AI & Machine Learning Examples @ Boeing Frankfurt

Dr. Jens Schiefele, Director Product Research & Incbuation
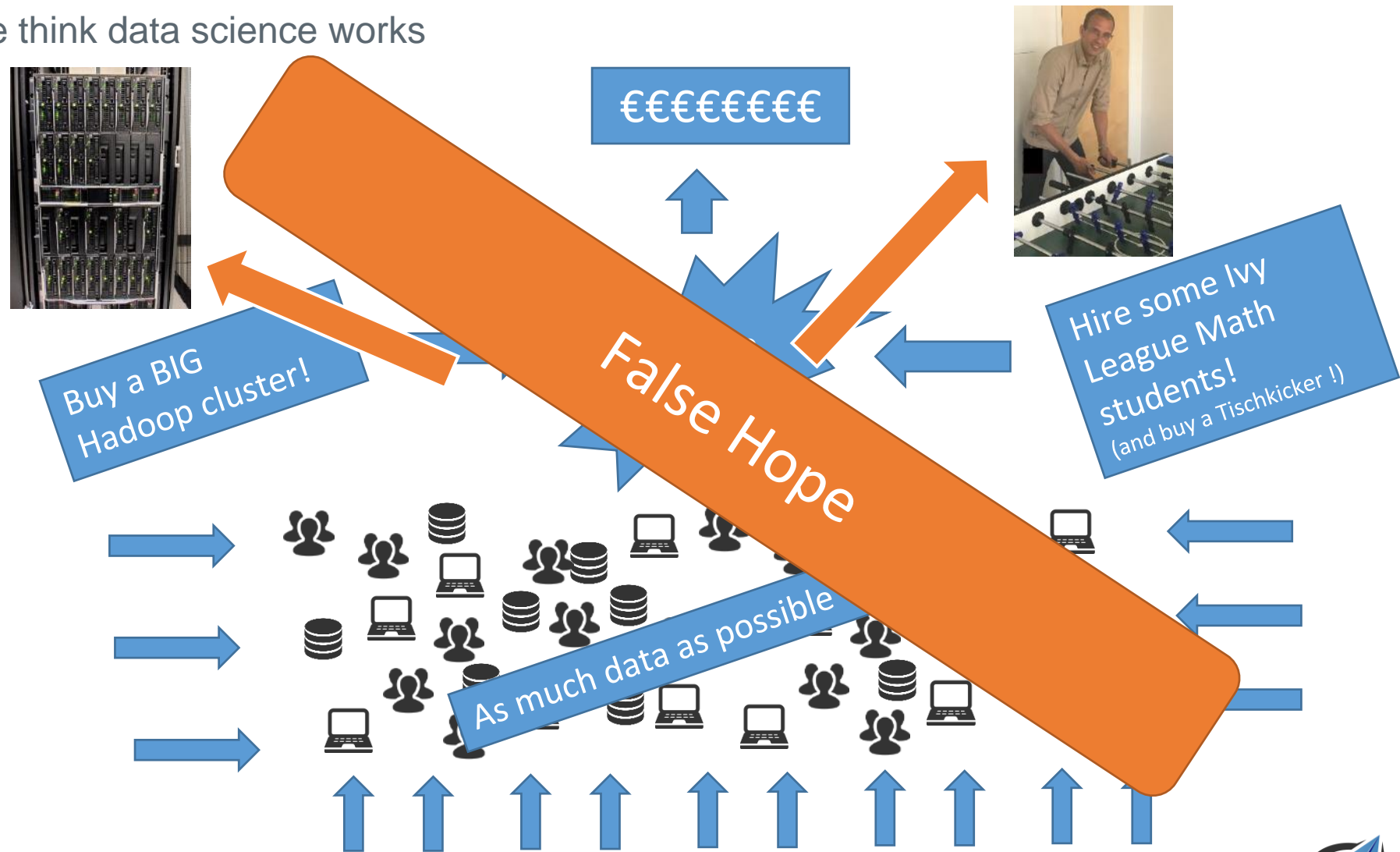
Boeing Labs Frankfurt

