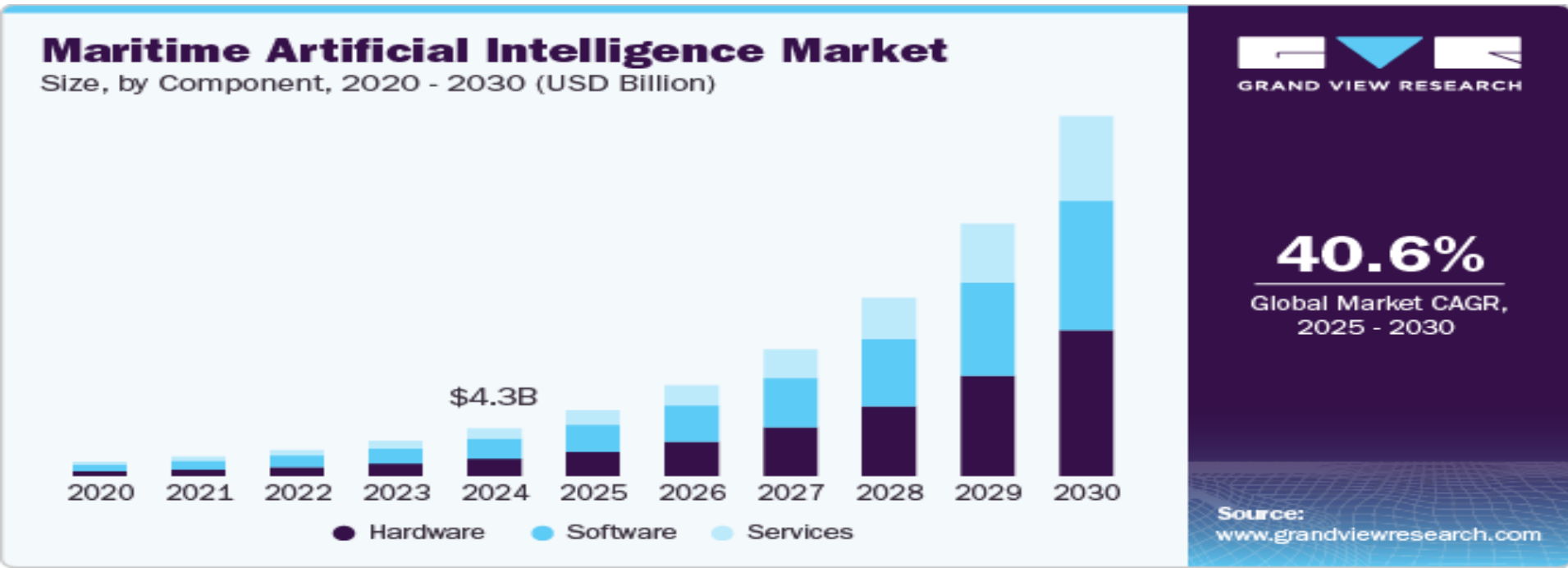


Maritime CyberSecurity under Artificial Intelligence

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Maritime Artificial Intelligence Market Trends 2025-2030

- The global maritime AI market size was \$4,32 billion in 2024 and is projected to grow at 40.6% Compound Annual Growth Rate from 2025 to 2030.
- This growth is driven by the increasing need for operational efficiency, improved safety, and environmental sustainability.
- AI applications in maritime are diverse and impactful.



Autonomous ships with Artificial Intelligence is the cutting edge technology of the future in shipping.

Phaeacians agree in that with their ships that are navigated by the mind, according to **Homer in Odyssey Θ 557-563**:

ὄφρα σε τῇ πέμπωσι τιτυσκόμεναι φρεσὶ νῆες:
οὐ γὰρ Φαιήκεσσι κυβερνητῆρες ἔασιν,
οὐδέ τι πηδάλι' ἔστι, τὰ τ' ἄλλαι νῆες ἔχουσιν:
ἀλλ' αὐταὶ ἴσασι νοήματα καὶ φρένας ἀνδρῶν,
καὶ πάντων ἴσασι πόλιας καὶ πίονας ἀγρούς
ἀνθρώπων, καὶ λαῖτμα τάχισθ' ἄλός ἐκπερόωσιν
ἠέρι καὶ νεφέλη κεκαλυμμένα: οὐδέ ποτέ σφιν
οὔτε τι πημανθῆναι ἐπιδέος οὔτ' ἀπολέσθαι.
ἀλλὰ τόδ' ὥς ποτε πατρὸς ἐγὼν εἰπόντος ἄκουσα

so that our ships may take you with their meditations; for we Phaeacians do not put captains or rudders on our ships, as is found in the ships of others; whatever we think, whatever we want, they only find for them, and knowing all the people and fertile fields and cities, they swiftly cross the breadth of the sea, wrapped in clouds and mist, and where they have no fear of sinking or of suffering any damage.

