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Innovation Cluster #1

Port Infrastructure

A. Sustainable & Resilient Infrastructure

1. Structural Health Monitoring of Port Infrastructure

Chennai Port's ageing berth infrastructure, spanning over six decades, faces critical structural integrity challenges that traditional manual inspection methods cannot adequately address. Current assessment practices fail to provide real-time, comprehensive structural health data without operational disruption, leaving potential internal defects, corrosion, and foundation issues undetected until visible damage occurs. The port requires a transformative non-invasive monitoring solution that leverages IoT sensor technologies and combined with innovative assessment techniques to continuously assess structural parameters while maintaining uninterrupted port operations.

Anchor Port: **Chennai Port Authority, Chennai**

2. Tidal Stream and Flow Monitoring for Navigation Safety

During the monsoon season, continuously varying tides, river discharge, and unpredictable wind action create unpredictable conditions in approach channels, especially at entrance channels. The current reliance on scattered tide gauges, forecasts, and visual judgment does not provide continuous, depth-wise, real-time current information. This poses a particular risk to deep-draft vessels, as cross-currents can cause aborted berthings, delays, excess tug use, and heightened safety risks. To address this, a real time tool using any innovative approach is needed to deliver live predicitons of cross currents, wind drift and ROT assimilated by short term measurements and forecasts available to VTS and pilot kits could significantly improve the safety and efficiency of navigation.

Anchor Port: **Cochin Port Authority, Kochi**

3. **Climate-Resilient Smart Port Infrastructure with Adaptive Design**

   Ports face rising risks from extreme weather events combined with climate driven sea-level rise and flooding, yet existing infrastructure is largely built on traditional codal provisions. Current planning frameworks lack forecast-based resilience modelling and adaptive structural flexibility, leaving critical port assets exposed. By integrating digital twins, innovative structural adaptation strategie,s and event-based design tools combined with smart design options, ports could optimize infrastructure costs while improving safety profiles.

   Anchor Port: **Visakhapatnam Port Authority, Visakhapatnam**

4. **Predictive Maintenance of Port Road and Drainage Infrastructure**

   Coastal and port infrastructure rely on robust road networks and effectively functioning drainage systems to ensure seamless logistics, personnel movement, and operational safety. Manual inspection regimes and reactive maintenance approaches often result in delayed defect detection, costly repairs, and operational disruptions—especially during adverse weather. There is a compelling need for state-of-the-art pore pressures and drainage routing techniques combied with adaptive planning strategies could enable continuous predictive insight into performance of the road and drainage infrastructure, supporting targeted, preventive maintenance and resilience planning.

   Anchor Port: **Deendayal Port Authority, Gandhidham**

Innovation Cluster #2

Smart & Integrated Port Operations

A. Intelligent Terminal Management

1. Trailer Movement and Gate Congestion Management

Port gates, serving as critical choke points for landside logistics, frequently experience significant congestion due to inefficient trailer movement and prolonged waiting times. This leads to severe operational disruptions, financial penalties such as demurrage charges, and heightened safety risks within the port environment. Ensuring the seamless and efficient flow of trailers requires a transformative shift from manual, reactive regulation of traffic to innovative real-time techniques / solutions supported by a suite of monitoring methods could result in smooth flow of traffic and trailor movements, thereby optimising gate operations and enhancing overall port throughput.

Anchor Port: **Chennai Port Authority, Chennai**

2. Vessel Monitoring and Compliance at Berths

Efficient berth utilisation is critical for maximising port throughput and minimising vessel turnaround time. At present, ports lack an automated, real-time system to monitor and analyse vessel activity status at berths. Current processes provide limited visibility into whether a berth is occupied, idle, or actively engaged in cargo discharge operations. This lack of granular, real-time data makes it difficult to diagnose inefficiencies, prevent unplanned delays, or optimise berth operations. Any innovative approaches that combine JIT arrival and departure schedules and berth & evaculation readiness parameters could enable ports to minimise operational bottlenecks, reduce idle time, and enhance berth productivity.

Anchor Port: **Cochin Port Authority, Kochi**

3. **Robotic Mooring System for Safe Berthing Operations**

   Traditional vessel mooring operations, heavily reliant on manual handling and tug assistance, are prone to significant safety risks, operational inefficiencies, and prolonged vessel turnaround times. These challenges lead to increased operational costs, potential damage to vessels and infrastructure, and disruptions to port schedules. Ensuring safe, swift, and cost-effective vessel berthing and unberthing requires a transformative shift towards an autonomous robotic mooring system that can precisely manage vessel docking and undocking in diverse conditions, and seamlessly integrate with port management systems for optimised, just-in-time docking.

