Digital Twin

Raising Children

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Digital Twin

Digital Twin Presentation	Hospitals Sterile Processing	Hospitals Logistics	Hospitaler Clinical
Breweries	Dairy	Food	Cold store
Biotech	Road	Automated Car parking	Building People flow & elevators

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Questions?

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NIRAS is the Scandinavian Flexsim distributor
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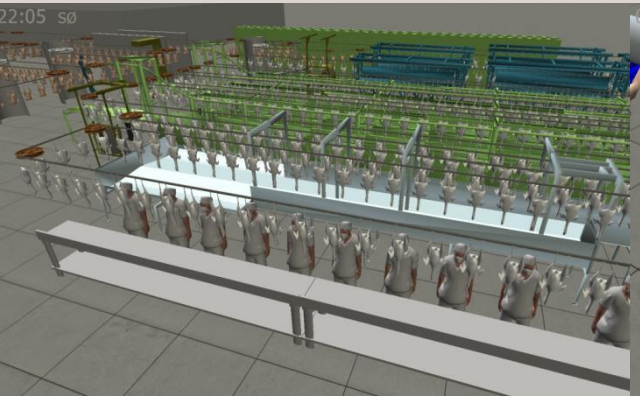
What is a digital twin?

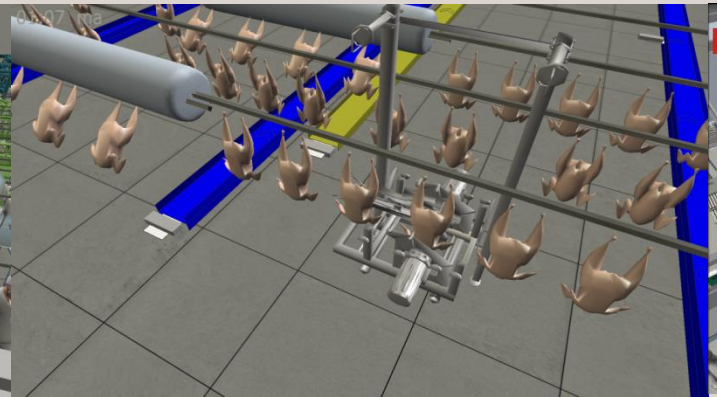
Digital twin is a digital representation of physical systems

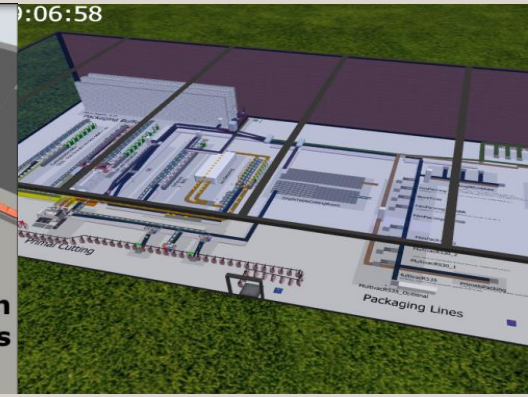
NIRAS has successfully created digital twins of production facilities, that enables simulation of production using:

- actual processing times, OEE’s and similar production parameters
- algorithms representing operational (incl. human) decision logic
- actual orders & production schedules

