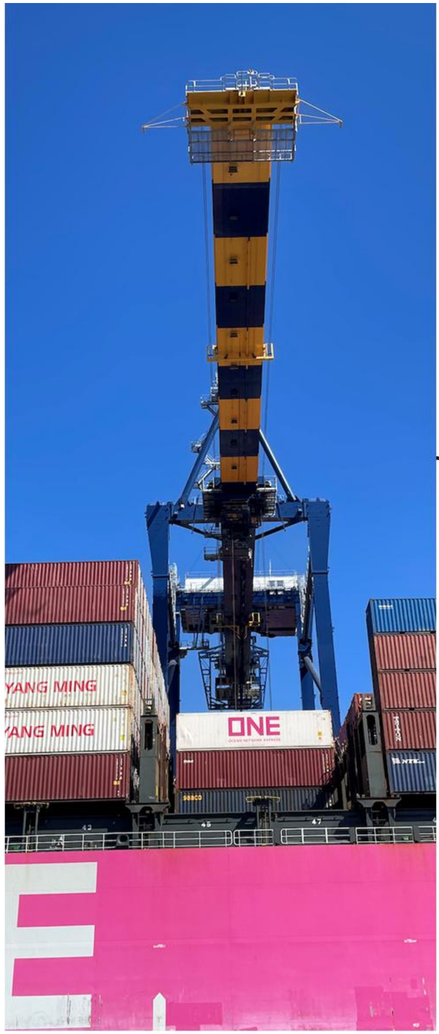

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2026 IAPH-KMI Port Forum

AI-Container Terminal

July 27th, 2026 @Azur Takeshiba, Tokyo, Japan

MITSUI E&S

MITSUI E&S Co., Ltd.
New Business Development Div.
Marketing Dept.
Kinya ICHIMURA, P.E. /Head of Technological Development Gr.

Topics

1. Digitalization of Container Terminals
2. Type of Simulations for Digital Twin
3. Example of Simulations
4. Conclusions

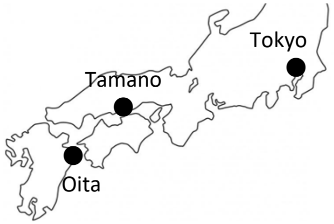
About MITSUI E&S *(Engineering & Services for Evolution & Sustainability)*

MITSUI E&S

1917 → MES MITSUI ENGINEERING & SHIPBUILDING CO.,LTD. → 2018 → MITSUI E&S Mitsui E&S Machinery Co., Ltd. Subsidiary of Mitsui E&S Holdings → 2023 →

↑Headquarters, Tokyo

↑Tamano Works



Oita works→

Industrial Machinery

After Services

Cranes & Systems

Marine Diesel Engines

MITSUI E&S

- New Business Development Div.
- Marine Propulsion Systems Div.
- Logistics Systems Div.

- Mitsui E&S Systems Research Inc.
- KAJI TECHNOLOGY CORPORATION.
- Burmeister & Wain Scandinavian Contractor A/S
- PACECO CORP.
- Mitsui E&S Power Systems Inc.

The other subsidiaries

Net Sales: 353,200 million Yen (FY2025)
Employees: 5,998 (As of March 31, 2026) (Consolidated)

1 Digitalization of Container Terminals

1-1. Container Terminal – Current Challenges

Smart Port: A strategy that goes beyond the automation and visualization of cargo handling operations to strategically utilize digital twins, addressing challenges such as improving efficiency and speed, enabling less-skilled workers, and implementing environmental measures.

Global figures
2024 container traffic volume
173.38 million TEU[*1]
2024 container terminal throughput
Approx. 919 million TEU[*2]
Number of container terminals
Approx. 1,300[*3]
Number of automated container terminals
Approx. 120[*4]

Sources:
※1 Japan Maritime Center
※2 CONTAINER TERMINAL FORESIGHT 2025 By DS Research
※3 Presentation by HYUNDAI U&I at TECH TOC
※4 Based on industry data (Corrected by Mitsui E&S)

