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IM MODEL FOR SHIP SAFETY

M. Furusho

Kobe University of Merchantile Marine, **JAPAN**

1. ABSTRACT

When thinking about the framework for ship safety, the element of this framework is an important viewpoint. The author would like to propose the "IM model" for ship safety as the elements that composed this framework to make the ships operate safely.

This basic idea of the framework is based on the technique by the National Transportation Safety Board (NTSB[1]). The elements, which compose the frame idea, are shown by these keywords such as 4M factors, ①Man, ② Machine, ③Media, ④Management.

The author propose to add "I" element to these 4M, because the human beings have the tendency to think about things centering on oneself.

There are three kinds of concept of this model as follows:

(1) Internal concept as a frame idea

(2) Intermediate concept for safety navigation

(3) External concept for maritime safety

2. OBJECTIVES

The marine accident is quite pitiless. How should we understand the accident for the safety technology? Is not the accident avoided in this age when the science and technology developed? What should we think so as not to repeat and to avoid the marine disasters?

The accident cannot be foreseen at all, and occurs suddenly even if the safety measures are done enough. It is necessary to analyze the system flow and the human activity in detail with the marine accident.

As for the human errors, there are three asking questions to the commonsense theory of accident in return. [2]

(1) There is no distinction of rudimentary mistake or special mistake in the human errors.

(2) Even the proper person has the mistake unexpectedly.

(3) When the machine and the system become convenient, man becomes those who idle.

In general, there are two important purposes to mechanize.

The first purpose of mechanization is to enable mass production with low-cost of the commodity which cannot be manually done of the standardization.

The second purpose of mechanization is to make difficult work to process done faultlessly in man's judgment and power.

3. ACCIDENT INVESTIGATION PHILOSOPHIES AND TECHNIQUE BY NTSB

The fault responsibility gives priority in Japan, and the pursuit of responsibility is confused with the investigation of the technical accident. It is difficult to investigate the accident reasonably. Table 1 shows the technique of the accident investigation, which NTSB adopts. This technique of accident investigation by NTSB is scientific and reasonable.

Table1: Accident investigation technique by NTSB

(1) Sequence of Events
○Time series to clarify the accident cause ○Safety－critical situation
(2) 4 M Factors
① Man ② Machine ③ Media ④ Management
(3) Probable Causes
○Squeezing the main causes
(4) Recommendations
--- "Who", "What", "When" --- ○Immediate action ○Long-term action

(1) Sequence of Events

It is necessary to dig up all the factors with an important effect safely with each other, according to the time series to clarify the accident cause and to clarify the chain relation of those factors.

For this reason, it is necessary to fix the fact by collecting the site investigation, the hearing, the material evidence and the experimental researches, etc.

(2) 4 M Factors

The "4M" factors are explained as follows;

① **Man** :

This term means the individual error of a person such as a master, an officer, a pilot, a VTIS's officer, and crew on board. This error has relation of "Human factors" including the mind stress or the mistake without the problem of responsibility.

② **Machine** :

This term means defect and breakdowns such as damages of hull and failures of engines and ship's other facilities.

③ **Media** :

This term has a considerably wide meaning, and indicates an environmental condition that affects the information on the communication and the service, the weather condition, the harbor facilities, and the navigational aids for sailing.

④ **Management** :

What do the company, the group, and the administration do for safety, or what did not they do? There is a phenomenon concerning with not only one-M but also an event which has affected two-M or more. The problem and measures of the system can be clarified for the first time by classifying the phenomenon into "4 M".

(3) Probable Causes :

The most immediate and main cause of the accident is described as a probable cause in various factors. Because the work to clarify the main cause as a probable cause is unavoidable as the report by the administration, it is not too important.

(4) Recommendations :

It is important to describe clearly, "Who executes?" "What is the item executed?" and "When will it execute by?" Especially, as for describing the time limit clearly, the execution of procedures has two kinds of action program. One is needed to require the emergency action. The other one is big scale action to require time and money. Therefore, it is necessary to describe the time limit clearly divided into "Immediate action" and "Long-term action".

There are two important procedures according to the above-mentioned procedures.

The first procedure is the work to clarify the (1) "Sequence of Events".

The second procedure is the work to classify (1) "Sequence of Events" into (2) "4 M Factors". If these two works are completely done, (3)"Probable causes" and (4) "Recommendations" are shown inevitably.

