

Leveraging Automation and Digital Solutions for Optimized Maritime Industry

A vision for India's maritime future

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Navigating Tomorrow's Maritime Landscape

Ports and in-land waterways infrastructure are not merely logistical hubs; they are the **lifeblood of trade**, the backbone of global supply chains, and a critical component of national security. In a rapidly evolving world, digitalisation is no longer a choice but an imperative—a pathway to unparalleled global leadership in safety, sustainability, and innovation.



India's Maritime Landscape

90% of India's trade volume handled via ports

Key drivers:

- Cargo growth
- Sustainability demands
- Global competition



Our Vision: A Green & Resilient Maritime Future

Our commitment is to pioneer a maritime sector that sets global benchmarks in environmental stewardship and operational excellence. We envision ports that are not only efficient but also carbon-neutral, driving reduced GHG emissions and embracing innovation for a truly sustainable future.

Reduced GHG Emissions
Pioneering sustainable practices.



Carbon-Neutral Ports
Minimising environmental impact.

Global Innovation
Setting new industry standards.

Digital Transformation: Core Technologies

Embracing cutting-edge technologies is crucial for enhancing efficiency, safety, and sustainability across port and water infrastructure. These tools drive seamless operations and informed decision-making.

Key Technologies:

- **IoT:** Real-time tracking of cargo and water levels.
- **Digital Twins:** Simulating and optimising processes.
- **Automation:** Streamlining gate, yard, and container moves.
- **SCADA & GIS:** Advanced water management systems.
- **Maritime Industrial Clusters:** Fueling port-led industrialisation.



Enhancing Port Sustainability Through Technology

Technology enables us to actively reduce our environmental footprint and respond dynamically to changing conditions, fostering a greener maritime ecosystem.

EEDI Integration

Reducing CO2 emissions per tonne-mile in shipping.

Sustainability Monitoring

Real-time tracking of emissions and resource use at ports.

Early Warning Systems

Digital alerts for tsunamis and adverse weather, linked to IMD.

Digitised SOPs

Ensuring consistency, compliance, and rapid response protocols.

✔ **Use Case:** Chennai Port's Sustainability Toolkit reduced energy intensity by 11% through automation and real-time monitoring.

Navigating Challenges, Seizing Opportunities

The journey to full digitalisation presents hurdles, yet it unlocks immense potential for innovation and efficiency.

Biggest Hurdles:

- **Legacy Systems Integration:** Bridging old and new technologies.
- **Digital Skills Gap:** Developing a future-ready workforce.
- **Cybersecurity Risks:** Protecting interconnected infrastructure.
- **Upfront Technology Investment:** Initial capital expenditure.

Opportunities:

- **AI/ML for Predictive Maintenance:** Optimising crane sensors and water pumps.
- **Smart Dashboards:** Real-time compliance monitoring and modular pilots for scalability.
- **Phased Digital Adoption:** Strategic implementation with measurable milestones.

✔ **Use Case:** Tuticorin Port's digital berth planner cut vessel turnaround time by 10%, showcasing tangible efficiency gains.