Overview of RTG type CT

8.4km quay,　65 STSCs,　210 RTGCs

1-2. The Ideal and Reality of Data-Driven Operations

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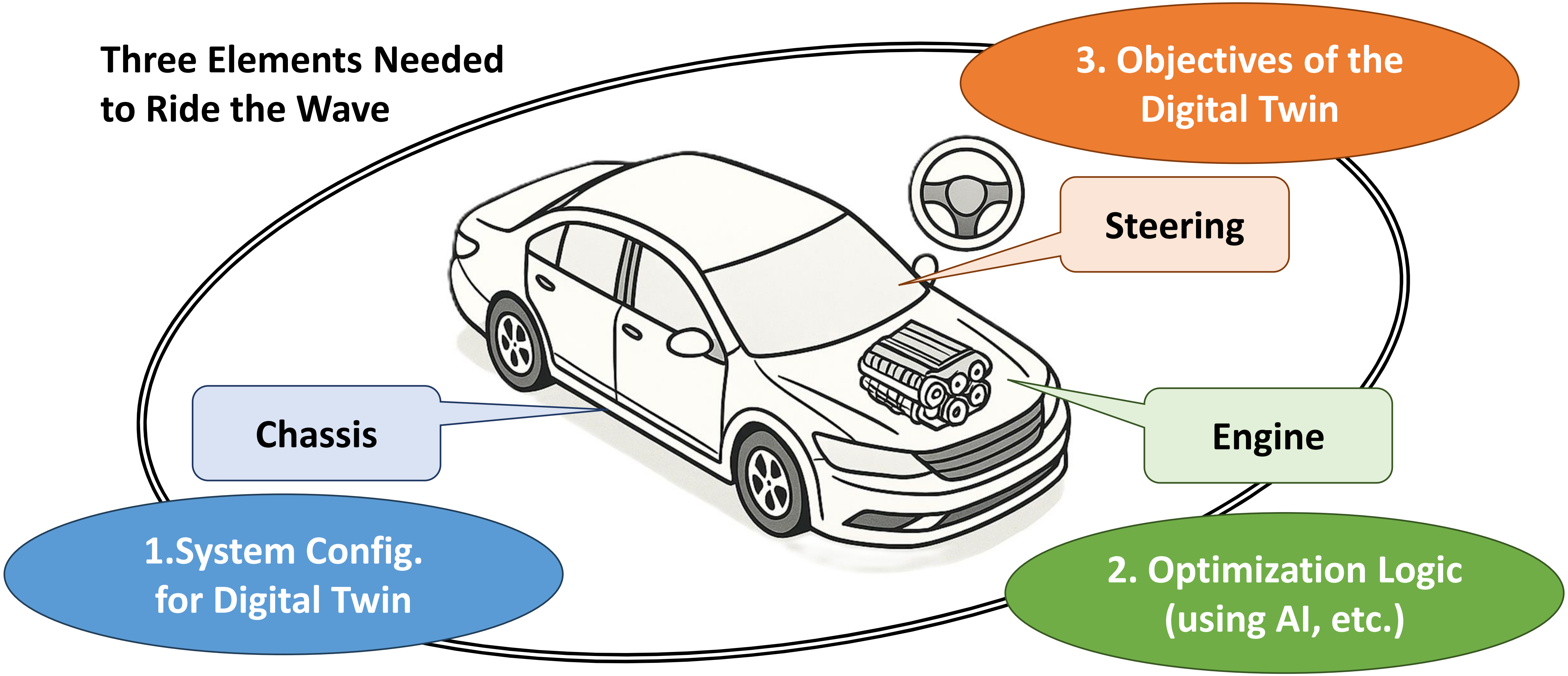
In reality, wouldn't you just get swept away and drown in a data wave?

Will AI help us... when the time comes?

出所)　Google Geminiを用いて著者作成

1-3. To Ride the Wave of Data in Data-Driven CT



Source: Prepared by the author using Microsoft Copilot.