   Anchor Port: **Jawaharlal Nehru Port Authority, Navi Mumbai**

B. Seamless Cargo Flow

1. **Real-Time Integrated Monitoring System for Vessel-to-Pipeline and Tank Farm Transfer Operations**

   Coordinating the transfer of liquid cargo from vessels at oil jetties, through pipelines, and into tank farms is a critical and complex port operation. Manual monitoring, disjointed systems, and information gaps can result in operational inefficiencies, underutilised infrastructure, delayed cargo transfer, and heightened safety and environmental risks. On the other hand, the liquid berths are highly sensored at different locations – indicating health of the system and readiness for operations. Use of these data and readiness assessment would be beneficial to optimise these transfer operations, enhancing visibility, safety, and throughput for all stakeholders.

   Anchor Port: **Deendayal Port Authority, Gandhidham**

2. **Aerial Cargo Evacuation Systems for Port Operations**

   Ports in India face significant delays in cargo evacuation due to reliance on ground-based systems such as cranes, trailers, and manual coordination. Congestion, downtime, and bottlenecks at the berth-to-yard interface extend vessel turnaround time, reducing overall operational efficiency. The challenge is to design an aerial cargo evacuation system leveraging drones, unmanned aerial vehicles (UAVs), and rotary-wing aircraft to accelerate cargo movement, ease ground congestion, and improve emergency response capacity in port operations.

   Anchor Port: **Kamarajar Port, Ennore**

C. Proactive Planning & Optimisation

1. Intelligent Siltation Analysis for Dredging Optimisation

Ports worldwide face escalating challenges due to siltation, which increases dredging needs, operational costs, environmental impacts, and navigational risks. Traditional dredging schedules often rely on fixed-interval hydrographic surveys, leading to inefficiencies, over-dredging, or missed hotspots. To maintain safe navigation, ports require a real-time Smart Siltation Monitoring System (SSMS) that integrates underwater sensor networks on IoT supported by suitable platforms could minimize draft loss and dredging cost leading to sustainable channel usage.

Anchor Port: **Cochin Port Authority, Kochi**

2. Automated Water Depth Monitoring with GPS Integration

JNPA's berths and approach channel at Vashi creek face critical depth monitoring challenges due to monsoon conditions, high traffic density, and strong tidal currents that cause seasonal siltation. Current survey boat operations are weather-dependent, cost-prohibitive, and operationally inadequate for continuous monitoring requirements. Any automated underwater drone based depth mapping solution may be essential to ensure continuous depth monitoring ensuring navigation safety, optimised dredging operations, and build predictive siltation management capabilities.

Anchor Port: **Jawaharlal Nehru Port Authority, Navi Mumbai**

3. Automated Berth Allotment Aligned to Cargo Dynamics and Policies

Berth scheduling at ports remains largely manual, reactive, and rule-bound. It struggles to factor in real-time changes such as vessel ETA delays, cargo dynamics, draft restrictions, and equipment availability. The absence of a unified decision support system optimizing vessel time at berth is required to imrove berth occupancy and effciency.

Anchor Port: **Visakhapatnam Port Authority, Visakhapatnam**

4. Real-Time Tidal Current Analysis and Prediction

Tidal currents are critical to safe navigation and efficient port operations. Current forecasting methods rely on manual measurements and static models that lack real-time accuracy. This leads to delays, unsafe manoeuvring, and inefficient scheduling. A predictive solution is required to provide reliable, real-time tidal current insights for safer and smoother marine operations.

Anchor Port: **Deendayal Port Authority, Gandhidham**

5. **Real-Time Dredging Volume Monitoring with GPS-Based Tracking**

   The Mormugao Port Authority faces critical transparency and efficiency challenges in its annual 45-day maintenance dredging operations across inner and outer channels and berth pockets. Current volume computation disputes between pre/post-dredge surveys using Simpson's method and contractor's Hypack software calculations create payment discrepancies and operational inefficiencies. Dredging monitoring based on realistic volume predictions in channel and at hopper could benefit effective maintenance dredging optimizing cost and resources.