Self Directed Teams
70 people
every 6mth a new product

B787 Flight Simulator
B787 Cabin
Airline Ops Center
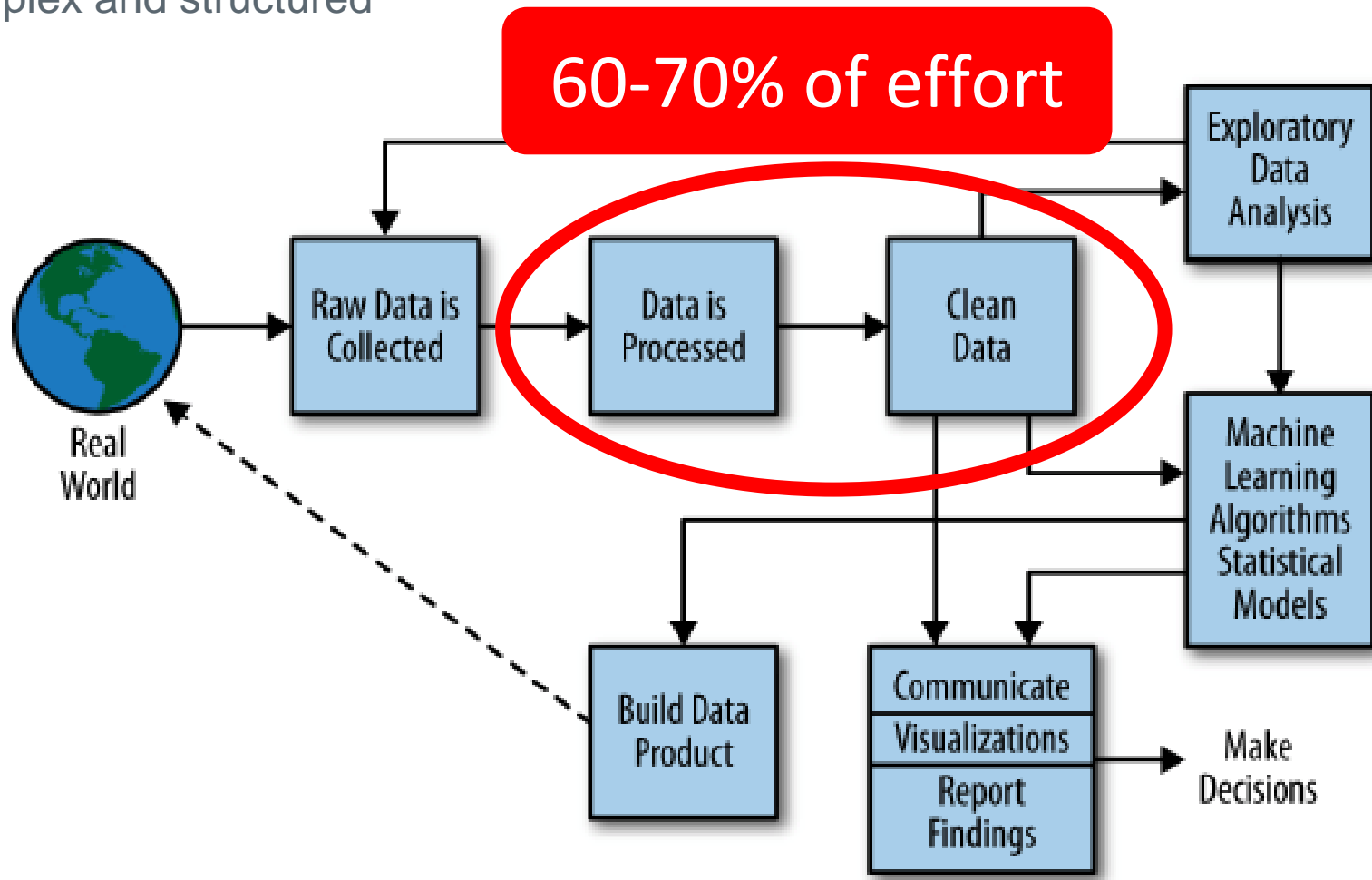Drone Cage

Analytics -- Dream

How people think data science works

€€€€€€€€

Buy a BIG Hadoop cluster!