Vision 2030 - SmartPorts

100% Paperless

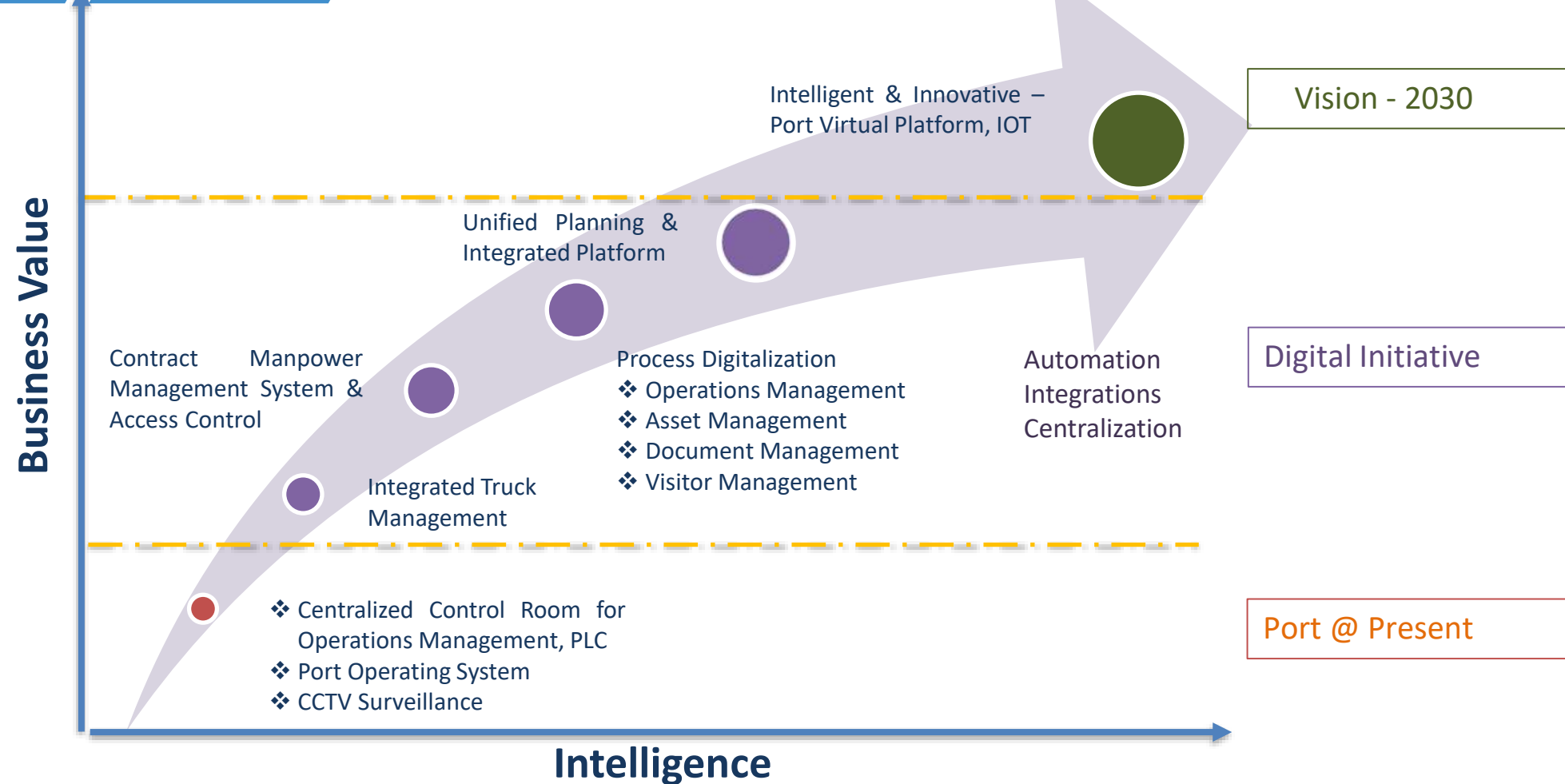
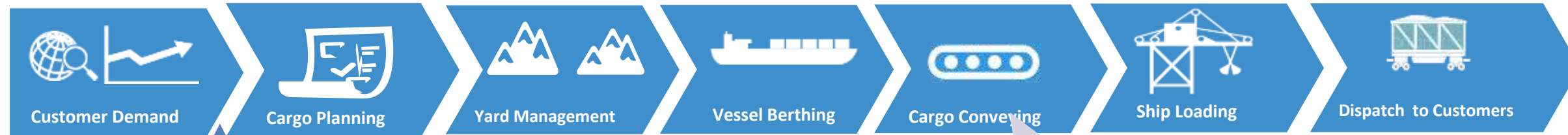
Blockchain-based documentation and EDI integration

IoT Enabled

Smart trucks & predictive analytics for efficiency

Single Window

National & Regional systems for seamless processing



Digitalisation - Broad Zones



Paperless

Thus all documentation through system



Man-Machine Interface

Thereby either moving towards Manless - Full automation or to have a safe environment for man to work



Proper Data Flow

Intelligence with Security so as to have the right information at the right time to the right person.



