Executive Summary

Tugboats are considered as ‘workhorses of ports’, they assist bigger vessels to come alongside, mooring & un-mooring activities & providing tow service in manoeuvring within the ports & on all seas. In literature, the significance of these small ships is often neglected but in fact their value is of great importance especially in manoeuvring during bad weather conditions in restricted areas within port in particular. Now-a-days tugs are considered as part of port infrastructure in harbours worldwide & it is almost part of the business at some ports.

Accidents don’t just happen on its own but they are cumulative results of series of unsafe events, in context to ports such as unsafe water conditions, human error, machinery & equipment failure - anyone or a combination of these can turn random events into accidents, sometimes with fatalities.

Ship Towage Operation involves one of the potentially hazardous operations i.e. mooring & unmooring of vessels at ports. These operations require an efficient team work as a prerequisite to secure safety. Crew members indulging in this operation must be efficiently trained & equipped. They must possess ample understanding of their role & responsibilities of their own as well as other team members.

From past four decades, researches have been conducted in order to have a better understanding of the effects on tug operations which are leading to many accidents in recent times.

It is a point of consideration that there are different ways to provide towage service in tug operation & these mainly differ from place to place. Basically there are two methods to
assist a ship, one is to push or pull a ship with tug fastened alongside the ship. In this method interaction forces have very small contribution. The other method is towing a ship on a line the tug is fastened to bow or stern to make a connection with towline near the bow in particular, in this interaction forces contributes in a major proportion.

Traffic at Indian Ports

The port sector of India can be divided into two categories namely Major Ports & Non-Major Ports. Major ports are those ports which are run & governed by an act of Indian Parliament while on the other hand Non Major ports includes private ports, captive ports, or ports which are owned by state government. In total there are 12 major ports in India along with 187 Non major ports stretched over 7512 kilometers of the coastal line of India.

Ninety percentage of India’s international trade by volume & seventy percentages by value are represented by Major & Non-major ports in India. Data shows that 975 million tons of total traffic was handled by Indian ports in 2013-14, whereas 40% of the total traffic was handled by Non Major ports. There are other coastal vessels which are also contributing to this high traffic. To handle this high volume of traffic efficiently, tugs play a vital role in providing safe mooring, unmooring operations & assistance to vessels coming alongside. Tug activities has increased tremendously in these ports & so is the risk to safety in these towage operations.

This study attempts to explore the safety risk factors which are threat to Routine Ship Towage operation in Indian Coastal Waters and explore various solutions practiced worldwide to mitigate such safety risks. This research was not subjected to extremely structured deductive approach & not able to control variables in order to generate data for analysis because it is an exploratory non-experimental research. Therefore a
phenomenological approach is adopted to gather relative experiences of people & used active experiences as an open ended enquiry.

Study uses various research tools & techniques to collect samples such as 10 years database of accidents related to harbour towage, survey through questionnaire of industry experts & semi-structure interview of experienced professional from towage industry, conclusion was derived after triangulation. The Principal Component analysis was used to find grouped dimensions from identified hazard variables. Critical analysis of incident type frequency, cause & consequences was done to get a clear picture of critical safety risk factors.

Hence, Research Problem comes as “Hazards identification, which is a preliminary step of most of the safety model and risk related methodology, has not yet been done for tugboat operation in Indian coastal waters and that is leading to incomplete process of risk assessment. Consequently, Indian maritime Industry is not able to adopt or form required safety management practices.”

Research Questions are “What are the hazards associated with tugboat operation in Indian Coastal Waters?” and “What are the known preventive measures practiced worldwide to mitigate these major identified hazards which can be used in Indian maritime industry?”

The main objectives of the study derived as:

- First objective is to identify hazards which are threat to Routine Ship Towage operation safety in Indian coastal waters
- After achieving first objective, the second objective is to explore existing towage safety management practices worldwide, which can be used in Indian maritime industry.
To achieve First Research Objective of finding leading safety risk factors, the three research methods were adopted:

1. Questionnaire survey of practitioners’ professional experience;
2. Quantitative analysis of existing accident data base using Investigation Reports and Case Reports data;
3. Semi-Structured Interview for observational analysis of expert witness opinion;

The first stage consisted of a questionnaire survey of current practitioners. Questionnaire was designed basis literature review. Likert style questionnaire was used to allow comparison of independent variables. It was to get precise contemporary figures, to help ascertain patterns of safety incident type, cause, result, frequency & criticality. Questionnaire was designed in such a way that most questions were closed, containing measurable factual information; also there was an option of providing additional descriptive information & facts. Factor analysis was done with the help of PCA subsequently significance test between risk factors & consequences.

The second stage consisted of an analysis of secondary 10 years data followed by statistical testing to establish any correlation between Routine Ship Towage & Non-Routine Ship Towage. The use of minimum 175 Investigation report/case studies aimed to reduce sampling error. A Chi Square test was performed to test Null Hypothesis to compare RST & NRST operations. This was to find out whether there is any noticeable difference between RST & NRST operations. During the process key safety risk factors were identified, critically evaluated & categorised. Their likelihood & severity was measured, & this information was used to test hypotheses.

The third stage involved interviews of experts in Indian subcontinent. Variables identified in first & second stage were used to frame questions. This was to explore other variables that were not identified in first & second stage, in addition to get the depth of perception & to
validate findings. The interview was semi-structured with judgmental sampling (non-probabilistic sampling).

Since this research has used different methods, some adjustment was necessary to allow comparison of the three distinct samples & enable triangulation to achieve and validate conclusions.

The findings of this research were that in broader category seven factors were responsible to a great threat to Routine Ship Towage safety and those are poor work process, poor maintenance of equipment, rough weather, poor or no risk assessment, occupational incompetence, the suitability of the type of tractor & poor safety management system. Expert Interview also confirms same.

Expert Interview also mentioned additional safety risk factors such as Stability (which can be taken in watertight Integrity), Commercial Pressure (Time), Poor Seamanship, Wash/squash effect (Navigational Obstacle), Fatigue & Bad attitude, these were not explicitly identified in the Case Studies and Questionnaires.

In second objective, the research design followed was thematic case study approach in which interviews were conducted of exceptionally high experienced experts and many solutions and good practices were explored which is been practiced worldwide in towage industry.

The aim of this research is just only to find the problems but also to suggest solutions. The solution presented in this research is just for indicative purpose, the research does not answer the effectiveness of those control measures. Hence, it is advisable the practitioners to do proper risk analysis before adopting one.