Hire some Ivy League Math students!
(and buy a Tischkicker !)

False Hope

As much data as possible

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Analytics -- Reality looks a bit different

Much more complex and structured

60-70% of effort

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Boeing -- Turnaround Management

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What if we could teach an airplane to monitor its own turn?

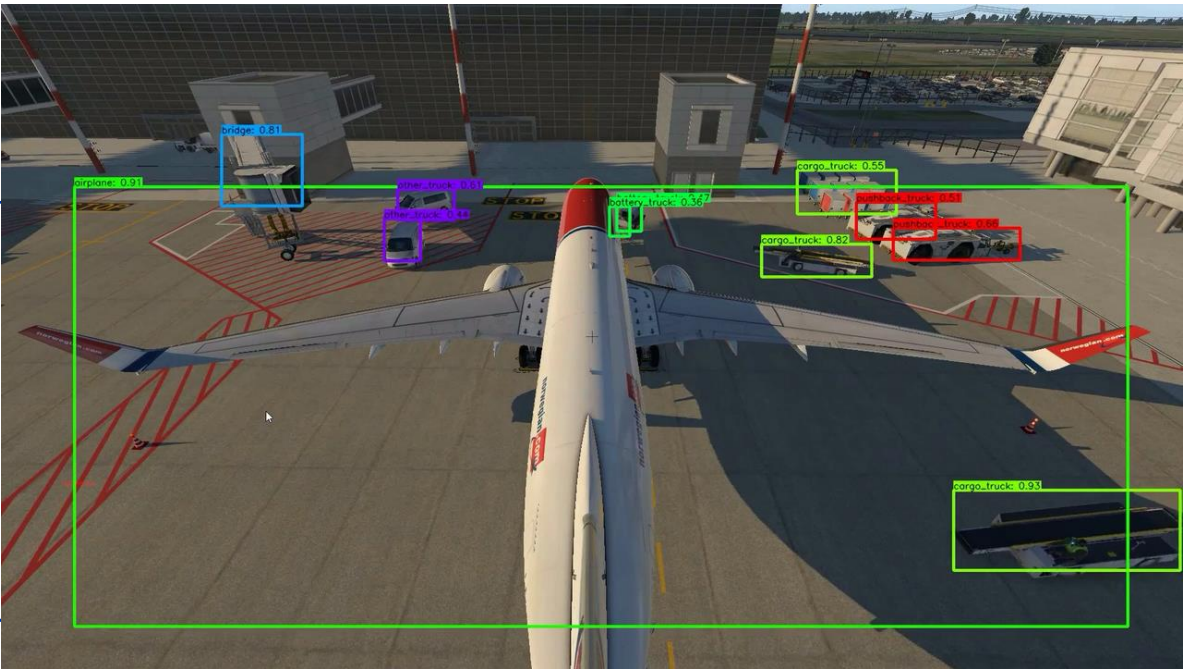Deriving value from computer vision

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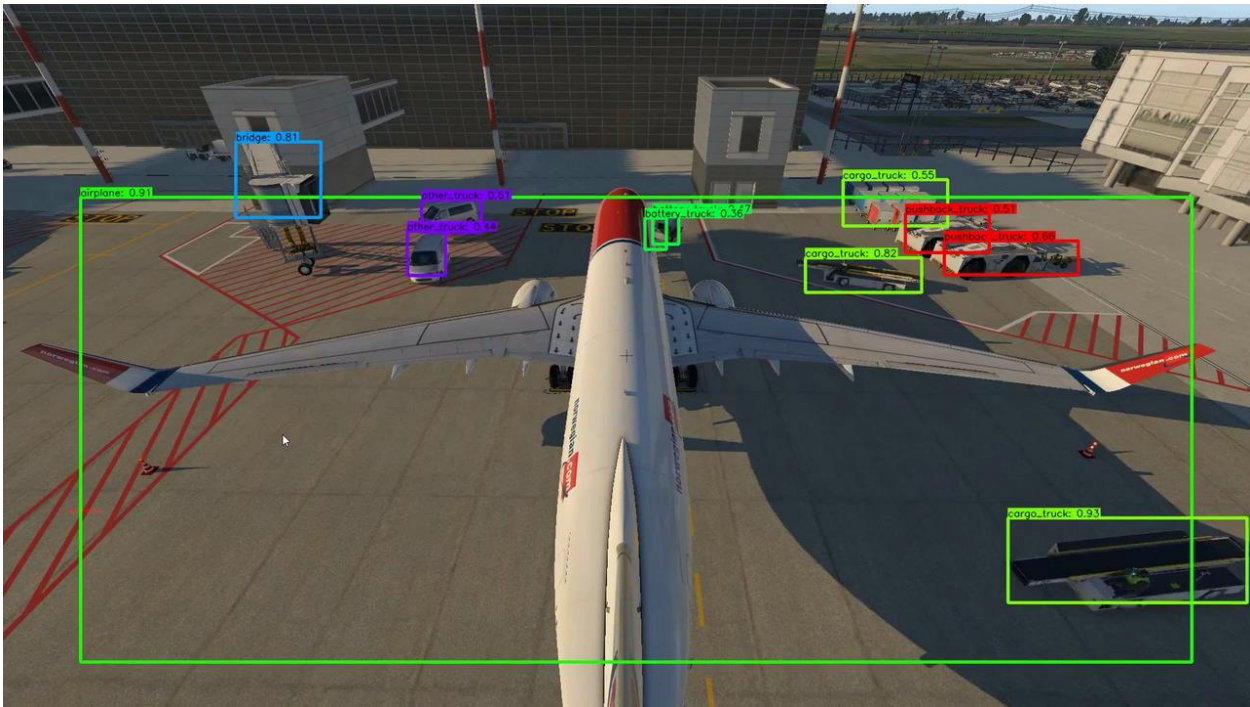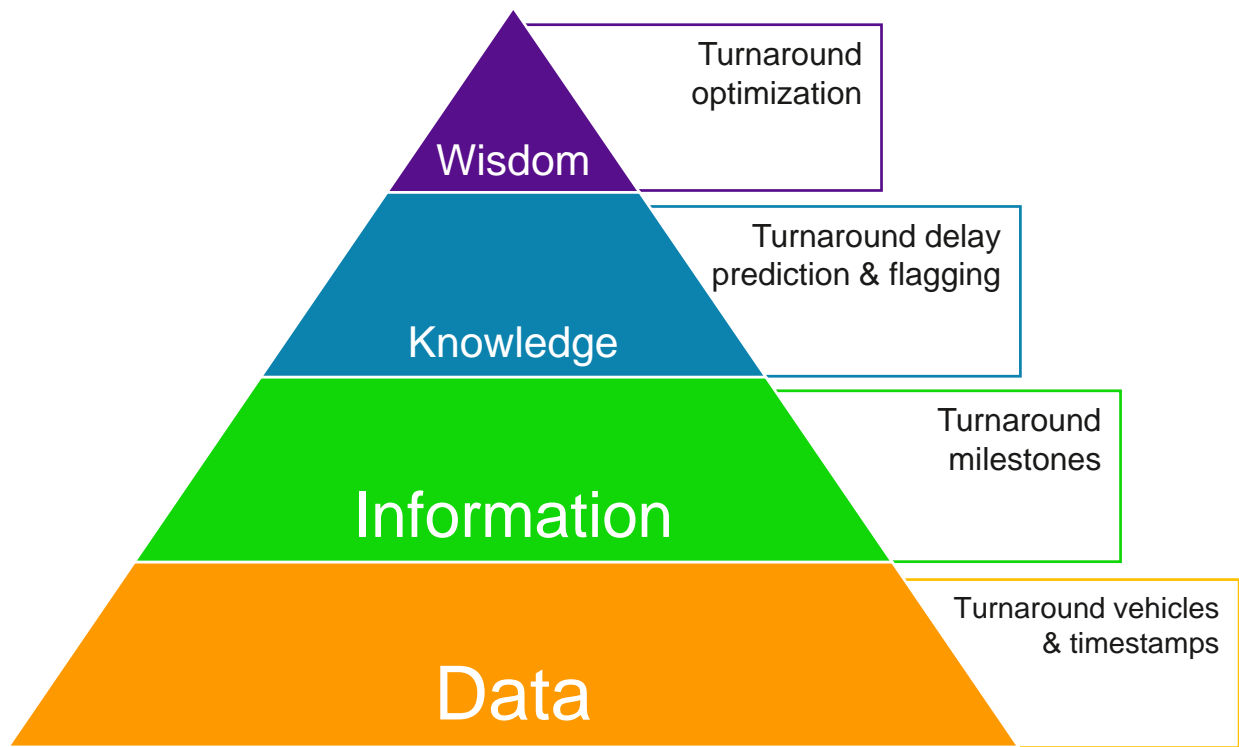
One technology, many opportunities