   Anchor Port: **Mormugao Port Authority, Goa**

6. **Siltation Control Solutions for NMPA Operations**

   Uncontrolled siltation at ports like NMPA leads to increased dredging frequency, reduced berth availability, higher maintenance costs, and operational delays. Current approaches rely heavily on reactive dredging without predictive insights, resulting in inefficiencies and unsustainable expenditure. The challenge is to design a draft optimizing method to reliably predict navigable depths and navigation windows.

   Anchor Port: **New Mangalore Port Authority, Mangaluru**

7. **Smart Tide–Weather–Draft Integration for Port Operations**

   Indian ports currently rely on fragmented inputs—draft surveys, tide windows, and weather data—which are not unified or updated in real time. This results in reactive dredging, avoidable anchorage congestion, and heightened navigation risks during adverse conditions. A real-time platform that integrates draft, tide, and meteorological data with operational inputs can enable proactive berth scheduling and optimised dredger tasking, significantly improving safety and productivity.

   Anchor Port: **Dredging Corporation of India**

8. **Dynamic Berth Allocation System**

   Berth allocation at Mumbai Port’s Indira Dock is a highly complex process governed by vessel size, draft availability, tidal cycles, lock gate access, and government priority rules. Manual scheduling is time-consuming, error-prone, and lacks transparency, often leading to vessel detention, high demurrage charges, and operational inefficiencies. A digital scheduling system is required to automate berth allotment, ensure compliance, and minimise pre-berthing delays.

   Anchor Port: **Mumbai Port Authority, Mumbai**

9. **Optimising Mooring Crew Planning and Deployment as per Vessel Schedule**

   Mumbai Port Authority (MbPA) seeks to modernise its manual system for managing mooring crews. The current process, which is reactive and disconnected from real-time vessel updates, leads to inefficiencies, delays, and suboptimal crew allocation. The core challenge is the absence of predictive

planning tools and integrated scheduling systems. A technology-driven solution is needed to dynamically plan, schedule, and deploy mooring crews in sync with real-time vessel movements and berthing plans.

Anchor Port: **Mumbai Port Authority, Mumbai**

10. **Real-Time Recording, Monitoring & Automated Data Integration of Vessel Movements**

    Mumbai Port Authority (MbPA) seeks to enhance its vessel monitoring to address operational complexities and delays, despite having an existing system, iPortman (EBS). The core challenge is the lack of real-time visibility into vessel-related events, which currently rely on manual data entry and fragmented reporting. This leads to inefficiencies in resource planning, billing, and coordination, particularly for vessels at outer anchorages. An integrated, technology-driven solution is needed to provide comprehensive, real-time data to optimise port operations and improve service levels.

    Anchor Port: **Mumbai Port Authority, Mumbai**

D. Unified Digital Platform

1. **Virtual Port Platform for Smart Port Operations**

   Cochin Port Authority faces critical operational challenges in transitioning from traditional port management to smart port operations, with limited real-time visibility, inadequate predictive insights, and fragmented automation systems. Current legacy infrastructure and connectivity constraints result in inefficient cargo movements, suboptimal berth utilisation, and reactive decision-making processes that impact overall port competitiveness. The transformative solution requires a comprehensive virtual port platform that integrates digital twin technology with Private 5G connectivity to enable real-time monitoring, predictive analytics, and automated decision support systems. This capability-building initiative aligns with the Maritime Amrit Kaal Vision 2047 goals of creating world-class digital port ecosystems that enhance operational efficiency and strategic positioning.

   Anchor Port: **Cochin Port Authority, Kochi**

E. Efficient Warehousing & Storage

1. **Real-Time Warehouse Space and Cargo Tracking**

   Efficient management of cargo flow and space utilisation in modern ports remains a complex challenge. Manual and siloed monitoring methods result in limited transparency, operational delays, and underutilised resources, which in turn lead to longer turnaround times and potential safety risks. This necessitates a need for advanced, data-driven solutions that can provide real-time intelligence for responsive yard and godown operations.

   Anchor Port: **Chennai Port Authority, Chennai**

2. **Real-Time Tracking of Cargo Occupancy and Movement in Plots and Godowns**

   Efficient management of cargo flow, space utilisation, and movement in allotted plots and godowns remains a complex challenge for modern ports. Manual or siloed monitoring approaches cause limited transparency, operational delays, and underutilised resources, leading to increased turnaround times and potential revenue and safety risks. There is a need for advanced, data-driven methods to deliver actionable, real-time intelligence for responsive yard and godown operations.