2 Type of Simulations for Digital Twin

2-1. Digital Twin - AI in the Loop -

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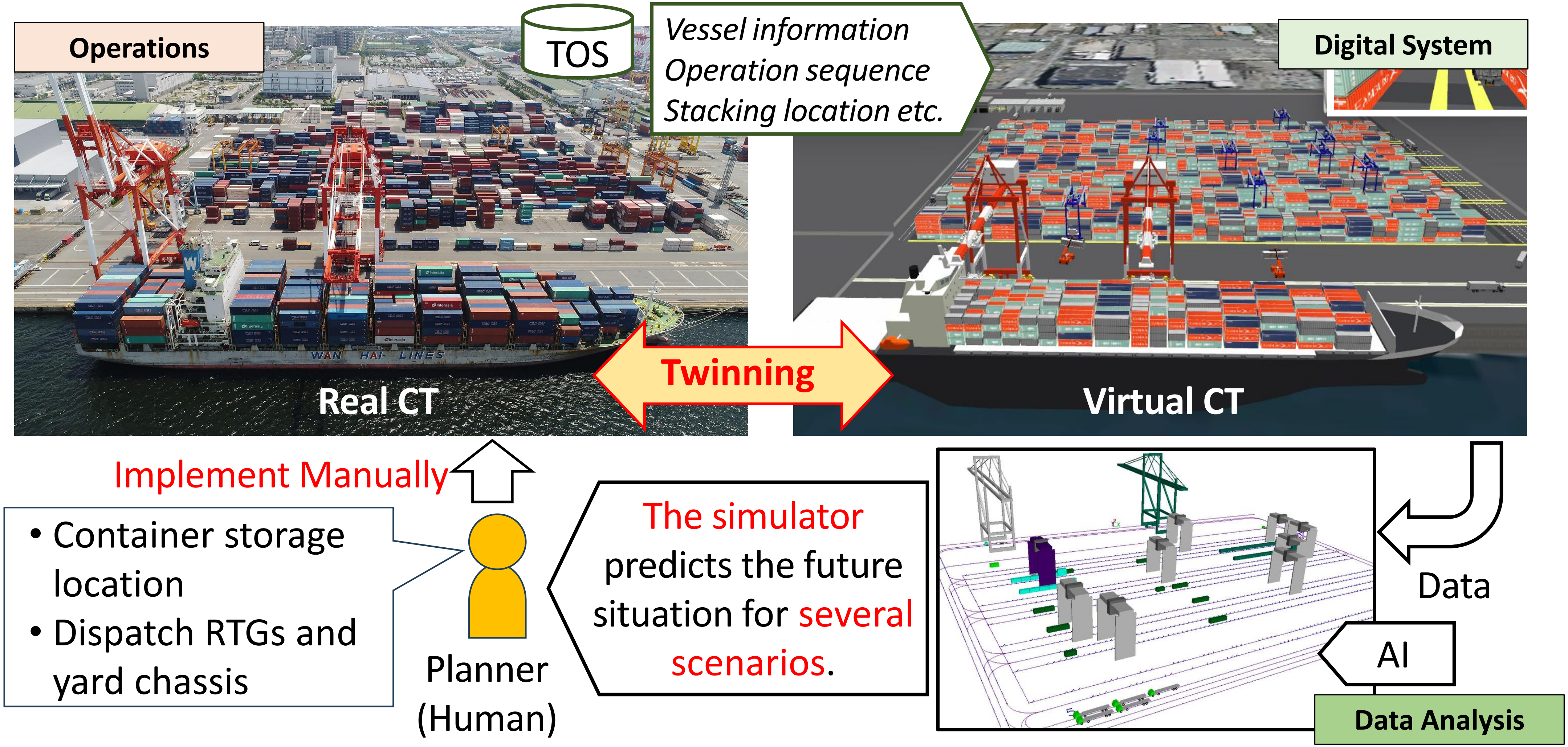

2-2. Discrete Event Simulator (DES) vs. Stochastic Simulator (SS)