Turnaround support for pilots

Turnaround support for AOC
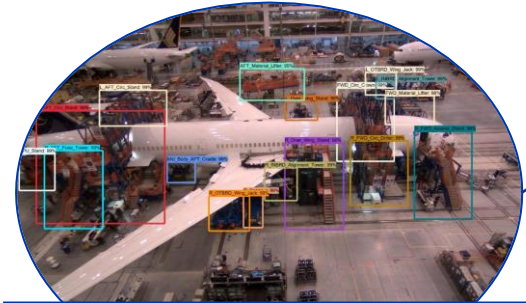
BCA commonality, design for manufacturing
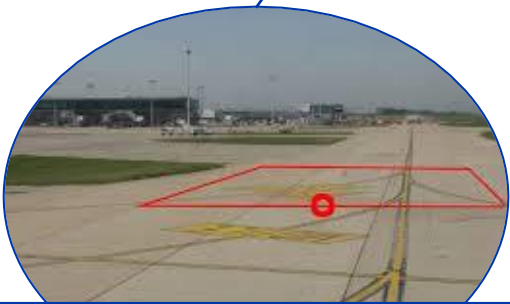
Airport security, facilities management, and FOD
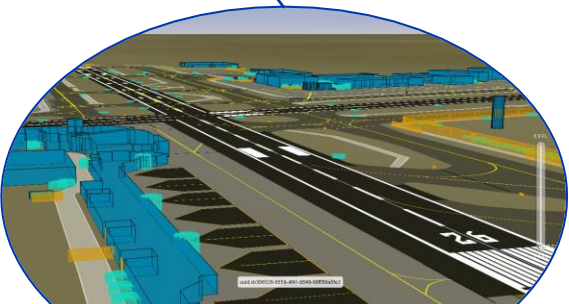
Automatic AMDB updates & autonomous aircraft operations

