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Review Article

## Integrated maritime picture for effective domain awareness

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### Abstract

According to the IMO (International Maritime Organization) MDA (Maritime Domain Awareness) is defined as “Effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment”. As per the geography, more than half of the countries in the world map are littoral states. Hence, Maritime Domain Awareness is a great concern of many states, as described by Bateman in his writing “Solving the “Wicked Problems” of Maritime Security”. However, incidents that are reported in maritime environments are evidence that the security and safety of the maritime environment are causing serious influence on the national security of states. Hence, maritime security has become a great concern of littoral and non-littoral nations, and action has been taken to have effective maritime domain awareness.

Even though the maritime environment is far from human occupation, each and every bit of ocean environment is monitoring by many agencies for their own interests. This was proven in the incident of Malaysian airliner MH370, showing the intensity of monitoring of the maritime environment and the international air space. However, in contradiction, exploitation of the sea for illegal activities are also increasing day by day, and drug trafficking, human smuggling, and human trafficking are some of the top listed criminal activities taking place in the maritime environment. Even though the capability is such to monitor the ocean mass effectively, sea routes have become the main supply routes of drugs and narcotics. The real cause for this situation is poor coordination among national and international organizations for information sharing on maritime picture. In the absence of such mechanisms, monitoring stations operate independently to obtain what they are interested in and, as a result, none of them obtain a complete picture of the domain. Using this background, this paper discusses an effective mechanism to integrate monitoring mechanisms for a complete maritime picture.

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## 1. Introduction

According to the IMO (International Maritime Organization), MDA (Maritime Domain Awareness) is defined as “Effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment” As per the geography, more than half of the countries in the world map are littoral states. Hence, Maritime Domain Awareness is a

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great concern of many states (Bateman, 2011). However, illegal activities that take place in global maritime environments confirm the presence of gray areas in maritime surveillance, and those gaps are exploited by interested parties for unlawful activities. As an example, Indian fishing boats poach in the Sri Lankan waters of Palk Strait (Wjegunaratna, 2012), maritime piracy operating off the East African coast, and illegal immigrant issues in Australia are some of the current global maritime issues (Kariyakarawana, 2013). Further piracy, maritime terrorism, drug running, human trafficking, and gun running are the top listed global maritime issues, and these are considered as non-traditional maritime security threats (UN Doc. A. CONF. 169/15/Add.1 1995).

Developments in the IT sector have been significant in the last 2 decades and have caused revolutionary changes in the fields of information and communication. Even though the maritime domain is far from many human activities, action has been taken to monitor each and every bit of ocean mass by many developed nations. Due to the high cost factor, obtaining such comprehensive maritime pictures is a dream for many developing nations. Ocean mass has become a busy place with the recent development of international trade, maritime transportation has become the number one means of transportation and, as a result, large number of ships and craft are operating out at sea round the clock.

Finally with this larger presence at sea maritime domain has become busy and vulnerable. Hence, effective monitoring on the maritime environment, and the collection and sharing of information, has become a priority security concern. Developed nations are using advanced technologies for Maritime Domain Awareness but, due to the cost factor, these systems are not affordable for developing nations. Hence, Maritime Domain Awareness has become a huge challenge for developing nations and, to deal with the demand, managing with available systems is the only option. But poor coordination among agencies for collaborative maritime pictures for a wide range of information is preventing possible solutions. With modifications for available systems, these can be integrated, and the range of information can be enhanced. To understand how this can be achieved, consider the following example.

AIS (Automatic Identification System) in merchant vessel tracking and management and VMS (Vessel Monitoring System) in fishing boat management are 2 remote sensing Maritime Domain Awareness systems which give real time maritime pictures for 2 different interest areas for effective decision making (Russell, 2014). Integration of these 2 different interests to a single platform is the core concept of this paper. Further, these basic platforms can be updated with additional inputs from various sources, such as long range radars, aerial vehicles like UAV (Unmanned Aerial Vehicle), and through naval deployments.

