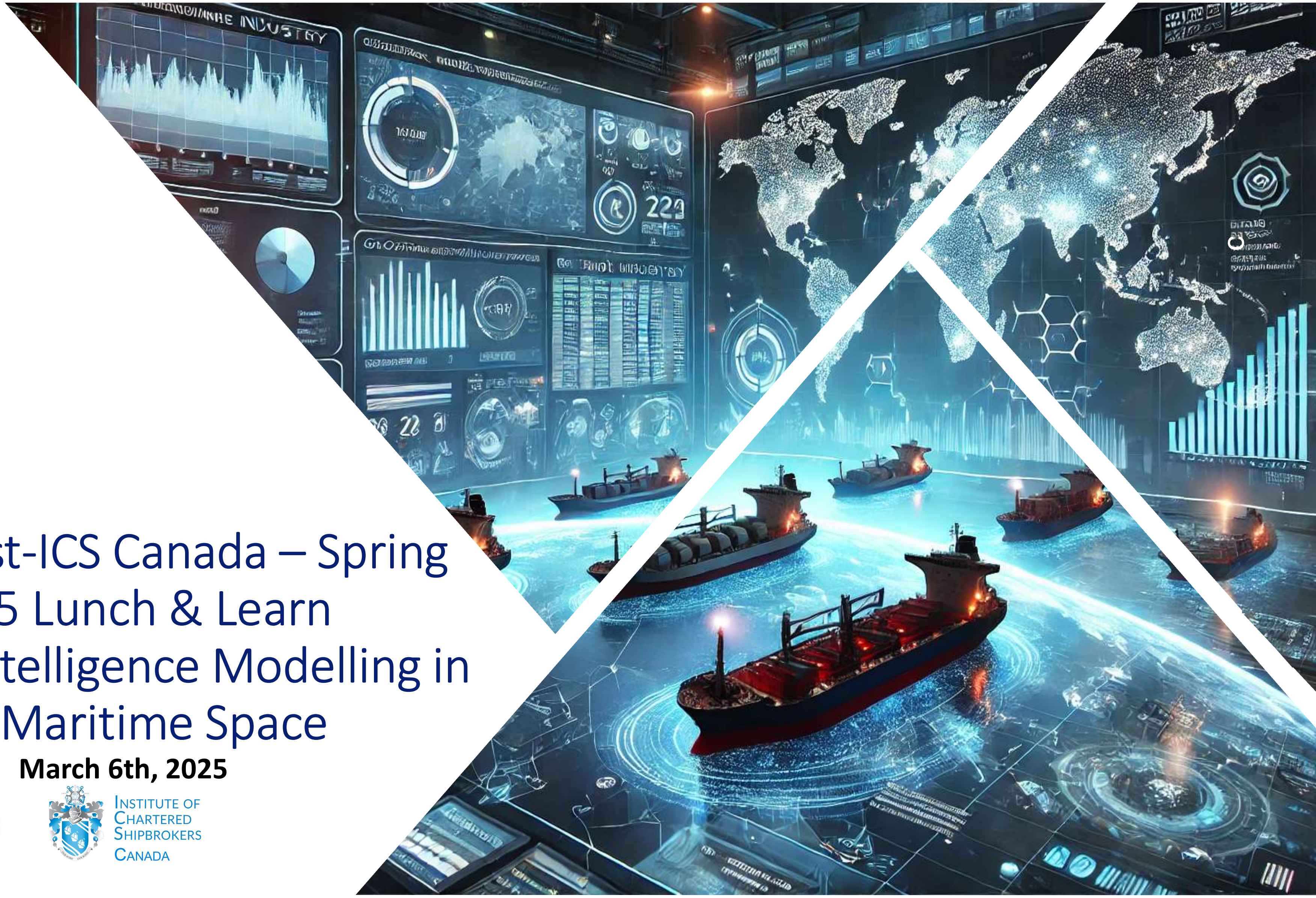

Soshianest-ICS Canada – Spring 2025 Lunch & Learn
Artificial Intelligence Modelling in the Maritime Space

March 6th, 2025

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Institute of Chartered Shipbrokers Canada

Presented by Soshianest, Hosted by ICS Canada

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NRC·CNRC Canada – NRC Industrial Research Assistance Program

SpringerLink

Soshianest was selected by CIIP for the 2024 PDA delegation to Singapore

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Our Mission

At Soshianest, we help maritime businesses navigate international trade complexities. By leveraging AI and machine learning, we provide accurate forecasts, optimize operations, and enhance market responsiveness, helping clients remain competitive.

Supporting shipping stakeholders in adopting AI for better operations and decision-making with AI Data Driven models.

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Artificial Intelligence Modelling in the Maritime Space

Why AI Deep Learning Outperforms Traditional Models in Freight Rate Prediction

Artificial intelligence and deep learning are transforming maritime freight rate prediction, enabling more accurate forecasting and strategic decision-making

ICS-Canada – Ship Owners and Charterers

Dr. Mehdi Hazrati

Dr. Payman Eslami

Volatile Market-Freight Rate & Prediction

- **Freight rate prediction** plays a critical role in the maritime industry, influencing **contract negotiations, strategic decision-making, and profitability.**

- **Maritime freight markets** experience **high volatility** and **cyclicality**, with complex dependencies on **geopolitical, economic**, and **seasonal factors**.

- Understanding **market fluctuations** is essential for **effective risk management** and long-term planning.

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The Strategic Impact of Freight Rate Forecasting on Maritime Operations

Freight Rate Forecasting

Predictive insights-AI Powered Analytics

- Demand Forecasting and Planning
- Predictive Disruption Analysis and Scheduling
- Port and Terminal Congestion Prediction

Smart Decision Making-AI Driven Strategy

- Smart Negotiations and Decision
- Action Oriented insights for Stakeholders
- AI Driven Market Intelligence
- Risk Mitigation and Scenario Planning

Operational and Financial Impact-Tangible Outcomes

- Dynamic Fleet Utilization Strategies
- Achieving Maximum Probability
- Fuel Consumption and Cast Optimization
- Vessel Performance Monitoring and Maintenance
- Sustainability and Compliance

