

CASE STUDY IDENTIFICATION SHEET

Practice 7: Continuous training and updates for pilots

This document has been developed by Piri Reis University as part of the activities under Task 3.2 of the “GREENPORT Alliances” project, for which MAR.TE. S.c.ar.l. serves as the responsible entity. Task 3.2 focuses on identifying and analysing case studies that exemplify best practices for behavioural change among operators aimed at reducing the environmental impact of port operations.

The primary objective of this activity is to collect, document, and analyse concrete examples of technological, managerial, or behavioural innovation that have proven effective in contributing to the environmental, economic, and social sustainability of the port services sector. Through a structured selection and evaluation process, the document highlights the specific features of each case study and assesses their performance against key environmental and economic impact indicators.

The information gathered will be integrated into the overall framework of the GREENPORT Alliances project to promote the dissemination of sustainable solutions and the development of curricula for: a. higher education students (future personnel); b. current professionals (professional training); c. educators (train-the-trainer courses).

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1. GENERAL INFORMATION

A. Case study title

Continuous Training and Updates for Pilots in Port of Rotterdam

B. Green practice implemented

Practice 7: Continuous training and updates for pilots

Continuous training programs for pilots to enhance sustainability. Regularly organize training sessions for pilots together with Tug Masters and engineers on sustainability and ecological practices, emphasizing the importance of reducing emissions.

C. Specific goals

Ensure safe, efficient, and environmentally friendly navigation through pilot training

D. Direct impact of the practice

Reduction in emissions, improved energy efficiency, and reduced operational costs

E. Place of implementation

Port of Rotterdam

F. Start and end date or duration of the pilot project

Ongoing initiative

2. CONTEXT AND DESCRIPTION

A. Description of the practice

Regular training sessions using simulations, real-time data, and environmental awareness programs for maritime pilots

B. Driving factor behind the adoption of the green practice

Need for improved navigation efficiency and compliance with environmental regulations

C. Stakeholders involved

Port authorities, shipping companies, environmental agencies

3. IMPLEMENTATION

A. Description of the adopted practice

Integration of advanced navigation simulators and digital training program

B. Technologies used (if applicable)

Ship simulators, Automatic Identification Systems (AIS), Electronic Chart Display and Information Systems (ECDIS)

C. Competencies required

Expertise in digital navigation, environmental regulations, and vessel manoeuvring

4. COLLECTED DATA

A. Before implementation

Higher fuel consumption, inefficient navigation, increased emissions

B. After implementation:

Reduced fuel usage, optimized vessel movements, lower environmental impact

5. ECONOMIC AND ENVIRONMENTAL ANALYSIS (*IF THE INFORMATION IS ACCESSIBLE*)

A. Initial investment required

Investment in training infrastructure and simulation technology

B. Key savings or economic impact

Reduction in operational costs through optimized pilotage

C. Contribution to environmental goals

Significant reduction in CO2 emissions and compliance with green port initiatives

6. CONCLUSIONS

The training initiative has led to enhanced navigation efficiency, reduced emissions, and cost savings. Plans to integrate AI-driven navigation training and expand collaboration with international ports. Further investment in digital learning tools and increased use of real-time environmental data.

This approach ensures that port pilots remain up to date with the latest developments and maintain high standards of safety and efficiency. Based on the lessons learnt, a course for **Continuous Training and Updates for Port Pilots** may be designed in accordance with following considerations:

Course Objectives:

- Enhance navigational skills and safety awareness.
- Update pilots on the latest maritime regulations and technologies.
- Improve decision-making and emergency response capabilities.
- Foster continuous professional development and knowledge sharing.
- Cooperation with port authorities
- Cooperation with port tugboat operators

Module 1: Introduction to Continuous Training

- Overview of Continuous Training: Importance and benefits.
- Course Objectives and Structure: What to expect.

Module 2: Navigational Skills and Safety

- Advanced Navigation Techniques: Use of modern navigational aids.
- Safety Protocols: Best practices and case studies.
- Risk Assessment and Management: Identifying and mitigating risks.

