



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



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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](https://www.leonardo.com)



[HubPerformance.com](https://www.hubperformance.com)

HUB PERFORMANCE
Planning Simulation Emulation

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%)

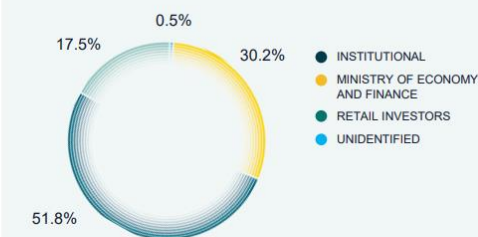
DEFENCE ELECTRONICS & SECURITY

- › 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%)

SHAREHOLDER COMPOSITION*



90% ca. of the institutional float is international
30% of investors are signatories of the Principle for Responsible Investments (PRI)

* Joint venture | % Leonardo's share

*As of February 2023



51,392

TOTAL WORKFORCE*



63%

32,327
Italy



15%

7,540
United Kingdom



14%

7,143
United States



5%

2,578
Poland



0,5%

248
Israel



2,5%

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

- French Value Added Reseller (VAR)

- Pre-Sales, Sales
- Training (Certified)
- Technical Support / Hotline
- Integration / Coaching

- 20+ Years Expert in modelling automated systems



*As of December 31, 2022

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



**THE NEW BAGGAGE HANDLING SYSTEM
TERMINAL 1 OF ROME FIUMICINO AIRPORT**

HIGH PERFORMANCE

ENERGY SAVING

SMOOTH HANDLING

Automation Systems / Airport Technology

Sample System

1355 conveyors covering ~5km

4 cross-belt sorters, >2km

57 barcode readers

111 sorting destinations

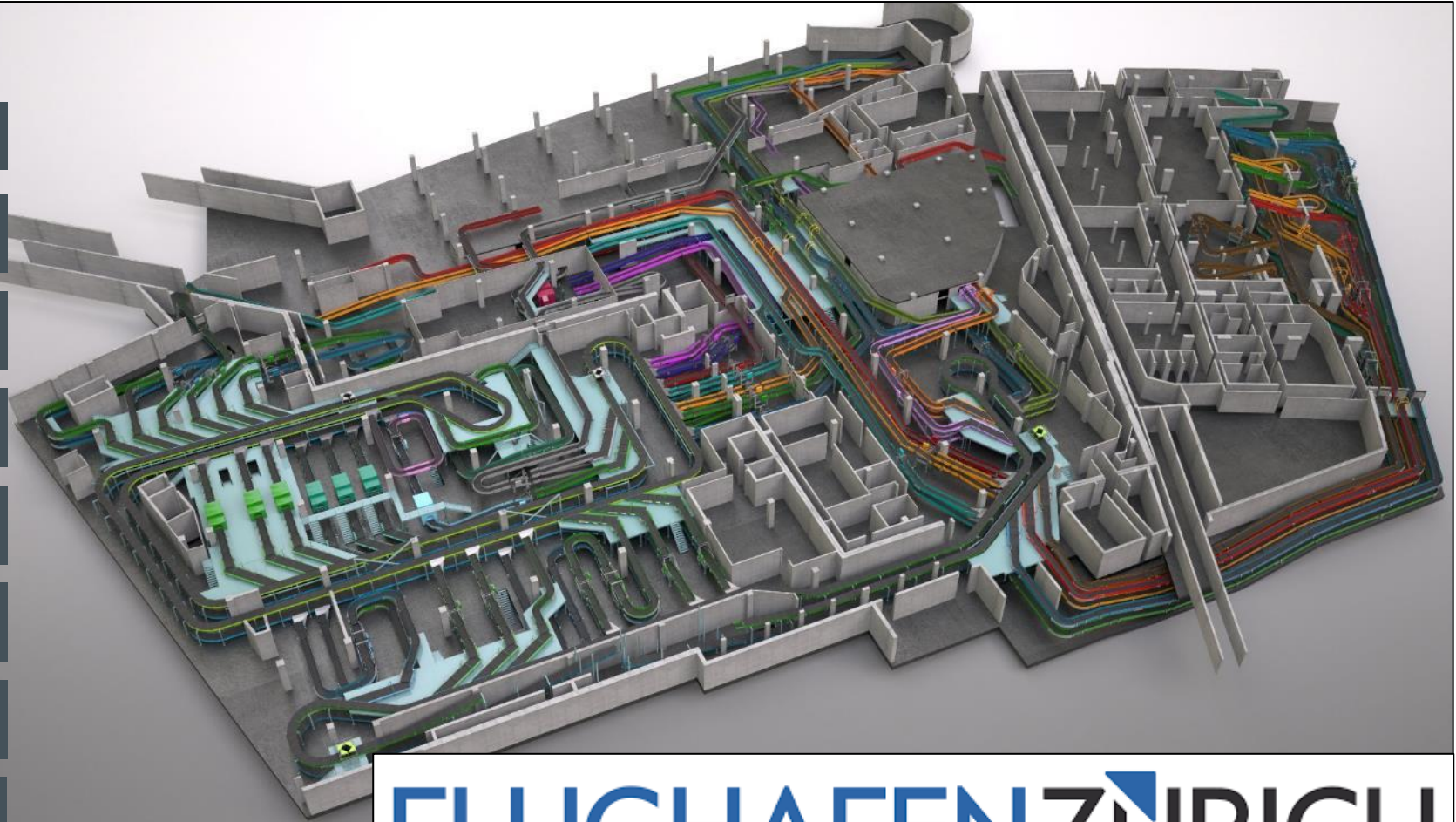
12 carousels

9 security screening machines

8 power distribution cabinets

46 motor control panels

108 PLCs



FLUGHAFEN ZÜRICH



Technology Deployment Risks & Tools Used

Solution Validation Phases

Key Activities

