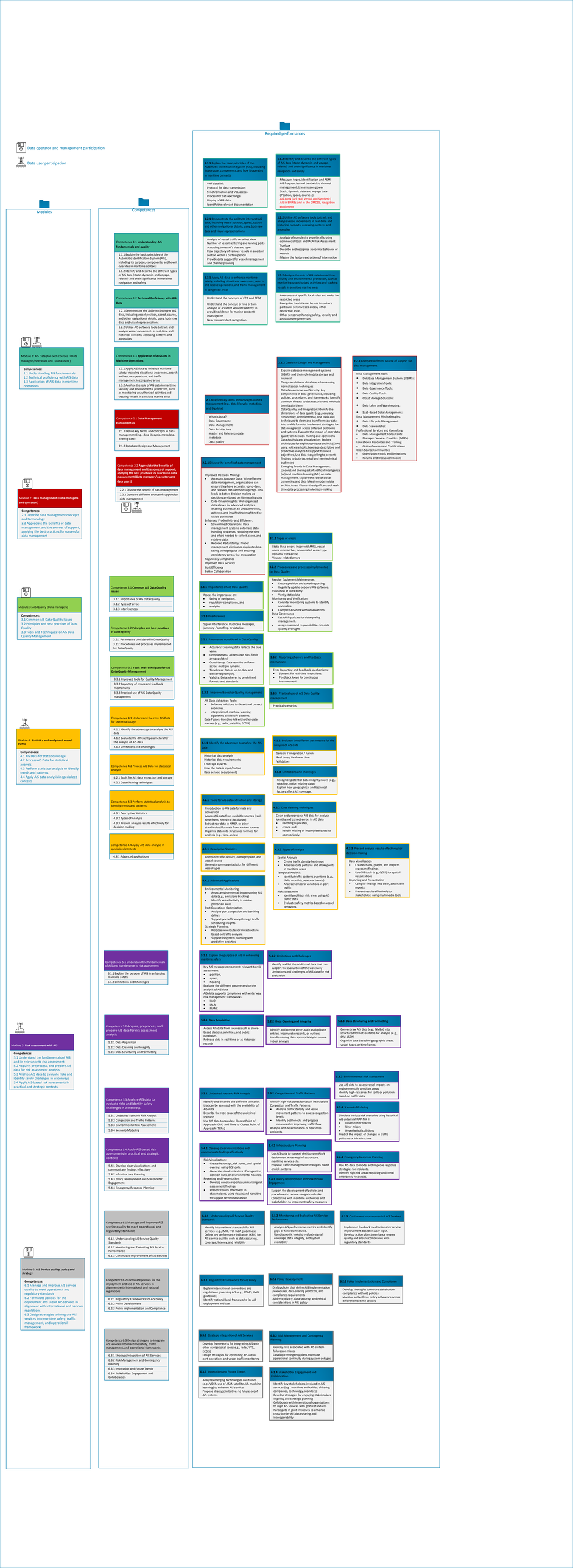
Data operator and management participation
Data user participation
Modules
Competences
Required performances
Module 1: AIS Data (for both courses =Data managers/operators and =data users)
Competences:
1.1 Understanding AIS fundamentals
1.2 Technical proficiency with AIS data
1.3 Application of AIS data in maritime operations
Competence 1.1 Understanding AIS fundamentals and quality
1.1.1 Explain the basic principles of the Automatic Identification System (AIS), including its purpose, components, and how it operates in maritime contexts
1.1.2 Identify and describe the different types of AIS data (static, dynamic, and voyage-related) and their significance in maritime navigation and safety
Competence 1.2 Technical Proficiency with AIS Data
1.2.1 Demonstrate the ability to interpret AIS data, including vessel position, speed, course, and other navigational details, using both raw data and visual representations
1.2.2 Utilize AIS software tools to track and analyse vessel movements in real-time and historical contexts, assessing patterns and anomalies
Competence 1.3 Application of AIS Data in Maritime Operations
1.3.1 Apply AIS data to enhance maritime safety, including situational awareness, search and rescue operations, and traffic management in congested areas
1.3.2 Analyze the role of AIS data in maritime security and environmental protection, such as monitoring unauthorized activities and tracking vessels in sensitive marine areas
1.1.1 Explain the basic principles of the Automatic Identification System (AIS), including its purpose, components, and how it operates in maritime contexts
VHF data link
Protocol for data transmission
Synchronisation and VDL access
Process for data exchange
Display of AIS data
Identify the relevant documentation
1.1.2 Identify and describe the different types of AIS data (static, dynamic, and voyage-related) and their significance in maritime navigation and safety
Messages types, identification and ASM
AIS Frequencies and bandwidth, channel management, transmission power
AIS data types (static, dynamic, voyage data (Position, speed, course...)