Module 3: Regulatory Updates

- International Maritime Regulations: Latest updates from IMO and other bodies.
- Local Port Regulations: Specific rules and guidelines for the port.
- Compliance and Enforcement: Ensuring adherence to regulations.

Module 4: Technological Advancements

- New Maritime Technologies: Autonomous ships, AI, and digitalization
- Energy Efficiency and Sustainability: Green technologies and practices
- Cybersecurity: Protecting maritime operations in a digital world

Module 5: Emergency Response and Crisis Management

- Emergency Procedures: Fire, collision, and grounding response.
- Crisis Management: Communication and coordination during emergencies.
- Simulation Exercises: Practical drills and scenario-based training.

Module 6: Human Factors and Crew Resource Management

- Human Factors in Maritime Operations: Understanding human error.
- Crew Resource Management (CRM): Effective teamwork and communication.
- Stress Management and Mental Health: Supporting pilot well-being.

Module 7: Environmental Awareness

- Environmental Regulations: MARPOL and other environmental laws.
- Pollution Prevention: Best practices for reducing environmental impact.
- Sustainable Practices: Implementing green initiatives in port operations.

Module 8: Continuous Professional Development

- Knowledge Sharing: Forums and workshops for pilots.
- Mentorship Programs: Pairing experienced pilots with newcomers.

- Feedback and Evaluation: Continuous improvement through feedback.

Module 9: Practical Assessments and Certification

- Practical Assessments: Evaluating skills through real-world scenarios.
- Certification and Recertification: Ensuring ongoing competence.
- Record Keeping: Maintaining training logs and certifications.

Conclusion and Wrap-Up

- Course Review: Summary of key points.
- Q&A Session: Addressing participant questions.
- Feedback Collection: Gathering participant feedback for course improvement.

For a comprehensive Continuous Training and Updates for Port Pilots course, incorporating the latest technologies is essential. Here are some key technologies to include:

1. Portable Pilot Units (PPUs):

- Description: PPUs are portable devices that provide pilots with real-time navigational data, including electronic charts, tidal information, and vessel positioning.
- Benefits: Enhance situational awareness, improve safety during manoeuvres, and provide up-to-date local hydrographic data

2. Simulation Technology:

- Description: High-fidelity simulators that replicate real-world scenarios for training purposes.
- Benefits: Allow pilots to practice complex manoeuvres, emergency responses, and decision-making in a controlled environment

3. Artificial Intelligence (AI):

- Description: AI systems for route optimization, predictive maintenance, and decision support.
- Benefits: Improve operational efficiency, reduce fuel consumption, and enhance safety

4. Augmented Reality (AR) and Virtual Reality (VR):

- Description: AR and VR tools for immersive training experiences.
- Benefits: Provide realistic training scenarios, improve spatial awareness, and enhance learning retention

5. Internet of Things (IoT):

- Description: IoT devices for real-time monitoring of vessel and port operations.
- Benefits: Enable data-driven decision-making, improve asset management, and enhance operational efficiency

6. Big Data and Analytics:

- Description: Advanced analytics platforms for processing and analyzing large datasets.
- Benefits: Provide insights into operational performance, identify trends, and support strategic decision-making

7. Cybersecurity Tools:

- Description: Systems and protocols to protect maritime operations from cyber threats.
- Benefits: Ensure the security of navigational and operational data, protect against cyber-attacks, and maintain operational integrity

8. Energy-Efficient Technologies:

- Description: Technologies focused on reducing energy consumption and emissions.
- Benefits: Promote sustainability, reduce operational costs, and comply with environmental regulations

9. Maritime Robotics:

- Description: Autonomous and remotely operated vehicles for various maritime tasks.
- Benefits: Enhance operational efficiency, reduce human risk, and support complex operations

10. Blockchain Technology:

- Description: Secure and transparent systems for managing maritime transactions and documentation.
- Benefits: Improve transparency, reduce fraud, and streamline administrative processes

Including these technologies in the training course will ensure that port pilots are well-equipped to handle modern maritime challenges and maintain high standards of safety and efficiency.