Physical Constraints Validation

Layout validation

Clash detection

Escape ways

Maintenance space

Low-level Process Validation

Unit throughputs

Scenarios switchover

Control interface

PLC software / logic validation

High-level Process Validation

Process throughputs

Process bottlenecks

Backup / fallback scenarios

Transit time

Key Tools



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

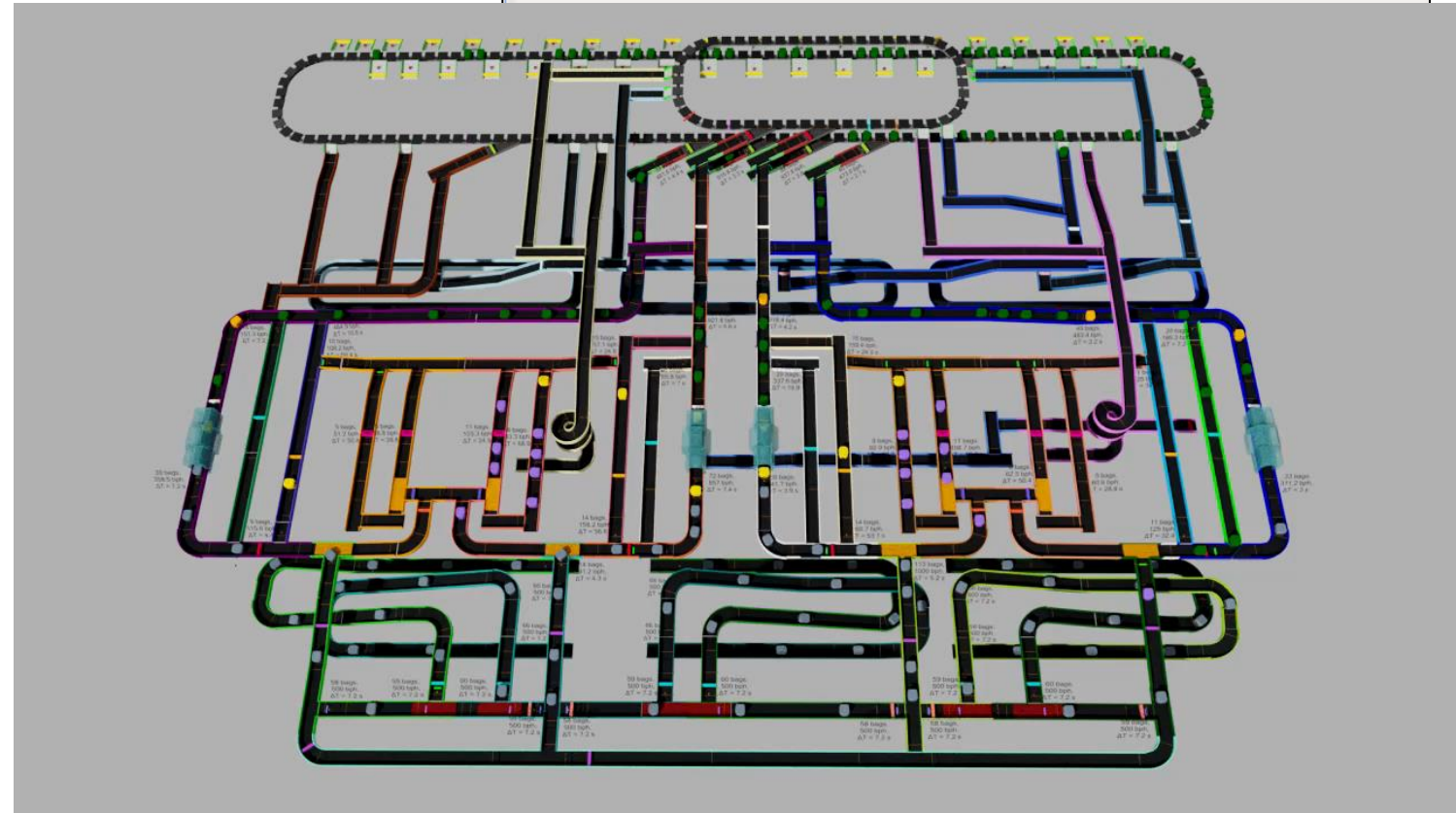
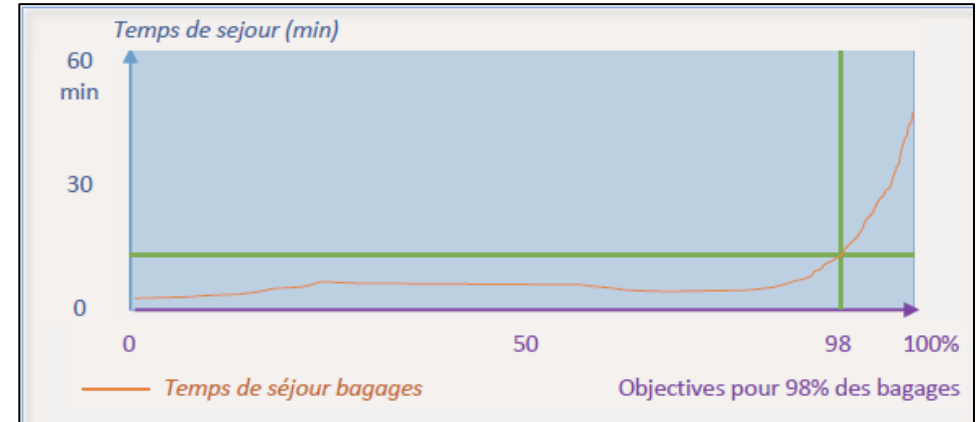
- Used mainly in:
 - **Proposal phase** to validate performance of designed system
 - Baggage Flow
 - Parameters (for example conveyor speed)
 - Scenarios (together with FMECA to validate backup/fallback solutions)
 - **Design & development** to validate above plus
 - Study & specify low-level control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



Power of Simulation (2/2)