AIS AtoN (AIS real, virtual and Synthetics)
AIS in EPIRBs and in the GMDSS, navigation equipment
1.2.1 Demonstrate the ability to interpret AIS data, including vessel position, speed, course, and other navigational details, using both raw data and visual representations
Analysis of vessel traffic on a first view
Number of vessels entering and leaving ports according to vessel's size and type
Identify vessels not complying with a in a certain section within a certain period
Provide data support for vessel management and channel planning
1.2.2 Utilize AIS software tools to track and analyse vessel movements in real-time and historical contexts, assessing patterns and anomalies
Analysis of complexely vessel traffic using commercial tools and IALA Risk Assessment Toolbox
Describe and recognise abnormal behavior of vessels
Master the feature extraction of information
1.3.1 Apply AIS data to enhance maritime safety, including situational awareness, search and rescue operations, and traffic management in congested areas
Understand the concepts of CPA and TCPA
Understand the concept of rate of turn
Analysis of accident vessel trajectory to provide evidence for marine accident investigation
Near miss accident recognition
1.3.2 Analyze the role of AIS data in maritime security and environmental protection, such as monitoring unauthorized activities and tracking vessels in sensitive marine areas
Awareness of specific local rules and codes for restricted area
Recognise the data can be use to enforce particular sensitive sea areas / other regulations
Other sensors enhancing safety, security and environment protection
Module 2: Data management (Data managers and operators)
Competences:
2.1 Describe data management concepts and terminology
2.2 Appreciate the benefits of data management and the sources of support, applying the best practices for successful data management
Competence 2.1 Data Management Fundamentals
2.1.1 Define key terms and concepts in data management (e.g., data lifecycle, metadata, and big data)
2.1.2 Database Design and Management
Competence 2.2 Appreciate the benefits of data management and the source of support, applying the best practices for successful data management (Data manager/operators and data users)
2.2.1 Discuss the benefit of data management
2.2.2 Compare different source of support for data management
2.1.1 Define key terms and concepts in data management (e.g., data lifecycle, metadata, and big data)
What is Data?
Data Governance
Data Management
Data Architecture
Master and Reference data
Metadata
Data quality
2.1.2 Database Design and Management
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 importance 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 Visualisation: Explore techniques for exploratory data analysis (EDA) to uncover patterns and insights, Introduce and predictive analytics to support business objectives, Use data storytelling to present findings to both technical and non-technical audiences
Emerging Trends in Data Management: Understand the impact of artificial intelligence (AI) and machine learning (ML) on data management, Explore the role of cloud computing in modern data management, Data architectures, Discuss the significance of real-time data processing in decision-making
2.2.1 Discuss the benefit of data management
Improved Decision-Making:
Access to Accurate Data: With effective data management, organizations can ensure they have accurate, up-to-date, and reliable data for decision-making. 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
2.2.2 Compare different source of support for data management
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
Module 3: AIS Quality (Data managers)
Competences:
3.1 Common AIS Data Quality Issues
3.2 Principles and best practices of Data Quality
3.3 Tools and Techniques for AIS Data Quality Management
Competence 3.1 Common AIS Data Quality Issues
3.1.1 Importance of AIS Data Quality
3.1.2 Types of errors
3.1.3 Interferences
Competence 3.2 Principles and best practices of Data Quality
3.2.1 Parameters considered in Data Quality
3.2.2 Procedures and processes implemented for Data Quality
Competence 3.3 Tools and Techniques for AIS Data Quality Management
3.3.1 Improved tools for Quality Management
3.3.2 Reporting of errors and feedback mechanisms
3.3.3 Practical use of AIS Data Quality management
3.1.1 Importance of AIS Data Quality
Assess the importance on:
Safety of navigation,
regulatory compliance, and
analytics
3.1.2 Types of errors
Static Data errors: incorrect MMSI, vessel name mismatches, or outdated vessel type
Dynamic Data errors
Voyage related errors
3.1.3 Interferences
Signal Interference: Duplicate messages, jamming / spoofing, or data loss
3.2.1 Parameters considered in Data Quality
Accuracy: Ensuring data reflects the true value.
Completeness: All required data fields are populated.
Consistency: Data remains uniform across multiple systems.
Timeliness: Data is up-to-date and delivered promptly.