AI can significantly enhance pilot operations in several ways:

1. Navigation and Route Optimization:

- Description: AI systems analyse vast amounts of data, including weather conditions, traffic patterns, and historical routes, to determine the most efficient and safest paths for vessels.
- Benefits: This reduces fuel consumption, minimizes travel time, and enhances safety by avoiding hazardous areas
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2. Predictive Maintenance:

- Description: AI-powered predictive maintenance systems monitor the condition of equipment and predict potential failures before they occur.
- Benefits: This proactive approach reduces downtime, lowers maintenance costs, and extends the lifespan of critical equipment

3. Real-Time Decision Support:

- Description: AI provides real-time data analysis and decision support, helping pilots make informed decisions quickly.
- Benefits: This improves operational efficiency, enhances situational awareness, and reduces the risk of human error

4. Autonomous Navigation:

- Description: AI enables autonomous navigation systems that can operate vessels with minimal human intervention.
- Benefits: This reduces the workload on pilots, allows for more precise manoeuvres, and enhances safety by continuously monitoring and adjusting to changing conditions

5. Energy Efficiency:

- Description: AI optimizes energy usage by analysing consumption patterns and suggesting more efficient operational practices.
- Benefits: This leads to significant cost savings and reduces the environmental impact of maritime operations

6. Enhanced Training and Simulation:

- Description: AI-powered simulators provide realistic training scenarios for pilots, allowing them to practice complex manoeuvres and emergency responses.
- Benefits: This improves pilot skills, enhances safety, and ensures preparedness for real-world situations

7. Port Operations Optimization:

- Description: AI systems optimize port operations by predicting vessel arrival times, managing berth allocations, and coordinating cargo handling.
- Benefits: This reduces waiting times, improves resource utilization, and enhances overall port efficiency

By integrating AI into pilot operations, the maritime industry can achieve greater efficiency, safety, and sustainability.

7. ANNEXES

A. Include relevant supporting materials

Key efficiency indicators and supporting materials for electric maritime transport:

1. Energy Efficiency Operational Indicator (EEOI)

- **Description:** EEOI measures the energy efficiency of a ship's operations by comparing fuel consumption to the cargo carried over a distance.
- **Formula:** $EEOI = \frac{\text{Total CO Emissions (grams)}}{\text{Cargo Carried (tons)} \times \text{Distance Traveled (nautical miles)}}$
- **Graph:** Below is a sample graph showing the EEOI trends for different types of vessels over time.

2. Annual Efficiency Ratio (AER)

- **Description:** AER divides the annual CO2 emissions of a ship by the product of the distance sailed and the deadweight of the ship.
- **Formula:** $AER = \frac{\text{Annual CO Emissions (grams)}}{\text{Distance Sailed (nautical miles)} \times \text{Deadweight (tons)}}$
- **Table:** Below is a sample table comparing AER values for different ship types.

Ship Type	Annual CO2 Emissions (grams)	Distance Sailed (nautical miles)	Deadweight (tons)	AER
Container Ship	1,000,000	10,000	50,000	2.0
Bulk Carrier	800,000	8,000	40,000	2.5
Tanker	1,200,000	12,000	60,000	2.0

3. Fuel Consumption Reduction

- **Description:** Monitoring and reducing fuel consumption is crucial for improving energy efficiency.
- **Graph:** Below is a sample graph showing the reduction in fuel consumption over time for a fleet of electric vessels.

4. Predictive Maintenance Indicators

- **Description:** Predictive maintenance uses AI to predict equipment failures and schedule maintenance proactively.
- **Table:** Below is a sample table showing predictive maintenance indicators for various ship components.

Component	Predicted Failure Rate (%)	Maintenance Scheduled (hours)	Downtime Reduced (%)
Engine	5	100	20

Component	Predicted Failure Rate (%)	Maintenance Scheduled (hours)	Downtime Reduced (%)
Propulsion System	3	80	15
Electrical System	2	60	10

These indicators and supporting materials provide a comprehensive overview of the efficiency and performance of electric maritime transport.