A Digital Twin can predict future plant operations

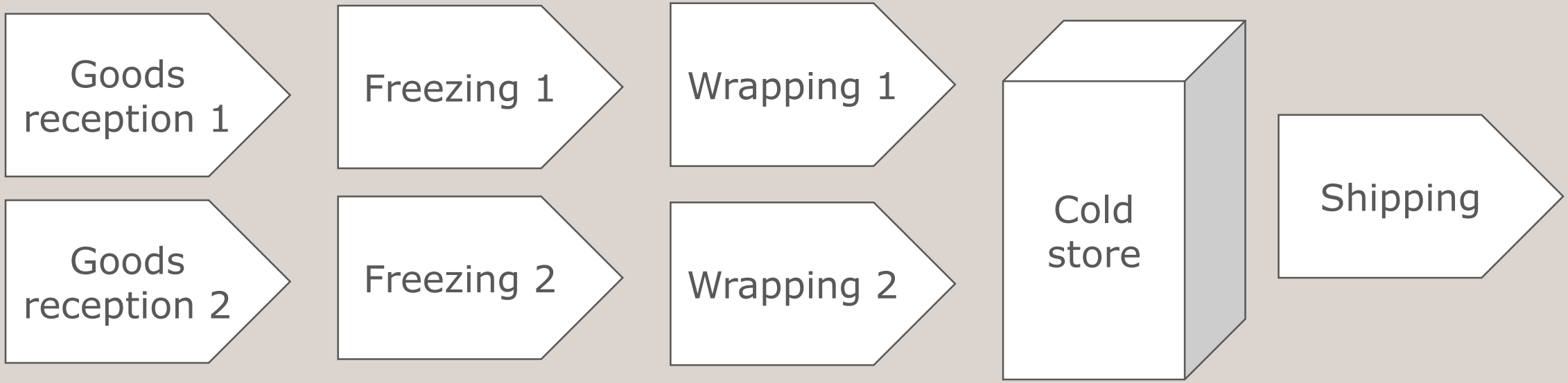






Example

A cold store – Agri-NorCold

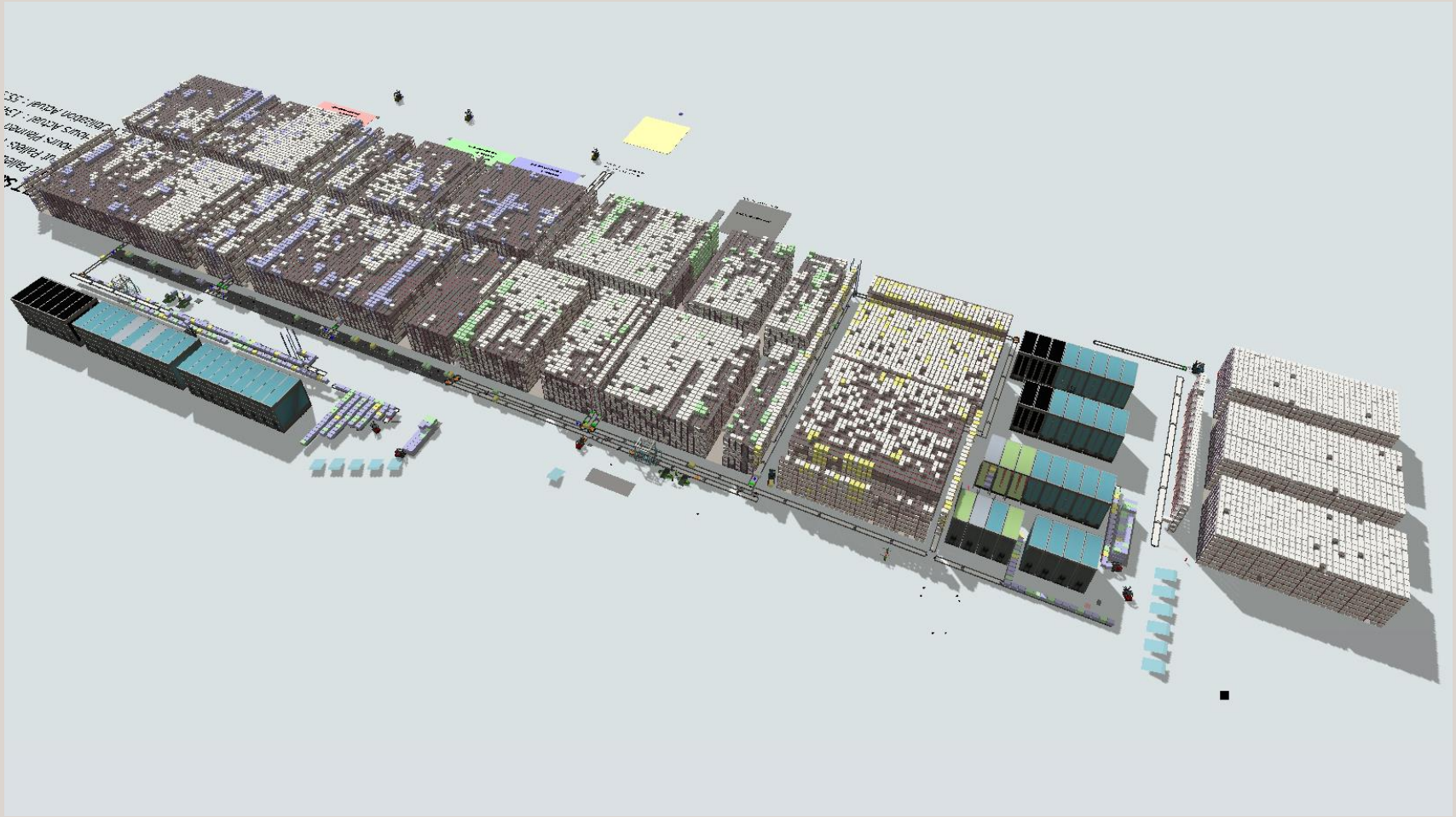


In the real world:

- 90.000 pallets, 15+ forklifts, 3-4000 pallets daily in and out
- 300 meters long, build in several phases during many years

