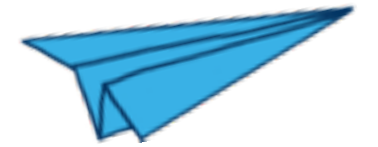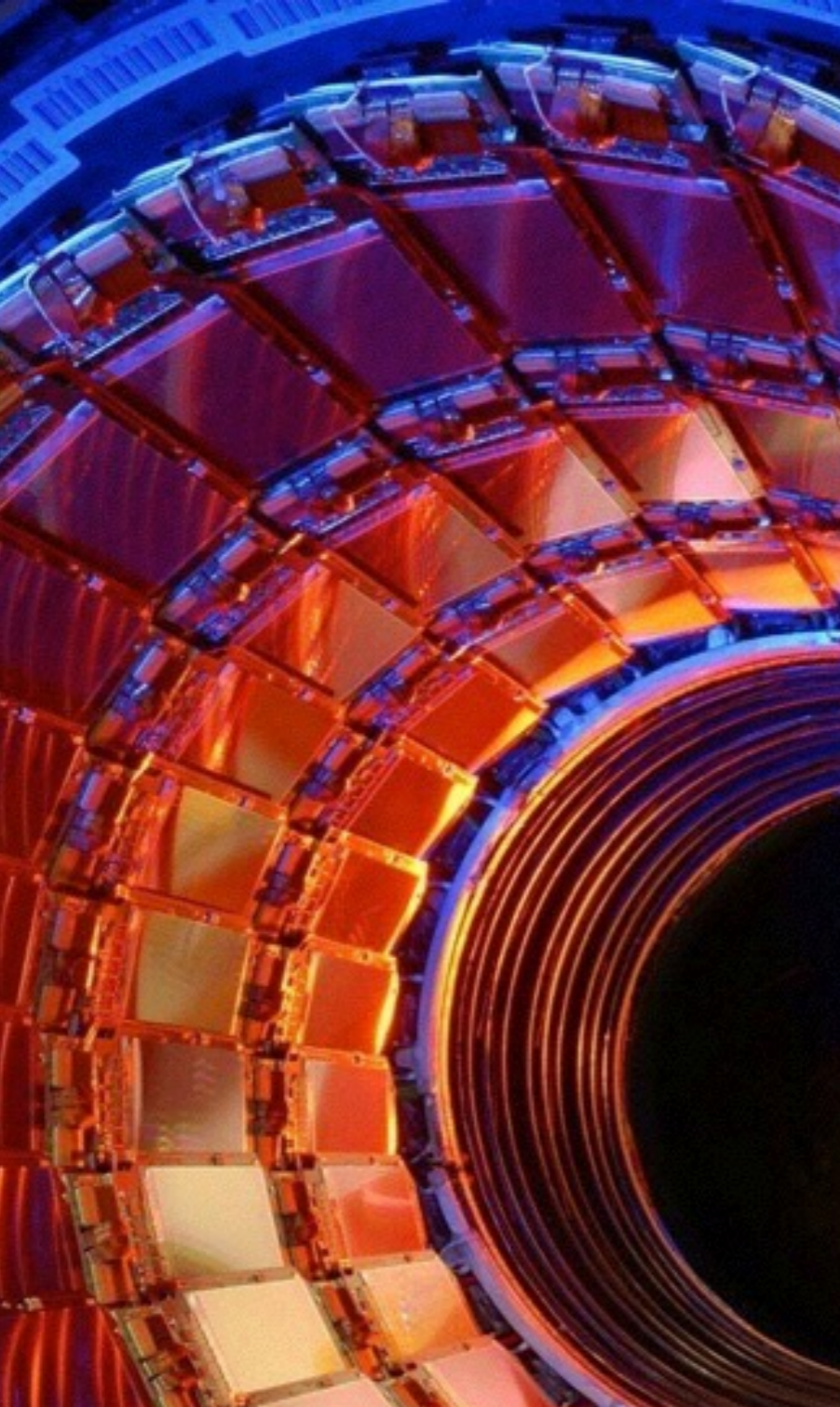# Transforming into a Predictive Enterprise

Optimisation of materials and processes

Dr. Ulrich Kerzel l @byanalytics_en

blue **yonder**

2008: Founded by CERN Data Scientists
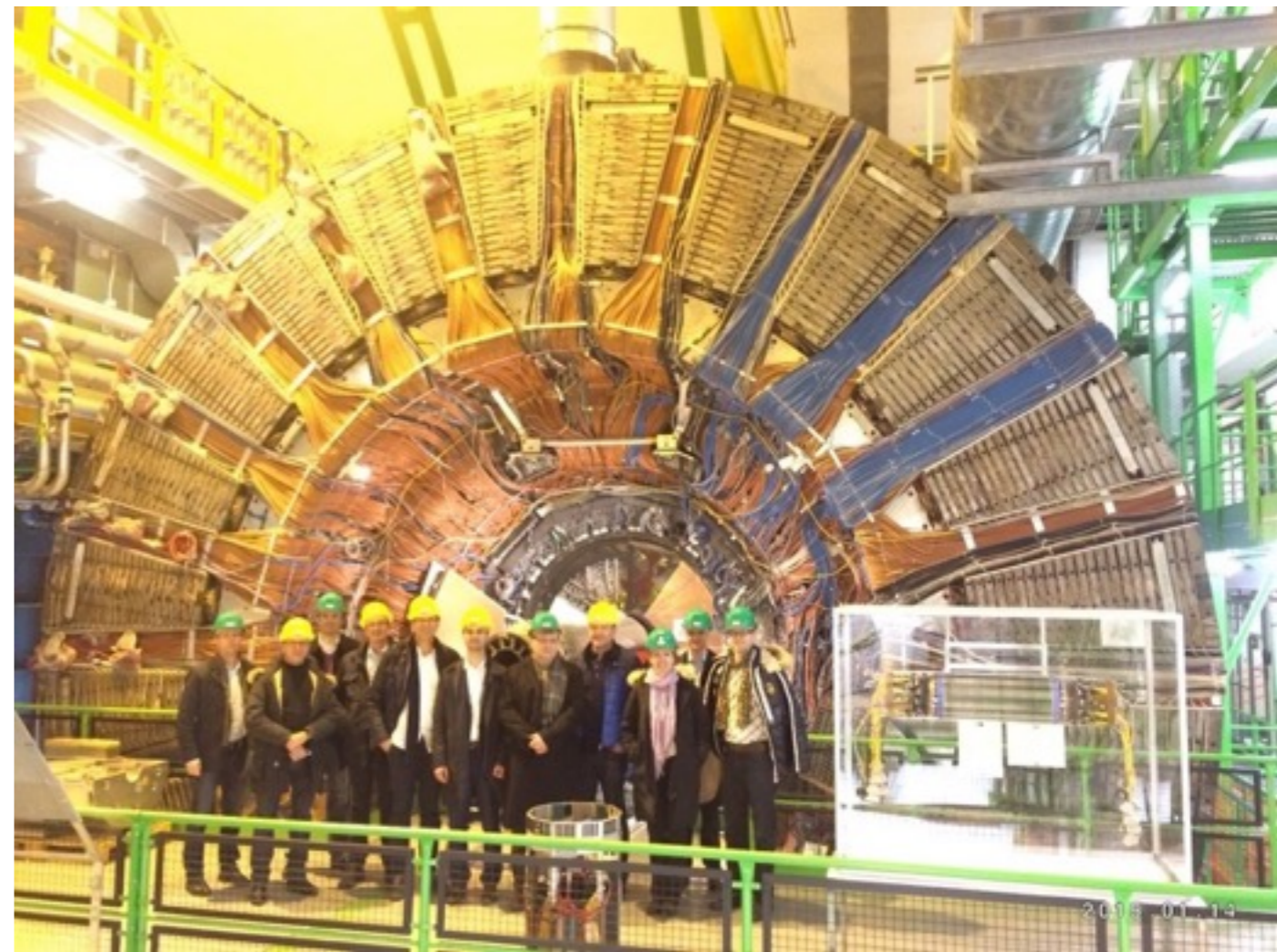
Since 2011: Award-winning retail solutions

2014: International expansion, predictive applications

Blue Yonder History: Founded by CERN physicists

Photos: CERN, Blue Yonder

LHC:
27km Umfang

Digital Innovation

2014 Award for "Most Innovative Use of Data":

IoTA
INTERNET OF THINGS AWARDS

2015 : 50 innovativste Unternehmen der Welt:

Technology Review

DIE 50 INNOVATIVSTEN UNTERNEHMEN

Gartner 2015
Cool Vendor

BARC
2014
BEST PRACTICE AWARD
BUSINESS INTELLIGENCE AND ANALYTICS

Hermes RetailWeek
SupplyChain
AWARDS 2014

BT RetailWeek
TECHNOLOGY AWARDS 2014
WINNER

Der Deutsche Innovationspreis

EY Entrepreneur Of The Year
Finalist 2013

Deutscher Preis für Onlinekommunikation

FOCUS
DIGITAL STAR ★
GERMAN DIGITAL INNOVATION AWARD

cyberOne 2012
BLUE YONDER

DEUTSCHE BÖRSE GROUP
Award 2012

Winner
retail technology awards europe
Best Enterprise Solutions

TOP PRODUKT HANDEL 2009

Cyber Champion 2011/12
CyberForum

INNOVATIONSPREIS-IT
BEST OF 2012
mittelstand
BUSINESS INTELLIGENCE

Blue Yonder Predictive / Prescriptive Analytics- Applications

DATA SCIENCE
ACADEMY

forward demand blue yonder – ...   Blue Yonder   Data Science Academy – Blue Y...   personnel – Google Search   Preview – Mac Guides

www.datascienceacademy.co.uk

mac screenshot

DATA SCIENCE
ACADEMY

Background   Questionnaire   Academy News | Deutsch

Blue Yonder's European Data Science Academy

At Blue Yonder our motto is, "No problem is too complex for the right team." A decade of research at CERN, KIT, and other leading scientific institutes and years of helping our clients to become predictive businesses has prepared us, a leading software provider for predictive analytics in Europe, to deliver groundbreaking new approaches to solving the world's most challenging problems. For this reason, Blue Yonder has founded The Data Science Academy (DSA). The goal of the academy is to promote awareness of big data within business enterprises and to foster the progress of a data science revolution.

We would like to know
what topics and forms of training interest you?

Simply fill out the questionnaire

This looks like an interesting training model.
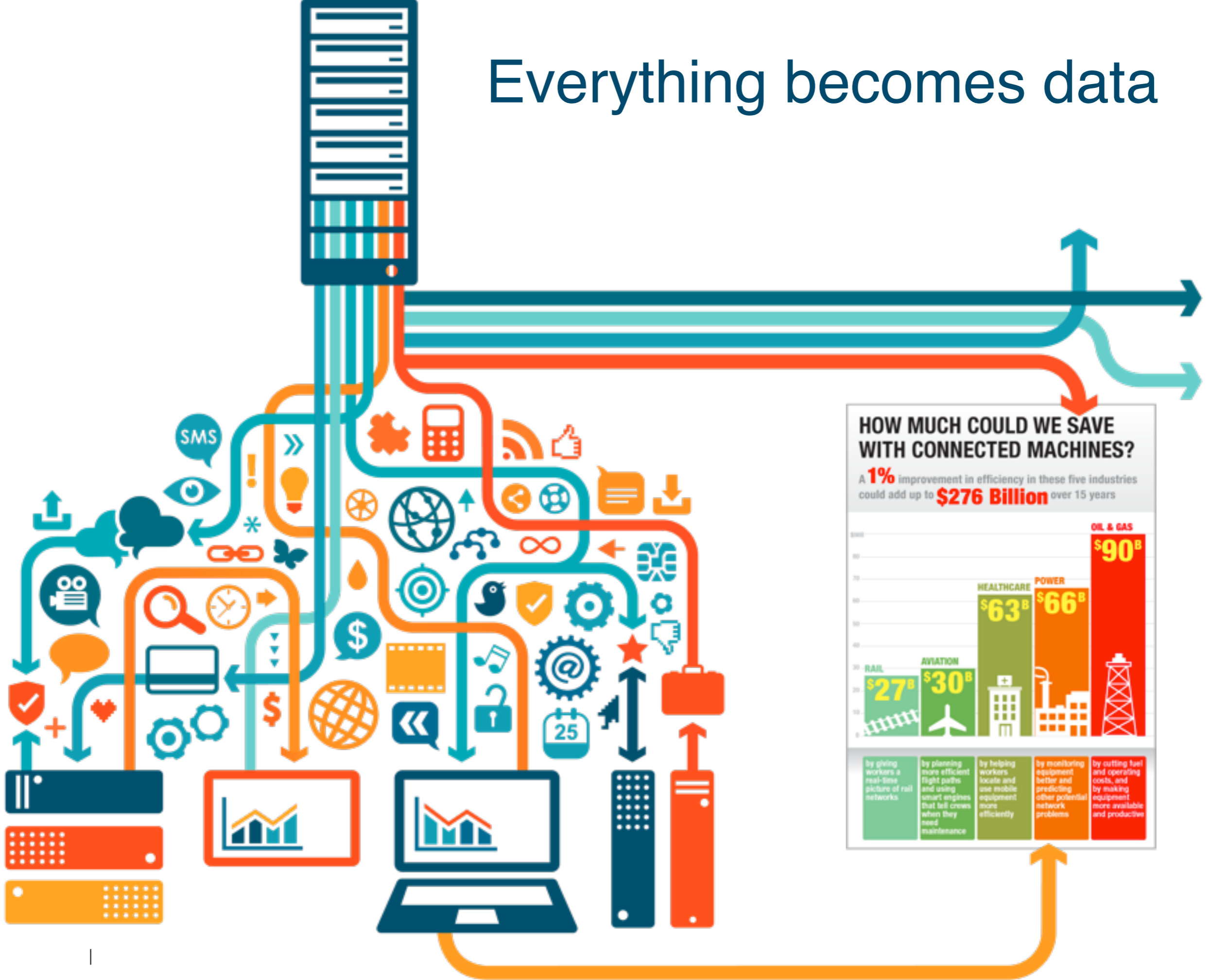Please keep me up to date on it.

Register for Academy news

In order to use big data correctly,
you need intelligent and well trained people.

www.datascienceacademy.eu   blue yonder

The key to becoming a better company are **better decisions**. The key to better decisions is using your own **data**.
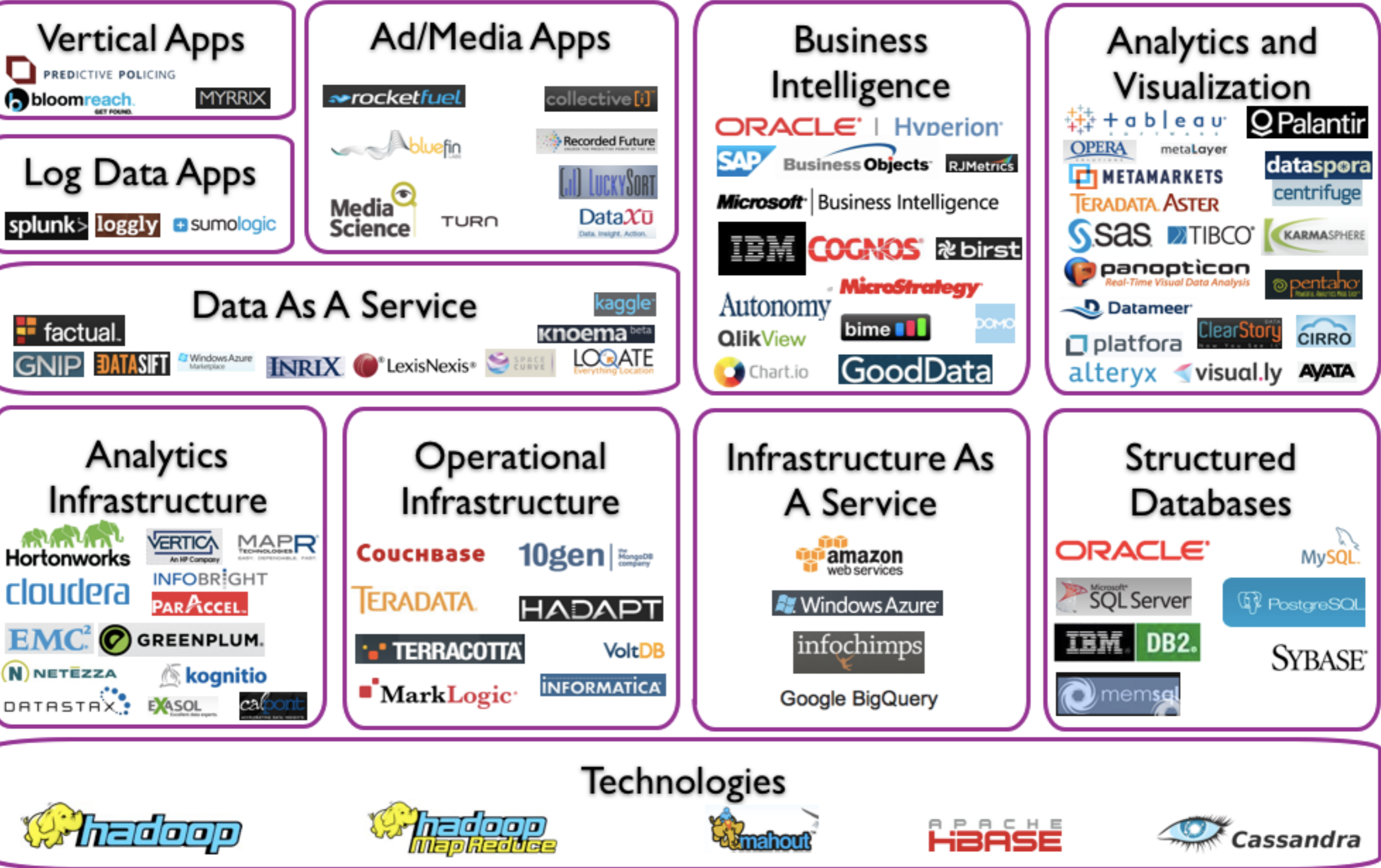
Everything becomes data

HOW MUCH COULD WE SAVE WITH CONNECTED MACHINES?

