not included in ITC-69 due to unsatisfactory reports from port authorities[26]. There is no provision for exemption or deduction of spaces, and a draft-to-depth ratio was incorporated to account for the 'shelter-deck' concept (Murphy&Stitt,1969). NT is calculated directly by measuring the cargo space, rather than subtracting non-cargo spaces from the total volume. The terms used were clearly defined, with limited scope for interpretation. The definition of 'Length' as defined in the 1966 Load Line Convention was adopted. The definition of 'excluded spaces' was adopted from the Panama Canal Tonnage regulations, which had not caused any difficulty in interpretation over a period of time. (Cuningham,1969; ESCAP,1991;IMO,1983a). As deck cargo was not very common when the ITC-69 regulations were framed, this aspect was not included as a factor for assessing cargo carrying capacity or tonnages (IMO,2003a).

5.2.2 Developments after adoption of ITC-69

In order to promote ITC-69 tonnage as a basis for charging tolls, the member Governments were requested to assist the Panama Canal Commission and Suez Canal Authority in their studies to determine conversion factors for assessing canal dues based on the new system (IMO,1982c). However, the Panama Canal Commission and Suez Canal Authority continued with their earlier methods for assessing tonnage. Ships need to have separate tonnage certificates for the Suez and Panama Canals even now.

[26] In March 1969, the International Association of Ports and Harbors (IAPH), recommended IMCO to eliminate the difficulties under 'Tonnage Mark Scheme' and that any new system should be simple and uniform (IMO, 1969a). A resolution to this effect was adopted during the sixth biennial conference of IAPH on 08th March,1969, at Melbourne, Australia.

Based on queries raised by member States during the implementation stage, interpretation and clarification of technical terms in ITC-69 were issued from IMO (IMO,1979;IMO,1983b;IMO,1994). Some of these clarifications were related to segregated ballast tanks, open-top container ships and dock ships, which were not so common when the convention was drafted.

Container ships had traditionally been designed with weather-tight hatch covers. Open-top container ships do not have hatch-covers, but are provided with higher freeboard and a de-watering system (Payer,2001). Owing to the higher freeboard, these ships have higher GT than a conventional container ship of the same displacement (Huismann&Vermeer,1991). After recognising this disadvantage, a circular was issued in 1993 (IMO,1993a) followed by a resolution in 2006 (IMO,2006d) to calculate the reduced GT of open-top container ships. Higher GT of other ship-types such as Livestock carriers, Ro-Ro vessels were also reported (Heirung,1996).

5.3 Developments after ITC-69 came into force.

Though IMO had adopted interim measures from time to time, the drawbacks of ITC-69 and its consequences were looming large. The UK mentioned in its submission[27] (IMO,2002b) that there is evidence of exploiting the loadline rules to minimise GT and the increased reserve buoyancy requirements of the proposed changes in loadline rules, will lead to higher GT and a demand to discontinue tonnage as a means of charging port dues.

Germany made a submission about the substantial changes in ship design after ITC-69 entered into force, and stated that the issues concerning admeasurement of open-top containerships and carriage of deck cargo are still not resolved (IMO,2003a). Germany also pointed out that the 20% disadvantage suffered by big open-top container ships under the ITC-69 is considered unacceptable and is leading to unilateral action by flag States (IMO,2004b;IMO,2005a). Since the port dues are based on GT, in some cases the port dues for an open-top container ship can be almost twice that of a conventional container ship of the same TEU ("Open-top Enigma",1995).

[27] A study on the influence of superstructures, sheer and tonnage on freeboard.

The Netherlands supported Germany's proposal and recommended a system, which is not based on enclosed volume. Unilateral interpretations of ITC-69 by a flag State arising out of economic disadvantage was mentioned, and a proposal was also made to discuss a revised tonnage measurement methodology (IMO,2003b). During SLF-48, a study[28] on the consequences of GT commissioned by the Netherlands was presented (IMO,2006b;PRC,2005).

In 2005, Australia submitted to IMO that vessels such as livestock carriers are also affected by the problems with ITC-69 (IMO,2005c), and that ships with greater than minimum freeboard and larger superstructures (*thus offering better protection for cargo from weather and sea*) suffer commercial penalties from increased GT values related to ships without those features. It was also stated that design features related to safety and seaworthiness, such as forecastle and sheer, may be sacrificed to minimise GT and to achieve the GT below the regulatory threshold values (such as 500 or 3000 GT in SOLAS Convention). Australia stressed the need for long-term solutions to the fundamental problems with the ITC-69, and proposed a third tonnage based on the 'Maritime Real Estate' concept, for all tonnage-bases fees (IMO,2005i).

The United States supported (IMO,2005e) the need to review the treatment of uncovered spaces and mentioned the disparate treatment of open spaces for dock ships and open-top container ships, under the interim measure[29]. Unilateral measures taken by a flag state and the 'adjusted approach' of reducing the GT, were opposed by the US.

Australia informed IMO (IMO,2007a) that AMSA is investigating the option of using 'maritime real estate' measure, instead on NT, as the basis of charging in Australian ports, and stressed the need to include 'tacit acceptance procedure' along with other amendments in ITC-69.

ICFTU[30] pointed out (IMO,2006a;IMO,2007b) the inappropriate methods chosen to reduce GT (such as reduced freeboard and no forecastle, inadequate

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[28] "Consequences of the Gross Tonnage Measurement, a discussion document' by Policy Research Corporation (PRC,2005).

[29] TM.5/Circ.5 (IMO,1994).

[30] International Confederation of Free Trade Unions. ICFTU has consultative status with IMO

recreation space for crew, drastically reduced floor area and height in crew accommodation) along with other unsafe practices for lowering tonnage and requested for appropriate action.

5.3.1 Developments in EU, ILO.

The EU encourages the Ro-Ro industry to look for a new measurement on its own, since GT and NT under ITC-69 were considered inadequate to indicate the carrying capacity or economic value of Ro-Ro cargo ship operations (“Freed from GT slavery”,2007).

In submissions to IMO, the discussions in ILO about the adverse effects of the ITC-69 on the on-board living conditions of the crew, lack of recreation space and the suggestion to exclude crew accommodation spaces from tonnage were mentioned (IMO,2003b;IMO,2006a; IMO,2006b).

5.4 Effect of ITC-69 on Ship Design

Owen (1907) discusses about a clever design in the 1900’s, the NRT of which worked out a negative quantity, after the statutory deductions. Therefore, one of the principles during conceptualisation of ITC-69 was that the measurement method should not influence the design or encourage constructional features which could detract safety aspects. Hence, the avenues for designers to reduce tonnage by design methods were very limited.

Ship-owners had always desired to minimise the enclosed volume to achieve a lower GT for a given deadweight since the operational expenses were dependant on GT. In order to do so, in addition to low freeboard and non-existent forecastle, measures such as cranes with open foundation, upside down hatches and complete lack of pipe ducts were also designed to bring down the GT (Bennet,2000;”Call for change”,2001;”GT-Design dilemma”,2000). The practice of reducing tonnage of ships by design measures is still prevalent as seen in the literature review (Glass,1997;Harris et al,1995: McKernan,2006;Pudio,2002;Van-Eijle,n.d).

GT-based port dues is identified as a constraint to introduce new safer and efficient designs (which unfortunately end up with higher enclosed volume). A report on ‘M.V.Estonia’ also mentions about the GT penalty on safer designs (Heirung,1996). Port authorities maintain that the safety at sea is not their concern and leaves the issue to IMO to change the tonnage rules, while IMO states it does not control the ports and thus is unable to disallow their use of GT as a basis. Some countries, like France, have been using other parameters for charging such as length, breadth and draft, but in most ports GT continues to be the basis (“Safer ships”,2001).

According to Payer (2001), open-top container ships are penalised for higher tonnage due to the added freeboard. It is an anachronism that discourages owners due to the cost penalty in operation, despite the improved safety aspects of these vessels (“Hatchcoverless”,2001b;Payer,2002).

5.5 Safety concerns

Containerisation gained momentum in the 1970s and the size of container ships grew much larger. New concepts in design of container ships for economic transport of containers over the following 40 years, could not have been foreseen while drafting the ITC-69. The carriage of large numbers of containers on deck was not considered while finalising regulations for GT or NT in ITC-69 (IMO,2004b;IMO,2005a). The absence of deck cargo in tonnage regulations, was an opportunity to evade tonnage by reducing the under-deck stowage and maximising deck cargo (Grey,1997;“GT-design dilemma”,2000). Open-top container ships were much safer, but these ships had higher GT than conventional container ships of similar deadweight (Grey,2002a).

Competition in container transport led to the design of ships with lower GT, that carry more containers on deck than in enclosed cargo spaces (“GT Design dilemma”,2000). A study into the capsizing of M.V.Dongedijk[31] in 2000, indicated that the vessel was designed to reduce its GT to the lowest possible (with containers 2-high in hold and 4-high on deck) so that it could save on port dues and sail with three fewer crew members, when compared to alternative designs for the same TEU (“Safer ships”,2001). According to a report (“Fresh Dongedijk capsize theory”, 2001), a safer design with one extra tier of containers below deck, (3 in hold and 3 on

[31] A container vessel of LOA-99.99m and GT-2926

deck), would have increased the GT from 2926 to 3800, and no shipyard could possibly sell such a design. A safety assessment study on small containerships indicates that ship-owners have an incentive to minimise the enclosed volume, and container ships operate with relatively lower freeboard placing as many containers as possible on the weather deck. Water accumulation due to low freeboard was one of the main reasons leading to the capsize of the M.V.Dongedijk in perfectly calm weather in August 2000 (Bekke et al, 2006).

5.6 Treatment of deck cargo

As per Regulation-3 read with Regulation-2(7) of ITC-69, spaces within enclosed areas only are considered for tonnage. The space occupied by deck cargo, which is outside the enclosed spaces, is therefore not considered for GT and NT. Those ships that utilise the deck area to carry cargo can reduce the GT and NT, thereby minimising tonnage-based fees (Grey,2005a).

This aspect has been exploited beyond the bounds of reasonable safety in the design of containerships, where up to 73% of the earning capacity may be carried above the deck while the underdeck tonnage is reduced to an absolute minimum to minimise port dues (Grey,1997;"Deck Cargoes",1999). Such measures to reduce GT could result in minimal freeboard and lower manning grades of crew, than ships of similar size ('Containerships:',1999).

Research concerning insurance claims from container ships, ("Container losses",2000; "Containers overboard",2001; "Overboard",2000) reveals that damaged and overboard containers accounted for 60% of claims for container ships. Even though open-hatch container ships have improved safety and operational aspects, the concept has not been widely adopted due to the significantly higher port charges based on the higher GT of such vessels. The desire to reduce the GT (hull size) is encouraging ship-owners to operate with higher stacks of containers on deck and lower freeboard (Grey,2005a;"Overboard", 2000).

Clarification regarding measurement of spaces used for deck cargo was sought as early as 1983 by the Federal Republic of Germany (IMO,1983c). Short-term measures for tonnage measurement of open-top container ships were taken in 1993 and 2006 (IMO,1993a;IMO,2006d).

5.7 Basis for port dues

Though port charges are made against GT and NT, the principal dimensions of a ship (such as length or draft) as the basis for charges has many advantages, since it directly reflects the ship's demand for most of the port's services, like quay length or dredged channel ("Abolition of tonnage",2001;UN,1975; UNCTAD,1995).

For certain ships, such as Ro-Ro ships or vehicle carriers, GT or NT may not be the ideal measure for charges since they have much higher enclosed volume than other ships of similar displacement. Hence these ships will be at a disadvantage when GT or NT is used as the basis for charges. The GT makes Ro-Ro ships less economic by making a serious dent by way of port charges since Ro-Ro vessels have much higher GT than other ships of the same displacement ("Freed from GT slavery",2007).

The GT includes spaces such as the forecastle deck and crew accommodation spaces. There is no justification to include forecastle or crew accommodation space for port dues, as these spaces do not require or utilise any additional services provided by the port such as dredging or quay length or tug assistance (IMO,2006a;"Taxing safety",1993). At the same time, it can have a detrimental effect on safety and the facilities for crew when the owner wants to reduce the tonnage (Grey,2002b).

5.8 Delay in amendments

The amendments to ITC-69 can be made by one of three methods mentioned in Article-18. They are

(i) amendment by unanimous acceptance,

(ii) amendment after consideration in the organisation, and

(iii) amendment by a conference.

In the 1960's the amendment procedure with positive acceptance from flag states, was included in IMO conventions. However, this procedure was so cumbersome that most amendments never received adequate positive acceptance to achieve entry into force and those which did were out of date long before they did so ("IMO's 50th Anniversary",1998).

A study of the amendments to the major maritime conventions, (i.e., SOLAS, MARPOL, STCW and LL-66) reveal that most of the amendments to technical provisions in these conventions have been made 'after consideration in the organisation'. The reason for this is the 'tacit amendment procedure' provided in these conventions, for amending the technical part.

The tacit amendment procedure was first introduced in 1972. ITC-69 do not have this procedure, unlike other major maritime conventions. At present, all major maritime conventions have 'tacit acceptance procedure' so that the amendments to technical provisions are simpler and faster (Ozcayir,2004). One of the reasons for delay in the amendments to ITC-69 is the 'classical' or 'explicit' acceptance procedure instead of 'tacit acceptance procedure'.

5.8.1 'Novel ships' under Reg.1(3) of ITC-69

Due to inadequate provisions and delay in amendments, some flag administrations are granting exemptions from measurement, under the 'novel craft provisions'. Submissions by the US(IMO,2002a;IMO,2005e) mention about the rapidly evolving designs of cargo-deck spaces on OSVs and states that 'the imprecise wording combined with incomplete interpretations has led to considerable difficulty in the uniform application of tonnage measurement of all vessel types.' Under Reg.1(3), OSVs with high structures bounding the cargo deck area were treated as novel crafts and the volume of uncovered cargo deck spaces were not included in GT and NT.

Similarly, a substantial volume of enclosed spaces was not included for computation of GT of 4 bulk carriers, considering the 'volume of crane housing' as the space to provide enhanced safety for crew and protection of cargo. Inclusion of these spaces would make the GT higher by 60% (IMO,2005f, attached as Appendix-1).

Since the interim measure in 1993 was for open-top container ships below 30,000GT (IMO,1993a), the growth in size of these ships led to the adoption of a separate formula for bigger open-top container ships by a concerned flag state (IMO,2004a). In 2006, MSC Res.234(82) was adopted for tonnage of open-top container ships irrespective of size(IMO,2006d).

The term 'novel design' is not defined in the convention. It may be noted that at least some of the vessels which utilised the provisions under Reg.3(1) are not really 'novel designs'. It will not be surprising if a canny ship-owner claims the 'void space envelope' in a double-hulled vessel or the 'atrium' in a cruise ship as 'novel design' and seeks exclusion of it from enclosed space.

5.9 Summary

The above discussion brings out various drawbacks of the measurement and usage of tonnage under ITC-69. The drawbacks do not catch public or media attention, unlike those concerning SOLAS or MARPOL. But the anomalies on various aspects are slowly emerging and it is clear that the existing regulations do not complement the developments in ship design and operation. The analysis of the above areas and evaluation of remedial measures are dealt with, in the next section.

SECTION-IV. ANALYSIS, CONCLUSIONS AND RECOMMENDATIONS

CHAPTER-6 . Analysis of Vexing Issues

A detailed analysis of the drawbacks and issues concerning ITC-69 identified during this research are covered in this Chapter. The efforts are aimed at identifying the root causes, so as to provide a sound basis for evaluation of solutions in Chapter-7.

The ITC-69 was developed as a universally acceptable tonnage measurement system for ships. As stated in Chapter-5, many of the loopholes in the earlier measurement methods were plugged and the calculation was made simpler. The primary aim of the 1969 Conference was to adopt a method acceptable to all parties, rather than developing the best method. The regulations were framed in the background of the maritime needs prevailing at that time. The economic impact on the existing fleet was also a major factor in deciding the new regulations. Considering these facts, the 1969 conference was successful in adopting a universally acceptable system. However, the exponential growth in ocean transportation requirements and consequent developments in ship-design during the last 40 years have changed the scene. These changes necessitated the need to update the ITC-69 provisions to match with current and future needs. However, no amendments have been made yet to the original convention, though interim measures have been taken by IMO to address certain issues.

6.1 Technical aspects

6.1.1 Economic disadvantage for certain ship-types

The economic disadvantages of having higher GT, mostly occur from tonnage-based dues. Historically, charges were levied on the ship based on the earning capacity and hence the NRT was used as the basis. According to Owen(1907), in the early days of sail, tonnage conveyed the size and capacity of a ship, but the advancement of technology deprived its original signification in the early 20th century. The 'Tonnage Mark Scheme' in the 1960's, discussed in Chapter-4, induced many port authorities to use GRT as the basis for charging, instead of NRT. NT was primarily intended as the basis for charging (Cunninhham,1970), but GT was commonly used as the basis for charging, though it did not reflect the true earning capacity.

The tonnage indicates the size of a vessel, but it may not realistically do so for all vessels. Since GT is not the appropriate measure for classification of fishing vessels, it is no longer used by FAO for that purpose; length is used instead (FAO,2003).

GT is a measure of the overall size of a ship and spaces such as the forecastle and crew spaces need to be included in GT. But a problem arises when GT is used as the basis for charging. A responsible owner, who provides these features liberally, is penalised by higher tonnage-based dues throughout the service life of the ship. In this case, it is the charging system which needs change. But the only two measures available are GT and NT, and NT is not favoured by many ports as the basis for charging mainly due to the tonnage mark scheme of the 1960's.

Progressive implementation of stringent regulations for safety and prevention of pollution during the last 30 years, has led to the development of segregated ballast tankers (SBT), double-hull tankers and double-hull bulk carriers. These vessels have void spaces of substantial volume to meet higher regulatory standards. Double-hull ships have greater survivability potential than single-hull ships due to the extra reserve buoyancy from these spaces. These spaces do not add to their earning capacity but increase their GT, and these ships pay much more in tonnage-based dues when compared to older ships of the same deadweight. Certain types of vessels, such as livestock carriers and Ro-Ro vessels have larger volume of enclosed space and/or higher freeboard due to their constructional features, leading to disproportionately higher GT. Here again, it is the GT-based charging system which causes the economic disadvantage (Grey,2005b;Mankabady,1991).

Another innovative design is the open-top container ship which does not have hatch covers, and has a much higher freeboard than conventional ships

(Payer,2002). Since the cargo hold is not bounded by the hatch cover, it cannot be categorised as an 'enclosed space', as defined at Regulation 2(4) of ITC-69. Though interim schemes (IMO,1993a;IMO,2006d) for open-top container ships have been adopted at IMO, they still end up with higher GT than conventional ships of the same deadweight, as detailed in Chapter-5. It may be recalled that the deck space occupied by containers on a conventional containership is not considered for GT or NT measurement. This creates a disparity between these two types of ships for treatment of open space and charging of tonnage based dues. The current provisions in ITC-69 cannot resolve this disparate treatment.

It is seen in Chapter-5 that the issues concerning economic disadvantages to certain ship-types were brought to IMO by flag States and were addressed to some extent through interim measures (such as 'reduced GT' for open-top container ships in June-1993, June-1994 and December-2006 (IMO,1993a;IMO,1994;IMO,2006c;IMO,2006d), and 'reduced GT' for SBTs in November-1993 (IMO,1993b)). The Circular adopted in 1993 for open-top container ships was for ships below 30,000 GT. Due to the growth in ship size it was subsequently amended in December-2006 to cover bigger ships also. In addition, flag States have also taken recourse of the provision under Regulation 1(3) for 'novel types of craft' for measurement of these new types of ships.

The interim measures from IMO are in the form of a circular or resolution. Since these are soft-laws of non-binding nature and may not be favoured equally by all States or ship-owners, this approach may not work in every situation. The beneficial parties will be keen to adopt while others may choose to ignore it, thereby making the uniform application difficult. Over a period of time, such interim measures may be needed more often than now, eventually leading to discordant situations. Further, the use of other provisions, such as those under Reg.1(3) for 'novel types of craft', will become more prevalent with interpretations widely varying between States (IMO,2005e). This is also an undesirable practice in a universally accepted system.

6.1.2 Tonnage-based dues

In order to find out the extent of the problem with certain types of vessels having relatively higher GT, a study was made using the database from LR-Fairplay. It is seen that about 10% of the world fleet have a relatively high GT-displacement ratio[32] .