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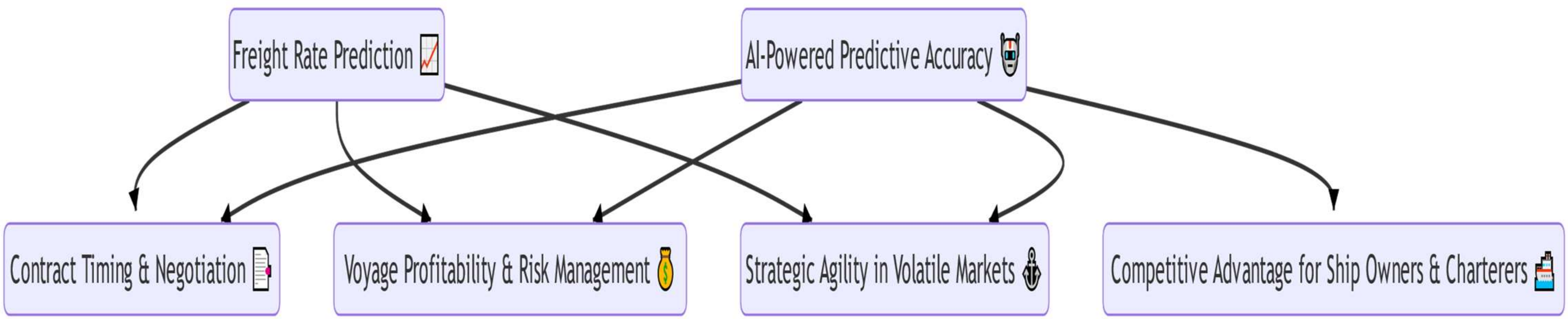
Strategic Decision Points Impacted by Freight Rate Prediction



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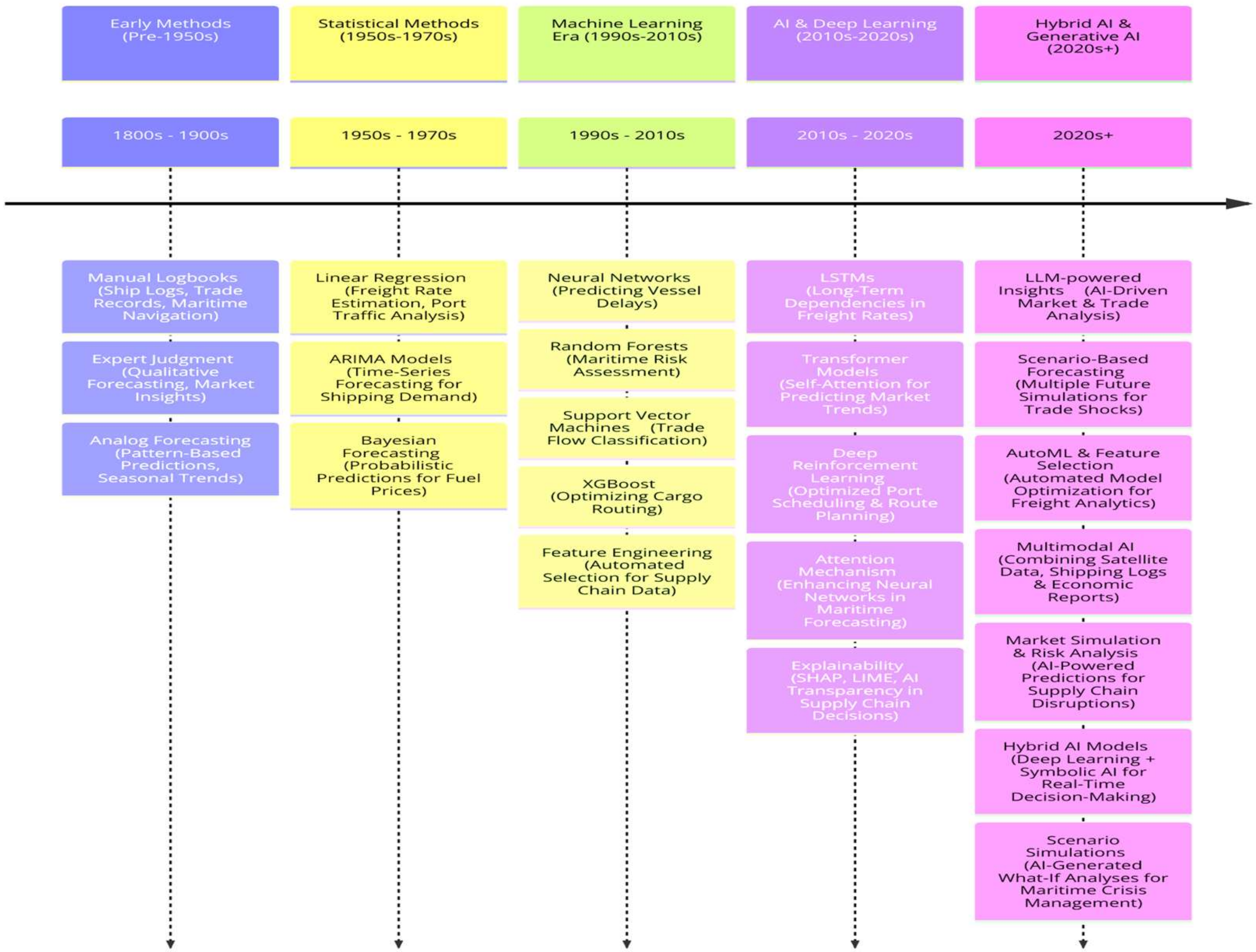
Evolution of Predictive Modeling



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Traditional Model, Limitations & Strategic Impact

Traditional Model	Strength	Limitation
Linear Regression	Simple & fast	Can’t handle market shifts
ARIMA	Good for time-series trends	Weak for non-linear markets
Bayesian Forecasting	Probabilistic modeling	Requires extensive data
VAR (Vector Autoregression)	Captures relationships between multiple variables	Assumes stationarity, struggles with long-term trends
Exponential Smoothing	Captures short-term trends	Too simple for complex patterns

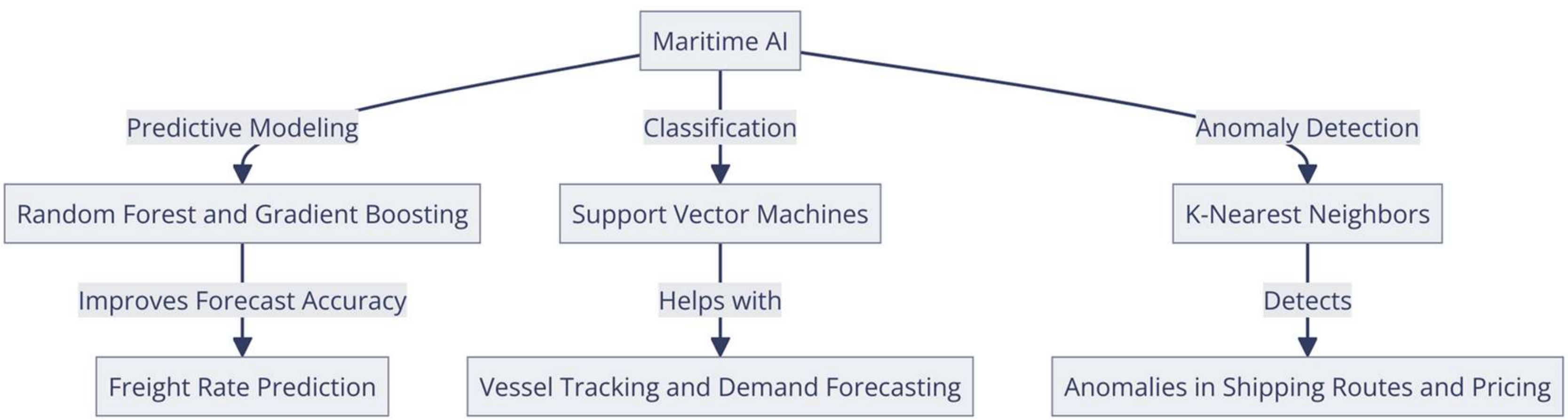
Traditional models struggle with maritime market complexities, leading to inaccurate predictions and higher financial risk, due to Static Assumptions human intervention, leading to bias and incomplete feature selection etc.