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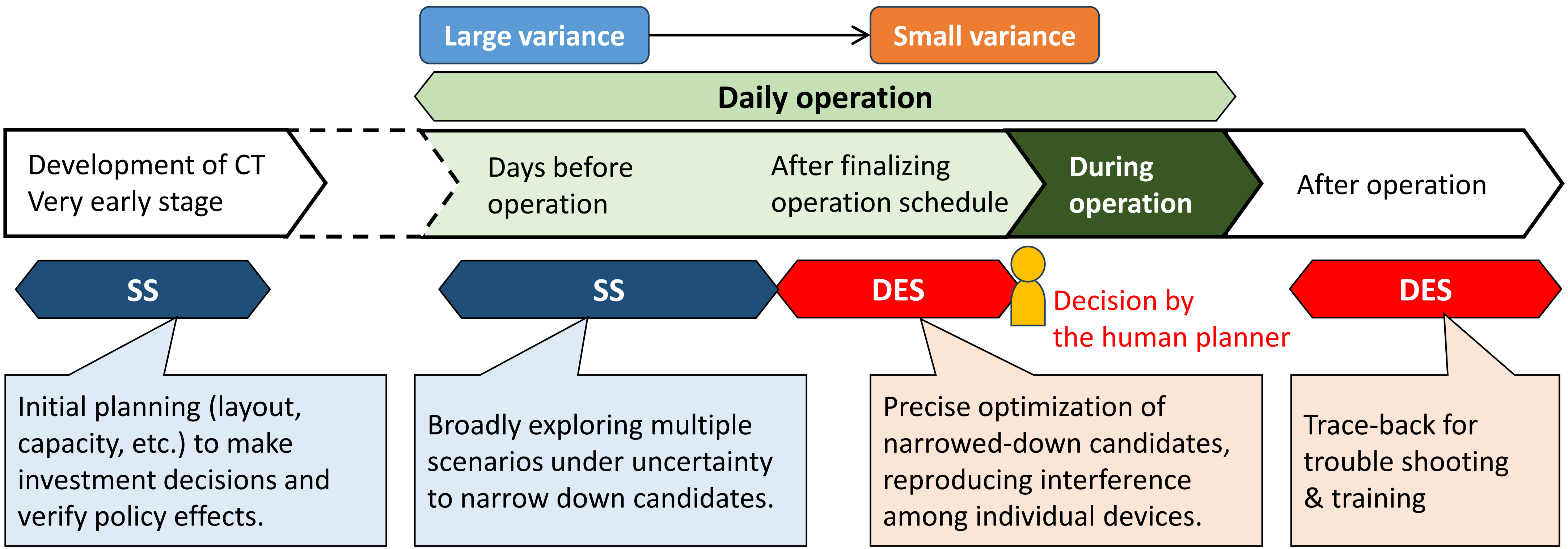
Aspect	Discrete Event Simulator (DES)	Stochastic Simulator (SS / Monte Carlo)
Basic concept	Tracks individual events (equipment / tasks) sequentially over time to reproduce actual movements	Aggregates events into statistical distributions and runs many Monte Carlo trials
Target of modeling	Reproduces individual equipment behavior and physical work interference in detail	Captures macro-level bottlenecks such as congestion and capacity limits
Input data	Confirmed, detailed data (large volume, high accuracy required)	Probability distributions (mean / variance); uncertainty can be input directly
Handling of individual events	Computed one by one (equipment interference and sequence explicitly represented)	Aggregated into distributions (physical interference not tracked directly)
Accuracy / granularity	High (can compute turn time down to each individual chassis)	Coarse (grasped as overall trends and distributions)
Calculation speed	Each case is time-consuming; exhaustive scenario testing is difficult	Runs thousands to tens of thousands of trials fast; suited to scenario search
Development cost	Extremely high (complex programming, large data requirements)	Low (lightweight, easy to implement)
Best-suited use	Detailed optimization and yard planning after data are confirmed; Trace-back of completed operation	Early-stage study, investment decisions, and policy-change impact evaluation before confirmation

2-3. Division of Roles between DES and SS

The two simulation methods are complementary, not competing. Along the timeline, roles are divided:
SS (early study before data are confirmed) → DES (detailed optimization after confirmation).

Input uncertainty (the variance of the distribution) shrinks over time.



3 Example of Simulations

3-1. Example of DES (Simulator)

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Cases
Stacking location, nos. of chassis, spec. of crane etc.

シミュレーション結果比較

シミュレーション条件

No	項目		条件1	条件2	条件3	条件4	条件5
1	有効設定		有効	有効	有効	有効	有効
2	GC基数	基	2	2	2	2	2
3	RTG基数	基	8	9	7	8	8
4	ギャング当たりトレーラー台数	台	3	3	3	4	2
5	アロケーション		A	A	A	A	A

