Using Emulate3D to Minimize Project Deployment Risks and Commissioning Time at Leonardo Automation

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HUB PERFORMANCE
Planning Simulation Emulation

AGENDA

- Leonardo Company / Hub Performance - Introduction
- Automation Systems / Airport Operation Context
- Automation Systems / Airport Technology
- Technology Deployment Risks & Tools Used
- Power of Simulation
  - BHS Simulation with Emulate3D
- Power of Emulation
- Q&A

Join Leonardo Automation & Hub Performance to learn how they use Emulate3D to design, develop and test systems before deploying physical equipment.

Leonardo Company / Hub Performance - Introduction

Leonardo.com

HUB PERFORMANCE
Planning Simulation Emulation

HubPerformance.com

Leader in Aerospace, Defence and Security

BUSINESS SECTORS

HELICOPTERS
- Helicopters Division
- PZL-Świdnik (100%)
- Kopter (100%)
- Leonardo UK/Helicopters (100%)
- NH Industries (32%)

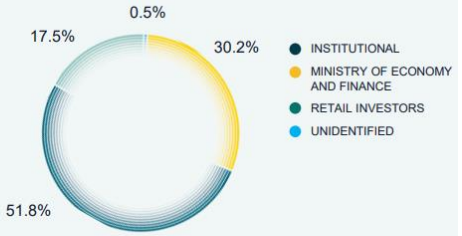
AERONAUTICS
- Aircraft Division
- Aerostructures Division
- ATR* (50%)
- Eurofighter GmbH (21%)

DEFENCE ELECTRONICS & SECURITY
- Electronics Division
- Cyber & Security Solutions Division
- Leonardo DRS (80.9%)
- Leonardo UK/Electronics/Cyber (100%)
- MBDA* (25%)
- Hensoldt (25.1%)
- Elettronica (31.3%)
- Larimart (60%)

SPACE
- Telespazio* (67%)
- Thales Alenia Space* (33%)
- AVIO (29.6%)

* Joint venture | % Leonardo's share

SHAREHOLDER COMPOSITION*



90% ca. of the institutional float is international

30% of investors are signatories of the Principle for Responsible Investments (PRI)

*As of February 2023

51,392
TOTAL **WORKFORCE***

63%	15%	14%	5%	0,5%	2,5%
32,327 Italy	7,540 United Kingdom	7,143 United States	2,578 Poland	248 Israel	1,556 Rest of the world

5
Domestic markets
(Italy, UK, US, Poland, Israel)

86%
of 2022 revenues comes from **international markets**

105
sites worldwide

150 countries
commercial presence

*As of December 31, 2022

- **French Value Added Reseller (VAR)**
  - Pre-Sales, Sales
  - Training (Certified)
  - Technical Support / Hotline
  - Integration / Coaching
- **20+ Years Expert in modelling automated systems**

