Integration of Asset and Operational Data to Optimize Port Performance

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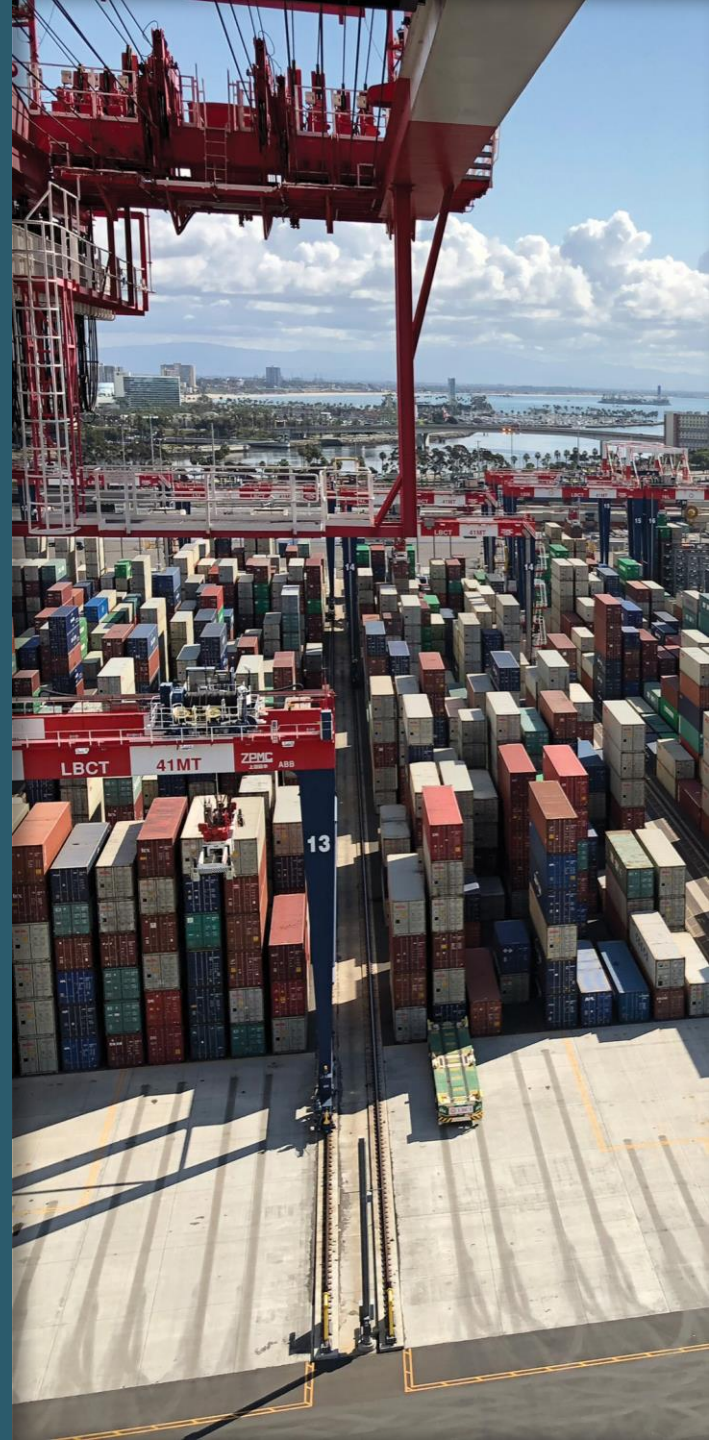
moffatt & nichol