CyberSecurity

A very important issue in autonomous ships is CyberSecurity, especially if the ship depends exclusively on technology and the internet for its journey.

Protection against cyberattacks must give full coverage to the shipowner to invest convincingly for the operational security of the autonomous ship.

CyberSecurity will be enhanced with AI supporting:

- 1) Real-time monitoring,
- 2) Predictive threat analysis, and
- 3) Automated response,

Weaknesses are the malicious:

- 1) AI-powered cyberattacks and
- 2) Manipulation Risk to AI systems by adversarial attacks.



Applications

- 1. ShipIn:** AI-Powered Maritime CCTV to Protect your Crew and Cargo
 - 2. SEA.AI:** alerts crews early and reliably about objects on the surface of the water.
 - 3. ClearSkies:** Centric AI-TDIR Platform, moving faster than the AI-threat, empowers SecOps to detect faster, adapt smarter and ensure operational continuity.
- ...

Advantages of AI in maritime CyberSecurity

- 1. Real-time threat detection:** process vast data, quickly identify anomalies in network traffic: cyberattack indication
- 2. Predictive analytics:** historical data analysis, predict potential security breaches before they happen, allowing companies to take pre-emptive action.
- 3. Automated response:** to mitigate threats instantly: isolate a compromised system, minimize damage, prevent the spread of malware.
- 4. Enhanced monitoring:** vessel movements, port operations, identify suspicious activities cyber-intrusion

Risks of AI in maritime CyberSecurity

- 1. AI-powered attacks:** Cybercriminals can use AI to automate and accelerate attacks, making them more efficient and harder to detect.
- 2. Adversarial attacks:** Attackers can manipulate the data inputs to AI-driven security systems, causing them to misidentify threats or ignore malicious activity.
- 3. Overreliance:** A growing digital divide exists where some systems rapidly integrate AI, while others lag behind, creating larger vulnerabilities.
- 4. Vulnerability of systems:** Many maritime Operational Technology (OT) systems are outdated and lack modern CyberSecurity protections, making them attractive targets, especially when integrated with AI.

Strategies for a secure future

1. **Robust CyberSecurity:** strong protocols, regular assessments protects against traditional & AI threats.
2. **Human-AI collaboration:** ensures human oversight and proper training for mariners to work alongside AI.
3. **Ethical development:** prioritize considerations in AI development and use unbiased data to ensure responsible deployment.
4. **Regulatory frameworks:** Develop comprehensive regulations to address AI-specific challenges in clear accountability.
5. **Continued innovation:** integrates new technologies: blockchain and quantum cryptography to strengthen maritime CyberSecurity frameworks

Autonomous vessels as i) Yara Birkeland, first fully electric autonomous container ship, and



ii) Mayflower Autonomous Ship, AI navigates complex routes, minimum crew, least error, & maritime accidents.



CyberSecurity in processes:

- AI predictive maintenance, sensor data analysis, equipment failures prediction, proactive maintenance, minimizes downtime and costs:

Rolls-Royce and Wärtsilä: AI monitor ship components optimize maintenance, extend vessel lifespans.

- AI optimized routes, analysis of: weather, traffic, fuel consumption, determine efficient and safe routes, reducing fuel consumption and emissions, boosting delivery time.

Network issues-Two general trends:

Global maritime was left behind in i) IT and ii) New Technologies-NT, the difficulty of providing an adequate internet connection on vessels was a burden

Starlink is a solution emerged the last couple of years, but expensive for the vessel/mariners

AI is resolving traditional problems in shipping: minimizing human errors, costs, increasing efficiency on condition

AI system stores the entire maritime experience
eg, avoid making the same mistake a captain
made 20 years ago led to an accident-humans
cannot have all this knowledge accumulated in
his mind.

Expensive cost of the first autonomous ship, but
will be reduced due to economies of scale and
reduced personnel: operational cost.

