Chapter 4 ECDIS Familiarisation Training

4－1 STCW

The convention related to the qualifications of seafarers responsible for ship operation is STCW (International Convention on Standards of Training, Certification and Watch keeping for Seafarers 1978).

In 2010, the IMO's Standards of Training and Watch Keeping Sub-Committee was convened in Manila in the Philippines. Discussions took place on "Ensuring the flexibility of compliance with the convention, training using innovations in science and technology, qualification certificates and how to attain the required level of watch keeping". The convention was revised after this.
With reference to ECDIS, it was specified that "The following knowledge, understanding, and skills are required to use ECDIS in terms of handling a new technology". The following items ① and ② are the minimum standards of proficiency in the STCW Convention for 2nd officers and 3rd officers. In addition, minimum standards of proficiency have been determined for the master and chief officer as well. (See Attachment ⑤ STCW Table A-II/2 Extract)

① ECDIS operational capability and knowledge of its limitations including the following matters

- Complete understanding of electronic navigational charts (ENC), data accuracy, display rules, display options, and other nautical chart data formats
- Risks of overdependence
- Familiarisation with ECDIS functions as required by existing performance standards.

② Familiarisation with ECDIS operation and interpretation and analysis of information obtained from ECDIS, including the following :

- Use of functions which are integrated with other navigational systems, including correct operation and adjustment to the proper settings
- Safe monitoring and co-ordination of information on the ship's position, display of navigation area, motion mode and bearings, displayed nautical chart data, route monitoring, information layer created by the user, other vessels that have been seized (If connected to AIS and/or radar tracking (ARPA)), and the radar overlay function (if connected)
- Checking the vessel position using other methods
- Efficient use of various settings including prevention of grounding, alert parameters when the vessel is approaching another vessel or special navigation areas, completeness of nautical chart data, update status of nautical charts, and backup measures, according to the operating procedures.
- Proper settings and adjustment of settings according to the current situation

- Awareness of the situation while ECDIS is in use, including the situations where the vessel is approaching a safe water area or hazardous water area and information regarding direction and speed of the current, selection of nautical chart data and scale, correctness of the route, detection of other vessels and dealing with them, and status of sensor maintenance.

These capabilities can be proved by the evaluation obtained from one or more of the following: “Approved training ship experience”, and “Approved ECDIS simulator training”.

4－2　Familiarisation Training

With regard to ECDIS operation, both the STCW Convention and the ISM Code specify that “Complete and appropriate training is required for correct and safe use of ECDIS”, and it is recommended that the training should consist of a total of 40 hours of lectures and simulator training (8 hours x 5 days).
In addition, the governments of various countries strongly require that the master and officers engaged in navigational watch duties should be in possession of certificates of completion of ECDIS training. ECDIS familiarisation training is broadly classified into the following 2 types:

1. Generic training - According to the STCW Convention 2010 Manila amendments
2. Model-wise training - According to the ISM code/STCW Convention

Further, the guidance regarding switching from navigation using paper charts to navigation using ECDIS has been issued by the IMO Safety of Navigation circular Ref. T2-OSS/2.7.1 SN.1/Circ.276 (10 December 2008) “Transitioning from Paper Chart to Electronic Chart Display and Information Systems (ECDIS) Navigation”. (See Attachment ④)

4－2－1　Generic Training

IMO has approved “The IMO Model Course 1.27 (Model course on Operational Use of Electronic Chart Display and Information Systems ECDIS)” in order to understand the capabilities, characteristics and limitations of ECDIS, and to learn how to use and operate ECDIS correctly. At present, the training program being conducted follows the “IMO Model Course 1.27 (2012 Edition), which is the version certified by the 2012 IMO/STCW subcommittee”.

This training covers all matters concerning safety during ECDIS operations as well as knowledge of the entire system, and describes matters that must be learnt by trainees before they can obtain the ECDIS training certificate.

Generic Training
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The certificate for education and training on ECDIS must record and clearly state the following:

- The certification candidates should have completed the training course on ECDIS operating methods based on the IMO Model Course 1.27.
- The training course should meet the requirements of IMOSTCW-95 " International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW Convention) " .

4－2－2　Type Specific Familiarisation Training

Trainees are required to familiarise themselves not only with the overall details regarding the operation of ECDIS, but with details of the model being used as well. They are thus required to undergo not only generic training, but type specific familiarisation training as well. Specifically, in AMSA (Australian Maritime Safety Authority), all masters and officers are required to be in possession of certificates of completion of Type Specific Familiarisation Training, which is familiarisation training on the on-board ECDIS (Familiarisation training provided by the ECDIS manufacturer). The authorities of other countries may have similar requirements.

