Smart Port Transformation with AI and Analytics

SMI Webinar

29 July 2021

Goh Kwong Heng

Industry Practice Lead (Transport), NCS Pte Ltd

Agenda

1. Future Port Operations
2. Applications of AI in Port Operations
3. Use Cases

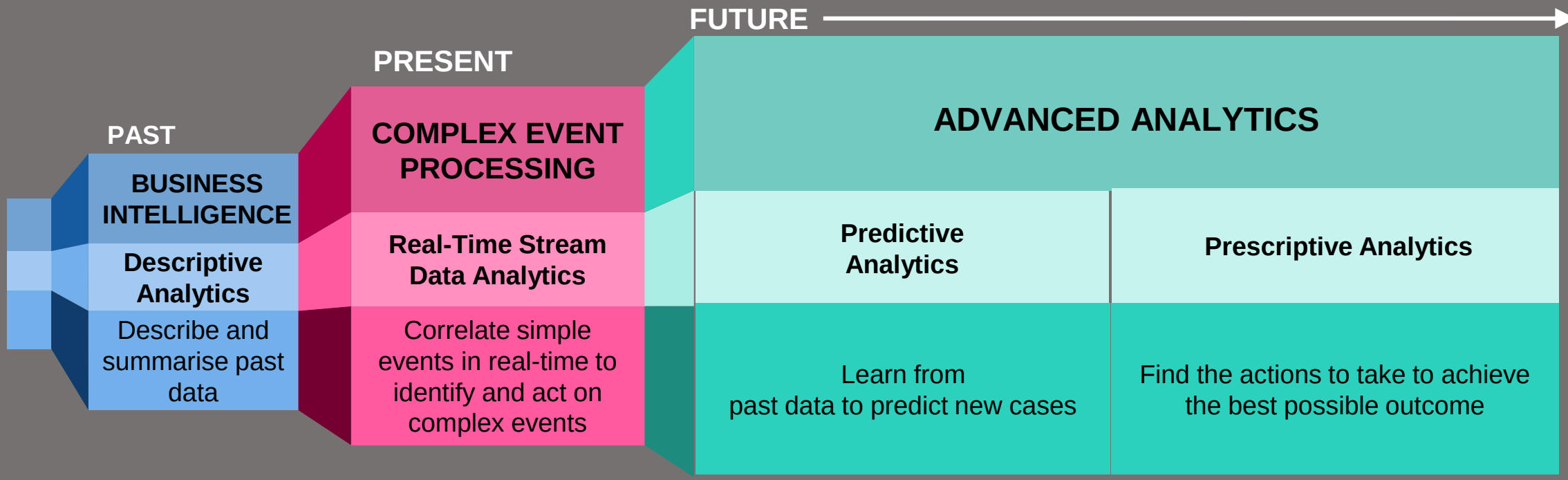
Applications of AI in Smart Port Transformation

Key Thrust	Seamless and Connected Operations	Data Driven Operations	Remote & Autonomous Operations	Fully Integrated Operations
Outcome	Enhance Port User Experience	Enhance Safety & Security	Enhance Efficiency & Productivity	
Maritime Operations 	**Digital Port Operations Platform** • Transacting with shipping community • Data exchange with international ports	**Next Generation Vessel Traffic Management System** • Prediction of Ships' ETA, Near Misses & Traffic Hotspot Areas • Analytics to mitigate potential collisions and hotspot **Maritime Sense Making** • Real-time anomaly detections • Detection of illegal activities	**Autonomous Tugboats/patrol boats** **Remote Piloting** **Intelligent Remote Inspections of Ships** **Maritime Drone for Surveillance**	**Integrated Port Operations for Crisis Incident Response, and Management** **Just-in-Time Arrivals and Services** • Dashboard of real-time operations event data • Optimisation of port resources
Outcome	Enhance Port User Experience	Enhance Labour Productivity Enhance Operations Efficiency		Enhance Connectivity
Terminal Operations 	**Digital Platform** • API connection with customers systems • Value-added services to enhance port connectivity **Blockchain platform** • Smart Contracts • Track and Trace • E-Bill of Lading	**Smart Planning** • Berth, Stowage, Yard, AGV **Smart Facility Management** • Video analytics for predictive maintenance **Smart Gate** **Smart Grid**	**Automated Yard Crane** Unload/Load containers with precision **Automated Guided Vehicles (AGV)** Driverless and battery-powered **Automated Quay Crane**	**Air-Sea-Land Integrated Operations** **Integrated Operations Centre** • Monitoring of Automated Crane Operations • Handle Exceptions • Coordinate multi-model transport