Key Machine Learning Architectures for Maritime AI

Ensemble Learning Methods:
Random Forest & Gradient Boosting
Improves predictive accuracy by combining multiple decision trees, making them effective for freight rate forecasting.

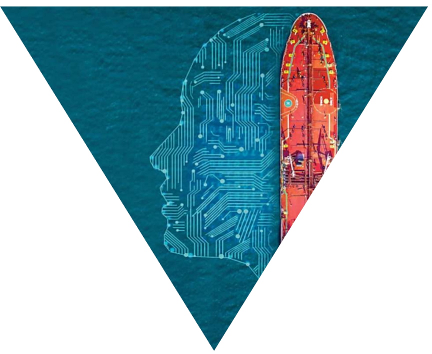
Classification & Pattern Recognition:
Support Vector Machines (SVM)
Detects patterns and classifies maritime data points, helping with vessel tracking and demand forecasting.

Clustering & Anomaly Detection:
K-Nearest Neighbors (KNN)
Used for clustering and anomaly detection in shipping routes and freight rate predictions, leveraging proximity-based learning.



What is Deep Learning?

Definition and Concept



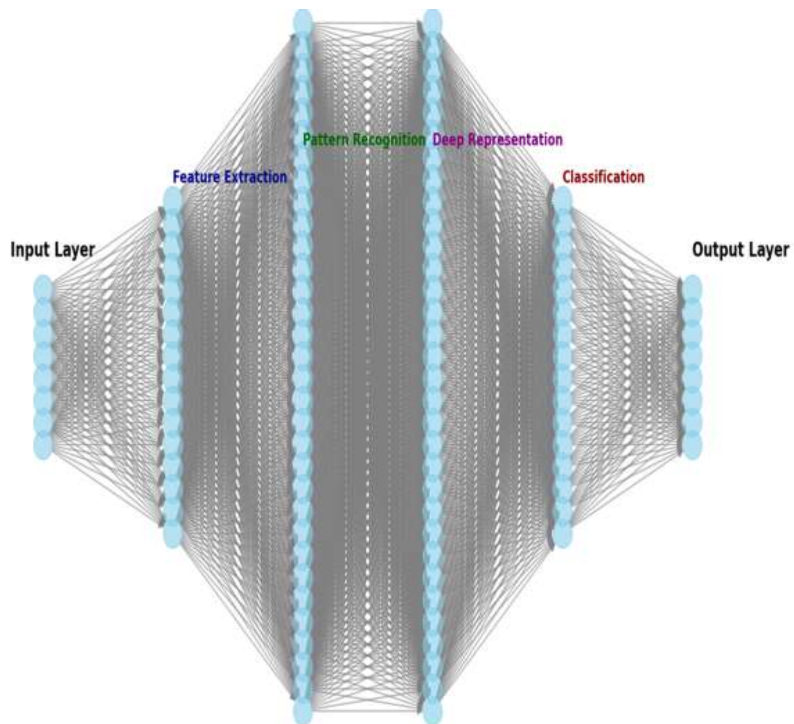
Deep learning models use neural networks to learn hierarchical representations of data, allowing them to identify complex patterns **without manual feature selection.**

Key Advantage

Unlike traditional models, deep learning **can capture non-linear interactions and complex dependencies** within maritime freight prediction.

High-Level Insight

Deep learning **automatically learns patterns from vast amounts of data**, making it a powerful tool for predictive analytics in dynamic markets



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Key AI & Deep Learning Architectures

LSTM (Long Short-Term Memory Networks)

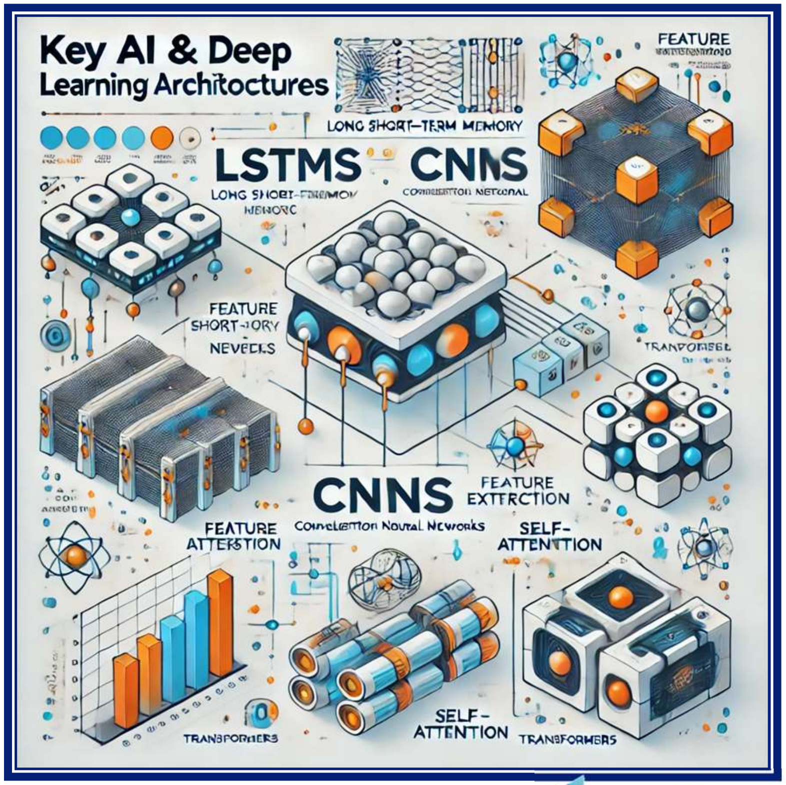
LSTM networks capture long-term dependencies and temporal patterns, making them ideal for sequential maritime data like historical freight rates.