For example, Figure 2 shows the relation between GT and displacement for bulk carriers and Ro-Ro ships. For a displacement of 20,000 tons, the average GT of a bulk carrier is 11,260 whereas as the GT for a Ro-Ro vessel is almost 3 times as much, i.e., 32,893. Similar relations exist for other vessels such as car carriers and open-top container ships. Consequently, vessels of similar physical size pay different amounts as tonnage-based dues.

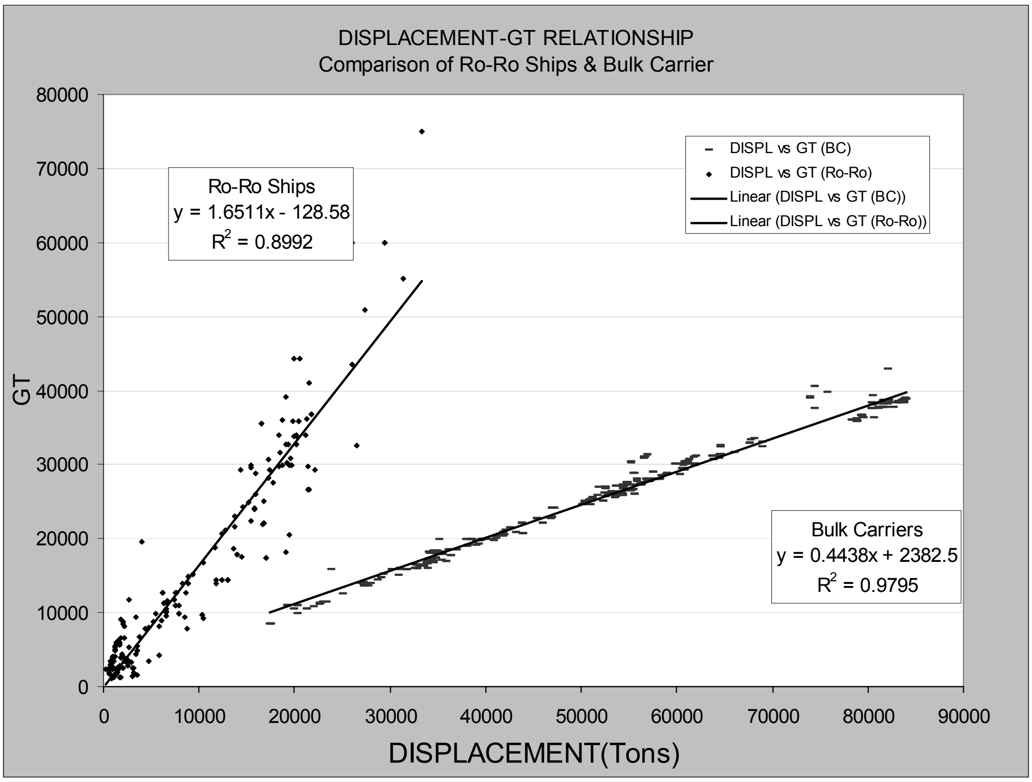

Figure 2 : GT-Displacement relationship: Ro-Ro ships and Bulk Carriers

[32] Number of vessels categorised under the disadvantaged 'types of ship', mentioned in submissions to IMO and other articles. 6,476 ships fall under the disadvantaged 'types of ship' out of 66,386 ships. Calculated using LR-Fairplay database.

In this situation, various options available for a practical solution to address the disadvantage arising out of higher GT are examined. One option is to correct the existing GT and NT, and indicate them as 'adjusted GT/NT' (or $GT_{adjusted}/NT_{adjusted}$) in the 'remarks' column (Page-2) of the tonnage certificate, as done for SBT and open-top container ships. This approach would be welcomed by ship-owners if the adjustment results in a lower value. If the adjustment increases the GT/NT, (for example when the deck cargo space is included), uniform enforcement may not be easy through this approach. As mentioned in submissions by Germany (IMO,2003a;IMO,2004b: IMO,2005e), the 'reduced GT' figure might start appearing on the face of the tonnage certificate (Page-1) contrary to the provisions, instead of being under 'Remarks' on Page-2. Such actions have far reaching implications for regulatory applications, and could cause confusion between different GT/NT figures after some years.

Another option is to encourage the use of NT as the basis for charging port dues as originally envisaged, instead of GT. Since many ports have based their tariffs on GT for a long time, a change may not be welcome unless the transition is smooth.

A study of the GT-NT relationship of 25,747[33] ships belonging to different types shows that the changeover from GT to NT may not be easy. The study shows that the correlation between GT and NT, varies significantly depending on the type of vessel (Figure 3), and the ratio NT/GT varies between 0.30 and 0.60, i.e., by 100%, depending on the type of ship. The correlation factor (R^2) also varies with the type of ship. Therefore, NT-based system will have a complicated tariff structure with separate rates for different ship categories and would increase the workload for ports. It is unlikely that port authorities will adopt such a change. Further, it is seen in Chapter-4 that the NT-based 'Tonnage mark scheme' did not find acceptance among port authorities in the 1960's, and they will be wary of any new proposal based on

[33] Generated from LR-Fairplay database. Vessels on international trade above 3000GT only are considered since, (i) river/inland/harbour vessels, which had undue influence on the results, were also listed in the database, (ii) inclusion of smaller vessels was giving a distorted picture, and (iii) data on smaller vessels were inadequate in many cases.

NT. In addition, since the matter is related to ports, the action from IMO can only be of advisory nature and uniform implementation is not certain.

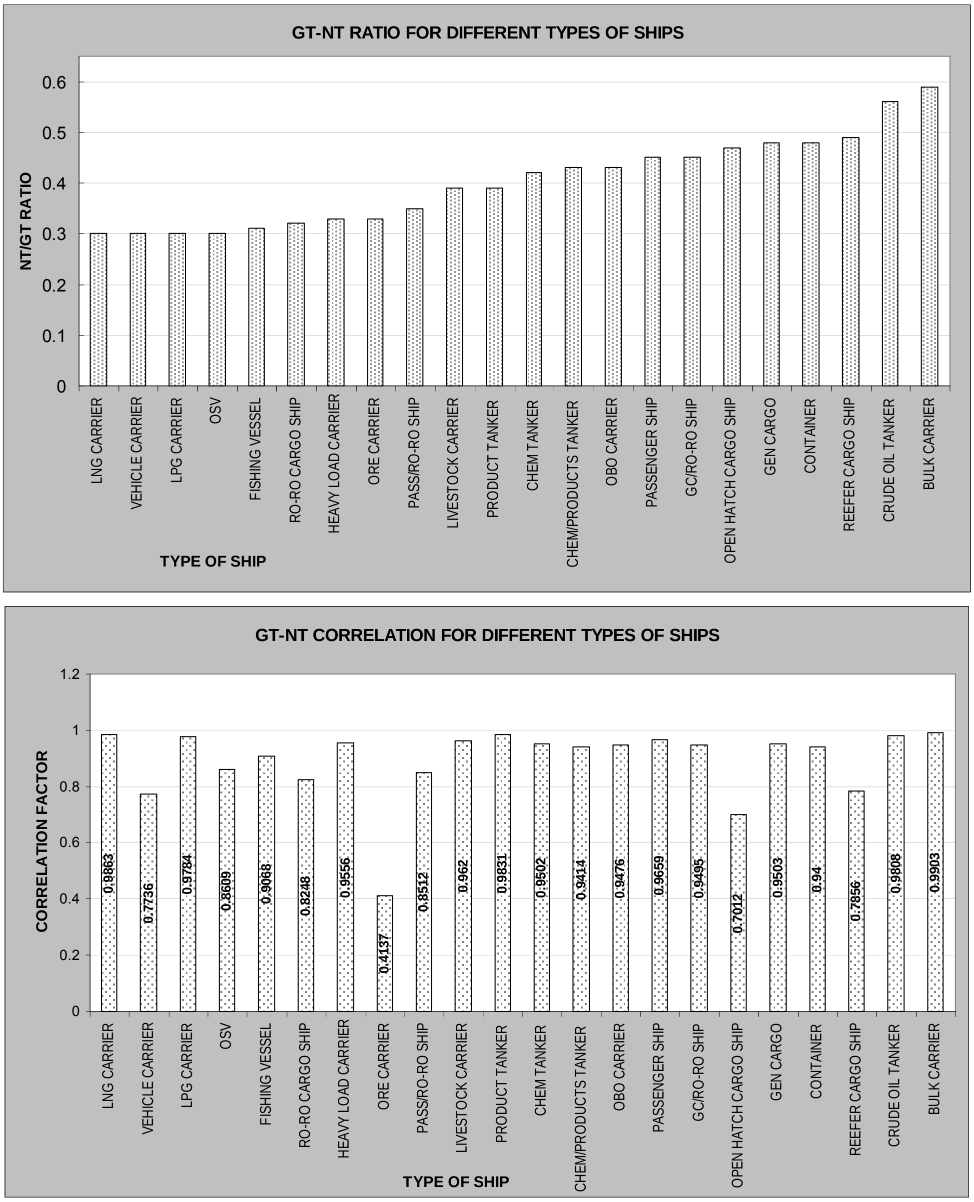

Figure 3 : GT-NT Ratio and Correlation for ships (Sample size: 25,747 ships)

The options discussed above are short-term solutions, and the handicap of old regulations in ITC-69 still remain. These issues can be resolved and uniform application ensured only by long-term measures such as including appropriate provisions in ITC-69.

6.1.3 Deck cargo

Since 1969, world seaborne trade grew more than thrice and the container fleet grew by 10 times (ISE,1979;UNCTAD,2009). Container shipping was in its infancy years when ITC-69 was held. The carriage of deck cargo has become more common since then and innovative ship-designs evolved to improve efficiency and economy in shipping. The exclusion of deck cargo from tonnage measurement was a boon for container ships which carried a considerable part of the cargo above deck (Grey,2006;Grey,2008). Due to increased globalisation and offshore activities, deck-cargo became more common on other types of ships also. Vessels, like timber carriers and heavy lift vessels, were tailor-made to carry cargo outside the enclosed spaces.

A study of *travaux preparatoires* of ITC-1969 (IMO,1969a;IMO,1969b; IMO,1969c) indicates that carriage of deck cargo was indeed discussed during the Conference, but was not considered while finalising the formula for NT. The initial proposal to define NT based on displacement would have taken care of this aspect, but seems to have been missed out after changing the basis to the volume of cargo spaces (V_c), during the final stages of the conference. The omission of deck cargo space from tonnage calculation has been the source of many undesired consequences.

An article in the Journal of Nautical institute ("Containerships:",1999), points out that the omission of deck cargo space from GT and NT, and the exploitation of this flaw in tonnage regulations, is putting seafarers and stevedores at risk.

Competition in container traffic has forced ship-owners and designers to explore every opportunity to save costs. The examples in Chapter-5 show how the omission of deck-cargo from tonnage measurement is exploited by container ships. Other ships carrying deck cargo also benefit from this flaw Despite being used as an earning volume, it is not considered for GT or NT. This is the reason why some ports are using TEU capacity as the basis for charging containerships.

In the current system, only the volume of 'enclosed cargo space' is considered for net tonnage, and it is reported that the omission of space occupied by deck cargo is leading to disparity (IMO,2005g). For addressing this problem the volume of spaces occupied by cargo, outside the 'enclosed spaces', should be added to the volume of 'enclosed space'[34] and volume of 'cargo space' while calculating GT/NT. It means that the maximum length, height and breadth of the open space appropriated for (or expended by) cargo need to be measured. For most ships, this is a design parameter known during early stages of design and can also be easily verified *in situ*. This change in approach will result in higher GT and NT for ships carrying deck cargo, truly reflecting their size and earning capacity.

6.2 <u>Amendment procedure</u>

Most maritime conventions have three procedures for amendments, i.e.,

(i) amendment by unanimous acceptance,
(ii) amendment after consideration in the Organisation, and
(iii) amendment by a conference.

In most cases the conventions, especially the technical provisions, are amended 'after consideration in the Organisation', this procedure being the easiest. Under this procedure, there are two options, i.e., tacit acceptance and explicit acceptance. The concept of 'tacit acceptance' was at discussion stages in IMO, when the Conference was held in May/June 1969. Hence, only the explicit acceptance procedure, as given in contemporaneous maritime conventions like SOLAS-60 and LL-66, was included in Article 18 of ITC-69.

The 'tacit acceptance' procedure, developed to avoid the inordinate delays in getting positive acceptance from States for adoption of essential changes to the major conventions, was introduced for the first time in 1972[35]. The SOLAS and LL-66 were subsequently updated to include 'tacit acceptance' procedure (SOLAS-74 and 1988 Protocol respectively), but ITC-69 continues to have the explicit acceptance (or classical amendment) procedure.

[34] 'Enclosed space' and 'Cargo space' as defined at Regulations 2(4) and 2(7) of ITC-69.
[35] Tacit procedure was introduced in COLREG-72 in October, 1972.

As per Art.18(3) of ITC-69, any amendment requires acceptance by **two-thirds majority each at MSC and Assembly**, **followed by positive acceptance by two-thirds of the Contracting Governments** before entry into force. With 150 Contracting Governments to ITC-69, it is a long-shot to get 100 positive acceptances for an amendment to enter into force. The absence of an expeditious amendment procedure is the main handicap in bringing ITC-69 in vogue with the developments in the maritime sector. ITC-69 has the 'distinction' of being the only major maritime convention without any amendments since its adoption. The delay in updating the convention and consequent economic impact on ships will force States to think about unilateral interpretations and actions. Some instances of unilateral action were already brought to the notice of IMO, as stated in Chapter-5.

It was recognised in IMO that delays in implementation of amendments due to the 'classical procedure', had encouraged unilateral legislation by States, which strike at the purpose of IMO and had been seriously disruptive to international shipping services (IMO,1998). This could be the situation for ITC-69 also if timely action is not taken.

According to Ozcayir (2004), the amendment procedures in the first conventions were satisfactory when it was adopted since most international treaties were ratified by a small number of countries. The growth of membership in the IMO and the serious situation wherein IMO could not amend the treaties that became out of date, led to the introduction of 'tacit acceptance procedure', the effectiveness of which is clearly visible for SOLAS-74 convention (Ozcayir,2004;Shi,1998).

Though the tacit procedure expedites the amendment process, it has disadvantages also. Amendments could be made without detailed discussion of all related issues and involvement of all concerned parties. As mentioned in the submission by China (IMO,2009b), it could also lead to more amendments than necessary, which is not a desirable practice. This is the reason why the 'tacit procedure' is applicable only to the technical provisions of maritime conventions. From past experience with other IMO conventions, it can be seen that the advantages of 'tacit procedure' heavily outweigh the disadvantages.

The explicit acceptance procedure in ITC-1969 needs to be changed sooner or later, as it will impede the amendment process. Interim measures to resolve individual technical issues, can only be temporary solutions and more of them will be needed as time progresses. It is seen in Chapter-4 that the failure to adopt timely amendments to Moorsom's System led to the adoption of Danube rules, Suez Canal tonnage rules and Panama Canal tonnage rules. It is agreed that the ITC-69 amendment process will be snail-paced and tedious, but it is not a justifying reason to skirt the issue. There is no advantage gained by delaying the amendments and the process will not become any simpler at a later date. The constraints imposed by the interim measures and unilateral action could be minimised if amendments are made early enough.

6.3 Consequences of inadequate provisions

6.3.1 Unilateral interpretations

In Para 3.8 and 5.1, the 'rule bending' in the case of S.S. Leviathan was mentioned. The vessel with an original GRT of 54,282 became a 'nine day wonder' as the largest trans-Atlantic passenger liner in 1923, when its GRT was declared as 59,956 (NRT as 27,696) after a re-measurement. But in 1931, out of commercial compulsions, the GRT and NRT were artificially lowered to 48,932 and 15,800 respectively, under the same rules. This example from history shows how the tonnage values of a ship were altered at different times **under the same rules**, to fulfill/suit the commercial needs of the ship-owner.

In order to examine the non-uniform interpretation of the regulations in ITC-69, an example[36] from IMO website is chosen for detailed study (IMO,2005f, attached as Appendix-1). In this case, four vessels were treated as crafts of 'Novel design' and their GT and NT were considerably reduced under Reg.1(3), as indicated in Table 1:

[36] The sole purpose of this example is to demonstrate the unilateral interpretation of, and consequences of inadequate regulatory provisions in ITC-69. It is not intended to question the rights of flag State or to offend any person or entity, in any manner.

Table 1 : Details of tonnage exemption granted to four ships by its flag State (IMO,2005f. Attached in Appendix-1) (Note: Slnos 2, 3 & 4 are sister-ships)

Slno	SHIP	ORIGINAL VALUES		AFTER EXEMPTION		% REDUCTION DUE TO EXEMPTION	
		GT	NT	GT	NT	GT	NT
1	Jaeger Arrow	29103	8730	17591	7911	**39.6%**	**9.4%**
2	Grouse Arrow	44398	24266	28157	8841	**36.6%**	**63.6%**
3	Mozu Arrow	44398	24266	28157	8841	**36.6%**	**63.6%**
4	Swift Arrow	44398	24266	28157	8841	**36.6 %**	**63.6%**

6.3.1.1 <u>M.V.Jaeger Arrow and M.V.Grouse Arrow</u>

Figure 4 : M.V. Jaeger Arrow(left) and M.V.Grouse Arrow (right). Superstructure of these ships were exempted from measurement (IMO,2005f).

(Picture Source:http://www.hmd.co.kr/english/03/01_3_8_2_pop.htm, http://www.pbase.com/portofsantos/image/81015156)

M.V.Jaeger Arrow[37] operated with a GT of 29,103 and NT of 8,730 between May,2001 and July,2005 (Register of Ships,2002). IMO was informed in July 2005 that the GT and NT of the ship were lowered to 17,591 and 7,911 respectively i.e., by 39.6% and 9.4% (Appendix-1).

M.V.Grouse Arrow[38] operated with a GT of 44,398 and NT of 24,266 between July,1992 and July,2005 (NIS, 2010). IMO was informed in July 2005 that the GT and NT of 'M.V.Grouse Arrow' and two of her sister-ships were lowered to 28,157 and 8,841 (*i.e., by 36.6% and 63.6 %)* respectively.

[37] Keel laid in April, 2000 and delivered in May, 2001.
[38] Keel laid in December, 1991 and delivered in July, 1992.

6.3.2 <u>Analysis of the case:</u>

In a detailed analysis of tonnage measurement aspects of these vessels, exemption from the flag State (Appendix-1) and study of related literature, the following were observed:

(i) The so-called ***'crane housing'*** is an enclosed space (*according to Reg.2(4) of ITC-69*), above the upper deck and bounded by permanent steel structure from all the sides. It provides commercial benefit to these vessels apparently '*designed for carrying sensitive cargo*', and the term '***crane housing'*** acts as a camouflage to the enclosed superstructure of substantial volume , as seen on photographs in Figure 4. This space does not fall under 'excluded spaces' defined by Regulation-2(5).

(ii) The *travaux preparatoires* of ITC-69[39] (IMO,1969a;IMO,1969b) indicate that it was decided to leave those aspects extraneous to tonnage (such as crew safety mentioned for these 4 ships) to the concerned bodies to deal with because there is a danger of losing sight of the real size of the ship if exemptions for such features are permitted. The concept of 'total enclosed volume' for GT was adopted to preclude the risk of manipulations (like this case) and to indicate the size of ships in a uniform manner.

(iii) Owing to the non-uniformity in the interpretation of 'shelter-deck spaces' and its consequences, it was decided during the 1969 Conference that no exemptions shall be granted for the shelter-deck spaces or spaces of similar nature. In principle, the treatment and exemption of '***crane housing***' in these ships, is similar to the shelter-deck space concept. The exemption of spaces such as the '***crane housing***' from the tonnage, could act as a precedent for other flags and ship-owners to reduce the tonnage of ships to artificially low values, citing similar interpretations.

[39] Plenary documents and General Committee documents, 4th and 5th of June, 1969.

(iv) the impact of this exemption on port dues, in comparison with another ship[40] (Figure 5) having approximately the same size, silhouette and tonnage of 'M.V.Grouse Arrow', is given in Table 2.

Figure 5 Comparison of ships
(left) 'M.V.Grouse Arrow'. GT-44,398, (but brought down to 28,157);
(right) 'M.V.Century Leader no.3', GT-44,830.