Automation Systems / Airport Operational Context

Provider of automated Baggage Handling Systems for airports worldwide

From check-in to make-up

Including Automated Security Screening

Including Automated Sorting

Including Early Baggage Storage

Used by leading airports worldwide

FLUGHAFEN ZÜRICH

Fraport

GENÈVE AÉROPORT

香港 國際機場 HONG KONG INTERNATIONAL AIRPORT

ADR

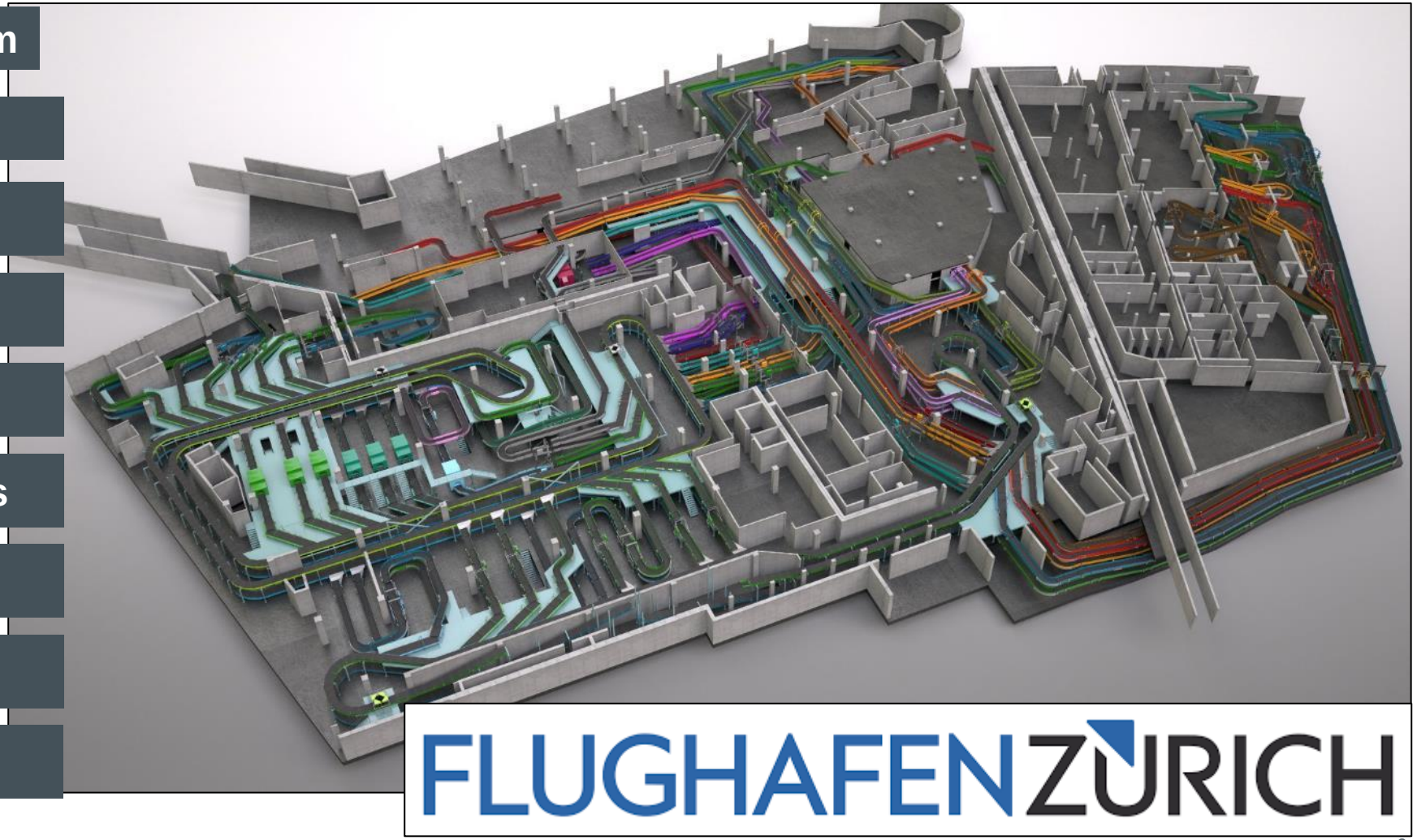
PARIS AÉROPORT

BHS Video 1

Automation Systems / Airport Technology

Sample System

- 1355 conveyors covering ~5km
- 4 cross-belt sorters, >2km
- 57 barcode readers
- 111 sorting destinations
- 12 carousels
- 9 security screening machines
- 8 power distribution cabinets
- 46 motor control panels
- 108 PLCs



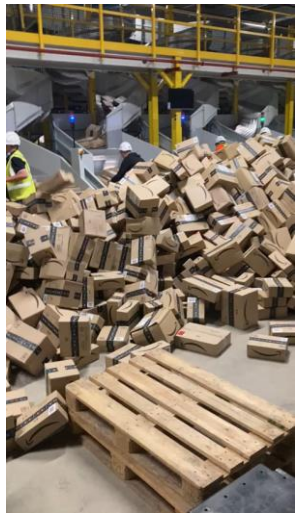
Technology Deployment Risks & Tools Used

Solution Validation Phases

	Physical Constraints Validation	Low-level Process Validation	High-level Process Validation
Key Activities	Layout validation Clash detection Escape ways Maintenance space	Unit throughputs Scenarios switchover Control interface PLC software / logic validation	Process throughputs Process bottlenecks Backup / fallback scenarios Transit time
Key Tools	Revit	EMULATE3D	EMULATE3D

Impact type: Performance | Schedule | Cost

Testing on Site Video 1



Power of Simulation (1/2)

Simulate “process-level” behavior of a given system design

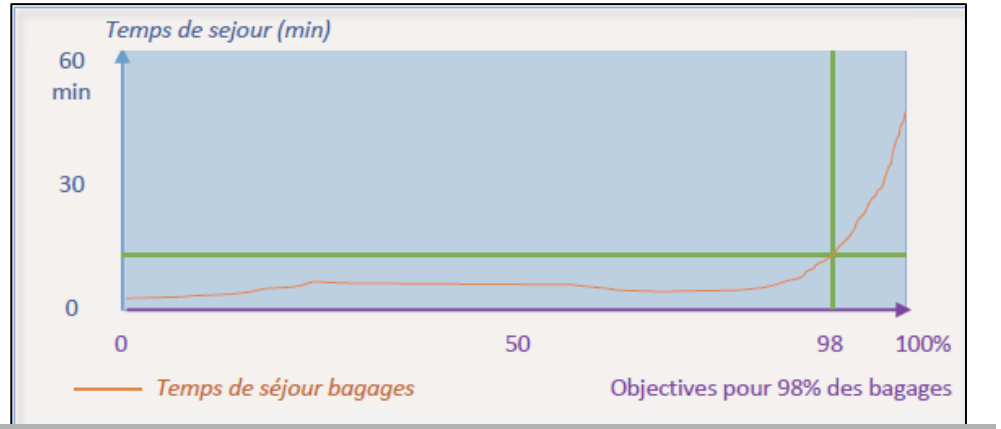
- Used mainly in:
  - **Proposal phase** to validate performance of designed system
    - Baggage Flow
    - Parameters (for example conveyor speed)
    - Scenarios (together with FMECA to validate backup/fallback solutions)
  - **Design & development** to validate above plus
    - Study & specify low-level control logics
    - Sorting Allocation Computer (SAC) and Flow Manager (where applicable)

