"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is *the most adaptable to change.*"

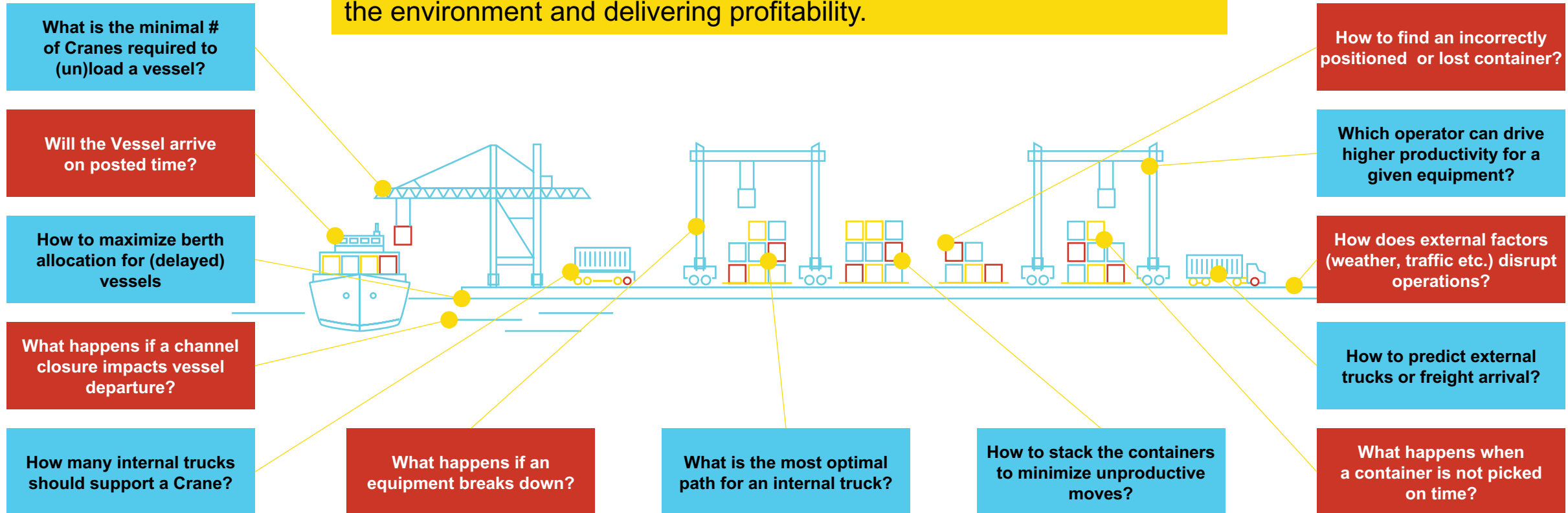- Charles Darwin

"Artificial intelligence is the capacity of a computational system to transcend manually created, soft or hardwired logic."

Why AI?
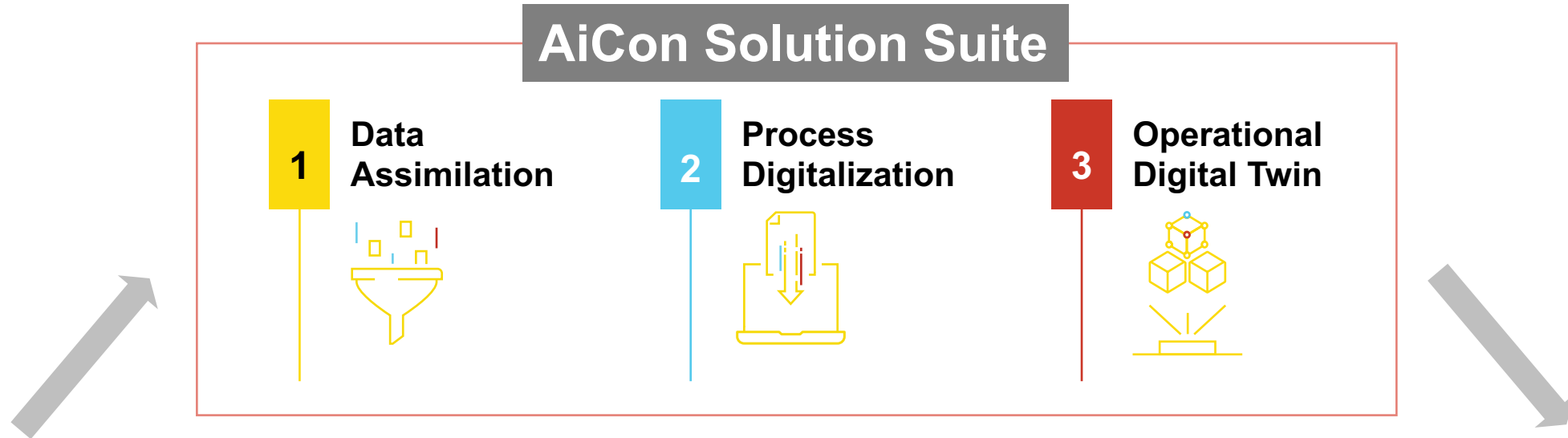## Numerous External Uncertainties and Hundreds of Possible Optimization Parameters

