

Data operator and management participation		Data user participation		
Modules	Competences	Required performances		
Module 1: AIS Data (for both courses ->Data managers/operators and ->data users)	<p><b>Competences:</b></p> <ul style="list-style-type: none"><li>1.1 Understanding AIS fundamentals</li><li>1.2 Technical proficiency with AIS data</li><li>1.3 Application of AIS data in maritime operations</li></ul>	<p><b>1.1.1</b> Explain the basic principles of the Automatic Identification System (AIS), including its purpose, components, and how it operates in maritime contexts</p> <p>VHF data link Protocol for data transmission Synchronization and VDL access Process for data exchange Display of AIS data Identify the relevant documentation</p> <p><b>1.1.2</b> Identify and describe the different types of AIS data (static, dynamic, and voyage-related) and their significance in maritime navigation and safety</p> <p>Messages types, Identification and ASM AIS frequencies and bandwidth, channel management, transmission power Static, dynamic data and voyage data (Position, speed, course...) AIS XDR (AIS real, virtual and Synthetic) AIS in EPRBs and in the GMDSS, navigation equipment</p> <p><b>1.2.1</b> Demonstrate the ability to interpret AIS data, including vessel position, speed, course, and other navigational details, using both raw data and visual representations</p> <p>Analysis of vessel traffic on a first view Number of vessels entering and leaving ports according to vessel's size and type Flow trajectory of various vessels in a certain section within a certain period Provide data support for vessel management and channel planning</p> <p><b>1.2.2</b> Utilize AIS software tools to track and analyse vessel movements in real-time and historical contexts, assessing patterns and anomalies</p> <p>Analysis of complexity vessel traffic using commercial tools and IALA Risk Assessment Toolbox Describe and recognise abnormal behavior of vessels Master the feature extraction of information</p> <p><b>1.2.3</b> Analyze the role of AIS data in maritime security and environmental protection, such as identifying unauthorized activities and tracking vessels in sensitive marine areas</p> <p>Awareness of specific local rules and codes for restricted areas Recognize the data can be used to enforce particular sensitive sea areas / other restrictive areas Other sensors enhancing safety, security and environment protection</p> <p><b>2.1.2</b> Database Design and Management</p> <p>Explain database management systems (DBMS) and their role in data storage and retrieval Design a relational database schema using normalization techniques Data Governance and Security: key components of data governance, including policies, procedures, and frameworks, identify common threats to data security and methods to mitigate them Data Quality and Integration: Identify the dimensions of data quality (e.g., accuracy, consistency, completeness). Use tools and techniques to clean and transform raw data into usable formats. Implement strategies for data integration across different platforms and systems. Evaluate the impact of poor data quality on decision-making and operations Data Analysis and Visualization: Explore techniques for exploratory data analysis (EDA) using software tools. Leverage descriptive and predictive analytics to support business objectives. Use data storytelling to present findings to both technical and non-technical audiences</p> <p><b>2.2.2</b> Compare different source of support for data management</p> <p>Data Management Tools: • Database Management Systems (DBMS): • Data Integration Tools: • Data Governance Tools: • Data Quality Tools: • Cloud Storage Solutions: • Data Lakes and Warehousing: SaaS-Based Data Management: Data Management Methodologies: Data Lifecycle Management: Data Stewardship: Professional Services and Consulting • Data Management Consultants: • Managed Services Providers (MSPs): Educational Resources and Training • Online Courses and Certifications Open Source Communities • Open Source tools and limitations • Forums and Discussion Boards</p>		
