ABSTRACT
Collision is the behaviour of ship against ship by way of striking or contact. On many occasions vessels encounters end up with not a collision but a near miss. Ships or other floating bodies are the main constituents of collision cases.

Collisions may occur under any conditions – day or night, in clear weather or restricted visibility, in narrow straits, coastal waters or in high seas.

World trade has increased and hence the shipping traffic. Increase in shipping traffic has brought in the outcome of shipping risks increase. In recent years “black points” methodology have been used to determine and similarly analyse the most risky regions within the areas where accidents / incidents occur in order to shed a light on possible steps forward to reduce losses.

Collision risk is a possibility or a chance of facing collision danger and the hazard of loss either to ship, lives, goods or other property as the outcome of such fortuitous event. No answer is given or reference made in the COLREGs concerning the question as to when or at which point a risk of collision initially exists. COLREGs Rule 7 as it stands merely considers such risk “is deemed to exist” if the relative bearing of an approaching vessel does not appreciably change, and vessels approach one another.

Quite many factors build up collision risks. More frequently faced ones, inter alia, are insufficient / improper watch-keeping, lack of situational awareness, lack of positive action, failure to communicate intentions, failure to comply with standard procedures and international regulations, lack of training, and incorrect / improper use of the bridge equipment.

In this paper it is aimed to analyse pros and cons of the existing international rules that guide OOW and masters in order to avoid or minimise to develop any collision risk(s). To that effect, relevant Rules of the existing COLREG are to be studied with possible effective outcomes.

Keywords: Collision, Collision Regulations, Collision Risks, Risk Management

1. INTRODUCTION
Shipping world has witnessed numerous developments on ships - from design, size and types to propulsion systems. Shipping was without mechanical power until the early 19th Century - sails and oars being the only means to move ships of the time.

Industrial era matched with notable technological developments made remarkable contributions to better up the “ship-shape” – powerful engines with reduced specific consumption, better hull characteristics, more efficient propellers, faster and larger ships to improve transport performance etc. Ultimately, the construction, design and size of ships have changed dramatically since the 1960s.
Ships trade in a complex and high-risk operating environment. Yet in the age of precision navigation many casualties and losses still occur at sea. Even the available advanced and sophisticated navigation instruments and the enhanced communication technologies have been unable to remedy this and halt marine accidents, notwithstanding some recent improvement.

Very many vessels differ from one another in size and type but all navigate round-the-clock. On their way to destinations they normally follow customary routes and courses; the primary objective being:

- to keep the shortest possible distance,
- to avoid navigational hazards, and
- to avoid collision.

Areas of heavy traffic, in vicinity of large ports or headlands where traffic is concentrated are the critical places that collisions are more likely to occur. In areas where shipping traffic concentrates, encounters of vessels, be it seldom or frequent, single or multi, take place if and when their courses coincide and maneuvering may become, sooner or later, inevitable.

The risk of collision for a vessel proceeding on a shipping route singly is almost zero. If, however, there is another vessel underway in the area even a simple encounter may create risk of collision if both parties do not correctly adhere to the Collision Regulations.

Vessels approaching one another so as to involve risk of collision either of the following encounter situations may occur:

a. meeting -
   - end-on or nearly end-on as to the other,
   - crossing on either side, or
b. overtaking the other.

Collision is one of the major types of shipping accidents. Ships or other floating bodies are the main constituents of the collision cases. Such accidents have still been the bane of modern navigation - despite the sustained improvements in navigation techniques.

2. COLLISION RISKS
Collision is the impact of ship against ship by way of striking or contact. Ships or other floating bodies are the main constituents of collision cases. Such accidents have still been the bane of modern navigation.

Collisions may take place anywhere, anytime and under any conditions – day or night, in clear weather or restricted visibility, in narrow straits, coastal waters or on the open ocean. In daytime and in a visual situation, it is easier to judge distances. Likewise, course alterations are more obvious and the other vessels around will notice any change of aspect. To judge distances and to estimate the visibility at night is at times quite difficult. Therefore, navigation, even on a dark clear night, requires special care in order to avoid collision risk(s).

Fast improvements in scientific methods and hence in technology have resulted in development of new transport modes and conveyances, ultimately giving rise to increase in speed and capacity with shipping traffic. Increase in shipping traffic adversely affected several shipping risks – collision risks inclusive.

Development in shipping traffic has accordingly tended increase in shipping risks. In recent years a new terminology so-called “black points” have been used to determine and hence analyse the most risky regions within the areas where accidents / incidents occur by way of accident-number, accident-ratio and number-ratio methods (Koldemir, 2006). Though the black points indicate the densely risky areas at first sight have the positive impact from the point of view of taking any necessary step forward in order to reduce losses (Koldemir, 2004 and 2006)

It is shown that how conventional black point analysis methods such as are improved with proposed intelligent algorithms, which are relatively new in the field of navigation.

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1 It has been computed, for instance, that the navigational lights exhibited on both sides of the Strait of Istanbul are visible only to 1.9 nautical miles at night, though their nominal range is 8 nautical miles. This is due to the presence of bright background lights from street lighting, road traffic, restaurants, city and residential lights. Nevertheless, the background lighting in the Strait usually masks the navigation lights of not only small crafts but also large vessels and in the author’s experience the presence of such floating objects is sometimes first noticed by the moving silhouette they cast against the shore lights (Akten,2004)
Collision risk, or specified in the Rules as the “risk of collision”, is a possibility or a chance of facing collision danger and the hazard of loss either to ship, lives, goods or other property as the outcome of such fortuitous event. No answer is given or reference made in the COLREGs concerning the question as to when or at which point a risk of collision initially exists. Rule 7 as it stands merely considers such risk “is deemed to exist” if the relative bearing of an approaching vessel does not appreciably change, and vessels approach one another.

A collision risk exists up to a point where a collision or a “near-miss” may take place and may well have different stages as in the following:

- no significant risk (3 nautical miles and over), it is just noticed,
- apparent risk (3 nautical miles and less), it becomes obvious,
- increased risk (1 to 2 nautical miles),
- imminent risk (or collision danger) (1 nautical mile or less), and,
- Near miss or collision. (Near miss=teğet geçme, sıyırıp geçme

Should distances of the order of 1 to 2 nautical miles exist between vessels that are already on a collision course in the open sea, the risk of collision as such, under the special circumstances of the case, is considered as the “increased risk”.

The criteria to deem a collision risk as the “imminent risk” is if the distance between vessels that are on a collision course be less than 1 nautical mile. If an imminent risk of collision happens there exists collision danger as well.

Exact assessment of the situation that at what point the collision danger or imminent risk starts is important in the eyes of officers in-charge on the bridge in order to be prepared to judge and to be on the alert for the possible need for last-minute action.

Sea-room around a vessel wherein a collision with any approaching vessel is imminent, unless whatever action and by whom taken be positive, made in ample time, substantial and with due regard to the observance of good seamanship may be defined as a “close quarter” situation.

Several authors suggest the range for a close quarter situation is likely to develop at distances as follows (Akten, 2005):

- 2 to 3 miles as the outer limits in restricted visibility, but smaller distances, probably of the order of 1 mile for vessels in sight of one another, (Cockcroft and Lameijer) 4
- about 3 miles, (Burger) 5
- about 3 miles in fog with radar and with unrestricted sea-room, (Wylie) 6
- a substantial distance in miles rather than yards, depending upon the size, characteristics and speed of the ships, (Lord Justice Willmer) 7

Up until the point at which a risk of collision is deemed to be apparent, a vessel may take whatever action she wishes to do so. As from the point where a risk of collision is apparent any action that a vessel may take has to be in compliance with the COLREG stipulation. Any wrong action at this stage will most likely give rise to an increase in the risk of collision and ultimately will result in an unwanted close quarter situation.

Ships while underway may be involved in meeting and / or overtaking situations, ultimately resulting in collision danger. Collision can best be avoided by not being trapped in a collision risk situation. “In so many

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2 “Risk of collision” means a chance, a probability, a strong or reasonable probability of collision. (Sturt : 1991)
3 “The said risk may sometimes exist even when appreciable bearing change is evident, particularly when approaching a very large vessel or a tow or when a vessel at close range.” (Reg.7 (d) (ii) (Sturt, 1991)
4 “in the open sea distances of the order of 2 to 3 miles are usually considered as the outer limits (at close quarters) in restricted visibility, but smaller distances, probably of the order of 1 mile would probably be accepted for vessels in sight of one another.” (Cockcroft and Lameijer,1982).
5 “it is a fairly safe proposition in the open sea to take the range of close quarters situation as about 3 miles.” (Burger, 1967).
6 “ships which are approaching one another in fog with radar and with unrestricted sea-room, enter a region of collision when about 3 miles”  (Wylie, 1970).
7 “...that in the case of ships of the class that we have here it must mean quite a substantial distance, and I venture to think, a distance measurable in miles rather than yards” (Lord Justice Willmer, (1961). Grepa/Varena case) (Cahill, 1983).
cases a collision occurs not because one vessel willfully disregarded the applicable Rule but because the mariner at the con suffered from a misconception as to what Rule governed.” (Cahill, 1983)

Hence a full understanding and thorough knowledge of internationally accepted rules and regulations is paramount to safe operations by all vessels on the water.

3. FACTORS BUILD UP COLLISION RISKS

Ship is an asset indispensable for ship owners and/or ship managers. They are nevertheless exposed to various external hazards such as darkness, poor or reduced visibility, inclement weather and sea conditions and currents, all of which one way or other may contribute to collision accidents or a casualty. Bad look-outs, not taking the proper action until a very late stage, close presence of a third ship which prevents taking early action and a late proper maneuver as against the crossing, overtaking and meeting end-on rules, lack of adequate knowledge about the region, loss of alertness etc. (Akten, 2004) also constitute the internal threats of such accidents.

Collision accidents are all seafarers’ nightmare and today it comes under the fierce public scrutiny. Should it occur in confined waters where the traffic is heavy, the sea-room is restricted, serious risks are likely to be faced by other shipping. In addition, such accidents become even more critical if spillage of oil is once involved.

Numerous recent examples on collision accidents indicate that seafarers make expensive and even tragic mistakes despite innovative bridge technology are available onboard ships. Equipment failure as a main causal factor on ship collisions is second to human error and accounts for 20 percent of all collision cases.8

The use of modern technology is nowadays a common practice onboard ship, allowing the centralization of ship control function on the bridge. Today’s sophisticated bridge equipment and collision avoidance aids in particular, are tailor-made and operate effectively. But there are dangers in the incorrect / improper use of the bridge equipment… Some of the collision avoidance aids that watch keepers rely on heavily may also contribute to the cause of a collision or accident if not treated properly.

A contributory factor in almost all navigational incidents is a failure, or in some cases an absence of, good bridge procedures. Such procedures are fundamental to STCW as well as the ISM Code. Experience has shown that properly formulated bridge procedures and the development of bridge teamwork are critical to maintaining a safe navigational watch.

The safe operation and handling of ships relies mainly on the standards of seafarers’ knowledge rather than the sophistication of the ship’s equipment and condition. Statistical analyses of the main causal trends explicitly reveal that human errors, though declining marginally, continue to be the major cause for all shipping accidents and are cited in almost 80 percent of accidents. Consequently, the acts or omissions of seafarers play a significant part in almost every accident. (Akten, 2004)

Recent casualty reports have highlighted the majority of collisions occurred due to negligence and failure on the part of the bridge team in performing basic navigational duties, that is, not following simple principles of bridge watch keeping. Reports on collision incidents and casualties reveal that human error was found to be the main underlying cause by 68 per cent of all collision cases, followed by equipment failures which are 20 per cent. (Gard News, 2004)

Hence the basic factors build up collision risks may be enumerated, inter alia, as the following ones:

- Insufficient / Improper watch-keeping,
- Lack of situational awareness,
- Failure to set priorities – lack of positive action,
- Preoccupation with administrative tasks,
- Failure to communicate intentions (officer/master/pilot),
- Failure to challenge incorrect decisions (officer/master/pilot),
- Failure to comply with standard procedures and international regulations,
- Failure to utilize available data and resources,
- Lack of training,

4. COLLISION REGULATIONS AND RISK OF COLLISION
Shipping traffic is regulated by way of internationally accepted rules to avoid any collision accident - namely COLREGs or as locally called “Rules of the Road”. Years before the “Rules of the Road” at sea was internationally applicable, the practice of seafarers had established rules to enable approaching ships to keep clear of one another. COLREGs of today however are the uniform rules designed to regulate the steps forward to be taken by the bridge team to avoid collision accidents at sea.

The Collision Regulations have been devised to make the navigation safer. It is simply the “no-collision” rules and primarily aims to prevent the development of a close quarter situation (Akten, 2005). However, with many OOW and masters not applying the rules properly or effectively can often cause even greater confusion and risk of collision (Signals Special, 2004).


Maritime states, having recognised the needs of having uniform rules on collision cases, entered into multiparty agreement in 1910 – namely the Brussels Regulations. It was in 1948 that the Collision Rules were first revised and accordingly formulated by the participating nations during the Conference on the International Convention on Safety of Life at Sea 1948. These revised Rules came into force from January 1954.

5. HOW TO MINIMISE TO DEVELOP COLLISION RISKS?
Risk can be defined as a function of the probability of an undesirable event and by the severity of the consequences of that event. Risk management is also defined as any techniques used either to minimize the probability of an accident or to mitigate its consequences with, for instance, good engineering designs, good operating practices, or proper preventive maintenance Shub et. Al (1994). Risk can be examined in several ways; one of which is the fuzzy cluster analysis.

The fuzzy cluster analysis and its extensions have been found in many successful applications in finance, medicine, MR images; inventory planning, multiple facility location, upwelling prediction in ocean and face recognition. Fuzzy cluster analyses have recently been employed grouping shipping accidents- collision cases inclusive. (Esna et al, 2008)

Shipping is and always will be full of risks despite high and ever increasing safety standards. Nevertheless, improved standards for ships, seafarers and management, development of navigational aids, and inclusion of traffic separation schemes for collision avoidance by way of internationally adopted measures have all made and will make a major impact on shipping safety and benefit the health of the oceans by reducing oil pollution.

“COLREG do not prevent collisions by simply laying down how ships must maneuver when they are already on a collision course. COLREG are designed to avoid the risk of collision by making sure that ships avoid a close quarters situation, which occurs whenever ships are not going to pass one another at a safe distance. COLREG 7 and 8 give specific guidance upon the “risk of collision” and “action to avoid collision” and the importance of these two rules is often overlooked.” (Moloney: 2002).

The Rule does not refer to any specific distance or range to indicate sufficient or “fairly safe” sea-room be available to avoid collision within which the risk of collision is deemed initially to exist. Moreover, “The courts have declined to lay down hard and fast rules for determining when risk of collision exists.” “That must always be decided, according to the circumstances of each case, by men of nautical experience” (Sturt: 1991).

Visibility distance of sidelights however is a good basis to assess that specific but important distance to be on alert for the vessels approaching one another.

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9 International Convention for the Unification of Certain Rules of Law with Respect to Collisions Between Vessels, September 23, 1910
Visibility distance of the front and back sailing lights onboard vessels is prescribed in the COLREG 22 – being 1 to 3 n.m for sidelights and stern lights; 2 to 6 n.m for masthead light(s) as minimum ranges and under normal weather conditions. The vessel size as specified in the Rules is of course the determining factor for the differing visibility of such lights.

The point when one of the approaching vessels first sights the sidelight(s) of the other is the first indication for that vessel to consider that the risk of collision actually exists and is apparent. In other words, the first indication received as to the presence of the other vessel is the observance of her sidelight(s).

Vessels 50 meters or more in length while approaching one another will observe the other’s sidelight(s) at the same instant and the distance off would be 3 n.m. The distance between those approaching vessels is thus the outer limit of the area within which the risk of collision first exists and is apparent – normally 3 n.m as the minimum range although this would depend on the lengths of approaching vessels. This minimum range, to a great extent, is the outcome of sea-sense (or nautical common sense), based on wide experience of the sea and ships, and conforms also to the sense of the COLREG.

Therefore, it would be useful to include the following additional sub-article to Rule 7 (d) to fill the gap and hence to guide OOWs and masters:

"iii. Such risk shall be deemed to exist and to be apparent when one of the approaching vessels first sights the other’s sidelight(s)."