A **1%** improvement in efficiency in these five industries could add up to **$276 Billion** over 15 years

RAIL $27B
AVIATION $30B
HEALTHCARE $63B
POWER $66B
OIL & GAS $90B
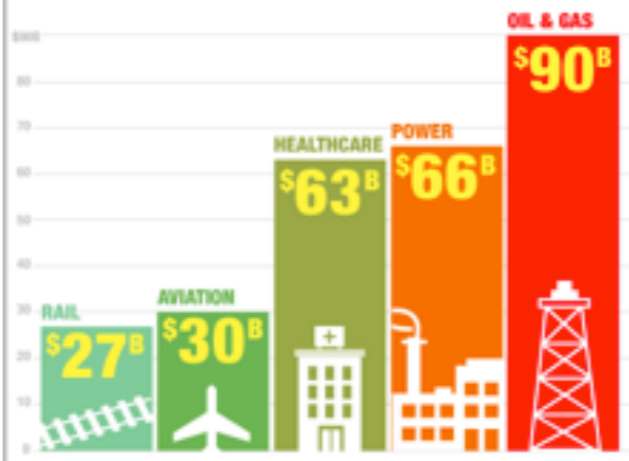
by giving workers a real-time picture of rail networks

by planning more efficient flight paths and using smart engines that tell crews when they need maintenance

by helping workers locate and use mobile equipment more efficiently

by monitoring equipment better and predicting other potential network problems

by cutting fuel and operating costs, and by making equipment more available and productive

Big Data Landscape

Vertical Apps

PREDICTIVE POLICING
bloomreach. GET FOUND.
MYRRIX

Log Data Apps

splunk> loggly +sumologic

Ad/Media Apps

rocketfuel
bluefin LABS
Media Science
TURN
collective[i]
Recorded Future
LuckySort
DataXu — Data. Insight. Action.

Business Intelligence

ORACLE | Hyperion
SAP Business Objects RJMetrics
Microsoft | Business Intelligence
IBM COGNOS birst
Autonomy MicroStrategy
QlikView bime DOMO
Chart.io GoodData

Analytics and Visualization

tableau SOFTWARE Palantir
OPERA SOLUTIONS metaLayer
METAMARKETS dataspora centrifuge
TERADATA ASTER
SAS TIBCO KARMASPHERE
panopticon Real-Time Visual Data Analysis pentaho Powerful. Analytics. Made. Easy.
Datameer
platfora ClearStory DATA CIRRO
alteryx visual.ly AYATA

Data As A Service

kaggle
factual. knoema beta
GNIP DATASIFT Windows Azure Marketplace INRIX LexisNexis SPACE CURVE LOQATE Everything Location

Analytics Infrastructure

Hortonworks VERTICA An HP Company MAPR TECHNOLOGIES EASY. DEPENDABLE. FAST.
cloudera INFOBRIGHT
ParAccel.
EMC² GREENPLUM.
NETEZZA kognitio
DATASTAX EXASOL Excellent data experts calpont ACCELERATED DATA INSIGHTS

Operational Infrastructure

COUCHBASE 10gen the MongoDB company
TERADATA. HADAPT
TERRACOTTA VoltDB
MarkLogic INFORMATICA

Infrastructure As A Service

amazon web services
Windows Azure
infochimps
Google BigQuery

Structured Databases

ORACLE MySQL.
Microsoft SQL Server PostgreSQL
IBM DB2. SYBASE
memsql

Technologies

hadoop
hadoop MapReduce
mahout
APACHE HBASE
Cassandra

Copyright © 2012 Dave Feinleib

dave@vcdave.com

blogs.forbes.com/davefeinleib

Big Data Landscape (Version 2.0)

© Matt Turck (@mattturck) and ShivonZilis (@shivonz) Bloomberg Ventures

Data Science is the sexiest Job ...

DATA

Data Scientist: The Sexiest Job of the 21st Century

by Thomas H. Davenport and D.J. Patil

FROM THE OCTOBER 2012 ISSUE

| SUMMARY | SAVE | SHARE | COMMENT | TEXT SIZE | PRINT | $8.95 BUY COPIES |

W hen Jonathan Goldman arrived for work in June 2006 at LinkedIn, the business networking site, the place still felt like a start-up. The company had just under 8 million accounts, and the number was growing quickly as existing members invited their friends and colleagues to join. But users weren't seeking out connections with the people who were already on the site at the rate executives had expected. Something was apparently missing in the social experience. As one LinkedIn manager put it, "It was like arriving at a conference reception and realizing

VIEW MORE FROM THE
October 2012 Issue

Harvard Business Review

Data Scientists are unicorns ...

Source: guardian.co.uk

07/08/15

Source: Flickr (by J. Farthing, CC)

Data Science will transform our world

„Software is eating the world"
(Marc Andreessen - 2011)

Source: Wikipedia.org

(Netscape, Mosaic,
Silicon Valley
Venture Capital, …)

Here's How Managers Can Be Replaced by Software

Source: Harvard Business Review/

NewScientist Life

AI interns: Software already taking jobs from humans

Source: New Scientist/

SMARTNEWS Keeping you current

Computers Are Learning About Art Faster than Art Historians

An algorithm took just a few months to draw connections between artists that scholars have been working on for years
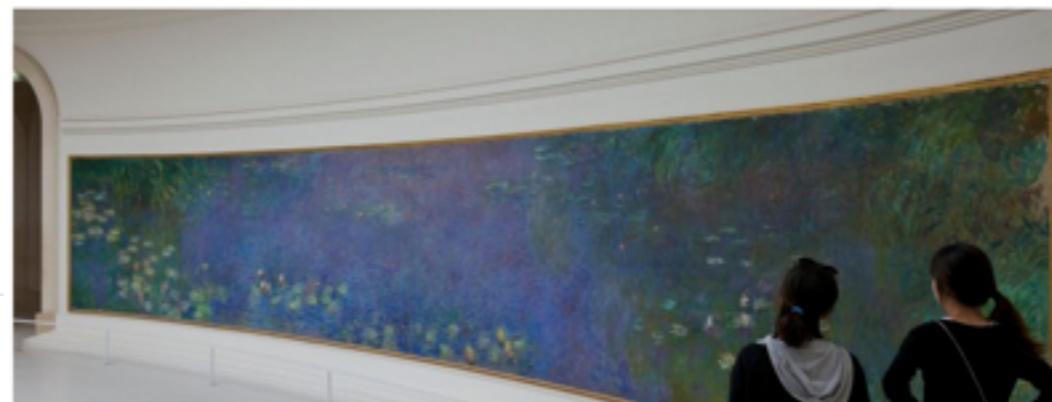
Source: Smithsonian

Data Science will transform our world

Home | Tech | News

The AI boss that deploys Hong Kong's subway engineers

❯ 04 July 2014 by Hal Hodson
❯ Magazine issue 2976. Subscribe and save

An algorithm schedules and manages the nightly engineering work on one of the world's best subway systems – and does it more efficiently than any human could

JUST after midnight, the last subway car slips into its sidings in Hong Kong and an army of engineers goes to work. In a typical week, 10,000 people carry out 2600 engineering works across the system – from grinding rough rails smooth and replacing tracks to checking for damage. People might do the work, but they don't choose what needs doing. Instead, each task is scheduled and managed by artificial intelligence.

Hong Kong has one of the world's best subway systems. It has a 99.9 per cent on time record – far better than London Underground or New York's subway. It is owned and run by MTR Corporation, which also runs systems in Stockholm, Melbourne, London and Beijing. MTR is now planning to roll out its AI overseer to the other networks it manages.