CNNs (Convolutional Neural Networks)

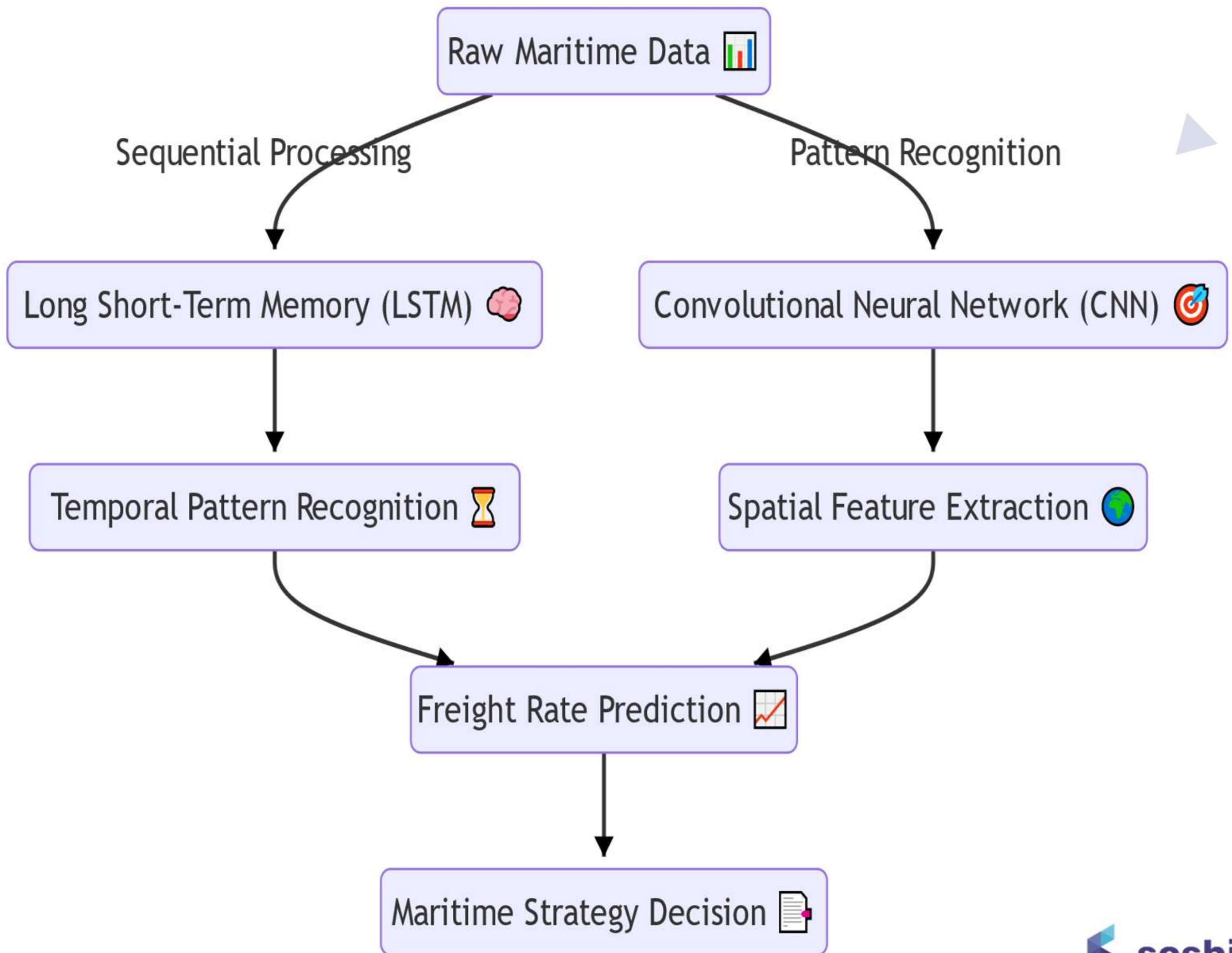
CNNs extract spatial-temporal patterns from complex maritime datasets, enabling applications in vessel tracking and maritime maps.

Transformers

Transformers improve upon traditional deep learning architectures by allowing parallel processing of data, making them ideal for large-scale maritime forecasting and anomaly detection.



LSTM and CNN Data Processing Pipelines



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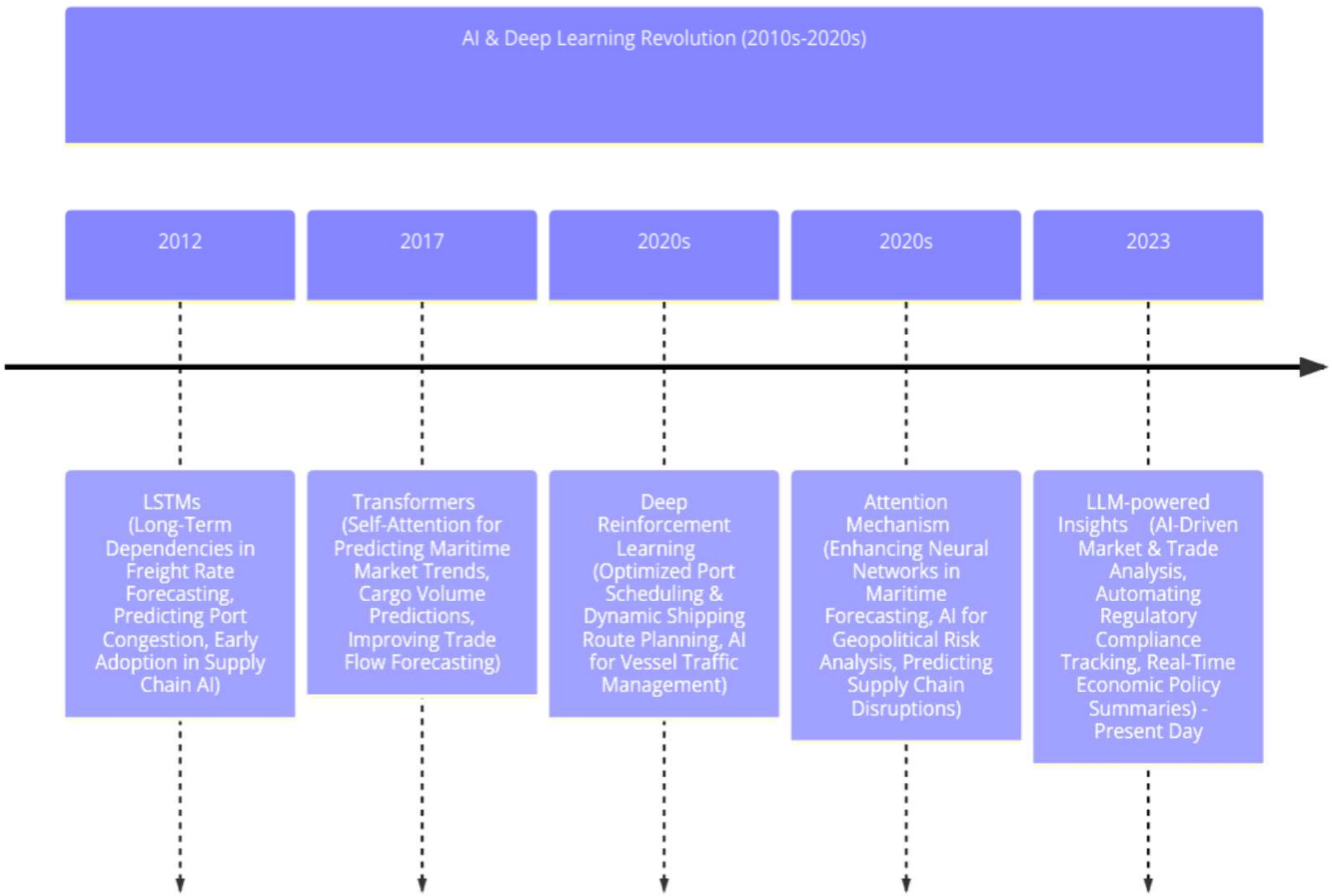
2010s-2020s AI & Deep Learning Evolution in Maritime Trade