Two major scenarios in ships:

i) Autonomous

ii) Semi-autonomous

Ships with various levels of automations in the Bridge, Engines, Ballast, Communications, Fuel system supervised remotely by companies' offices

The profit margin of this scenario is very important for the shipowners, it will reduce today's operational cost of crews during the voyage

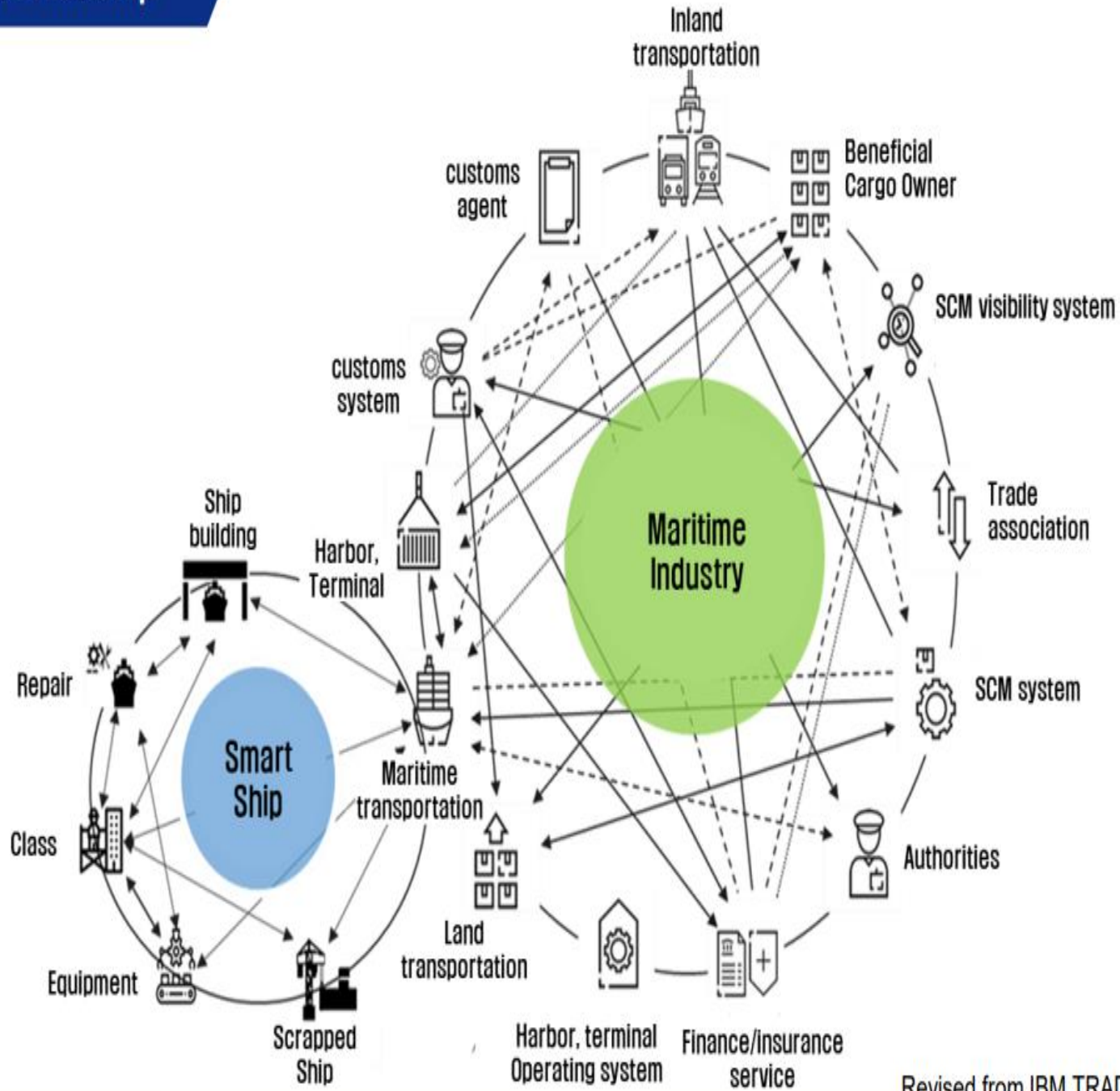
Autonomous Ships:

Not certain if fully autonomous ships will be to dock in ports, load & unload without humans.

There is no significant economic incentive to implement such a method.



Ecosystem of Smartship



Legal & Regulatory Restrictions, Allocation of responsibilities in case of accidents or other unforeseen situations in autonomous ships:

Who will assume the responsibility of the Captain?

Countries will initially define laws and regulations, until there is a global consensus (e.g. IMO) on certification of systems and overall management of autonomous ships.