Validity: Data adheres to predefined formats and standards.
3.2.2 Procedures and processes implemented for Data Quality
Regular Equipment Maintenance
Monitor vessel position and speed reporting.
Regularly update onboard AIS software.
Validation at Data Entry
Verify static data
Monitoring and Verification
Consider monitoring systems to identify anomalies.
Compare AIS data with observations
Data Governance
Establish policies for data quality management.
Assign roles and responsibilities for data quality oversight.
3.2.3 Reporting of errors and feedback mechanisms
Error Reporting and Feedback Mechanisms:
Systems for real-time error alerts.
Feedback loops for continuous improvement.
3.3.1 Improved tools for Quality Management
AIS Data Validation Tools:
Software solutions to detect and correct anomalies.
Application of machine learning algorithms to identify patterns.
Data Fusion: Combine AIS with other data sources (e.g., radar, satellite, ECDIS).
3.3.2 Reporting of errors and feedback mechanisms
Systems for real-time error alerts.
Feedback loops for continuous improvement.
3.3.3 Practical use of AIS Data Quality Management
Practical scenarios
Module 4: Statistics and analysis of vessel traffic
Competences:
4.1 AIS Data for statistical usage
4.2 Process AIS Data for statistical analysis
4.3 Perform statistical analysis to identify trends and patterns
4.4 Apply AIS data analysis in specialized contexts
Competence 4.1 Understand the core AIS Data for statistical usage
4.1.1 Identify the advantage to analyse the AIS data
4.1.2 Evaluate the different parameters for the analysis of AIS data
4.1.3 Limitations and Challenges
Competence 4.2 Process AIS Data for statistical analysis
4.2.1 Tools for AIS data extraction and storage
4.2.2 Data cleaning techniques
Competence 4.3 Perform statistical analysis to identify trends and patterns
4.3.1 Descriptive Statistics
4.3.2 Types of Analysis
4.3.3 Present analysis results effectively for decision-making
Competence 4.4 Apply AIS data analysis in specialized contexts
4.4.1 Advanced Applications
4.1.1 Identify the advantage to analyse the AIS data
Historical data analysis
Historical data requirements
Coverage aspects
How the data is input/output
Data sensors (equipment)
4.1.2 Evaluate the different parameters for the analysis of AIS data
Sensors / Integration / fusion
Real time / Real near time
Validation
4.1.3 Limitations and challenges
Recognize potential data integrity issues (e.g., spoofing, noise, missing data).
Explain how geographical and technical factors affect AIS coverage.
4.2.1 Tools for AIS data extraction and storage
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)
4.2.2 Data cleaning techniques
Clean and preprocess AIS data for analysis
Identify and correct errors in AIS data
handling duplicates,
errors, and
handle missing or incomplete datasets appropriately
4.3.1 Descriptive Statistics
Compute traffic density, average speed, and vessel counts
Generate summary statistics for different vessel types
4.3.2 Types of Analysis
Spatial Analysis
Create traffic density heatmaps
Analyze traffic 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 trafic data
Evaluate safety metrics based on vessel behaviors
4.3.3 Present analysis results effectively for decision-making
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
4.4.1 Advanced Applications
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
Module 5: Risk assessment with AIS
Competences:
5.1 Understand the fundamentals of AIS and its relevance to risk assessment
5.2 Acquire, preprocess, and prepare AIS data for risk assessment analysis
5.3 Analyze AIS data to evaluate risks and identify safety challenges in waterways
5.4 Apply AIS-based risk assessments in practical and strategic contexts
Competence 5.1 Understand the fundamentals of AIS and its relevance to risk assessment
5.1.1 Explain the purpose of AIS in enhancing maritime safety
5.1.2 Limitations and Challenges
Competence 5.2 Acquire, preprocess, and prepare AIS data for risk assessment analysis
5.2.1 Data Acquisition
5.2.2 Data Cleaning and Integrity
5.2.3 Data Structuring and Formatting
Competence 5.3 Analyze AIS data to evaluate risks and identify safety challenges in waterways
5.3.1 Undesired scenario Risk Analysis
5.3.2 Congestion and Traffic Patterns
5.3.3 Environmental Risk Assessment
5.3.4 Scenario Modeling
Competence 5.4 Apply AIS-based risk assessments in practical and strategic contexts
5.4.1 Develop clear visualisations and communicate findings effectively
5.4.2 Infrastructure Planning
5.4.3 Policy Development and Stakeholder Engagement
5.4.4 Emergency Response Planning
5.1.1 Explain the purpose of AIS in enhancing maritime safety
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
5.1.2 Limitations and Challenges
Identify and list the additional data that can support the evaluation of the waterways
Limitations and challenges of AIS data for risk evaluation
5.2.1 Data Acquisition
Access AIS data from sources such as shore-based stations, satellites, and public databases.