Who's in charge? (Image: Bloomberg/Getty)

Source: New Scientist

Qualification as maintenance engineer :

New EU wide industry norms

- DIN EN 13306 Terminology
- DIN EN 15628 Qualification of personnel
- DIN EN 15341 KPI
- …

Data Science will transform our world

Source: Guardian

Predictive Applications

Predictive Applications Enable Ongoing Optimization

Data delivery

controller

Predictive Application

External factors

Decisions & Actions
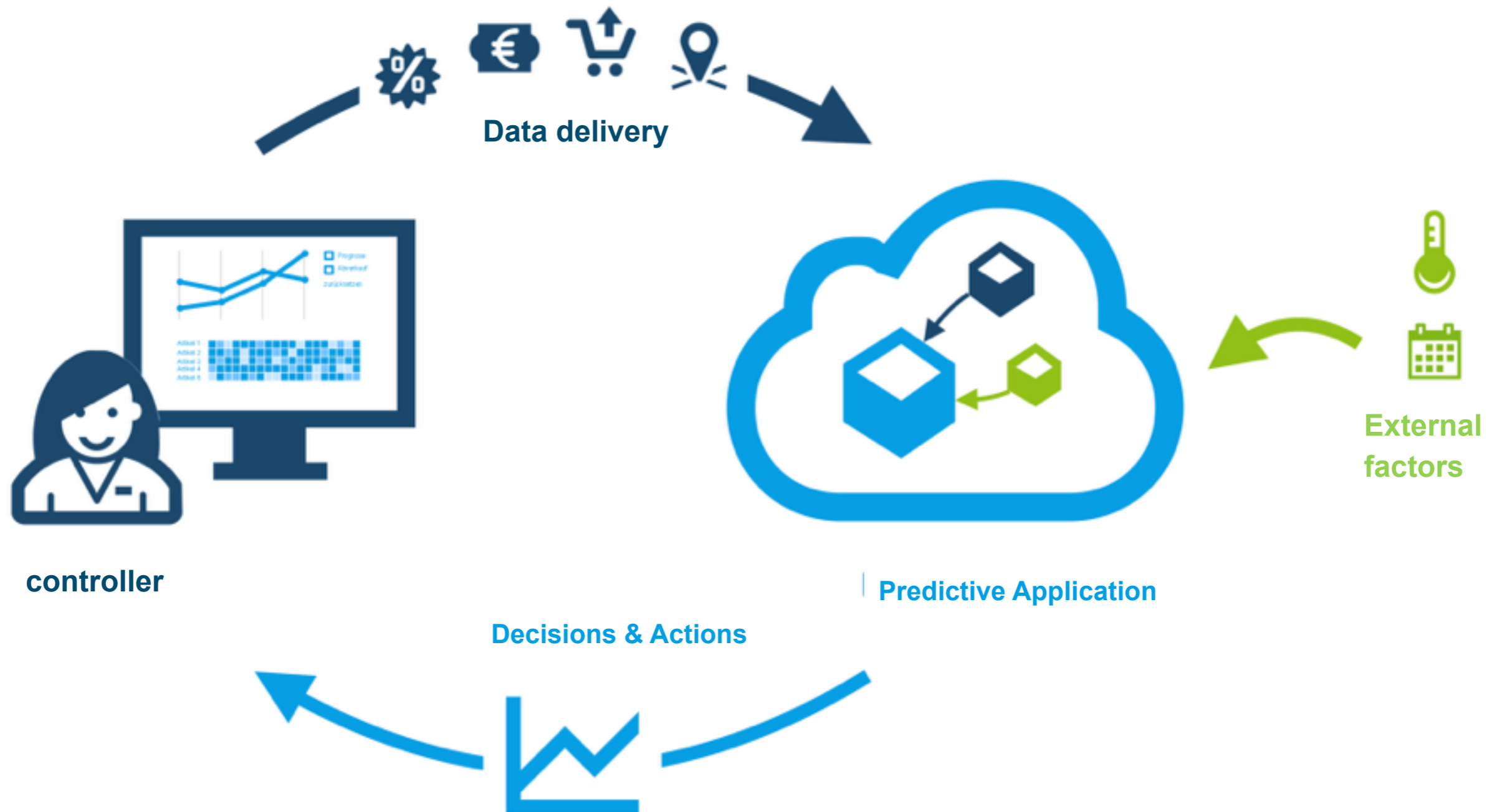
The truth about human decisions….

D. Kahneman
Behavioral Psychologist and Nobel Laureate

Humans are not capable of making statistical and quantitative decisions correctly on a permanent basis. They get frequently deceived.

-- D. Kahneman (Nobel Laureate for Behavioral Economics and author of "Thinking Slow and Fast"

Impact of Decision Automation

— Prescriptive Analytics   — Automated Decisions

5% average Out of Stock Rate

0,5% average Out of Stock Rate
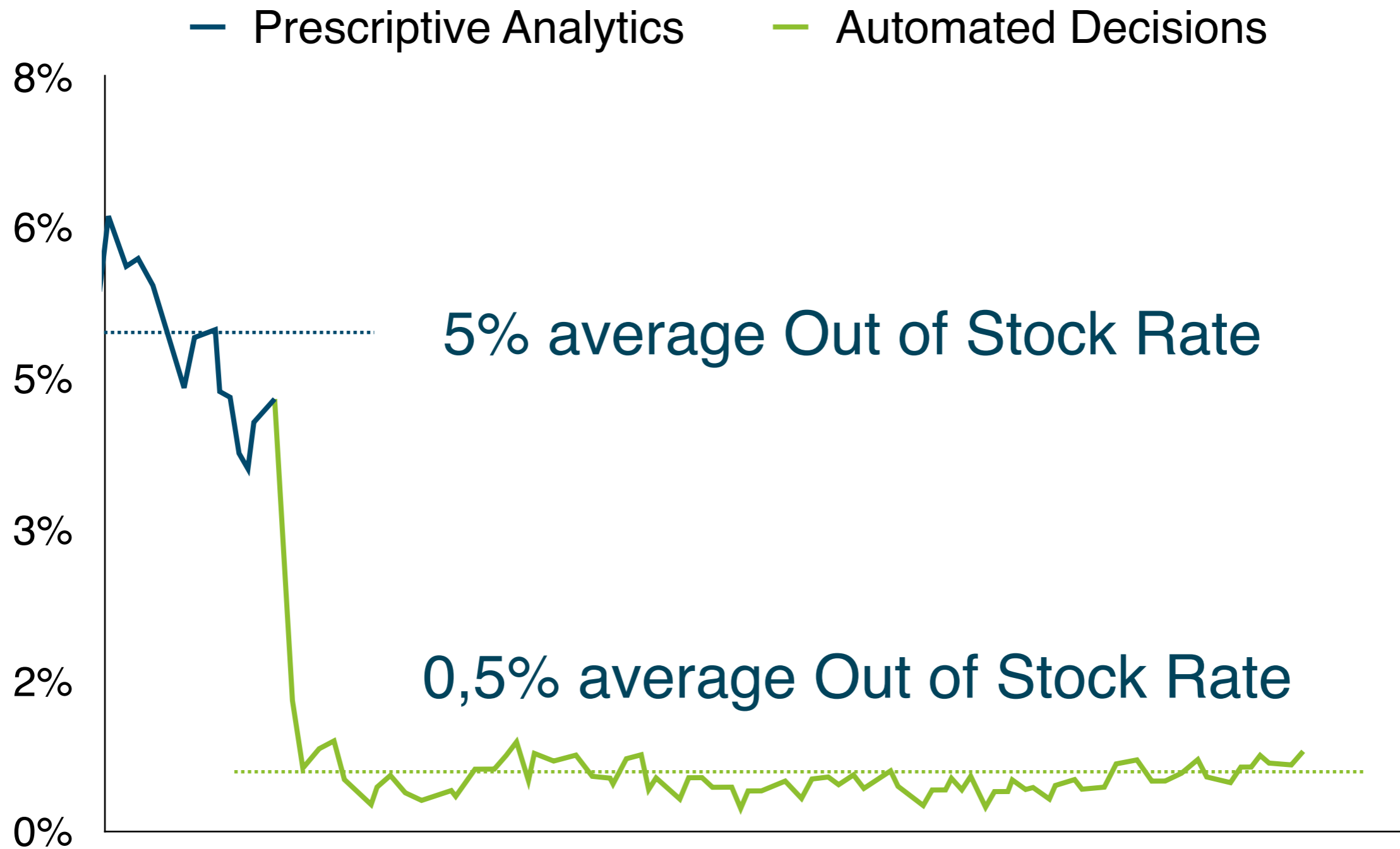
Out of stock rate at a major German supermarket