In Short why AI

To decreases the chances of human mistakes and promotes impartial decision-making.

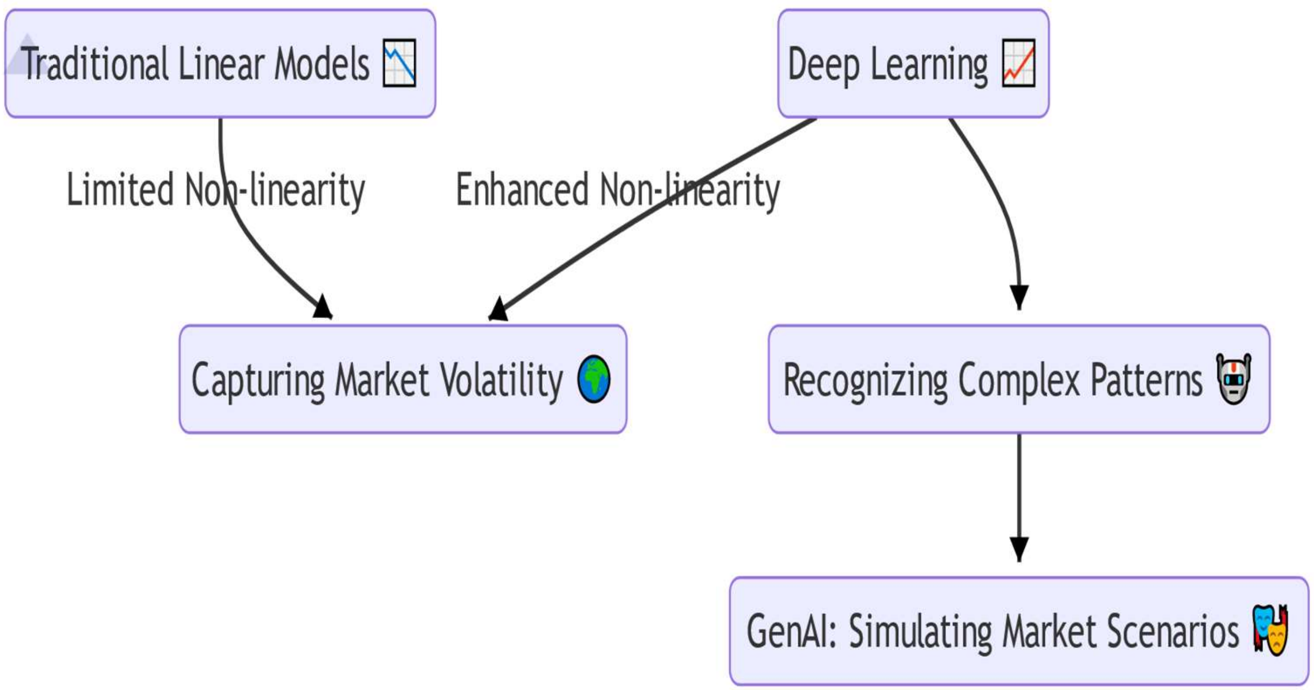
To Evaluates hundreds of factors with enhanced precision and efficiency.

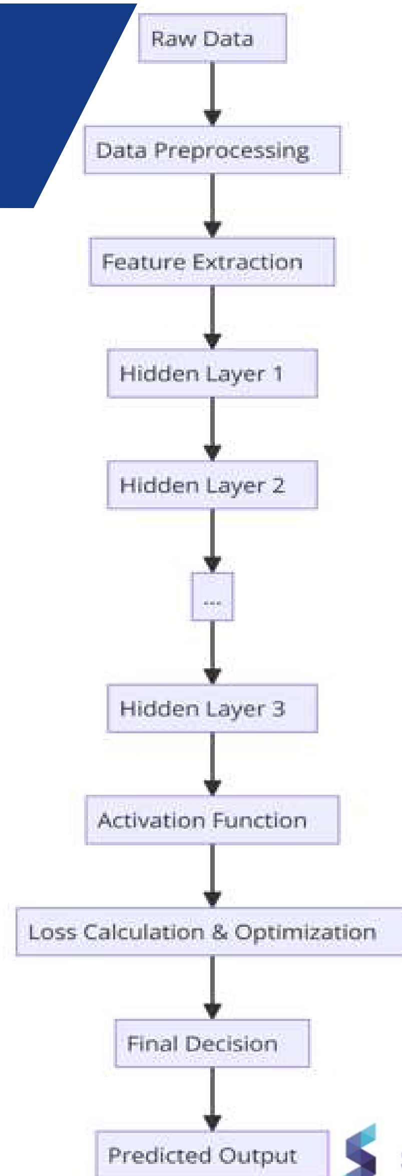
To reveals concealed patterns by detecting underlying relationships.

