Report on MASS trials in China

Submitted by:	China MSA
Executive summary:	This report is based on research of the development of MASS trials in China according to the work plan of MASS PT1 wp2-wp6. It concludes the data used in MASS trials, requirements of China government on MASS, research and utilization of the latest data standards.
Related documents:	MASS PT1 minutes

Introduction

The Maritime Safety Committee of IMO, at its 101st session (5 to 14 June 2019), approved the Interim Guidelines for MASS trials (hereinafter referred to as the Guidelines), and encouraged Member States to report the results of MASS trials and the experience gained to the Organization, as appropriate, for the purpose of providing the supportive evidence before the issuance of the Guidelines.

In China, the development of MASS is still far behind at its early stage. Some Maritime institutes and universities have initiated some projects and research of MASS. Meanwhile, some companies have started the works of development and trial of MASS. At present, most of the projects are being developed and on trial. Quite a few institutes and universities have put their project of MASS on trial aiming the alignment of scientific research and teaching, etc.

SECTION ONE: Summary of MASS trials platform of China

At present, two MASS trials are ongoing in China.

1.ZhiFei Hao

ZhiFei Hao, as the first autonomous container ship in China, is built by Qingdao Shipyard in June of 2021.Her particulars are as follows: displacement 8,000 tons, capacity 316 TEU, LOA 110 meters, Width 15 meters, Depth 10 meters, power-driven propulsion, speed 12 knots, endurance 4,500 nautical miles. She is on her trial along the coastal waters for container shipment and intelligent system trial.

Her trial areas are covered the coast waters of Qingdao in Shandong Provence. She sails along the typical route which departs from Qingdao port (automated container terminal) to Dongjiakou port. This integrated trial platform is undertaking the works of MASS trial development, trial verification, marine equipment industry, inspection approval and operating management.

Installed with the system of shipborne navigating assistance, ZhiFei Hao enables her sailing within three modes: man-driven, remote control, unmanned autonomous. In the man-driven mode, the navigating assistance system will provide relevant supports to the operator with surroundings identification, collision-avoidance actions, safety alert, etc.

Zhifei Hao has realized intelligent functions of surroundings identification, route tracking, autonomous route planning, intelligent collision-avoidance, automatic berthing and unberthing, remote control drive. With multi-model communication system of 5 G and satellites, this ship can coordinate with ports, shipping industry, maritime safety administrations and ship insurances for the shore-based services including production, service, dispatch control, inspection, etc.

An integrated sensing system has been applied with the S-57 ECDIS, navigating RADAR, AIS, visual light/laser equipment, wind anemometer, ship movement sensors to check and acquire the information of sailing surroundings, dynamic and static dangers etc.

2.Jing Dou Yun 0 Hao

Jin Dou Yun 0 Hao is a scale test ship designed and built in 2019 for autonomous navigation trials. In compliance with the Classification Rules issued by China Classification Society, an additional autonomous navigation system was installed on board the ship. The ship has been used for the research, development and trials of autonomous navigation system, without impairing the safety and reliability of the basic platform. At present, the ship is capable of basic autonomous navigation, such as remote control navigation, autonomous tracking navigation, autonomous collision avoidance, etc. in certain scenarios. Remote control navigation is used for berthing and departing and for the navigation in heavy traffic areas. In this mode, the ship is remotely operated from the shore, and it is mostly used for tracking navigation and emergent collision avoidance in the navigational environment when performing tasks. 500 tons, LOA 50 meters, endurance 500 nautical miles with power-driven propulsion.

To ensure the stability of cyber security and data transfer, the ship has:

A. Adoption of a designated communication protocol. B. Usage of safe internet channel within public internet. C. Internet backup equipment. D. The ship has top priority to shift to manual control onboard ship when the cyber security is threatened. E. Public internet and designated internet can be shifted as necessary, designated internet is with security packages. F. Any delay and data miss will be remedied by programming

Jing Dou Yun 0 Hao navigation system was based with S-57 ECDIS, provided with traditional sensors such as shipborne echo sounder, GPS, other data of ocean currents, tides, meteorological information, camera, etc.

The data of tides and ocean currents will be transferred in the form of electronic file or paper file

between ship and control center. the meteorological data will be collected by shipborne weather instrument and be transferred to the navigating system.