Example

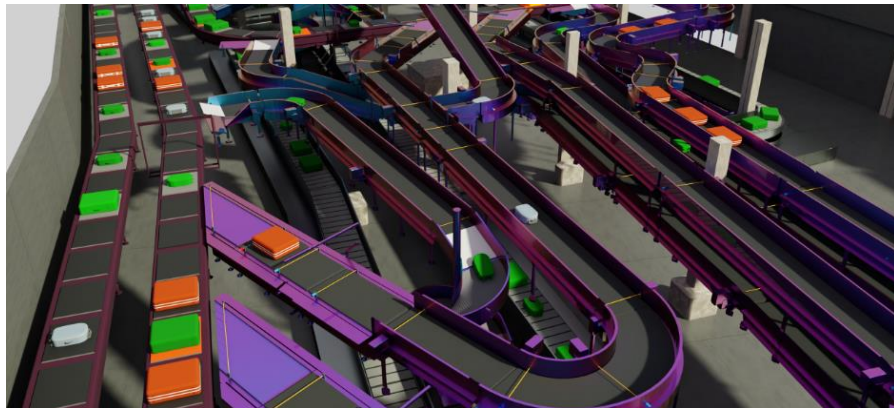
- Upgraded terminal for an important European Airport:
 - 6 inbound lines (from other terminals)
 - 3 carousels
 - 694 conveyors (almost 2 mi.)
 - 4 screening lines
 - 8 manual processing stations
 - 2 cross-belt sorters (> 800ft)
 - 4800 bags / hour throughput
- Different simulated scenarios:
 - Nominal: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



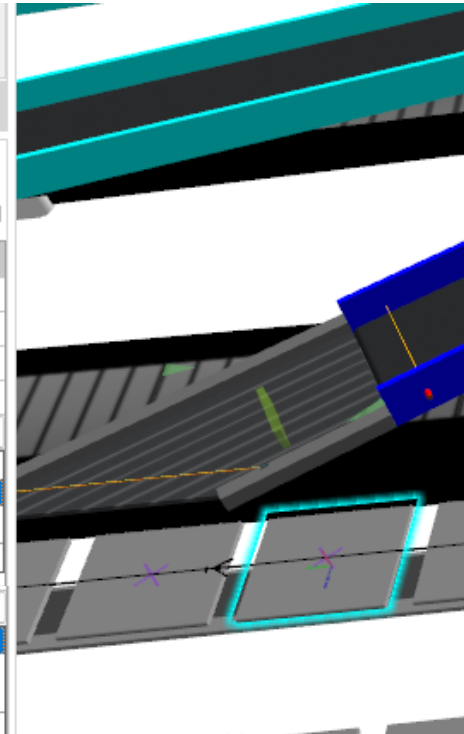
V216

TiltTrayVehicle

Notes Explorer Hierarchy Catalogs

Properties: TiltTrayVehicle

Configuration	
AutoFillEvenlySpace	True
AutoFillPitch	1.248 m
CrossBeltResetColor	Gray
VehicleLength	1.1 m
VehicleType	CrossBelt
VehicleWidth	0.9 m
CrossBelts	
CrossBeltPadding_X	0.025 m
CrossBeltPadding_Z	0.025 m
NumberCrossBelts	1
Status	
CrossBeltID	1
	2
	3
NumVehicles	



Catalogs ▾ Baggage Handling ▾

Checkin Controller Curve Diverts Injectors

5

Luggage Scanning Straight Tilt Tray Tote Systems

Tilt Tray Vehicle Tilt Tray Loop TiltTrayTra ck TiltTrayTra ck C90R TiltTrayTra ck C60R

TiltTrayTra ck C45R TiltTrayTra ck C90L TiltTrayTra ck C60L TiltTrayTra ck C45L Tilt Tray Infeed