Despite these challenges, ports are tasked with optimizing service to the lines and truckers consistently all while considering their impact on the environment and delivering profitability.

What is the minimal # of Cranes required to (un)load a vessel?

Will the Vessel arrive on posted time?

How to maximize berth allocation for (delayed) vessels

What happens if a channel closure impacts vessel departure?

How many internal trucks should support a Crane?

What happens if an equipment breaks down?

What is the most optimal path for an internal truck?

How to stack the containers to minimize unproductive moves?

How to find an incorrectly positioned or lost container?

Which operator can drive higher productivity for a given equipment?

How does external factors (weather, traffic etc.) disrupt operations?

How to predict external trucks or freight arrival?

What happens when a container is not picked on time?

UNCERTAINTIES   OPTIMIZATIONS

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Implementing the 3 Step Autonomous Industrialization in Container Terminals

AiCon Solution Suite

1 Data Assimilation

2 Process Digitalization

3 Operational Digital Twin

- Operational Data
- Weather Data
- Equipment Data
- Ext Truck Data
- Consigner Data
- Consignee Data
- Customs Data
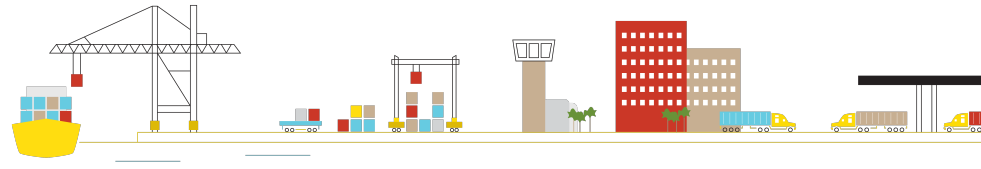
Autonomous Operations

- Vessel Berthing
- Crane Allocation
- Container Stacking
- Routing & Scheduling
- Failure Prediction
- Operator Allocation
- Gate Planning

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A Practical Implementation - A 3.3M TEU Manual RTG Operation