IoT: Technology Pyramid

Smart Services

Goal of every smart service is to automate decisions based on validated data:

build and derive predictive applications

Big Data Platform

Big data software framework with multiple tasks: collect, combine, predict,

capability that different frameworks can connect

Connectivity

Gateways which allow to connect to the internet wireless or wireline

mastering heterogeneous protocols

Machines Devices

Sector specific devices, often the core business of device manufactures

device centric optimization

Sensors

Tracking the information by using an efficient embedded devices

smaller, faster, cheaper,

source: goetzpartners

Clash of IoT Software Philosophies
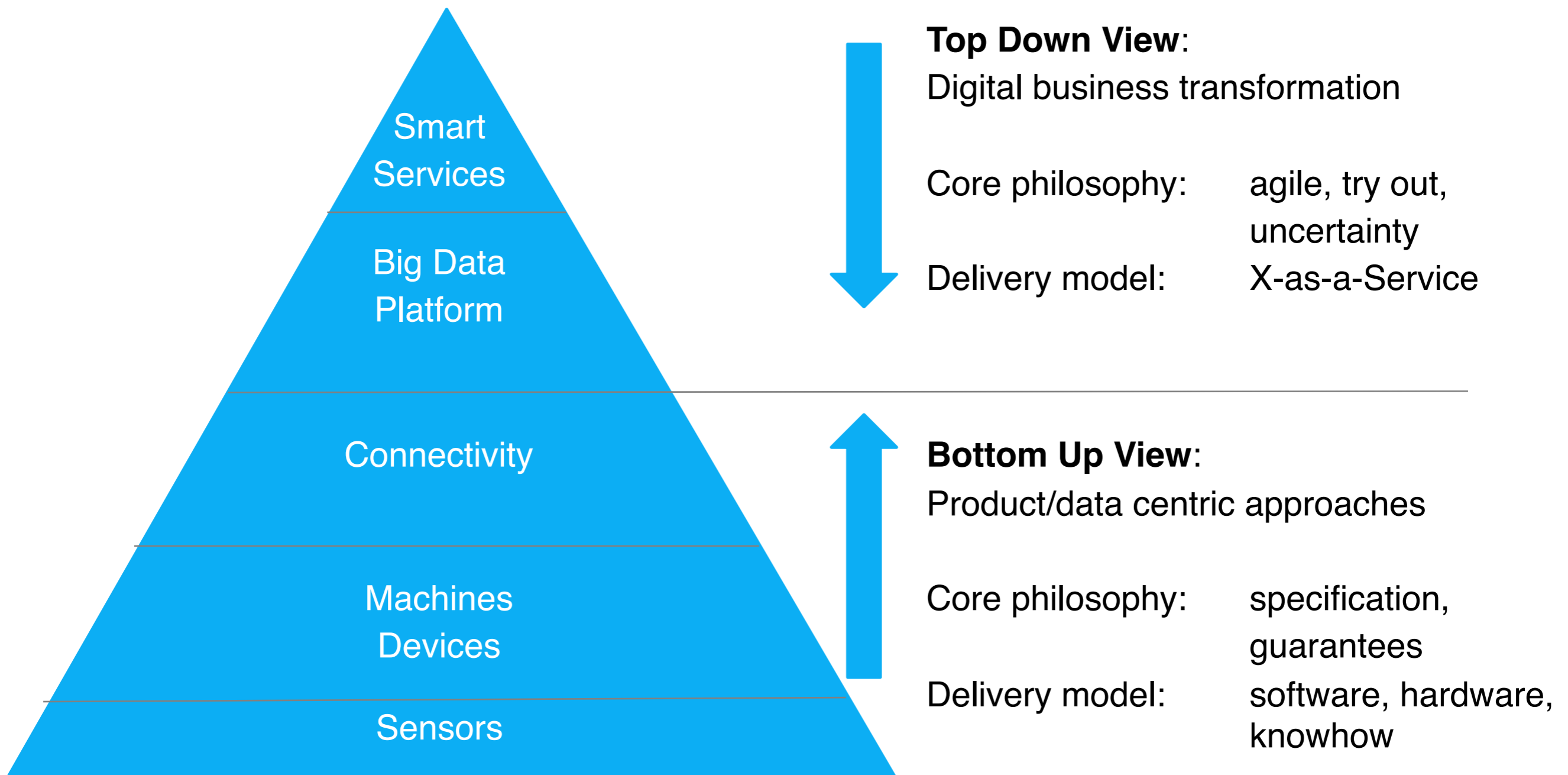
Smart Services

Big Data Platform

Connectivity

Machines Devices

Sensors

Top Down View:
Digital business transformation

Core philosophy: agile, try out, uncertainty

Delivery model: X-as-a-Service

Bottom Up View:
Product/data centric approaches

Core philosophy: specification, guarantees

Delivery model: software, hardware, knowhow

source: goetzpartners

blue yonder

Production line optimisation

iProdict

USE CASE: STEEL PRODUCTION

▶ Complex sensor network exist for quality monitoring: chemical analysis data, quality checks , video streams.

▶ Blue Yonder's predictive process has the task to predict quality fluctuations. Goal is to separate effects which can be optimized and effects which can be predicted.

▶ Long term goal: real time processing.

*Source: www.iprodict.com

Production line optimisation

iProdict

Intelligent Process Prediction
Optimization and control of the steel bar production process at Saarstahl AG. Prediction of expected final steel quality during production process.

Value potential
Avoiding unnecessary processing steps and energy costs for steel with final low quality.

Blue Yonder's contribution
Real-time quality prediction with structured and unstructured data. Data input are preprocessed real-time video data together with process data gathered during production process.

SPONSORED BY THE

Federal Ministry of Education and Research
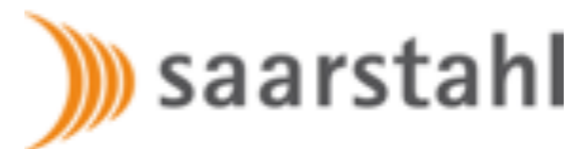
Production line optimisation

iProdict

Title: **iPRODICT**

Intelligent Process Prediction based on Big Data Analytic

Optimization and control of the steel bar production process at Saarstahl AG. For this a real time prediction of quality becomes mandatory with a seamless integration with respect to the deployed business process intelligence
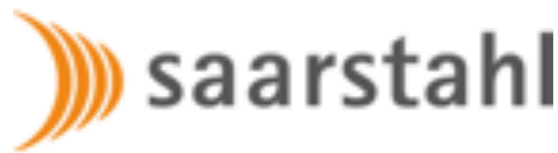
Delivers business use case and data provider

Responsible for integration in business process logic

Real time quality prediction with structured and unstructured data

Project leader and experts in innovative business logic design

Expertise in Big Data infrastructure and analytics

Video pattern recognition preprocessing for input BY

Production line optimisation

SePiA.Pro

 Service Plattform für die intelligente Anlagenoptimierung in der Produktion

"Die intelligente Verwertung von Sensordaten und Auftragsparametern aus modernen Produktionsanlagen stellt eine der größten Herausforderungen im Kontext Industrie 4.0 dar. Ziel des Projekts SePiA.Pro ist die Entwicklung und Erprobung einer standardisierten, offenen, Cloud-basierten Service Plattform. Besagte Plattform erlaubt es kleinen und mittleren Unternehmen, internetbasierte Dienstleistungen, sog. Smart Services, anzubieten und zu nutzen. Diese Dienste haben das Potential, Produktionsprozesse zu optimieren und einen Mehrwert bei allen Beteiligten zu generieren." (Pressemitteilung)
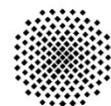
Production line optimisation

SePiA.Pro

Pressemitteilung
21.7.2015

"Smart Service Welt" – Gewinner des Technologiewettbewerbs stehen fest

© Sergey Nivens/Fotolia.com

Das Bundesministerium für Wirtschaft und Energie hat 16 Projekte zur Förderung im Technologieprogramm "Smart Service Welt - Internetbasierte Dienste für die Wirtschaft" ausgewählt. Daran beteiligt sind innovative Unternehmen unterschiedlichster Branchen sowie zahlreiche Forschungsinstitute. Über die Hälfte der Unternehmen sind aus dem Mittelstand. Rund 50 Mio. Euro an Fördermitteln werden aus dem Bundeshaushalt für die Projektförderung und eine Begleitforschung zur Verfügung gestellt. Durch Eigenmittel der Projektpartner erreicht das Programm insgesamt ein Volumen von rund 90 Mio. Euro. Das Thema "Smart Services" ist Teil der "Digitalen Agenda" und der "Hightech-Strategie" der Bundesregierung. Das dem Technologieprogramm "Smart Service Welt" zugrunde liegende Konzept basiert auf Ergebnissen des von der Deutschen Akademie der Technikwissenschaften (acatech) koordinierten Zukunftsprojekts "Internetbasierte Dienste für die Wirtschaft".