(Source: http://farm3.static.flickr.com/2320/2424087039_db6835290b.jpg, http://www.shipspotting.com/modules/myalbum/photo-695484-GROUSE+ARROW)

Table 2 : Comparison of ship size and effect on port charges.

	M.V. Grouse Arrow	M.V. Century leader no.3
Length BP (metres)	175.0	170.01
Breadth (metres)	30.4	32.21
Draft (metres)	12.2	8.82
GT (as built)	44,398	44,830
NT (as built)	24,266	13,440
GT (After exemption)	28,157 (37% reduction)	44,830 (no reduction)
Loss to port revenue (on GT based charges)	**37%**	Nil (Charges paid on actual GT)
NT (After exemption)	8,841 (64% reduction)	13,440 (no reduction)
Loss to port revenue (on NT based charges)	**64%**	Nil (Charges paid on actual NT)

It can be see that the cost incurred by a port in servicing the above vessels is nearly the same, but the revenue earned by the port from M.V.Grouse Arrow is considerably less due to the exemption granted.

[40] It is assumed that the resource needs, like pilotage, quay length, draft of channel or towage, do not depend significantly on the type of ship for comparing revenue loss to the port. Hence, a ship physically similar in size and silhouette is chosen, though the type is different. These ships have close GT values, but the NT values will not comparable since it depends on the cargo space.

(v) The ***'crane housing'*** is provided for protection to the crane and the cargo, and the vessel is designed for transportation of '*sensitive forest products*' (as per Appendix-1). The disadvantages of higher GT mentioned in the letter, without comparison to the savings and commercial benefits earned out of these provisions, give a distorted picture. It is seen in publications and periodicals[41] that cargoes other than 'sensitive forest products' are also carried on the ship.

(vi) When a space is not appropriated for carriage of cargo, its volume need not be considered for calculation of NT, as per Regulation 2(7). However, this volume cannot be excluded from GT calculation, since the GT is meant to indicate the overall size of the ship.

(vii) The Regulation-1(3) of ITC-69 is meant for situations where the application of provisions is '*unreasonable or impracticable*'. All the four vessels operated with 'original' GT and NT for quite some time (M.V.Jaeger Arrow for 3 years and other ships for 13 years) before the tonnages were lowered in July, 2005 under Regulation-1(3). This indicates that it was not 'impracticable' to apply the provisions of ITC-69 for measurement of these vessels. The term 'unreasonable' in Regulation-1(3) can have widely varying interpretations, especially from the commercial point view.

(viii) Ships such as Ro-Ro ships, livestock carriers, passenger ships and car carriers, also have unutilised overhead spaces of substantial volume, providing protection to cargo and/or safety to people, which are similar in principle to the exempted ***'crane housing'*** space. To decline their request on the same grounds for a lower GT by a flag State would be unfair, while a favourable action will eventually lead to chaos.

The example of 'M.V.Grouse Arrow' is chosen to demonstrate that such unconventional interpretations can undermine the integrity of ITC-69 and contravene the interest of important stakeholders such as port authorities.

It is agreed that the term 'novel design' is not clearly defined in ITC-69 or in its interpretations. At the same time, the provisions under Regulation 1(3)

[41] Fairplay (12th April,2001), Port Progress (January,2008, St.Johns Port Authority)

are not intended for alteration of tonnage for extraneous reasons. If the regulations are not clear enough to treat all ships reasonably equally, unilateral interpretations of this nature will be resorted to more often, thereby eroding the founding principles of ITC-69. According to the *travaux preparatoires*, one of the basic principles behind ITC-69 was that the tonnage should not be influenced by design/construction features of ships. Therefore the moulded dimensions are measured as per ITC-69, unlike the earlier system[42]. The doctrine of 'shelter-deck exemption' and its subsequent abuse by ship-designers, indicated in Chapter-3, originated from an interpretation of 'space under awning' similar to the above case.

The regulatory provisions should be adequate to cover various existing and emerging ship-types and sizes, so that the tonnage values realistically reflect the overall size of the ship. The rebuff to the 'Tonnage Mark Scheme' by port authorities is one such example, since some ships paid much less in port charges owing to their disproportionately low tonnage, despite utilising the port resources to the same extent and causing the same expenses to the port.

Submissions to IMO (IMO,2003a;IMO,2003b) by member States mention about the unilateral practices adopted by Administrations, citing economic disadvantages. A detailed study may indicate more such instances where such steps have been taken under the guise of commercial disadvantages and/or lacunae in ITC-69. Similar to the 'Leviathan' case in 1931, the 'Grouse Arrow' case in 2005 signifies the need for corrective measures, before unilateral interpretations by States become widespread and habitual.

6.3.3 Impact on ship design- safety and crew spaces

It is seen that the GT and NT are dependant on the volume of 'enclosed spaces' and 'cargo spaces' respectively. The 'enclosed space' includes non-earning spaces such as the living spaces for the crew and forecastle, and these are counted for calculation of GT. The owners always wanted to save on tonnage-based charges and explored various ways to reduce GT. The efforts

[42] Internal measurements were taken, ie, from the top of the floor or from the inside of the frames.

to reduce enclosed volume resulted in the design of ships without forecastle, with bare minimum space for crew and minimal freeboard. The investigations and studies after the loss of M.V.Derbyshire revealed the importance of forecastle in reducing the green seas and deck wetness, thus improving safety (DoT,1998;IMO,2007a;IMO,2007b;Vassalos et al,2003;Vossnack,2002). The investigation reports on M.V.Dongedijk given in Chapter-5 also point towards GT as an influencing factor for lower freeboard.

The elimination of forecastle and poopdecks were measures to reduce the GT of ships ("Lost for words",2008). When the GT is reduced by artificial measures, there could be a reduction in manning grades and scale disproportionate to the physical size of the ship, which is not desirable from a safety point of view.

During the 1969 Conference, it was pointed out that the inclusion of crew spaces in the tonnage measurement would inhibit willing ship-owners from providing higher than minimum standards of crew accommodation (Wilson,1970). Based on submissions to IMO, it can be seen that this is indeed true in many cases. According to ILO, the way in which tonnage is calculated has a direct influence on the welfare of seafarers since many ILO conventions use GT as a base for the application of their provisions. Further, ILO opined that the existing economic incentives for building ships with minimal accommodation space for crew might be eliminated if GT is not used as basis for tonnage-based fees (ILO,2008;IMO,2007b;IMO,2007c).

As seen in Chapter-5, provision of more space and more facilities for the crew will result in an increase tonnage, and tonnage-based costs, throughout the lifetime of the vessel. Unfortunately, the ship-owner does not derive any economic benefit out these extra facilities provided to the crew.

It is strange that the 'earning space' occupied by deck cargo is not considered for GT or NT, whereas the 'socially desirable space' such as crew accommodation is included in GT and penalised. A willing ship-owner providing better living facilities for crew, should not be penalised by way of higher GT and GT-based fees.

Some modern ship designs, like open-hatch container ships or double-hull ships were much safer, but had higher GT due their design features ("Hatchcoverless",2001a). The higher GT acted as a disincentive and discouraged owners from buying such ships, though there are certain mandatory provisions to have double-hulls for tankers.

It can thus be seen that although ITC-69 did not have any direct relation with safety measures on ships, it eventually had an influence on safety features of ships. ITC-69 does not differentiate between commercially beneficial spaces and the extra spaces provided for better safety or social benefits. While it is necessary to include all the spaces in GT because GT is an indicator of the overall size of the ship, the issue arises when GT is used as a basis for charging ships and the desirable features are penalised throughout the lifetime of the ship ("GT-design dilemma",2000). It is not suggested that the safety or social aspects should be considered for exclusion from measurement. But, if a suitable measure other than GT is used as basis for charging, it may remove this discouraging factor by not penalising safety and socially beneficial measures.

6.4 GT and NT as basis for dues and regulatory purposes

As discussed in Chapter-2, the measurement of vessels originated from the need to collect dues from the vessel depending on its size. The transition from sailing ships to mechanically propelled ships and use of steel instead of wood as the construction material, gave rise to different measurement methods. The volume below the deck was a good measure of the carrying capacity of sailing ships and it was indicated as GRT. But the part allocation of cargo space below deck for the machinery in mechanically propelled ships, gave rise to certain deductions from GRT, and resulted in NRT. The NRT was predominantly used as a basis for tonnage-based dues (Owen,1907). Wide variation in NRT of similar ships 'Tonnage Mark Scheme' in the 1960's prompted many ports to adopt GRT instead of NRT.

That trend continued with the use of GT in place of GRT after ITC-69 came into force. Though IMO do not have any role in port operations or charging dues from ships, most of the ports use GT and/or NT as a basis. According to a study by the UN in 1975, there is no uniform base for charging dues on ships worldwide. The charging could be based on GRT(GT), NRT(NT), length of ship, length of quay or cargo characteristics (UN,1975).

In addition, the tonnage figures have been used in international conventions for regulatory purposes also. The uses of GT as threshold values in application of regulations in major conventions are shown in Appendix-2. It can be seen that in some cases, there is no rational link between the tonnage and the technical requirements under the regulation (Bennet,2001;Eriksson in 1969c). In the ILO-126[43], the length of a fishing vessel is used as a criterion in addition to GT, due to inability of the GT to reflect the correct size of fishing vessels. The GT is no longer used by FAO as a criterion for classification of fishing vessels (FAO,2003;ILO,1966).

In addition to the GT and/or NT , other concepts based on the physical characteristics of the vessel were also used for collecting port charges. France follows a system based on the physical dimensions of the ship. As per the French regulations ('Code des Ports Maritimes',2001), the base for calculation of charges is the volume given by $V=LxbxT_e$, (Length x Breadth x Draft). A new tariff structure based on the French system was implemented in Poland in 1994 (EC,2006). Australia indicated that a system, based on length breadth and draft, is under consideration for Australian ports (IMO,2007a).

The port of Delfzijl in the Netherlands has chosen to replace GT by the quantity of cargo loaded/discharged. This has resulted in more revenue for the port because it was advantageous for ship-owners to call at this port with relatively small quantity of cargo (Vossnack,2002). The ship-owners association in the Netherlands (KVNR) also favoured the removal of GT as a basis for port dues (Vossnack,2001).

As seen from Chapter-4, the GT as a basis for fees is a barrier to safer new designs which have more enclosed volume. Vossnack (2001) comments that designs for much safer, efficient and entirely different designs for container ships, oil tankers and chemical tankers could be made, if higher GT was no longer an objection by ship-owners ("Call for change",2001). According to Dr.Hans Payer, ("Time running out",2001), unless the port dues and canal charges are paid on a

[43] ILO Convention 126.

parameter other than GT, hatchless ships would remain too expensive due to their higher freeboard.

The Cost-Performance-Value (CPV) approach (UNCTAD,1995) relates the maximum charges in a port to the value received by the user. Robinson (2002) describes the role of port in a value-driven chain. The value received by the user for certain types of ships cannot be determined based on GT or NT, but may be better established by the physical resources utilised by a ship. This indicates that a parameter based on principal dimensions would be more appropriate than GT or NT for uniform charging.

From the earlier discussions, it emerges that a measure other than GT or NT is necessary, to collect dues from different types of ships in a fair manner. Various proposals have been submitted by member States to IMO about the need to resolve this issue. Any decision taken in this regard should be acceptable to the port authorities also and hence active participation of agencies like IAPH is essential. However, if a new tonnage measure is to be developed, it is for IMO to take initiative.

6.5 Other areas

The control provisions in ITC-69 are limited. Under Article-12, when a discrepancy on GT or NT is observed during port state control (PSC) inspection, the only action that can be taken is to inform the flag State. But, a discrepancy in GT and/or NT has serious implications since various regulatory requirements applicable to the vessel may be substantially different under the higher tonnage values. It is illogical when a vessel with artificially low GT and NT can escape control provisions under major conventions (such as SOLAS,MARPOL or STCW) citing those low values, while a vessel of similar size with truthful GT and NT values could be detained for non-compliance under the same control provisions. Hence it is necessary that control provisions in Article-12 of ITC-69 are identical to those in other major conventions. The existing provisions should be amended to include clear grounds and to allow port States to take steps necessary to ensure that ships can proceed without danger to safety, security, life or environment.

6.6 Summary

In this chapter, the vexing issues of ITC-69 were brought out and discussed to identify the causes behind them. The major causes identified are the delay in amendments to ITC-69 leading to unilateral interpretations, omission of deck cargo space from measurement, use of GT as a basis for charging and effect of tonnage on safety and social matters. In the next chapter, different measures to address these areas will be discussed.

CHAPTER-7 . Options For a Way Forward

In this chapter, the issues identified in Chapter-6 are set against the historical background for better perception and to form a sound basis for deciding the recommendations.

It is seen in Sections II and III, that technological developments and growth of shipping in 19th and 20th centuries necessitated a uniform method of measurement to indicate the size of ships. Britain, as the greatest maritime power, controlled about 50% of the world tonnage and the rules for measurement were framed to the advantage of the British ship-owners (Johnson,1913;McIntyre,1960). At the time of the ITC-69 Conference, different methods were followed worldwide and the tonnage of a ship varied widely when measured under different national rules. It was also necessary for universal acceptance of ITC-69 that any new method would not substantially alter the existing GRT and NRT figures of ships. This approach restricted the adoption of some positive changes proposed during the 1969 convention.

The main areas of concern about ITC-69 are highlighted in Chapter-6. It is neither intended nor possible to cover all the issues in this thesis due to various constraints. In this Chapter, the three priority areas concerning ITC-69 will be discussed, and the recommendations made thereafter will resolve some other issues also simultaneously. These three areas are :

(i) Inclusion of tacit acceptance procedure in ITC-69,

(ii) Inclusion of space occupied by deck cargo for GT and NT, and

(iii) Inclusion of 'Toll Tonnage', which is intended as a basis for vessel-related charges.

7.1 Inclusion of Tacit Acceptance Procedure

The idea of 'tacit acceptance procedure', evolved in 1968, was at the embryonic stage when the ITC-69 Conference was held. The amendment procedures prevalent at that time, similar to those in SOLAS-1960 and Loadline-1966 conventions, were therefore included in the ITC-69 text.

It is seen in Chapter-6 that the 'tacit acceptance procedure' did reduce the time taken for incorporating important amendments to the technical provisions in many IMO conventions. The creation or amendment of legislation at IMO is often reactive, and typically follows a major disaster (Knapp&Franses,2009), and public and media attention to major maritime casualties led to rapid and time-bound amendments to the conventions on safety and pollution prevention. Though ITC-69 also needed amendments on various grounds for quite some time (Bennet,2000), the consequences of its delay did not lead to any 'disaster'. As stated in Chapter 4, quicker amendments, as and when needed, was one of the reasons which prompted the Panama Canal Authority to opt for separate measurement rules (Johnson,1913), which benefitted them for easier amendments in 2002 keeping with the current international maritime traffic and a far more realistic tax establishment for ships such as container ships (Llacer,2005).

IMO had 65 members when the ITC-69 convention was held, but the situation is different now. Out of 169 member States, 150 States have ratified ITC-69 (as of 31st July, 2010). Therefore, unless 100 Contracting Governments communicate positive acceptance (after adoption with two-thirds majority at MSC and Assembly), no amendments to ITC-69 can enter into force[44]. A difficult, if not impossible, task. Obviously this was not the intention of those who drafted the convention.

For example, a solution to the economic disadvantage to open-hatch container ships or Ro-Ro ships will be of concern only to those States who have beneficial interest in these ships. In such a case, it will be a daunting task to get positive acceptance from two-thirds of Contracting Governments, since this issue may not be on the priority list for many of them.

According to Helfer (2008), major increases in treaty commitment levels require the affirmative consent of every State. Majority adoption and automatic or tacit entry-into-force rules may be adequate for fine-grained revisions and

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[44] According to the amendment procedure at Article 18(3).

adjustments of pre-existing obligations. However, non-consensual methods like tacit procedure may result in major amendments entering into force without sufficient consideration and debate of all related issues arising out of the amendments. Another disadvantage of tacit acceptance procedure is the tendency to amend the provisions more often than necessary, which is not a desirable practice.

Notwithstanding the above, keeping the maritime conventions up-to-date will strengthen IMO's role as an international body. Past experiences about *'tacit acceptance procedure*' show that the advantages outnumber the drawbacks by a huge margin. One of the handicaps of ITC-69 is the absence of the '*tacit acceptance procedure*'. A comparison of the procedures for 'amendment after consideration in the organisation' for ITC-69 and other major maritime conventions is illustrated in Figure 6.

In order that the role of IMO is not undermined by the inability to make requisite amendments in reasonable time, the inclusion of the '*tacit acceptance procedure*' is essential in all conventions. The International Convention on Load lines, 1966, adopted before ITC-69 has already been amended[45] to include '*tacit acceptance procedure*'.

The consequences of delay in amendment to ITC-69 were given through earlier examples. It is seen in chapter-4 that the failure to make much-needed amendments to Moorsom's System led to the development of the Danube rules(1871), Suez Canal rules (1873) and later on Panama Canal rules (1913), which still haunt ships in the form of complicated calculations and separate tonnage certificates.

Therefore one of the top priorities is the inclusion of *'tacit acceptance procedure*' in ITC-69 by amending the existing text under Article 18(3).

[45] Amended by 1988 Loadline Protocol

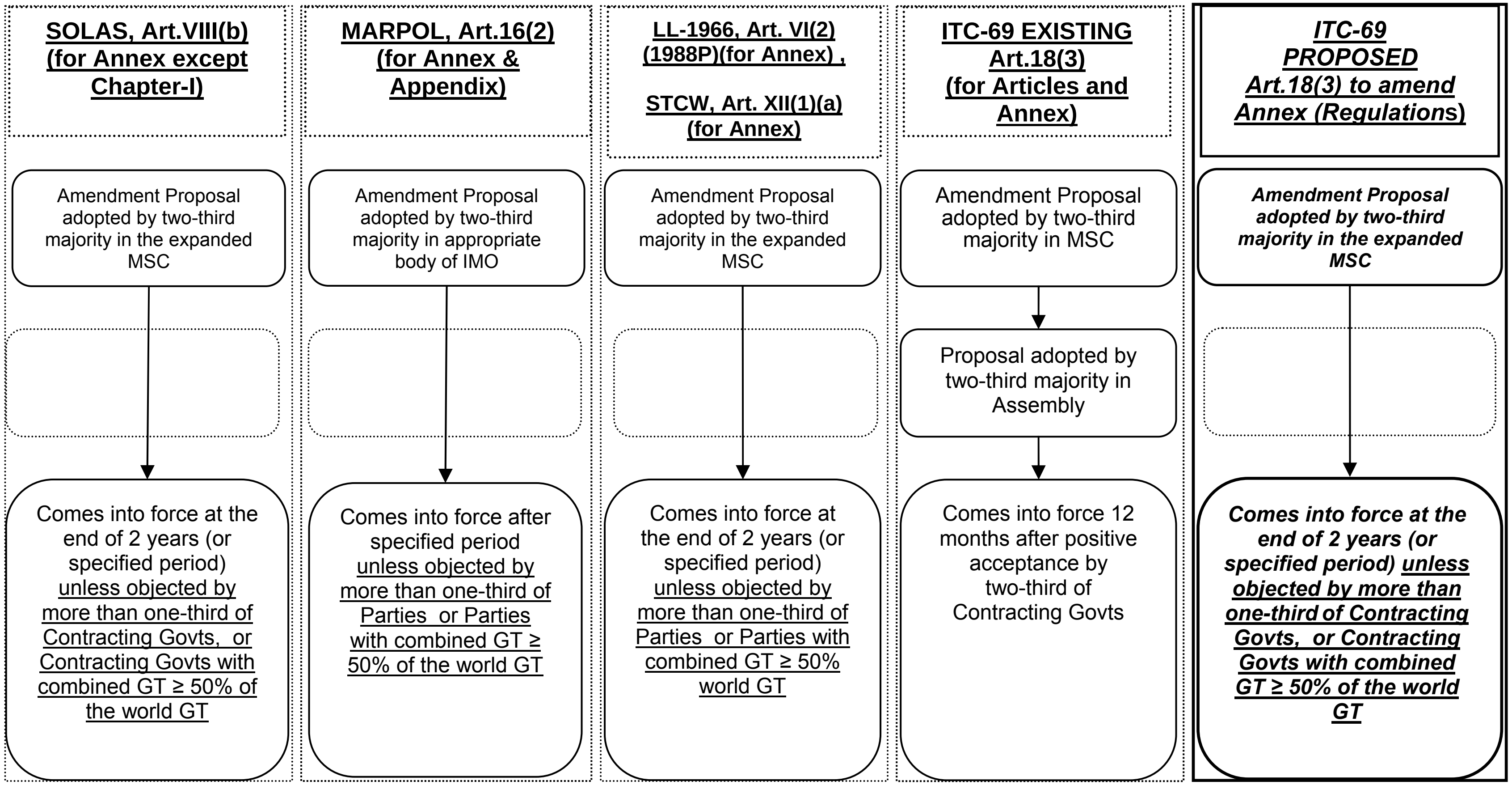

Figure 6 : Amendment after consideration within Organisation.
Comparison of Art. 18(3) of ITC-69 and 'Tacit Acceptance Procedure' in major IMO Conventions

7.2 <u>Inclusion of Deck Cargo</u>

It is seen in Chapter 4 that Moorsom's System had provisions to include deck cargo in tonnage calculations, separately. Also in the case of the Panama Canal, the 1913 rules included deck cargo, but was discontinued in 1914. As the carriage of deck cargo became more common, the system was re-introduced in 1997 and revised in October, 2002 (Llacer,2005;Moloney,1997). Suez Canal tonnage rules of 1873 did not include deck cargo, but from 1975 onwards, deck cargo was included for charging tolls (Barnett&Ruben,2005;Brown,1920; Corkhill,1980;Johnson, 1938).