Module 2: Data management (Data managers and operators)	<p><b>Competences:</b></p> <ul style="list-style-type: none"><li>2.1 Describe data management concepts and terminology</li><li>2.2 Appreciate the benefits of data management and the sources of support, applying the best practices for successful data management</li></ul>	<p><b>2.1.1</b> Define key terms and concepts in data management (e.g., data lifecycle, metadata, and big data)</p> <p>What is Data? Data Governance Data Management Data Architecture Master and Reference data Metadata Data quality</p> <p><b>2.2.1</b> Discuss the benefit of data management</p> <p>Improved Decision-Making: • Access to Accurate Data: With effective data management, organizations can ensure they have accurate, up-to-date, and relevant data at their fingertips. This leads to better decision-making as decisions are based on high-quality data • Data-Driven Insights: Well-organized data allows for advanced analytics, enabling businesses to uncover trends, patterns, and insights that might not be visible otherwise Enhanced Productivity and Efficiency: • Streamlined Operations: Data management systems automate data handling processes, reducing the time and effort needed to collect, store, and retrieve data. • Reduced Redundancy: Proper management eliminates duplicate data, saving storage space and ensuring consistency across the organization Regulatory Compliance Improved Data Security Cost Efficiency Better Collaboration</p> <p><b>3.1.1</b> Importance of AIS Data Quality</p> <p>Assess the importance on: • Safety of navigation, • regulatory compliance, and • analytics</p> <p><b>3.1.2</b> Interferences</p> <p>Signal interference: Duplicate messages, jamming / spoofing, or data loss</p> <p><b>3.1.2.1</b> Parameters considered in Data Quality</p> <ul style="list-style-type: none"><li>• Accuracy: Ensuring data reflects the true value.</li><li>• Completeness: All required data fields are populated.</li><li>• Consistency: Data remains uniform across multiple systems.</li><li>• Timeliness: Data is up-to-date and delivered promptly.</li><li>• Validity: Data adheres to predefined formats and standards.</li></ul> <p><b>3.1.3</b> Improved tools for Quality Management</p> <p>AIS Data Validation Tools: • Software solutions to detect and correct anomalies. • Integration of machine learning algorithms to identify patterns.</p> <p>Data Fusion: Combine AIS with other data sources (e.g., radar, satellite, ECDIS).</p> <p><b>3.1.2</b> Types of errors</p> <p>Static data errors: incorrect MMSI, vessel name mismatches, or outdated vessel type Dynamic data errors Voyage related errors</p> <p><b>3.2.2</b> Procedures and processes implemented for Data Quality</p> <p>Regular Equipment Maintenance: • Ensure position and speed reporting. • Regularly update onboard AIS software.</p> <p>Validation at Data Entry • Verify static data</p> <p>Monitoring and Verification • Consider monitoring systems to identify anomalies. • Compare AIS data with observations</p> <p>Data Governance • Establish policies for data quality management. • Assign roles and responsibilities for data quality oversight.</p> <p><b>3.1.3</b> Reporting of errors and feedback mechanisms</p> <p>Error Reporting and Feedback Mechanisms: • Systems for real-time error alerts. • Feedback loops for continuous improvement.</p> <p><b>3.1.3</b> Practical use of AIS Data Quality management</p> <p>Practical scenarios</p> <p><b>4.1.1</b> Identify the advantage to analyse the AIS data</p> <p>Historical data analysis Historical data requirements Coverage aspects How the data is input/output Data sensors (equipment)</p> <p><b>4.1.2</b> Evaluate the different parameters for the analysis of AIS data</p> <p>Sensors / integration / fusion Real time / Real near time Validation</p> <p><b>4.1.3</b> Limitations and challenges</p> <p>Recognize potential data integrity issues (e.g., spoofing, noise, missing data) Explain how geographical and technical factors affect AIS coverage.</p> <p><b>4.2.2</b> Data cleaning techniques</p> <p>Clean and preprocess AIS data for analysis Identify and correct errors in AIS data • handling duplicates, errors, and handle missing or incomplete datasets appropriately</p> <p><b>4.3.3</b> Types of Analysis</p> <p>Spatial Analysis • Create traffic density heatmaps • Analyze route patterns and chokepoints in maritime areas Temporal Analysis • Identify traffic patterns over time (e.g., daily, monthly, seasonal trends) • Analyze temporal variations in port traffic Risk Assessment • Identify collision risk areas using AIS traffic data • Evaluate safety metrics based on vessel behaviors</p> <p><b>4.3.3</b> Present analysis results effectively for decision-making</p> <p>Data Visualization • Create charts, graphs, and maps to represent findings • Use GIS tools (e.g., QGIS) for spatial visualizations Reporting and Presentation • Compile findings into clear, actionable reports • Present results effectively to stakeholders using multimedia tools</p>		