Sigmar Gabriel, Bundesminister für Wirtschaft und Energie: "Mit dem Technologieprogramm Smart Service Welt unterstützen wir die Wirtschaft darin, sich für die Zukunft richtig aufzustellen. Die digitale Revolution verlagert Wertschöpfung in rasantem Tempo von den Waren hin zu Service-Plattformen. Daher können internationale Internetakteure auch zunehmend in die klassischen Märkte eindringen. Wenn die deutsche Wirtschaft ihre hochwertigen Produkte durch Smart Services ergänzt, können wir hier gegensteuern und die klassischen Stärken des Standorts Deutschland mit neuen Dienstleistungen so kombinieren, dass wir den 'Kontrollpunkt' zum Kunden in der Hand behalten."

ıe yonder

Production line optimisation

SePiA.Pro

users / customers / vendors

Abstraction layer:
R&D - production
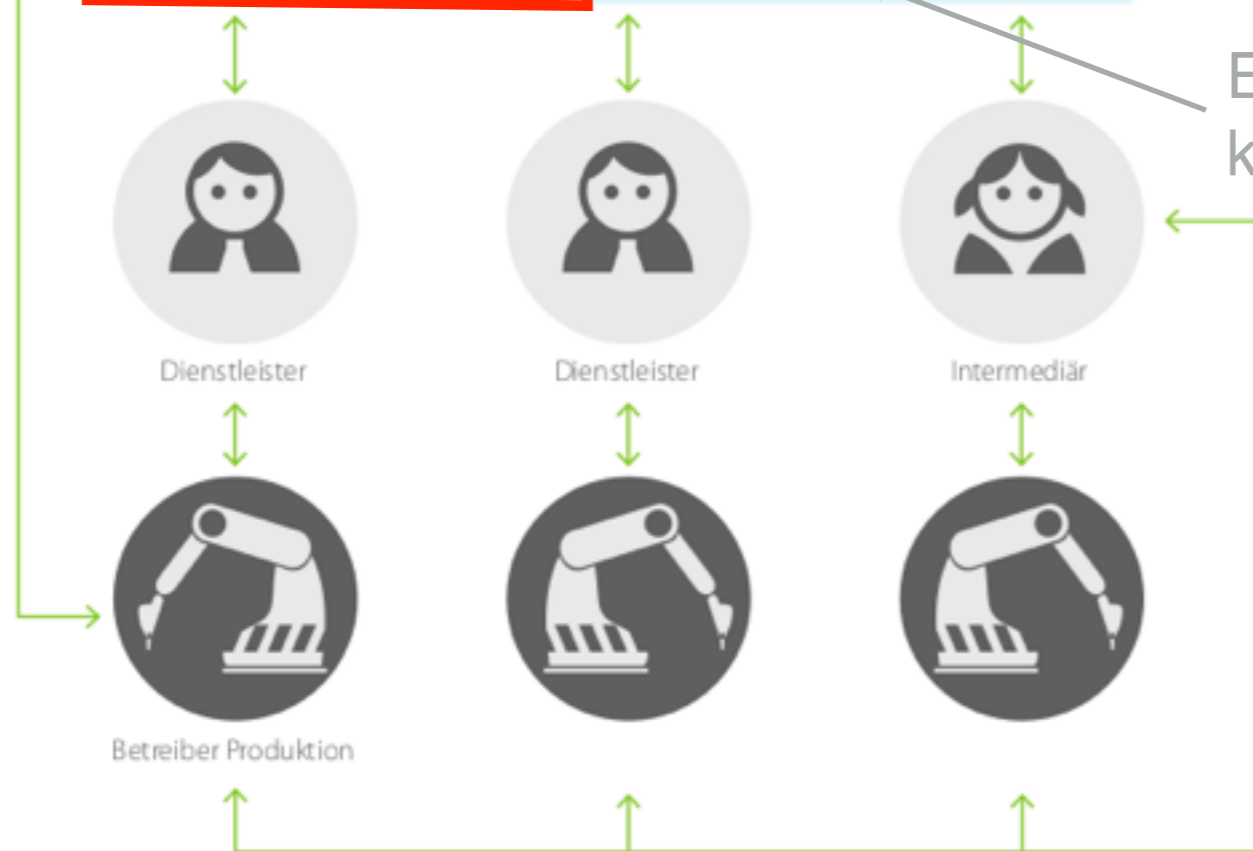
Expert and domain
knowledge

production plant

Industrial
Data Science
Platform

| Wertschöfungsstufe 1 **Zulieferer** | Wertschöfungsstufe 2 **Produzent** | Wertschöfungsstufe 3 **Kunde** |

Industrial Data Service Platform

Industrial Analytics Platform

Smart Prediction Services | **Wissensarbeit & Kollaboration**

Dienstleister

Dienstleister

Intermediär

Betreiber Produktion

Wertschöpfung in der digitalen Welt

Daten, Informtionen

Created by jon trillana from the Noun Project

blue yonder

Spare parts optimisation

USE CASE: SPARE PARTS

▶ Spare parts logistics is a delicate global task and a high degree of automation is very desirable.

▶ Sales histories, stock levels, minimum stock levels, shipment times are available as continuous data.

▶ Challenge is to find the right balance between spare part availability and cost of storage and delivery (for each single item).

▶ Blue Yonder forecasts allow to optimize the optimal order quantity given constraints and risk / cost functions.

Spare parts challenge

"emergency" delivery 50 pcs

"emergency" delivery 100 pcs

Stock vs. Demand pattern of spare part No. 27410924

Legend	
Actual Demand	
Stock (BoM)	
Stock(EoM)	