As per the *travaux preparatoires* of ITC-69, the carriage of deck cargo was discussed while drafting ITC-69. But it was not included in GT and NT calculations since the carriage of deck cargo was not so common at that time (IMO,2003a). The priority in 1969 was a universally acceptable measurement method, and this aspect was not given importance at that time. But the situation is different now. There are purpose-built ships (such as container ships, supply vessels and project cargo vessels) for carrying a significant amount of deck cargo. The open spaces on decks of these ships are designed to increase the earning capacity of the ship.

The NT is intended to represent the 'useful capacity' of a vessel[46]. Hence, it is logical and necessary that the spaces occupied by deck cargo on these ships are included in tonnage measurement. The economic advantage of carrying deck cargo without increase in tonnage, encourages carriage of more cargo on the deck at the expense of safety and sea keeping performance, as seen in the example of M.V.Dongedijk casualty, in Chapter-6.

It is seen in earlier Chapters that the 'earning capacity of the ship' was the principle on which the old tonnage laws were based, and ITC-69 follows the same. When the deck space is utilised, it adds to the earning capacity of the vessel. But the tonnage-based dues are charged only for the cargo carried in enclosed spaces (cargo holds), while those stowed on deck are free from dues. It is an irony that the earning space, such as deck cargo space, is omitted from tonnage whereas

[46] NT as defined at Art.2(5) of ITC-69, and as per the *travaux preparatoires* of ITC-69

desirable features such as crew space or forecastle or double-hull envelope are included. Since more and more cargo are being carried on deck, ports have started using other means than GT or NT to recover the dues. For container ships, many ports are using TEU as the basis. It may be recalled that the 'Tonnage mark scheme' failed in the 1960's, since it did not realistically reflect the size of the ship and port authorities had to adopt other measures, as detailed in Chapter-4. Before the GT is termed as obsolete measure for certain ship-types which predominantly carry deck cargo, the lacunae in regulations need to be removed.

In order to include the deck cargo space in tonnage, Regulations 3 and 4 of ITC-69 needs to be amended, and a new Regulation-2(9) to define 'Deck cargo space' be added. The proposed amendments by the author are:

Regulation-3: Existing description of V is replaced by "***V=Total volume of all enclosed spaces and the deck cargo space of the ship in cubic metres***".

Regulation-4: In paragraph 4(1)(c), existing description of V_c is replaced by "***V_c = total volume of cargo spaces and the deck cargo space in cubic metres***".

A new regulation 2(9) is added: ***"(9). Deck Cargo space: Deck cargo space to be included in the calculation of GT and NT is the maximum volume of all spaces allocated on open decks and spaces other than enclosed spaces for carriage of cargo. The length, breadth and height of such spaces, included in GT and NT, shall be certified by permanent marking with the letters OCS (Open Cargo Space) to be so positioned that they are readily visible and not to be less than 100 millimetres (4 inches) in height."***

7.3 A new parameter : 'Toll Tonnage (TT) '

It is seen in Chapter-6 that certain types of vessels suffer economic disadvantages when GT is used as a basis for dues, though ITC-69 was developed based on the principle that ships should not be discriminated based on design or construction features. Unfortunately, some of the new ship-types, designed to meet the modern transport needs and to comply with stringent requirements of safety and pollution prevention, pay much more dues than vessels physically similar or having similar deadweight. For example the volume which provides extra reserve buoyancy and better environmental protection in double-hull ships increases the GT as well, and the ship is destined to pay higher GT-based charges during her service life.

The major port resources utilised by a ship are (i) aids to navigation, (ii) berth, (iii) pilotage, (iv) towage, (v) channel depth and (vi) berthing and un-berthing, as seen in Chapter-6. The 'aids to navigation' are utilised equally by all ships, irrespective of size, but the utilisation of quay is dependant on the length of the vessel. The pilotage and towage depend on the physical parameters and manoeuvring characteristic of the vessel. Since GT does not represent these parameters realistically, some ships are bound to have disadvantages or unfair treatment. This problem becomes more significant, as new designs evolve. GT and NT being volume-based measures, do not (and cannot) truly represent the service requirements needed for all types of ships uniformly. The economic disadvantage to certain ships originates from this approach. For the charges to be proportionate to the utilised services, a better representation of the physical size of the vessel is necessary.

The *travaux preparatoires of ITC-69* reveals that, during the Conference, one tonnage based on volume and the other based on weight (or displacement), were proposed (IMO,1969a;Wilson,1970). During the deliberations, the volume-based approach was adopted for GT. But NT calculations based on displacement did not give adequate correlation, especially due to the 'artificially low' NRT of shelter-deck ships. Hence, in a subsequent decision by the plenary, 'volume' (of cargo space) was decided as the basis for NT.

The question being asked is why should port dues be based on volume-based tonnage, and not another parameter. According to Biles (1908), there are two views of the basis of tonnage upon which vessel related charges are paid, i.e., (i) according to the ship's earning capacity and (ii) according to the service rendered to the ship. The present system is based on (i), the ability to pay. But the second principle is the one which holds in all commercial transaction, and hence is logical for ships also, i.e., the dues should be paid based on the services provided to the ship, not based on the earning capacity. However, as seen in Chapter-3 and 4, the traditional practice was to charge the ship based on its 'earning capacity'. This principle of payment for the services provided can be seen in simple day-to-day examples, wherein the charges paid for train or bus travel or the cost of services in a restaurant are not based on the earning capacity of the customer, but based on the type and quality of services provided to, and utilised by the customer. For a ship, this approach will lead to a solution based on length and draft, which represent the service needs of the ship in a port, more honestly than GT and NT. This parameter will represent the resources provided by the port, and utilised by the ship, more realistically (such as the length of quay, depth of dredged channel and tugs/towage).

The technical reason for adopting the volume-based approach in place of displacement-approach in 1836, was the '**impossibility of ascertaining the drafts in a satisfactory manner**', since ships did not have loadline marking on their sides (Moorsom,1855a:Salisbury,1966c). The same volume-based principle was carried forward Moorsom's System and ITC-69 also, though the earlier problem was resolved after introduction of loadline marking[47]. Since LL-66 is in force now and the moulded draft is indicated[48] on the 'International Tonnage Certificate', ascertaining the draft of a ship is no longer difficult.

Australia studied the effect of implementation of a new tonnage ('register tonnage') based on the displacement approach and its impact on the world fleet as well as ships calling at Australian ports (IMO,2005b).

In this background, the author proposes a new measure '**Toll Tonnage (TT)**' based on the displacement approach and dependant on the principal dimensions of the ship. The block coefficient, C_b, is not included because the factors that determine toll-dues are not directly influenced by the C_b. Further, there could be divergent opinions on the value of C_b to be used and calculation will no longer remain simple.

The fundamental principles on which the TT is based and the steps followed in establishing a formula for TT are given below, followed by the development of a formula for TT.

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[47] The loadline mark was made compulsory by 1876 Act, but the position of the marking line was not fixed by law until 1894. The first international agreement was 1930, and was revised in 1966. 'International Convention on Loadlines,1966 (LL-66)' is in force now.

[48] Moulded draft is indicated on Page-2 of the International Tonnage Certificate.

7.3.1 Fundamental Principles:

- The measure should be acceptable to port and harbour authorities,
- It should reflect the demand characteristics of a ship and the comparative benefits derived by a ship from the port, more honestly than currently done by GT,
- Its calculation has resemblance to GT and NT calculations in ITC-69,
- It should be easy to determine and easy to verify, when necessary,
- It can be determined during early stages of ship-design,
- It should not be unduly influenced by any one parameter,
- It should address all types and sizes of ships uniformly,
- It should not influence the safety, design or constructional features of the ship,
- It should be able resolve the existing issues related to tonnage-based charges, as much as possible,
- It should not necessitate major changes to the format of the 'International Tonnage Certificate', and
- The changeover from the existing GT/NT-based system to the new one should be easy.

7.3.2 Steps followed in deriving a formula:

Step 1: Identify the parameters on which TT should be based, by analysing a sample of world's ship fleet;

Step 2: Decide a format for the proposed formula, in resemblance to the existing formula in ITC-69 for GT and NT; and

Step 3: Select a suitable coefficient from a set of values, by analysing the impact of each value on a sample of world's ship fleet.

[*Note: The following abbreviations are used:*
L=Length, as per Article-2(8),
B=Breadth, as per Regulation-2(3),
D=Moulded Depth, as per Regulation-2(2), and
d=Moulded draft, as per Regulation-4(2) of ITC-69]

7.3.3 Step 1: Identification of parameters

It is already established at Para-6.1.2 that there is no uniform correlation between NT and GT for different types of vessels. Considering the fundamental principles at 7.3.1, the following options are evaluated:

(i) Option-I: TT as a function of the product of L,B and D ,i.e., *f(LBD)*, and

(ii) Option-II: TT as a function of the product of L, B and d, i.e., *f(LBd)*.

Initially, an analysis of the world fleet is carried out in order to choose one of these options. The GT is plotted against 'LBD' and 'LBd' for a sample database[49] with 25,747 ships of 22 different types. The correlation factor R^2 is determined to see how closely these parameters are related to GT (R^2 closer to unity indicates better correlation, i.e., transition to the new charging system would be easier). The R^2 values of GT-LBD and GT-LBd, calculated for each type of vessel, are given in Table 3 and plotted in Figure 7.

Table 3 : Correlation for sample fleet of ships (See Figure 7)

Type of ship	*Number of Samples*	*Value of R^2 (GT-LBd)*	*Value of R^2 (GT-LBD)*
VEHICLE CARRIER	947	0.920	0.497
PASS/RO-RO SHIP	1,078	0.816	0.669
PASSENGER SHIP	421	0.937	0.648
LNG CARRIER	315	0.967	0.969
RO-RO CARGO SHIP	747	0.844	0.879
LIVESTOCK CARRIER	39	0.909	0.862
LPG CARRIER	1,065	0.993	0.997
HEAVY LOAD CARRIER	109	0.916	0.949
GC/RO-RO SHIP	30	0.980	0.975
FISHING VESSEL	383	0.891	0.929
GENERAL CARGO	4,183	0.979	0.984
OPEN HATCH CARGO SHIP	214	0.956	0.977
OFFSHORE SUPPLY VESSEL	1,913	0.899	0.921
CONTAINER SHIP	4,247	0.984	0.994
BULK CARRIER	3,317	0.996	0.998
PRODUCT TANKER	2,437	0.996	0.999
CHEMICAL TANKER	490	0.986	0.995
CHEM/PRODUCTS TANKER	1,465	0.959	0.974
OBO CARRIER	54	0.996	0.998
REEFER CARGO SHIP	729	0.940	0.964
CRUDE OIL TANKER	1,488	0.995	0.998
ORE CARRIER	76	0.947	0.973
TOTAL NO OF SHIPS	**25,747**		

[49] Vessels above 3000GT on international trade, generated from LR-Fairplay database.

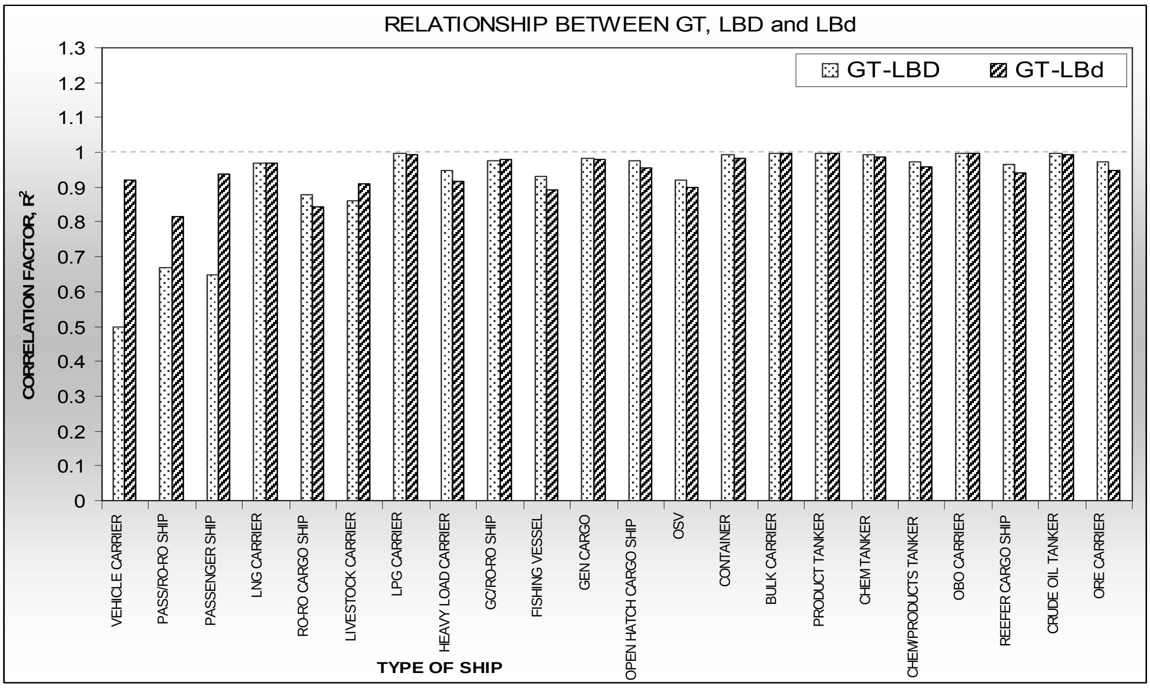

Figure 7 : Correlation of GT with LBD and LBd (Sample size: 25,747 ships)

Analysis of data in Figure.7 indicates that 'LBd' has higher and uniform correlation with GT than 'LBD'. Therefore 'LBd' is selected for defining TT. For further study and analysis, only 'LBd' is considered.

7.3.4 Step 2: Format for the formula

In ITC-69, GT and NT are determined from the volume of enclosed spaces and cargo spaces, by means of coefficients[50] K_1 and K_2 respectively (eg. GT= K_1V, Regulation-3 of ITC-69). According to the *travaux preparatoires* of ITC-69, these coefficients were introduced to achieve GT/NT values comparable to the GRT/NRT values of the existing fleet in 1969, so that the impact of the new system on the shipping fleet and industry is minimised.

In order to maintain resemblance with the existing formulae for GT and NT, a similar format is adopted for the formula for TT, i.e., as the product of a coefficient, L, B and d. (TT=(Coefficient)x(LBd)). The coefficient will be dependant on 'LBd'.

[50] K_1 and K_2 are dependant on the volume of enclosed space (V), and volume of cargo space (V_c) resp..

7.3.5 Step 3: Selection of value for Coefficient, K_4

In ITC-69, the value of K_1 and K_2 are:

$K_1 = 0.20 + 0.02 \log_{10}V$, and

$K_2 = 0.20 + 0.02 \log_{10}V_c$. (Regulations 3&4,ITC-69).

Therefore, the coefficient for TT is named[51] as K_4 and a format identical to the other two coefficients is adopted, i.e.,

$$K_4 = a + b \log_{10}(LBd).$$

The values of 'a' and 'b' are to be determined based on the analysis of the sample data of 25,747 ships of 22 types, referred at Table-3.

At first, the TT of sample data is calculated with 'a'=0.20 and 'b'=0.02 (*same values used for K_1 and K_2*), i.e, $K_4 = 0.20+0.02 \log_{10}(LBd)$. The calculated TT is compared with the existing GT.Thereafter, same process is repeated for different values of 'a' and 'b', to cull the most suitable values.

The TT is calculated for nine different combinations of 'a' and 'b' (*options A to I, given in Table 4*) and compared with the existing GT.

Table 4 : Different values of coefficient K_4 used and the TT results

OPTIONS	'a'	'b'	% difference between TT and GT (Median)
A	**0.20**	0.02	-29.85 %
B	**0.24**	0.02	-20.24 %
C	**0.26**	0.02	-15.41 %
D	**0.28**	0.02	-10.59 %
E	**0.30**	0.02	-5.76 %
F	**0.33**	0.02	1.47 %
G	0.20	**0.03**	-18.90 %
H	0.20	**0.04**	-8.07 %
I	0.20	**0.05**	2.87 %

[51] K_3 is already used in ITC-69 as the coefficient for obtaining the volume of passenger spaces from the number of passengers. Therefore decided to use K_4.

The results are given in

- **Figure 9** , showing variation of TT from the mean GT of sample data, as a box plot (*the numerical difference between mean GT and TT are also indicated on Table-4),*

- **Figure 10** , showing the percentage difference between TT and GT for different types of ships, and

- **Figure 11** , showing the percentage difference between TT and GT for different sizes of ship.

The boxplot in Figure 9 shows the variation of calculated TT (in %) from the mean GT for the sample data for the nine options for easy comparison and analysis.

(*An example of boxplot is illustrated in Figure 8.*

- *The boxplot graphically displays the distribution, symmetry and skewness of the data.*
- *It indicates the median, upper & lower quartiles and the extreme values.*
- *The box at centre contains 50% of the data, and the vertical line inside the box indicates the median value.*
- *The left edge of the box indicates 25th percentile (lower quartile).*
- *The right edge of the box indicates 75th percentile of the data (upper quartile).*
- *When the median line inside the box is not equidistant from the edges, the data is skewed.*
- *The end of horizontal line from the outside edges of the box show the minimum and maximum values.*)

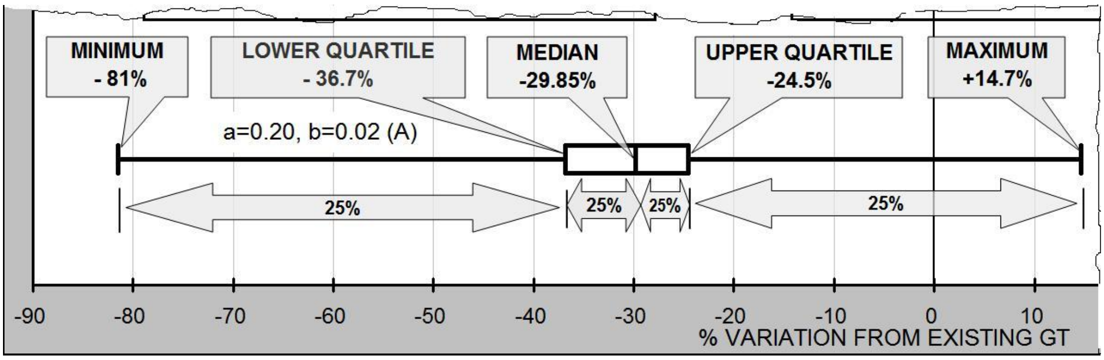

Figure 8 : Example on how to read boxplots given in Figure 9.
(The % variation of the calculated TT is plotted from the mean GT of sample data.
It shows that the median of TT is lower than the mean GT by -29.85% for option-A.
The TT varies between -81% and +14.7% of the mean GT.
50% of TT values lie between -24.5% and -36.7% of mean GT.)