SECTION TWO: Regulations on navigating data used in MASS trial or MASS under operation operating issued by national regulators

The national regulators in China is at her early stage of the research on navigating data during MASS trial or MASS under operation operating process. The summary is as follows:

Rules for intelligent ships 2015 was issued by CCS, which is in accordance with IMO instruments on MASS and practices on the application of MASS Guidelines. In 2020, guidelines for autonomous cargo ships were issued by CCS, with the amendments of remote control ships and autonomous ships with their clear functional requirements. The guidelines 2020 specify six functions: intelligent sailing, intelligent hull, intelligent engine room, intelligent energy efficiency management, intelligent cargo management and intelligent integration platform. The guidelines is the first guidelines for intelligent ships in the world, which is written in the format of GBS. It includes specific aspects of intelligent ships: the objectives, the functional requirements, the verification requirements, etc. The guidelines specify the annexes and functional symbols of intelligent ships to provide the supports and evidence for the registry of intelligent ships in the near future.

2.3.2.4 in open waters, the autonomous ships are capable to sense and acquire the following information at all times, for her autonomous sailing：

(1) live weather data en route：

① wind force, wind direction；

② visibility at sea.

(2) ship live information：

① position, speed, course；

② ship motion，including but not limited：roll, pitch, yaw；

③ port&starboard bow/beam/quarter drafts

(3) AIS data of objects at sea；

(4) update of ECDIS；

(5) live information of other objects at sea：

① other ships: positions，course，speed, size, actual distance, bearing, sailing signals and status；

② other fixed dangers and mobile objects.

(6) actual depth of water at ship's position

For the fully autonomous ship, besides of the situational awareness of 2.3.2.4, she is capable of capturing the following information for her navigation:

(1) live awareness of the distance and bearings from ship's bow and stern to the shore.

(2) tides, currents speed, currents set and other information related within the port and fairway.

In particular, it is clearly specified the ECDIS data and updates, tides, currents speed, currents set and other information related within the port and fairway.

In November,2021, CCS drafted technical guidelines of MASS trials(drafted) and Test Areas regulations on MASS trials(drafted). For technical requirements, they specify the sensor system of ship movement shall include but not limited to the information of position, heading, radar, charts, speed, AIS, etc. All these sensors shall meet the requirements of IMO instruments. Other sensors are also applicable including camera, laser radar, etc. On the control panel, the following information will be displayed:

data source of live position, course, speed

sensor information: position, course and speed

planned trail(including collision avoidance),displayed on charts or in other forms or images

wheel order, rudder angle

TCPA , DCPA

Dangerous targets, will be plotted on radar, for instance.

SECTION THREE: China practices on MASS trials

China MSA are promoting the research and development of MASS, and coordinating the MASS trials nationwide. CMSA, CCS and Yunzhou Intelligent organized the trial of the IMO Guidelines in China and report the trial experience and practices.

With the cooperation of CMSA, Zhifei Hao was started to be on trial and Jingdou Yun 0 Hao started her trial as an unmanned intelligent ship. CMSA has completed the MASS trials report and submitted to IMO. The proposal covered sorts of intelligent technology elements including remote control, autonomous tracking navigation, autonomous collision avoidance, etc. The recommendations included trial risks assessment, infrastructure, manning and qualification on trial, communication and data transfer, sailing symbols and marks, information sharing, safety and security liabilities, etc. The report has provided a practical evidence for further revising and improving the Guidelines. Meanwhile, it laid a solid stand for regulation system of safety sailing of MASS and explored the possibility of the commercialized operation of MASS .

SECTION FOUR: Summary on Data supply to MASS from China Hydrographic Office &New standardized navigating data for MASS(S-100 etc.)

At present, the MASS trials in China are established on ECDIS with S-57 format, integrated with tides, currents, weather data as reference for MASS navigation. China Hydrographic Office provides

the S-57 ECDIS, tides and currents data in digital form.

In the recent years, China is tracking the new navigating data standard-S-100 and its progressing research. The prototype of the data cluster including S-101, S102, S124, S127 is being developed and testing, ECDIS with high-density depth contour is of trial production, and it is being tested in designated areas with the alignment of E-navigation. S-100 trial platform is still on an early stage, the existing ECDIS has no compatibility of S-100 standardized data. As a result, the trial data is not applied into the MASS trials for the time being.