Overview

From flow diagram to Digital Twin



Overview

From flow diagram to Digital Twin

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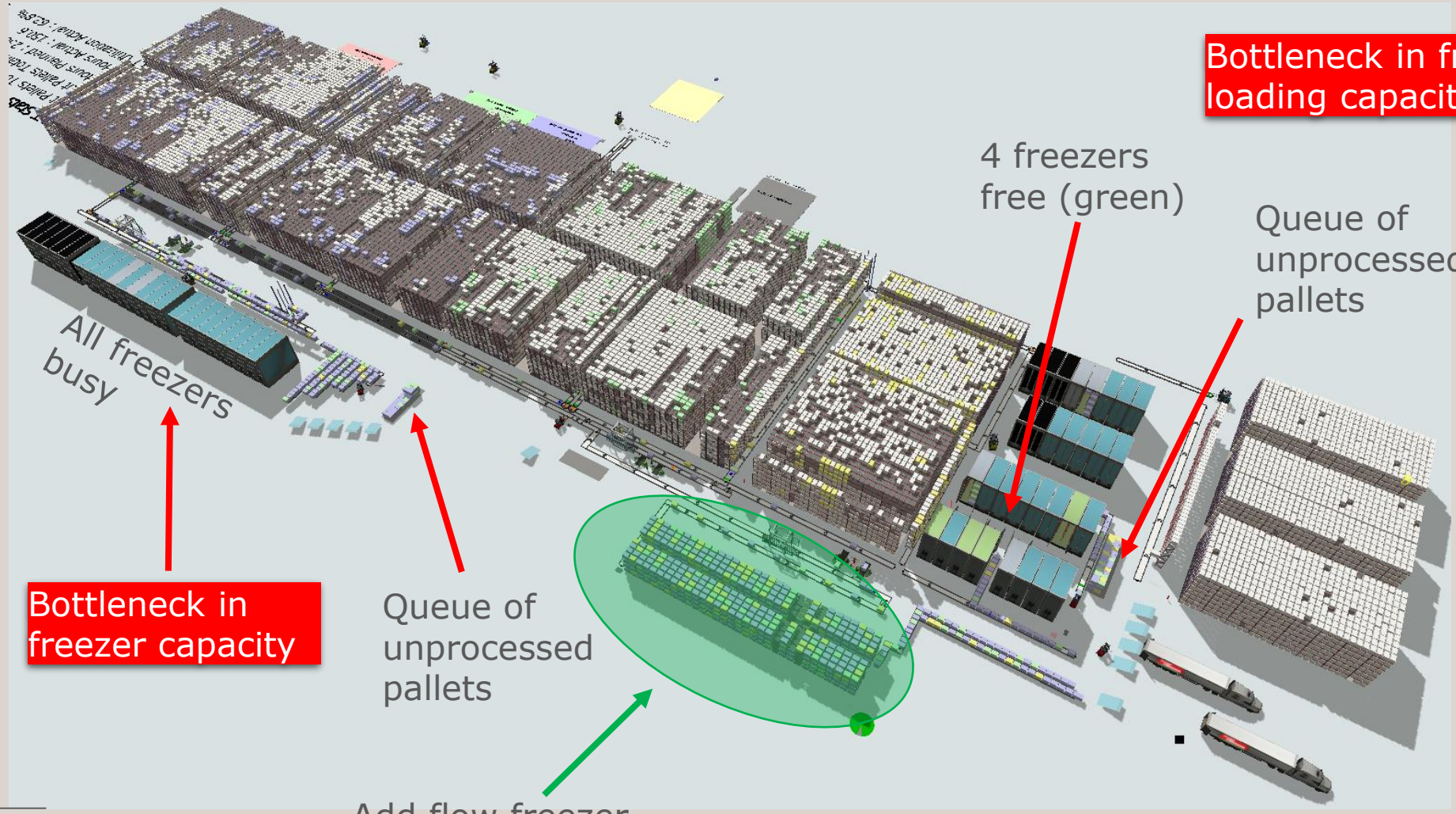
Test volume increase of 30%

