MARITIME SECTOR

Executive Summary:

This paper presents an overview of Autonomous Shipping as the fourth shipping revolution. It further depicts the effort of International Maritime Organization(IMO) defining the regulatory sequence necessary for the implementation of Maritime Autonomous Surface Ship(MASS) starting from the year 2020. It examined and explained some intrigues, MASS taxonomy, as well as contemporary issues and provides insight into various autonomous vessel projects being currently in progress. However, it emphasis the place of human involvement and competence gap needed for future autonomous vessel operations as well as the impart of 'MASS' on the Coastal Shipping vis a-vis Local Content promotion within West Africa sub-region, with Nigeria as a reference.

Maritime Autonomous Surface Ship (MASS):

The 4th Shipping Revolution; Impart on Maritime Cabotage Human (Seafarers)Competence Development

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Contents

1). General overview of Autonomous Systems, Age of ''Artificial Intelligence'' Revolution,

2). Autonomous Ship System; The Fourth Shipping Revolution

3). International Maritime Organization (IMO) Autonomous Ship level of Implementation

4). Ship Autonomy: Current Major Projects in Development

5). The Degree of Human (Seafarers) Competence Development (Research area)

6). IMO Implementation: Coastal Shipping (CABOTAGE) in West African-Nigeria

7) Offshore, Local Content & Competence Development

1). General Overview of Autonomous System, Age of ''Artificial Intelligence'' Revolution

The current revolution system: The **''Fourth Age''** is regarded as '**Artificial Intelligence Age'** characterised with the ''fusion of technologies''(5TH Age) that loops between the physical, digital, and biological sphere (Ballantyne, Cheung and Morgan, 2017)

S/N	Period	Energy resource	Civilization Stages	Age Period Term	Shipping Industry	Period Ahead
1st					Sailing to Steam Ship	Energy discovery & utilization
2nd				Industrial	Internal Combustion Engine-vessel	Energy Reduction
3rd			Computerization	Information	Electric, gas vessel and EDI, Automation phase	Manned Ship-Emission reduction-Green Ship
4th	2000-	Green Energy: Electric & Battery	Digitalization & Internet of a Thing (IoT)	**Artificial Intelligence**	**Advance Automation - Sensor Control System**	Remotelly controlled, Semi-Autonomous Ship vision 2020
5th		Complete Renewable Energy	Robot & Autonomous	***Smart & Fusion***	Remote controlled-Autonomy	Fully, Autonomous Ship vision 2035

1). General Overview of Autonomous System, Age of ''Artificial Intelligence'' Revolution

- **Fourth Age Revolution: Place of Artificial Intelligence**
  - Is this really coming?
  - Is this changing our system of work?
  - inclusive of transport modes?
  - Well !!!, West African Countries, Nigeria may not be affected?
  - Digitalization is a transformational process & model due to digital changes and possible disruption

CND : General Overview –
Artificial Intelligence(A I)

- **Artificial Intelligence (AI)** can learn from the previous situation to provide impact and automate complex future decision making process, making it easier and faster to arrive at concrete conclusion based on data and past experiences (Schwab, 2015).
- **Ship Autonomy** or 'Autonomous and Unmanned Ship' **will change the conventional methods for designing, retrofitting, testing, classification and regulatory approval** for ship and their systems .

2). Autonomous Ship: The Fourth Shipping Revolution (Shipping 4.0)

- Terminologies:
  - Maritime Autonomous Surface Ship (**MASS**),
  - Waterborne Surface Vehicle (WSV)
  - Auto-Ship,
  - SMART-Ship,
  - Digital -Ship,
  - Unmanned Surface Vehicle (USV)

- However, IMO termed the autonomous ship as **MASS** which seems to be the common terminology that will be used frequently in this paper and subsequent research.

CND 2. Autonomous Ship System:

Comprises of two folds *in all discovery at the moment.*

Designed Operating Domain-DOD

- that is- Driving Task or the Vehicle with following attributes,

Co-operative System Functionality- CSF

- that is DOD system support functions.

CND: Autonomous Shipping: Benefits and Challenges

Benefits

- It reduces human error
- Reduce environmental impacts of CO2 emission
- The Cost benefits
- Reduce accident
- Increase freight earning for profitability
- Create another job opportunity and with a high level of competence
- Occupational risk reduction
- Economic Growth

Challenges

- Accountability & Liability Application:
- Cyber-Security & Hacking possibility
- **Human Element / Remote Operator and Shore Control Centre**
- Regulatory Frameworks & governance
- Failing out of Algorithms
- Trust-how to trust data & Data Management
- Job losses for the unskilled
- Accountability- who is responsible, fiduciary right,
- Failing foul of the algorithm

3). International Maritime Organization (IMO), Autonomous Ship's 'Level of Control' for Implementation

- IMO through its Maritime Safety Committee (MSC) has identified four **Regulatory Control level** for '**Maritime Autonomous Surface Ship' (MASS)** :

  - **Level 1:** Ships with automated processes and decision support: seafarers are on board to operate and control ship port systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control. (2020 target).