AI & Deep Learning vs Machine Learning – Key Differences

Aspect	Machine Learning (ML) in Maritime	AI & Deep Learning (DL) in Maritime
Definition	Uses statistical models to learn from historical shipping & trade data	Uses deep neural networks to analyze **vast, complex maritime datasets**
Feature Engineering	Requires manual selection of features (e.g., port congestion, fuel costs)	**Automatically extracts features** from raw data (satellite images, weather reports, market trends)
Data Processing	Works well with structured tabular data (shipping logs, trade records)	Handles **unstructured & multimodal data** (text reports, images, IoT sensor data)
Complexity Handling	Struggles with dynamic & non-linear market behaviors	Excels at **recognizing nonlinear dependencies** (global supply chain disruptions)
Adaptability	Learns from past data but requires frequent retraining	**Continuously adapts to real-time maritime data,** optimizing forecasts dynamically
Use Cases in Maritime	Freight rate estimation, route optimization based on historical trends	AI-driven vessel scheduling, anomaly detection, multimodal trade forecasting

Deep Learning Vs Traditional-Arc





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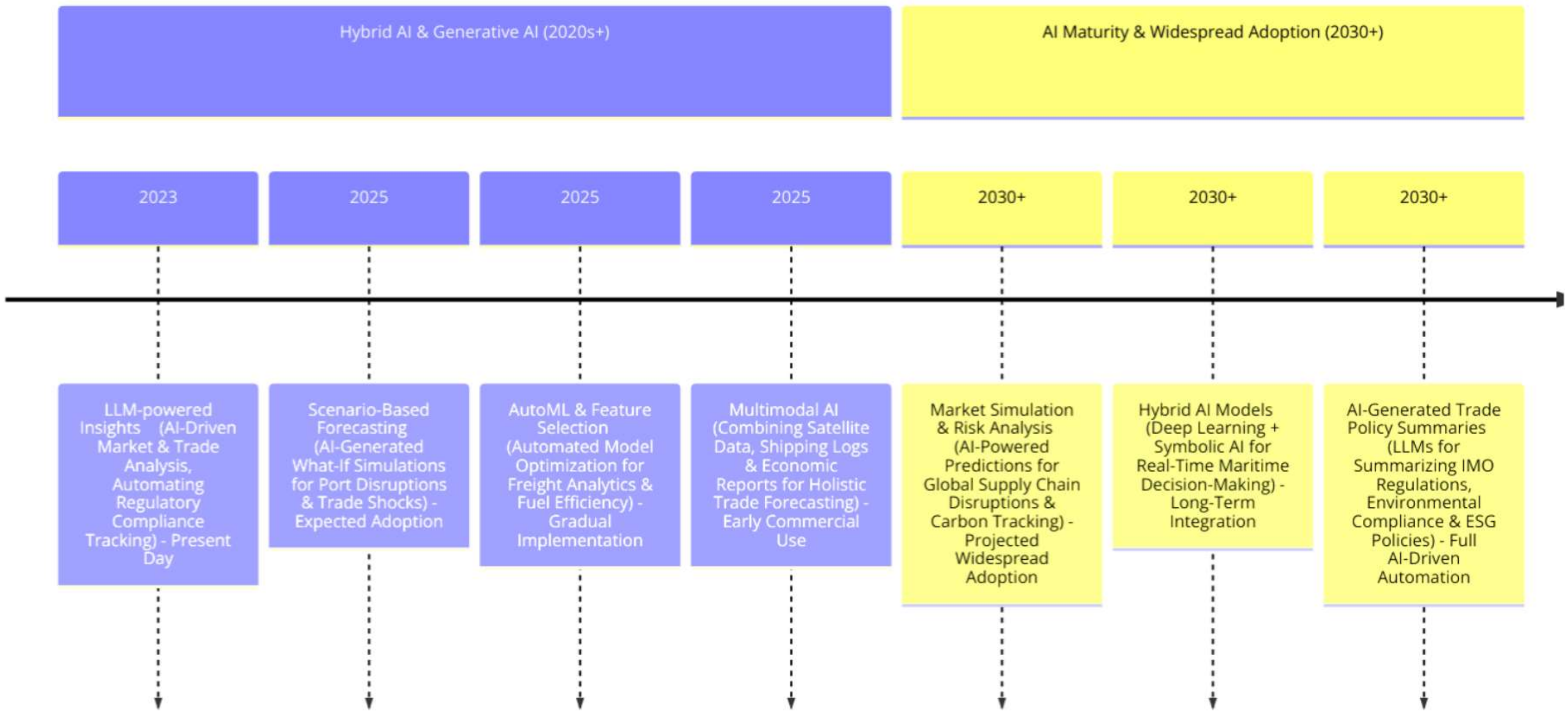
Future Evolution of AI in Industry & Maritime



Economic Impact: McKinsey & Company estimates that **AI could contribute an additional $13 trillion to the global economy by 2030,**
Productivity Growth: Generative AI, a subset of AI technologies, has the potential to **increase U.S. labor productivity by 0.5 to 0.9 percentage points annually through 2030, depending on the rate of technology adoption and effective integration into business processes.**

Why we need to act: what is Projection (2025-2030+)?

- **Maritime Industry Adopts New Technology More Slowly Than Other Sectors**

- AI in finance, e-commerce, and manufacturing moves quickly.

- But maritime & logistics have longer adoption cycles due to:
- Infrastructure limitations (ships, ports need modernization).
- Regulatory requirements (IMO rules, emissions compliance).
- Risk aversion (shipping companies prioritize reliability over fast AI adoption).

Challenges in AI-Driven Maritime Forecasting

Explainable AI for Decision Transparency

Ensuring AI predictions are interpretable and trusted by industry stakeholders.

Computational Complexity & Data Needs

Deep learning requires high processing power and large datasets for accurate predictions.

Risk of Overfitting

Balancing model complexity to avoid overfitting on historical maritime data.

Data Quality and Availability: Reliable data sources are critical for accurate maritime freight forecasting.

Ensuring AI Reliability in Maritime

01 Data Quality & Availability: AI models rely on diverse and high-quality datasets to improve predictions.

02 Industry Adoption: Integrating AI into traditional maritime decision-making requires trust and adaptation.

03 Regulatory & Ethical Considerations: Compliance with industry standards and ethical AI use is essential.

04 Human-AI Collaboration: AI should complement, not replace, human expertise in maritime forecasting.

05 Developing robust AI strategies ensures sustainable adoption in the maritime industry.

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Why Ethical AI Matters

AI plays a growing role in maritime decision-making.

Ethical AI ensures trust, fairness, and compliance.

Soshianest Ethical AI Framework Pillars → Inclusive & Sustainable Growth → Human-Centered & Fairness → Transparency & Explainability → Robustness, Security & Safety

Overall Industry Challenges

Port Congestion & Supply Chain Disruptions

Global supply chains face bottlenecks due to port congestion, extreme weather, and labor strikes, causing inefficiencies and delays

Market Volatility & Uncertainty

Fluctuating freight rates, economic downturns, and geopolitical risks make it difficult for stakeholders to predict costs and revenues..

Regulatory & Sustainability Compliance

Shipping companies must meet IMO regulations, reduce emissions, and adapt to changing environmental policies, requiring significant investment.

Operational Inefficiencies & Cost Pressures

Rising fuel prices, inefficient fleet deployment and unexpected maintenance costs put financial strain on maritime businesses.