Test expansion with flow freezer

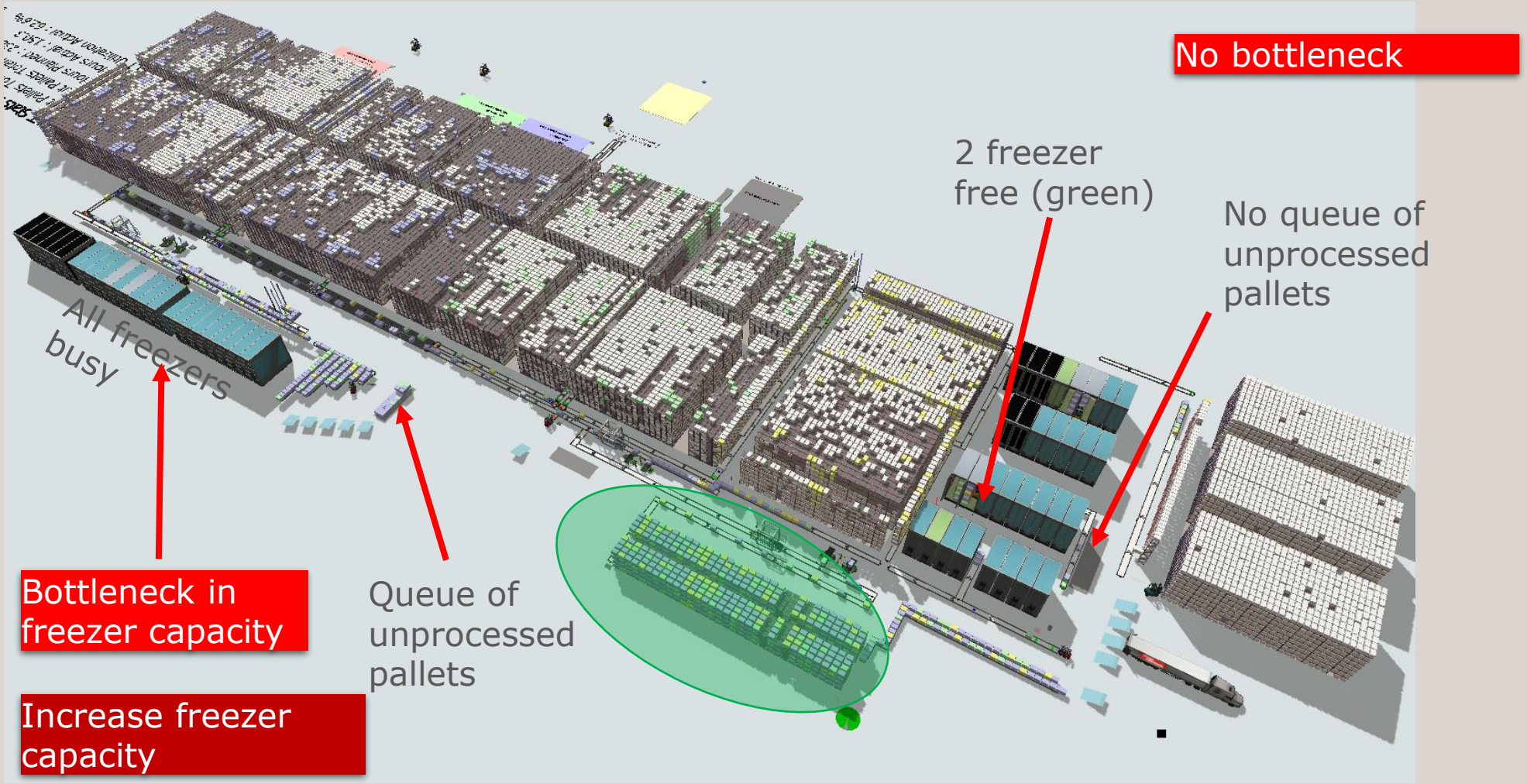


Increase volume 30%

1. Add flow freezer
2. Increase loading capaci

Test volume increase of 30%

Test expansion with flow freezer



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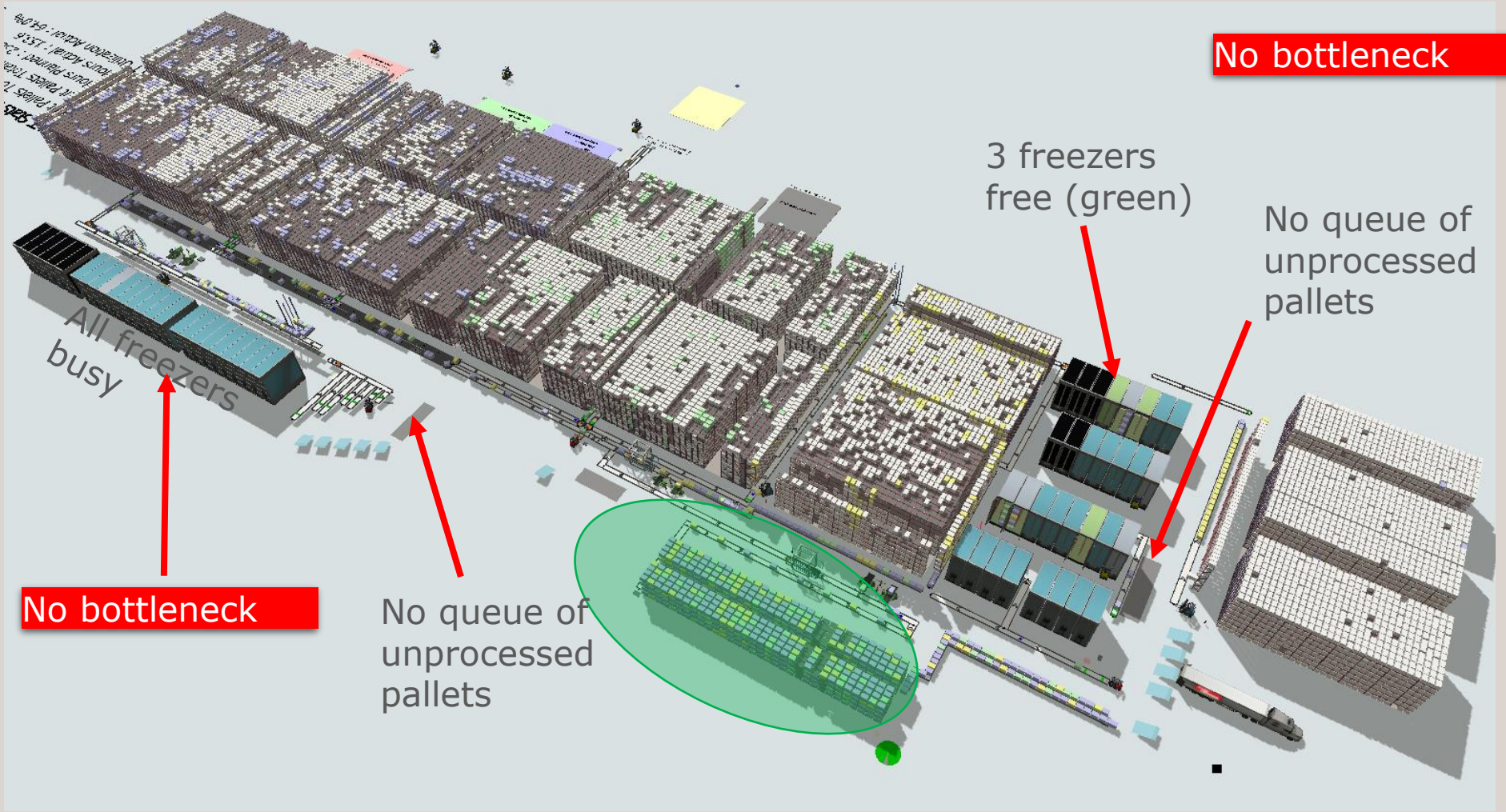