- High Yard Utilization

- Uneven RTG Workload distribution
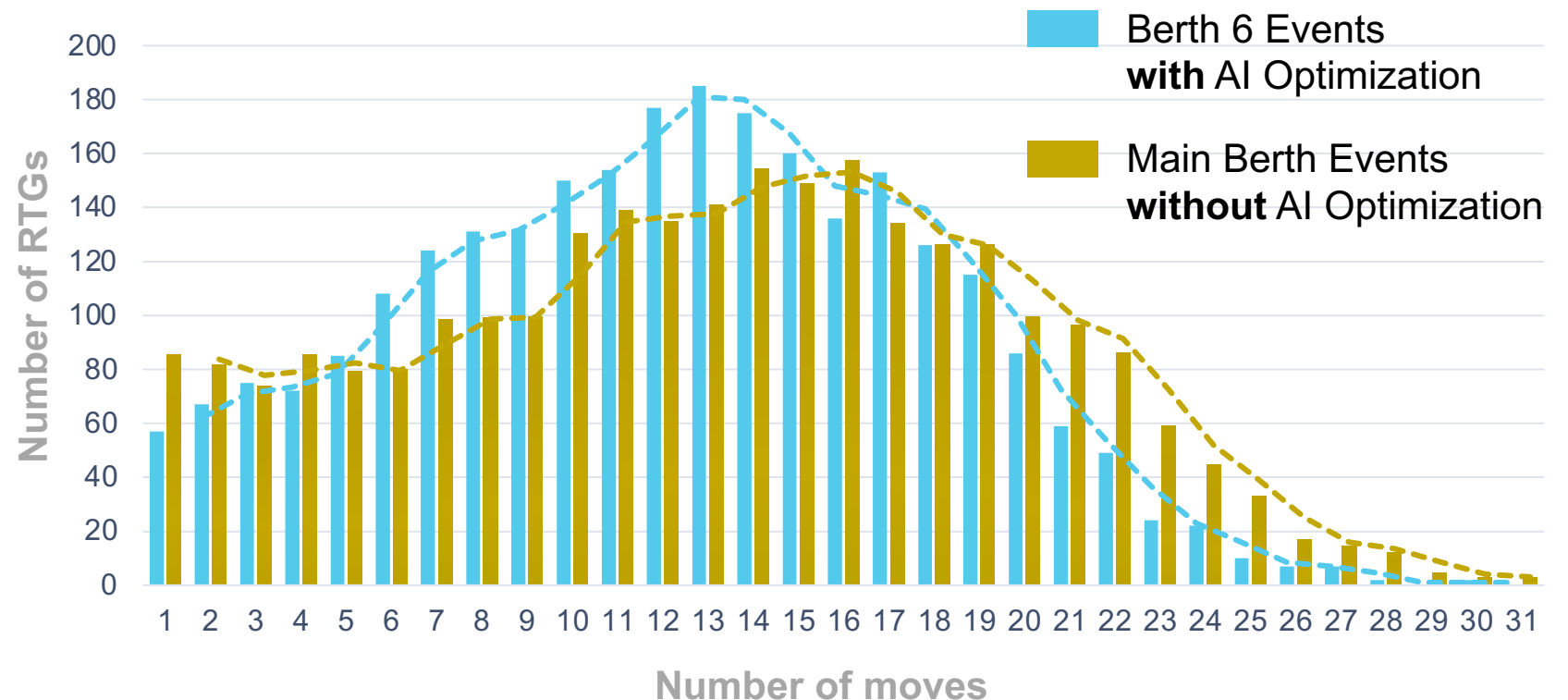
- High Rehandle Count

- Lower Productive Moves %

The client deployed the AiCon Solution Suite's AI Yard Optimization module to mitigate these challenges

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AI Optimization Results

MICT quickly saw an improved bell curve with better RTG work distribution.

- **~15% Positive shift**

- **Reduced turn for internal PM ~2 minutes too**

- **AI now rolled out to full terminal**

Discharge RTG Work Distribution, May 2021 with same Average Prod.

Legend:
- Berth 6 Events **with** AI Optimization
- Main Berth Events **without** AI Optimization

Y-axis: Number of RTGs (0–200)
X-axis: Number of moves (1–31)

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YardSight

Results that will be measured on a sustained basis

PM Metrics
Decrease in PM Active Time

Within YardSight Physical Access	1-3 months prior to YardSight implementation	1-3 Months post YardSight implementation

YardSight

Yard

	1-3 months prior	1-3 Months post
Total Moves / Number of PMs	17,000 / 34	Total Moves / Total number of PMs — 15,800 / 32 ▲
Active Time / Inactive Time	73 hrs / 94 hrs	Active Time / Inactive Time — 91 / 76 ▲
Productive Moves / Total Moves	15,000 / 34	Productive Moves / Total Moves — 15,000 / 32 ▲

RTG Metrics
Reduce distance traveled and increase Productive Moves

Within YardSight Physical Access	1-3 months prior to YardSight implementation	1-3 Months post YardSight implementation