TOC EUROPE

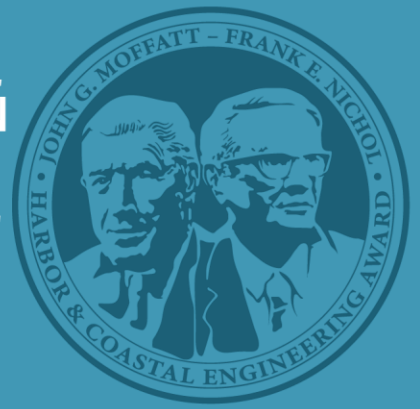


Moffatt & Nichol Today

14,000+
PROJECTS COMPLETED

ENR
Engineering News-Record
TOP 100
DESIGN FIRM

AMERICAN SOCIETY OF CIVIL ENGINEERS JOHN G. MOFFATT–FRANK E. NICHOL HARBOR AND COASTAL ENGINEERING AWARD



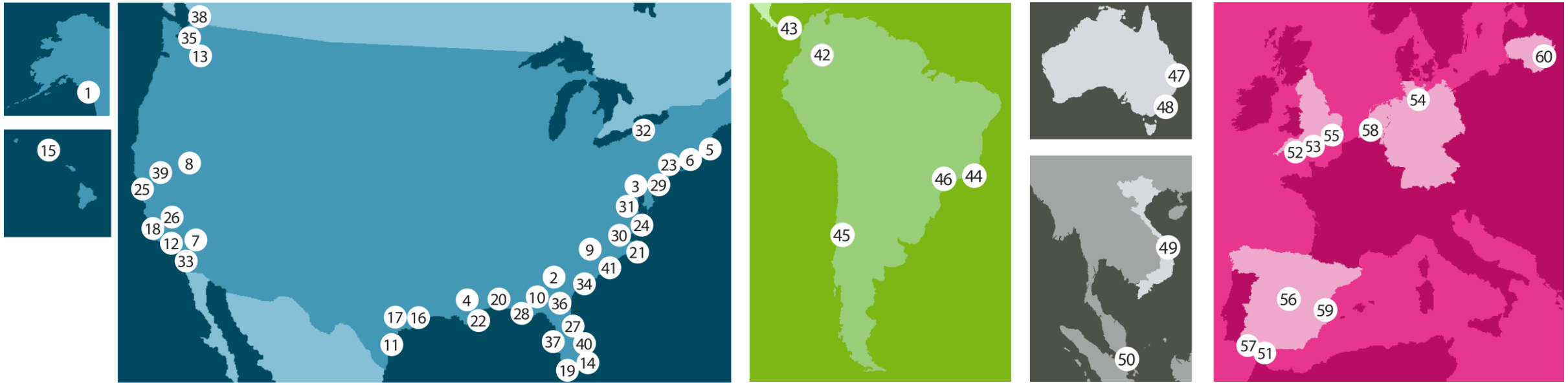
FOUNDED IN
1945

50+
OFFICES

80%
REPEAT BUSINESS

1,200+
EMPLOYEES

Office Locations



NORTH AMERICA

1. Anchorage, AK
2. Atlanta, GA
3. Baltimore, MD
4. Baton Rouge, LA
5. Boston, MA
6. Bridgeport, CT
7. Carlsbad, CA
8. Carson City, NV
9. Charlotte, NC
10. Chipley, FL
11. Corpus Christi, TX
12. Costa Mesa, CA
13. Federal Way, WA
14. Fort Lauderdale, FL
15. Honolulu, HI
16. Houston, TX
17. Katy, TX
18. Long Beach, CA
19. Miami, FL
20. Mobile, AL
21. Morehead City, NC
22. New Orleans, LA
23. New York, NY
24. Norfolk, VA
25. Oakland, CA
26. Ontario, CA
27. Orlando, FL
28. Pensacola, FL
29. Philadelphia, PA
30. Raleigh, NC
31. Richmond, VA
32. Rochester, NY
33. San Diego, CA
34. Savannah, GA
35. Seattle, WA
36. Tallahassee, FL
37. Tampa, FL
38. Vancouver, BC
39. Walnut Creek, CA
40. West Palm Beach, FL
41. Wilmington, NC