Technologies

- Blockchain
- Digital Platforms
- Applications of AI
  - Data & Video Analytics
  - Machine Learning
  - Video and Data Analytics Autonomous Systems
  - Digital Twin/ Simulation
- IoTs, Cloud Computing
- Data Lake
- 5G Network & Long-range Wifi for Port Waters

Understanding different types of Analytics and their applications in the Port Operations



Port Regulators & Operators

- Past Cargo Throughput
- Past Vessel Arrivals/Calls
- Past Bunker Sales
- Past Passenger Arrivals

- Speeding vessels in restricted zone
- Illegal cargo operations
- Illegal entry to restricted areas
- Crowd building up at passenger terminals

- Vessel ETA
- Potential congestion hotspot
- Port equipment predictive maintenance

- Just-in-time arrivals & services
- Optimise sea space usage
- Avoid congestion in terminals and port waters

Ship Operators

- Past Revenue Performance
- Past Operating Costs
- Past Bunker consumption Costs

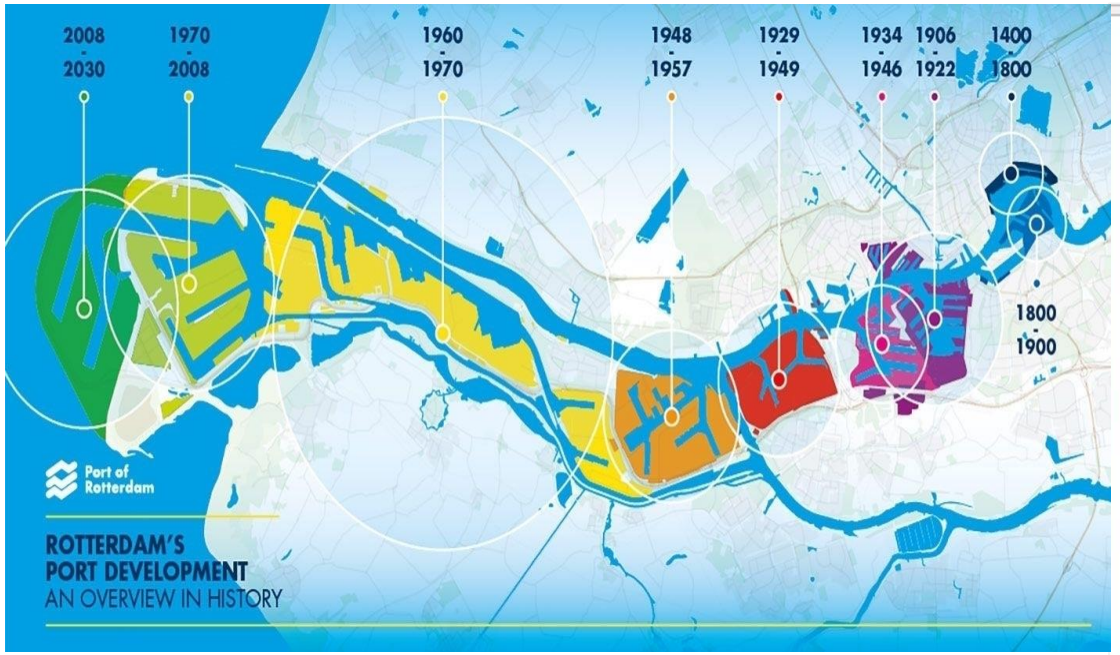
- Pirate Approaching Ships
- Systems/Equipment failure

- Cargo space demand forecast
- Freight rates
- Bunker Price

- Network Optimization
- Empty Container Reposition
- Improve Profitability of Service Routes
- Introduce New Service Lines

Big Data and Analytics Use Cases

Use Case (1) : Port of Rotterdam - Use IoTs and Analytics to better manage Waterway



- Install sensors across 42 KM of land and sea
- Collect and analyse real-time data
- Determine optimal times for ships to dock, load and unload

Use Case (2) : Hamburg Port Authority - Use IoTs and Analytics to optimise traffic flow and maintenance of port infrastructure

