

Digital Twins & Their Applications

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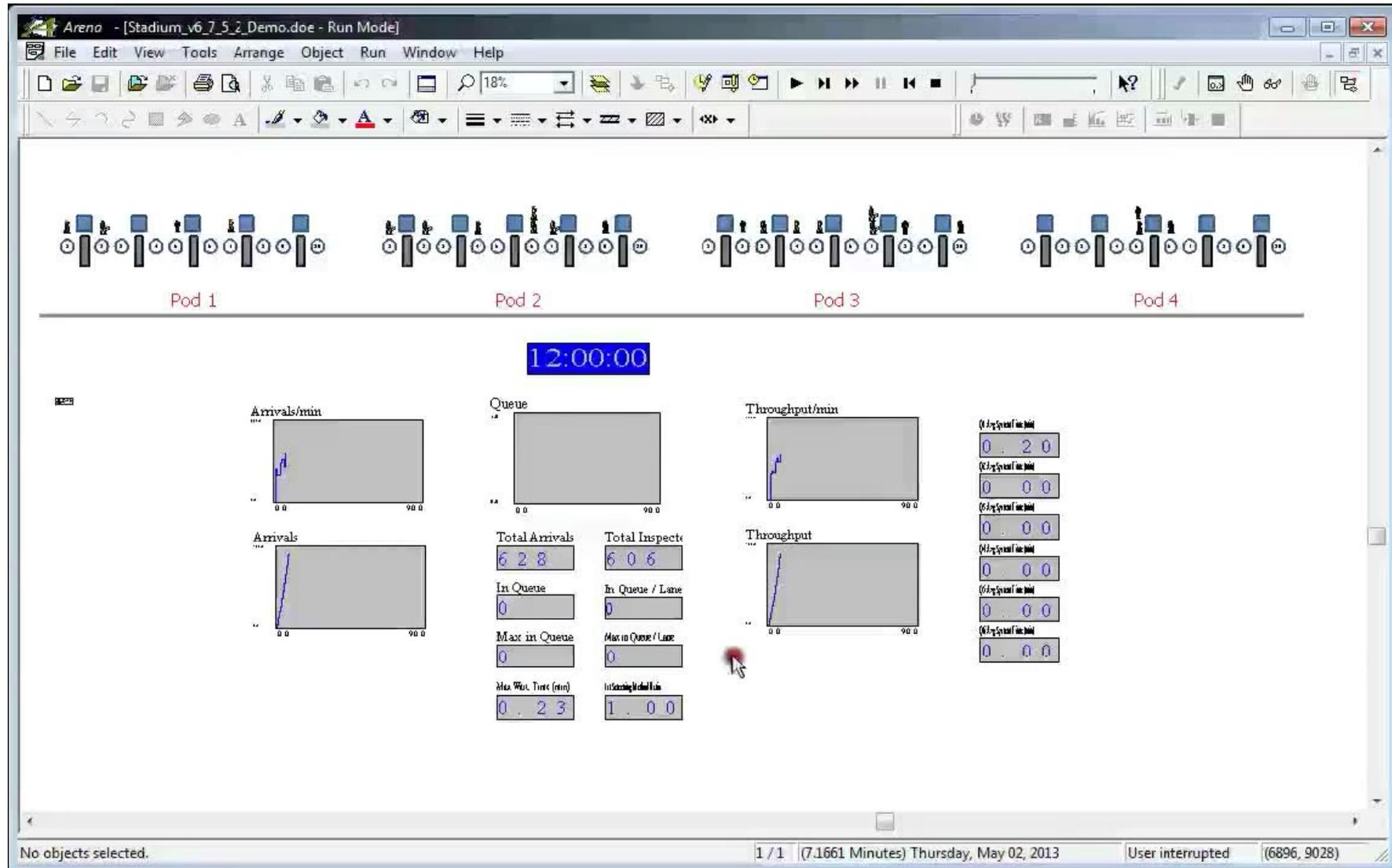
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Digital Twins