SOUTH AMERICA

42. Bogotá, Colombia
43. Panama City, Panama
44. Rio de Janeiro, Brazil
45. Santiago, Chile
46. São Paulo, Brazil

AUSTRALIA

47. Brisbane, Australia
48. Sydney, Australia

SOUTHEAST ASIA

49. Ho Chi Minh City, Vietnam
50. Singapore

EUROPE

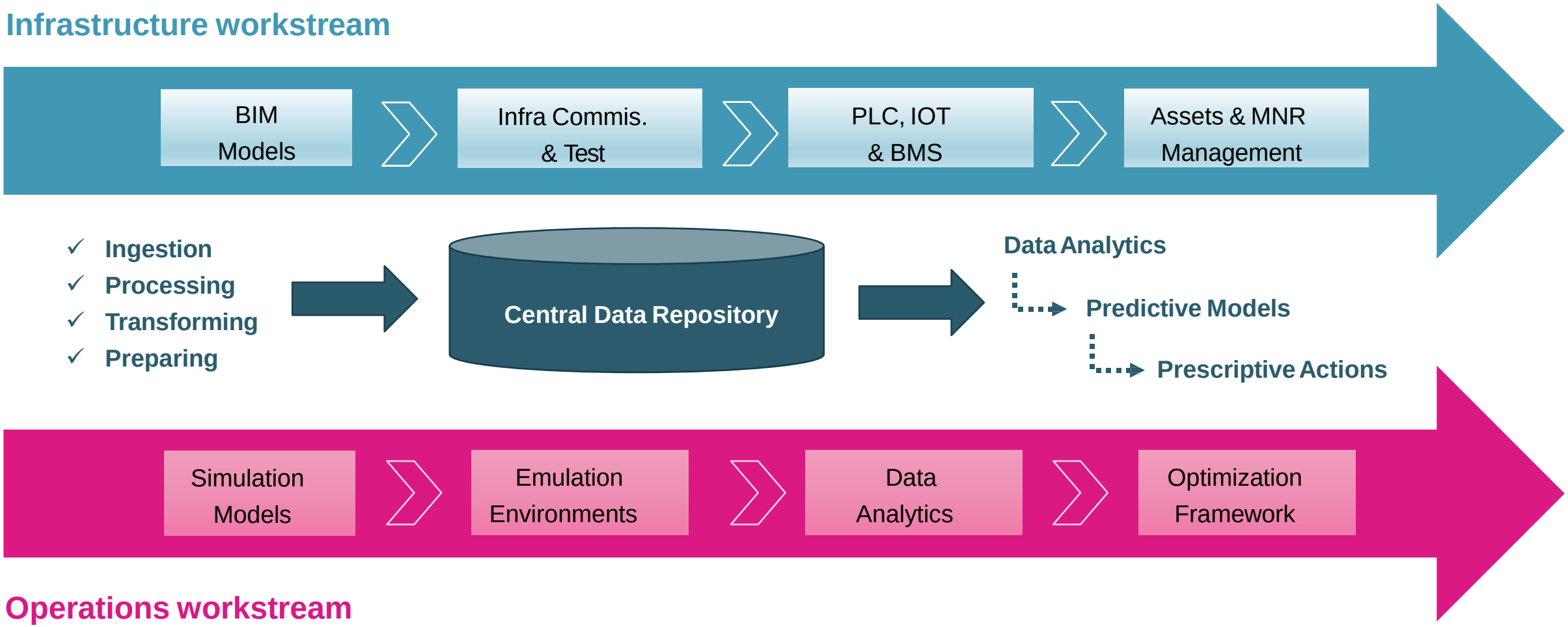
51. Algeciras, Spain
52. Exeter, United Kingdom
53. Farnham, United Kingdom
54. Hamburg, Germany
55. London, United Kingdom
56. Madrid, Spain
57. Rota, Spain
58. Rotterdam, Netherlands
59. Valencia, Spain
60. Vilnius, Lithuania