stock filled up to 200 pcs

delivery of 150 pcs

delivery of 120 pcs

delivery of 200 pcs

shipment lead time
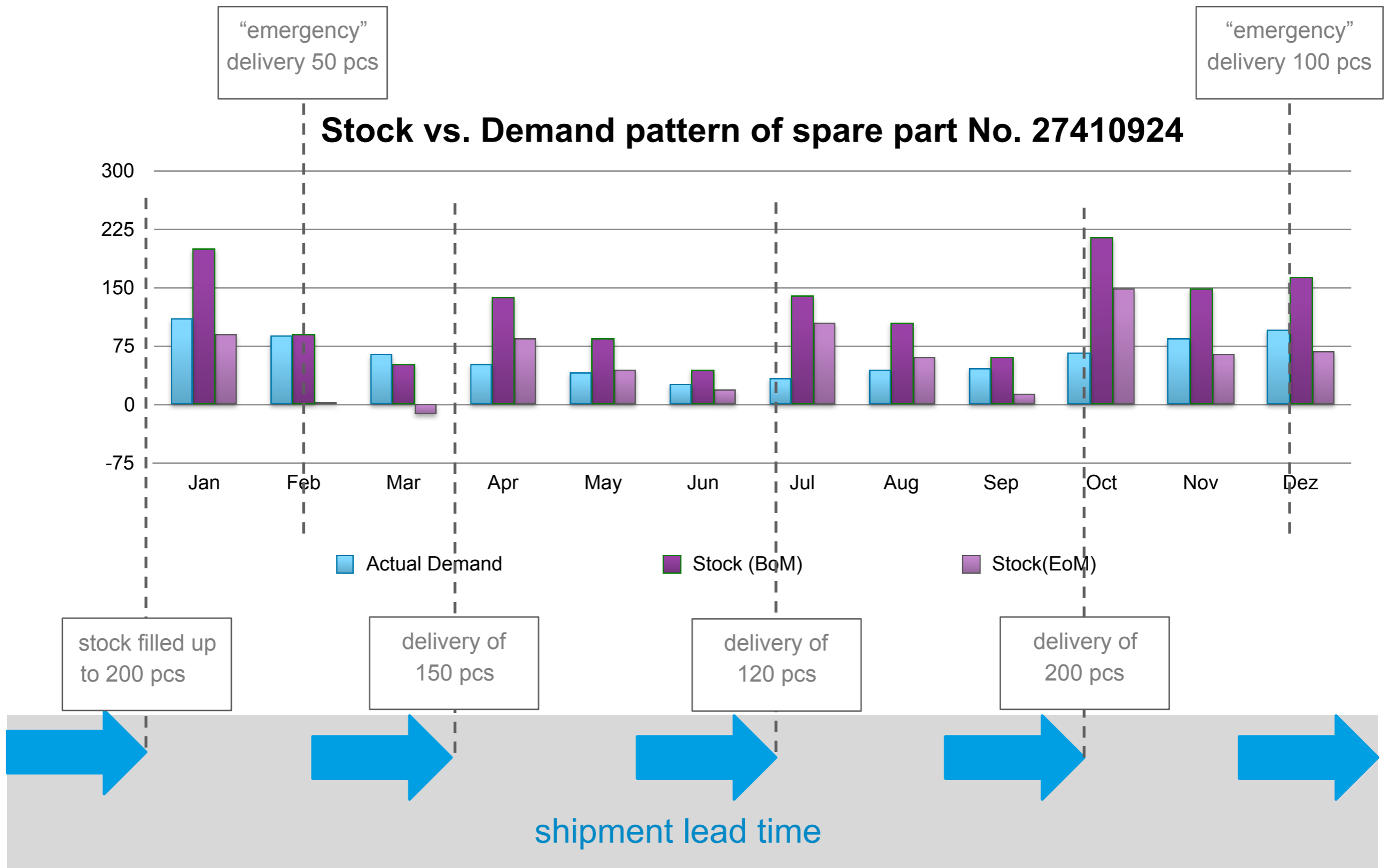
Spare parts challenge
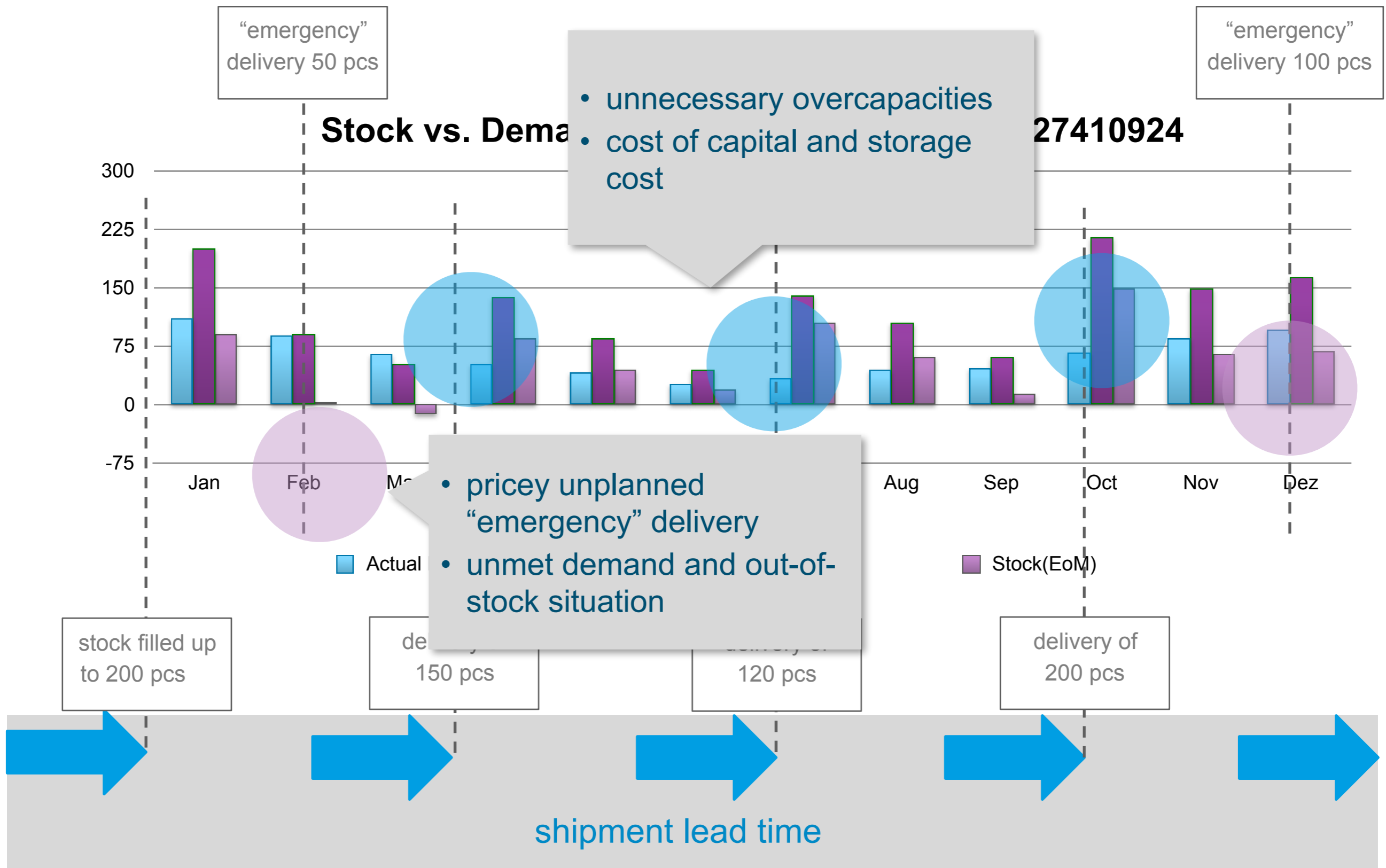
Holistic optimisation

Blue Yonder Forecast

optimal order quantity given
- cost function
- probability distribution

Median

Mean

5%-Quantile

95%-Quantile

Sales in pcs

0   10   20   30   40   50   60   70   80
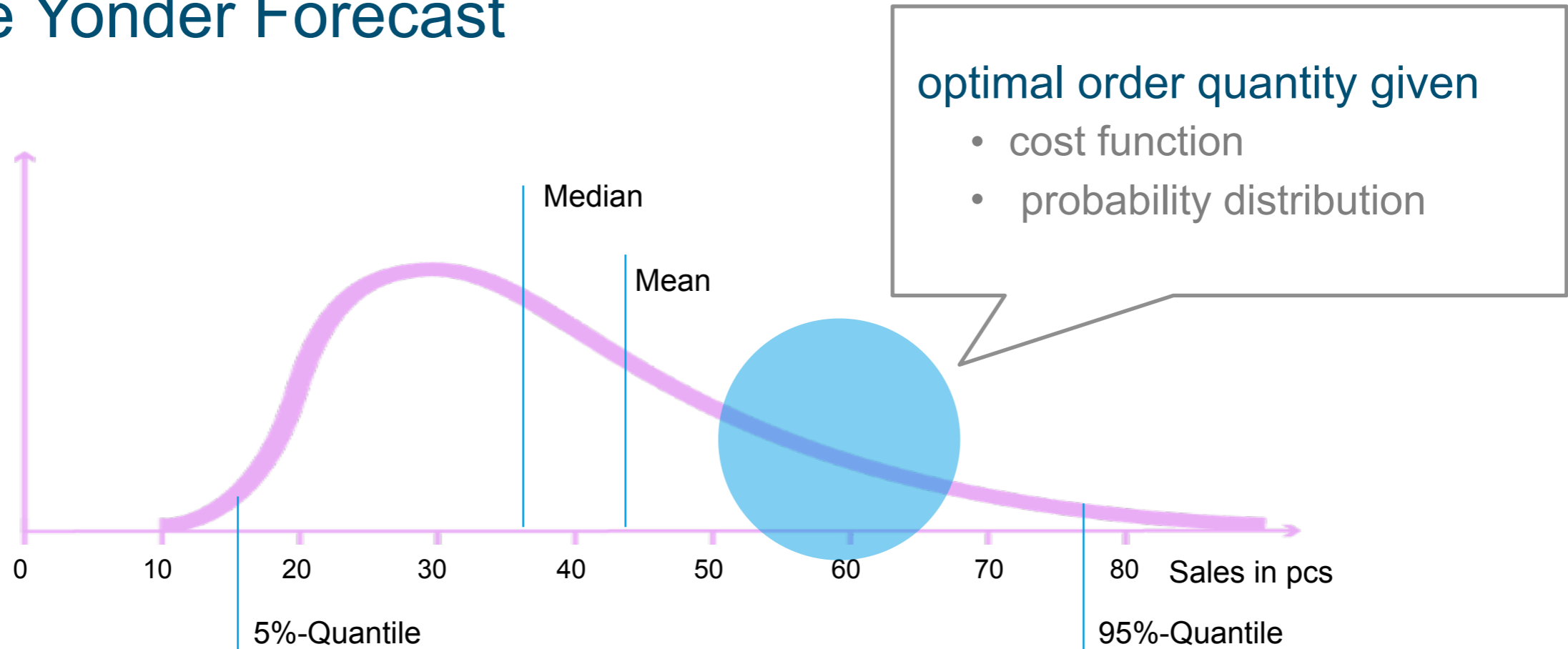
Asymmetric Cost Function

Cost of Storage	Cost of Capital	Emergency Deliveries	Reputation loss
warehouse cost, expiry date	per piece and interest rate	per piece / minimum order quantity	not quantified