比較　全て

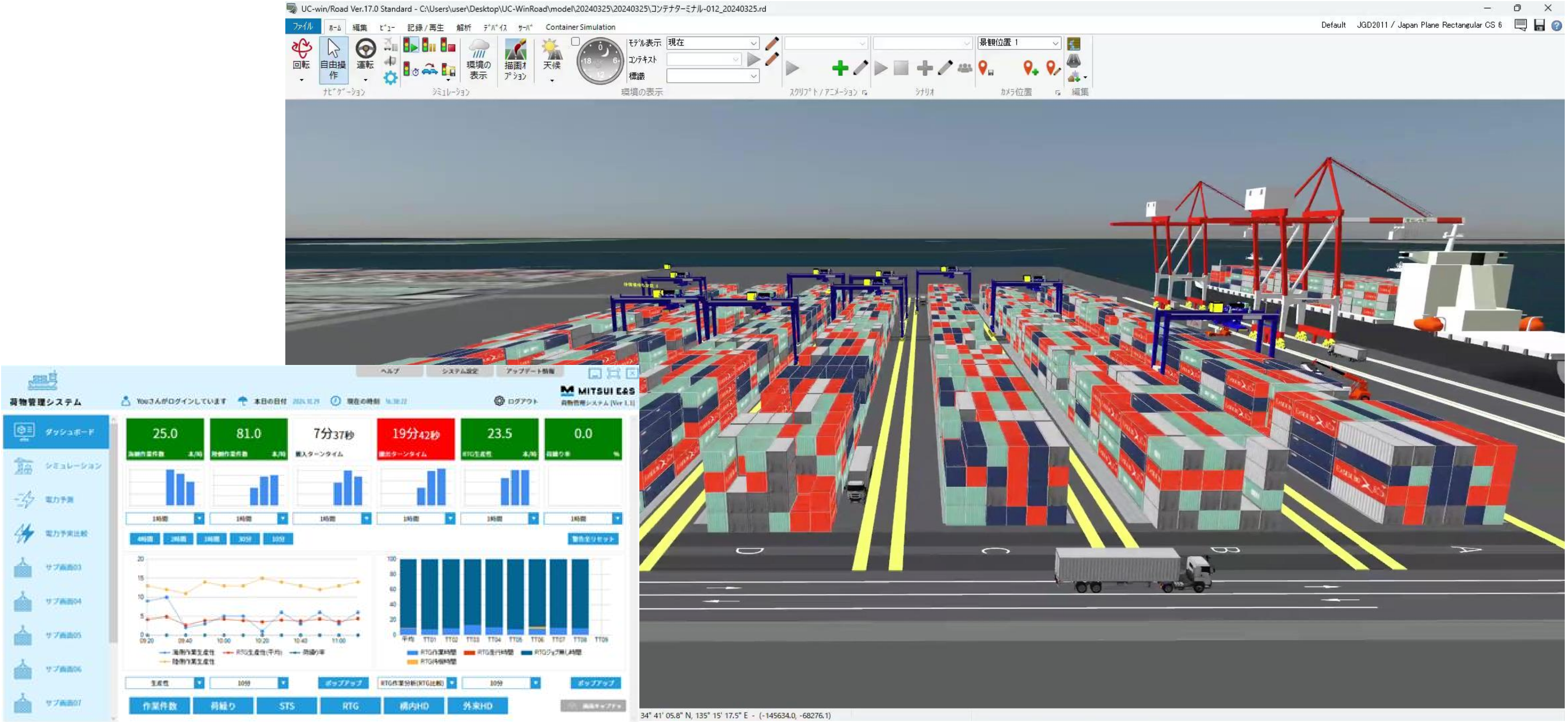
緑：良い　赤：悪い

No	項目		条件1	条件2	条件3	条件4	条件5
	比較チェック		☑	☑	☑	☑	☑
1	海側作業件数平均	本/時	29.37	29.37	29.21	29.37	11.37
2	海側作業件数総計	本	186	186	185	186	72
3	陸側作業件数平均	本/時	69.63	69.63	69.63	69.63	69.63
4	陸側作業件数総計	本	441	441	441	441	441
5	RTGプロダクティビティ	本/時	12.38	11.00	14.12	12.38	10.13
6	干渉時間	分	0.00	0.00	0.00	0.00	0.00
7	荷繰り率	%	98.84	98.84	98.84	98.84	98.84
8	荷繰り件数	本	255	255	255	255	255
9	作業時間平均	分/基	178.54	158.83	203.63	178.17	156.27
10	作業時間最小	時間	151.97	126.95	179.87	142.18	113.57
11	作業時間最大	時間	202.45	195.42	218.77	217.58	199.13
12	待機時間平均	分/基	30.69	29.20	32.36	26.43	23.47
13	待機時間最小	時間	3.77	0.95	13.78	12.65	0.00
14	待機時間最大	時間	69.13	102.60	68.30	49.75	62.15
15	走行時間平均	分/基	89.14	75.00	106.56	89.31	82.71
16	走行時間最小	時間	75.05	59.12	85.77	64.60	76.53
17	走行時間最大	時間	103.87	94.88	127.15	113.33	88.72
18	ジョブなし時間平均	分/基	81.63	116.98	39.85	86.09	117.54
19	ジョブなし時間最小	時間	51.40	50.52	0.00	48.07	70.58
20	ジョブなし時間最大	時間	118.25	172.13	79.53	101.52	177.18

閉じる　画面キャプチャ

Key Performance Indicators (KPIs)
Crane operation hours, productivity, waiting time
Road chassis turn time, waiting time etc.

3-2. Example of DES (Dashboard)



3-3. How AI Reduces Container Moves (Example)