Automation

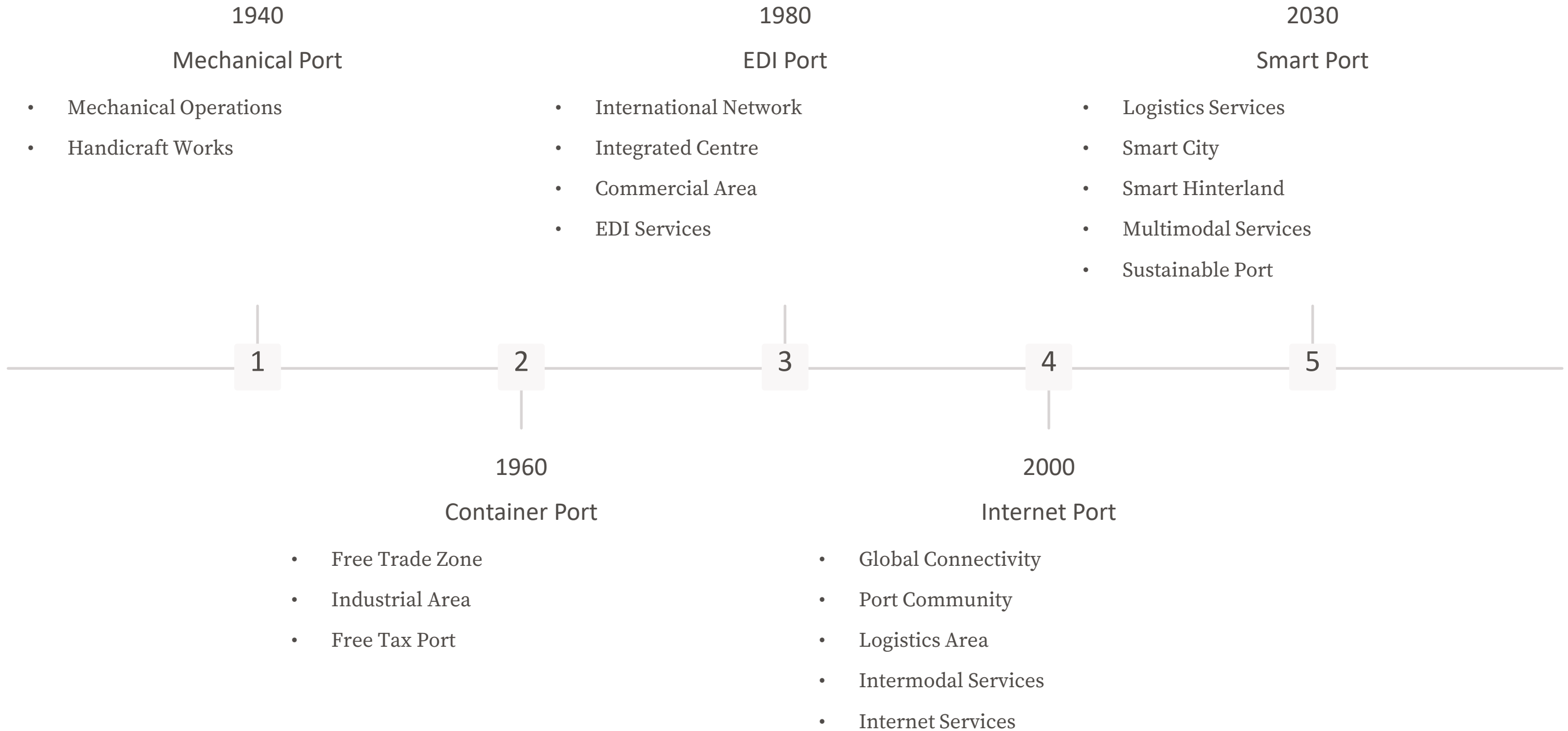
Automation of activities