Digital Twin Solution Concept

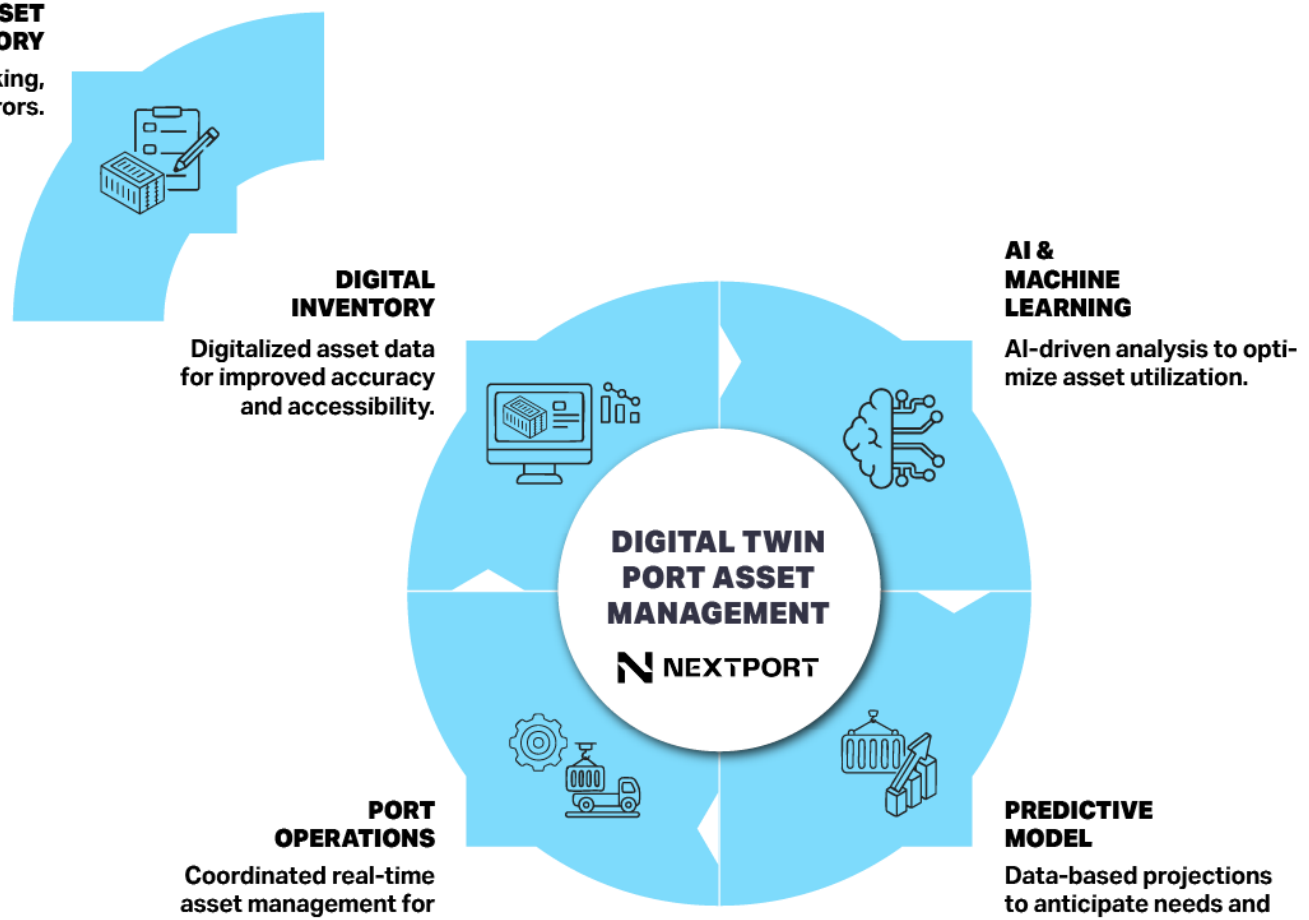
Data Sources

- **IOT Sensors and Devices**
  - Equipment telemetry, Energy Usage, SHM…
- **Geospatial Data**
  - GPS, RFID, 3D lidar and radar…
- **Operational and Logistics Systems**
  - TOS, GOS, ERP, WMS, ECS…
- **Maritime and Traffic Data**
  - Vessel Tracking, PCS, road and rail traffic …
- **Imaging Systems**
  - CCTV, Drones, thermal cameras…
- **External Data Feeds**
  - Weather and tide forecasts, Market fluctuations, Regulatory and compliance data…