  - **Level 2:** Remotely controlled ship with seafarers on-board: the ship is controlled and operated from another location. Seafarers are available on-board to take control and to operate the ship board systems and functions.

  - **Level 3:** Remotely controlled ship without seafarers on-board: the ship is controlled and operated from another location. There are no seafarers on-board.

  - **Level 4:** Fully autonomous ship: the operating system of the ship can make decisions and determine actions by itself.

Look- Ahead, Target Years

- Rolls Royce has set target year for accomplishing the full level of Autonomous Ship operations

S/N	Level	Target year	Scope
1	One	2020	Remotely controlled operated local vessel, with reduced crew and remote support operations of certain function (SMART Ship equipment).
2	Two	2025	Remote Controlled Unmanned Coastal Vessel
3	Three	2030	Remote Controlled Unmanned Ocean-going Vessel
4	Four	2035	Complete Autonomous, Unmanned Ocean-going Ship

4). Ship Autonomy: Current Major Projects in Development

Project Name	Project Lead/Initiator	Vessel Type	Trade Area/Sea Lane	Classification Society	DimensioN		Cargo Capacity
Yara Birkeland	Rolls Royce (UK)/Konsberg	Container Vessel	West Coast & Coastal	DNV GL, LR	80m X 15m X 5m	Build	120TEUs
Revolt	DNV GL	Multipurpose	Coastal (100nms)	DNV GL	60.23m X 14.5 X 4.8m	Build	100TEUs
Hronn	Bourbon	OSV	Offshore, High Sea	DNV GL	X X..X.. X 5	Build	
SeaZip3	SeaZip & 17 partners	Crew Supply Vessel	Offshore	Bureau Veritas	26m X 10m X 2m	Conversion	167tons
PSA Polaris	Keppel & MPA-Singapore	Harbour Tug	Harbour area		27m X 11M X 4.9M	Re-trofitting	65tons

5). The Degree of Human (Seafarers) Involvement & Competence Development -Research Area

- The research investigates the human competence and the degree of interaction between **Designed Operating Domain (DOD) and Co-operative Functionalities (COF)** i.e Shore Control Centre; MRCC/GMDSS; Local Port functions; VTS, Pilot, linesmen, Data Centre & Emergency Preparedness.

6).IMO Implementation: Near Coastal Shipping (CABOTAGE) IN West Africa-Nigeria)

- How do we prepare for IMO Autonomous Ship Implementation?
  - Focus on Human and Regulatory functions.
  - Need research team to partner with specialist Institution.

- What are the Likely Imparts & Opportunities ahead?
  - Impart: It may shape, our Cabotage & Local Content Programs, Policies, and Promotions.
  - Opportunities like;
    - Robust Data Centre capable to support Autonomous Ship for West Africa
    - Future Shore Control Centre (SCC) with VTS centre , shore sensor /A.I .
    - Identify suitably possible area/lane for future autonomous OSV operations.

7) Offshore, Local Content & Competence Development

Offshore, Local Content Promotion

- To prepare for A-OSV at our Offshore; Oil & Gas sector.
- Bourbon Autonomous OSV- Hronn project. if ROV works, then A-OSV might not be too far away from West Africa .

Competence Development: Education & Training

- Implication for maritime training and preparing for future competence requirement (next 5-10years).

End & Questions

- **It will be naive to claim that we know exactly where the fourth industrial revolution is leading us to. But it would be equally naive to be paralysed by fear and uncertainty about what that direction might be.**

  (Schwab, 2015, Komianos, K. 2018, ICS/HBS 2018, Stopford, M. 2018, Daemmrich,A.2017)

- However, where it will lead, would ultimately be determined by our ability to shape it in a way to unleashes its full potentials.

Appendix

- Norwegian Forum of Autonomous Shipping (NFAS) has proposed four operational levels for **Maritime Autonomous Surface Ship' (MASS)**

1). Decision Support;

- for today or tomorrow advance ship type with relatively advance anti-collision radar, and navigational system requiring direct command of the ship operations.

2). Automatic, but monitored (Onboard or SCC);

- The ship uses artificial intelligence (AI) or advance automation (A.A) to monitor the ship operations pre-programmed sequence and will require human intervention at a point within voyage,
- ship complete certain leg of voyage without human interaction with the aid of A.A
- Initiate remote or direct control when needed.

3). Constrained Autonomous (with SCC);

- The Ship can operate fully automatic and solve some problems like collision avoidance, but require human to intervene in deviation or emergency and continuously supervises the operations.

4). Fully Autonomous- the ship handles all situations by itself, well unlikely scenario.

- (ICS, 2018) If a navigator can use ECDIS and receive added decision data making input (e.g weather, currents & dynamic position system) which has transform the process due to digital changes, then, is called **Digitalization**

- Generally speaking, the more variations and complexity the mission has the more the ship will have to rely on operators assistance & remote control at lease in the first phase of the implementation **(AAWA)**