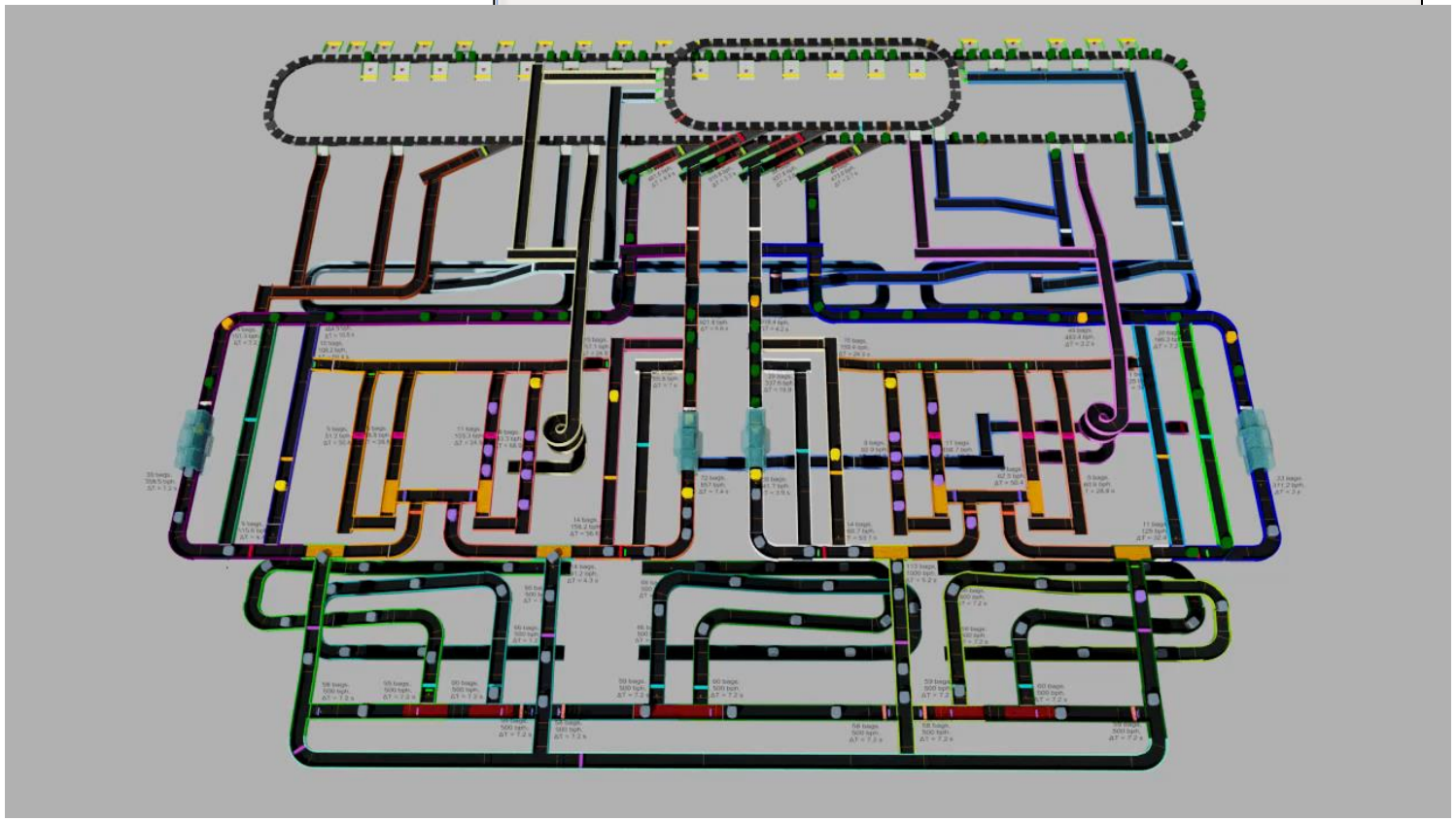
Power of Simulation (2/2)

Example

- Upgraded terminal for an important European Airport:
  - 6 inbound lines (from other terminals)
  - 3 carousels
  - 694 conveyors (almost 2 mi.)
  - 4 screening lines
  - 8 manual processing stations
  - 2 cross-belt sorters (> 800ft)
  - 4800 bags / hour throughput

- Different simulated scenarios:
  - Nominal: 1
  - Degraded: 8
  - Robustness check: 12

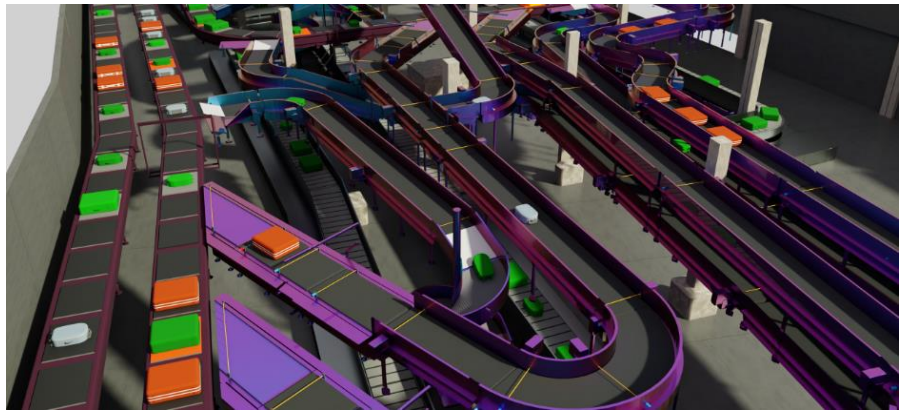


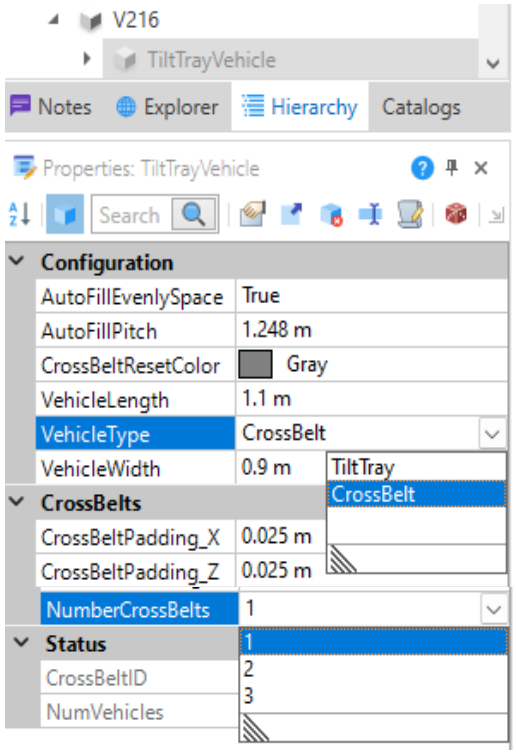


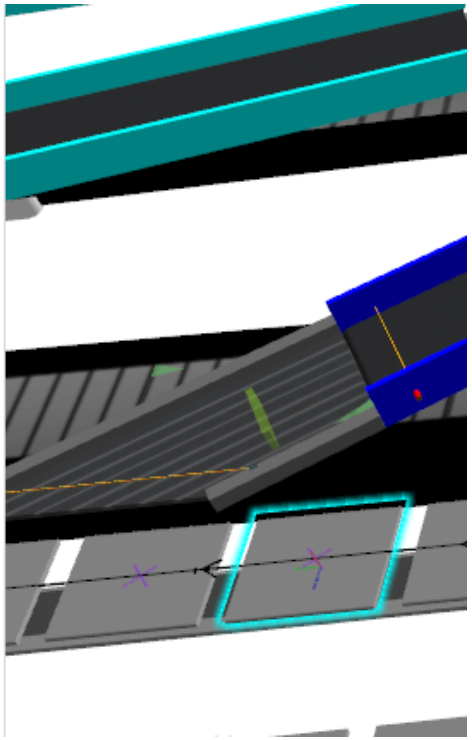
Power of Simulation - BHS Simulation with Emulate3D