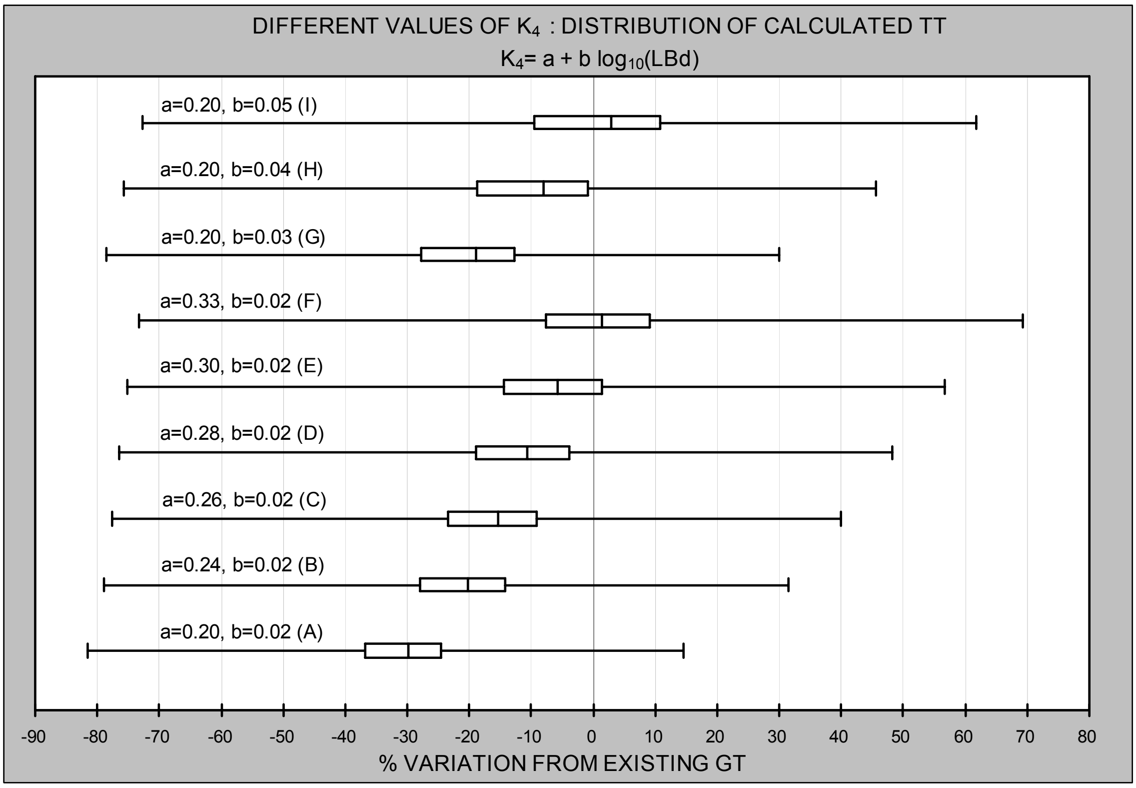

Figure 9: Distribution of TT for different values of K_4

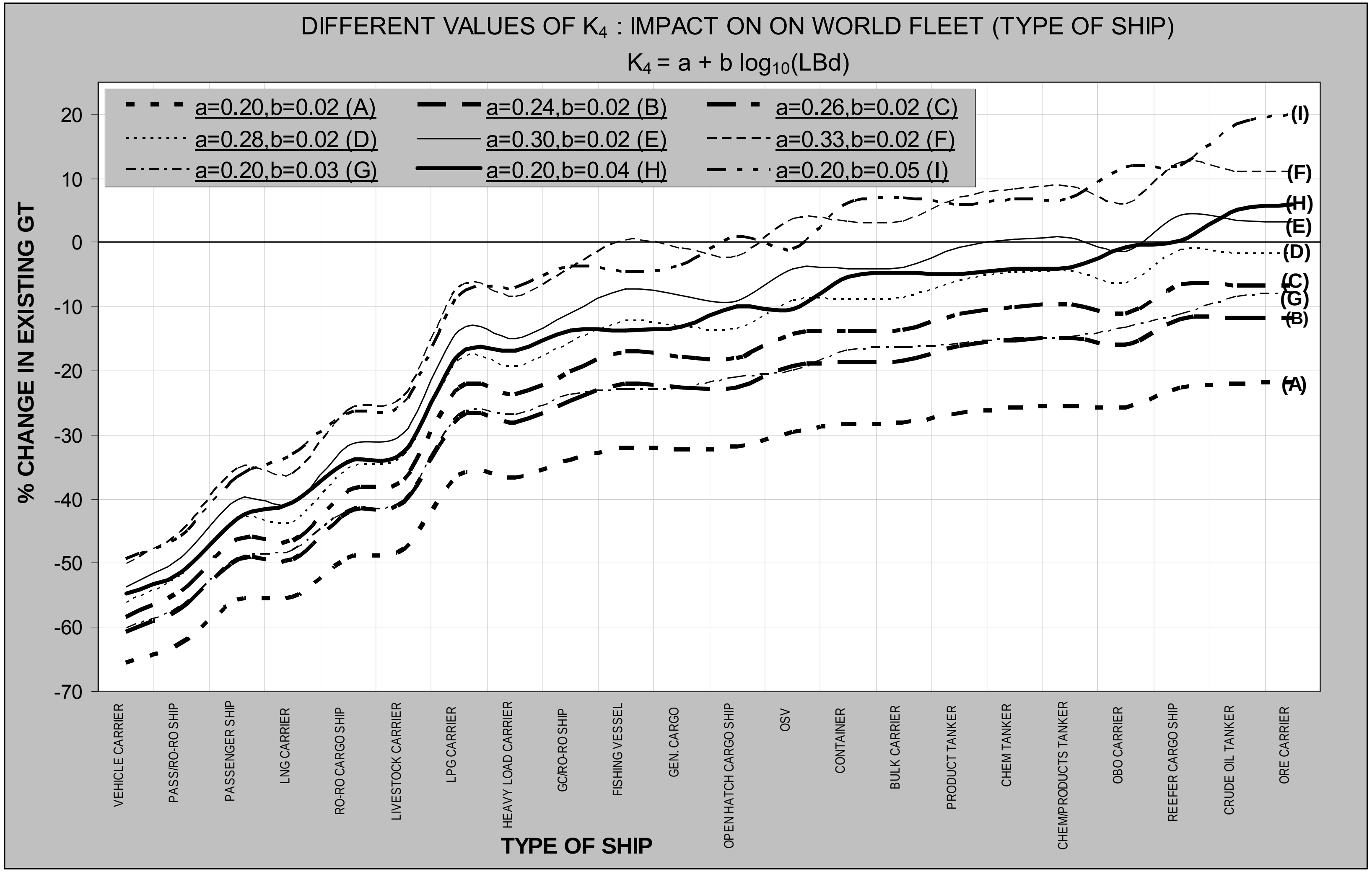

Figure 10 : Percentage Difference between GT and TT- for various ship types

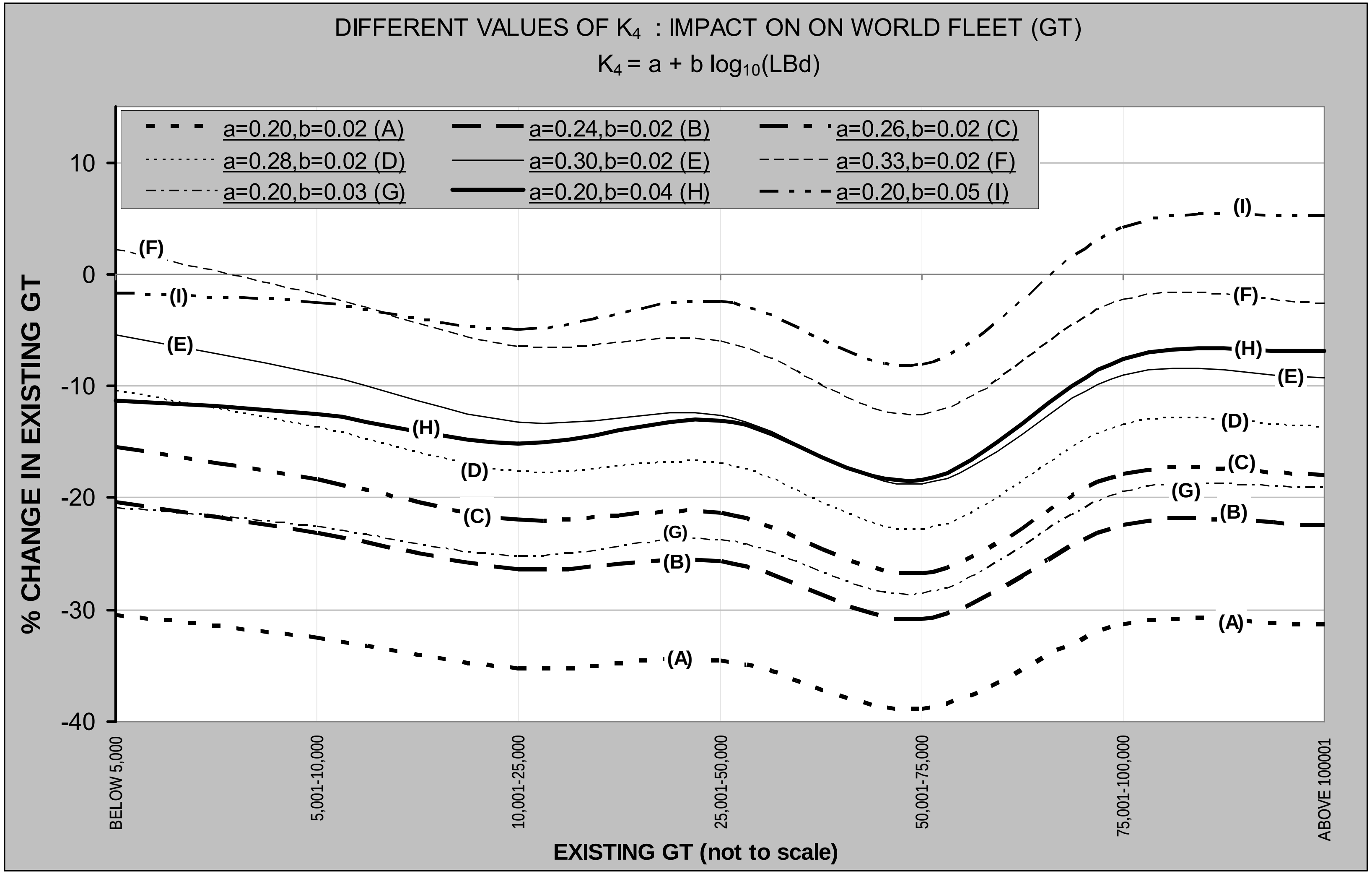

Figure 11 : Percentage Difference between GT and TT- for various ship sizes

From **Figure 9**, it is seen that the options-E, F, H & I have their median closest to the mean GT of sample data (-5.6%, +1.5%, -8.1% and +2.9% respectively). For options F&I, the extremities are too far away from the mean GT, and the medians are more than the mean GT. Therefore options F & I are not preferred. From the remaining two,i.e., E & H, the distance between extremities is the closest for option-H (-75.7% to +45.7%), but the variation of the median is lower for option-E (-5.6%). Therefore options E&H are preferable over the others.

Another factor considered for selection of K_4 is the analysis of the impact of different options on the shipping fleet. The variation of calculated TT from the mean GT is plotted for 22 ship types (**Figure 10**). The TT is considerably lower than GT for volume carriers such as vehicle carriers, Ro-Ro ships and passenger ships. These ships are known to have higher GT values than other ship-types with same principal dimensions, and will benefit from TT. **Figure 10** shows that the TT is higher than GT for a larger number of ship types for options-F & I (number of affected ships are 16,599 and 14,517 respectively). When the TT is higher than the existing GT, it would act as a discouraging factor for faster adoption and wider acceptance of TT. Therefore, options-F and I are not preferred. Though options-E&H also result in higher TT, it affects only a few ship types (number of affected ships are 4,248 and 2,293 respectively) and by a smaller margin (less than 5%). Options, A,B,C & G result in much lower TT values than GT. Since one of the fundamental principles is to have the TT values close to the GT, the options A,B,C &G are not considered suitable. Hence the favoured options are D, E &H under this criterion.

In **Figure 11,** the variation of calculated TT from the mean GT is plotted for different ship sizes. It shows that the TT is much lower than GT for options-A,B,C,D&G. Similarly options-F & I result in TT higher than GT for certain sizes of ships and hence not preferred. Therefore, options are E & H are considered more suitable than others.

The above correlations between TT and GT (Figures 9, 10 & 11) were done to ascertain the feasibility of easy transition from GT to TT as the basis for charging. It does not mean that a curve having high correlation with GT will lead to the optimal choice for K_4. The aim is to establish a new parameter TT, which is different from GT. The TT for volume carriers (such as car carriers, Ro-Ro ships and passenger ships) will be much lower than GT, but it is an acceptable result. One of the parameters considered for selection of K_4 is the impact on ships due to the change from GT to TT. If the TT is significantly higher than GT, the industry will be cautious and reluctant to accept the change. But if TT is less than GT or close to the existing GT values, less resistance is anticipated in adopting the TT.

From the above analysis and a detailed study of the Figures 9,10 &11, options-E & H are considered the most suitable, out of which one needs to be chosen. Based on the following reasons, option-H is selected for K_4:

- Fewer ships are affected by having TT higher than GT, i.e., 2,293 ships (8.9% of sample data) under option-H against 4,248 ships (16.5% of sample data) under option-E;

- Vessels below 50,000 GT have about 6% lower TT values under option-H than option-E (**Figure 11**). Approximately 85% of the world shipping fleet is below 50,000 GT and a lower TT under option-H would make the new system agreeable to a larger part of the world fleet, thereby making the adoption of the new system easier;

- About 52% of the world fleet is below 10,000 GT. The lower TT in option-H (**Figure 11**) for vessels below 10,000 GT, will garner wider support from developing economies which own vessels and operate many of the smaller sized vessels;

- Option-H has a more uniform impact (-18% to -7%) on different sizes of ships than option-E (-19% to -5%). The curve of option-H is flatter in **Figure 11**;

- The coefficients used in ITC-69 for the calculation of GT and NT are $K_1 = 0.20+0.02 \log_{10}V$ and $K_2= 0.20+0.02 \log_{10}V_c$, respectively. Though technically not correct, option-E, i.e., $K_4= 0.30+0.02 \log_{10}(LBd)$, will create an illusory impression at the first glance that the coefficient is higher than those used in ITC-69 and will result in higher TT values. It may be recalled that the amendment procedure of ITC-69 is difficult and requires acceptance by two-thirds of the Contracting Governments. Option-H, i.e., K_4=0.20+0.04 $\log_{10}$(LBd), is more appealing in this aspect to the decision makers at different levels, than option-E.

Based on the fundamental principles stated at 7.3.1 and factors stated above, option-H i.e., K_4 = 0.20+0.04 $\log_{10}$(LBd), is chosen as the coefficient for TT.

For the 'disadvantaged' ships discussed in Chapter-6, the TT will be much lower than GT whereas for those vessels with low freeboard (i.e., lesser reserve buoyancy), the TT will be closer to GT, and will even be higher in some cases. It also shows that with the use of TT system, there is no incentive to reduce the enclosed volume. These results are consistent with the findings of Gehling (2006) in a study relating to safety and tonnage measurement.

Except for vessels with low freeboard (Type-A or reduced Type-B), the TT is lower than GT in almost all cases under option-H. The considerably low TT for volume carriers is not likely to be welcomed by port authorities due to loss of revenue from these vessels. Here, the concept of 'Cost-Performance-Value', discussed in Chapter-6 needs to be applied. The TT is to be used only for vessel related charges. Separate charges may be used for recovering expenses related to handling of passengers or vehicles, depending on the services provided by the port and/or benefit (value) derived by the ship. In most cases, the charges for discharging cargo from a cargo ship are dependant on the utilisation of port infrastructure and are collected separately. The same approach is to be used for volume carriers.

When TT is used as the basis for charging, some of the GT-related issues stated in Chapter-6 will be addressed simultaneously. It is stated earlier that the ITC-69 is not the right instrument to address safety issues or living conditions. But there are some aspects related to ITC-69 which discourages willing ship-owners to provide certain features (such as more living space for crew, extra cabins for cadets, higher freeboard, forecastle) for which they were penalised by way of higher dues. By using TT as a basis for charging, these issues will be resolved since the charges are no longer dependant on the total enclosed volume.

Introduction of TT requires only one additional entry on the ‘International Tonnage Certificate’, i.e., “TOLL TONNAGE…” to be added on Page-1, after ‘NET TONNAGE…’. The accuracy of the TT of a ship can be easily verified since ‘L’, ‘B’ and ‘d’ are already available on the Tonnage Certificate itself. It is seen in Chapter-4 that the undue influence of the breadth had led to poor designs, during the 19^{th} century. In the case of TT, all three factors , i.e., L,B and d, have equal influence on the TT.

7.3.6 Result: The Formula for TT

To conclude, the TT is defined as

$$TT=K_4\,(LBd),$$

where $K_4= [0.20+0.04 \log_{10}(LBd)]$. This definition of TT may be included in ITC-69, as a new Regulation-4A, along with the associated definitions.

This study has been carried out based on the data of 25,747 ships of 22 different types from LR-Fairplay database. The approach used to determine K_4 is similar to the method used in the 1969 convention.

7.3.7 Transition to new system.

IMO has no direct role with port activities or the charging system on ships. However, in 1991 and 1993, member governments were invited to advise the port and harbour authorities to apply the reduced GT for assessing fees for segregated ballast tankers (IMO,1991;IMO,1993b). A similar approach may be made to advise member governments to adopt the TT for charging ships.

The GT and NT are indicators of the total size of the ship and the earning capacity respectively, whereas the TT is intended as the basis for collecting dues from the ship. It is evident from the discussions in Chapter-6, based on various submissions to IMO, that all ships are not treated equally when the GT is used as the basis of charging. Statistics concerning international maritime trade and shipping are always based on GT and NT. It is not desirable to modify these parameters for the purpose of charging alone, since they have a number of other existing applications. Even if it is modified to $GT_{adjusted}$ or $NT_{adjusted}$, the transition would not be that easy, and there would be confusion resulting out of different tonnage figures. A TEU based charging system would solve the issue of container ships, but the problems remain for other ship types such as live-stock carriers, Ro-Ro ships and car carriers.

The initial deliberations of the 1969 conference decided to have two tonnage figures, the GT based on volume of enclosed spaces and the NT based on displacement (IMO,1969a). The suggested method based on displacement was not adopted for NT in 1969, since the results did not give reasonable parity with existing net tonnage figures (Wilson,1970).

The 'Toll Tonnage' is an unambiguous new term, and will resolve the unequal treatment of ships as well as penalising the desirable safety and social aspects.

CHAPTER-8 . Conclusion and Recommendations

8.1 Conclusion

The main purpose of the 1969 Convention was to establish an international system, for which compromises had to be made on many logical options while drafting ITC-69. It was necessary at that time, since parity with existing GRT/NRT and wider acceptance was far more important than the best solution. Now that a universal system is in place, it is time to think about amendments to the regulations on a logical basis.

In the preceding chapters, a number of issues were discussed and selected areas were analysed in detail to highlight the need for modernising the existing system. Interim measures on individual issues, in the form of soft law, will result in contradiction and confusion at a later stage. When the interim measure is likely to result in higher tonnages, those flags that do not implement the soft law will attract more ship-owners and encourage flag hopping. The author fully agrees that the amendment of ITC-69 will be a long and tedious process, but at the same time strongly affirms that by postponing it, the process will definitely not become any shorter or simpler.

It is wiser to catch the bull by its horn as early as possible and find long-term solutions. Interim measures for specific cases, taken over a period of time, may also become impediments for better and logical options at a later stage. When unilateral measures and unconventional interpretations become more common, it will strike at the purpose of IMO and will be disruptive to international shipping. There could be commercial compulsions or egoistic reasons behind the reluctance to consider new proposals, but there is a desideratum for all to update the ITC-69 for long-term benefits. The tonnage laws are based on the principle of 'earning capacity', but substantial space occupied by deck cargo is not included in measurement. Based on the above viewpoints and the discussion in earlier chapters, the first two recommendations are made at 8.2.(i) and 8.2.(ii).