Digital Twin for Infrastructure and Operations



Digital Port Asset Management System

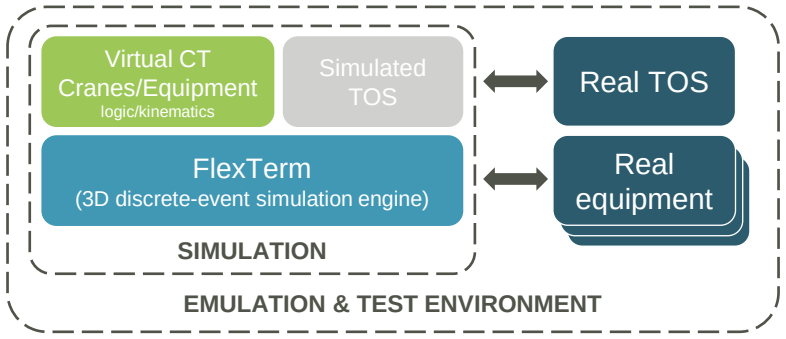


Operational Digital Twin

DIGITAL TWIN stage 1: **SIMULATION**

should support/include:

- Toolbox-based modelling functions
- Enhanced 3D graphics
- Easy configuration and adaptation
- Simple to integrate, learn and use
- Flexible on analysis and reporting
- Powerful enough to model complex operations and high volumes



DIGITAL TWIN stage 2: **EMULATION**

should support/include:

- Potentially advancing out of the SIMULATION
- Functions to be supported:
  - Integration and Go-Live support
  - Testing and quality-management (functions, interfaces, performance, upgrades)
  - Training and qualification
  - TOS configuration, improvement and testing
  - Operational process improvement and testing

EXAMPLE: **FlexTerm Simulation/ Emulation** produced out of the M&N Toolbox:

- Same system for simulation / emulation
- Open platform for easy integration
- Configuration out of TOS possible (based on yard/terminal configuration, inventory, data out of ops planning, etc.)
- Set-up for a one-click start
- Internal reports and data export
- 3D graphics for visualization

FLEXTERM SIMULATION and EMULATION PLATFORM:

- **DIGITAL TWIN supporting your terminal and automation development.**

Pavement Deterioration Modeling with AI/ML

By analyzing historical maintenance records, traffic (load intensity, movement frequency), and environmental conditions (weather, temperature) we can develop robust AI/ML road deterioration model.