   Anchor Port: **Deendayal Port Authority, Gandhidham**

3. **Real-Time Monitoring for Smarter Warehouse Utilisation & Cargo Visibility**

   At Mumbai Port's Indira Dock, rising cargo volumes and diverse cargo types (bulk, break-bulk, automobiles, containers) have created significant pressure on limited warehouse sheds and open yards. Manual space allotment leads to underutilisation, delays, and conflicts, directly affecting vessel turnaround and port efficiency. A real-time monitoring and analytics system is needed to optimise storage use, track cargo movement, and ensure transparent, efficient cargo handling.

   Anchor Port: **Mumbai Port Authority, Mumbai**

F. End-to-End Visibility

1. **Real-Time Recording and Integration of Vessel Movement Data**

   Across the port, terminals, Vessel Traffic Services (VTS), and pilots record the same vessel-movement events in separate systems and formats. Manual entries, delayed updates, and differing codes create duplicate records and timestamp mismatches, disrupting planning, billing, and compliance. A unified, real-time platform is needed to capture, validate, and synchronise movement data once, share it everywhere, and establish a single source of truth for all stakeholders.

   Anchor Port: **Jawaharlal Nehru Port Authority, Navi Mumbai**

G. Streamlined Processes

1. **Hired Vehicle Pool Tracking and Maintenance System**

   Ports rely heavily on hired vehicles for cargo movement, logistics, and staff transportation. However, manual tracking of hired vehicles and their maintenance cycles leads to inefficiencies, higher downtime, and escalating costs. The absence of a unified monitoring system creates challenges in vehicle availability, usage transparency, and preventive maintenance planning. A Smart Fleet & Pool Vehicle Management System is needed to automate tracking, monitor performance, optimise utilisation, and reduce operational costs.

   Anchor Port: **V. O. Chidambaranar Port Authority, Tuticorin**

H. Strategic Hub Development

1. **Cargo Forecasting and Trade Incentive Intelligence Platform**

   Ports today depend on manual reporting and static historical trends for cargo forecasting, which are insufficient in a volatile global trade environment. Without an integrated forecasting system, ports cannot anticipate demand shifts, align incentives, or proactively engage with shippers and trade partners. A cargo forecasting and trade incentive intelligence platform powered by combining vessel movement plans across the globe and cargo booking patterns could result in products that to provide accurate, multi-timeframe forecasts, enabling proactive planning and policy-driven trade incentives.

   Anchor Port: **New Mangalore Port Authority, Mangaluru**

I. Future-Proof Workforce

1. **Marine Infrastructure and Manpower Optimisation Framework**

   Ports incur high operational costs due to inefficient deployment of infrastructure (cranes, berths, storage areas) and fluctuating manpower needs. Current planning is often reactive, relying on manual estimates and limited visibility into peaks and lulls. An perfomrnace based optimisation framework is needed to dynamically align infrastructure and workforce deployment with real-time demand, improving productivity, reducing idle capacity, and enhancing service levels.

   Anchor Port: **New Mangalore Port Authority, Mangaluru**

J. Vessel Performance Optimisation

1. **Long-Period Berthing Simulation Using Digital Modelling**

   Ports, terminals, and pilots often record the same vessel-movement events in separate systems and formats. Manual entries, delayed updates, and inconsistent codes create duplicates and timestamp mismatches, disrupting planning, billing, and compliance. A unified, real-time platform is required to capture and synchronise vessel events at key locations by any automated logging system combining AIS data could effectively be used to polulate the vessel movement data across all systems.

   Anchor Port: **New Mangalore Port Authority (NMPA), Mangalore**

2. **Vessel Performance Monitoring System for Ports**

   Port and terminal operators currently lack a comprehensive vessel monitoring mechanism to accurately identify reasons for operational delays and implement effective preventive measures. The absence of integrated performance tracking systems results in subjective assessments, incorrect delay attribution, and missed opportunities for operational optimisation. This challenge is particularly acute in multi-cargo terminals where complex combinations of mechanical and manual activities occur simultaneously.