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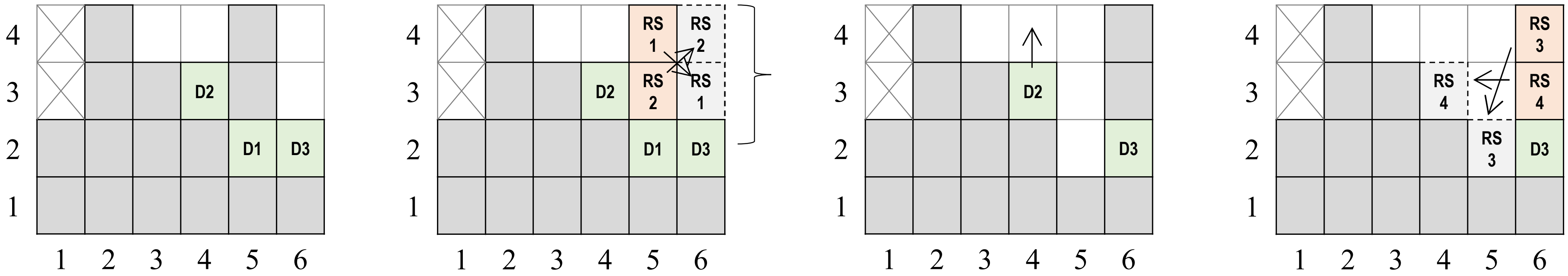
Container delivery sequence; D1→D2→D3

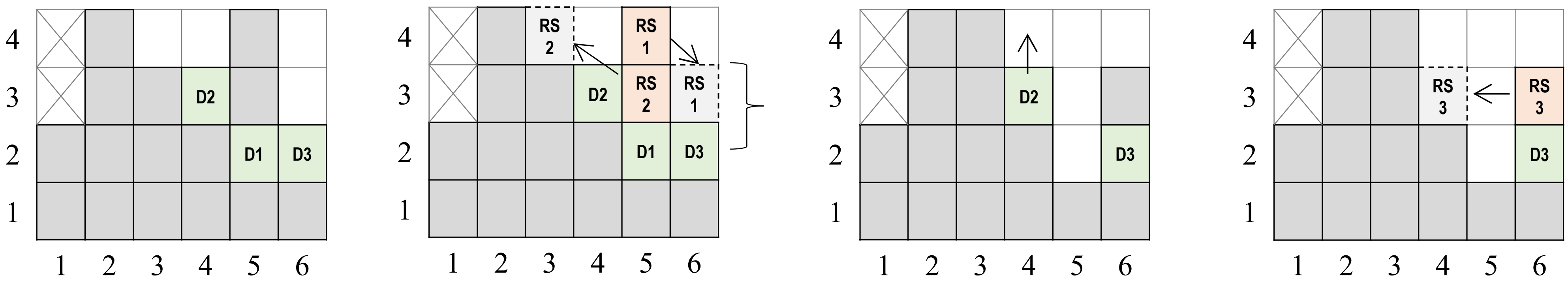
Conventional

7 moves to deliver 3 containers



Optimized

6 moves to deliver 3 containers



3-4. Example of SS (Simulation model)