Fundamentally, there are two approaches to determine the size of a ship, weight-based and volume-based. The volume-based system was increasingly used in the past as seen in Chapter-3, and ITC-69 continued with the same approach.

In the opinion of the author, the integrity of ITC-69 as an instrument to determine the size of a vessel, in terms of GT and NT from a volume-based approach, should be preserved. GT and NT are used for various regulatory and statistical purposes in shipping. Therefore, the existing provisions for GT and NT in ITC-69, should be retained without any modification.

The author strongly argues for the introduction of a new weight-based parameter, as another measure of ship-size. The very fact that it is based on the law of nature, i.e., Archimedes principle, makes it more logical and better suited for consistent application and verification. It will not be easy to conceal or evade this measurement, and it applies equally to all ships in the past, present and future.

George Moorsom wrote in 1855,[52] about the 1854 British tonnage regulations:

> 'The circumstances and trade of America may require the principle of displacement as their basis of law, while those of Great Britain may be better served by the principle of capacity. Our merchants, underwriters, ship-owners and ship-builders, all called loudly for capacity' (as cited in "Cubical Measurement",1855).

The volume-based British tonnage regulations were adopted in 1836 and 1854, due to the difficulty in establishing the draft in the absence of loadline marking, and to suit the British commercial and national interests. It was subsequently followed by most maritime nations, and tonnages determined under those rules were influential in deriving the formula for GT and NT during ITC-69 also. With the LL-66 in force, there is no ambiguity about the summer draft now. In

[52] In his letter dated 22nd February,1855, to the Monthly Nautical Magazine, see 'Cubical Measurement of Vessels', p.45

view of the above and the evaluation done in earlier chapters, a new displacement-based parameter 'Toll Tonnage', is recommended, as given at 8.2.(iii) and 8.2.(iv).

Safety and social aspects such as crew accommodation, freeboard or forecastle, can not, and will not, get resolved by amending ITC-69 alone. Therefore these matters should be left to other more appropriate instruments and concerned bodies to deal with. The choice of GT or NT, or any other parameter, as the basis of port dues is a decision by the port and harbour authorities. A technically and logically sound method of measuring ship's size, impervious to manipulations, is more likely to be accepted by the stakeholders.

8.2 Recommendations

(i) Article 18(3) of ITC-69 may be amended to include the 'tacit acceptance procedure' for amendments to Annex-I of ITC-69. It is recommended that 'any proposed amendment to the technical regulations under Annex-I, shall come into force at the end of two years after its adoption by two-thirds majority at the expanded MSC, unless one-third of the Contracting Governments notify their objection to the amendment'. (Details in the proposed text at Appendix-3.)

(ii) The following amendments are recommended in ITC-69, to include aspects related to deck cargo. (Proposed text is given at Appendix-4)

   a) Amendment to the definition of 'cargo space' at Reg.2(7) to include space occupied by deck cargo.

   b) Addition of a new regulation 2(9) to define space for deck cargo.

(iii) A new tonnage, 'Toll Tonnage(TT)', be included in ITC-69, by adding a new Article-2(5)A and a Regulation 3-1. (Proposed text is given at Appendix-5). The Toll tonnage shall be determined by the following formula:

$$\mathbf{TT = K_4\ (LBd)}$$

where, $K_4 = 0.02 + 0.04 \log_{10}(LBd)$,

L= Length in metres, as defined at Art.2(8),

B= Breadth in metres, as defined at Reg.2(3), and

d= moulded draft in metres, as defined at Reg.4(2),

Close co-operation with IAPH and canal authorities is necessary during the development and adoption of this tonnage, to promote the use of 'Toll Tonnage' as a basis for charging worldwide.

(iv) The format of ‘International Tonnage Certificate’ may be modified to include ‘**TOLL TONNAGE…**’ on page-1 and ‘**Space for deck cargo’** on Page-2 of the certificate. (Proposed changes on Pages 1 & 2 of the certificate are given at Appendix-6.)

1.2.1 Further work

The time period allotted for this thesis was not adequate for consideration of all the issues connected with ITC-69. For improvements of ITC-69, further studies of tonnage related matters are suggested in areas such as:

(i) evolving trends in ship design and their peculiar aspects,
(ii) GT of double-hull ships, and
(iii) negative influence of ITC-69 on crew accommodation, deck cargo and the design of forecastle deck or freeboard.

1.2.2 Special Remarks

The author suggests a 2-stage approach for implementing the recommendations. In the first stage, the ‘tacit acceptance procedure’ and amendments to the Articles may be included in ITC-69. Thereafter, the remaining recommendations can be included. This approach is likely to reduce the overall duration for adopting the amendments.

These recommendations are made after a detailed study of the history of tonnage measurement and in-depth analysis of the current issues related to ITC-69. It is considered that any regulation should be framed on ‘correct basic principles’, and be open to changes and improvements to meet ever-changing transport needs. The maritime world will benefit from a unified tonnage measurement system and a uniform basis for tolls at all ports and ocean canals of the world. There is a need to update and simplify the rules that were formulated a long time ago, according to the needs and interests at that time. Though the outcry for updating ITC-69 cannot match the media hype created with the images of ‘oil-covered bird’ or ‘invasive species’ or ‘acid rain’ that amplify the public perception, the author is confident that the IMO will adopt a pro-active approach in resolving the issues concerning ITC-69.

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Appendices

Appendix-1 : TM/Circ.91 dated 22 July,2005 (IMO,2005f) (8 pages)

Appendix-2 : Use of GT in International Maritime Conventions

Appendix-3 : Proposed amendments to Article 18(3)

Appendix-4 : Proposed amendments to Regulation 2

Appendix-5 : Proposed new Article 2(5)A and Regulation 3-1

Appendix-6 : Proposed amendments to the International Tonnage Certificate

Appendix-7 : International Convention on Tonnage Measurement of Ships,1969

Appendix-1 : TM/Circ.91 dated 22 July,2005 (IMO,2005f) (8 pages)

INTERNATIONAL MARITIME ORGANIZATION
4 ALBERT EMBANKMENT
LONDON SE1 7SR

Telephone: 020 7587 3152
Fax: 020 7587 3210

IMO

E

Ref. T4/5.04

TM/Circ.91
22 July 2005

NOVEL TYPES OF CRAFT UNDER REGULATION 1(3)

Information submitted by the Bahamas

The Secretary-General has the honour to transmit herewith a communication received from the Government of the Bahamas regarding the four ships which are treated as crafts of novel design and whose crane housings are not included in the total volume of all enclosed spaces, under the provisions of regulation 1(3) of the International Convention on Tonnage Measurement of Ships, 1969.

THE BAHAMAS MARITIME AUTHORITY

2nd Floor
Latham House
16 Minories
London EC3N 1EH
England

Telephone + (44) 20 7264 2550 (switchboard)
Fax: + (44) 20 7264 2589 (Registration & General)
Fax: + (44) 20 7264 2579 (Technical)
Telex 892617 BAHREG G
www.bahamasmaritime.com

12 July 2005
Our ref. inspect/gearbulkitc69/deh

International Maritime Organization,
4 Albert Embankment,
London SE1 7SR.

Attention of: Mr. Alexander A. Petrov,
Senior Deputy Director, Maritime Safety Division.

Dear Mr. Petrov,

<u>International Convention on Tonnage Measurement of Ships, 1969: Notification of novel design of craft under Regulation 1(3)</u>

In accordance with Regulation 1(3) of the International Convention on Tonnage Measurement of Ships, 1969, this correspondence serves to inform the Organisation that this Administration is treating the following vessels as crafts of novel design and is not including the volume of the crane housing in the total volume of all enclosed spaces:

1. JAEGER ARROW, IMO no. 9215347
2. GROUSE ARROW, IMO no. 8918215
3. MOZU ARROW, IMO no. 8918227
4. SWIFT ARROW, IMO no. 8918239

Our full submission is contained in the attached documents, which is respectfully submitted for circulation to all member States.

Regards,

Dwain E. Hutchinson,
Deputy Director,
The Bahamas Maritime Authority.

INTERNATIONAL CONVENTION ON TONNAGE MEASUREMENT OF SHIPS, 1969

Novel design of Craft under Regulation 1(3)

Submitted by the Bahamas

General

1. In accordance with Regulation 1(3) of the International Convention on Tonnage Measurement of Ships, 1969, this correspondence serves to inform the Organisation that this Administration is treating the following vessels as crafts of novel design and is not including the volume of the crane housing in the total volume of all enclosed spaces:

- JAEGER ARROW, IMO no. 9215347
- GROUSE ARROW, IMO no. 8918215
- MOZU ARROW, IMO no. 8918227
- SWIFT ARROW, IMO no. 8918239

2. Regulation 1(3) uses the term "novel" but we note that there is not a definition for this term in either the Convention or the associated interpretation.

3. Technical description of vessels

3.1 The vessels were designed for the transportation of sensitive forest products in routes known to have severe weather conditions with the crane housing constructed to afford full protection of the crane and the cargo area.

3.2 The construction of the crane housing was designed to provide work way/space for the cargo cranes, which are overhead travelling cranes with telescopic arms operating through a set of doors in the housing.

3.3 The cargo holds, which are used for the carriage of the forest products, are NOT fitted with hatches and cargo can only be carried in the cargo holds. *Figure 1* show the general arrangement of the unique designed vessel and *Figure 2* is the general arrangement of a similar conventional designed vessels.

4. Safety features and benefits of the design

The vessels have been in safely operated for over 10 years and some of the safety/beneficial aspects, based on their design, of the vessels are as follows:

- Added safety to the crew whilst on deck due to the crane housing which protects from exposure to outside elements,
- Reduction of the risk of injury by using overhead cranes rather than pedestal gantry cranes for cargo operations,
- Ability to monitor the cargo within a protected environment,
- Protection of the cargo during carriage and loading/unloading operations,
- Reduced maintenance of the crane due to less exposure to outside elements.

Conclusion

5. After reviewing the design of the vessels particularly the features that enhances the safety of the crew whilst on deck and the protection of the sensitive cargo during cargo operations, this Administration has concluded that the design is of a novel type within the intent of the Regulation.

6. Further the Administration notes the principles of economic disadvantage as contained in TM.5/Circ.4 and a comparison of the ships with conventional pedestal crane vessels of similar deadweight shows that the subject vessels' gross tonnage is approximately 60 % higher. The comparisons are provided in the *Appendix*.

7. This Administration has advised its Recognised Organisations to assign tonnages to the vessels based on the novel design principles.

Appendix

Comparison of unique design vessels with conventional design vessels

1. For the purpose of this comparison, the Administration used a conventional pedestal crane vessel with the similar deadweight with the tabulated results shown in *Tables 1* and *2* highlighting the economic disadvantage of the ships. The figures in *Table 2* have been plotted on a graph with the unique designed vessel shown as a box and the conventional designed vessel shown as diamonds.

Table 1: Comparison of the unique designed vessel (JAEGER ARROW) to a conventional designed vessel

Design (Conventional/Unique)	Vessel Name	IMO No	Flag	Gross Tonnage (ITC69)	Net Tonnage (ITC69)	DWT
Unique	*JAEGER ARROW*	*9315347*	*Bahamas*	*29103*	*8730*	*29103*
Conventional	THAI BRIGHT	8310944	Marshall Island	18732	8596	26140
Difference: Convention to unique design	-	-	-	10371	134	37

Table 2: Comparison of the unique designed vessels to conventional designed vessels

Design (Conventional/Unique)	Vessel Name	IMO No	Flag	Gross Tonnage (ITC69)	Net Tonnage (ITC69)	DWT
Conventional	AUK ARROW	8309397	Bahamas	27962	12660	43952
Conventional	AVOCET ARROW	8324359	Bahamas	27470	13642	39260
Conventional	BARBET ARROW	8324373	Bahamas	27470	13642	39218
Conventional	BERGEN ARROW	8130291	Bahamas	25063	11236	38800
Conventional	CORMORANT ARROW	8400634	Bahamas	28005	12818	41728
Conventional	CRANE ARROW	8308147	Bahamas	27818	12649	42913
Conventional	FINCH ARROW	8207329	Bahamas	26130	11832	39273
Conventional	GANNET ARROW	8324361	Bahamas	27470	13642	39260
Conventional	IBIS ARROW	8313702	Bahamas	28239	12870	42497
Conventional	PETREL ARROW	8308161	Bahamas	27824	13244	42964
Conventional	SISKIN ARROW	8207331	Bahamas	26130	11832	39273
Conventional	STAR FLORIDA	8309828	Norway	25345	11625	40790
Conventional	STAR FRASER	8309842	Norway	25345	11625	40850
Conventional	STAR FUJI	8309830	Norway	25345	11625	40850
Conventional	TEAL ARROW	8309402	Bahamas	27962	12660	44010
Conventional	WREN ARROW	8316699	Bahamas	27824	13244	43003
Average of all conventional design	-	-	-	*26963*	*12553*	*41165*
Unique	***GROUSE ARROW****	***8918215***	***Bahamas***	***44398***	***24266***	***42276***
Difference: Convention to unique design	-	-	-	17435	11713	1111

* *GROUSE AROW, MOZU ARROW and SWIFT ARROW are all sister ships*

2. The design of the crane housing with overhead travelling cranes reduces the capability of the vessels, which have no hatch covers, to carry cargo above the hatch coaming as opposed to a conventional vessel that can load cargo on the hatch covers. This is illustrated in *Figure 3*.

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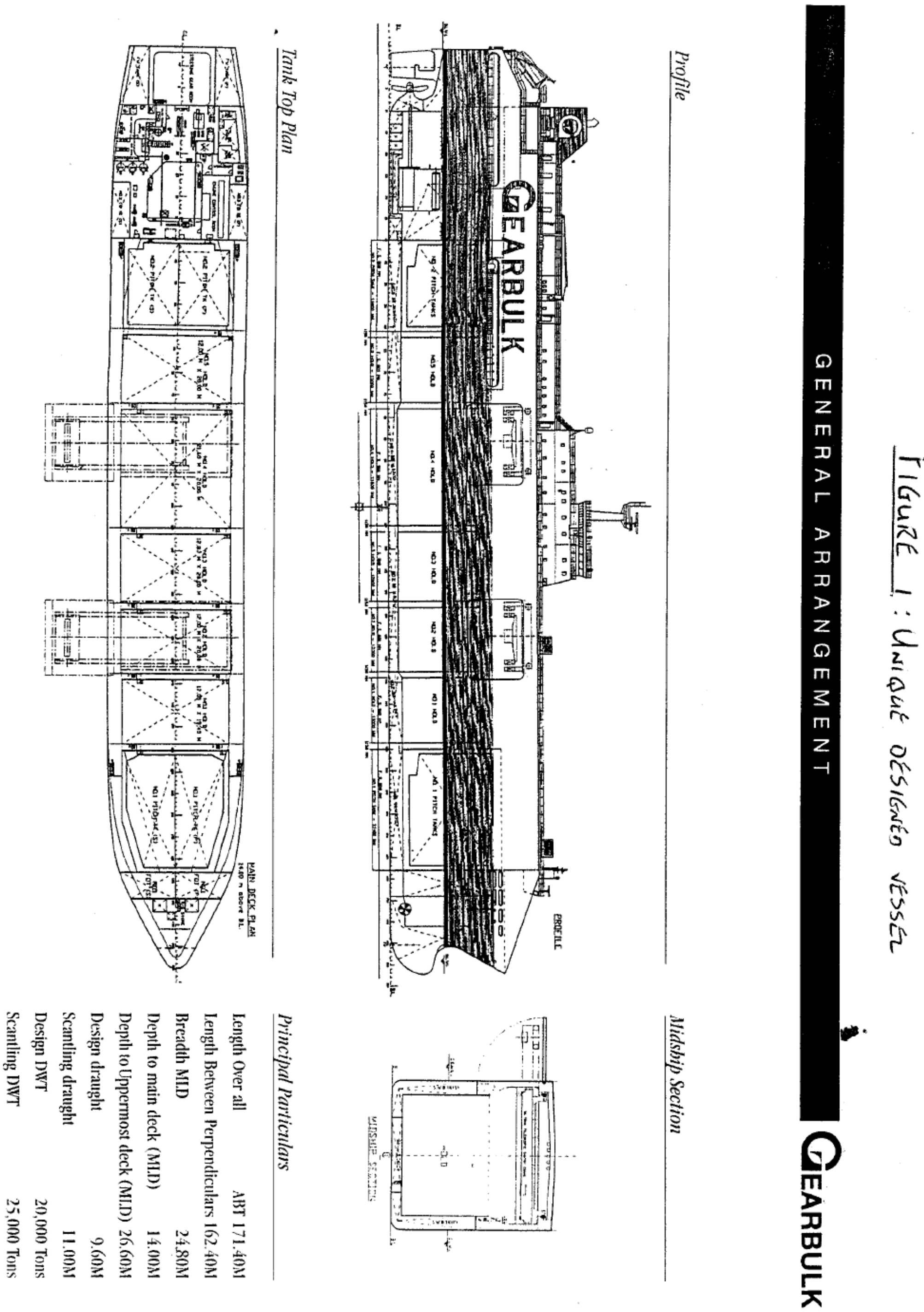
FIGURE 1 : UNIQUE DESIGNED VESSEL
GENERAL ARRANGEMENT
GEARBULK
Profile
Midship Section
Tank Top Plan
Principal Particulars
Length Over all ABT 171.40M
Length Between Perpendiculars 162.40M
Breadth MLD 24.80M
Depth to main deck (MLD) 14.00M
Depth to Uppermost deck (MLD) 26.60M
Design draught 9.60M
Scantling draught 11.00M
Design DWT 20,000 Tons
Scantling DWT 25,000 Tons