   Anchor Port: **V. O. Chidambaranar Port Authority, Tuticorin**

Innovation Cluster #3

Integrated Logistics & Multimodal Connectivity

A. Efficient Connectivity

1. **Enhancing Last-Mile Cargo Connectivity with Real-Time Data**

   Paradip Port Authority faces critical inefficiencies in cargo evacuation due to fragmented data systems across port operations, Indian Railways, and road transporters, resulting in increased dwell times, congestion, and elevated logistics costs. The absence of a unified real-time data integration platform prevents coordinated decision-making across multiple transportation modes, creating bottlenecks that undermine the port's operational efficiency. A transformative system that could integrate cargo movement statuses is needed to consolidate disparate data streams into a single intelligent dashboard that enables predictive analytics, proactive planning, and seamless coordination between all stakeholders.

   Anchor Port: **Paradip Port Authority (PPA), Paradip**

B. Seamless Intermodal Transfers

1. **Rail Evacuation Planning to Overcome First/Last Mile Barriers**

   Mormugao Port Authority faces significant operational inefficiencies in rail cargo evacuation due to single-line constraints and inadequate infrastructure optimisation between the port's R&D yard and the broader rail network. Current manual scheduling and routing processes, coupled with incomplete rail doubling from Vasco to Hubbali, result in extended rake turnaround times that severely limit cargo evacuation capacity.

   Anchor Port: **Mormugao Port Authority, Goa**

2. **Sustainable Bulk Cargo Transport Network for Next-Gen Ports**

   Bulk cargo such as coal, iron ore, and fertilisers is currently evacuated from berths to yards using truck fleets and conveyor systems. These methods face limitations like traffic congestion, high operating costs, environmental concerns, and frequent downtime. During peak operations, the inefficiency of these systems directly delays cargo clearance and vessel turnaround. The challenge is to design a scalable, high-capacity, and low-emission bulk cargo evacuation system that reduces dependency on fossil-fuel trucks while ensuring faster and cleaner transport.

   Anchor Port: **Kamarajar Port Limited**

Innovation Cluster #4

Green & Sustainable Maritime Sector

A. Carbon Neutrality

1. **Digital Emissions Monitoring for Carbon-Neutral Port Transition**

   Ports produce significant emissions from vessels, equipment, vehicles, and facilities, yet lack a unified monitoring framework. Current green initiatives remain fragmented and fail to provide a full emissions profile. A centralised digital system is needed to deliver real-time visibility, actionable insights, and ensure compliance with global carbon-neutrality standards.

   Anchor Port: **Paradip Port Authority, Jagatsinghpur**

B. Resource Efficiency & Alternate Energy Sources

1. **Universal Ship-to-Shore Power Supply Interface Development**

   Mormugao Port Authority (MPA) faces critical challenges in implementing universal shore power systems due to the lack of standardisation across diverse vessel types and absence of IMO regulations for ship-to-shore power interfaces. The current infrastructure limitations, including inadequate power capacity (2 MVA vs required 10 MVA), frequency conversion challenges (50Hz grid vs 60Hz ship systems), and regulatory constraints around power distribution licensing, prevent effective implementation of emission-reducing shore power solutions.

   Anchor Port: **Mormugao Port Authority, Goa**

2. **Universal Ship-to-Shore Power Supply Interface Standardisation**

   There is currently no universal plug-and-socket interface that accommodates the diverse electrical receiving configurations of different vessels. This mismatch forces manual connection and disconnection, leading to safety risks, operational delays, and poor adoption of shore power. An operational prototype is needed to standardise the interface, improving safety and promoting eco-friendly ship-to-shore electrification.

   Anchor Port: **New Mangalore Port Authority, Mangalore**

3. **Standardised Shore Power Supply Systems for Ports**

   Indian ports currently lack standardised shore power supply systems, creating significant operational challenges for commercial and cruise vessels seeking to connect to grid electricity while berthed. The absence of universal voltage standards, capacity specifications, and compatible reception facilities on visiting vessels results in continued reliance on onboard diesel generators, contributing to harmful emissions and operational inefficiencies. A comprehensive standardisation framework is needed to establish universal ship-to-shore power interfaces that accommodate varying electrical configurations while ensuring safety, reliability, and environmental sustainability.

   Anchor Port: **Cochin Port Authority, Kochi**

4. **Power from Movement – Sustainable Energy Solutions for Port Infrastructure**

   Major Indian ports experience heavy vehicular traffic, with over 2,000 cargo trucks moving daily—creating an untapped opportunity to generate renewable energy from vibrations. Embedding piezoelectric systems under port roads can convert this movement into usable electricity for operations. However, challenges such as limited domestic expertise, high import costs, and a lack of scalable models hinder adoption. The goal is to develop indigenous, cost-effective, and durable solutions suited to India's port conditions.