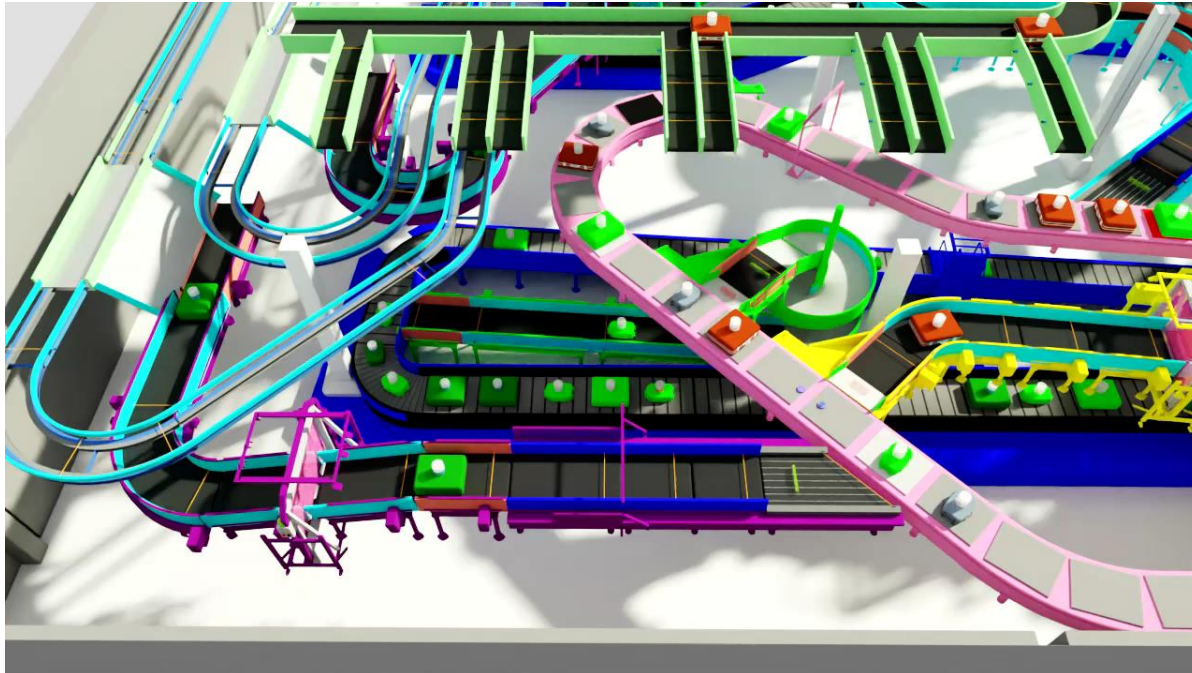
Tilt Tray Outfeed Sorter Power Saver Sorter Content Tracker



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



Properties: CHUT- MU3-2

Search

Configuration

AnimateDepositForVc	True
InhibitTimeoutDelay	2 s
InhibitTimeoutDelayC	Black

Control: Chute

ChuteSensorEnabled	False
ChuteSensorWidthOf	-0.1 m

Control: Load Rotation

LoadRelRotY	0 deg
ModifyLoadRelRotY	False

Control: Looping

MaxNumLoopsEnabl	False
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Control: Receiving

ReceiveEnabled	True
ReceiveEnabledFalseC	Red
ReceiveEnabledTrueC	Lime
ResetColor	Silver
TiltInterval	3
TiltTrayColorCodedCc	Silver
UseTiltTrayColorCodir	True

InhibitTimeoutDelay
Duration to elapse after tilting, before tilt tray can be inducted to again.



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)

The screenshot displays the Emulate3D simulation interface. On the left, a 'Properties: SorterContentTracker2' panel shows various system parameters. The 'Tray Spacing' section is expanded, showing 'InfeedTraySpacing' and 'OutfeedTraySpacing' settings. The 'TimeoutRange' section is also visible. In the center, two configuration tables are shown. The 'Table - InfeedTraySpacing' table lists induction points with columns for Name, UseOutfeedTraySpacing, and TimeoutRange. The 'Table - OutfeedTraySpacing' table lists chutes with columns for Name and TrayInterval. On the right, a 3D perspective view of the baggage handling system is shown, featuring a complex network of conveyor belts, chutes, and sorting mechanisms, with different sections highlighted in various colors (cyan, yellow, purple, green) to represent different destination chutes.

Name	UseOutfeedTraySpacing	TimeoutRange
1 INJ-2221 EDS2	<input checked="" type="checkbox"/>	8
2 INJ-2	<input type="checkbox"/>	8
3 INJ-1818	<input type="checkbox"/>	8
4 INJ-8006 Tr2	<input checked="" type="checkbox"/>	8
5 INJ-2113 EDS1	<input checked="" type="checkbox"/>	8
6 INJ-1124	<input type="checkbox"/>	8
7 INJ-3108 N4	<input checked="" type="checkbox"/>	8
8 INJ-1604	<input type="checkbox"/>	8