4－2－3　Training Facility

The facility/institution conducting the ECDIS training shall conduct it after being certified by the government or an authorised institution (such as a Classification Society). The facility/institution shall issue a certificate of training completion attested by the government or an authorised institution. As of the year 2016, type specific familiarisation training does not require a completion certificate to be issued by the government of each country. Instead, the training facility issues a certificate of completion attested by Classification Society.

Familiarizataion
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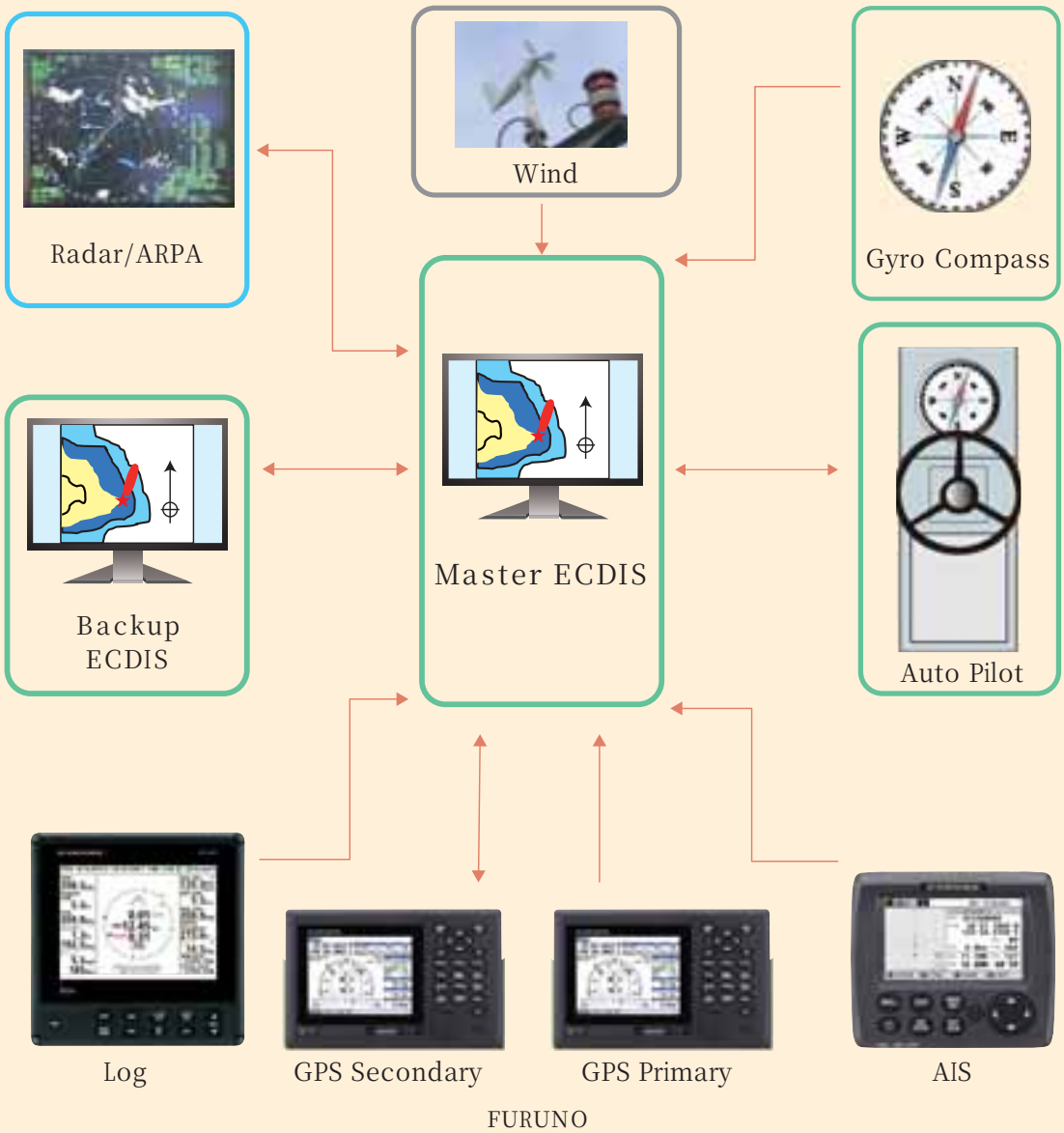
Chapter 5 Handling of Electronic Charts from the Viewpoint of Masters and Officers

So far, various nautical instruments on the vessel bridge have been providing information independently to the Conning Officer. Now, with the introduction of ECDIS, the information obtained from these nautical instruments is stored in ECDIS. (See Figure 15)

Figure : 15 ECDIS and other Nautical Equipment



For example, after checking the vessel name and movements from AIS for hazardous vessel information displayed in ARPA, the intentions of the vessel used to be determined using VHF, if required. Then after confirming the compass reading, and steering to avoiding collision on Auto Pilot, the LOG display was checked to find the trend in changes in speed, and the display on the wind direction meter and anemometer was checked to determine the relative wind direction and wind speed and examine whether there were any problems before and after collision avoidance manoeuvres. The position of the vessel was checked using radar, GPS and target bearings to check for any problem in the manoeuvring of one's own vessel, or checking for deviation from the planned course, then entered in the paper chart.