YardSight

Yard

	1-3 months prior	1-3 Months post
Total Moves / Number of RTGs	17,000 / 10	Total Moves / Total number of RTGs — 21,000 / 9 ▲
Total Moves / Total distance travelled	17,000 / 350Km	Total Moves / Total distance travelled — 21,000 / 287Km ▲
Productive Moves / Total Moves	15,000 / 10	Productive Moves / Total Moves — 18,000 / 9 ▲

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YardSight

Results that will be measured on a sustained basis

Yard Metrics
Reduce Unproductive moves

	Decease in Re-handles	

Within YardSight Physical Access	1-3 months prior to YardSight implementation	1-3 Months post YardSight implementation	
	Avg Re-handles Per Container in the Past Month For Deliver	1.65	Avg Re-handles Per Container in the Past Month For Deliver	1.4	▼
	Yard Utilization n the Past Month	85%	Yard Utilization in the Past Month	85%	
	Containers Delivered	20,000	Containers Delivered	20,000	
	Total Unproductive Moves	13,000	Total Unproductive	8,000	▼
	Total Moves	33,000	Total Moves	28,000	▼

STS Metrics

	Decease in Re-handles	

Within YardSight Physical Access	1-3 months prior to YardSight implementation	1-3 Months post YardSight implementation	
	Total Moves	130	Total Moves	0150	▲
	Number of RTGs	32 (85%)	Total number of RTGs	31 (85%)	
	Total Moves	130	Total Moves	0150	▲
	Total distance travelled	32 (85%)	Total distance travelled	31 (85%)	
	Productive Moves	130	Productive Moves	0150	▲
	Total Moves	32 (85%)	Total Moves	31 (85%)	

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Client Deliverable

Objective
1) Automation all of required housekeeping moves at night before start of the landside delivers/receives.
2) Automation all of housekeeping 24/7

Success Metrics
a. Truck turnaround time should be reduced.
b. No manual intervention

YardSight Release for Client

- YardSight V1.8 objectives:

  - Plan housekeeping moves to transfer delivery containers with a truck appointment

  - Housekeeping 7.00pm to 6.00am

- XPS will continue to handle OOG, 45, Reefers and Hazards, and Discharges

- In the next YardSight Release (V2.0), the following objectives will be included:

  - 24/7 hours of housekeeping between waterside/landside movement of all containers

  - Discharges

  - Load

  - Receives

  - Deliveries

Measurement Metrics

Success Measurement:

1) Reduction in Truck Turnaround Time

- ➢ Deliveries per hour

- ➢ Block In/Out Time
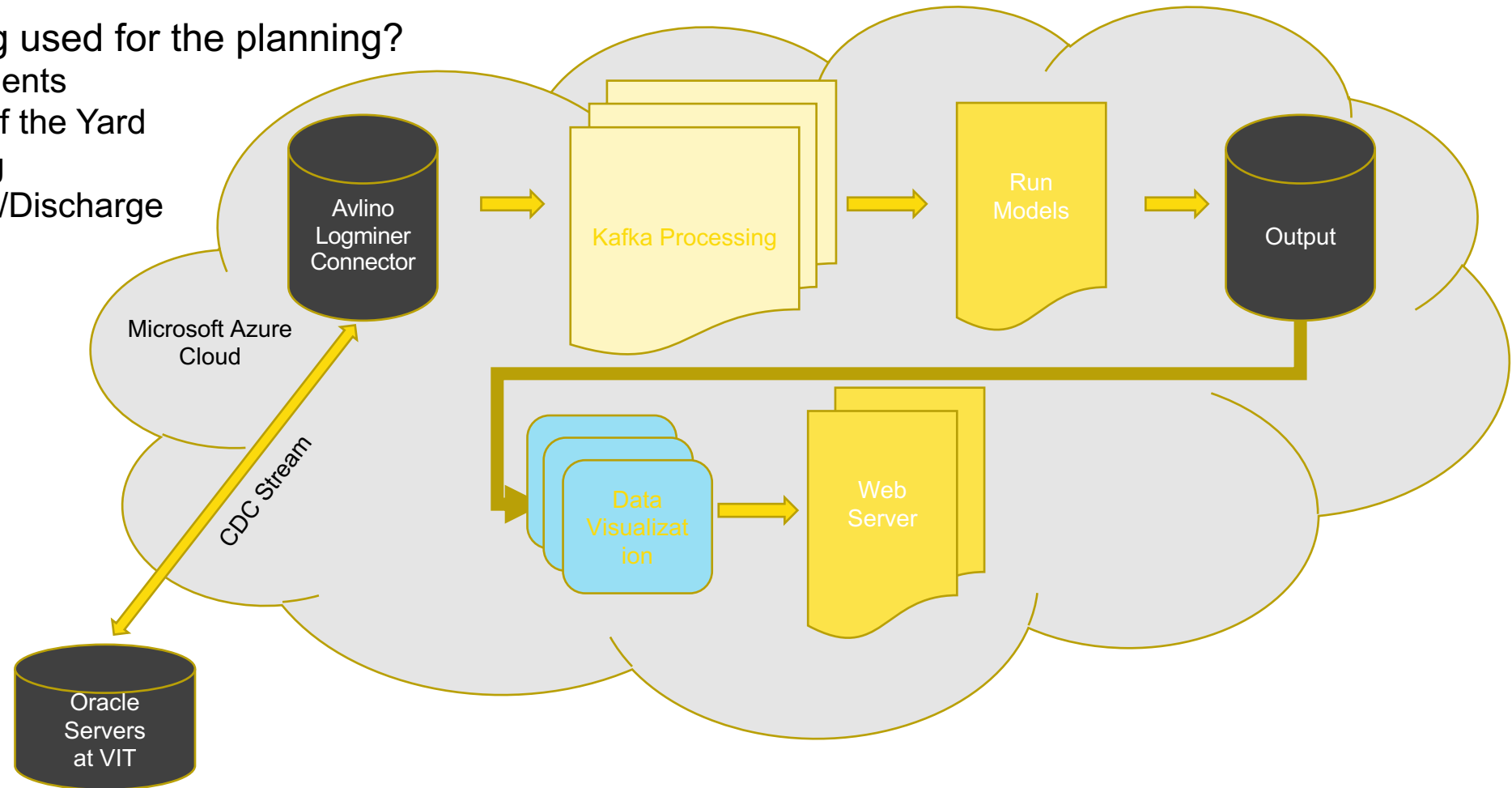
- ➢ Number of Moves per deliver

- ➢ Distance to Deliver

2) Reduction in re-handles for a given throughput and capacity.

YardSight Solution Architecture

➢ What data is being used for the planning?
- Truck appointments
- Current State of the Yard
- Vessel Berthing
- Vessel Loading/Discharge

Results from the simulation exercise

Measurement Metrics	Base	YardSight	Improvement
Number of Deliveries/Receive (mph)	9.10	12.20	34%
Block In/Out Time (min)	15.00	11.25	25%
Number of Moves per deliver	2.10	1.18	43%
Distance to Deliver (feet)	283.81	94.72	62%

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EquipmentSight™

AI Module for Equipment Failure Prediction

Client Profile:

- A fully automated terminal with 59 AGV's in operation.

The Goals:

- **Predict** a critical AGV failure 2-8 hours in advance
- **Minimize** operational impact

Engagement Scope:

- Create a prototype that can predict failures with at least 75% precision
- Integrate the solution with the existing standard operating procedures

The Results:

75%

Confidence Level in **Predicting** AGV failures 2-4 hours in advance

10

High Risk AGVs identified to date - anomalies validated by the Client Engineering team
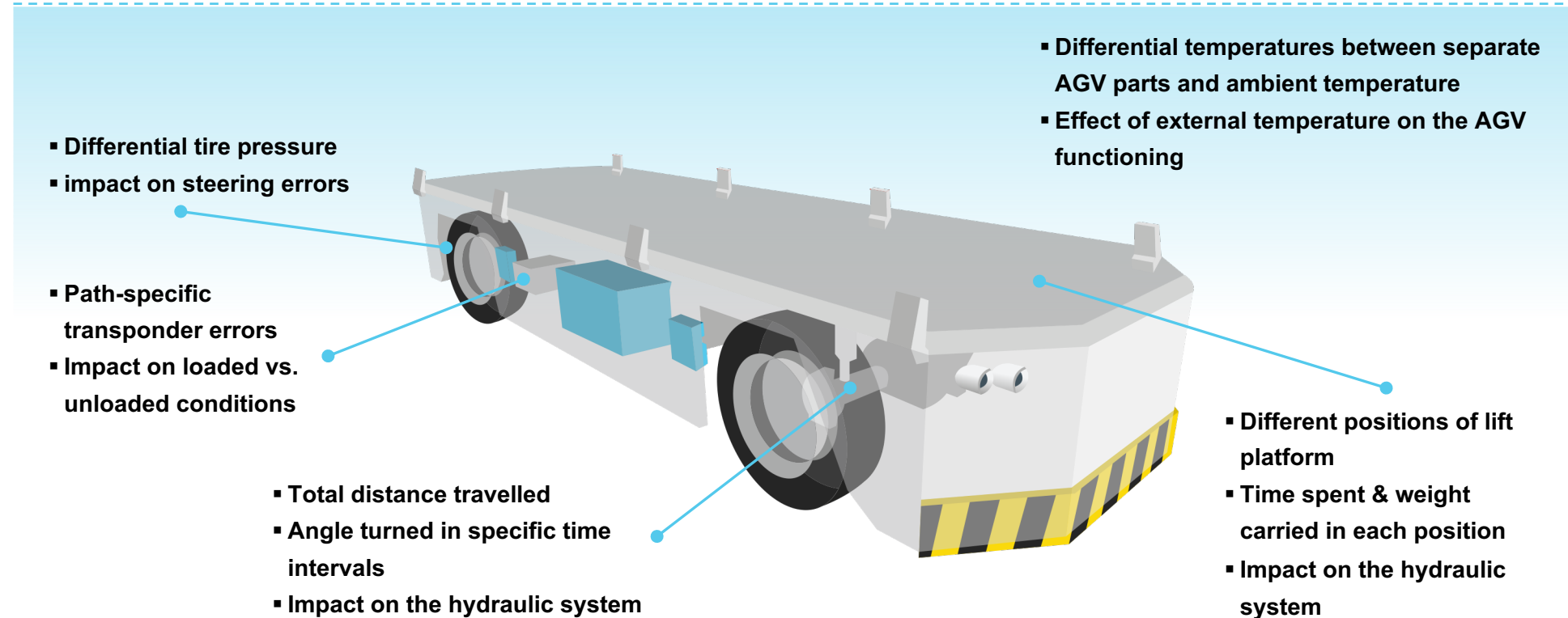
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100GB of raw data was ingested, from which over 20 TB of data models were extracted and created.

These data models were used to create AGV digital twins that accurately predict the AGV failures or anomalous operations

Data Required	Client	Table Names	Status
Equipment Monitoring System	FMDS	Events and Errors Tables	Online
Equipment Routing	Teams	1. All tables starting with "agv"/"AGV". 2. MESSAGES 3. ELP_AGV_STATUS_CHANGE 4. ELP_GUI_MESSAGES 5. ELP_MESSAGES	Online
Equipment ERP	Maximo	MAXIMO_WORKORDER and MAXIMO_WORKORDER_LABOR tables	Online
Weather	3rd Party API	Historical and Forecast (Minimum of historical 1 year and forecast for 24 to 72 hours)	Historical Online

- **Differential tire pressure**
- **impact on steering errors**

- **Path-specific transponder errors**
- **Impact on loaded vs. unloaded conditions**

- **Total distance travelled**
- **Angle turned in specific time intervals**
- **Impact on the hydraulic system**

- **Differential temperatures between separate AGV parts and ambient temperature**
- **Effect of external temperature on the AGV functioning**