Module 3: AIS Quality (Data managers)	<p><b>Competences:</b></p> <ul style="list-style-type: none"><li>3.1 Common AIS Data Quality Issues</li><li>3.2 Principles and best practices of Data Quality</li><li>3.3 Tools and Techniques for AIS Data Quality Management</li></ul>	<p><b>Competence 3.1 Common AIS Data Quality Issues</b></p> <ul style="list-style-type: none"><li>3.1.1 Importance of AIS Data Quality</li><li>3.1.2 Types of errors</li><li>3.1.3 Interferences</li></ul> <p><b>Competence 3.2 Principles and best practices of Data Quality</b></p> <ul style="list-style-type: none"><li>3.2.1 Parameters considered in Data Quality</li><li>3.2.2 Procedures and processes implemented for Data Quality</li></ul> <p><b>Competence 3.3 Tools and Techniques for AIS Data Quality Management</b></p> <ul style="list-style-type: none"><li>3.3.1 Improved tools for Quality Management</li><li>3.3.2 Reporting of errors and feedback mechanisms</li><li>3.3.3 Practical use of AIS Data Quality management</li></ul> <p><b>Competence 4.1 Understand the core AIS Data for statistical usage</b></p> <ul style="list-style-type: none"><li>4.1.1 Identify the advantage to analyse the AIS data</li><li>4.1.2 Evaluate the different parameters for the analysis of AIS data</li><li>4.1.3 Limitations and Challenges</li></ul> <p><b>Competence 4.2 Process AIS Data for statistical analysis</b></p> <ul style="list-style-type: none"><li>4.2.1 Tools for AIS data extraction and storage</li><li>4.2.2 Data cleaning techniques</li></ul> <p><b>Competence 4.3 Perform statistical analysis to identify trends and patterns</b></p> <ul style="list-style-type: none"><li>4.3.1 Descriptive Statistics</li><li>4.3.2 Types of analysis</li><li>4.3.3 Present analysis results effectively for decision-making</li></ul> <p><b>Competence 4.4 Apply AIS data analysis in specialized contexts</b></p> <ul style="list-style-type: none"><li>4.4.1 Advanced applications</li></ul>		
Module 4: Statistics and analysis of vessel traffic	<p><b>Competences:</b></p> <ul style="list-style-type: none"><li>4.1 AIS Data for statistical usage</li><li>4.2 Process AIS Data for statistical analysis</li><li>4.3 Perform statistical analysis to identify trends and patterns</li><li>4.4 Apply AIS data analysis in specialized contexts</li></ul>	<p><b>4.2.1</b> Tools for AIS data extraction and storage</p> <p>Introduction to AIS data formats and conversion Access AIS data from available sources (real-time feeds, historical databases) Extract raw data in NMEA or other standardized formats from various sources Organize data into structured formats for analysis (e.g., time-series)</p> <p><b>4.3.1</b> Descriptive Statistics</p> <p>Compute traffic density, average speed, and vessel counts Generate summary statistics for different vessel types</p> <p><b>4.4.1</b> Advanced Applications</p> <p>Environmental Monitoring • Assess environmental impacts using AIS data (e.g., emissions tracking) • Identify vessel activity in marine protected areas Port Operations Optimization • Analyze port congestion and berthing delays • Support port efficiency through traffic scheduling insights Strategic Planning: • Propose new routes or infrastructure based on traffic analysis • Support long-term planning with predictive analytics</p> <p><b>5.1.1</b> Explain the purpose of AIS in enhancing maritime safety</p> <p>Key AIS message components relevant to risk assessment: • position, • speed, • heading Evaluate the different parameters for the analysis of AIS data AIS data supports compliance with waterway risk management frameworks • IMO • IALA • PIANC</p> <p><b>5.2.1</b> Data Acquisition</p> <p>Access AIS data from sources such as shore-based stations, satellites, and public databases Retrieve data in real-time or as historical records</p> <p><b>5.2.2</b> Data Cleaning and Integrity</p> <p>Identify and correct errors such as duplicate entries, incomplete records, or outliers Handle missing data appropriately to ensure robust analysis</p> <p><b>5.2.3</b> Data Structuring and Formatting</p> <p>Convert raw AIS data (e.g., NMEA) into structured formats suitable for analysis (e.g., CSV, JSON) Organize data based on geographic areas, vessel types, or timeframes</p> <p><b>5.3.3</b> Environmental Risk Assessment</p> <p>Use AIS data to assess vessel impacts on environmentally sensitive areas Identify high-risk areas for spills or pollution based on traffic data</p> <p><b>5.3.4</b> Scenario Modeling</p> <p>Simulate various risk scenarios using historical AIS data in IWRAP Mk II • Undesired scenarios • Near-misses • Hypothetical collisions Predict the impact of changes in traffic patterns or infrastructure</p> <p><b>5.4.4</b> Emergency Response Planning</p> <p>Use AIS data to model and improve response strategies for incidents. Identify high-risk areas requiring additional emergency resources.</p>		