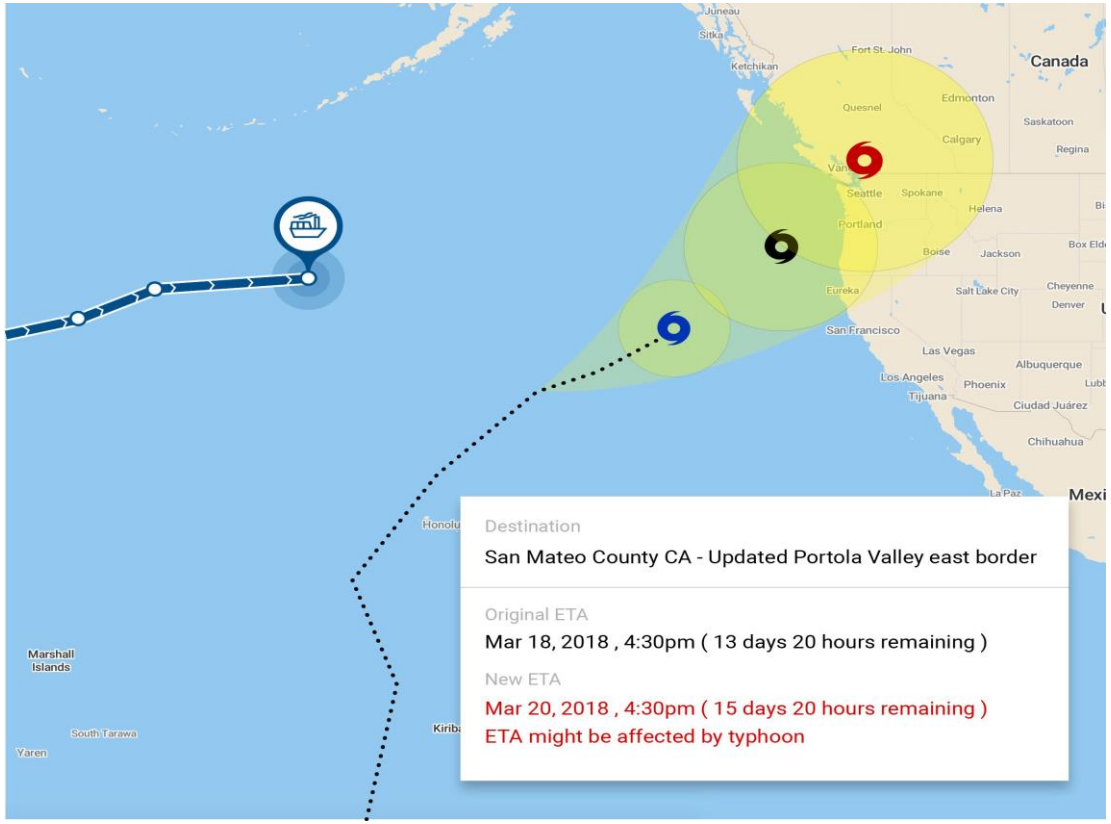
- The intelligent Railway Point (predict wear & tear)
- Smart maintenance