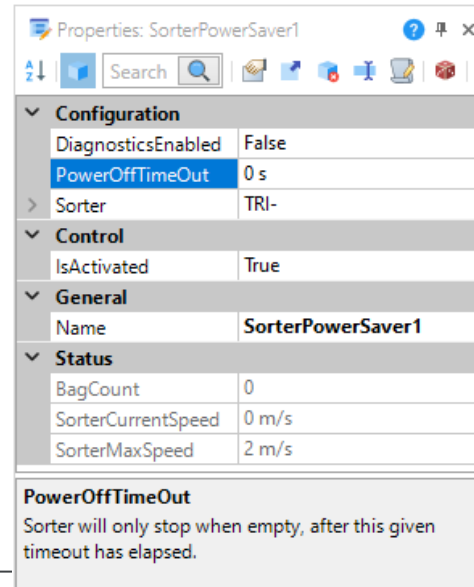
Name	TrayInterval
1 CHUT- CC1	3
2 CHUT- EDS1	6
3 CHUT- EDS2-1	6
4 CHUT- EDS2-2	6
5 CHUT- MU1-1	3
6 CHUT- MU2-1	3
7 CHUT- MU3-2	3
8 CHUT- MU4-1	3
9 CHUT- T2	3



Power of Simulation - BHS Simulation with Emulate3D

Cross-Belt Sorter: other advanced features

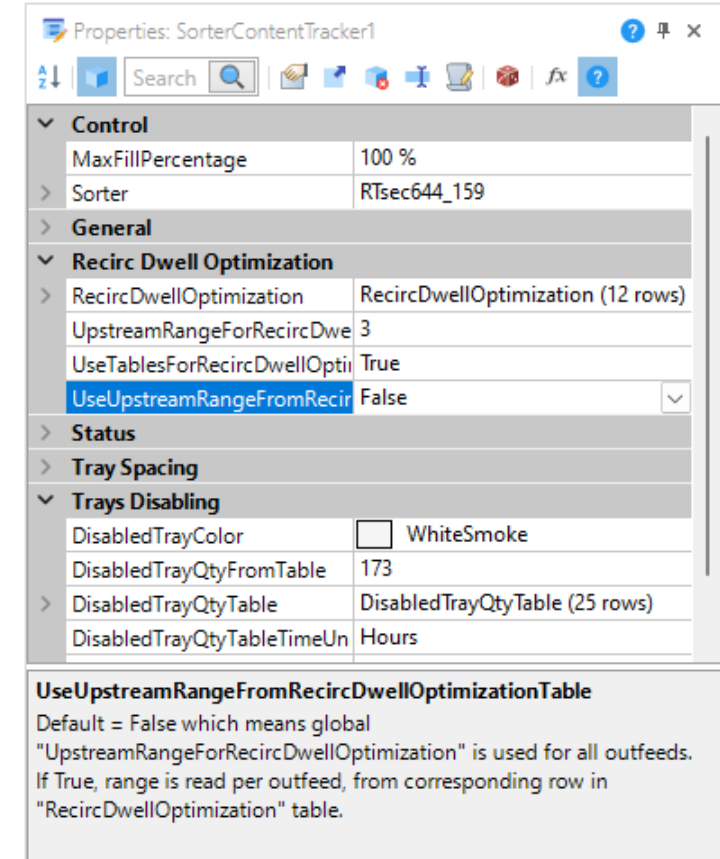
- Sorter Content Tracker
 - Max Fill Percentage
 - Works together with “Shutdown When Content Threshold Met” on Infeeds
 - Recirc Dwell Optimization
 - Chooses the most critical bag to unload against Flight closing time and In-System-Time
 - “TimeSec_Closing” and “TimeSec_Input” properties to be set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



Properties: SorterPowerSaver1

Configuration	
DiagnosticsEnabled	False
PowerOffTimeOut	0 s
Sorter	
TRI-	
Control	
IsActivated	True
General	
Name	SorterPowerSaver1
Status	
BagCount	0
SorterCurrentSpeed	0 m/s
SorterMaxSpeed	2 m/s

PowerOffTimeOut
Sorter will only stop when empty, after this given timeout has elapsed.