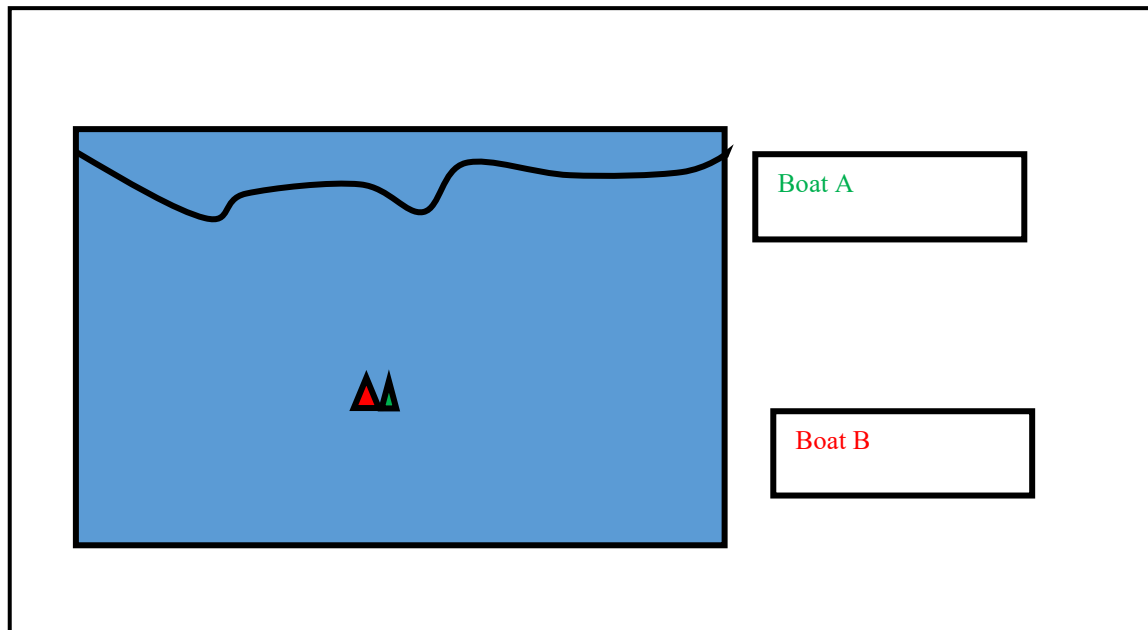
## 2. Problems in integration

Integration is not that complex with modern technology; however, the main problem in integration is the different interests among users and the lack of understanding of the benefits of integration (Caballero & Emmers, 2006). Hence, the negative attitude towards integration and prioritization of individual interests is the great barrier to cross. Other limitation is most of the systems that provide maritime picture are for commercial purposes and, hence, monetary objectives and the cost factor is also a barrier to cross. Above all, individual interests will cause isolation, and segmentation of information will avoid a complete maritime picture. These limitations are allowing free environments for illegal acts to take place out at sea. As an example, stakeholders who are interested in merchant shipping will monitor only shipping movements by AIS, and departments of fishery may focus on fishing boats movements on VMS. Finally, both organizations monitor the same maritime domain from 2 different locations for 2 different interests on 2 different monitoring platforms, and will get a partial maritime picture on what they are interested in. Neither of them will get a complete maritime picture, due to individual interest.

Effective utilization of available systems to get complete the maritime picture to ensure the security of the maritime domain is the concern of this paper. Security is a broader perspective, and

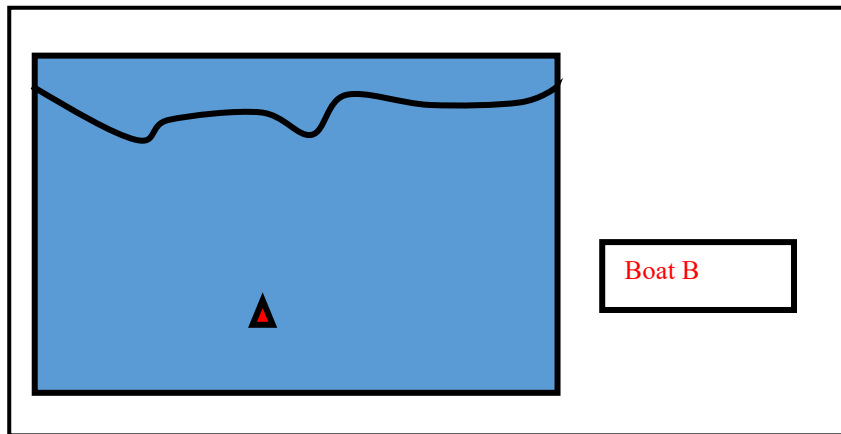
the national security of a state is prime concern and must give due care for it. In this case, if developing countries can manage available resources to optimize the national security requirements, it would be a great relief to the respective governments. Hence, integration of existing monitoring mechanisms to achieve optimum results is the best option, as cost is a concern for sophisticated systems. Merging different sources of information to get a complete maritime picture for a greater range of information is the principle behind integration. AIS, VMS, long range radar, satellite radar, and satellite images are some of the individual sources of information in the maritime picture. Sources of information and the maritime picture on a present position indicator (PPI) is called a layer of information. Integration of the individual layers into one display or PPI for a wide range of information, in order to have a complete picture of the maritime domain, is the concept of this paper (**Figure 1**).