Source : Hamburg Port Authority Website

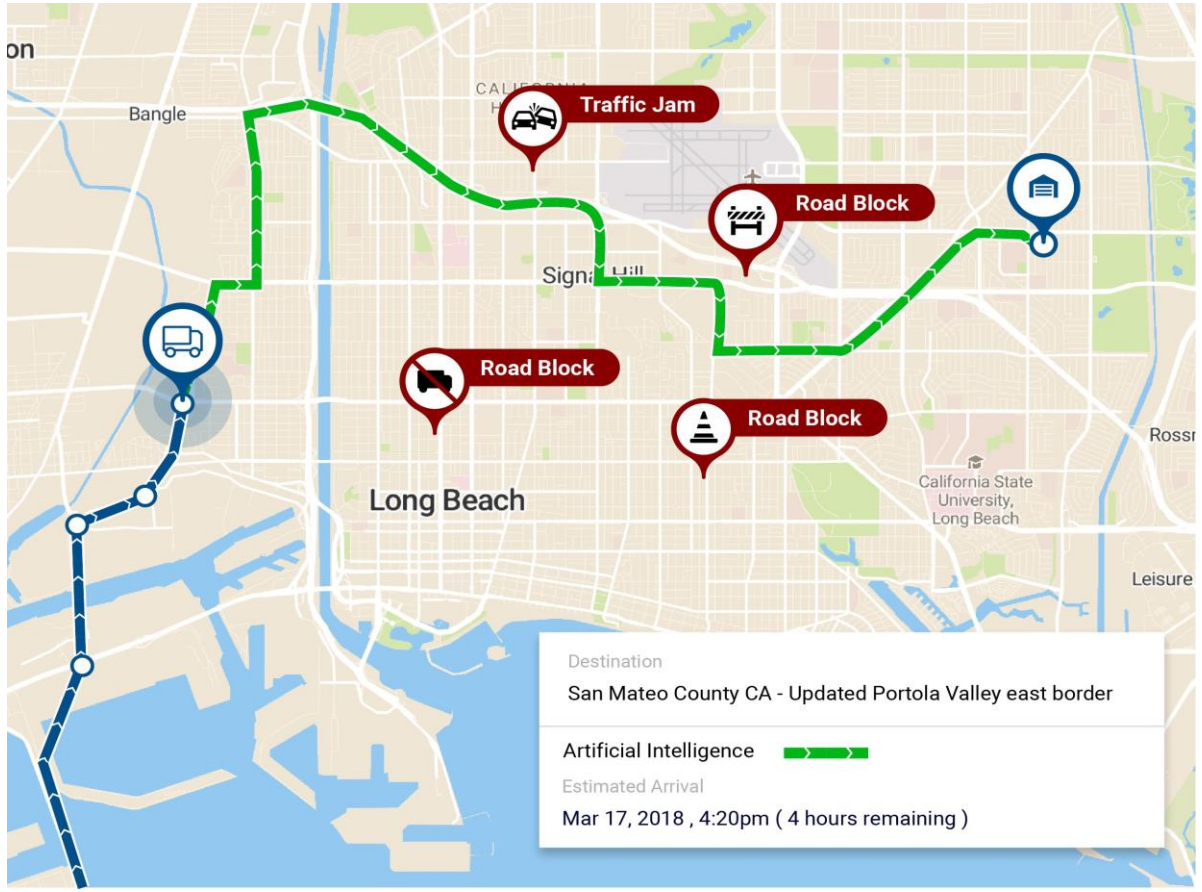
- 2nd busiest container port in Europe
- Maintains 140 kilometers of roads and 130 bridges within the port area
- Use emerging technology to help optimise traffic and cargo flow, and maintenance of the port infrastructure
  - Predict wear & tear
  - Smart Maintenance

Use Case 3 : OOCL uses Advanced Analytics with AI capability to better predict ETA of reefer containers

- Provide predictive insights as to how changes to a mix of variables may affect the shipment schedule
- Enable customers to make well-informed decisions for their supply chains based on the new information

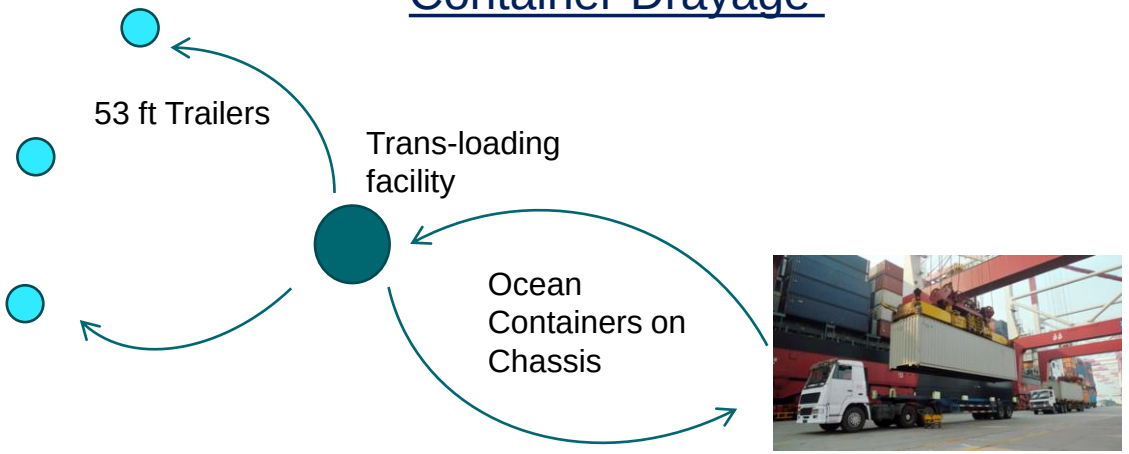


When a typhoon is detected by the system, a new ETA will be calculated based on this weather variable among many others that are being analyzed in real-time.