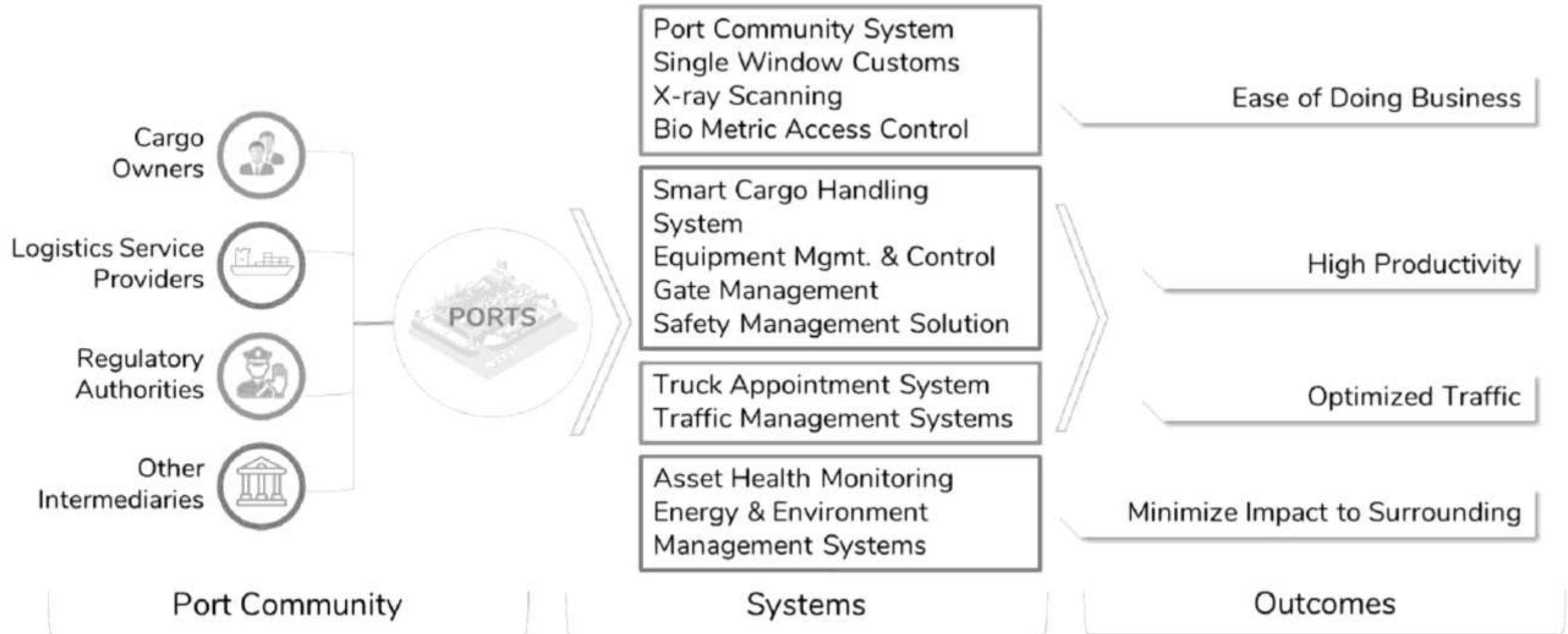
Interface

Interface of various software in use and proposed based on studies.