Retrieve data in real-time or as historical records.
5.2.2 Data Cleaning and Integrity
Identify and correct errors such as duplicate entries, incomplete records, or outliers
Handle missing data appropriately to ensure robust analysis
5.2.3 Data Structuring and Formatting
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
5.3.1 Undesired scenario Risk Analysis
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)
5.3.2 Congestion and Traffic Patterns
Identify high-risk zones for vessel interactions
Congestion and Traffic Patterns:
Analyse 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
5.3.3 Environmental Risk Assessment
Use AIS data to assess vessel impacts on environmentally sensitive areas
Identify high-risk areas for spills or pollution based on traffic data
5.3.4 Scenario Modeling
Simulate various risk scenarios using historical AIS data in INRAP MK II
Undesired scenarios
Near-misses
Hypothetical collisions
Predict the impact of changes in traffic patterns or infrastructure
5.4.1 Develop clear visualisations and communicate findings effectively
Risk Visualisation:
Create heatmaps, risk zones, and spatial overlays using GIS tools.
Develop visual indicators of congestion, collision risks, or environmental hazards.
Reporting and Presentation:
Develop concise reports summarising risk assessment findings.
Present results effectively to stakeholders, using visuals and narrative to support recommendations.
5.4.2 Infrastructure Planning
Use AIS data to support decisions on AtoN deployment, waterway infrastructure, maritime services etc.
Propose traffic management strategies based on risk patterns
5.4.3 Policy Development and Stakeholder Engagement
Support the development of policies and procedures to reduce navigational risks
Collaborate with maritime authorities and stakeholders to implement safety measures
5.4.4 Emergency Response Planning
Use AIS data to model and improve response strategies for incidents.
Identify high-risk areas requiring additional emergency resources.
Module 6: AIS Service quality, policy and strategy
Competences:
6.1 Manage and improve AIS service quality to meet operational and regulatory standards
6.2 Formulate policies for the deployment and use of AIS services in alignment with international and national regulations
6.3 Design strategies to integrate AIS services into maritime safety, traffic management, and operational frameworks
Competence 6.1 Manage and improve AIS service quality to meet operational and regulatory standards
6.1.1 Understanding AIS Service Quality Standards
6.1.2 Monitoring and Evaluating AIS Service Performance
6.1.3 Continuous Improvement of AIS Services
Competence 6.2 Formulate policies for the deployment and use of AIS services in alignment with international and national regulations
6.2.1 Regulatory Frameworks for AIS Policy
6.2.2 Policy Development
6.2.3 Policy Implementation and Compliance
Competence 6.3 Design strategies to integrate AIS services into maritime safety, traffic management, and operational frameworks
6.3.1 Strategic Integration of AIS Services
6.3.2 Risk Management and Contingency Planning
6.3.3 Innovation and Future Trends
6.3.4 Stakeholder Engagement and Collaboration
6.1.1 Understanding AIS Service Quality Standards
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
6.1.2 Monitoring and Evaluating AIS Service Performance
Analyse AIS performance metrics and identify gaps or failures in service.
Use diagnostic tools to evaluate signal coverage, data integrity, and system availability
6.1.3 Continuous Improvement of AIS Services
Implement feedback mechanisms for service improvement based on user input.
Develop action plans to enhance service quality and ensure compliance with regulatory standards
6.2.1 Regulatory Frameworks for AIS Policy
Explain international conventions and regulations governing AIS (e.g., SOLAS, IMO guidelines)
Identify national legal frameworks for AIS deployment and use
6.2.2 Policy Development
Draft policies that define AIS implementation standards, operational protocols, and compliance requirements.
Address privacy, data security, and ethical considerations in AIS policy
6.2.3 Policy Implementation and Compliance
Develop strategies to ensure stakeholder compliance with AIS policies
Monitor and enforce policy adherence across different maritime sectors
6.3.1 Strategic Integration of AIS Services
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
6.3.2 Risk Management and Contingency Planning
Identify risks associated with AIS system failures or misuse
Develop contingency plans to ensure operational continuity during system outages
6.3.3 Innovation and Future Trends
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
6.3.4 Stakeholder Engagement and Collaboration
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
Facilitate workshops and conferences to enhance cross-border AIS data sharing and interoperability