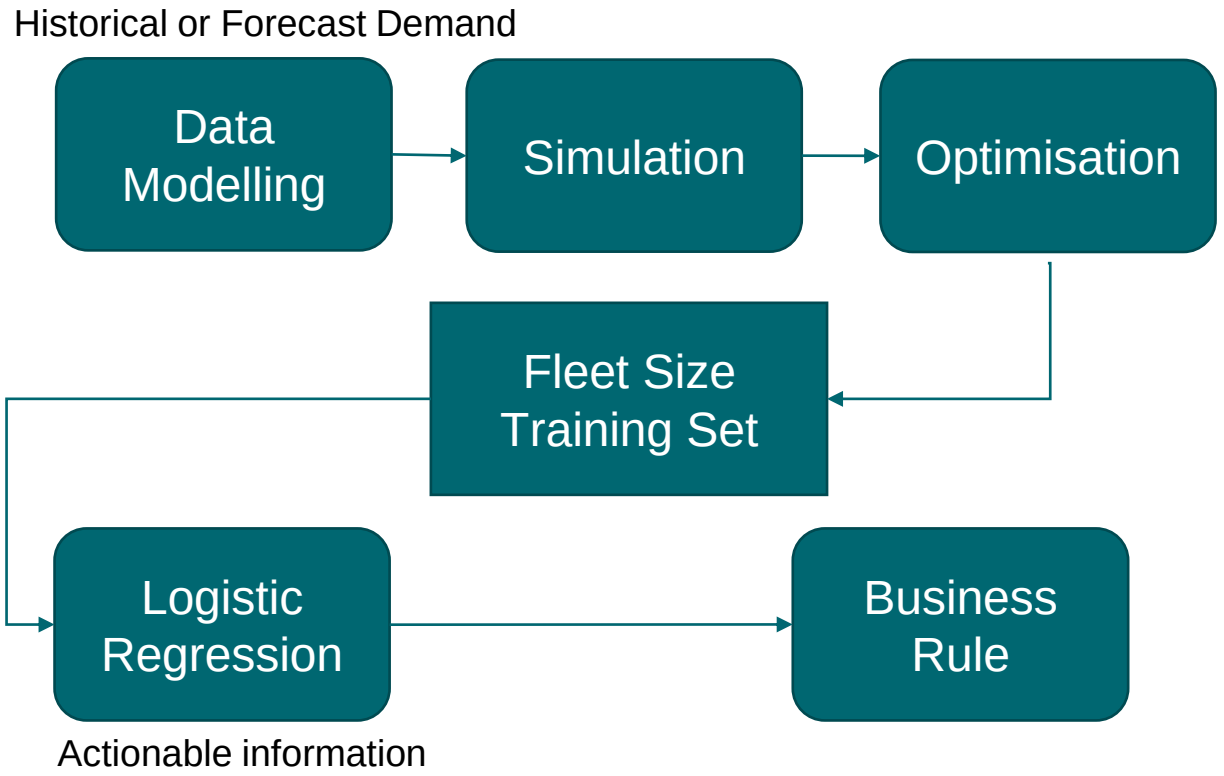
Use Case 4 : Chassis Leasing and Selection Policy for Port Operations by Schneider National (US)

Container Drayage



- Ocean freight containers arrive on cargo ship at port facilities
- Containers are paced on chassis for transport to/from trans-loading facility
- Operational challenge : how many chassis should be leased for the whole year vs how many should be rented on a daily basis.

Solution Approach (Simulation + Optimisation + Machine Learning)



Addresses the two decision problems:
1) the optimal fleet size for leased chassis and
2) a real-time decision policy for selecting between rental and leased chassis as containers are received.

Learning From Other Industry : Use Case 5 - Situation Awareness for Marathon Event