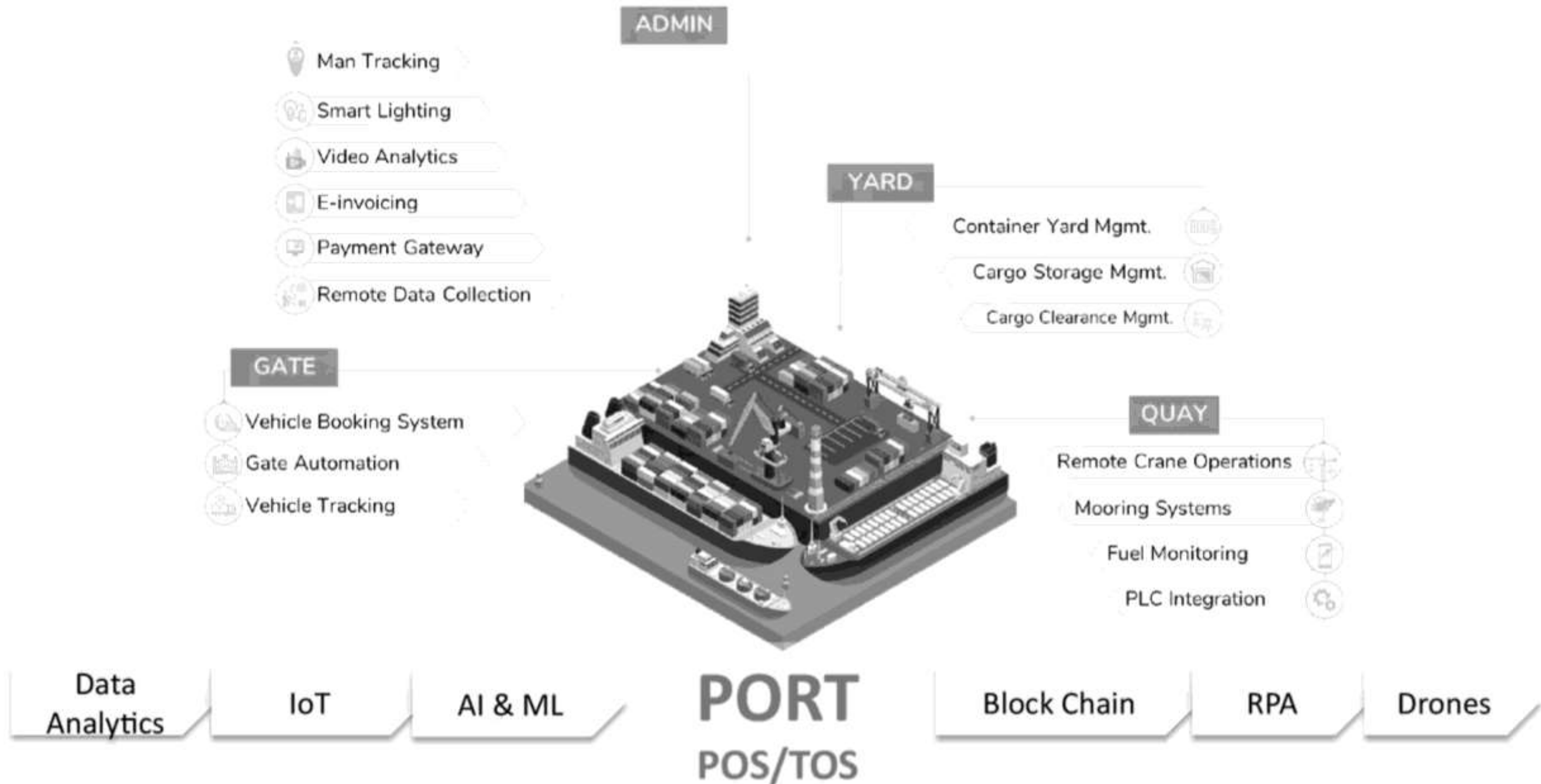
From Digital to Smart



Digitalization of Ports : Horizontal Integration



Digitalization of Ports : Vertical Integration



Amrit Kaal Vision 2047

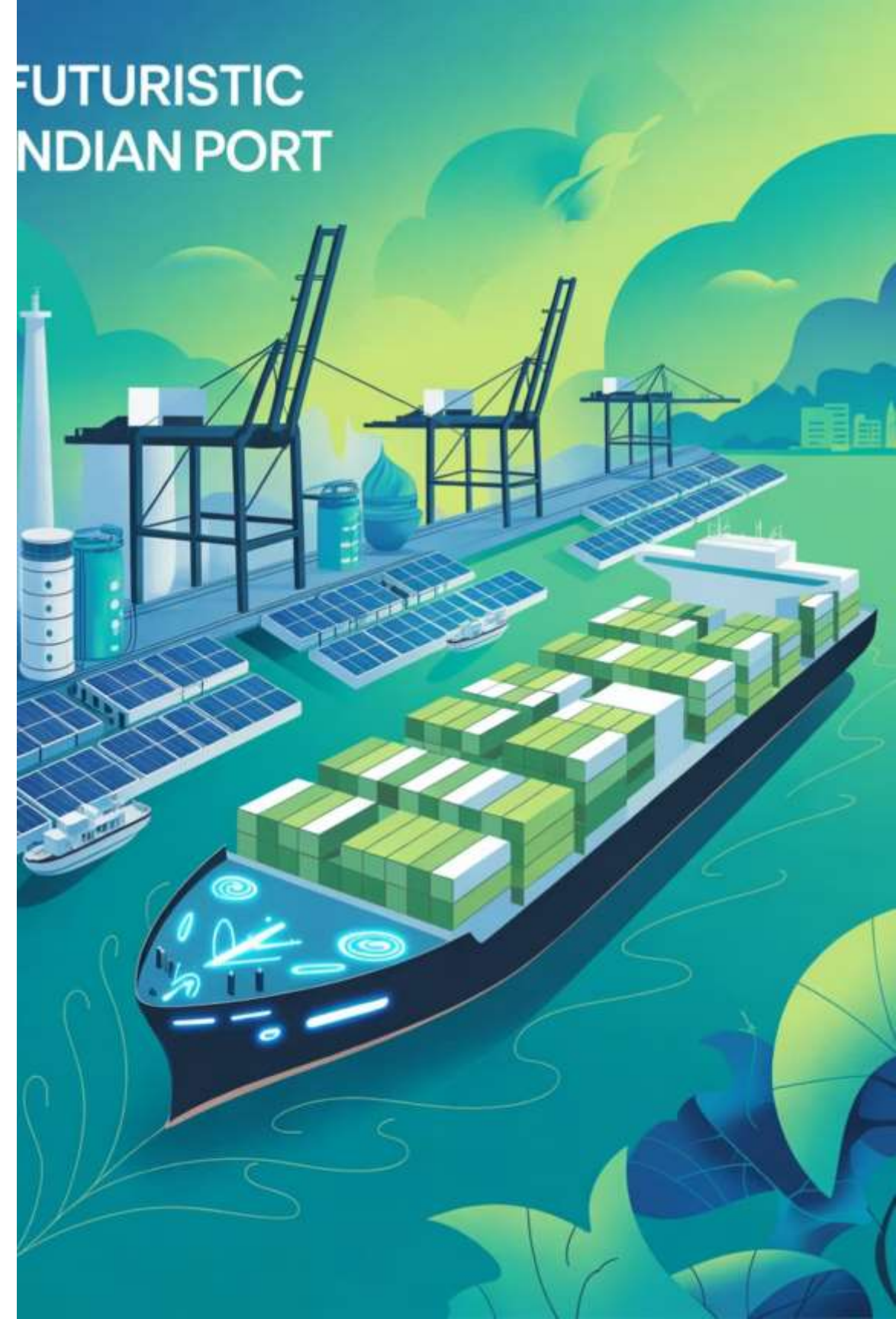
Carbon-neutral ports

Hydrogen/ammonia hubs

MTPA port capacity

Global shipbuilding rank

FUTURISTIC
INDIAN PORT



Case Studies: Digital Transformation

Mundra Port

AI + digital twin for berth allocation

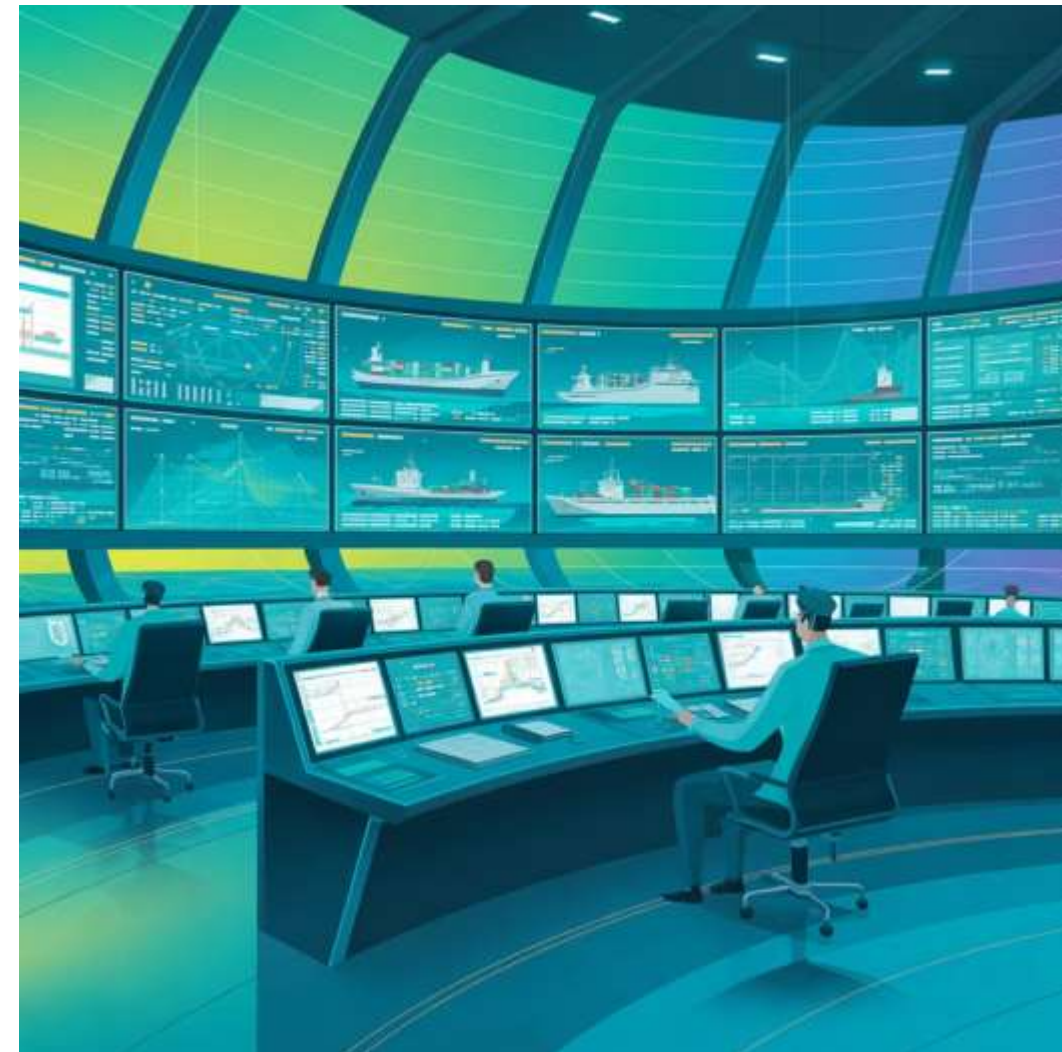
Result: 30% reduction in vessel turnaround time



Port of Rotterdam

Digital twin ecosystem

Result: 20+ hour reduction in waiting times



Inland Waterways: Green Logistics

Vision 2030

Operationalising National Waterways with multimodal integration

Amrit Kaal 2047