- Space: *Improving inspection processes to find weapons and contraband, designing facilities with security in mind.*
- Solution: ***Build a digital twin: a virtual replica of a complex physical system***
 - *One-to-One mapping of a physical entity allowing one to study it in the lab.*
- Uses:
 - ***Provides a powerful platform for exploring “what-if” questions:***
 - *Locations/quantities for sensors, cameras, WTMDs; staffing positioning, size; pre-positioning services; effect of structural changes; evacuation planning*
 - *Supports improved decision making.*
 - *Helps understand crowd behavior and dynamics.*
- How to Build one? *Primitive (ruler & pencil) → Sophisticated (LiDAR scan)*
- *Will Describe Successful Applications:*
 - Choosing WTMDs for an NFL Stadium
 - Developing new container inspection processes at ports
 - Supporting staffing needs at airport customs inspection
 - Evaluating effect of architectural changes at a major bus terminal in NYC
 - Developing a flood management system at a critical NJ Transit terminal

How Many WTMDs are Needed? MetLife Stadium, NJ



How Many WTMDs are Needed? MetLife Stadium, NJ

- Helped MetLife Stadium decide how many WTMDs were needed.
- Helped with location planning, staff planning.
- Led to extensive study of how WTMDs operate in realistic conditions.
- NIST got interested. Study conclusions validated by NIST.

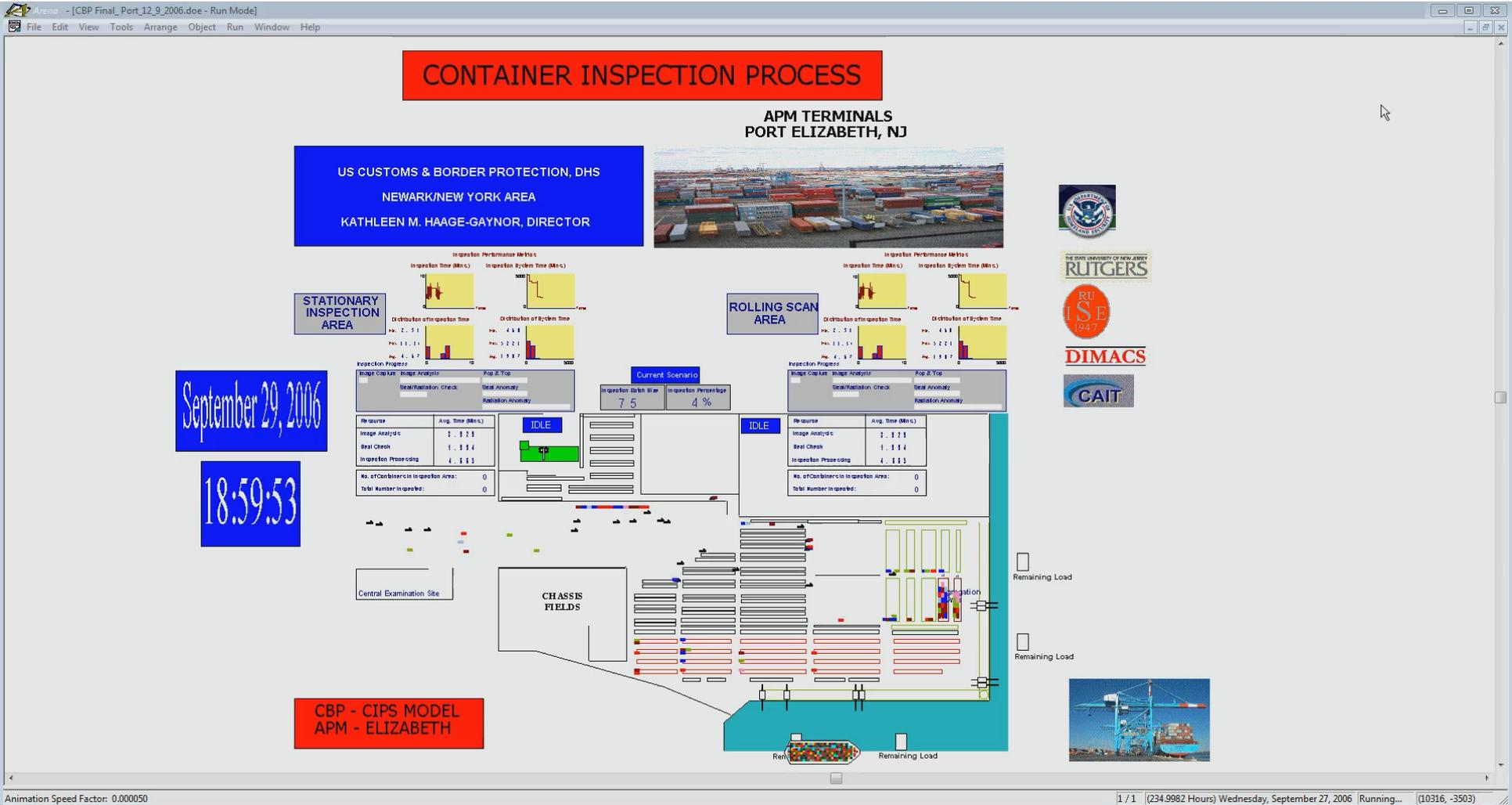
“We were all impressed at how you could take the raw information about ticket scans, and develop a complete simulation of how the guests were queued up and waiting at football games.” – **Daniel DeLorenzi, VP of Security and Safety Services, MetLife Stadium**