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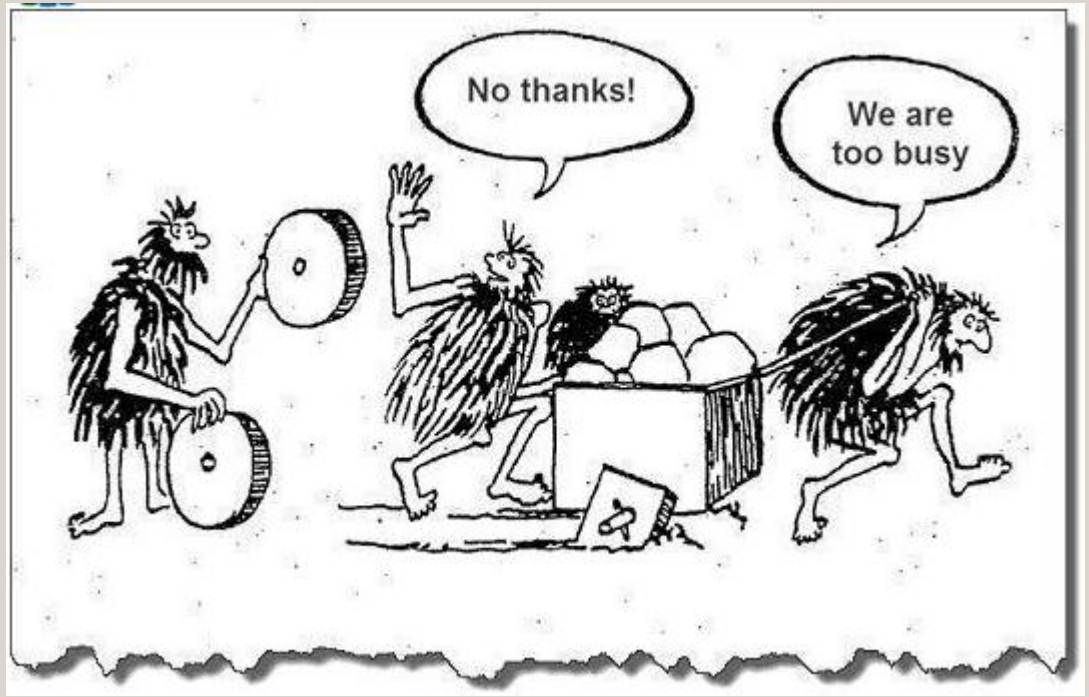
Why Now?



The concept of digital twins is not new

The tools are now available

Disruptive trend

Gartner Group predicts that by 2021, half of large industrial companies will use digital twins, resulting in those organizations gaining a 10% improvement in effectiveness.

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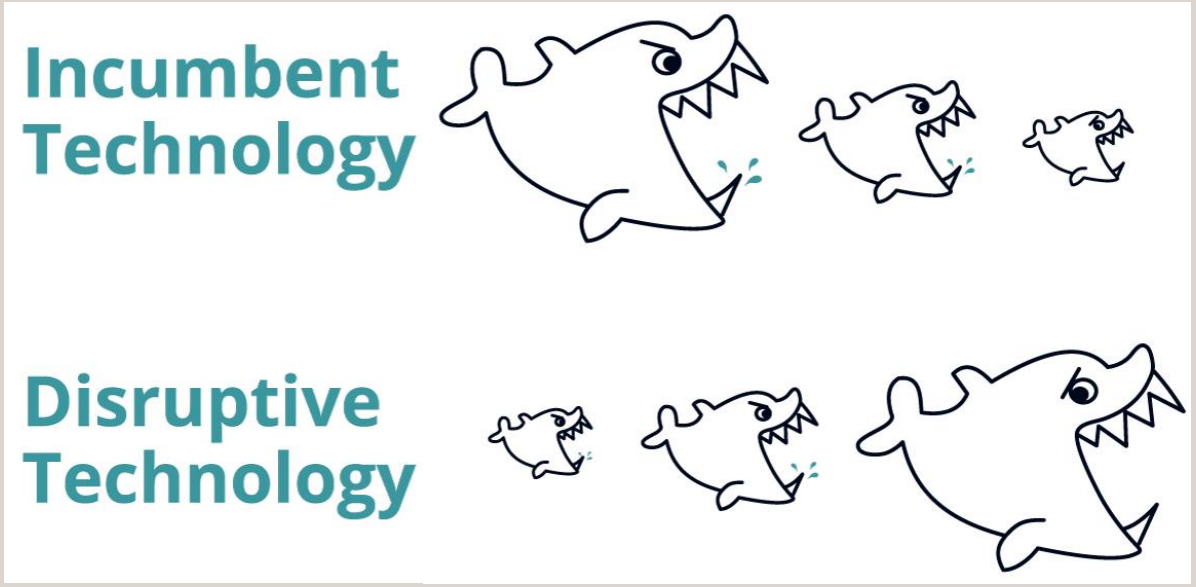
Is Digital Twin a “Disruptive” Technology?



Is it “distruptive”?

- Yes, because designs can be tested risk free
- Yes, because it is possible to challenge “this is how we always design our factory”
- Yes, because the Digital Twin provides new insight
- Yes, because the Digital Twin is a “real world” model, not averages like a spreadsheet

What is the limitation for using a Digital Twin?