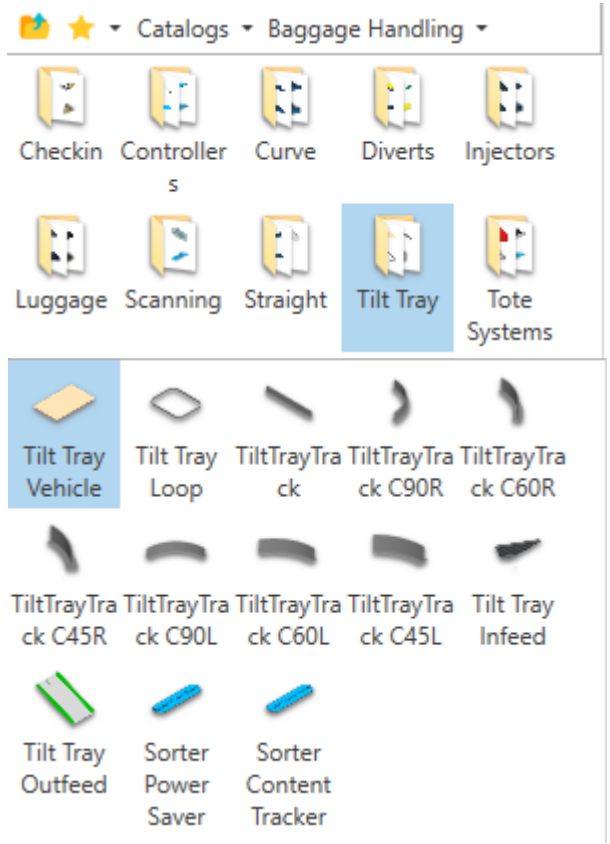
Cross-Belt Sorter: featured in Baggage Handling catalog

- Sub-Type of the generic Sorter Vehicle
  - To be configured, attached to a Track, and simply “Auto-Fill”
  - Can set Carrier Dimensions and Pitch
  - Can set multi-Cell Carriers (up to 3)