50+ waterways, 500+ MMTPA cargo via IWT

Benefits

Green, low-cost, safe alternative to road/rail



Automation & AI Tools



Automated Cranes & AGVs

24/7, error-free operations



AI-Driven Tracking

Predict berth availability, reduce dwell time



Drone Surveillance

Yard monitoring & security

IoT & Data Analytics Revolution



Real-time Monitoring

IoT sensors tracking assets, vessels, and cargo movement



Predictive Analytics

Forecasting arrivals, volumes, and maintenance needs



Centralised Control

Integrated CCTV/PLC systems for port-wide visibility

Key platforms: NLP Marine 2.0, Sagarmanthan, Maritime Single Window



Overcoming Implementation Challenges

Legacy Integration

Complex ERP/OT system integration requirements

Workforce Upskilling

New competencies in robotics, AI, and data science

Cybersecurity Risks

Ransomware threats to critical port operations

National Policy Alignment



Sagarmala

Port-led industrialisation & automation



Maritime Single Window

Unified digital trade system by 2026



Harit Sagar / Harit Nauka

Emission monitoring & green dashboards

Supporting [Industry 4.0](#) & global IMO e-maritime standards

JNPT Success Story



Direct Port Delivery

Dwell Time Reduction

Key initiatives:

- PCS 1x & NLP-Marine digitisation
- Blockchain pilots for Bill of Lading



Rotterdam: Global Benchmark

Key innovations:

- Digital twin + AI simulation for port-wide operations
- CO₂ capture and reuse facilities
- Renewable energy hubs powering port activities