To understand the concept of integration, the following hypothetical situation will be explained. Initially, a situation of a mid-sea transfer by 2 trawlers fitted with VMS will be illustrated as follows (FAO 2010 - 2016, VMS). The VMS monitoring station on shore will see the boats' movements as indicated, because both vessels are fitted with onboard VMS, and the shore station can monitor their movements. Hence, the possibility of an illegal act is minimal unless the system is switched off, and switching off the system at sea is an offence.



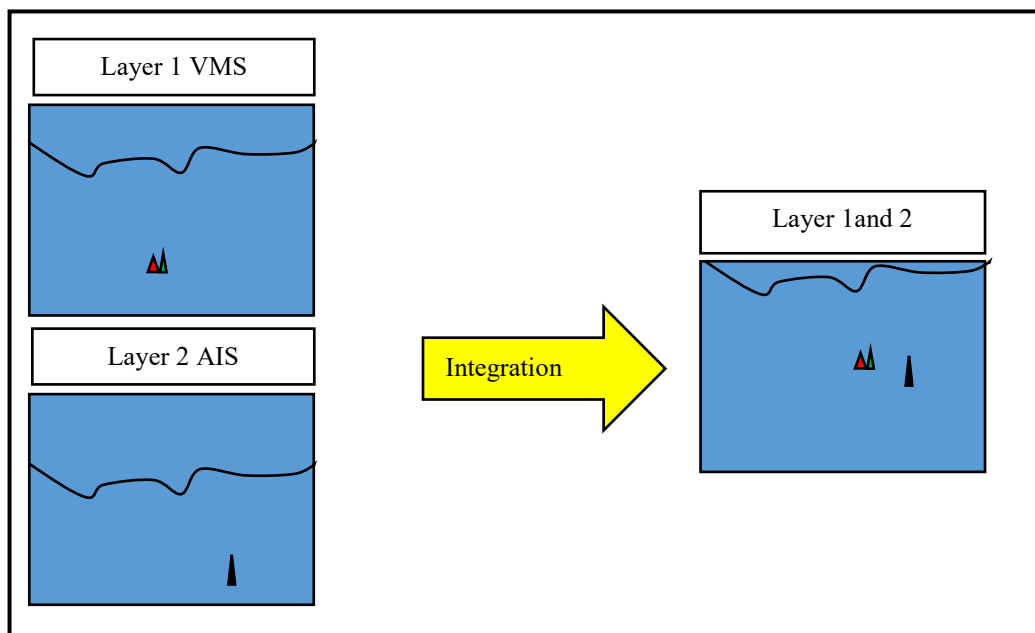
**Figure 1** Appearance of VMS monitoring station PPI.

Assume the situation where one of the fishing boats was not fitted with VMS; then, the picture will appear on PPI at the VMS monitoring station as depicted in **Figure 2**. The monitoring station will receive the picture as only one fishing boat is at sea, and it is a completely false picture. These kind of situations provide misleading information and give opportunities for criminals and their illegal acts at sea (Swanstrom, 2010, pp. 35-51). Unless there is another source of detection, a completely false picture will be received by the recipient.