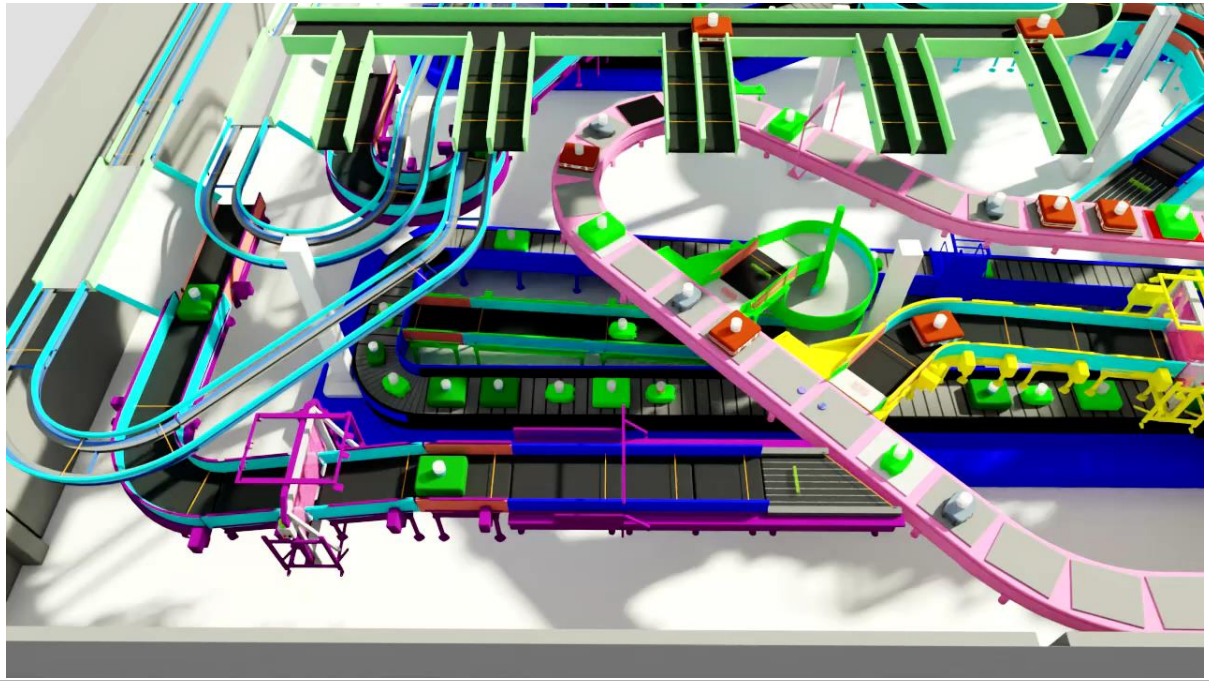


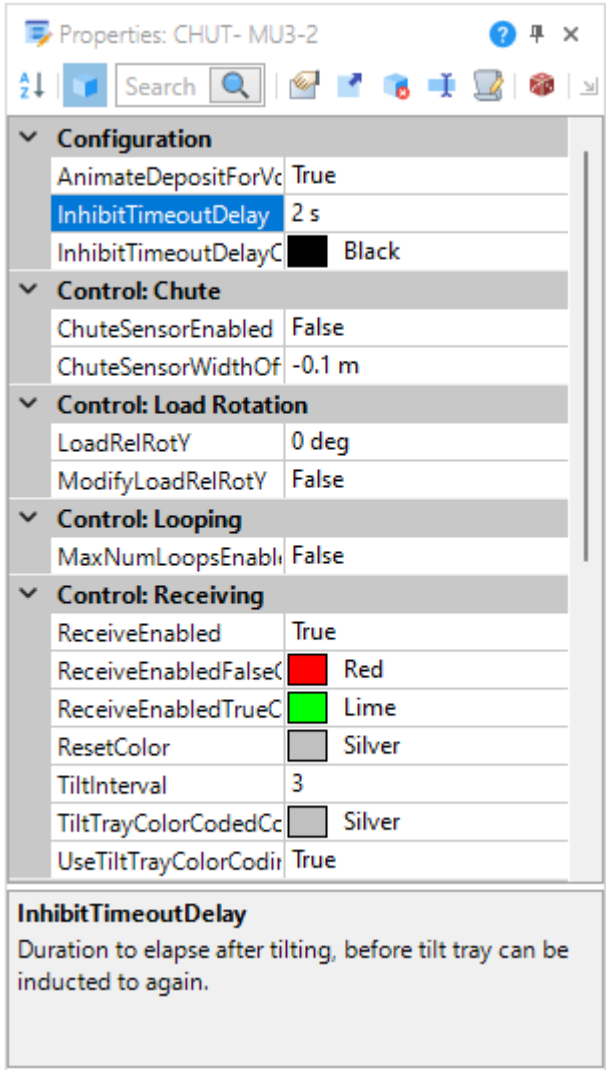


Power of Simulation - BHS Simulation with Emulate3D

Cross-Belt Sorter: specific Baggage Handling features used with Leonardo technology

- Cell inhibit delay after unload
  - Bringing better realism by obeying the real equipment constraints
  - New set of parameters on Sorter Outfeed (chute)
    - Inhibit Timeout Delay
    - Inhibit Timeout Delay Color