- It is like raising children, it takes time and a continuous effort

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Raising a Digital Twin

Being a parent

- Like any child, the twin develops over time, accumulating knowhow and experience.
- In the beginning the twin will sometimes look as it is not following your logic; so is it your logic that is wrong or is some additional logic missing?
- Looking and behaving more and more like its parents – if effort continuously is spent educating it.
- A digital twin can be self-regulating if linked to the actual operations and monitor actual performance using IoT sensor data and AI for pattern recognition and optimization.

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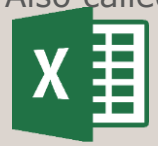
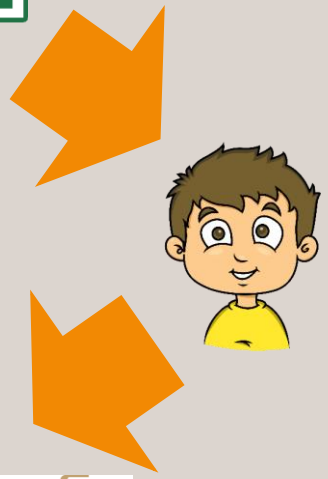
From unborn to adult

Volatile years….

The unborn child,
Also called a spreadsheet





The adult digital twin.
Fully grown and ready
to tackle all obstacles

Growing the child

The 1st DT: The main functionality is present, but it can only handle standard processes

The 2nd DT: Add relevant physical parts

The 3rd DT: Add human skills – Production scheduling / Control system

The 4th DT: Add variation - estimated

The 5th DT: Add variation – linked to actual performance via IoT or ERP/MES/SCADA

The 6th DT: Add robustness – How robust is the child to challenges – Monte Carlo simulation

The 7th DT: Configurations – Test of different configurations

The 8th DT: Result analysis – Use Big Data tools and BI to analyze results

The 9th DT: Self-optimizing – Artificial Intelligence

The 10th DT: Virtual interaction – Interact with the twin using VR and hands - while running

Growing the data

Data 1st edition: Simple and coherent test data

Data 2nd edition: Start using real data, but to be done offline and with manual data validation

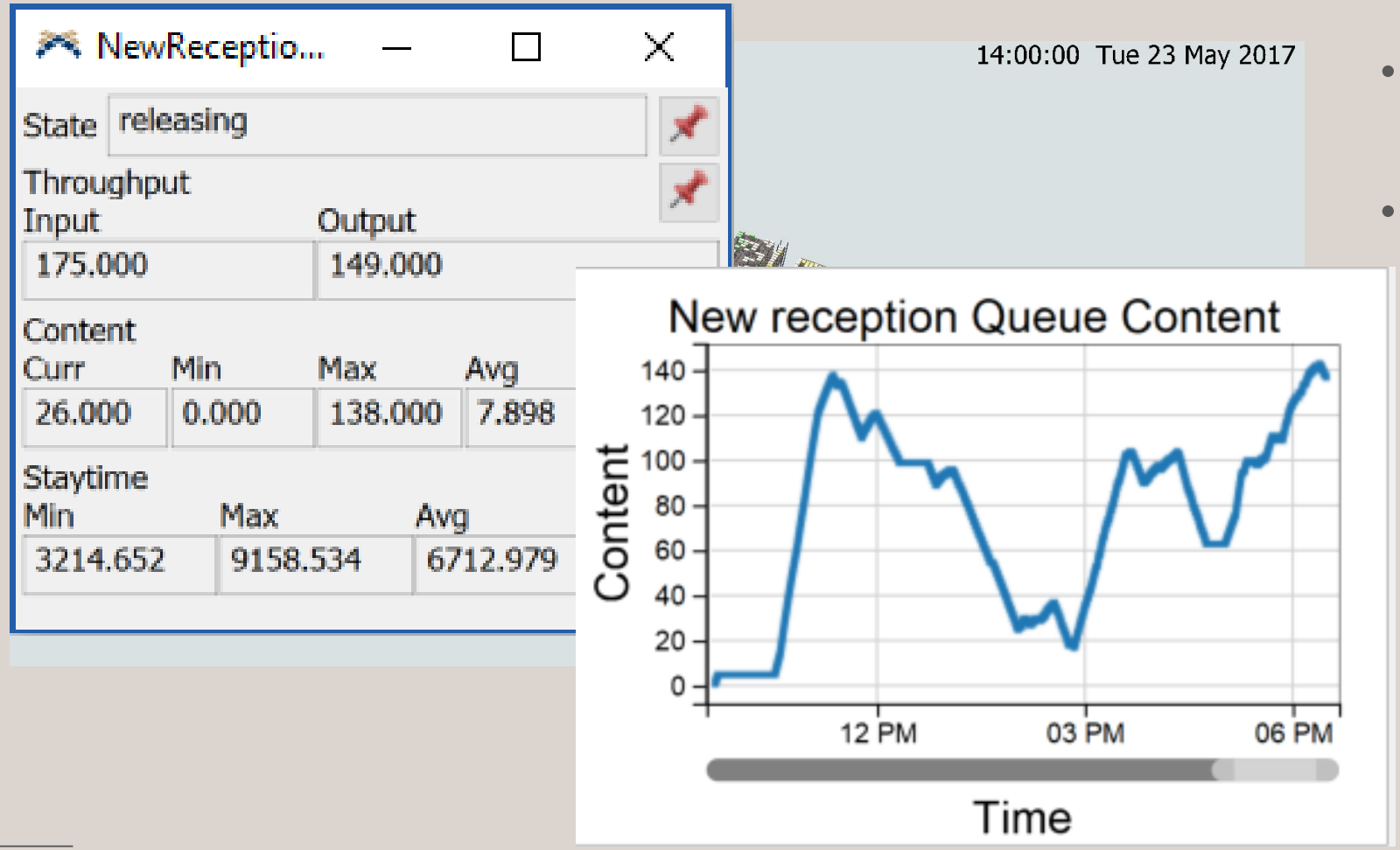
Data 3rd edition: Add data validation rules. Only accept validated data