Airline IFE

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Architecture

Ram memory: 32GB
GPU: GTX 1080ti with 11GB of memory
CPU: i5-8600K
SSD hard drive
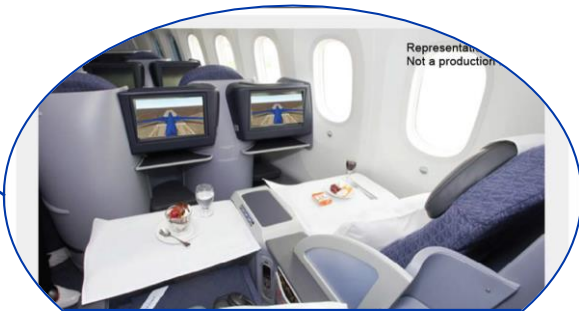
Raw images
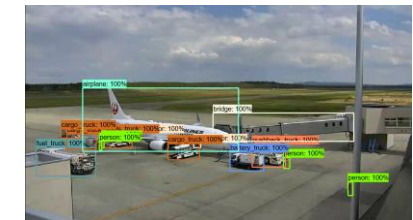
~2,000 images

Hokkaido - JP
Gdansk – PL
Nagasaki – JP
Frankfurt – DE
…
You Tube
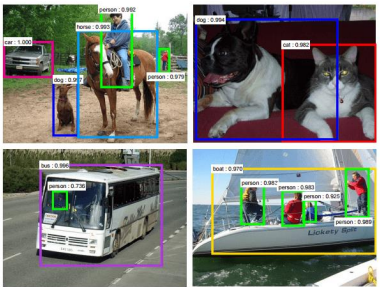
Raw videos

~25 hours

COCO dataset

Training dataset

Training
< 10 hours
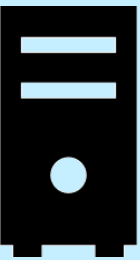
TensorFlow

- Faster Region Convolutional Neural Network (faster RCNN)
- Single Shot Detectors (SSD)
- 16 Classes

TurnView Model

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Boeing -- Spare parts

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Spare Parts Process Overview

How can digital solutions transform the spare parts business

Customer

Boeing Part Page

Customers order parts over this digital front door. These purchase orders are routed to the corresponding distribution center.

Parts Forecasts

Data is usually sent via email to specific email addresses.

IF a customer provides data, it usually comes in the form of flat files, e.g. CSV, XLSX, TXT. Customer provided data can be what *they* forecast they will need, planned maintenance events, or actual historical consumption.

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Spare Parts Management Software

Generates a global forecast of spare parts demand based on historic sales.

Manual extract of forecast as a flat file (e.g. CSV, XLSX, TXT)

Part Demand Planning

A team of analysts compares all of these inputs and creates a final spare parts demand forecast.

Spare Parts Management Software

The demand planning team inputs forecasted demand into spare parts management software which generates stocking plans for distribution centers based on their demand forecast.

Forecasting Analytics

Data is usually sent via email to specific email addresses.

Commercial Market Outlook team provides forecasted number of active tails based off of macroeconomic factors, deliveries, & retirements.

Supplier Management

Procures parts that are out of stock but in demand.

Parts are sent to the customer. Sales feed back into the management software.

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Why Sales is not the same as Consumption

Sales to Number of Active Parts: based on Shervin Beygi, Stefan Partin, Sridhar Dandapanthula

Global Services

SNAP Analysis for PN 90-900-1032

Historical Number of Active Parts

Calculated From
- Airplane Configuration Tracking
- Quantity of Parts per Aircraft
- Historical Aircraft Retirement Data
- Aircraft Delivery Data

Historical Sales to NAP Ratio (SNAP)

Historical Sales / Historical NAP

Historical Sales

Sold by Honeywell Aerospace Trading ★ ★ ★ ★ ☆
90-900-1032
GAUGE, PRESSURE, DIAL INDICATING

Future Number of Active Parts

Calculated From
- Flight Hour Forecast Model (Learn From Asia)
  - Stock Prices, John Hopkins Covid-19, Flightradar24, Future Deliveries etc.