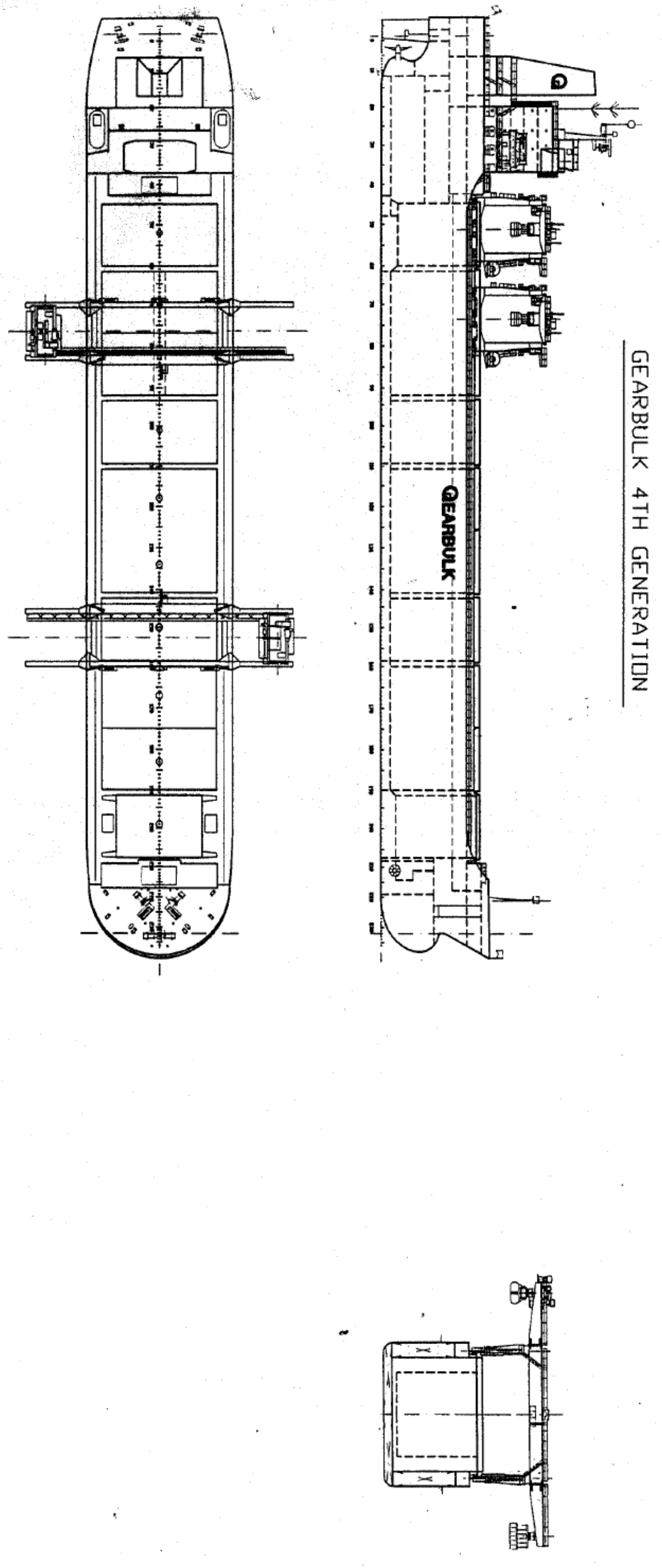

FIGURE 2 : CONVENTIONAL DESIGNED VESSEL

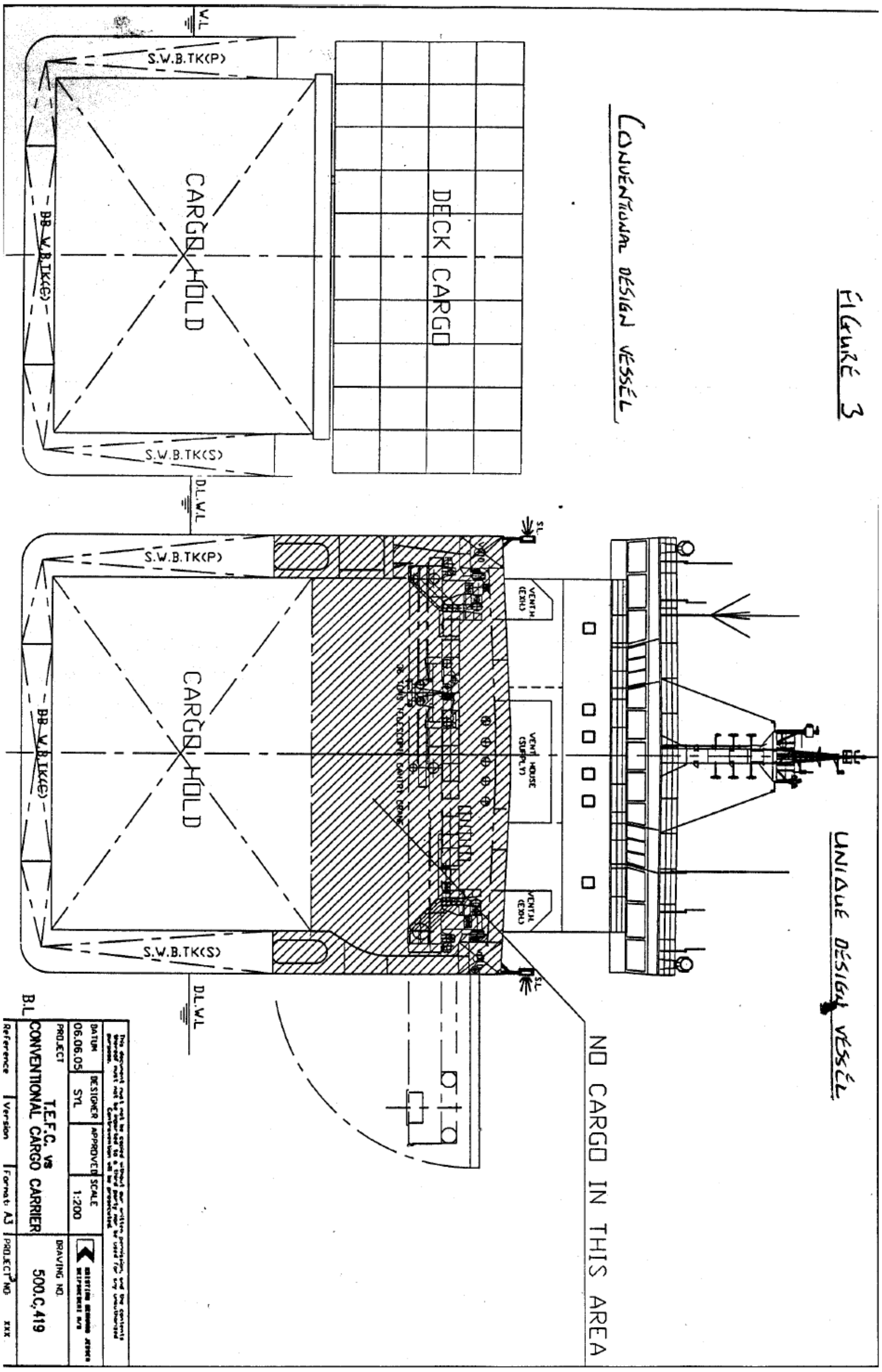
FIGURE 3
CONVENTIONAL DESIGN VESSEL
UNIQUE DESIGN VESSEL
DECK CARGO
CARGO HOLD
CARGO HOLD
S.W.B.TK(P)
S.W.B.TK(S)
S.W.B.TK(P)
S.W.B.TK(S)
BB. W.B.TK(C)
BB. W.B.TK(C)
V.L
D.L.W.L
D.L.W.L
B.L
NO CARGO IN THIS AREA
DATUM 06.06.05
DESIGNER SYL
APPROVED
SCALE 1:200
PROJECT
T.E.F.C. vs CONVENTIONAL CARGO CARRIER
DRAWING NO. 500.C.419
Reference
Version
Format: A3
PROJECT NO. XXX

Appendix-2 : Use of GT in International Maritime Conventions

Convention	Chapter	Threshold values of GT	Item
SOLAS	I/3	500	SOLAS Application
	I/8	500	Survey –Safety Equipment
	II-1/3-6	20000	Means of access
	II-1/29	10000, 70000	Steering Gear
	II-1/30	40000	Steering Gear
	II-1/31	1600	Steering Gear
	II-1/43	5000	Emergency Source of Power
	II-1/45	1600	Protection against shock
	II-2/9.7.2	4000	Containment of fire
	II-2/10.2.1	1000, 1600, 4000, 6000	Firemains
	II-2/10.5.6	2000	Fixed fire extinguishing system
	II-2/13.4.1.3	1000	Means of escape
	III/6	300	LSA-communications
	III/33	20000	Launching of lifeboat while underway
	IV	300	Radio communications
	V	300, 500	Safety of navigation
	V/19	3000, 10000, 50000	Navigational eqpt
	V/20	3000	VDR
	XI-1/3	100, 300	IMO Number
MARPOL	Annex-I	150, 400	Survey and certification
STCW	II/1,2,3	500, 3000	Manning on Navigation side
MLC 2006	REG.3	3000, 10000	Accommodation, Recreation, Food Catering

Appendix-3 : Proposed amendments to Article 18(3).

Revised procedure recommended, for amendments to technical Regulations at the Annex to ITC-69

Amendment Proposal adopted by $2/3^{rd}$ majority in the expanded MSC

↓

Amendments enter into force at the end of 2 years (or specified period) from the date of adoption at Expanded MSC, unless objected by more than $1/3^{rd}$ of Contracting Govts, or Contracting Govts with combined GT ≥ 25% of the world GT

Existing text of Article 18(3) may be replaced by the following text:

'(3). Amendment after consideration within the Organization:

(a) Any amendment proposed by a Contracting Government to the present Protocol or the Convention shall be submitted to the Secretary-General of the Organization, who shall then circulate it to all Members of the Organization and all Contracting Governments to the Convention at least six months prior to its consideration.

(b) Any amendment proposed and circulated as above shall be referred to the Maritime Safety Committee of the Organization for consideration.

(c) States which are Contracting Governments to the present Protocol, whether or not Members of the Organization, shall be entitled to participate in the proceedings of the Maritime Safety Committee for the consideration and adoption of amendments

(d) Amendments shall be adopted by a two-thirds majority of the Contracting Governments to the present Protocol present and voting in the Maritime Safety Committee expanded as provided for in subparagraph (c) (hereinafter referred to as "the expanded Maritime Safety Committee") on condition that at least one third of the Contracting Governments shall be present at the time of voting.

(e) Amendments adopted in accordance with subparagraph (d) shall be communicated by the Secretary-General of the Organization to all Contracting Governments to the present Protocol for acceptance.

(f) (i) An amendment to an article to the present Protocol or an amendment to an article of the Convention, shall be deemed to have been

accepted on the date on which it is accepted by two thirds of the Contracting Governments to the present Protocol.

(ii) An amendment to the Annex-I to the Convention, shall be deemed to have been accepted:

(aa) at the end of two years from the date on which it is communicated to Contracting Governments to the present Protocol for acceptance; or

(bb) at the end of a different period, which shall not be less than one year, if so determined at the time of its adoption by a two-thirds majority of the Contracting Governments present and voting in the expanded Maritime Safety Committee.

However, if within the specified period either more than one third of the Contracting Governments, or Contracting Governments the combined merchant fleets of which constitute not less than twenty five per cent of the gross tonnage of all the merchant fleets of all Contracting Governments, notify the Secretary-General of the Organization that they object to the amendment, it shall be deemed not to have been accepted.

(g) (i) An amendment referred to in subparagraph (f)(i) shall enter into force with respect to those Contracting Governments to the present Protocol which have accepted it, six months after the date on which it is deemed to have been accepted, and with respect to each Contracting Government which accepts it after that date, six months after the date of that Contracting Government's acceptance.

(ii) An amendment referred to in subparagraph (f)(ii) shall enter into force with respect to all Contracting Governments to the present Protocol, except those which have objected to the amendment under that subparagraph and which have not withdrawn such objections, six months after the date on which it is deemed to have been accepted. However, before the date set for entry into force, any Contracting Government may give notice to the Secretary-General of the Organization that it exempts itself from giving effect to that amendment for a period not longer than one year from the date of its entry into force, or for such longer period as may be determined by a two-thirds majority of the Contracting Governments present and voting in the expanded Maritime Safety Committee at the time of the adoption of the amendment.'

Appendix-4 : Proposed amendments to Regulation 2

Proposed amendments (shown in bold) to include aspects related to deck cargo.

(A). Definition of cargo space at Regulation 2(7) be amended as:

> "Cargo spaces to be included in the computation of net tonnage are enclosed **or open** spaces appropriated for the transport of cargo which is to be discharged from the ship, provided that such spaces have been included in the computation of gross tonnage. Such cargo spaces shall be certified by permanent marking with the letters CC (cargo compartment) to be so positioned that they are readily visible and not to be less than 100 millimetres (4 inches) in height." ; and,

(B). after Regulation 2(8), the definition of deck space may be added, as:

'(9) ***Deck cargo space***

Deck cargo space to be included in the calculation of GT and NT is the maximum volume of all spaces allocated on an open deck for carriage of cargo. The length, breadth and height of stowage on open deck spaces shall be certified by permanent marking with the letters OCS (Open Cargo Space) to be so positioned that they are readily visible and not to be less than 100 millimetres (4 inches) in height.'

Appendix-5 : Proposed new Article 2(5)A and Regulation 3-1

Proposed amendments (shown in bold) to include toll tonnage.

(A). A new Article 2(5)A be included, as:

‘(5A) “toll tonnage” means the measure for collecting dues from the ship, determined in accordance with the provisions of the present convention.’; and,

(B). a new Regulation 3-1 be added as :

‘Regulation 3-1

Toll Tonnage

The Toll Tonnage (TT) of a ship shall be determined by the following formula:

$$TT= K_4 . (LBd)$$

where, $K_4 = 0.02+0.04 \log_{10} (LBd)$,

L= length in metres, as defined at Article 2(8),

B= breadth in metres, as defined at Regulation 2(3), and

d= moulded draft in metres, as defined at Regulation 4(1)(c)’.

Appendix-6 : Proposed amendments to the International Tonnage Certificate

Proposed amendments (highlighted below) are:

(A). on page 1, add '**TOLL TONNAGE…**' after 'NET TONNAGE…' ,

Length (Article 2(8))	Breadth (Regulation 2(3))	Moulded depth amidships to Upper Deck (Regulation 2(2))

THE TONNAGES OF THE SHIP ARE:

GROSS TONNAGE ....

NET TONNAGE ....

TOLL TONNAGE ....

This is to certify that the tonnages of this ship have been determined in accordance with the provisions of the International Convention on Tonnage measurement of Ships,1969.

Issued at .... **(PAGE-1)**

and (B). on page-2, add '**Spaces for Deck Cargo'**, under NET TONNAGE'.

SPACES INCLUDED IN TONNAGE					
GROSS TONNAGE			NET TONNAGE		
Name of Space	Location	Length	Name of Space	Location	Length
			Spaces for Deck Cargo		
			Name of Space	Location	Length
			NUMBER OF PASSENGERS (Regulation 4(1)) Number of passengers in cabins with not more than 8 berths .... Number of other passengers		
EXCLUDED SPACES (Regulation 2(5))			MOULDED DRAFT (Regulation 4(2))		

(PAGE-2)

INTERNATIONAL CONVENTION ON TONNAGE MEASUREMENT OF SHIPS, 1969

The Contracting Governments,

DESIRING to establish uniform principles and rules with respect to the determination of tonnage of ships engaged on international voyages;

CONSIDERING that this end may best be achieved by the conclusion of a Convention;

HAVE AGREED as follows:

Article 1

General Obligation under the Convention

The Contracting Governments undertake to give effect to the provisions of the present Convention and the Annexes hereto which shall constitute an integral part of the present Convention. Every reference to the present Convention constitutes at the same time a reference to the Annexes.

Article 2

Definitions

For the purpose of the present Convention, unless expressly provided otherwise:

(1) "Regulations" means the Regulations annexed to the present Convention;

(2) "Administration" means the Government of the State whose flag the ship is flying;

(3) "international voyage" means a sea voyage from a country to which the present Convention applies to a port outside such country, or conversely. For this purpose, every territory for the international relations of which a Contracting Government is responsible or for which the United Nations are the administering authority is regarded as a separate country;

(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;

(6) "new ship" means a ship the keel of which is laid, or which is at a similar stage of construction, on or after the date of coming into force of the present Convention;

(7) "existing ship" means a ship which is not a new ship;

(8) "length" means 96 per cent of the total length on a waterline at 85 per cent of the least moulded depth measured from the top of the keel, or the length from the fore side of the stem to the axis of the rudder stock on that water-

line, if that be greater. In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the designed waterline;

(9) "Organization" means the Inter-Governmental Maritime Consultative Organization.

Article 3

Application

(1) The present Convention shall apply to the following ships engaged on international voyages:

(a) ships registered in countries the Governments of which are Contracting Governments;

(b) ships registered in territories to which the present Convention is extended under Article 20; and

(c) unregistered ships flying the flag of a State, the Government of which is a Contracting Government.

(2) The present Convention shall apply to:

(a) new ships;

(b) existing ships which undergo alterations or modifications which the Administration deems to be a substantial variation in their existing gross tonnage;

(c) existing ships if the owner so requests; and

(d) all existing ships, twelve years after the date on which the Convention comes into force, except that such ships, apart from those mentioned in (b) and (c) of this paragraph, shall retain their then existing tonnages for the purpose of the application to them of relevant requirements under other existing International Conventions.

(3) Existing ships to which the present Convention has been applied in accordance with sub-paragraph (2) (c) of this Article shall not subsequently have their tonnages determined in accordance with the requirements which the Administration applied to ships on international voyages prior to the coming into force of the present Convention.

Article 4

Exceptions

(1) The present Convention shall not apply to:

(a) ships of war; and

(b) ships of less than 24 metres (79 feet) in length.

(2) Nothing herein shall apply to ships solely navigating:

(a) the Great Lakes of North America and the River St. Lawrence as far east as a rhumb line drawn from Cap des Rosiers to West Point, Anticosti Island, and, on the north side of Anticosti Island, the meridian of longitude 63°W;

(b) the Caspian Sea; or

(c) the Plate, Parana and Uruguay Rivers as far east as a rhumb line drawn between Punta Rasa (Cabo San Antonio), Argentina, and Punta del Este, Uruguay.

Article 5

Force Majeure

(1) A ship which is not subject to the provisions of the present Convention at the time of its departure on any voyage shall not become subject to such provisions on account of any deviation from its intended voyage due to stress of weather or any other cause of *force majeure*.

(2) In applying the provisions of the present Convention, the Contracting Governments shall give due consideration to any deviation or delay caused to any ship owing to stress of weather or any other cause of *force majeure*.

Article 6

Determination of Tonnages

The determination of gross and net tonnages shall be carried out by the Administration which may, however, entrust such determination either to persons or organizations recognized by it. In every case the Administration concerned shall accept full responsibility for the determination of gross and net tonnages.

Article 7

Issue of Certificate

(1) An International Tonnage Certificate (1969) shall be issued to every ship, the gross and net tonnages of which have been determined in accordance with the present Convention.

(2) Such certificate shall be issued by the Administration or by any person or organization duly authorized by it. In every case, the Administration shall assume full responsibility for the certificate.

Article 8

Issue of Certificate by another Government

(1) A Contracting Government may, at the request of another Contracting Government, determine the gross and net tonnages of a ship and issue or authorize the issue of an International Tonnage Certificate (1969) to the ship in accordance with the present Convention.

(2) A copy of the certificate and a copy of the calculations of the tonnages shall be transmitted as early as possible to the requesting Government.

(3) A certificate so issued shall contain a statement to the effect that it has been issued at the request of the Government of the State whose flag the ship is or will be flying and it shall have the same validity and receive the same recognition as a certificate issued under Article 7.

(4) No International Tonnage Certificate (1969) shall be issued to a ship which is flying the flag of a State the Government of which is not a Contracting Government.

Article 9

Form of Certificate

(1) The certificate shall be drawn up in the official language or languages of the issuing country. If the language used is neither English nor French, the text shall include a translation into one of these languages.

(2) The form of the certificate shall correspond to that of the model given in Annex II.

Article 10

Cancellation of Certificate

(1) Subject to any exceptions provided in the Regulations, an International Tonnage Certificate (1969) shall cease to be valid and shall be cancelled by the Administration if alterations have taken place in the arrangement, construction, capacity, use of spaces, total number of passengers the ship is permitted to carry as indicated in the ship's passenger certificate, assigned load line or permitted draught of the ship, such as would necessitate an increase in gross tonnage or net tonnage.

(2) A certificate issued to a ship by an Administration shall cease to be valid upon transfer of such a ship to the flag of another State, except as provided in paragraph (3) of this Article.

(3) Upon transfer of a ship to the flag of another State the Government of which is a Contracting Government, the International Tonnage Certificate (1969) shall remain in force for a period not exceeding three months, or until the Administration issues another International Tonnage Certificate (1969) to replace it, whichever is the earlier. The Contracting Government of the State whose flag the ship was flying hitherto shall transmit to the Administration as soon as possible after the transfer takes place a copy of the certificate carried by the ship at the time of transfer and a copy of the relevant tonnage calculations.

Article 11

Acceptance of Certificate

The certificate issued under the authority of a Contracting Government in accordance with the present Convention shall be accepted by the other Contracting Governments and regarded for all purposes covered by the present Convention as having the same validity as certificates issued by them.

Article 12

Inspection

(1) A ship flying the flag of a State the Government of which is a Contracting Government shall be subject, when in the ports of other Contracting Governments, to inspection by officers duly authorized by such Governments. Such inspection shall be limited to the purpose of verifying:

(a) that the ship is provided with a valid International Tonnage Certificate (1969); and

(b) that the main characteristics of the ship correspond to the data given in the certificate.

(2) In no case shall the exercise of such inspection cause any delay to the ship.

(3) Should the inspection reveal that the main characteristics of the ship differ from those entered on the International Tonnage Certificate (1969) so as to lead to an increase in the gross tonnage or the net tonnage, the Government of the State whose flag the ship is flying shall be informed without delay.

Article 13

Privileges

The privileges of the present Convention may not be claimed in favour of any ship unless it holds a valid certificate under the Convention.

Article 14

Prior Treaties, Conventions and Arrangements

(1) All other treaties, conventions and arrangements relating to tonnage matters at present in force between Governments Parties to the present Convention shall continue to have full and complete effect during the terms thereof as regards:

(a) ships to which the present Convention does not apply; and

(b) ships to which the present Convention applies, in respect of matters for which it has not expressly provided.

(2) To the extent, however, that such treaties, conventions or arrangements conflict with the provisions of the present Convention, the provisions of the present Convention shall prevail.