Technological Adaptation & Digital Transformation

Many maritime companies struggle to implement AI and data-driven solutions due to legacy systems and lack of technical expertise.

AI in Maritime Operations-Tackling Industry Challenges

AI in Sustainability & Compliance

Increasing regulatory pressure to reduce carbon emissions.

AI models optimize fuel consumption and reduce CO_2 emissions.

Machine learning simulates and optimizes energy-efficient routes.

AI assists in monitoring IMO compliance and alternative fuel adoption.

AI in Vessel Performance Monitoring Maintenance

AI-powered optimization enhances fuel efficiency and maintenance scheduling.

IoT sensors collect real-time data on engine health, fuel efficiency, and hull conditions

AI-driven predictive maintenance detects early signs of equipment failure, reducing vessel downtime and saving maintenance costs."

Shipowners face high maintenance costs and unexpected breakdowns.

AI in Port & Terminal Congestion Prediction

Port congestion leads to delays, inefficiencies, and increased costs.

AI analyzes real-time AIS data, satellite imagery, and historical congestion trends.

Machine learning predicts vessel arrival times and berth availability.

AI-powered re-routing recommendations help reduce waiting times.

Most Commonly Foundational Concepts in Modern AI-Text Processing

Transformers
Leverage self-attention(understand, interpret, and generate human language) to capture global dependencies in **NLP**(Natural Language Processing) and other fields, making them ideal for maritime forecasting. Examples: BERT (NLP), GPT-4 (NLP), Vision Transformer (ViT - Computer Vision), Time Series Transformer (TST - Forecasting).

LLMs (Large Language Models)
Analyze unstructured data like **news** and social media, using NLP and **sentiment analysis** to improve predictions. Examples: ChatGPT, LLaMA 2, Claude (Anthropic), Mistral AI.

Generative AI (GenAI)
Generates scenario-based forecasts, offering best, worst, and average-case freight rate predictions with explainability. Examples: DALL·E (Image GenAI), Gemini (Multimodal GenAI), OpenAI Codex (Code GenAI), MidJourney (Image GenAI).

Automatic Feature Engineering & Extraction and Adaptive Learning Loop

Core Advantage

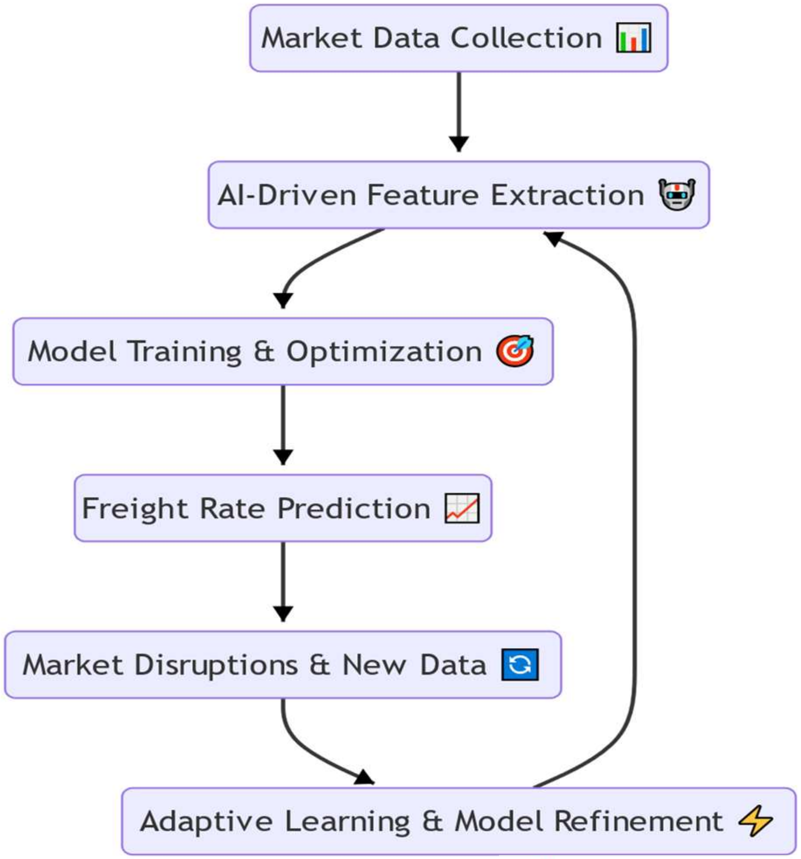
AI-driven models automatically learn hidden patterns without manual intervention, eliminating human bias in feature selection.

Market Adaptability

Deep learning adapts dynamically to market disruptions, improving predictive accuracy even in volatile maritime conditions.

Strategic Impact

By continuously refining insights, AI enables strategic agility and provides a competitive edge in maritime decision-making.



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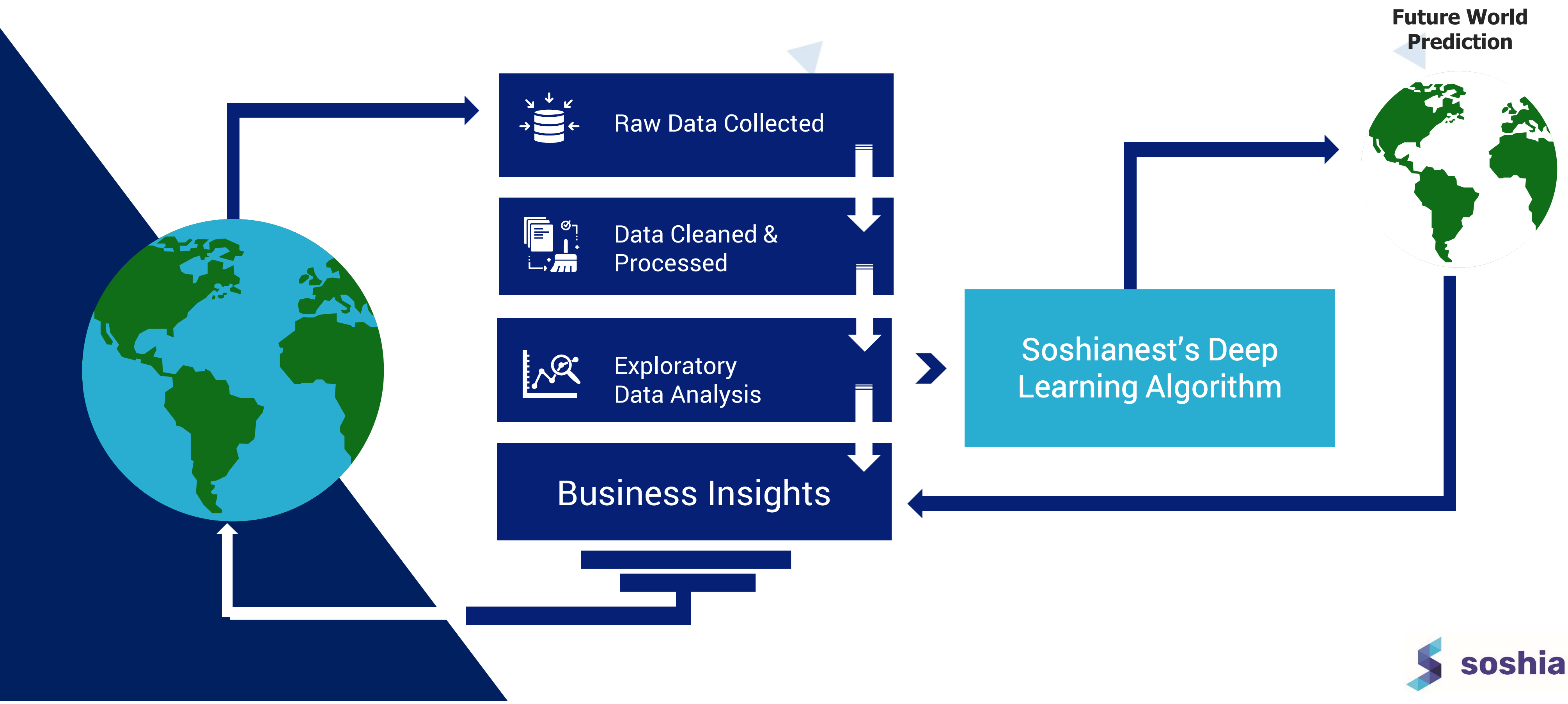
Modeling Process