Module 5: Risk assessment with AIS	<p><b>Competences:</b></p> <ul style="list-style-type: none"><li>5.1 Understand the fundamentals of AIS and its relevance to risk assessment</li><li>5.2 Acquire, preprocess, and prepare AIS data for risk assessment analysis</li><li>5.3 Analyze AIS data to evaluate risks and identify safety challenges in waterways</li><li>5.4 Apply AIS-based risk assessments in practical and strategic contexts</li></ul>	<p><b>Competence 5.1 Understand the fundamentals of AIS and its relevance to risk assessment</b></p> <ul style="list-style-type: none"><li>5.1.1 Explain the purpose of AIS in enhancing maritime safety</li><li>5.1.2 Limitations and Challenges</li></ul> <p><b>Competence 5.2 Acquire, preprocess, and prepare AIS data for risk assessment analysis</b></p> <ul style="list-style-type: none"><li>5.2.1 Data Acquisition</li><li>5.2.2 Data Cleaning and Integrity</li><li>5.2.3 Data Structuring and Formatting</li></ul> <p><b>Competence 5.3 Analyze AIS data to evaluate risks and identify safety challenges in waterways</b></p> <ul style="list-style-type: none"><li>5.3.1 Undesired scenario Risk Analysis</li><li>5.3.2 Congestion and Traffic Patterns</li><li>5.3.3 Environmental Risk Assessment</li><li>5.3.4 Scenario Modeling</li></ul> <p><b>Competence 5.4 Apply AIS-based risk assessments in practical and strategic contexts</b></p> <ul style="list-style-type: none"><li>5.4.1 Develop clear visualizations and communicate findings effectively</li><li>5.4.2 Infrastructure Planning</li><li>5.4.3 Policy Development and Stakeholder Engagement</li><li>5.4.4 Emergency Response Planning</li></ul>	<p><b>5.3.1</b> Undesired scenario Risk Analysis</p> <p>Identify and describe the different scenarios that can be assessed with the availability of AIS data Describe the root cause of the undesired scenario Use AIS data to calculate Closest Point of Approach (CPA) and Time to Closest Point of Approach (TCPA)</p> <p><b>5.3.2</b> Congestion and Traffic Patterns</p> <p>Identify high-risk zones for vessel interactions Congestion and Traffic Patterns: • Analyze traffic density and vessel movement patterns to assess congestion levels • Identify bottlenecks and propose measures for improving traffic flow Analysis and determination of near-miss accidents</p> <p><b>5.4.1</b> Develop clear visualizations and communicate findings effectively</p> <p>Risk Visualization: • Create heatmaps, risk zones, and spatial overlays using GIS tools. • Generate visual indicators of congestion, collision risks, or environmental hazards. Reporting and Presentation: • Develop concise reports summarizing risk assessment findings. • Present results effectively to stakeholders, using visuals and narrative to support recommendations</p> <p><b>5.4.2</b> Infrastructure Planning</p> <p>Use AIS data to support decisions on Aton deployment, waterway infrastructure, maritime services etc. Propose traffic management strategies based on risk patterns.</p> <p><b>5.4.3</b> Policy Development and Stakeholder Engagement</p> <p>Support the development of policies and procedures to reduce navigational risks Collaborate with maritime authorities and stakeholders to implement safety measures</p> <p><b>6.1.1</b> Understanding AIS Service Quality Standards</p> <p>Identify international standards for AIS services (e.g., IMO, ITU, IALA guidelines) Define key performance indicators (KPIs) for AIS service quality, such as data accuracy, coverage, latency, and reliability</p> <p><b>6.1.2</b> Monitoring and Evaluating AIS Service Performance</p> <p>Analyze AIS performance metrics and identify gaps or failures in service. Use diagnostic tools to evaluate signal coverage, data integrity, and system availability</p> <p><b>6.1.3</b> Continuous Improvement of AIS Services</p> <p>Implement feedback mechanisms for service improvement based on user input. Develop action plans to enhance service quality and ensure compliance with regulatory standards</p> <p><b>6.2.1</b> Regulatory Frameworks for AIS Policy</p> <p>Explain international conventions and regulations governing AIS (e.g., SOLAS, IMO guidelines) Identify national legal frameworks for AIS deployment and use</p> <p><b>6.2.2</b> Policy