Systems and materials that can be used for continuous training and updates for port pilots:

1. Simulation Technology

- Description: High-fidelity simulators replicate real-world scenarios for training purposes.
- Visual: A screenshot of a maritime simulator showing a complex manoeuvre scenario.

!Maritime Simulator

2. Augmented Reality (AR) and Virtual Reality (VR)

- Description: AR and VR tools provide immersive training experiences.
- Visual: An image of a pilot using AR glasses to visualize navigational data overlaid on the real world.

3. Portable Pilot Units (PPUs)

- Description: PPUs provide real-time navigational data, including electronic charts and vessel positioning.
- Visual: A photo of a pilot using a PPU on the bridge of a ship.

4. Predictive Maintenance Dashboards

- Description: AI-powered dashboards monitor equipment conditions and predict potential failures.
- Visual: A dashboard showing predictive maintenance data for various ship components.

5. Energy Efficiency Indicators

- Description: Graphs and charts showing energy efficiency metrics such as EEOI and AER.
- Visual: A sample graph showing the EEOI trends for different types of vessels over time.

6. Cybersecurity Tools

- Description: Systems and protocols to protect maritime operations from cyber threats.
- Visual: An infographic illustrating the layers of cybersecurity measures in maritime operations.

7. Environmental Awareness

- Description: Visuals highlighting best practices for pollution prevention and sustainable operations.

- **Visual:** An image showing a ship equipped with green technologies like solar panels and wind turbines.

These visual materials can enhance the learning experience for port pilots, making the training more engaging and effective.

Implementing visuals in training can significantly enhance the learning experience for port pilots. Here are some practical steps to integrate these visuals effectively:

1. Interactive Presentations

- **Description:** Use tools like PowerPoint or Prezi to create interactive presentations.
- **Implementation:** Embed images, graphs, and infographics into slides. Use animations to highlight key points and transitions.
- **Example:** Include a slide with the EEOI trends graph and use animations to explain how the indicator is calculated and its importance.

2. Simulation-Based Training

- **Description:** Incorporate high-fidelity simulators that replicate real-world scenarios.
- **Implementation:** Use simulation software to create scenarios where pilots can practice manoeuvres and emergency responses.
- **Example:** Set up a simulation exercise where pilots navigate a vessel using a Portable Pilot Unit (PPU) in challenging conditions.

3. Augmented Reality (AR) and Virtual Reality (VR)

- **Description:** Use AR and VR tools for immersive training experiences.
- **Implementation:** Provide AR glasses or VR headsets to trainees. Develop AR/VR modules that overlay navigational data or create virtual environments for practice.
- **Example:** Use VR to simulate a port environment where pilots can practice docking and undocking procedures.

4. Dashboards and Data Visualization

- **Description:** Use dashboards to display real-time data and predictive maintenance indicators.
- **Implementation:** Set up digital dashboards in training rooms. Use software like Tableau or Power BI to visualize data.
- **Example:** Display a predictive maintenance dashboard and walk trainees through interpreting the data and scheduling maintenance.

5. Infographics and Posters

- **Description:** Create infographics and posters to summarize key concepts and best practices.
- **Implementation:** Design visually appealing infographics using tools like Canva. Print and display them in training rooms or distribute digital copies.
- **Example:** Develop an infographic on cybersecurity measures and display it prominently in the training area.

6. Video Tutorials and Demonstrations

- **Description:** Produce video tutorials that demonstrate the use of new technologies and procedures.
- **Implementation:** Record videos using screen capture software or cameras. Include step-by-step instructions and real-world examples.
- **Example:** Create a video tutorial on using AR glasses for navigational data visualization and share it with trainees.

7. Workshops and Hands-On Sessions

- **Description:** Conduct workshops where trainees can interact with the technologies.
- **Implementation:** Organize hands-on sessions where pilots can use PPUs, AR glasses, or simulators.
- **Example:** Host a workshop on predictive maintenance where trainees use dashboards to identify potential equipment failures.