45,000 runners

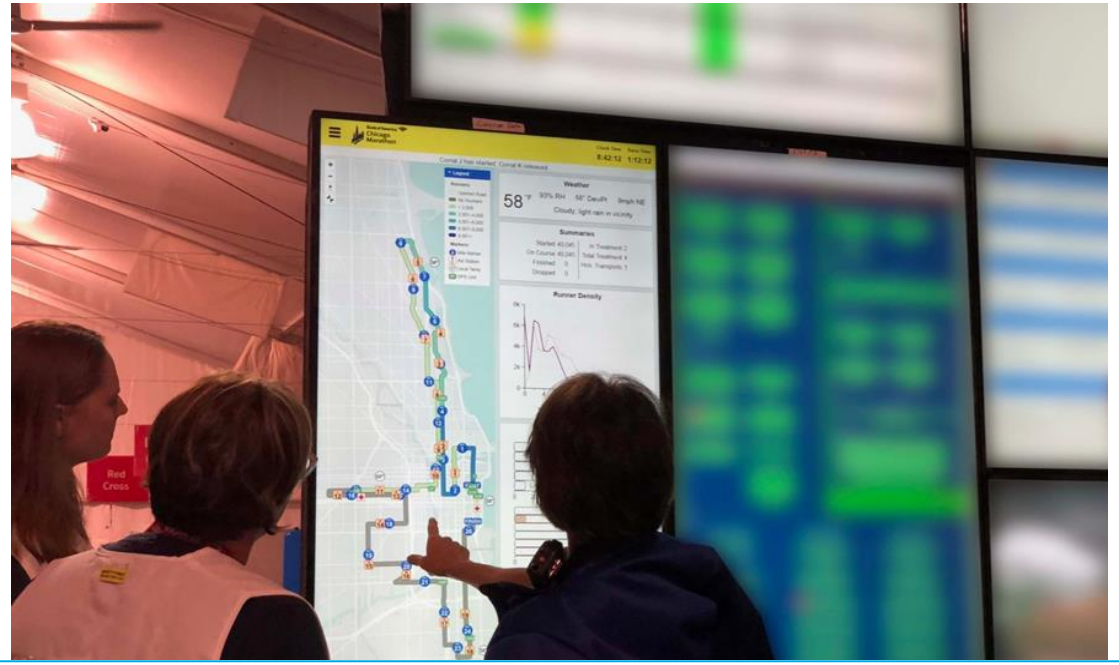
1.7M spectators

26.2 Miles (42KM) racecourse

8-hour event

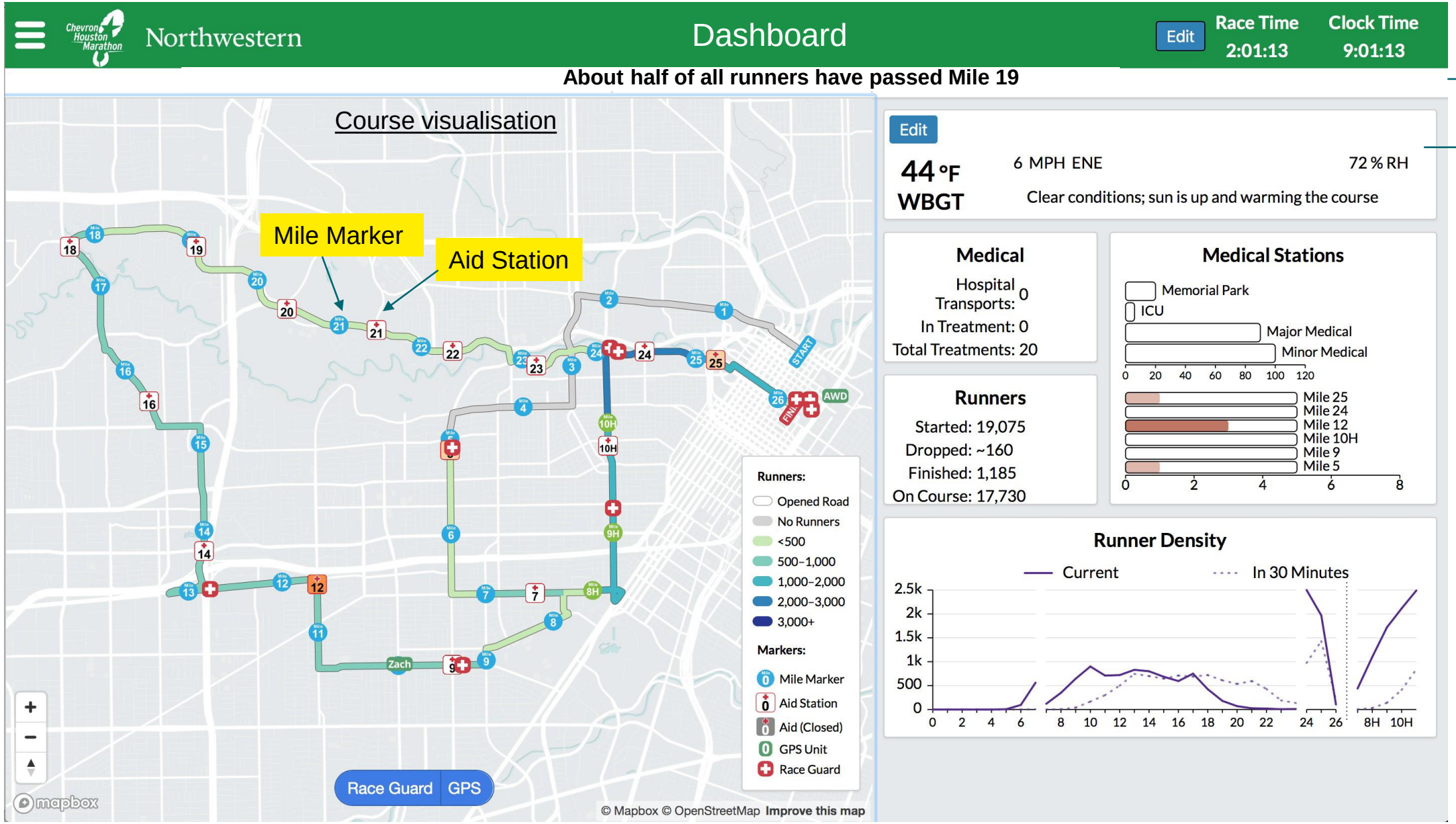
1,400 medical volunteers

By Northwestern University researchers and Bank of America Chicago Marathon (Chicago Marathon) organizers



- Help race organizer effectively manage all participants, monitor the dynamic location of