

of technologies, will become crucial. Equally important is developing skills to troubleshoot and repair systems during failures, thereby nurturing a growing reliance on advanced information systems. It is also recommended that a technology sector specialist be an integral part of the team, both onboard and in the ROC.

Seafarers and ROC 's operators will also need to be adept in new risk management, equipped to handle a range of challenges that are different in nature from traditional issues. These include navigation problems, collisions, fires, emergencies, and system outages, which could be complex in more technologically oriented workplace.

Overview: the current situation

The shipping industry is sailing ahead of regulatory bodies. Countries renowned for their shipyard capabilities and technology, such as Norway, Finland, Korea, Japan, and China are directing funds toward the development of intelligent maritime systems, revolutionising the sector. A considerable number of autonomous ships are already operational within national jurisdictions. However, this indicates a gap between the regulatory framework for autonomous ships and

their actual implementation. For instance, the current International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) does not explicitly address these technological shifts. It is expected that in 2025, the STCW will undergo revisions through a MASS Code to address the required training and competencies of seafarers for advanced maritime operations. The IMO is also developing a non-mandatory goal-based MASS Code for the design and operation of autonomous ships. In this scenario, there is a noticeable disparity in pace between the industry's rapid advancement and the slower progress of the IMO, highlighting the need for the IMO to strategically realign itself to synchronise. Achieving a successful coexistence of autonomous and manned ships in national and international jurisdictions requires a critical balance and harmonious integration of human expertise with technological capabilities.

Lessons from COVID-19

The COVID-19 pandemic was a harsh lesson. It caught us off guard, drastically changing our work and lifestyles, and accelerating our reliance on technology. This pandemic forced us to adapt and reassess our roles and skills, which

are continually being reshaped by technological advancements. Similarly, the trends in digitalisation and decarbonisation are having a comparable impact and are transforming our society and the world in unprecedented ways. We are already witnessing significant progress in remotely operated, autonomous, and green shipping systems worldwide. However, we must not overlook the human element amidst this technological evolution. The users of these sophisticated systems are crucial, and the technology-driven workplace is creating a need for a new breed of workforce, one capable of operating advanced technical and technological systems.

We should keep in mind that the shipping industry has historically evolved and adapted to change and will continue to do so. As we move towards future shipping, it is recommended that all maritime sectors design and develop a human-technology synergy roadmap. This roadmap should aim to decode their requirements in this evolving technological landscape, turning challenges into opportunities. This approach will ensure a smooth and efficient transition into the future of shipping, maintaining harmony between technological advancement and human expertise. ▲

Backgrounder: robot shipping and seafarers

In a world where industries are competing to embrace digitalisation, the shipping industry, known for its passive nature, is positioning itself to embrace this revolutionary shift. This gradual but inevitable transition towards a more technologically orientated future is a natural progression for the industry that has historically evolved through different Industrial Revolutions. In shipping, the transition began with moving from sail to steam and then to diesel engines followed by incorporation of automation on ships. Currently, the Industry 4.0, is moving the shipping industry toward the intelligent operations and paving the way for the arrival of remotely operated and autonomous ships. However, this shift has repercussion far reaching beyond mere technological advancements in the ship itself. This transition has implications in key areas such as safety, port operations, global supply chain, human workforce dynamics, environment, legal, and regulatory framework.

This growing landscape is recognised by IMO, which refers to autonomous shipping as Maritime Autonomous Surface Ships (MASS). The MASS classified the future ships under four levels of autonomy. Such a classification by IMO illustrates a progressive transition. As advanced technologies integrate both on ships and ashore, the

number of crew members on board ship is expected to decrease, with many responsibilities transitioning to ship operators in Remote Operations Centres (ROCs). The control and monitoring of ship operations will gradually be managed from ROC in collaboration with onboard ship crew, supported by advanced technologies that enhance decision-making process.

However, the scope of current technological shift extends beyond modification of traditional roles of seafarers, highlighting the need for maritime workforce to develop a blend of advanced technical, non-technical, and technology-oriented skills. In this context, the concept of the human element in future shipping is promoting a human-technology synergy approach within the maritime industry. Therefore, as the industry undergoes a transformation based on Industry 4.0 framework to integrate the new technologies into existing industry sectors, the roles and responsibilities of workforce are evolving. The common misconception that AI and autonomy will render seafarers obsolete overlooks the reality. These technologies at their best are tools. They will not replace seafarers. They will empower seafarers.