8. Online Learning Platforms

- **Description:** Use online platforms to deliver training modules and resources.
- **Implementation:** Upload visuals, videos, and interactive content to platforms like Moodle or Blackboard.
- **Example:** Create an online course module on energy efficiency indicators with embedded graphs and interactive quizzes.

Evaluation Criteria

Evaluating the effectiveness of training methods is crucial to ensure they meet learning objectives and improve performance. Here are some key methods and criteria for evaluating training effectiveness:

1. Kirkpatrick's Four-Level Training Evaluation Model

- **Level 1: Reaction**
 - **Description:** Measure participants' immediate reactions to the training.
 - **Methods:** Post-training surveys and feedback forms.
 - **Example Questions:** Did you find the training useful? Was the content relevant to your job?
- **Level 2: Learning**
 - **Description:** Assess the increase in knowledge or skills.
 - **Methods:** Pre- and post-training tests, quizzes, and practical assessments.
 - **Example:** Comparing test scores before and after the training to measure knowledge gain.

- **Level 3: Behaviour**
 - **Description:** Evaluate changes in behaviour and application of skills on the job.
 - **Methods:** Observations, performance reviews, and 360-degree feedback.
 - **Example:** Monitoring how often new skills are applied in the workplace.
- **Level 4: Results**
 - **Description:** Measure the impact of training on organizational goals.
 - **Methods:** Key performance indicators (KPIs), return on investment (ROI) analysis.
 - **Example:** Assessing improvements in productivity, quality, or customer satisfaction.

2. Phillips' ROI Model

- **Description:** Adds a fifth level to Kirkpatrick's model, focusing on the financial return of training.
- **Methods:** Cost-benefit analysis, calculating the monetary value of training outcomes.
- **Example:** Comparing the cost of training to the financial benefits gained from improved performance.

3. Learning Transfer Evaluation

- **Description:** Assess how well participants apply what they learned in their work environment.
- **Methods:** Follow-up surveys, interviews, and on-the-job performance metrics.
- **Example:** Evaluating the frequency and effectiveness of new skills used in daily tasks.

4. Pre- and Post-Training Assessments

- **Description:** Measure knowledge or skill levels before and after training.
- **Methods:** Tests, quizzes, practical demonstrations.
- **Example:** Comparing pre-training and post-training test scores to determine learning gains.

5. Behavioural Observation

- **Description:** Observe and document changes in behavior and performance.
- **Methods:** Direct observation, video recordings, peer reviews.
- **Example:** Supervisors observing pilots' use of new navigational technologies during operations.

6. Feedback and Surveys

- **Description:** Collect feedback from participants and stakeholders.
- **Methods:** Surveys, focus groups, interviews.
- **Example:** Gathering feedback on the effectiveness of simulation-based training from pilots.
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7. Performance Metrics

- **Description:** Use specific metrics to evaluate the impact of training on job performance.
- **Methods:** KPIs, performance dashboards, productivity reports.
- **Example:** Tracking improvements in docking efficiency and safety incidents after training.

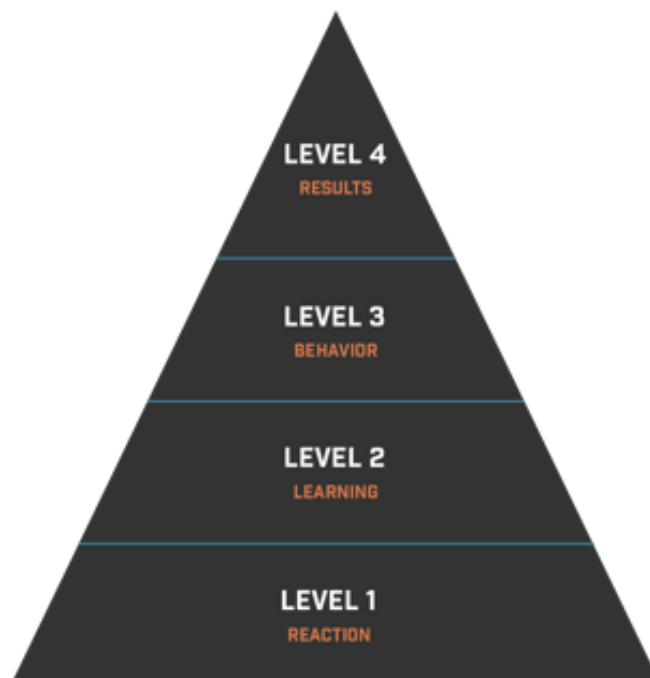
Sample Survey Questions for Level 1: Reaction