race participants, and manage health and safety resources throughout the event
- Uses historical and real-time data to provide pre-event and on-site analytics via descriptive, predictive, and prescriptive models.
- Systems deployed for Chicago Marathon and Houston Marathon (2017- 2019)

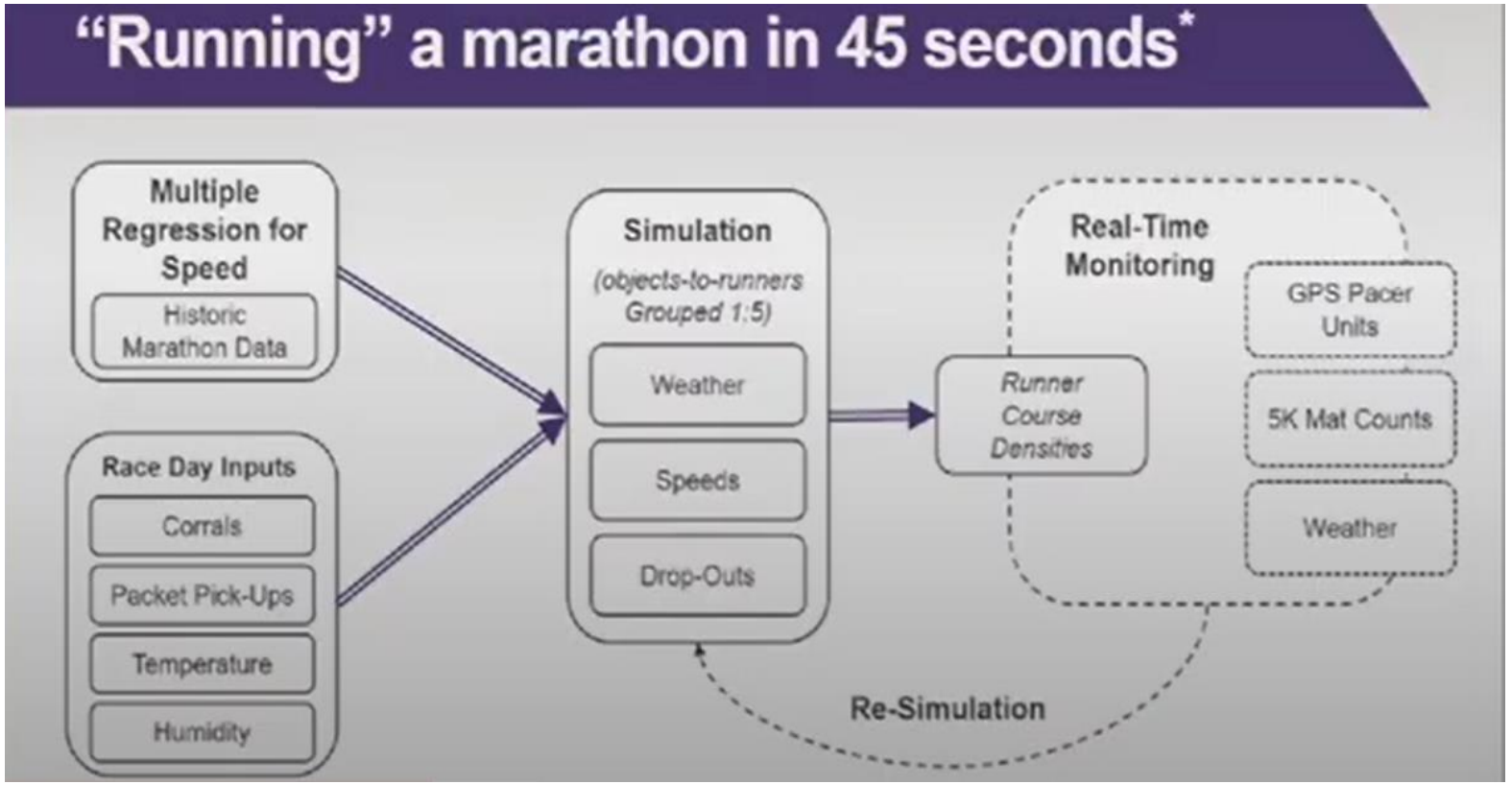
Use Case 5 : Situation Awareness for Marathon Event