Development</p> <p>Draft policies that define AIS implementation procedures, data-sharing protocols, and compliance requirements Address privacy, data security, and ethical considerations in AIS policy</p> <p><b>6.2.3</b> Policy Implementation and Compliance</p> <p>Develop strategies to ensure stakeholder compliance with AIS policies Monitor and enforce policy adherence across different maritime sectors</p> <p><b>6.3.1</b> Strategic Integration of AIS Services</p> <p>Develop frameworks for integrating AIS with other navigational tools (e.g., radar, VTS, ECDIS) Design strategies for optimizing AIS use in port operations and vessel traffic monitoring</p> <p><b>6.3.2</b> Risk Management and Contingency Planning</p> <p>Identify risks associated with AIS system failure or misuse Develop contingency plans to ensure operational continuity during system outages</p> <p><b>6.3.3</b> Innovation and Future Trends</p> <p>Analyze emerging technologies and trends (e.g., VDES, use of ASM, satellite AIS, machine learning) to enhance AIS services Propose strategic initiatives to future-proof AIS systems</p> <p><b>6.3.4</b> Stakeholder Engagement and Collaboration</p> <p>Identify key stakeholders involved in AIS services (e.g., maritime authorities, shipping companies, technology providers) Develop strategies for engaging stakeholders in policy and strategic planning Collaborate with international organizations to align AIS services with global standards Participate in joint initiatives to enhance cross-border AIS data sharing and interoperability</p>	
Module 6: AIS Service quality, policy and strategy	<p><b>Competences:</b></p> <ul style="list-style-type: none"><li>6.1 Manage and improve AIS service quality to meet operational and regulatory standards</li><li>6.2 Formulate policies for the deployment and use of AIS services in alignment with international and national regulations</li><li>6.3 Design strategies to integrate AIS services into maritime safety, traffic management, and operational frameworks</li></ul>	<p><b>6.1.1</b> Understanding AIS Service Quality Standards</p> <p>Identify international standards for AIS services (e.g., IMO, ITU, IALA guidelines) Define key performance indicators (KPIs) for AIS service quality, such as data accuracy, coverage, latency, and reliability</p> <p><b>6.1.2</b> Monitoring and Evaluating AIS Service Performance</p> <p>Analyze AIS performance metrics and identify gaps or failures in service. Use diagnostic tools to evaluate signal coverage, data integrity, and system availability</p> <p><b>6.1.3</b> Continuous Improvement of AIS Services</p> <p>Implement feedback mechanisms for service improvement based on user input. Develop action plans to enhance service quality and ensure compliance with regulatory standards</p> <p><b>6.2.1</b> Regulatory Frameworks for AIS Policy</p> <p>Explain international conventions and regulations governing AIS (e.g., SOLAS, IMO guidelines) Identify national legal frameworks for AIS deployment and use</p> <p><b>6.2.2</b> Policy Development</p> <p>Draft policies that define AIS implementation procedures, data-sharing protocols, and compliance requirements Address privacy, data security, and ethical considerations in AIS policy</p> <p><b>6.2.3</b> Policy Implementation and Compliance</p> <p>Develop strategies to ensure stakeholder compliance with AIS policies Monitor and enforce policy adherence across different maritime sectors</p> <p><b>6.3.1</b> Strategic Integration of AIS Services</p> <p>Design strategies for integrating AIS services into maritime safety, traffic management, and operational frameworks</p> <p><b>6.3.2</b> Risk Management and Contingency Planning</p> <p>Identify risks associated with AIS system failure or misuse Develop contingency plans to ensure operational continuity during system outages</p> <p><b>6.3.3</b> Innovation and Future Trends</p> <p>Analyze emerging technologies and trends (e.g., VDES, use of ASM, satellite AIS, machine learning) to enhance AIS services Propose strategic initiatives to future-proof AIS systems</p> <p><b>6.3.4</b> Stakeholder Engagement and Collaboration</p> <p>Identify key stakeholders involved in AIS services (e.g., maritime authorities, shipping companies, technology providers) Develop strategies for engaging stakeholders in policy and strategic planning Collaborate with international organizations to align AIS services with global standards Participate in joint initiatives to enhance cross-border AIS data sharing and interoperability</p>		