Article 15

Communication of Information

The Contracting Governments undertake to communicate to and deposit with the Organization:

(a) a sufficient number of specimens of their certificates issued under the provisions of the present Convention for circulation to the Contracting Governments;

(b) the text of the laws, orders, decrees, regulations and other instruments which shall have been promulgated on the various matters within the scope of the present Convention; and

(c) a list of non-governmental agencies which are authorized to act in their behalf in matters relating to tonnages for circulation to the Contracting Governments.

Article 16

Signature, Acceptance and Accession

(1) The present Convention shall remain open for signature for six months from 23 June 1969, and shall thereafter remain open for accession.

Governments of States Members of the United Nations, or of any of the Specialized Agencies, or of the International Atomic Energy Agency, or parties to the Statute of the International Court of Justice may become Parties to the Convention by:

(a) signature without reservation as to acceptance;

(b) signature subject to acceptance followed by acceptance; or

(c) accession.

(2) Acceptance or accession shall be effected by the deposit of an instrument of acceptance or accession with the Organization. The Organization shall inform all Governments which have signed the present Convention or acceded to it of each new acceptance or accession and of the date of its deposit. The Organization shall also inform all Governments which have already signed the Convention of any signature effected during the six months from 23 June 1969.

Article 17

Coming into Force

(1) The present Convention shall come into force twenty-four months after the date on which not less than twenty-five Governments of States the combined merchant fleets of which constitute not less than sixty-five per cent of the gross tonnage of the world's merchant shipping have signed without reservation as to acceptance or deposited instruments of acceptance or accession in accordance with Article 16. The Organization shall inform all Governments which have signed or acceded to the present Convention of the date on which it comes into force.

(2) For Governments which have deposited an instrument of acceptance of or accession to the present Convention during the twenty-four months mentioned in paragraph (1) of this Article, the acceptance or accession shall take effect on the coming into force of the present Convention or three months after the date of deposit of the instrument of acceptance or accession, whichever is the later date.

(3) For Governments which have deposited an instrument of acceptance of or accession to the present Convention after the date on which it comes into force, the Convention shall come into force three months after the date of the deposit of such instrument.

(4) After the date on which all the measures required to bring an amendment to the present Convention into force have been completed, or all necessary acceptances are deemed to have been given under sub-paragraph (b) of paragraph (2) of Article 18 in case of amendment by unanimous acceptance, any instrument of acceptance or accession deposited shall be deemed to apply to the Convention as amended.

Article 18

Amendments

(1) The present Convention may be amended upon the proposal of a Contracting Government by any of the procedures specified in this Article.

(2) Amendment by unanimous acceptance:

(a) Upon the request of a Contracting Government, any amendment proposed by it to the present Convention shall be communicated by the Organization to all Contracting Governments for consideration with a view to unanimous acceptance.

(b) Any such amendment shall enter into force twelve months after the date of its acceptance by all Contracting Governments unless an earlier date is agreed upon. A Contracting Government which does not communicate its acceptance or rejection of the amendment to the Organization within twenty-four months of its first communication by the latter shall be deemed to have accepted the amendment.

(3) Amendment after consideration in the Organization:

(a) Upon the request of a Contracting Government, any amendment proposed by it to the present Convention will be considered in the Organization. If adopted by a majority of two-thirds of those present and voting in the Maritime Safety Committee of the Organization, such amendment shall be communicated to all Members of the Organization and all Contracting Governments at least six months prior to its consideration by the Assembly of the Organization.

(b) If adopted by a two-thirds majority of those present and voting in the Assembly, the amendment shall be communicated by the Organization to all Contracting Governments for their acceptance.

(c) Such amendment shall come into force twelve months after the date on which it is accepted by two-thirds of the Contracting Governments. The amendment shall come into force with respect to all Contracting Governments except those which, before it comes into force, make a declaration that they do not accept the amendment.

(d) The Assembly, by a two-thirds majority of those present and voting, including two-thirds of the Governments represented on the Maritime Safety Committee and present and voting in the Assembly, may propose a determination at the time of its adoption that an amendment is of such an important nature that any Contracting Government which makes a declaration under sub-paragraph (c) of this paragraph and which does not accept the amendment within a period of twelve months after it comes into force, shall cease to be a party to the present Convention upon the expiry of that period. This determination shall be subject to the prior acceptance of two-thirds of the Contracting Governments.

(e) Nothing in this paragraph shall prevent the Contracting Government which first proposed action under this paragraph on an amendment to the present Convention from taking at any time such alternative action as it deems desirable in accordance with paragraphs (2) or (4) of this Article.

(4) Amendment by a conference:

(a) Upon the request of a Contracting Government, concurred in by at least one-third of the Contracting Governments, a conference of Governments will be convened by the Organization to consider amendments to the present Convention.

(b) Every amendment adopted by such a conference by a two-thirds majority of those present and voting of the Contracting Governments shall be communicated by the Organization to all Contracting Governments for their acceptance.

(c) Such amendment shall come into force twelve months after the date on which it is accepted by two-thirds of the Contracting Governments. The amendment shall come into force with respect to all Contracting Governments except those which, before it comes into force, make a declaration that they do not accept the amendment.

(d) By a two-thirds majority of those present and voting, a conference convened under sub-paragraph (a) of this paragraph may determine at the time of its adoption that an amendment is of such an important nature that any Contracting Government which makes a declaration under sub-paragraph (c) of this paragraph, and which does not accept the amendment within a period of twelve months after it comes into force, shall cease to be a party to the present Convention upon the expiry of that period.

(5) The Organization shall inform all Contracting Governments of any amendments which may come into force under this Article, together with the date on which each such amendment will come into force.

(6) Any acceptance or declaration under this Article shall be made by the deposit of an instrument with the Organization which shall notify all Contracting Governments of the receipt of the acceptance or declaration.

Article 19

Denunciation

(1) The present Convention may be denounced by any Contracting Government at any time after the expiry of five years from the date on which the Convention comes into force for that Government.

(2) Denunciation shall be effected by the deposit of an instrument with the Organization which shall inform all the other Contracting Governments of any such denunciation received and of the date of its receipt.

(3) A denunciation shall take effect one year, or such longer period as may be specified in the instrument of denunciation, after its receipt by the Organization.

Article 20

Territories

(1) (a) The United Nations, in cases where they are the administering authority for a territory, or any Contracting Government responsible for the international relations of a territory, shall as soon as possible consult with such territory or take such measures as may be appropriate in an endeavour to extend the present Convention to that territory and may at any time by notification in writing to the Organization declare that the present Convention shall extend to such territory.

(b) The present Convention shall, from the date of receipt of the notification or from such other date as may be specified in the notification, extend to the territory named therein.

(2) (a) The United Nations, or any Contracting Government which has made a declaration under sub-paragraph (a) of paragraph (1) of this Article at any time after the expiry of a period of five years from the date on

which the Convention has been so extended to any territory, may by notification in writing to the Organization declare that the present Convention shall cease to extend to any such territory named in the notification.

(b) The present Convention shall cease to extend to any territory mentioned in such notification one year, or such longer period as may be specified therein, after the date of receipt of the notification by the Organization.

(3) The Organization shall inform all the Contracting Governments of the extension of the present Convention to any territories under paragraph (1) of this Article, and of the termination of any such extension under the provisions of paragraph (2) stating in each case the date from which the present Convention has been or will cease to be so extended.

Article 21

Deposit and Registration

(1) The present Convention shall be deposited with the Organization and the Secretary-General of the Organization shall transmit certified true copies thereof to all Signatory Governments and to all Governments which accede to the present Convention.

(2) As soon as the present Convention comes into force, the text shall be transmitted by the Secretary-General of the Organization to the Secretariat of the United Nations for registration and publication, in accordance with Article 102 of the Charter of the United Nations.

Article 22

Languages

The present Convention is established in a single copy in the English and French languages, both texts being equally authentic. Official translations in the Russian and Spanish languages shall be prepared and deposited with the signed original.

IN WITNESS WHEREOF the undersigned being duly authorized by their respective Governments for that purpose have signed the present Convention.*

DONE AT LONDON this twenty-third day of June 1969.

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* Signatures omitted

ANNEX I

REGULATIONS FOR DETERMINING GROSS AND NET TONNAGES OF SHIPS

Regulation 1

General

(1) The tonnage of a ship shall consist of gross tonnage and net tonnage.

(2) The gross tonnage and the net tonnage shall be determined in accordance with the provisions of these Regulations.

(3) The gross tonnage and the net tonnage of novel types of craft whose constructional features are such as to render the application of the provisions of these Regulations unreasonable or impracticable shall be as determined by the Administration. Where the tonnage is so determined, the Administration shall communicate to the Organization details of the method used for that purpose, for circulation to the Contracting Governments for their information.

Regulation 2

Definitions of Terms used in the Annexes

(1) *Upper Deck*

The upper deck is the uppermost complete deck exposed to weather and sea, which has permanent means of weathertight closing of all openings in the weather part thereof, and below which all openings in the sides of the ship are fitted with permanent means of watertight closing. In a ship having a stepped upper deck, the lowest line of the exposed deck and the continuation of that line parallel to the upper part of the deck is taken as the upper deck.

(2) *Moulded Depth*

(a) The moulded depth is the vertical distance measured from the top of the keel to the underside of the upper deck at side. In wood and composite ships the distance is measured from the lower edge of the keel rabbet. Where the form at the lower part of the midship section is of a hollow character, or where thick garboards are fitted, the distance is measured from the point where the line of the flat of the bottom continued inwards cuts the side of the keel.

(b) In ships having rounded gunwales, the moulded depth shall be measured to the point of intersection of the moulded lines of the deck and side shell plating, the lines extending as though the gunwales were of angular design.

(c) Where the upper deck is stepped and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth shall be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

(3) *Breadth*

The breadth is the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material.

(4) *Enclosed Spaces*

Enclosed spaces are all those spaces which are bounded by the ship's hull, by fixed or portable partitions or bulkheads, by decks or coverings other than permanent or movable awnings. No break in a deck, nor any opening in the ship's hull, in a deck or in a covering of a space, or in the partitions or bulkheads of a space, nor the absence of a partitition or bulkhead, shall preclude a space from being included in the enclosed space.

(5) *Excluded Spaces*

Notwithstanding the provisions of paragraph (4) of this Regulation, the spaces referred to in subparagraphs (a) to (e) inclusive of this paragraph shall be called excluded spaces and shall not be included in the volume of enclosed spaces, except that any such space which fulfils at least one of the following three conditions shall be treated as an enclosed space:

- the space is fitted with shelves or other means for securing cargo or stores;
- the openings are fitted with any means of closure;
- the construction provides any possibility of such openings being closed:

(a) (i) A space within an erection opposite an end opening extending from deck to deck except for a curtain plate of a depth not exceeding by more than 25 millimetres (one inch) the depth of the adjoining deck beams, such opening having a breadth equal to or greater than 90 per cent of the breadth of the deck at the line of the opening of the space. This provision shall be applied so as to exclude from the enclosed spaces only the space between the actual end opening and a line drawn parallel to the line or face of the opening at a distance from the opening equal to one half of the width of the deck at the line of the opening (Figure 1 in Appendix 1).

(a) (ii) Should the width of the space because of any arrangement except by convergence of the outside plating, become less than 90 per cent of the breadth of the deck, only the space between the line of the opening and a parallel line drawn through the point where the athwartships width of the space becomes equal to, or less than, 90 per cent of the breadth of the deck shall be excluded from the volume of enclosed spaces (Figures 2, 3 and 4 in Appendix 1).

(a) (iii) Where an interval which is completely open except for bulwarks or open rails separates any two spaces, the exclusion of one or both of which is permitted under sub-paragraphs (a) (i) and/or (a) (ii), such exclusion shall not apply if the separation between the two spaces is less than the least half breadth of the deck in way of the separation (Figures 5 and 6 in Appendix 1).

(b) A space under an overhead deck covering open to the sea and weather, having no other connexion on the exposed sides with the body of the ship than the stanchions necessary for its support. In such a space, open rails or a bulwark and curtain plate may be fitted or stanchions fitted at the ship's side, provided that the distance between the top of the rails or the bulwark and the curtain plate is not less than 0·75 metres (2·5 feet) or one-third of the height of the space, whichever is the greater (Figure 7 in Appendix 1).

(c) A space in a side-to-side erection directly in way of opposite side openings not less in height than 0·75 metres (2·5 feet) or one-third of the height of the erection, whichever is the greater. If the opening in such an erection is provided on one side only, the space to be excluded from the volume of enclosed spaces shall be limited inboard from the opening to a maximum of one-half of the breadth of the deck in way of the opening (Figure 8 in Appendix 1).

(d) A space in an erection immediately below an uncovered opening in the deck overhead, provided that such an opening is exposed to the weather and the space excluded from enclosed spaces is limited to the area of the opening (Figure 9 in Appendix 1)

(e) A recess in the boundary bulkhead of an erection which is exposed to the weather and the opening of which extends from deck to deck without means of closing, provided that the interior width is not greater than the width at the entrance and its extension into the erection is not greater than twice the width of its entrance (Figure 10 in Appendix 1).

(6) *Passenger*

A passenger is every person other than:

(a) the master and the members of the crew or other persons employed or engaged in any capacity on board a ship on the business of that ship; and

(b) a child under one year of age.

(7) *Cargo Spaces*

Cargo spaces to be included in the computation of net tonnage are enclosed spaces appropriated for the transport of cargo which is to be discharged from the ship, provided that such spaces have been included in the computation of gross tonnage. Such cargo spaces shall be certified by permanent marking with the letters CC (cargo compartment) to be so positioned that they are readily visible and not to be less than 100 millimetres (4 inches) in height.

(8) *Weathertight*

Weathertight means that in any sea conditions water will not penetrate into the ship.

Regulation 3

Gross Tonnage

The gross tonnage (GT) of a ship shall be determined by the following formula:

$$GT = K_1V$$

where: V = Total volume of all enclosed spaces of the ship in cubic metres, $K_1 = 0{\cdot}2 + 0{\cdot}02 \log_{10}V$ (or as tabulated in Appendix 2).

Regulation 4

Net Tonnage

(1) The net tonnage (NT) of a ship shall be determined by the following formula:

$$NT = K_2V_c\left(\frac{4d}{3D}\right)^2 + K_3\left(N_1 + \frac{N_2}{10}\right),$$

in which formula:

(a) the factor $\left(\frac{4d}{3D}\right)^2$ shall not be taken as greater than unity;

(b) the term $K_2V_c\left(\frac{4d}{3D}\right)^2$ shall not be taken as less than 0·25 GT; and

(c) NT shall not be taken as less than 0·30 GT,
and in which:

V_c = total volume of cargo spaces in cubic metres,

K_2 = $0{\cdot}2 + 0{\cdot}02 \log_{10}V_c$ (or as tabulated in Appendex 2),

K_3 = $1{\cdot}25 \frac{GT + 10{,}000}{10{,}000}$,

D = moulded depth amidships in metres as defined in Regulation 2 (2),

d = moulded draught amidships in metres as defined in paragraph (2) of this Regulation,

N_1 = number of passengers in cabins with not more than 8 berths,

N_2 = number of other passengers,

$N_1 + N_2$ = total number of passengers the ship is permitted to carry as indicated in the ship's passenger certificate; when $N_1 + N_2$ is less than 13, N_1 and N_2 shall be taken as zero,

GT = gross tonnage of the ship as determined in accordance with the provisions of Regulation 3.

(2) The moulded draught (d) referred to in paragraph (1) of this Regulation shall be one of the following draughts:

(a) for ships to which the International Convention on Load Lines in force applies, the draught corresponding to the Summer Load Line (other than timber load lines) assigned in accordance with that Convention;

(b) for passenger ships, the draught corresponding to the deepest subdivision load line assigned in accordance with the International Convention for the Safety of Life at Sea in force or other international agreement where applicable;

(c) for ships to which the International Convention on Load Lines does not apply but which have been assigned a load line in compliance with national requirements, the draught corresponding to the summer load line so assigned;

(d) for ships to which no load line has been assigned but the draught of which is restricted in compliance with national requirements, the maximum permitted draught;

(e) for other ships, 75 per cent of the moulded depth amidships as defined in Regulation 2 (2).

Regulation 5

Change of Net Tonnage

(1) When the characteristics of a ship, such as V, V_c, d, N_1 or N_2 as defined in Regulations 3 and 4, are altered and where such an alteration results in an increase in its net tonnage as determined in accordance with the provisions of Regulation 4, the net tonnage of the ship corresponding to the new characteristics shall be determined and shall be applied without delay.

(2) A ship to which load lines referred to in sub-paragraphs (2) (a) and (2) (b) of Regulation 4 are concurrently assigned shall be given only one net tonnage as determined in accordance with the provisions of Regulation 4

and that tonnage shall be the tonnage applicable to the appropriate assigned load line for the trade in which the ship is engaged.

(3) When the characteristics of a ship such as V, V_c, d, N_1 or N_2 as defined in Regulations 3 and 4 are altered or when the appropriate assigned load line referred to in paragraph (2) of this Regulation is altered due to the change of the trade in which the ship is engaged, and where such an alteration results in a decrease in its net tonnage as determined in accordance with the provisions of Regulation 4, a new International Tonnage Certificate (1969) incorporating the net tonnage so determined shall not be issued until twelve months have elapsed from the date on which the current Certificate was issued; provided that this requirement shall not apply:

(a) if the ship is transferred to the flag of another State, or

(b) if the ship undergoes alterations or modifications which are deemed by the Administration to be of a major character, such as the removal of a superstructure which requires an alteration of the assigned load line, or

(c) to passenger ships which are employed in the carriage of large numbers of unberthed passengers in special trades, such, for example, as the pilgrim trade.

Regulation 6

Calculation of Volumes

(1) All volumes included in the calculation of gross and net tonnages shall be measured, irrespective of the fitting of insulation or the like, to the inner side of the shell or structural boundary plating in ships constructed of metal, and to the outer surface of the shell or to the inner side of structural boundary surfaces in ships constructed of any other material.

(2) Volumes of appendages shall be included in the total volume.

(3) Volumes of spaces open to the sea may be excluded from the total volume.

Regulation 7

Measurement and Calculation

(1) All measurement used in the calculation of volumes shall be taken to the nearest centimetre or one-twentieth of a foot.

(2) The volumes shall be calculated by generally accepted methods for the space concerned and with an accuracy acceptable to the Administration.

(3) The calculation shall be sufficiently detailed to permit easy checking.

ANNEX II

CERTIFICATE

INTERNATIONAL TONNAGE CERTIFICATE (1969)

(Official seal)

Issued under the provisions of the International Convention on Tonnage Measurement of Ships, 1969, under the authority of the Government of

....

(full official designation of country)

for which the Convention came into force on...19....

by ....

(full official designation of the competent person or organization recognized under the provisions of the International Convention on Tonnage Measurement of Ships, 1969)

Name of Ship	Distinctive Number or Letters	Port of Registry	*Date

* Date on which the keel was laid or the ship was at a similar stage of construction (Article 2(6)), or date on which the ship underwent alterations or modifications of a major character (Article 3(2)(b)), as appropriate.

MAIN DIMENSIONS

Length (Article 2(8))	Breadth (Regulation 2(3))	Moulded Depth amidships to Upper Deck (Regulation 2(2))

THE TONNAGES OF THE SHIP ARE:

GROSS TONNAGE..

NET TONNAGE ....

This is to certify that the tonnages of this ship have been determined in accordance with the provisions of the International Convention of Tonnage Measurement of Ships, 1969.

Issued at ....19....
(place of issue of certificate) (date of issue)

....
(signature of official issuing the certificate)
and/or
(seal of issuing authority)

If signed, the following paragraph is to be added:

The undersigned declares that he is duly authorized by the said Government to issue this certificate.

....
(Signature)

SPACES INCLUDED IN TONNAGE					
GROSS TONNAGE			NET TONNAGE		
Name of Space	Location	Length	Name of Space	Location	Length
Underdeck	—	—			

NUMBER OF PASSENGERS
(Regulation 4(1))

Number of passengers in cabins with not more than 8 berths ....

Number of other passengers ....

EXCLUDED SPACES
(Regulation 2(5))

An asterisk (*) should be added to those spaces listed above which comprise both enclosed and excluded spaces.

MOULDED DRAUGHT
(Regulation 4(2))

Date and place of original measurement ....

Date and place of last previous remeasurement ....

REMARKS: