

There are a lot of advantages of this new mean of rescue:

- The man over board can enter the liferaft and is out of the water. The possibility of hypothermia is reduced as well as the other dangers of the environment (sun, rain, animals, etc.).
- The life raft contains an AIS transmitter and a VHF handheld. Therefore the position of the liferaft is
 visible on the radar and the person in the MOB-RR can communicate with all ships around. For the
 rescuer it is important to know how many persons are involved and are they all right or injured and for
 the victim(s) it is important to know are the others aware of me and what is planed / how long will it
 take.
- The complete liferaft with the person inside can be retrieved from the water by connecting the lifting slings with any crane hook, davit hook or other heaving line. There is no need of launching the rescue boat and to bring other persons into unnecessary danger.
- Knowing the man over board in a safe and protected place gives me sufficient time to plan the next maneuvers. It can even be considered to wait view hours for better weather or other assistance.

Current life-saving equipment for MOB (Status Quo)

Life-saving equipment and appliances fitted on present SOLAS vessels assigned for MOB rescue purpose including determined quantity of lifebuoys (as per vessel's length) and one pair of lifebuoys provided with self-activating smoke signal and light, usually fitted on the bridge. For recovering of MOB is also assigned rescue boat with launching equipment. The Rescue boat as per SOLAS can be substitute by the one life boat when this substituting life boat comply with SOLAS requirements for rescue boats, this life boat cannot be a free fall type. Boats are usually lowered or launched to water by conventional deck davit with the galvanized steel wires. Recovering of these boats back to deck is difficult even during perfect and calm weather, this is a fact well known in seagoing practice.

Main disadvantages of present MOB rescue system

When the **heavy weather** prevailing at sea, the man overboard can be in the serious risk of life. High sea swell and sea waves can cause, that man over board can be hardly identifiable during this sea surface condition. The head of man which fall overboard can be simply overlooked or lost from sight from the navigational bridge of the vessel. The man's head is excessively small when we compare height of sea wave and average dimensions of human head.

The provided lifebuoy with light and self-activating smoke signal can be in the most of MOB situations un-sufficient. **Daylight:** the smoke signal is emitted only 15 minutes and light is un-visible during day light. Is the 15 minutes of smoke emission sufficient for identification? **Night-time:** when the vessel will be so far from MOB, light can be simply overlooked (same situation as head in waves) and smoke signal is practically un-visible. These circumstances can cause that MOB will be not found by vessel after returning manoeuvre (usually Williamson's turn). How is the identification of survivor ensured during restricted visibility?

Heavy weather also creating serious obstruction for rescue boat launching. The height of sea waves can disallow lowering of rescue boat completely or make launching highly dangerous and risky. Standard rescue boat team is composed from five persons, this all persons must risk their life to rescue only one man. Recovering of boat back to deck seems to be impossible during heavy weather and excessively dangerous. Is this status quo acceptable?

Sea water temperature often create unfriendly conditions for MOB. Crewmember which fall overboard is directly exposed to sea environment without any possible protection. Hypothermia in the cold sea water can appear soon after accident.

Present personal life-saving equipment seems to be not enough safe for MOB situation. Equipment and appliances not bringing sufficient protection of MOB against sea environment. Risk of life has been found unacceptably and wildly high. Owners spending great amount of money for rescue boats purchase and maintenance and looks like that is not enough effective. How to check the effectiveness of present system? In previous paragraphs some questions appeared, let's go to find some good answers or solutions in the text which will follow.

Main disadvantages of current recovery system

- Problematic identification of MOB in the sea (when bad weather, reduced visibility etc.);
- Thermal protection is missing (MOB situation most probably appear during a bad weather conditions and bad weather mostly appear in cold regions);
- No solution for restricted visibility (smoke and light are not effective in this conditions);
- Problems with launching of rescue boats (swell and waves alongside vessel);
- Problems with recovering of rescue boats (swell and waves alongside vessel);
- Problems with communication between the vessel and MOB (MOB cannot communicate with the vessel even when the vessel is in his sight – psychological effect);
- Command of the ship which is rescuing the survivor is under heavy time stress, because survivor is all the time exposed to sea environment without any protection and can be simply lost from the ship's sight.

How to solve and eliminate the inadequacies of present man-overboard recovery system?

Introduce the new system, the MOB-Rescue Raft™

Read the following facts and consider: When man-overboard accident happened on board of vessel, the immediate action is required, that's a fact.

What the man in the water may need? – Immediate assistance, any kind of psychical support, often thermal protection, always additional flotation, always visual and radio identification and always effective protection from the sea environment.

Man-overboard situation is not only about the survivor needs, but also about the needs of the vessel. What the "mother" vessel may need? – Calm weather for the safe lowering of the rescue boat, but often is not available. Vessel generally need the great amount of time, time to make a proper returning manoeuvre, time to find the man in the water (e.g. smoke signal works only 15min – often is time for one approach only due to ship's manoeuvring ability), time to safely lower the rescue boat, time to proceed with rescue boat to MOB position, again time to find the man in the water, time to pick up the man and pull him inside the rescue boat. On the other hand, the survivor in the water need immediate assistance, usually he has no time to wait. The new MOB-Rescue Raft[™] react on all these challenges.

Current & New System Comparison

Rescue operation conditions and possibilities	Current system	MOB Rescue Raft™ new system
Bring additional flotation for survivor	\checkmark	\checkmark
Create shelter for survivor (isolation from sea environment, TPA)	\boxtimes	
Safe to use when sea state less than 2 Beaufort	\checkmark	\checkmark
Safe to use when sea state more than 2 and less than 4 Beaufort (Rescue boat lowering and heaving up difficulties can appear)	\mathbf{X}	\checkmark
Safe to use when sea state more than 4 Beaufort (Rescue boat lowering and heaving up difficulties)	\boxtimes	
Effective during night or restricted visibility (light buoy for 2 hours only)	\boxtimes	
Effective when sea water temperature less than 12°C - high danger for hypothermia	\boxtimes	
Effective when sea water temperature is favorable (low danger for hypothermia)	\boxtimes	\checkmark
Possibility of radio communication between survivor and ship (VHF)	\boxtimes	\checkmark
Possibility of RADAR localization of survivor (AIS)	\boxtimes	

MOB statistics, historical data and current system effectiveness

Information's regarding MOB accidents are not easily accessible. The many of maritime organizations, ship registers, governments, cost guards or other authorities not provide any database with suitable information's. Thereto, for statistical analysis has been used following databases containing required information's which allow to construct the representative sample: **MISLE** (Marine Information for Safety and Law Enforcement), **MAIB** (Marine Accidents Investigation Branch), **BMA** (Bahamas Maritime Authority), **NCG** (Netherlands Coast Guards); To not loose time with obstructive and routine statistic calculations we provide directly some results for all world fleet vessels below (all calculations and documentations are available on request).

World Fleet MOB accidents between the years 2000-2010

(Ships of 100GT or more)

Total quantity of MOB accidents: Total quantity of Casualties from MOB: **258,4** persons/year; **83,9** persons/year;

These valuable results mean that most probably each third seafarer, which fall into the water, is doomed to die. The quantity of world fleet vessels in year 2000 was 87546 vessels and in 2008 was 99741 vessels. These two values present that world fleet still growing. For the 10 years between years 2000 and 2010 we can use the average value of 93277,09 vessels for world fleet and calculate new valuable data. We used all world fleet vessels like our statistical population:

Risk of MOB for one World Fleet vessel: **0,003** person/year; Risk of Casualty due to MOB for one World fleet vessel: **0,001** person/year;

Two (2) numbers above showing the calculated accident risk for one world fleet vessel, but from the other side also the total amount of people which we can rescue. Per year we can maximally rescue 0,003 person on each world fleet vessel, and we can save the life of 0,001 person on board of world fleet vessel (from existing casualties). Most probably we can't! Effectiveness of new system is not 100% and never can be, it is logical way. Let's go to find more answers!

Estimation for life saving

Now is necessary to estimate how many people we can rescuing per year and how many people will be rescued in one year by the new recovery equipment on the one vessel.

Facts which have the main influence on quantity of people which we can rescue by the new MOB-Rescue Raft[™] are listed below. Maximum quantity of people which could be rescue is 0,003 person per vessel per year.

- Suicides
- Ship's position (e.g.: in port)
- Falling overboard after vessel's collision
- MOB is seriously hurt or under alcohol or drug influence
- If person falling overboard was seen by somebody

These facts *(above)* reducing the maximum quantity of people to be rescued. Presumed quantity reduction of people to be rescued per year has been estimated to 30%. Temperature of sea water also reducing the quantity of people to be rescued. Let says that half of accidents happened in the cold water and half in the 'hot' water, that's fair. Looks that we can reduce the total amount by 50%, but with consideration to sea state we cannot. When in the 50% of 'hot' water cases will be rough sea we will use our MOB-Rescue Raft[™] also. On the end, we can accept 25% for quantity reduction only. After recalculation we will get following result:

Total qtty of persons to by rescued by MOB-Rescue Raft[™]: **0,001575** person/ vessel/year

Estimation for total quantity of casualties which can be rescued was performed by the same way as above. We discount the ship's position and suicide cases because is not expected that man which fall overboard in the port will die and that suicide most probably won't be planned in the port. Due to previous fact the total reduction for these cases is 20% only. The 'bad weather' reducing also the quantity of people which can be rescued, but in this case, we expect that all casualties appear mainly due to bad weather and impossibility to launch the rescue boat or due to low sea water temperature etc. To be fair we can reduce the total quantity of casualties which can be rescue by 5%. After final recalculation we will obtain the following result.

Total quantity of casualties to be rescue by MOB-Rescue Raft[™]: **0,00076** person/ vessel/year

First number (0,001575 person/vessel/year) showing the total quantity of people which can be rescuing by new equipment when new system will completely replace the old one. The second number (0,00076 person/vessel/year) showing the total quantity of people which can be rescued by new equipment from the current quantity of casualties. The truth will be somewhere in the middle and till the Cost-Benefit analysis we will use both of numbers.

Maybe some questions appearing now:

Is the risk of MOB casualty tolerable or not?

Is the new equipment reducing the risk for vessel sufficiently and effectively? Cost-Benefit Analysis

Cost benefit analysis is widely used tool for economical and engineering calculations when checking of economical effectiveness for some new products is needed. In our case we have the following rules in our C/B analysis:

COSTS – are the costs for buy new equipment, simply the price of final product;

BENEFITS – are the benefits from saving of human life (social benefits, humanity etc.);

First thing what we need is the benefit calculation. Benefit we can calculate simply like multiple of risk (quantity of people what we can safe) with human life value. These benefits we can obtain from rescuing of human life.

Risk we already estimate in previous part of this paper and now we must calculate the average value of seaman life. Here is necessary note that is not real value (price) of human but only economically unit to compare effectiveness. For estimation of human life value has been used the tool called **Life Quality Index**. Seaman population is highly mixed and is consists from great amount of nationalities. Due to this fact has been used BIMCO & ISF (publication Man-Power 2010) information regarding seaman's nationality working on world fleet vessels. Finally, averages for gross domestic products has been calculated, average lengths of life in health (index HALE – Healthy Life Expectancy) and work/free time ratio to compute the value of human life in accordance with Life Quality Index tool which is suggested to use by IMO. All detailed tables and calculations are available and can be showed on request. Below is presented only final average value of seaman's life which will be used for Cost-Benefit calculation.

Average value of seaman's life: **3.366.335,00,-** USD/seaman

Benefits from rescuing of persons

Previous part containing calculation for this total quantity of persons to be rescued by MOB-Rescue Raft[™]. Result was **0,001575** person per vessel and per one year of raft exploitation. Human life value (LQI) is mentioned above. Multiplying these two values we will obtain the benefits for one world fleet vessel for one year.

Benefit = Value of seaman's life x Quantity of people/casualties (to be rescued) Benefits for one vessel and one year of exploitation of MOB-Rescue Raft[™]: 5301,98 USD/vessel;

Usually we can expect at least 10 years exploitation period for one raft container, so we can multiply the benefits by 10 to obtain more veritable value.

Ten (10) years benefits for using MOB-Rescue RaftTM: 53019,78 USD/ vessel; 53019,78 USD/

Of course, some of these benefits is possible obtain by existing system, so this amount is not a clear benefit from new equipment but is very close to the pure benefit when the new system will completely replace the old one.

Benefits from rescuing of casualties (current casualties)

Previous part containing calculation for this total quantity of casualties to be rescued by MOB-Rescue RaftTM. Result was **0,00076** person per vessel and per one year of raft exploitation. Human life value (LQI) is mentioned above. Multiplying these two values we will obtain the benefits for one world fleet vessel for one year.

Benefits for one year of exploitation of MOB-Rescue Raft[™]: **25584,15** USD/vessel;

Previous benefit from rescuing of total quantity of persons is not pure and on the other side this **'casualty benefit' is excessively pure**, because bases only on rescuing of people which existing system *(equipment)* was not able to rescue and not including the persons which could be rescued additionally *(also)* by the new rescue raft equipment. As was mentioned above the truth will be somewhere between.

In order to have only one benefit value for comparing with costs, we can make the average of both benefits above. **Average value should be perfect for final** calculation.

Total Benefits for 10 years of using the MOB-RescueRaft[™]: 39.302,- USD/ vessel

Cost calculation (Estimation only!)

As mentioned before, the 'costs' (CBA) are connected to the price of the new equipment. Now we will slightly jump forward and estimate the costs of new equipment. Cost estimation is based on the current inflatable life rafts, radio communication and safety equipment prices. Price for the life raft holder (cradle with movable arms, belt and lock) has been estimated with safe margin and is not expected to be higher.

MOB-Rescue Raft[™] consist from these parts and equipment:

TOTA	AL PRICE (COST) WITHOU SART	1050,- USD
TOTAL PRICE (COST)		1750,- USD
•	Others	10,- USD
•	Lamp & Whistle	10,- USD
•	GMDSS VHF CH 16 (external battery)	100,- USD
•	SART Transponder	700,- USD
•	TPA	30,- USD
•	Inflatable rescue raft suitable for one person	800,- USD
•	Holder including all material	100,- USD

Each vessel should be equipped by the two (2) pieces of MOB-RescueRaft. The final price is necessary multiplied by two (2);

Total Costs for one (2) MOB-Rescue Raft™ set:3500,- USDTotal Costs for one (2) MOB-Rescue Raft™ set WITHOUT SART:2100,- USD

Final step of the cost benefit analysis – compare the results

Total benefits has been calculated and partly estimated to 39.302,- USD per ten (10) years. Total costs for ten (10) years has been estimated to 3.500,- USD (or 2.100,- USD without SART).

RESULTS:

- During the 10 years of exploitation the benefits 11 times covering the general costs;
- During the 2 years of exploitation the equipment benefits covering the equipment costs;
- Like benefit we can also accept the replacing of current equipment by the new one (old life ring with smoke and light signal);

Conclusion

Saving of human life have always highest priority and 'green light' in the all kinds of industry. If we had found any opportunity to safe the human life, we must follow this opportunity, especially when is highly effective. I hope that my equipment will help in the future save at least one sailor's life and help to seafarers to get home alive and health. Even the half replacing of problematic rescue boats during some incidents and life-buoys with smoke and light signal is innovative and progressive step forward.