1. How satisfied were you with the training content?
2. How relevant was the training to your job?
3. How effective was the trainer in delivering the content?

Sample Pre- and Post-Training Test Results

Participant Pre-Test Score Post-Test Score Improvement (%)

Pilot A	70%	90%	20%
Pilot B	65%	85%	20%
Pilot C	80%	95%	15%



The Kirkpatrick Model is a globally recognized method of evaluating the results of training and learning programs. It assesses both formal and informal training methods and rates them against four levels of criteria: **reaction, learning, behaviour, and results**.

Kirkpatrick's Four-Level Training Evaluation Model

Level 1: Reaction

The first level of criteria is “reaction,” which measures whether learners find the training engaging, favourable, and relevant to their jobs. This level is most commonly assessed by an after-training survey (often referred to as a “smile sheet”) that asks students to rate their experience.

A crucial component of Level 1 analysis is a focus on the learner versus the trainer. While it may feel natural for a facilitator to fixate on the training outcome (such as content or learning environment), the Kirkpatrick Model encourages survey questions that concentrate on the learner’s takeaways.

EVALUATION CATEGORY	TRAINER-CENTERED	LEARNER-CENTERED
PROGRAM OBJECTIVES	The program objectives were clearly defined. The program objectives were covered by the instructor. The material was the right level of complexity for my background.	I understood the learning objectives. I was able to relate each of the learning objectives to the learning I achieved. I was appropriately challenged by the material.
COURSE MATERIALS	The course materials were well organized. The course materials complemented the course content.	I found the course materials easy to navigate. I felt that the course materials will be essential for my success.
CONTENT RELEVANCE	The material was relevant to my needs.	I will be able to immediately apply what I learned.
FACILITATOR KNOWLEDGE	The facilitator demonstrated a good understanding of the material. The facilitator shared his/her experiences in regards to the content.	My learning was enhanced by the knowledge of the facilitator. My learning was enhanced by the experiences shared by the facilitator.

Level 2: Learning

Level 2 gauges the learning of each participant based on whether learners acquire the intended **knowledge, skills, attitude, confidence and commitment** to the training. Learning can be evaluated through both formal and informal methods and should be evaluated through pre-learning and post-learning assessments to identify accuracy and comprehension.

Methods of assessment include exams or interview-style evaluations. A defined, clear scoring process must be determined in advance to reduce inconsistencies.

Level 3: Behavioural Change

One of the most crucial steps in the Kirkpatrick Model, Level 3 measures whether participants were truly impacted by the learning and if they’re applying what they learn. Assessing **behavioural**

changes makes it possible to know not only whether the skills were understood, but if it's logistically possible to use the skills in the workplace.

Oftentimes, evaluating behaviour uncovers issues within the workplace. A lack of **behavioural change** may not mean training was ineffective, but that the organization's current processes and cultural conditions aren't fostering an ideal learning environment for the desired change.

Level 4: Results

The final level, Level 4, is dedicated to measuring direct results. Level Four measures the learning against an organization's business outcomes—the Key Performance Indicators that were established before learning was initiated. Common KPI's include higher return on investments, less workplace accidents, and larger quantity of sales.

Using the Kirkpatrick Model creates an actionable measurement plan to clearly define goals, measure results and identify areas of notable impact. Analysing data at each level allows organizations to evaluate the relationship between each level to better understand the training results—and, as an added benefit, allows organizations to readjust plans and correct course throughout the learning process.

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