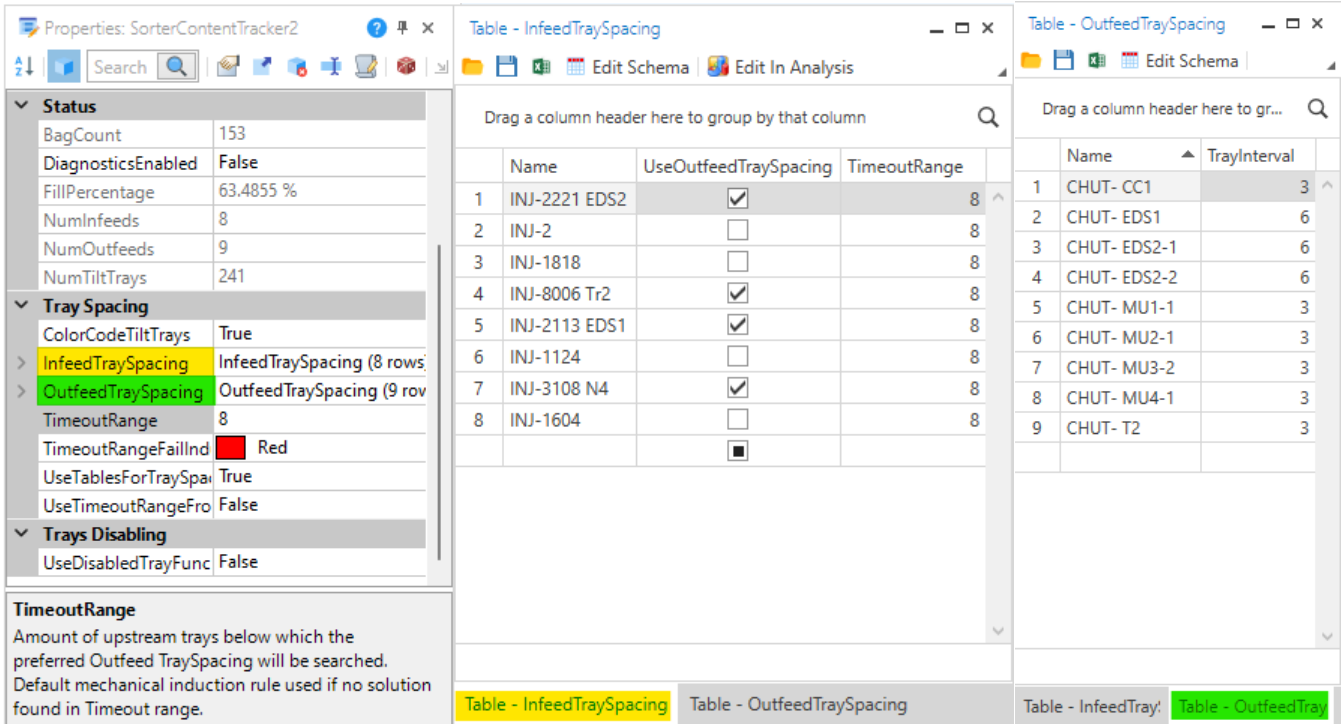


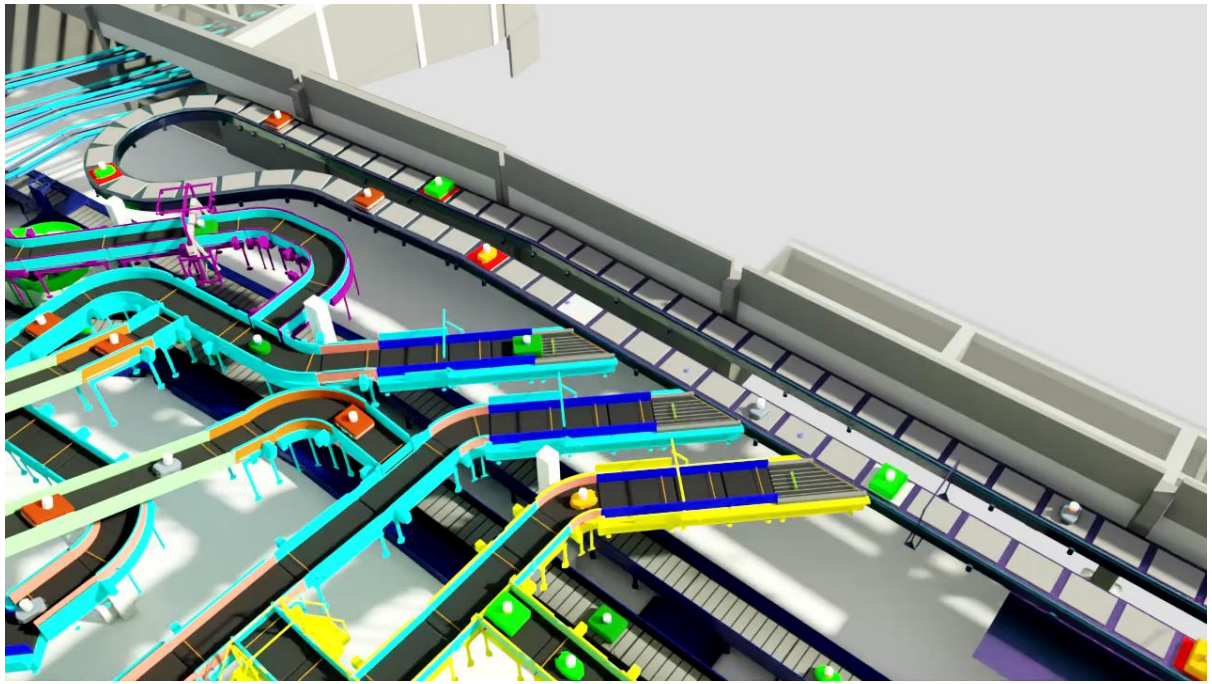


Power of Simulation - BHS Simulation with Emulate3D

Cross-Belt Sorter: specific Baggage Handling features used with Leonardo technology

- Optimized induction spacing to prevent Recirculation
  - Optimized bags induction on Sorter, considering the allowed unloading interval at their destination Chute.
  - Cell coloring based on destination Chute (or Red when Failed to optimize in the TimeOut cells Range)



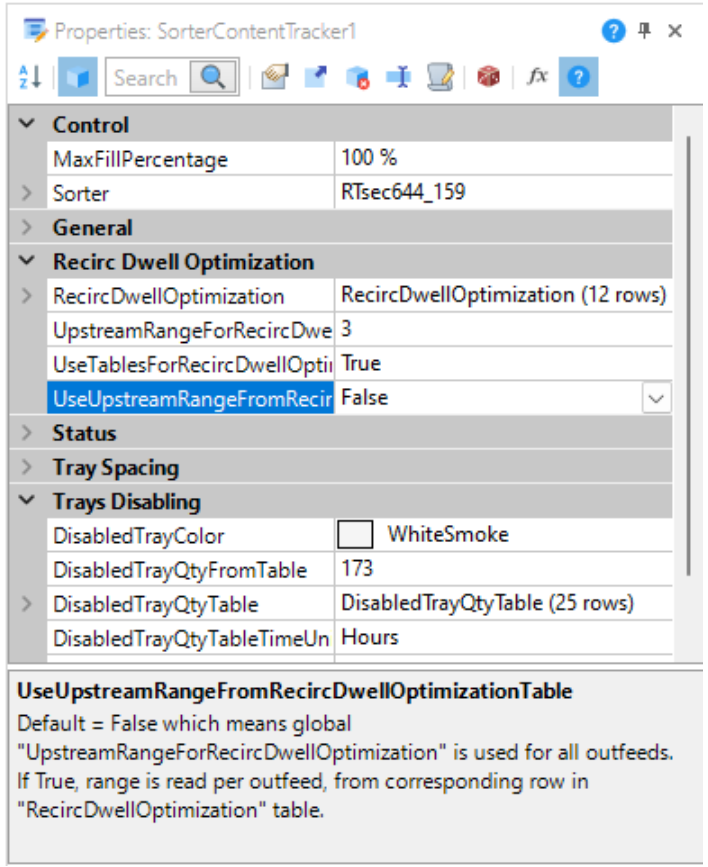


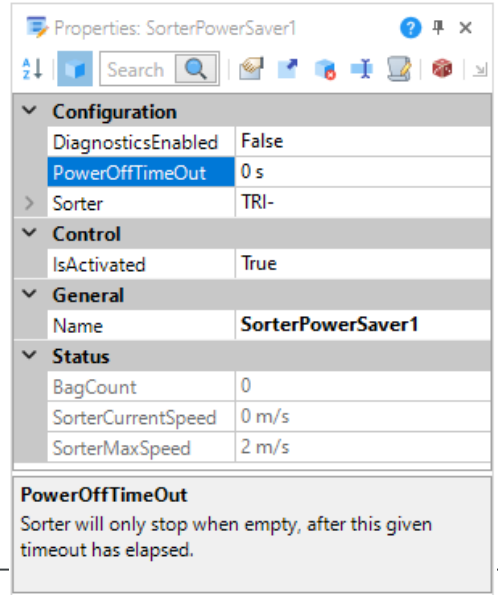
Power of Simulation - BHS Simulation with Emulate3D