Impact: 20+ hour reduction in vessel waiting times

Way Forward for India

Scale AI Digital Twins

Deploy across all major ports

Expand Waterways

Boost inland & coastal shipping

Green Infrastructure

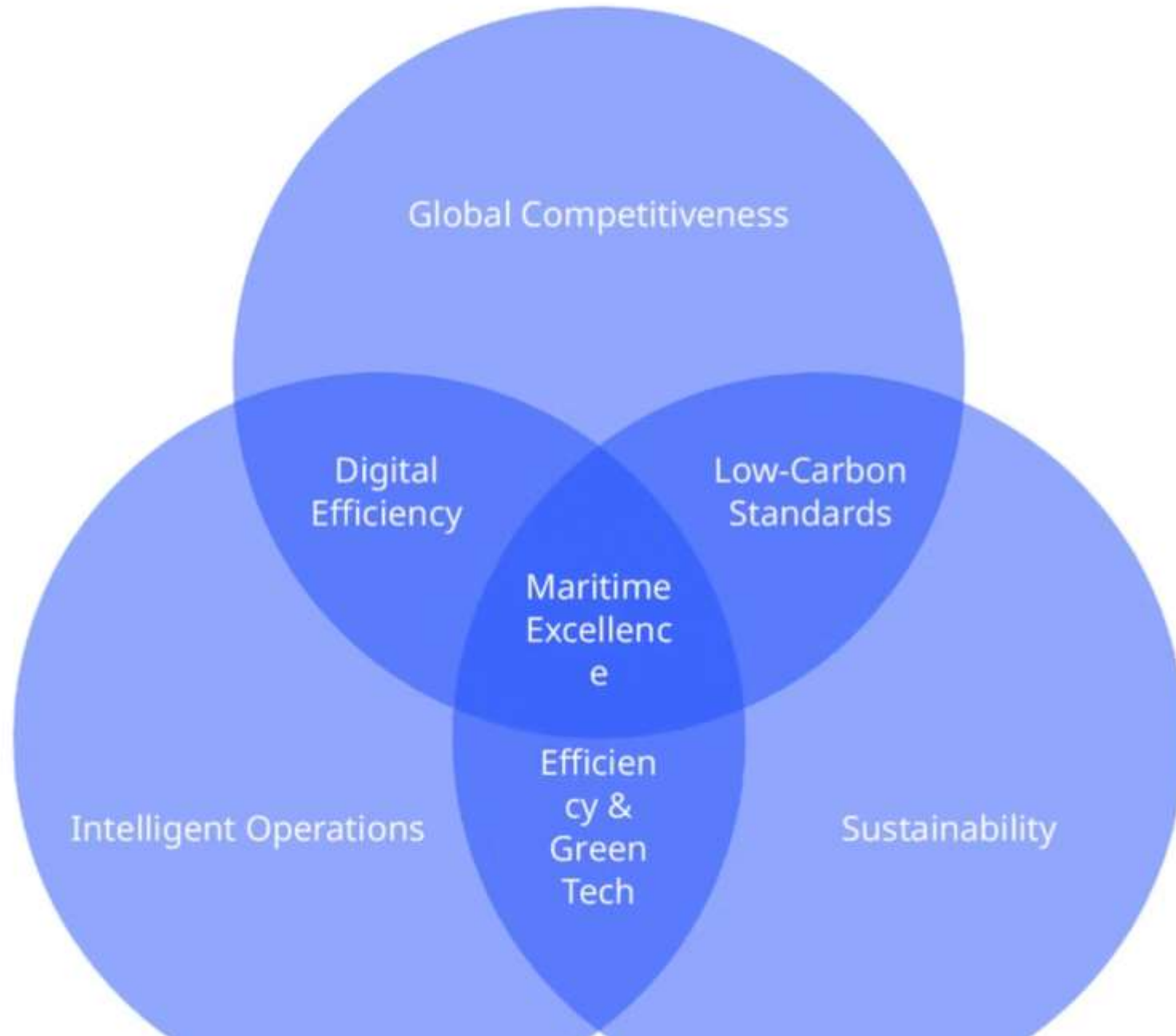
Carbon-neutral port operations

Value-Driven Governance

Digital ROI measurement

Positioning India as global leader in Smart & Sustainable Ports

Realizing Maritime Excellence



India's ports are becoming **intelligent**, **sustainable**, and **sustainable**, and **globally competitive** ecosystems

By embracing automation, digitalisation, and sustainability under Vision 2030 and Amrit Kaal 2047, India is poised to lead the world in maritime excellence