Use Case 5 : Situation Awareness for Marathon Event

Runner Tracking Simulation with predictive and prescriptive capabilities

- Predicts the spatial-temporal density of runners along the course using past and current runner and event data.
- As the race evolves, the simulation responds dynamically as information inputs are updated
- Accurately predicts the current and future locations of the runners
  - Enable staff at aid stations to accurately evaluate their resources required
  - Allows city agencies to plan street reopening



Conclusions

- Be clear on the business objectives, problem statements and the expected outcome
- No one size fit all solutions for AI & Analytics Applications
- Determining what predictive modeling techniques are best for your company is key to getting the most out of an analytics solution
- Clean and quality data is key
- Use agile and iterative approach for implementation
- In enterprise AI systems, the algorithm is 5% of the code. The required surrounding infrastructure is vast and complex.

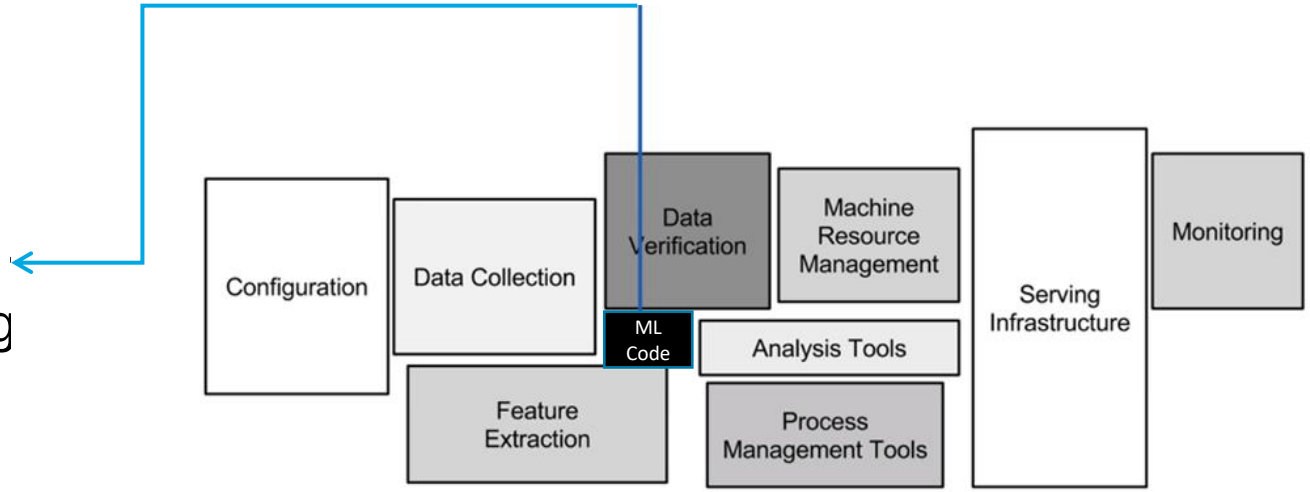


Figure 1: Only a small fraction of real-world ML systems is composed of the ML code, as shown by the small black box in the middle. The required surrounding infrastructure is vast and complex.

-- D. Sculley, et. al., Hidden Technical Debt in Machine Learning Systems, NIPS 2015[1]

make extraordinary happen