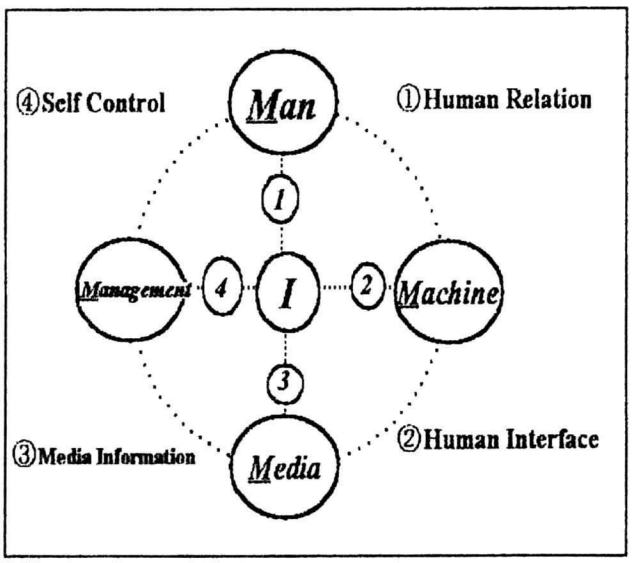
As mentioned above, the technique of accident investigation by NTSB does not intend only procedure. The technique of accident investigation by NTSB includes the philosophical proof where the essential meaning and the suggestion of the accident are pointed out.

4. INTERNAL CONCEPT OF IM MODEL AS A FRAME IDEA

The author proposes the IM model for maritime safety. The frame idea of this model is composed by the combination of 4M factors that are adding by "*I*" factor, shown as Fig.1, because man always put oneself in the center of the earth.

In the Fig.1, ① ~ ④ shows the relation between "4M" and "*I*". The relation between "Man" and "*I*" means ①"**Human Relation**" or "**Human Communication**". The relation between "Machine" and "*I*" means ②"**Human Interface**". The relation between "Media" and "*I*" means ③"**Media Information**". The relation between "Management" and "*I*" means ④"**Self Control**".

Fig.1 Internal Concept of IM Model as a Frame Idea



① "Human Relation" or "Human Communication" means human factors such as 6**P** that are as follows; [3]

1. **P**hysiological factors
2. **P**hysical factors
3. **P**athological factors
4. **P**harmacological factors
5. **P**sychological factors
6. **P**sycho-social factors

Above items 1.~4. are described as a physiological factor. On the other hand, items 5. & 6. are described as a psychological factor. "Human Communication" needs not only verbal interface but also nonverbal interface.

② "Human Interface(HI)"means the interaction of man with their mechanical facilities and equipments. The main objective of HI is designed by fitting human characteristics according to the ergonomics and also to the human engineering.

③ "Media Information" has the meaning of the interaction through the environmental problems such as weather, the sea-surface condition, and the information technology (IT).
④ "Self Control" means the management scheme based on the **SRK**-model (Human activity depends on the **S**kill · **R**ule · **K**nowledge-base) by Rasmussen-1990-.

5. INTERMEDIATE CONCEPT OF IM MODEL FOR SAFETY NAVIGATION

Author shows the internal concept as a frame idea in the previous chapter 4. On the other hand, with regard to the intermediate concept of IM model for Safety Navigation, Fig.2 indicates the relations among 4M.

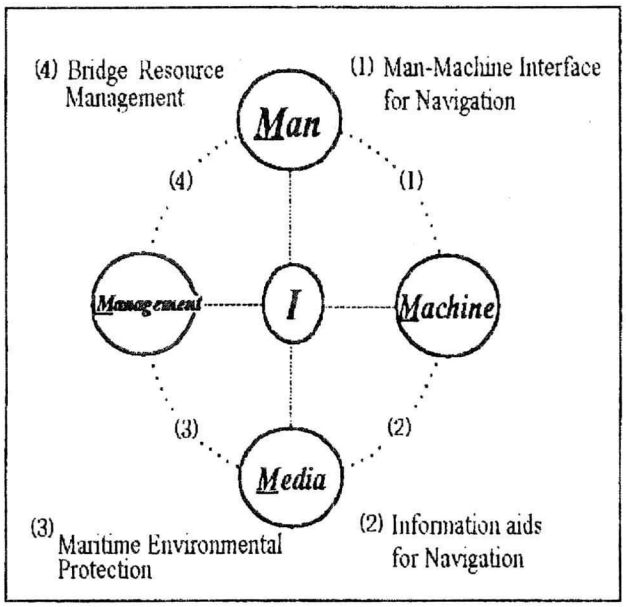


Fig.2 Intermediate Concept of IM Model for Safety Navigation

In the Fig.2, the relation between "Man" and "Machine" means (1) "**Man-Machine Interface for Navigation**".
The relation between "Machine" and "Media" means (2) "**Information aids for Navigation**".
The relation between "Media" and "Management" means (3) "**Maritime Environmental Protection**".
The relation between "Management" and "Man" means (4) "**Bridge Resource Management**"

(1) "Man-Machine Interface for Navigation" means the basic concept of system design that has comfortable operation without user's special attention.

(2) "Information aids for Navigation" means the measurement devices, so that navigators can obtain the effective and essential information through the environmental situation such as meteorological, geographical, traffic and other navigational information.

(3) "Maritime Environmental Protection" means the problems that is concerned with marine pollution caused by exhaust gas, de-ballast water and garbage etc.

(4) "Bridge Resource Management" means the human relation factors among persons in the navigation bridge. A large number of marine disasters have occurred by these causes of the human relation factors. Master has several kinds of responsibilities on board as you know. For the ship safety, it is important to have only one line order system, and also to confirm each other for the confirmation of the order's content by repeating and by speaking order with a simple body action.

It is easy to consider by setting "***I***" mainly. because each relation among items cannot be separated exactly, and each item has close relation.

7. EXTERNAL CONCEPT OF IM MODEL FOR MARITIME SAFETY -INTERNATIONAL CONVENTION LEVEL-

After a serious and hazardous marine disaster had occurred, the international convention has been often established.
The first and well-known international

convention was the SOLAS that was adopted due to the marine disaster of Titanic. This convention provides for the seaworthiness of the ship and the safety of life at sea.

The STCW convention was provided as international standards concerning the execution of knowledge, the skill, the training and the duty of sesfarers to prevent an accident because of "Torrey Canyon".

The MARPOL convention that came into effect in 1983 takes the abbreviation of MARINE POLLUTION and is called MARPOL73/78 convention.

A basic international rule of the marine traffic system is "the International Regulations for Preventing Collisions at Sea, 1972", and is called COLREG.

Fig.3 shows the external concept of IM model for maritime safety by applying these main international conventions and regulations.

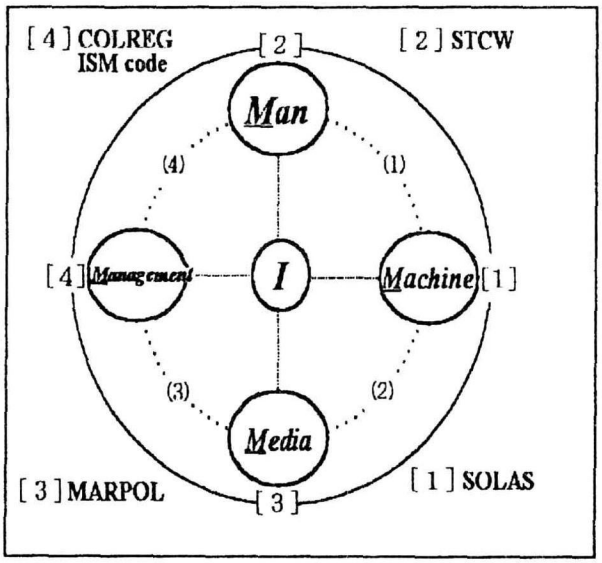


Fig.3 External Concept of IM Model for Maritime Safety -International Convention Level -

The ISM code [5] should be indicated as the Management-factors however this code is described with the new chapter IX of the SOLAS convention. It is the reason why the ISM code for pollution prevention is also described with the same one.

Table2: Main lectures (partly) for students of navigation class at KUMM [4]

4M	Main Lectures for Navigation class
Man	Maritime Labor
	Boat Seamanship
	Seafarers Law
	Marine Sanitation
Machine	Dynamics of Ship Motion
	Naval Architecture
	Navigation Systems
	Marine Engineering
	Theories of Ship handling
	Transportation Engineering
	Navigational Aids
	Marine Electric Apparatus
Media	Transportation Economics
	Fix and Sailing
	Navigation Systems
	Marine Meteorology
	Oceanography
	Signal Communication on board
	Marine Environmental Science
	Chemical Oceanography
Management	Seminar on Maritime System
	Marine Insurance
	Fleet Operation
	Port and Harbors Engineering
	Marine Traffic Engineering
	Maritime Public Law
	Maritime Safety and Maintenance
	Navigation Planning and Routing
	Logistics Planning
	Maritime Law
	Advanced Cargo Handling
	Safety Assessment for Ship
	International Law of the Sea
	Rules of the Maritime Roads
	Marine Casualties
	Management of Machinery
	Radio Regulation for National