Container Inspection Processes

APM Terminals, Port Elizabeth, NJ

With CBP



Container Inspection Processes APM Terminals, Port Elizabeth, NJ With CBP

- Led to revisions in the way that CBP measured hourly throughput in inspection operations.
- CBP then decided to see if new procedures for off-site container inspection were more efficient and asked CCICADA to assist.

“This is an important project for CBP due to the challenges in cargo growth and resource management We have benefited from CCICADA’s analytical support in our critical decision making... This approach also has a strong potential application for resource management at other ports throughout the United States.” - John Lava, CBP’s Assistant Area Director, Port of New York/Newark



Screening Returning International Travelers Newark Airport, with CBP

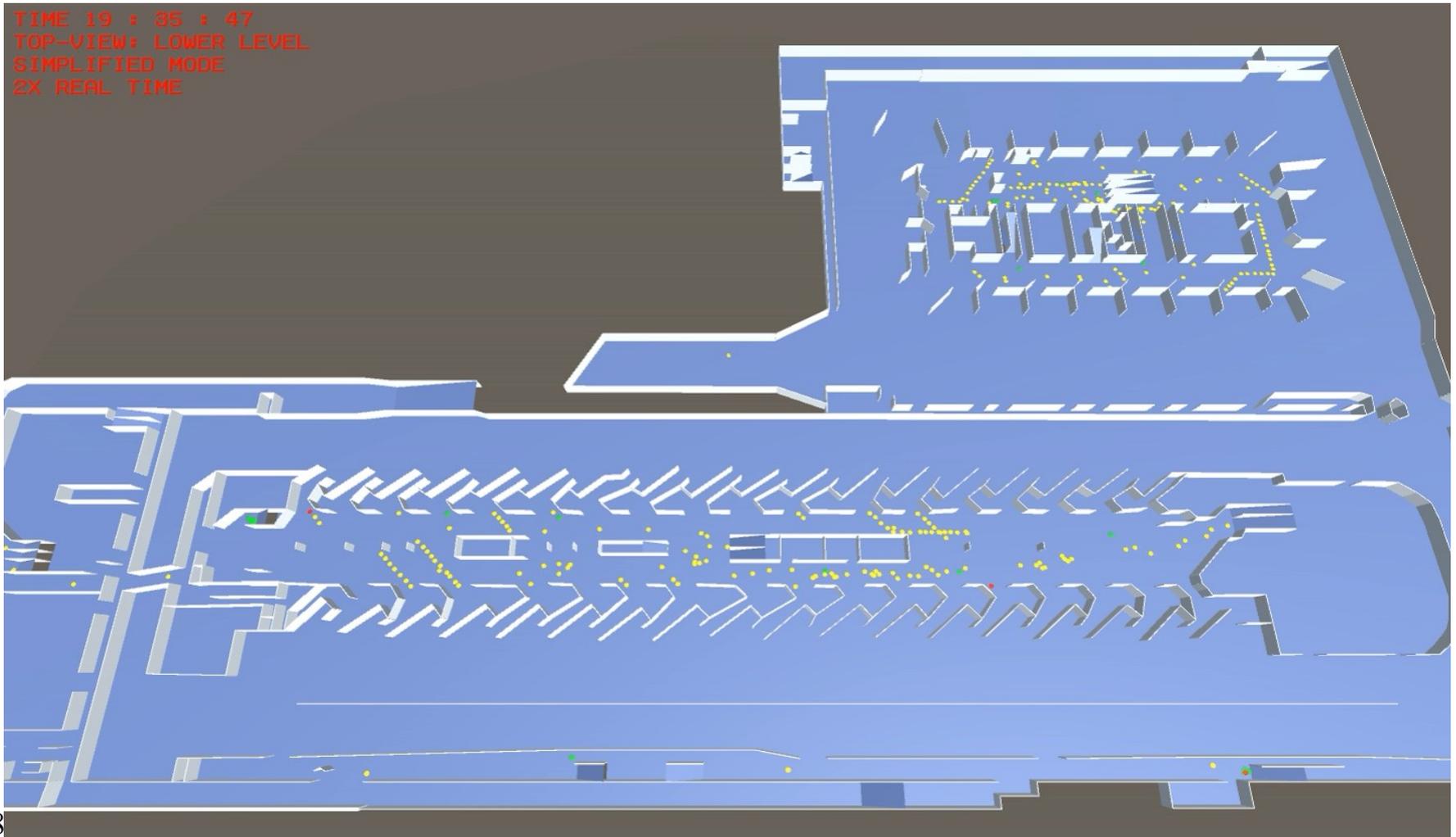


- Early digital twin: Used information about expected passenger arrivals to staff airport customs inspection.
- Future uses of a more sophisticated digital twin:
 - Routing arriving passengers
 - Arrangement of queues and kiosks
 - Effect of physical changes in arrival hall
 - Emergency evacuation planning

Credit: Wikimedia commons,
[AH829](#); and CBP

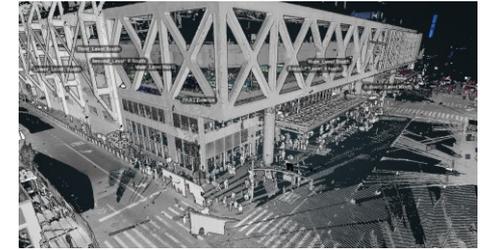
Port Authority Bus Terminal, NYC Facility Model for Terminal Remodeling & Safety/Security Planning Afternoon Scenario

TIME 19 : 35 : 47
TOP-VIEW: LOWER LEVEL
SIMPLIFIED MODE
2X REAL TIME