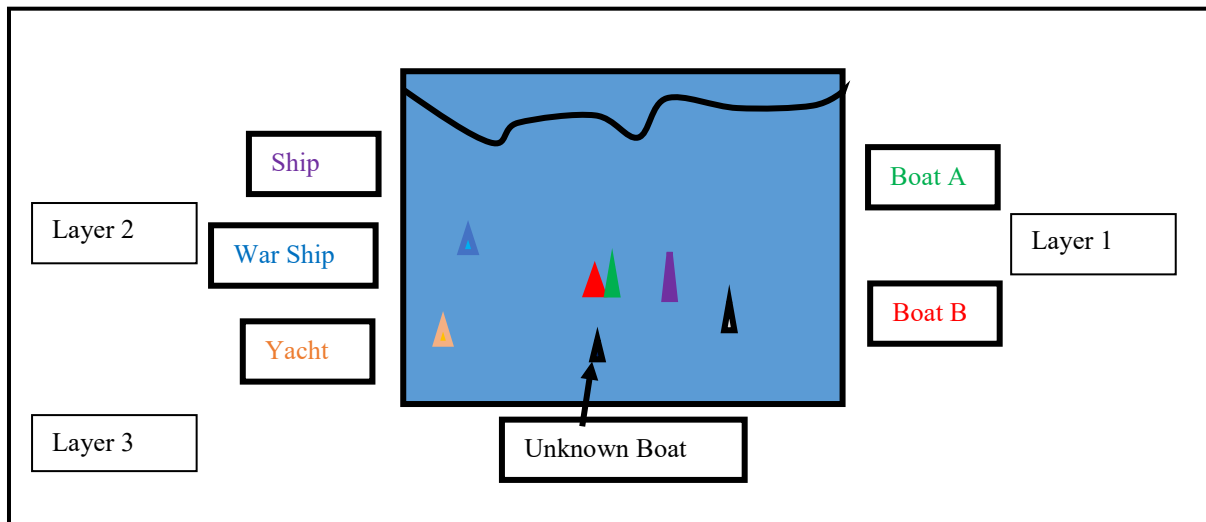
**Figure 2** Difference between PPI picture and real picture.

It is easy to understand that sometimes the picture from the system and the actual picture of the maritime environment may have contrasting differences, and these gaps can be exploited by interested parties for unlawful acts. These information gaps can be potential threats to maritime security and, finally, to the national security of the coastal states. Further, take another situation; a merchant vessel is operating nearby these fishing boats. In this situation, VMS will not detect any of the movements of the merchant ship, as VMS cannot detect merchant shipping or merchant ships that are not fitted with VMS onboard. For monitoring merchant shipping, AIS is fitted onboard merchant ships, and port authorities regulate their movements. In this situation, fishery monitoring stations will not see the presence of the merchant ship near the fishing boats and, in the same way, shipping regulatory bodies will not detect the fishing boats operating near the ship. The reason is that 2 government bodies are monitoring the same maritime environment for 2 different interests. Finally, neither of them are obtain the real maritime picture, due to the individual interests. These gaps are already exploited, and this is the reason for increased maritime crime. The situation is explained in **Figure 3**. If both VMS and AIS layers are received by one platform, a broader range of information will be provided in order to understand the real situation in the domain.



**Figure 3** VMS and AIS integrated picture.

In addition to these layers, the range of information can be increased with the number of layers added to the system. As an example, if a satellite radar picture is merged with the existing picture, it may provide additional information on the particular area which VMS and AIS will not provide. As an example, assume a war ship and a yacht are operating in a given area. Then, once satellite radar has been integrated into the system, additional information will be provided, and then a picture can be depicted, as follows, on the monitoring station display. As per international maritime law, each and every ship must have identification and a state flag. If any ship does not carry these, it is considered unknown and illegal. **Figure 4** explains this situation clearly.



**Figure 4** Complete maritime picture by many layers.

In today's context, no ship can go to sea without proper identification. In that security arrangement, no unidentified vessel or ship can operate in any maritime domain without a state flag or identification. If any unknown ship or craft is present in the domain, further clarification can be made by deploying state naval or air power and dealing with the situation accordingly. To have such a mechanism, precise information is required. Hence, an integration of different sources of information is required to obtain a complete maritime picture.

### 3. Recommendation

Information is an essential element of the present day context when it comes to security. Sharing information is also important, as information in isolation has no purpose. However, for various reasons, sharing information within state organizations is also significant, and this has contributed indirectly to maritime crimes at sea. National maritime security can be tightened if cooperation is there among state organizations. Hence, the recommended action plan is to develop unity among state bodies in order to share information for integration, and to establish a centralized state maritime monitoring station to ensure safe seas around the world.

### 4. Conclusions

It is a fact that 75 % of world trade is composed of maritime transportation and hence, secure seas are a mandatory requirement in global finance. Other than this, the security of the maritime environment of the coastal states has a direct bearing on their national security. Hence, a clear picture of the maritime environment in any part of the world has an impact on world peace.

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