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Doppler Sonner

The conventional approach, where the Conning Officer would check each piece of information generated by each individual nautical instrument and organise it mentally before using it for manoeuvring may gradually change to an approach where all the information obtained by viewing the ECDIS screen may be treated the same as information actually gained using the human eye, and used for manoeuvring.
In other words, ECDIS can be considered as an integrated navigation system (INS) that is extremely information-intensive and is set up on the bridge for the automated operation of the vessel.

Sponsored by FURUNO　New Generated Bridge System　Voyager

5−1　Human Errors due to Overdependence

ECDIS is one of several useful nautical instruments, but if it is not used correctly, the risk of serious accidents such as collision or grounding arises. With the rapid advancements in computing technology we are seeing in recent times, there is a feeling that people are tending to trust computers excessively. However, computers merely use programs to perform calculations based on data that has been entered, and display the results only, and cannot judge whether the entered data is correct. Thus, if wrong data is entered, the result that is output and displayed is based on calculations performed using wrong information.

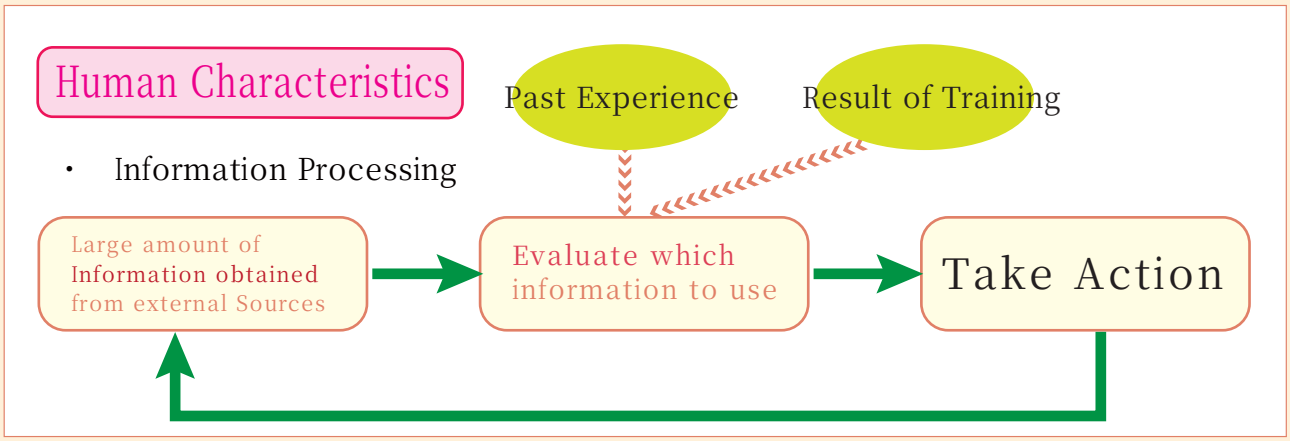
If we check and compare against "Human traits" (For details, see "Thinking Safety" in the Loss Prevention Bulletin No. 35 of our Club), we find that more human errors are caused by misinterpretation of information displayed on ECDIS, and this implies that the use of ECDIS leads to hazardous situations.
From our knowledge of human behavioural traits, let us consider the nature of risks caused by overdependence on ECDIS. Human behavioural traits (Table 16), and the information processing (Figure 17) that takes place when acting based on human traits are shown below.

Table: 16　Human Characteristics

Twelve Human Characteristics from Web "ANZEN NO KOMADO"

Human Charcteristics			
①	People beings sometimes make mistakes	⑦	People beings are sometimes in a hurry
②	People beings sometimes careless	⑧	People beings sometimes become emotional
③	People beings sometimes forget	⑨	People beings sometimes make assumptions
④	People beings sometimes do not notice	⑩	People beings are sometimes lazy
⑤	People beings have moments of inattention	⑪	People beings sometimes panic
⑥	People beings sometimes are able to see or think only one thing at a time	⑫	People beings sometimes transgress when no one is looking

Figure: 17　Human Characteristics : Information Processing in case of taking action



Approximately 90% of all maritime accidents are said to be caused by human error, and there are 12 human behavioural traits that lead to such human errors. The information processing that takes place when a person makes a move is as shown in Figure 17. A large amount of information is obtained from external sources and compared with past experience and what has been learned in training in order to select the required information. Once the person makes a move, new information appears, thus the process keeps on repeating. But if the wrong information is selected due to one or more of 12 behavioural traits, human error occurs, leading to an accident or problem.