Cross-Belt Sorter: other advanced features

- Sorter Content Tracker
  - Max Fill Percentage
    - Works together with “Shutdown When Content Threshold Met” on Infeeds
  - Recirc Dwell Optimization
    - Chooses the most critical bag to unload against Flight closing time and In-System-Time
    - “TimeSec_Closing” and “TimeSec_Input” properties to be set each bags
  - Carrier disabling
    - For Cell failure or dynamic storage

- Sorter Power Saver
  - Saves run time by stopping Sorter when empty

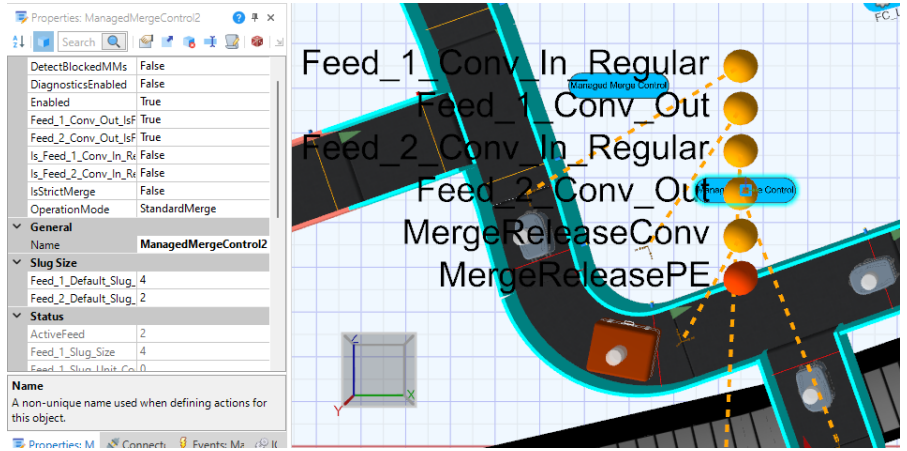


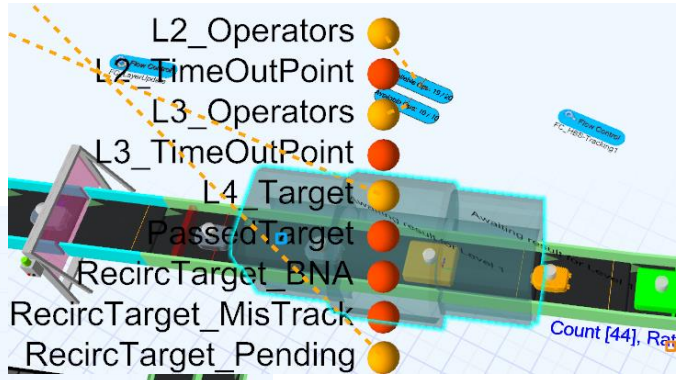


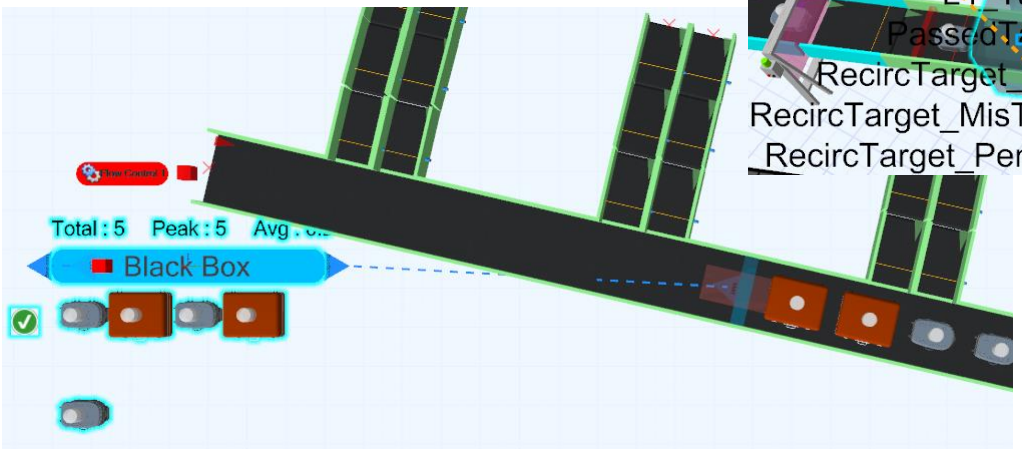
Power of Simulation - BHS Simulation with Emulate3D

Other BHS Simulation related features

- Baggage Handling catalogue
  - Tote Systems (2017)
  - Managed Merge Control (2018)
  - Collector Belt Controller (several improvements in years)
  - Bags Screening (xRay machine & Operators improvements)
    - Standard 2 L1/L3 & Standard 3 modes
    - Deterministic mode
    - Decision times tables
    - Timeout modes (Time / Station)
    - Operators multiplexing
    - “Waiting for Operator” status
- Black Box, initial spec (2018)
  - Input buffer
  - Storage





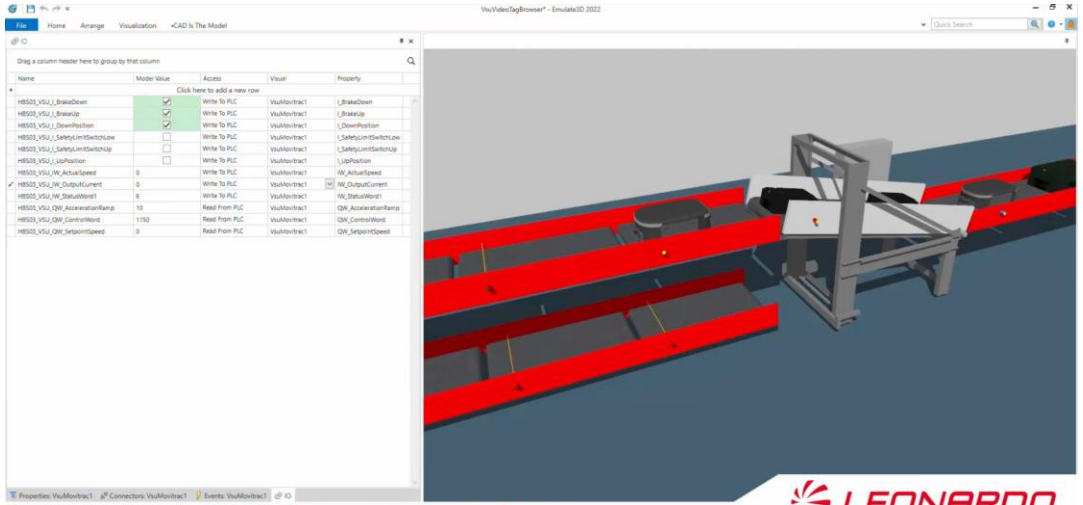


Power of Emulation (1/2)