Future SNAP
- Using a time series forecasting method (Moving Average / ARIMA / Exponential Smoothing)

Future Sales

Future NAP X Future SNAP

Legend: NAP — Sales — NAP — Sales — SNAP — SNAP

X-axis (Year): 20—, 2008, 2013, 2014, 2015, 2016, 2020, 2021, 2022, 2023, 2024

Left Y-axis (Number of Parts): 0, 200, 400, 600, 800, 1000, 1200, 1400, 1600

Right Y-axis (SNAP Ratio): 0, 0,02, 0,04, 0,06, 0,08, 0,1, 0,12, 0,14, 0,16

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BACKUP

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Classification classes

person

car

airplane

bus

bridge

cargo_door

crew_door

stairs_truck

catering_truck

fuel_truck

sa_truck

cargo_truck

pushback_truck

battery_truck

deicing_truck

other_truck

Special Assistant truck

Fuel truck

Source: google.
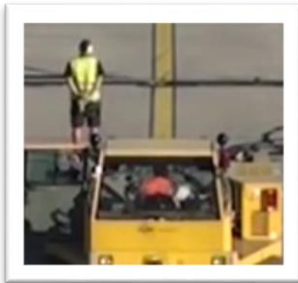
Pushback truck

Cargo truck

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The algorithms – TensorFlow model zoo

Extremally fast training time.

Initial experiments show very promising results, added to our to check list.

Mask R-CNN
- Object Detection
- Segmentation

The coolest but too expensive to run in our GTX 1080 and painful to label.

Discarded.

Faster Region Convolutional Neural Network (faster RCNN)

Works well, especially good at detecting smaller objects compared to the rest of the models.
Cons: Easy to overfit, slow to run, hard to train.

Single Shot Detectors (SSD)
This works as good as faster r-cnn and it's more robust in mid-big objects, but the performance drops a bit in small objects.

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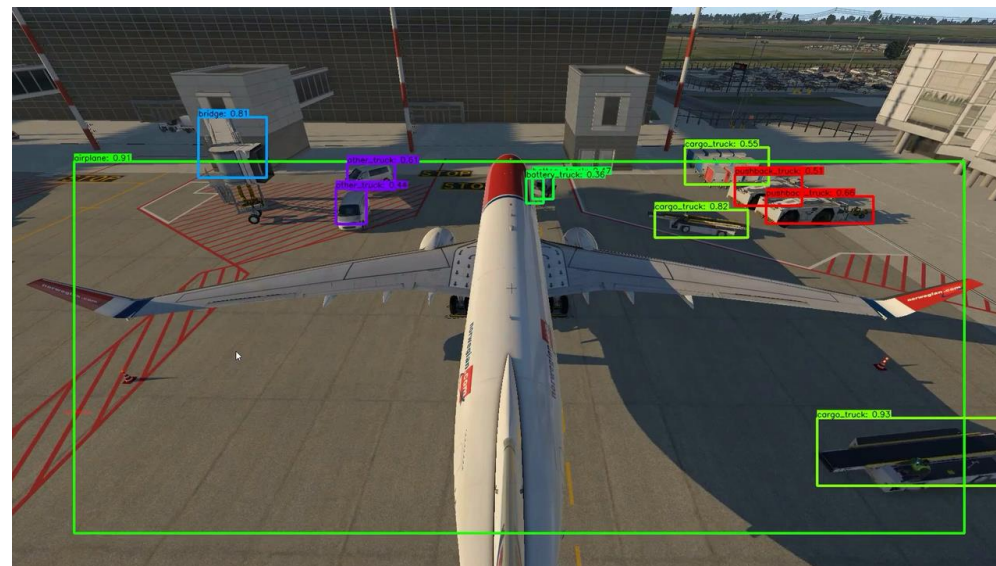
Two development paths, short- and long-term

Short-term

Long-term

Gate cameras:

  Technically feasible with current expertise but…
  Limited market, competition growing

Aircraft cameras

  Boeing differentiator, local to aircraft but…
  Technology lacking

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