- **Different positions of lift platform**
- **Time spent & weight carried in each position**
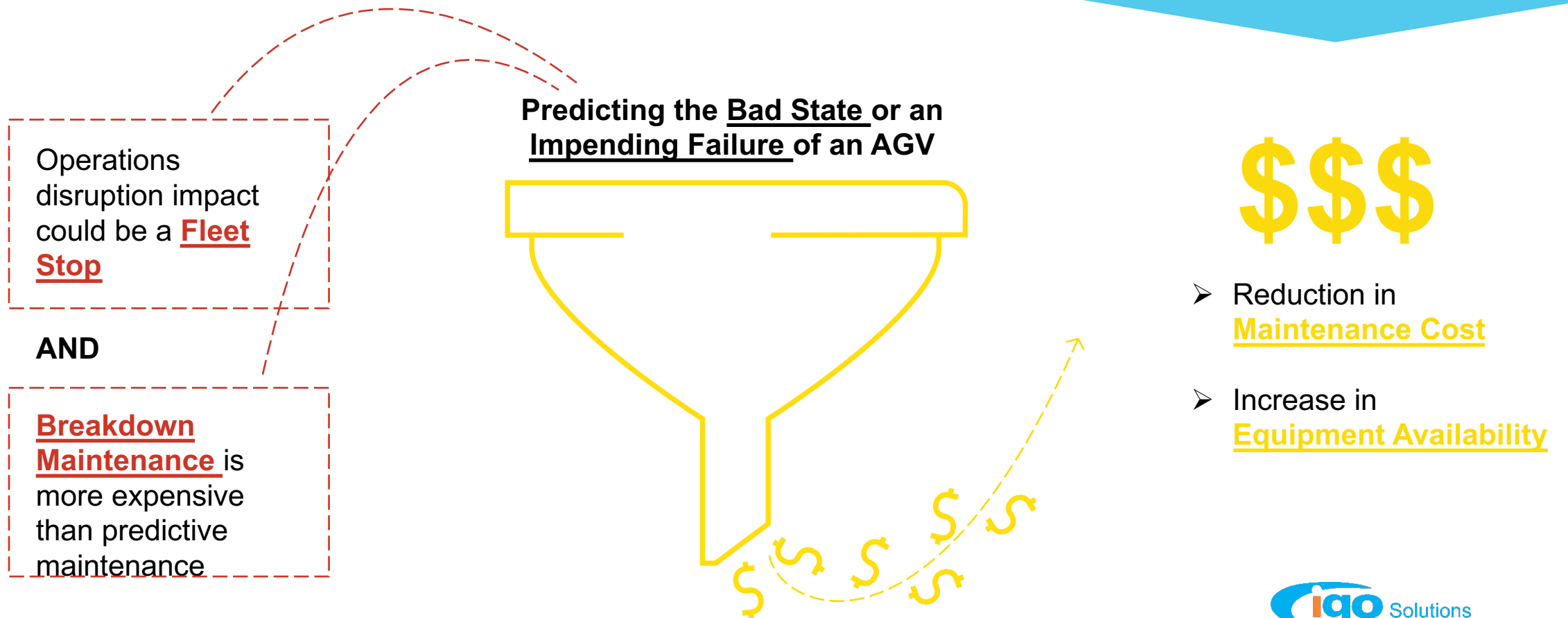- **Impact on the hydraulic system**

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How does EquipmentSight Add Value to client Operations?

Client's Engineering team current disruptors.

EquipmentSight – AGV ability to predict unexpected failures, enables Client's Engineering team to take corrective action by pulling out the AGV.

Through reduction in AGV breakdown hours and reduction of Perimeter Stops, Increases ROI for Client's Management Team.

Operations disruption impact could be a **Fleet Stop**

AND

Breakdown Maintenance is more expensive than predictive maintenance

Predicting the Bad State or an Impending Failure of an AGV

$$$

➢ Reduction in **Maintenance Cost**

➢ Increase in **Equipment Availability**

igo Solutions

Thank You

As for the future, your task is not to foresee it, but to enable it"

Antoine de Saint-Exupéry

French writer, poet, aristocrat, journalist and pioneering aviator.

igo Solutions

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