Prerequisites for Deterioration Modeling

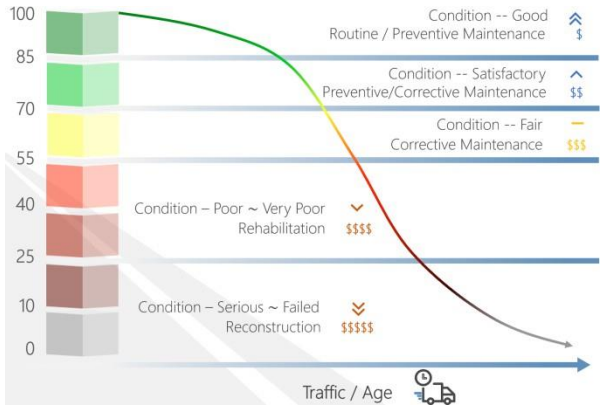
Construction History

Maintenance Logs

Historical Condition Data

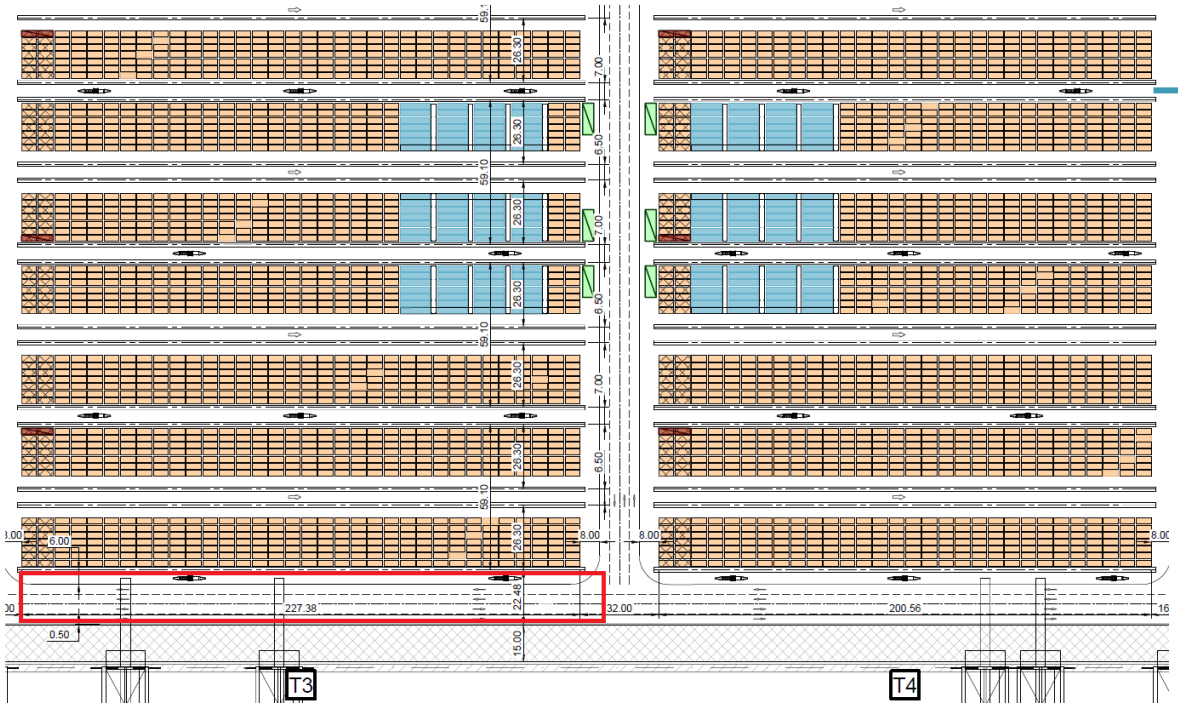
Influencing Factors

- Traffic loading
- Environmental factors
- Material properties
- Construction
- Pavement structure



- **Proactive Maintenance:** Predict when and where pavements will deteriorate, enabling timely interventions. Cost Savings: Reduce emergency repair costs and optimize maintenance budgets by predicting failures.
- **Increased Asset Lifespan:** Extend the life of pavements through targeted, efficient repairs.
- **Resource Optimization:** Prioritize high-risk areas, improving the allocation of maintenance resources. Improved Safety: Prevent major damage or safety hazards, reducing accidents and road disruptions.

Repair Pavements – What if Scenarios for Resource Allocation



Multi-Criteria Decision Analysis (MCDA)

Repair Options and Time Needed

Call Schedules (Look Ahead Planning)

Simulation

FlexTerm BY MOFFATT & NICHOL

Weigh Options and Make Recommendations

Equipment Maintenance Example

MEMORY-AUGMENTED AGENTS

Adds long-term memory and context carryover

- Maintenance history
- Component replacements
- Past anomalies (e.g., overheating, slowdown)

EVENT-DRIVEN AGENTS

Triggered by system events and data updates

- A crane's motor temperature exceeds normal
- Unexpected idle time is detected in operational logs
- Port workload surges due to incoming vessels

ENSEMBLE VOTING AGENTS

Multiple agents generate options, "judge" selects the best one

- Agent A checks vibration patterns
- Agent B uses an ML model to assess motor health
- Agent C checks hydraulic pressure deviations
- Judge agent weighs risk and recommends the best action

FlexTerm BY MOFFATT & NICHOL

- If we take this RTG offline now for 6 hours, how will it impact berth clearance?
- What happens if we delay until next week?

Thank you

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