Properties: SorterContentTracker1

Control	
MaxFillPercentage	100 %
Sorter	
RTsec644_159	
General	
Recirc Dwell Optimization	
RecircDwellOptimization	RecircDwellOptimization (12 rows)
UpstreamRangeForRecircDwe	3
UseTablesForRecircDwellOpti	True
UseUpstreamRangeFromRecir	False
Status	
Tray Spacing	
Trays Disabling	
DisabledTrayColor	<input type="checkbox"/> WhiteSmoke
DisabledTrayQtyFromTable	173
DisabledTrayQtyTable	
DisabledTrayQtyTable (25 rows)	
DisabledTrayQtyTableTimeUn	Hours

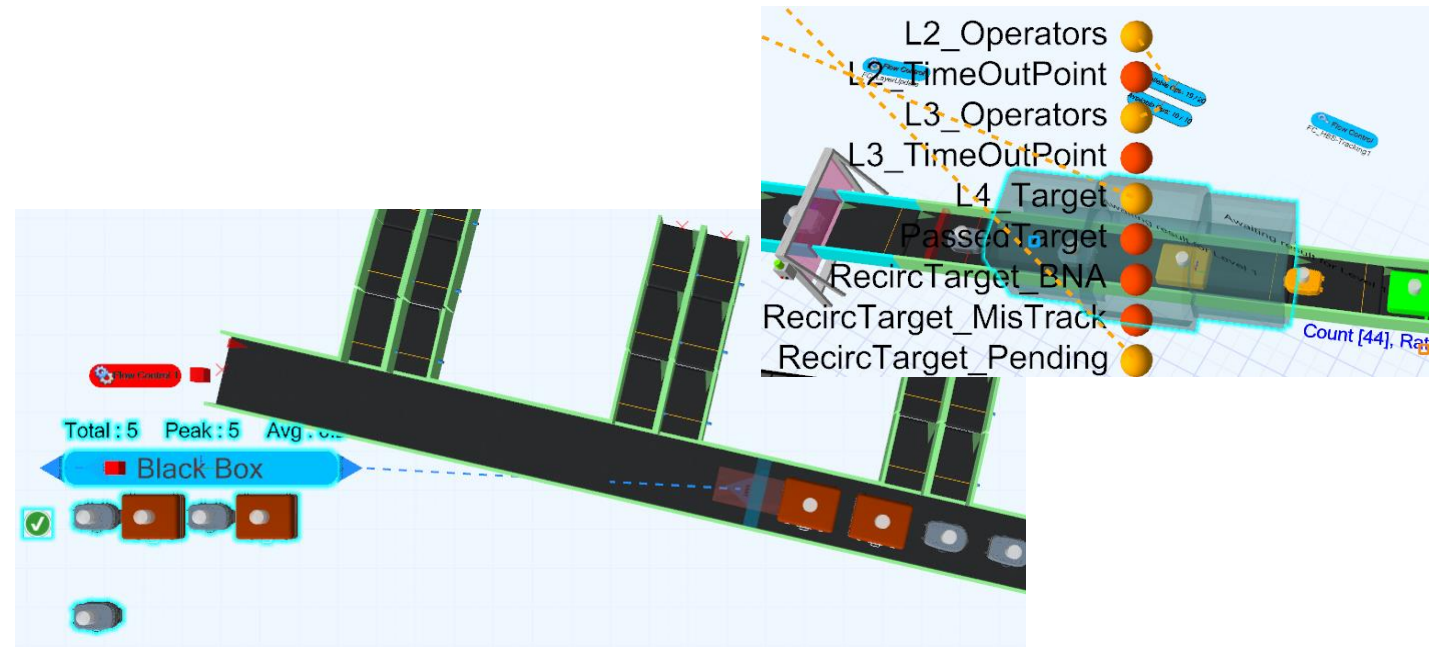
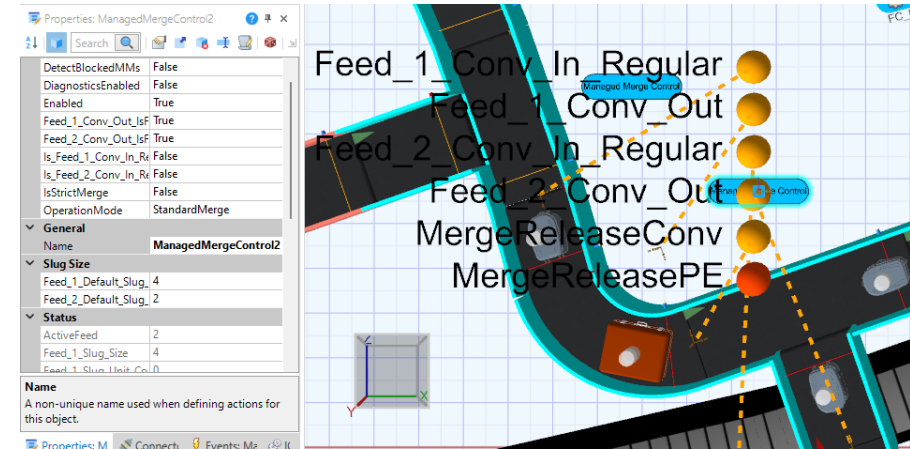
UseUpstreamRangeFromRecircDwellOptimizationTable
Default = False which means global
"UpstreamRangeForRecircDwellOptimization" is used for all outfeeds.
If True, range is read per outfeed, from corresponding row in "RecircDwellOptimization" table.