Data 4th edition: Live link to data with upload of validated data. Data with errors handled manually

Data 5th edition: Live link to actual data

Communicating with the twin

Visual observations combined with graphs



- Visually observe operations
- Click on any object to display performance figures and graphs

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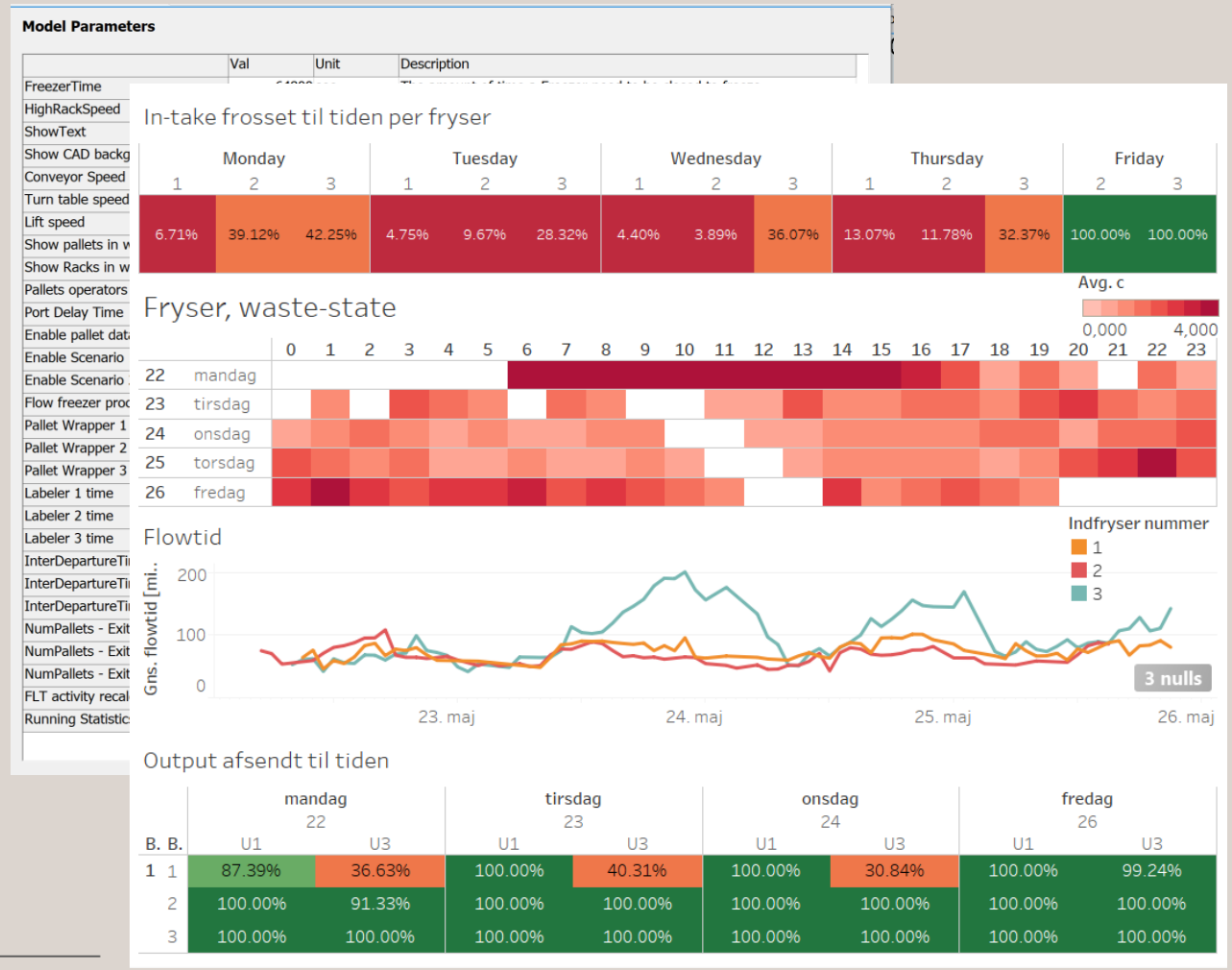
Communicating with the twin