The changes in human behavioural traits of the concerned persons before and after the introduction of ECDIS are summarised in Figure 18. The behavioural traits described in points ③ , ⑥ , ⑧ , ⑨ , ⑩ and ⑪ are thought to lead to increased risk.

Table: 18 Comparison table of Human Characteristics Before/After ECDIS Implementation

Human Characteristics				
Characteristics		Before ECDIS	After ECDIS	Evaluation
①	People beings sometimes make mistakes	○	○	No Changed
②	People beings sometimes careless	○	○	No Changed
③	People beings sometimes forget	△	○	Risk Increased
④	People beings sometimes do not notice	○	○	No Changed
⑤	People beings have moments of inattention	○	○	No Changed
⑥	People beings sometimes are able to see or think only one thing at a time	△	○	Risk Increased
⑦	People beings are sometimes in a hurry	○	○	No Changed
⑧	People beings sometimes become emotional	△	○	Risk Increased
⑨	People beings sometimes make assumptions	△	○	Risk Increased
⑩	People beings are sometimes lazy	△	○	Risk Increased
⑪	People beings sometimes panic	△	○	Risk Increased
⑫	People beings sometimes transgress when no one is looking	○	○	No Changed

The comments below are numbered according to above table.

③ People may become forgetful

When using paper charts to check the vessel's position, Masters and Officers may unconsciously check the status of the compass or log too. But in the case of electronic charts, they may overlook important information because they are checking the information on the screen.

⑥ Eyes and thoughts are focused only on one object

Excessive concentration on the electronic chart screen may lead to neglect of the lookout, which is actually of the greatest importance.

⑧ People may get carried away by emotions

Excessive concentration on the electronic chart screen tends to reduce conversation between the crew keeping watch. If work is hampered due to such reasons, there may be emotional exchanges between those keeping watch on the bridge.

⑨ People may have subjective biases

For example, even though Masters and Officers are fully aware that the water depth stated in the nautical charts incorporates some error element, there is a tendency to place excessive trust in the information displayed in digital images.

⑩ People may be lazy and shirk work

Digitisation of information on the ship ' s course and speed may lead to blind trust in these numbers, whereas before the introduction of electronic charts, the information generated by each nautical instrument was processed mentally and used to arrive at a judgement.

⑪ People may panic

If the ECDIS display disappears for some reason, panic may ensue. As a result, excessive concentration on the recovery of ECDIS tends to divert the attention of Masters and Duty Officers/Crew on the bridge from " Lookout " duties, which is the main task of the navigational watch.

The 131st Lecture of the Japan Institute of Navigation (held on 31 October and 1 November 2014), and the Japan Institute of Navigation Lecture proceedings, Volume 2, Issue 2 dated September 30, 2014 included a paper entitled “Effectiveness and safety of navigational support using「ECDIS」(Noriko Nishii (National Institute of Technology, Toyama College)”. An extract from this report is reproduced below. (From the Navigational Sciences No. 28-85 Reprinting permitted on September 26, 2016 with permission from the Japan Institute of Navigation)

Excessive trust on “ECDIS” and the trends among younger personnel:

Japan Institute of Navigation Lecture proceedings, Volume 2, Issue 2 dated September 30, 2014: Effectiveness and safety of navigational support using “ECDIS”

In the ship personnel training facility, lectures on “ECDIS” were started in 2014 in order to meet “ECDIS” proficiency standards. In an on-board training ship fitted with “ECDIS”, a watch-keeping or manoeuvring simulator is used for exercises on avoidance manoeuvres. But trends different from before are being observed in students of late. By adding information from GPS, AIS, and radar, we are able to see that “ECDIS” is being perceived and operated in the same manner as a car navigation system or a PC or smart phone. The car navigation system is akin to “ECDIS” in that it displays the current position accurately using information from the GPS, 3D Gyro, vehicle speed, and VICS, and it can accurately calculate and display the distance to the destination and estimated arrival time. As a result, there are many students who believe that it is possible to navigate the vessel using “ECDIS” alone. This trend is also seen in young officers, who tend to be overly dependent on systems such as ECDIS and AIS. Many veteran officers complain that the visual lookout is being neglected.

This writer has sailed as Master on several vessels fitted with ECDIS. Once ECDIS has been installed, my experience is that not only is there a drop in the number of times young officers use binoculars to check the movement of other vessels, they also spend more time simply standing in front of the ECDIS. Sometimes the less experienced officers even commence avoidance manoeuvres without using their own eyes to look at what is happening in front of them.

5－2　Objectives of ECDIS

The following objectives are defined in IMO MSC.232(82) Scope of ECDIS.

The primary function of ECDIS is to contribute to safe navigation

Paper charts are used for planning a route and checking the vessel’s position when navigating that particular route, or judging whether something can be safely avoided when performing an avoidance manoeuvre. Thus, the main objective of paper charts appears to be the prevention of groundings and the selection of the shortest and best sailing routes. We believe that Masters and officers should not expect that electronic charts will add any value to what was provided by paper charts.

ECDIS is one of “all the available means that are appropriate for the situation at that time” according to Clause 5 (Lookout) and Clause 7 (Risk of collision) in the Act for Preventing Collisions at Sea.
However, Trust in ECDIS data should not mean neglecting the basics of preventing collisions, such as visual confirmation of the area around the ship, checking radar information, and observing changes in the bearings of other vessels.
.
However, when I was sailing as Master in vessels fitted with ECDIS, as I have described earlier, I observed that young officers in particular would not even carry binoculars, or step away from their position in front of the electronic charts, or

perform visual lookouts. Even when performing avoidance manoeuvres, they would not confirm the compass readings before giving instructions to the helmsman. Excessive concentration on ECDIS operations also led to a lack of attention being paid to the reports of the helmsman, with the officers completely immersed in the ECDIS screen.
This situation points to a collapsed BTM (Bridge Team Management), which poses a threat to the safe operation of the vessel.

5－3　BTM and ECDIS

BTM is a practical management technique in which team members on the bridge use various resources during navigation of the vessel for systematically achieving safe operation based on clear standards. (See Figure 19)

Figure 19　BTM

Team members	All personnel on the bridge
Various resources	Human and physical resources
Clear standards	Standards regarding factors such as navigation plan, rules, guidelines from the company and master of the vessel
Organisation	Establishment of an efficient organisation structure including the company
Practical	Management consisting of training using a simulator management techniques

In other words, this is a management technique that considers everyone on the bridge as part of a team, and demonstrates effective teamwork so that individual lapses do not directly result in accidents.

Needless to say, the first responsibility and role that must be fulfilled by the team on the bridge is the achievement of safe operation. In order to fulfil this responsibility and role, resources including personnel must be utilised.

The article titled “Thinking Safety” in the Loss Prevention Bulletin No. 35 published by our Club in July 2015 compared BRM (Bridge Resource Management) and BTM. BRM and BTM may be described as follows :

BRM

Has the objective of promoting effective utilisation of resources including people, and applies to the management functions that should be performed by the leader of the team that has been organised for effective utilisation of human resources.

BTM

To achieve safe operation, the efforts of the leader alone are not enough, and there must be increased activity by all the members belonging to the team. BTM is the management that recognises that improvement of the functioning of all the team members, including the leader, is indispensable, and works to achieve this.

In other words, both BRM and BTM have the same objective, and I believe that there is no need to differentiate between them.

> BRM (Bridge Resource Management) emerged from the concept of CRM (Cockpit Resource Management) in the airline industry. " The Tenerife tragedy " of 1977 led to CRM training being implemented by airlines across the world since 1980. However, BTM training has been conducted since 1977 by the then Warsash Maritime Centre in the UK. At present, BTM and BRM are known by different names depending on the relevant rules and training facilities in each country, and there seems to be no point in debating about their definitions or differences.
>
> (Practical Navigator: Scientific work from Japan Marine Science Inc., Edited by Capt. Hiroshi Sekine, and published by Seizando Shoten Publishing Company Limited)

The main objective of BTM is to eliminate individual human error to ensure that all the team members on the bridge are always conscious of safe operation of the vessel. For example, the pilot on board must also be considered as a supporting member, as he plays an important role on the bridge. At the same time, the crew must also understand that, while on the bridge, it is their team's responsibility to assist the pilot.

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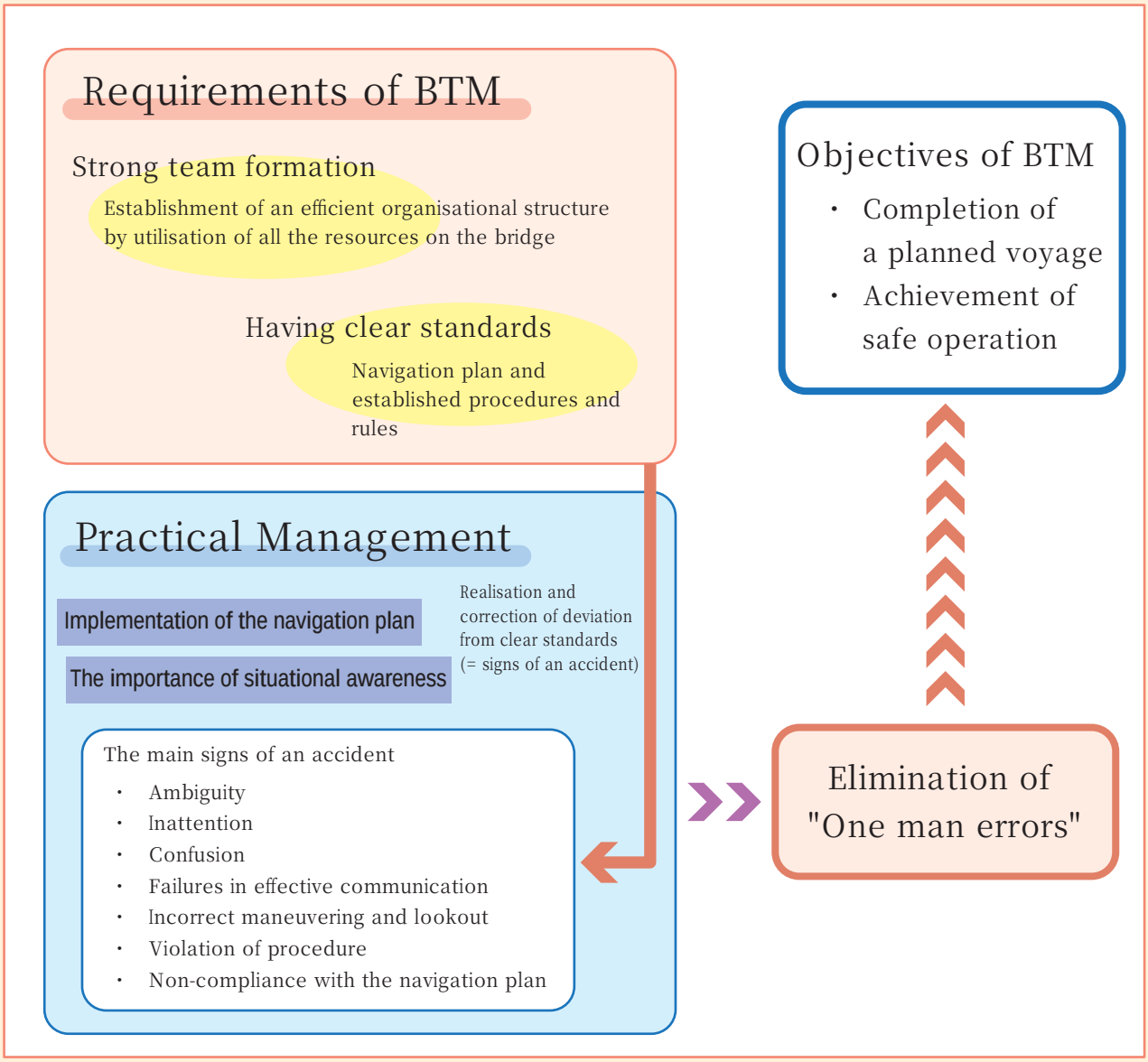
DVD [For Effective Practice of the BRM]

Most accidents while the pilot is on board happen because manoeuvring is left completely to the pilot, and the crew working under the master do not perform their duty of lookout. Instead, they but act only when instructed by the pilot. At this point, it can be determined that BTM has failed, including the pilot's involvement.

To ensure that an error by a single individual does not create a hazardous situation, it is necessary to spot the error quickly and work as a team to support one another and correct it.
Merely because ECDIS has been put into use does not mean that a basic safe operation system has been achieved. This concept of BTM is shown in Figure 20.

Figure: 20 Concept of BTM



Further, the relation between the resources is as shown in Figure 21 (M-SHELL model), where communication is not limited to “Person” to “Person” alone, but also exists between “Person” and “Software (S: the so called documents)” or “Hardware (H: Equipment)” or “Environment (E: External information)”. If successful communication is established between each pair of resources, all the resources amalgamate well to build a good relationship, leaving no room for error.

But, as soon as communication fails, the resources get easily separated and a gap forms between them. These gaps increase the probability of human errors, and as a result, invite accidents (problems).

From the viewpoint of this M-SHELL model, ECDIS information is one of the pieces of information transmitted by H (Hardware), and is just one of the resources available on the bridge.

Figure : 21 M-SHELL Model

However, excessively trusting ECDIS information, or speaking only to ECDIS, leads to unsatisfactory communication with information generated by persons (L), software (S), and equipment (Hardware (H)), thereby obstructing the conversation with each of these resources. This excessive trust not only leads to a communication gap with ECDIS but also with other resources.

In case Masters and Officers have excessively trusted the data without realizing that wrong information has been entered into ECDIS, no meaningful conversation is possible with ECDIS, and gaps are left in communication.
For example, cases have been reported where the alert settings for information on water depth and draft have been wrongly entered, with the mistakes not noticed. As a result, the alert was not issued, the vessel entered shallows which were not navigable and grounded.

Masters, Officers and other Bridge team members must not forget the basic aim of BTM which is to establish good communications with each resource and to prevent errors due to gaps in communication.
Show Figure 22 and 23 : the image of Bridge Before/After ECDIS

Figure : 22
Before ECDIS introduction

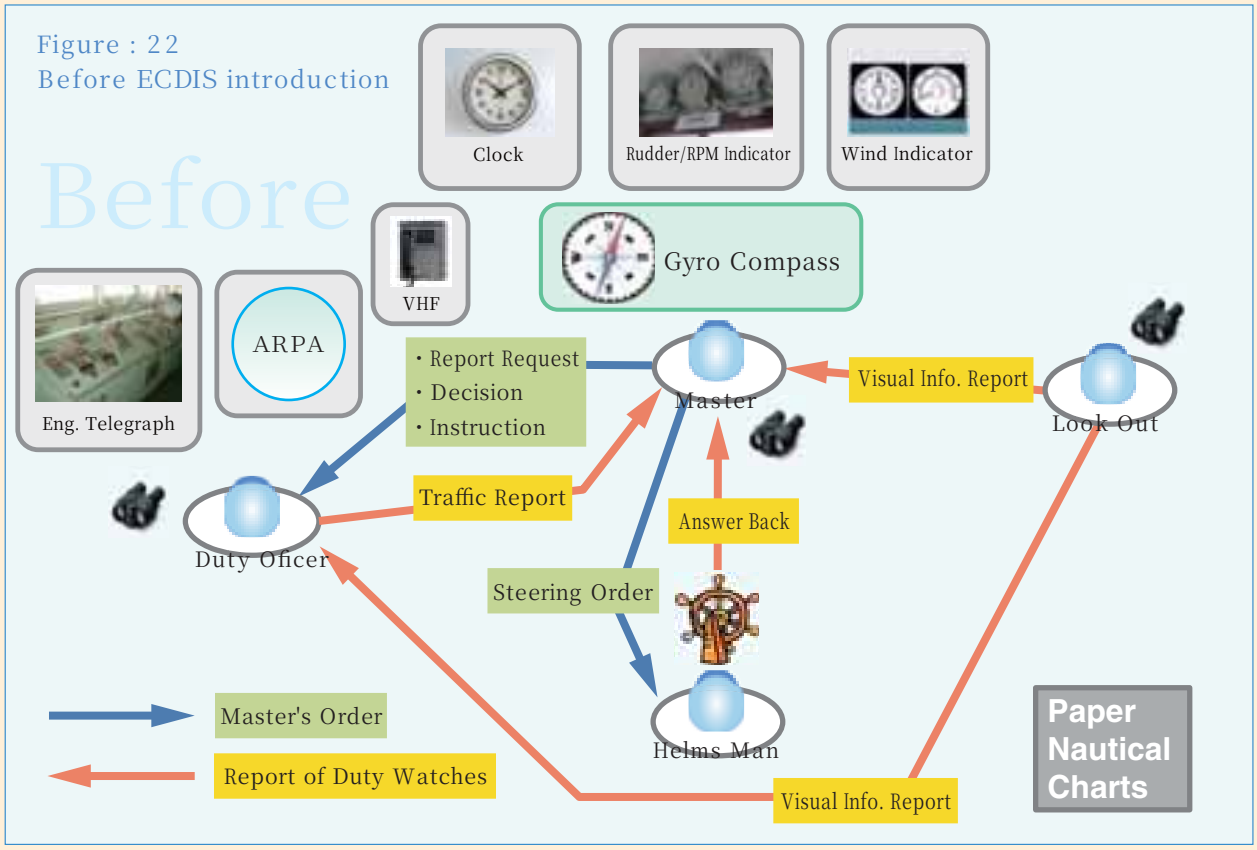
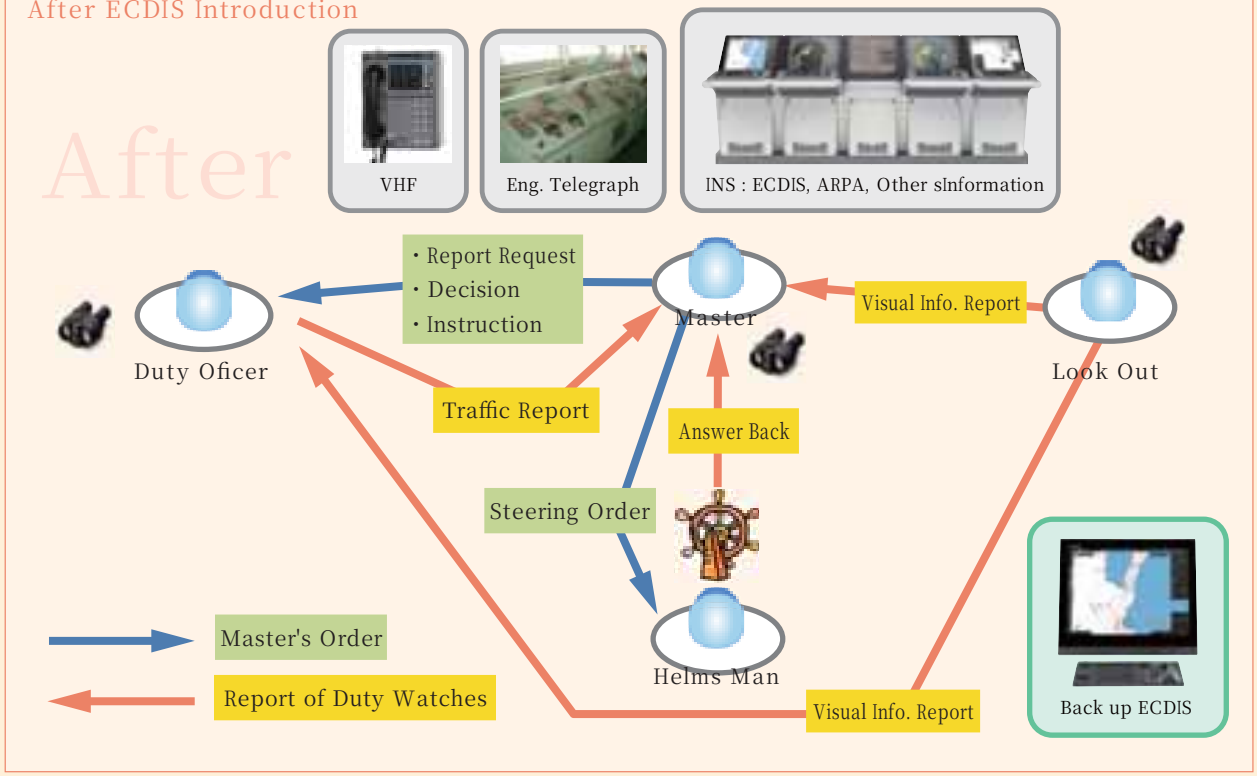


Figure : 23
After ECDIS Introduction



5－4　ECDIS Information Management

Many Electronic Chart Display and Information Systems (ECDIS) that have been fitted so far use Windows XP as the basic software. Anti-virus support for Windows XP has now ended, and it appears to be vulnerable to computer virus attacks.
For example, data on the route plan is sometimes stored on personal USB devices. But to keep ECDIS safe from computer viruses, it is necessary to send text messages to the crew to inform them not to upload data from their own USB devices, and to formulate provisions for Safety Management Regulations.

Conclusion

ECDIS has significantly changed conventional navigational watch-keeping methods, and may arguably be termed as a navigational watch revolution.
However, Master, Officers and other Bridge team members must understand that trouble will not be far away if they make a single mistake when evaluating the information displayed by ECDIS or using ECDIS without completely understanding the ECDIS configuration.

In any case, as their dependence on such a convenient system increases, they must not forget that since the information being displayed is a digital display. If the team blindly accepts the displayed numbers, and does not continuously monitor them or compare them with the information obtained from other nautical instruments, and as a result makes a wrong judgement, the trouble caused will have a much larger impact on safe operation than the trouble caused by mistakes using other nautical instruments. Masters, Officers and other Bridge Members must also not forget that there may be sudden IT troubles such as the screen hanging or a sudden shut-down of the system, as experienced with PCs and other electronic devices.

As described in 5-4 ECDIS Information Management, it is a “person” whose actions end up introducing viruses into a computer system. Hence, one must also build methods to prevent the invasion of these computer viruses.
Further, it is necessary to remind ourselves that lookout is the basis of the navigational watch, and the Bridge members using ECDIS must have complete knowledge of the system and pay close attention to it.