   Anchor Port: **Kamarajar Port, Ennore**

C. Circular Economy & Resource Reuse

1. **Port-Wide Plastics-to-Products Circular Economy Platform**

   Visakhapatnam Port Authority faces significant environmental and operational challenges from plastic waste generated across ship operations, fishing activities, and general port operations that currently end up in marine ecosystems or landfills. The absence of an integrated circular processing model represents a critical capability gap that prevents the port from transforming waste streams into commercially viable products while meeting environmental compliance requirements.

   Anchor Port: **Visakhapatnam Port Authority, Visakhapatnam**

D. Air Emissions & Air Quality

1. **Environmental Monitoring and Pollution Mapping for Ports**

   Reactive, fragmented environmental monitoring in port areas makes the timely detection and containment of pollution difficult. Fugitive dust from coal yards, oil slicks at berths, and effluent discharges from drainage outlets are often detected late or not spatially mapped in real time, delaying response and increasing environmental, operational and regulatory risk. Ports need an integrated, real-time sensing/modelling and mapping layer that turns scattered sensor signals and ever available climate prediction models into actionable plume maps and automated alerts for rapid containment and enforcement.

   Anchor Port: **Visakhapatnam Port Authority, Visakhapatnam**

2. **Mineral Extraction from Dredged Sand for Sustainable Revenue Generation**

   Major Indian ports, including Kamarajar Port Limited, generate large volumes of dredged sand during maintenance dredging, most of which is dumped or stored, causing waste and environmental concerns. This material, however, contains valuable minerals like silica, shells, and clay, widely used in construction, ceramics, and glass industries. The absence of standardised mechanisms, infrastructure, and partnerships limits its utilisation. An innovative solution is required to extract and commercialise these resources, creating sustainable revenue while supporting circular economy principles.

   Anchor Port: **Kamarajar Port, Ennore**

Innovation Cluster #5

Advanced Safety, Security & Regulatory Compliance

A. Digital Compliance & Governance

1. **Legal Compliance and Court Judgment Implementation System**

   Government departments often face contempt of court due to delays in implementing judicial orders, mainly because respondents named in cases lack decision-making power, while actual authorities like DoE or DoPT are not engaged. This misalignment causes compliance delays and legal risks. An integerated Legal Compliance and Enforcement System is needed to extract judgments, map them to rules, and notify competent authorities. Such a solution would enable timely compliance, accountability, and reduction of contempt cases in line with governance protocols.

   Anchor Port: **Directorate General of Lighthouses and Lightships, Noida**

2. **Marine Pollution (MARPOL) Compliance Monitoring and Violation Detection**

   During busy harbour operations—especially with tides and strong tidal streams—multiple vessels and craft make it hard to spot and trace oil slicks or garbage dumping in time. Current patrols and scattered cameras miss events, respond late, and rarely identify the offender. Ports need a unified, real-time monitoring layer that detects spills and dumps, pinpoints location & size, and traces likely sources for swift response and MARPOL enforcement – smoothly integerating the response systems and preparedness system.

   Anchor Port: **Jawaharlal Nehru Port Authority, Navi Mumbai**

3. **Strengthening MARPOL Compliance through Real-Time Violation Detection**

   Compliance with MARPOL(marine pollution) regulations is essential for protecting port waters from oil spills, bilge discharges, sewage, garbage dumping, and harmful emissions. Current enforcement relies on manual inspections, vesstel reporting, and limited surveillance, which often miss real-time violations. To strengthen environmental governance, Mumbai Port requires technology-driven solutions—drones, satellites, sensors, and AI analytics—to enable continuous monitoring, rapid detection, and transparent reporting of violations.

   Anchor Port: **Mumbai Port Authority, Mumbai**

B. Proactive Risk Management

1. **GPS Signal Loss and Range Variation Alert System**

   The current reliance on satellite-based navigation systems makes modern port navigation vulnerable to signal interference and false signals, which can cause vessel position errors and drifting, posing a significant risk to safe vessel movement and berthing. To address this, there is a need for a reliable system that can automatically detect these issues in real time and switch to a more resistant, alternative navigation method. This shift to a resilient, multi-source navigation setup will ensure safe vessel movements, reduce delays, and maintain efficient operations even under harsh weather and signal disruption conditions.