No expert required



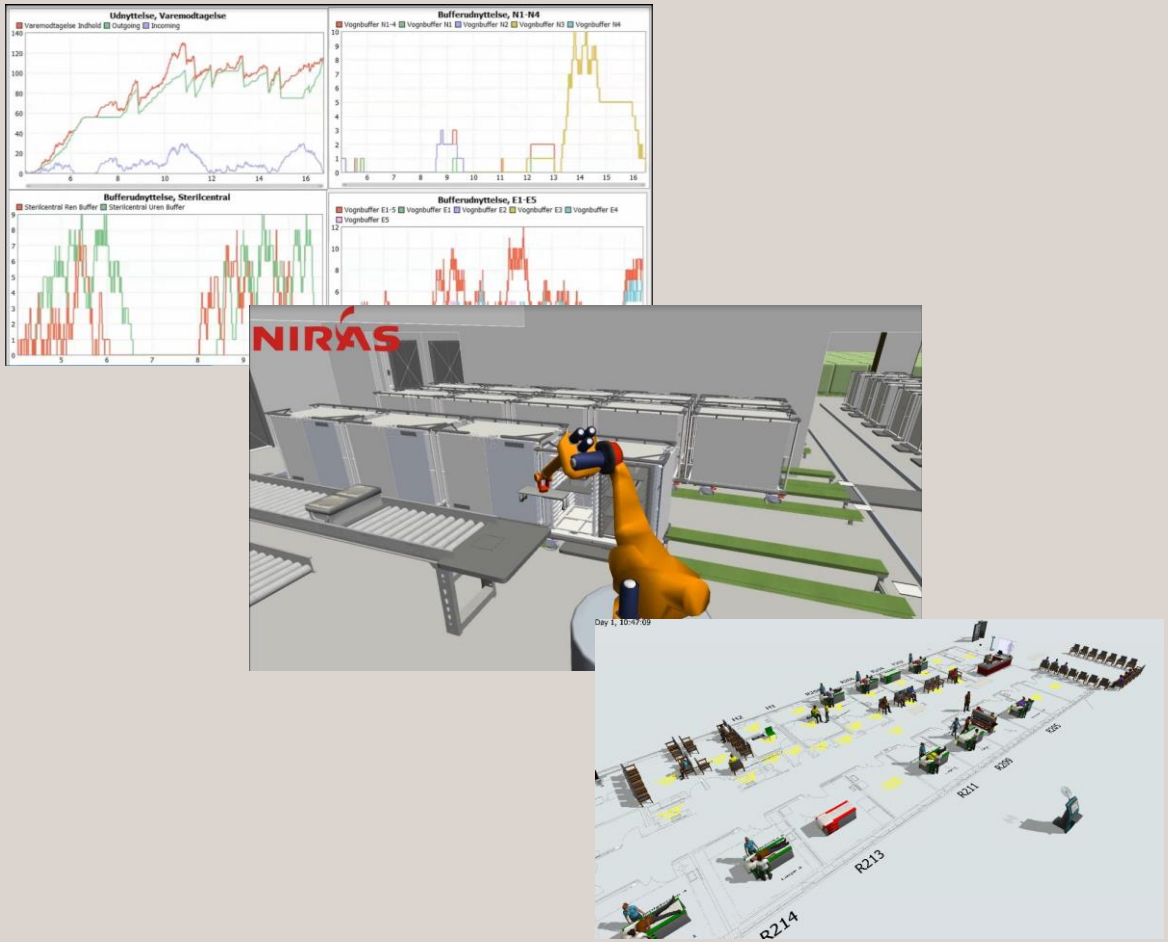
- Parameters are entered directly in the digital twin
- Big data sets are loaded automatically on model start from Excel or a database
- Results available in BI tool as the model runs

Benefits from the Digital Twin

Create overview	Alignment was secured faster across the various team members because the model is visual intuitive
Debottlenecking	The model simulated that proposed debottlenecking initiatives will work and not just move the bottleneck.
New capacity	Investments could be tested with real life orders and stochastic variations providing better proof of design
Service parameters	Service parameters e.g. delivery windows and response times could be verified before contracting
Quality control	Waiting time before freezing could be verified
Education	Planners & managers can explore how the plants works under different setups, and test changes without risk.
Operations Planning	Next week/month/year production kan be simulated and manning etc can be adjusted in time.

Hospital Focus Areas

Digital Twin



- **Automated Logistics**
- **Automated Sterile Instrument Re-processing Plants**
- **Clinical Processes**
  Moving to new facilities
  Optimizing processes at new location

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Learnings from Hospitals

Proof of Concept	Supports the transition from manual to automated logistics and automated production
Common understanding	Visual model explains functionality and problem areas
Process thinking	It enforces process thinking
Born as an adult?	Our experience is that it takes 2-3 repetitions to standardize a Digital Twin. Thus, if you have the experience, you don't have to start with an infant, but you start with a well trained adult
Multi disciplinary	Developing a complete Digital Twin requires knowledge of the subject matter, operations management, simulation, operations research, programming, data structures and CAD
Standardization possible	Automated Logistics and Sterile Instrument Re-processing Plants can be standardized. Even complex Clinical Processes can be configurable

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Hospitals

Logistics

- Odense Universitetshospital
- Universitetshospital Køge
- DNV-Gødstrup
- Herlev Hospital
- Rigshospitalet
- Stavanger Nye Universitetshospital

Hospitaler

Clinical

- Rigshospitalet Glostrup – Spinal surgery
- Bispebjerg Hospital – Emergency ward
- Aarhus Universitetshospital – Ear, Nose, Neck
- Rigshospitalet – Neuro

Hospitals

Sterile Processing Plant

- Rigshospitalet
- Herlev Hospital
- Stavanger Nye Universitetshospital
- Førde
- Sjukehuset Nordmøre og Romsdal
- Mo I Rana
- Drammen

Process Industry

- Breweries
- Dairy
- Cold Store Warehouse
- Biotech
- Pork Processing
- Chicken Processing

Brewery

Production