Replicate machine behavior (conveyors, screening systems, sorting systems, etc)

- Used mainly during project lifecycle to:
  - Validate field interfaces (machine – machine, machine – sensors, machine – actuators, etc)
  - Validate baggage flow management functions / logic / algorithms
  - Validate change requests for live systems in a virtual environment
  - Support tool for analysis of difficult technical issues during commissioning / go-live
  - Validate software while equipment is being procured / installed
  - Regression testing of updated software libraries

- Video Example
  - Vertical Sorting Unit



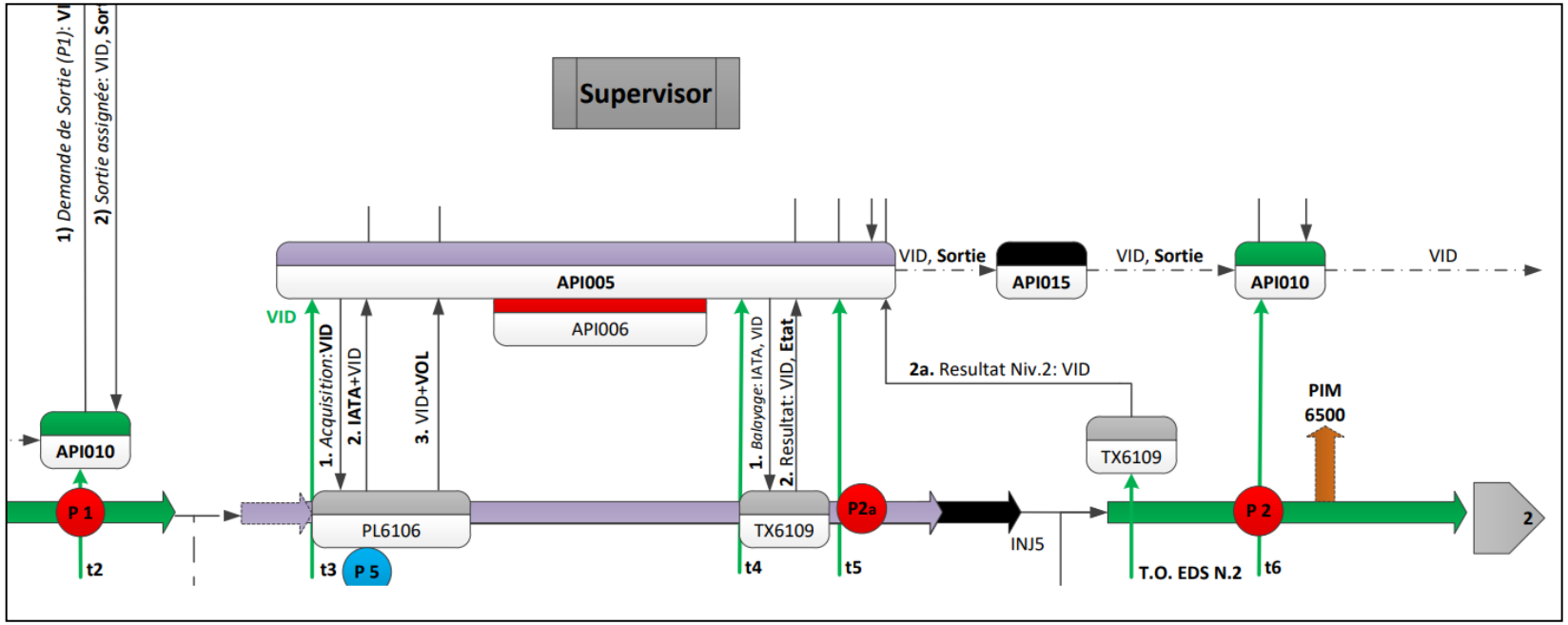
Vertical Sortation Unit Switching – 5:1 Ratio

Power of Emulation (2/2)

Additional Example

- PLC (“API005”) that manages a conveyor line that interfaces two complex machines:
  - PL6106 which is a Barcode Reading System (BCR, including OCR capability)
  - TX6109 which is a Security Screening System (SSS)
- The emulator is used to validate:
  - Quantity / positioning of photocells
  - PLC software logic
  - Control interface with BCR
  - Control interface with SSS

time stamp	messaggio
31-10-2023 11:38:25.322	*t3 Trigger pht*
31-10-2023 11:38:25.349	*1. Acquisition VID: 202310319341265431*
31-10-2023 11:38:26.121	*2. IATA - VID: 202310319341265431*
31-10-2023 11:38:31.121	*3. VOL - VID: 202310319341265431*



Ongoing & Future evolutions

- Overall
  - Hub Performance to train and support the team for their growth (both ECT & Sim3D)

- Flow Simulation
  - Make better/wider use of public Sim3D tools, and improve/adapt the current custom Framework
  - Provide Operational Decision tool (“Operations Support System”)

- Controls Testing / Virtual Commissioning
  - Continuous Integration testing of software libraries
    - Regression testing
  - Support to test other systems (SAC)
    - HLE (High Level Emulation)

Q&A

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