Port Authority Bus Terminal, NYC Facility Model for Terminal Remodeling & Safety/Security Planning

- Largest terminal in the U.S.
- Busiest in the world by volume of traffic
- Has reached peak hour capacity
- Critical to plans for evacuating NYC
- Built a 3-D facility model for PABT for use in terminal remodeling and safety and security planning
- Building Information Model (BIM) and simulation software installed on PABT computers
- Helped guide evaluation of architectural changes/queuing protocols
- Helped plan evacuation strategies



“We believe it will be a very powerful tool during future modifications to the terminal, as well as in the overall management of hundreds of thousands daily passenger-trips.”

**-- Joaquin Gonzalez, Assistant
Director Priority Capital Programs,
Port Authority of NY/NJ**

Hoboken Terminal NJ Transit Flood Warning System

- NJ Transit Hoboken Terminal unique in complexity:
 - 5 modes of transportation: rail, light rail, ferry, PATH subway train, bus
 - Critical link between NJ and NYC
- Designed and developed an early flood warning system for NJ Transit OEM at Hoboken Terminal.
- So they could effectively operate Hoboken Terminal during storm events.
- Through SENTRY, planning to extend this work to look at security aspects of the terminal as part of a case study of surface transit security.



LiDAR Scanning:
To build a dynamic digital twin, we conducted approximately 300 3D imaging scans and drone-based mapping throughout the terminal to capture all the details.