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

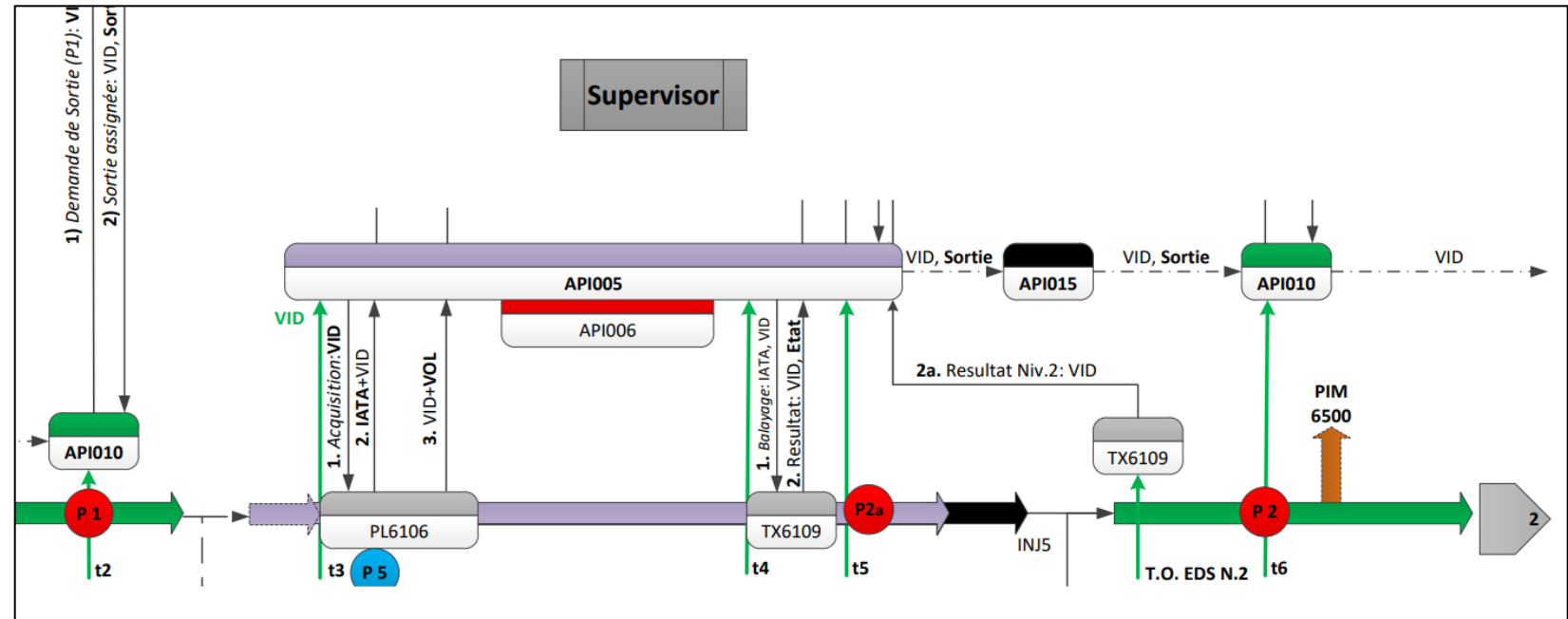


Power of Emulation (2/2)

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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