The observance of one of the sidelights (or both) of an approaching vessel is thus to impose the existence of an apparent risk of collision for the observant vessel as per Rule 7(d)(iii).

Likewise, such a reference be included in the Rule 7(d) is to facilitate to perceive from the very beginning the level of risk of collision situations.

Sea-room around a vessel wherein a collision with any approaching vessel is imminent, unless whatever action and by whom taken be positive, made in ample time, substantial and with due regard to the observance of good seamanship may be defined as a “close quarter” situation.

Exact assessment of the situation that at what point the collision danger or imminent risk starts is rather important in the eyes of seafarers in-charge on the bridge in order to be prepared to judge and to be on the alert for possible last-minute action.

A new additional sailing light, which is not prescribed in the COLREG so far, may well serve for such assessment.

Vessels of 50 meters and more in length carry two masthead lights according to the rules – one forward and the second abaft and higher than the forward one. A second set of sidelights, placed under the forward masthead light so as to be in a vertical line (i.e carried on the fore and aft centre line of the vessel), green and red lights being side-by-side and combined in one lantern, visible at a minimum distance of 1 n.m., showing an arc of 225 degrees “fitting in with” the masthead lights and the main sidelights, shall be exhibited by vessels of 50 metres and above in addition to the existing main sidelights to indicate the collision danger.

As soon as the approaching vessel observes the proposed sidelight exhibited on the forward masthead of the other, it would simply mean that collision danger exists and it is the time and last chance to take precise action in compliance with the Rules.

Hence, the following changes and additions made to rules 21 and 22 be made would be appropriate to specify when and at what point a collision danger exists (be in question) and accordingly to guide seafarers how to assess such a particular situation by way of visual observation:

**Rule 21 (c):**

“second sidelights” means a green light on the starboard side and a red light on the port side, combined in one lantern carried under the forward masthead light so as to be in a vertical line, each showing an unbroken light over an arc of the horizon of 112.5 degrees and so
fixed as to show the light from right ahead to 22.5 degrees abaft the beam on its respective side.

Rule 22 (a):

In vessels of 50 meters or more in length:

- a second (combined) sidelights, 1 mile.

To estimate the degree of risk of collision is done either by manual plotting methods or automatically by electronic radar plotting aids (ATA or ARPA). The current COLREG refers only to radar and plotting aids to obtain early warning of risk of collision. (Rule 7(b)) Extensive revision and accordingly inclusion of new-sophisticated devices such as AIS, ECDIS and EPFS equipment in SOLAS Chapter V makes some modification in the Rule 7(b) necessary. Hence, a new sub-article 7(b) to include the new bridge equipment may read as follows (Akten, 2006):

Rule 7 (b):

“Proper and harmonised use shall be made of collision avoidance equipment inter alia radar, electronic radar plotting aids, the AIS and ECDIS, when operational, to obtain early assessment of risk of collision, including electronic plotting or equivalent systematic observation of detected objects.

6. CONCLUSION

The Collision Regulations have been devised to make the navigation safer. It is simply the “no-collision” rules and primarily aims to prevent the development of a close quarter situation. However, many OOW and masters do not apply the rules properly or effectively; this often causes even greater confusion and risk of collision. (Signals Special, 2004)

COLREG is the binding instrument for seafarers of all maritime nations, operating vessels of any size and any type in international trade. Its interpretation from the Convention language(s) to any native tongue may no doubt differ – sometimes even leading to confusion about authenticity of terminology in the native interpretations. The Rules however do not reflect thoroughly the whole aspects of the risk of collision matters to guide the bridge team.

The safe navigation and handling of ships relies not only on the contemporary bridge equipment, but also on clear-cut awareness of how to avoid a possible close quarter and better assessment of the collision risk. Yet the current Rules have certain shortcomings to that effect, and the proposed amendments will assist the bridge team to perceive and assess better at what point a collision danger exists (or, be in question) by way of visual observation. (Akten, 2005)

Minimizing losses, making mitigation more effective, increasing responsiveness to different type of accidents, collisions included, and hence conserving resources is closely linked with the efficiency of knowledge discovery. (Torun and Düzgün, 2006) Revised COLREGs by way of improving its related rules, namely the risk of collision, will shed a light on possible steps forward to reduce collision losses.

7. REFERENCES