   Anchor Port: **Directorate General of Lighthouses and Lightships, Noida (HQ)**

C. Comprehensive Surveillance & Monitoring

1. **Lighthouse Security through Integrated Surveillance and Alerts**

   Remote lighthouse installations across India's extensive coastline face critical security vulnerabilities due to inadequate surveillance capabilities and manual monitoring limitations. Current security measures are insufficient to detect, alert, and respond to unauthorised infiltration and trespassing activities at these vital maritime navigation infrastructure assets. Developing an AI-powered, integrated surveillance system with real-time intrusion detection and automated alert capabilities is essential to protect lighthouse infrastructure and ensure continuous navigation services.

   Anchor Port: **Directorate General of Lighthouses and Lightships, Noida (HQ)**

2. **Low-Cost Drone Detection and Neutralisation System**

   Indian ports face escalating drone-related security threats that require comprehensive surveillance and neutralisation capabilities, yet existing anti-drone systems are prohibitively expensive and maintenance-intensive for budget-constrained port authorities. The challenge demands the development of a cost-effective, highly accurate drone detection and neutralisation system that integrates seamlessly with existing port security systems while yielding maintaining reliable detection accuracy.

   Anchor Port: **Mormugao Port Authority, Goa**

D. Emergency Response & Disaster Management

1. **Early Detection and Containment of Port Safety Incidents**

   Monitoring safety incidents like container damage, smoke, or chemical leakage is difficult with manual surveillance, often causing delayed responses and higher risks. An AI-powered detection framework with IoT sensors and real-time monitoring can provide early anomaly detection, instant alerts, and faster emergency response to enhance port safety and reduce large-scale hazards.

   Anchor Port: **Jawaharlal Nehru Port Authority, Navi Mumbai**

2. **Gas Monitoring in Confined Spaces for Ship Safety**

   Ship repair operations at Cochin Shipyard Limited currently rely on single-point-in-time gas measurements during pre-entry safety checks, leaving workers vulnerable to undetected hazardous atmosphere development during ongoing confined space activities. This reactive approach fails to capture sudden changes in gas concentrations caused by residual contamination, leaks, or disturbed sediments within fuel tanks, ballast tanks, and cargo holds. The shipyard requires a transformative IoT-integrated wireless gas monitoring solution that provides continuous real-time atmospheric surveillance, ensuring worker safety while building advanced digital safety capabilities.

   Anchor Port: **Cochin Shipyard Limited, Kochi**

Innovation Cluster #6

Shipbuilding & Lifecycle Management

A. Advanced Shipbuilding & Repair

1. **Cargo Tank Inspection Using Remote Systems**

   Current cargo tank inspections on oil tankers require manual scaffolding erection and physical surveyor access to heights of up to 25 meters within confined, hazardous spaces, creating significant safety risks and operational inefficiencies. This labour-intensive process results in extended vessel downtime, substantial costs, and potential accidents due to exposure to toxic gases and fall hazards. The challenge seeks an automated underwater/immersive drone-based inspection system that eliminates human entry into confined spaces while providing superior inspection capabilities through advanced imaging technologies.

   Anchor Port: **Shipping Corporation of India, Chennai**

B. Green Fleet Transition

1. **Low-Dust Abrasive Material for Eco-Friendly Ship Surface Preparation**

   Cochin Shipyard Limited faces significant operational and environmental challenges due to excessive dust generation from copper slag-based surface preparation activities in shipbuilding and repair operations. The current blasting process creates substantial air pollution, interferes with ongoing shipyard activities, necessitates extensive clean-up time, and poses health and safety concerns for workers. This challenge seeks innovative, eco-friendly abrasive materials that can match copper slag's surface preparation efficiency while minimising environmental impact, improving workplace air quality, and reducing operational downtime. The solution must align with Maritime Amrit Kaal Vision 2047's goals of sustainable shipyard operations and environmental stewardship.

   Anchor Port: **Cochin Shipyard Limited, Kochi**

C. Sustainable Vessel Lifecycle

1. Underwater Hull Cleaning for Operational Efficiency

Diver-based underwater hull cleaning is slow, hazardous, weather-dependent, and difficult to verify. Complex geometries (bilge keels, sea chests, bow thrusters) limit access; poor visibility & currents extend cleaning time, and manual reporting rarely provides auditable, digital proof of work. Ports also face environmental restrictions on in-water cleaning and debris release, causing operational downtime and schedule risk. A safer, faster, and diver-free approach with verifiable results is needed.

Anchor Port: **Shipping Corporation of India (SCI), Mumbai**