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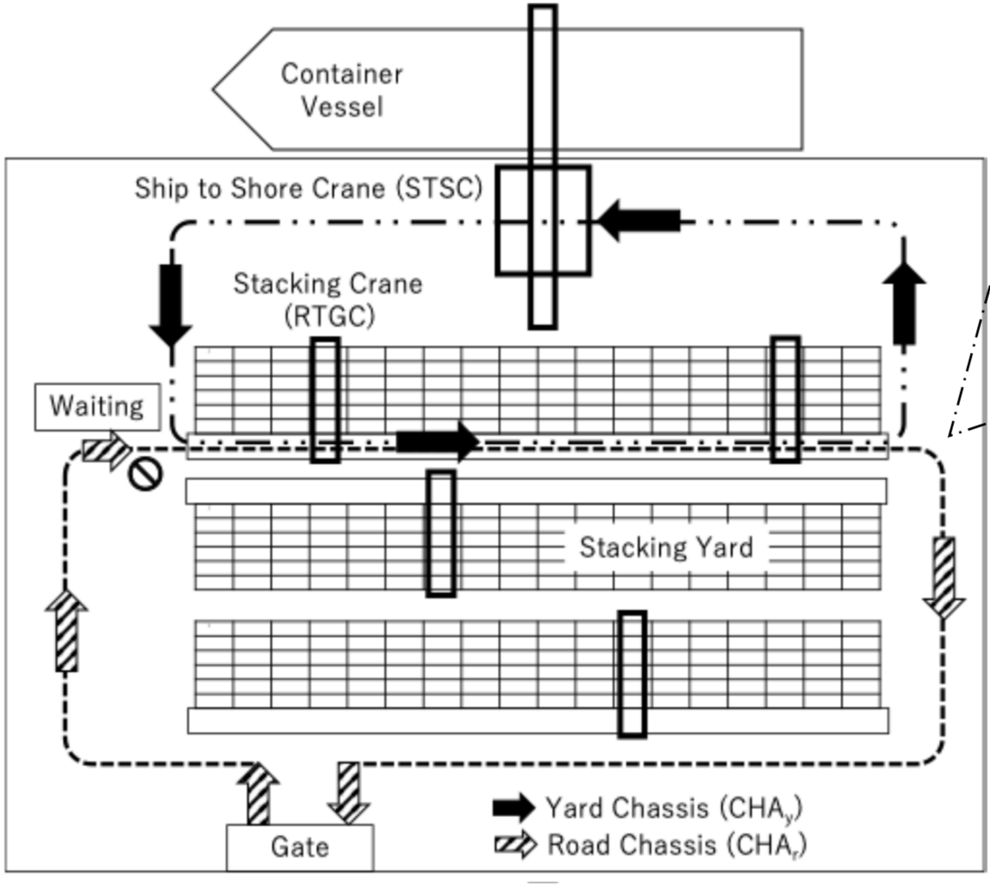
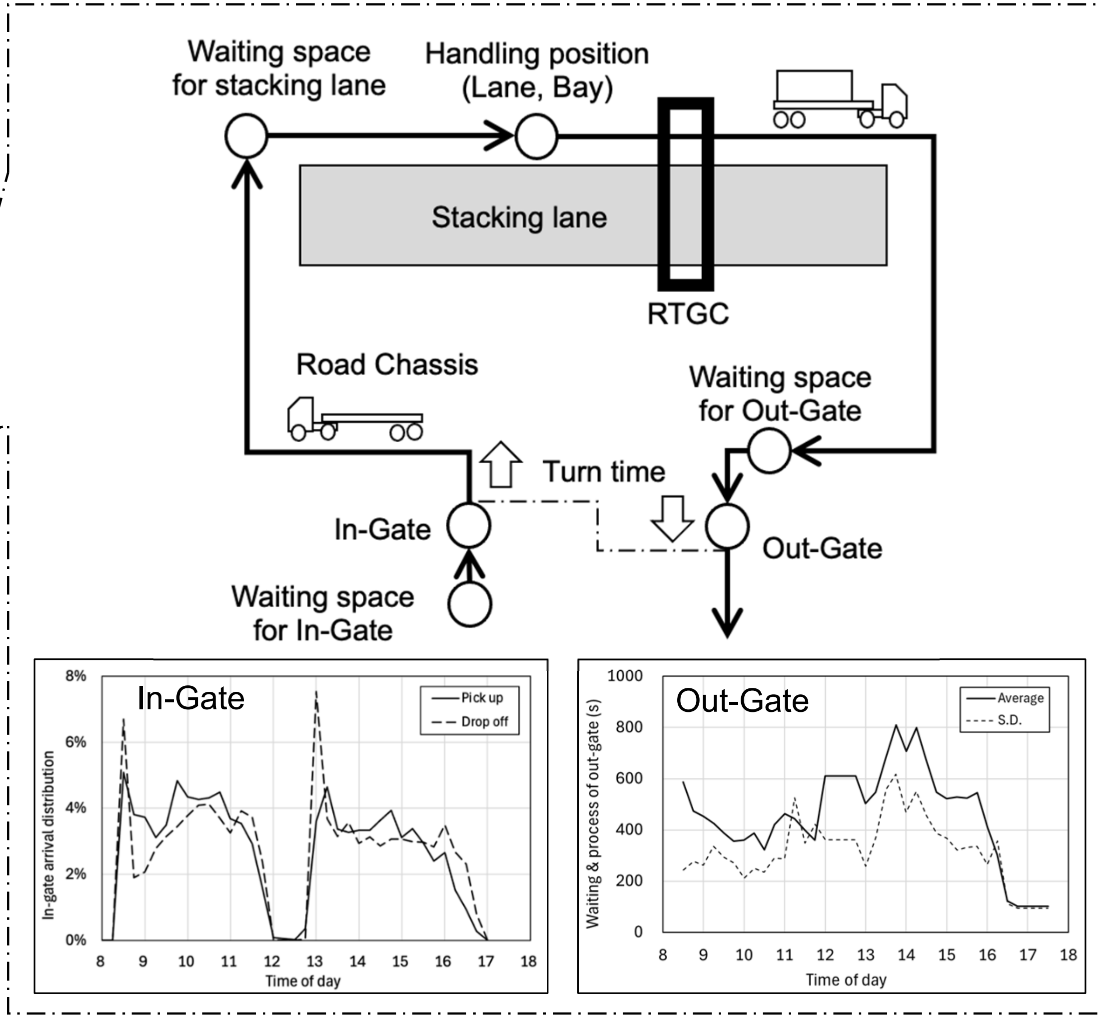
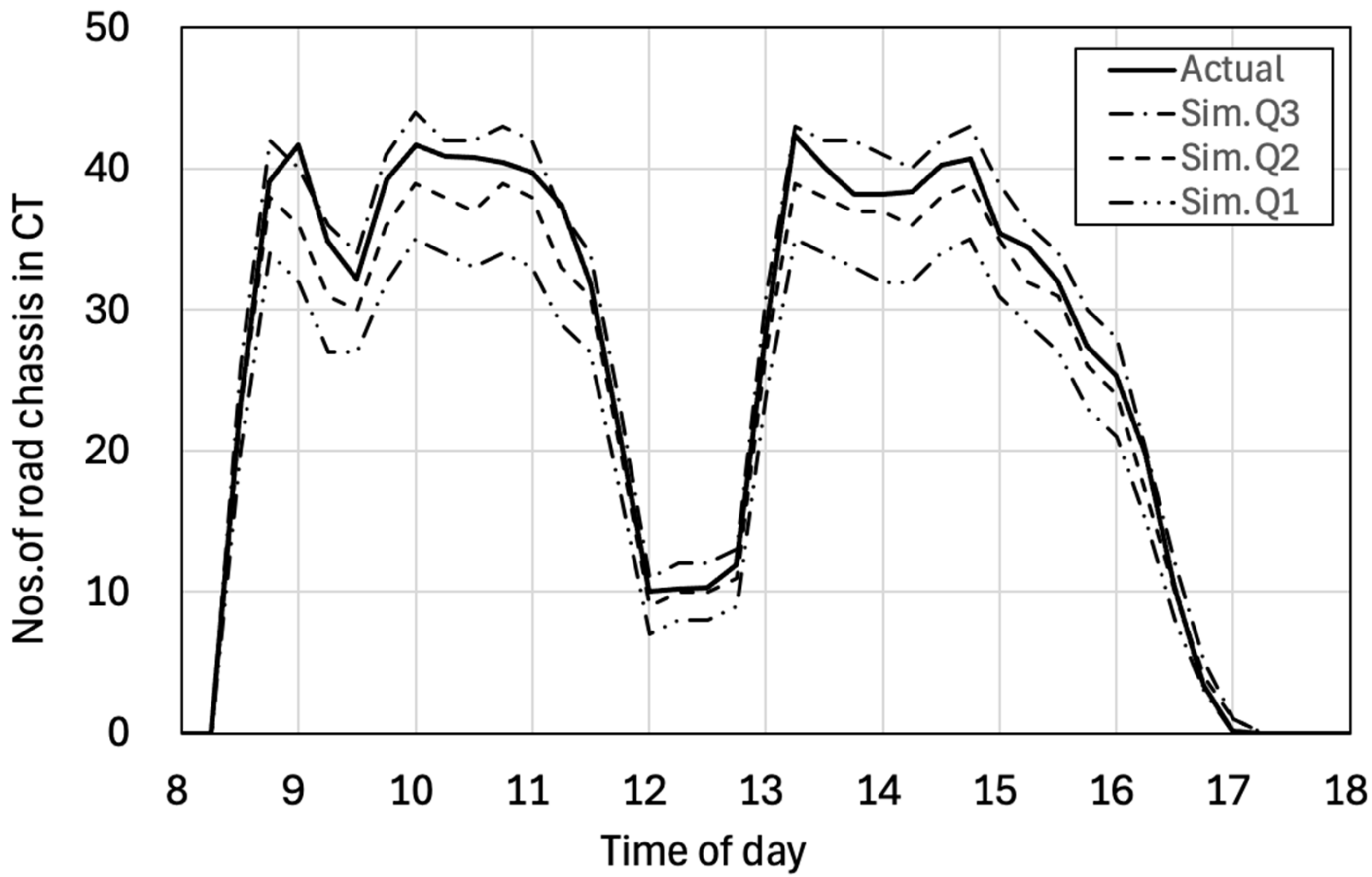




Input data (statistical distribution) can be obtained from the digital-twin system

3-5. Example of SS (Simulation result)



Q1–Q3: quartiles of 1,000 trials

4. Conclusions

- Digital Twin is the foundation of data-driven container terminal operations.
- Effective Digital Twin requires three elements: system configuration, optimization logic (AI), and clear operational objectives.
- AI supports planners' decision-making by presenting simulation results.
- Discrete Event Simulator (DES) and Stochastic Simulator (SS) are complementary tools, each suited to different planning and operational phases.
- Combining Digital Twin, AI, DES, and SS enables smarter, more efficient, and resilient container terminals.

“The future of Smart Ports lies in combining Digital Twin, AI, and simulation technologies to support better human decision-making.”

Thank you for your attention.

MITSUI E&S Co., Ltd.
New Business Development Div.
Marketing Dept.,

Contact: kinya@mes.co.jp