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Factors Influencing The Market

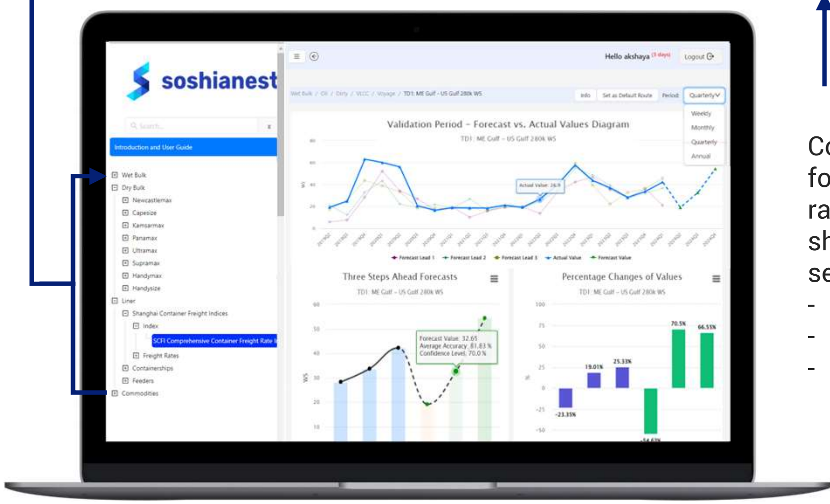
Model Inputs

Vessel Supply	Orderbook	Deliveries	Demolitions	Scrap Value	Secondhand Price	Newbuild Price/Capacity
Global Economic Conditions	GDP	Interest Rate	Exchange Rate	Oil Price	Industrial Production	Commodity Price
Seaborne Trade	Seaborne Trade Volume	Import & Export	Bunker Price	Port Congestion	Regulations	Deployment & Port Call Activity

Soshianest Current Dashboard Freight Rate Prediction

Wet bulk, dry bulk, liner and commodity (wheat & corn) forecasts

Selecting weekly, monthly, quarterly, or annually provides a forecast for the next 3 periods



Comprehensive forecast of freight rates, earnings, and ship prices, segmented by
- Cargo category
- Ship type
- Shipping route

Value, average accuracy and confidence level for each forecast

Download chart and data table in various formats

Most effective factors considered for model-data driven predictions

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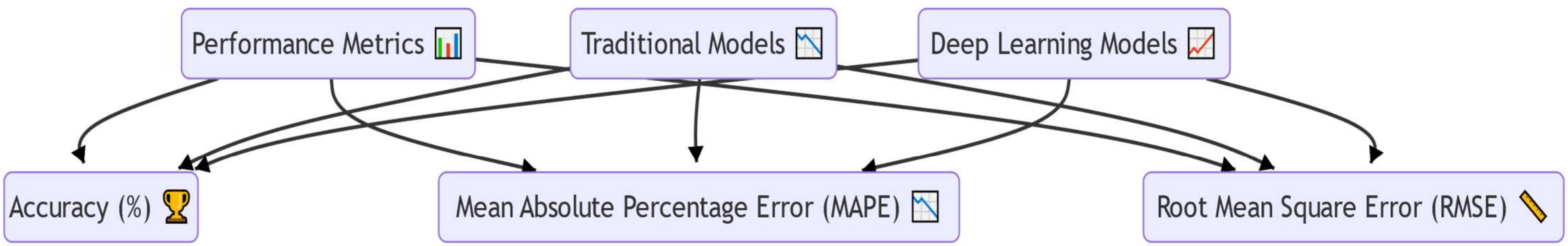
Performance Comparison: Deep Learning vs. Traditional Models

Comparison Metrics
Deep learning models outperform traditional models across key metrics such as accuracy, Mean Absolute Percentage Error (MAPE), and Root Mean Square Error (RMSE).

Accuracy & Error Reduction
AI-driven models significantly reduce forecasting errors, making them more reliable for freight rate predictions.

Strategic Benefit
Higher accuracy leads to better decision-making in maritime freight forecasting, ensuring improved market competitiveness.



Future Outlook of AI in Maritime

01 **Generative AI:** Simulating future market **scenarios** for proactive planning.

02 **Multi-Modal Learning:** Integrating **diverse data sources** for improved predictions.

03 **Explainable AI:** Enhancing **model transparency** and decision trustworthiness.

04 **AI-Driven Automation: Reducing manual efforts** and improving operational efficiency.

05 Maritime AI evolution is shaping **smarter and more adaptive** forecasting solutions.

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AI in Maritime: Future, Opportunities & Call to Action

Strategic Advantage

AI models provide a competitive edge, improving risk management and decision-making.

Emerging Trends

Future advancements include Generative AI, Multi-Modal Learning, and Explainable AI for enhanced transparency and adaptability.

Call to Action

Maritime stakeholders should embrace AI-driven models to optimize operations, reduce risks, and stay ahead in dynamic markets.

Engagement Opportunities

Engage

Engage with Soshianest : Collaborate with us to harness AI technologies for transformative improvements in maritime logistics operations.

Tailored Solutions

Address your unique challenges with data-driven insights.

Pilot Program

Work with us for customized AI solutions for your organization.

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Thank You