Holistic optimisation

The different point estimates of the probability density

Forecasted expected value: number of pieces, which is sold on average

Median

Mean

But a lot of days with higher sales

0 10 20 30 40 50 60 70 80 Sales in pcs

5%-Quantile

95%-Quantile

Quantity that needs to be kept in stock, so that the out-of-stock rate of products is not more than 5%
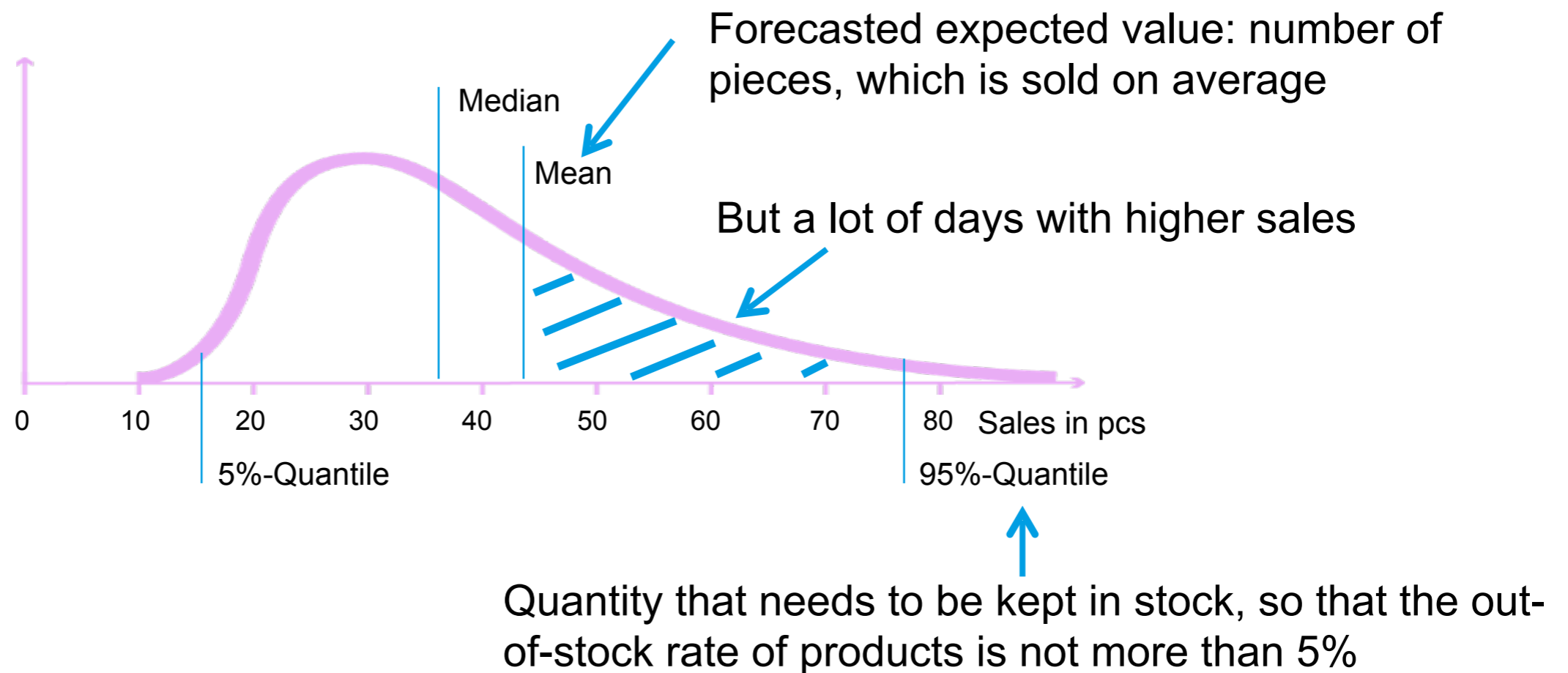
for a single item and a predefined time-horizon

Spare parts challenge with Blue Yonder predictions

Stock vs. Demand pattern of spare part No. 27410924 with BY suggestions

Legend: ■ Actual Demand   ■ Stock (BoM)   ■ Stock(EoM)

stock filled up to 270 pcs

delivery of 120 pcs

delivery of 120 pcs

delivery of 250 pcs

shipment lead time
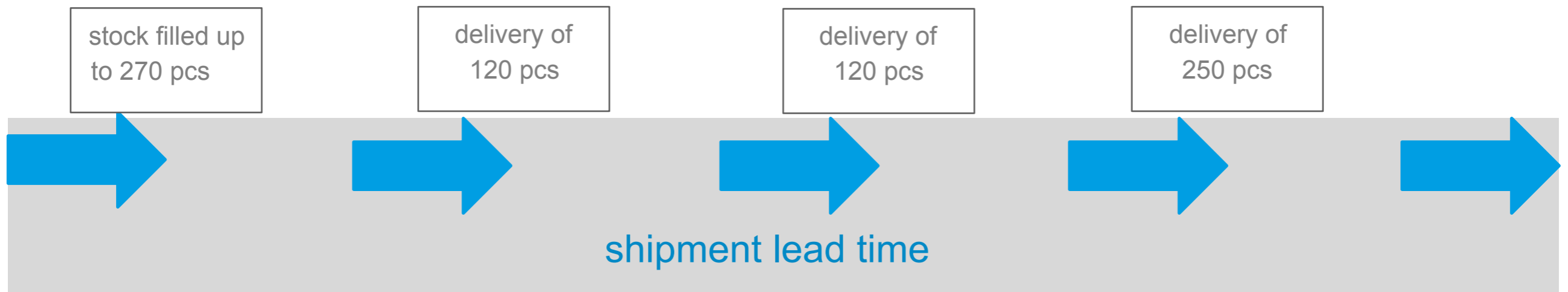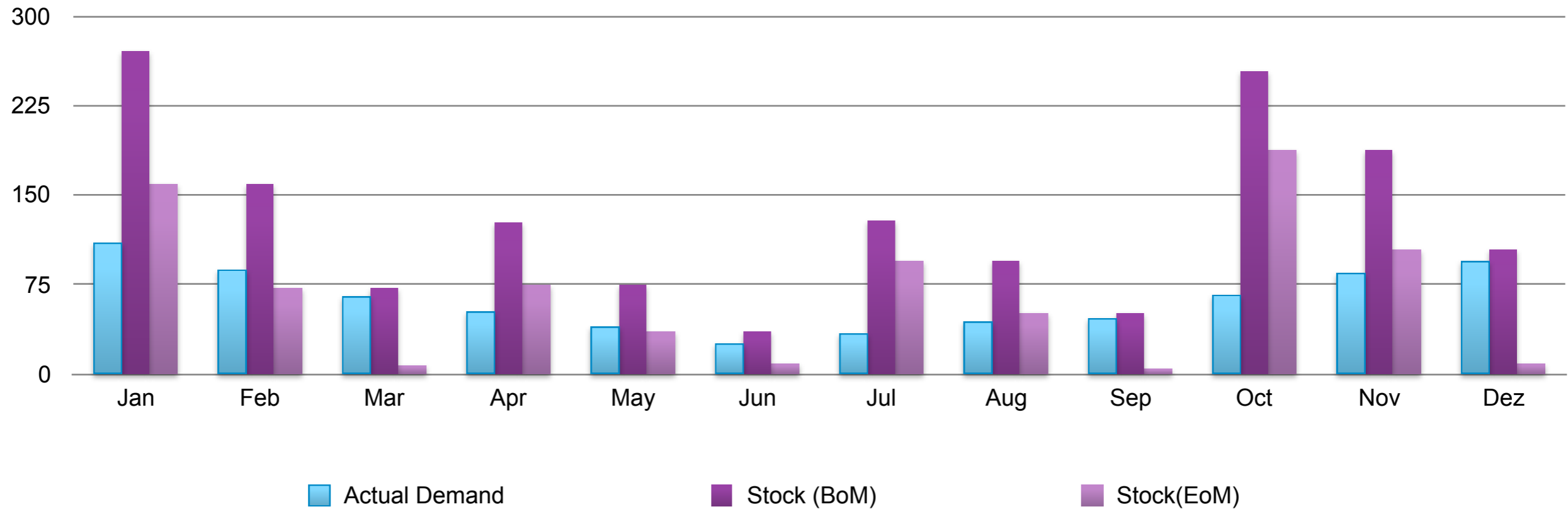
Example: Gas turbines

Scenario Description

► Gas turbines burn a lot of fuel during start up

► Start ups are not always successful

► Several conditions influence gas turbine operations

► Hundreds of sensor data available

► Most sensor data is not useful or redundant
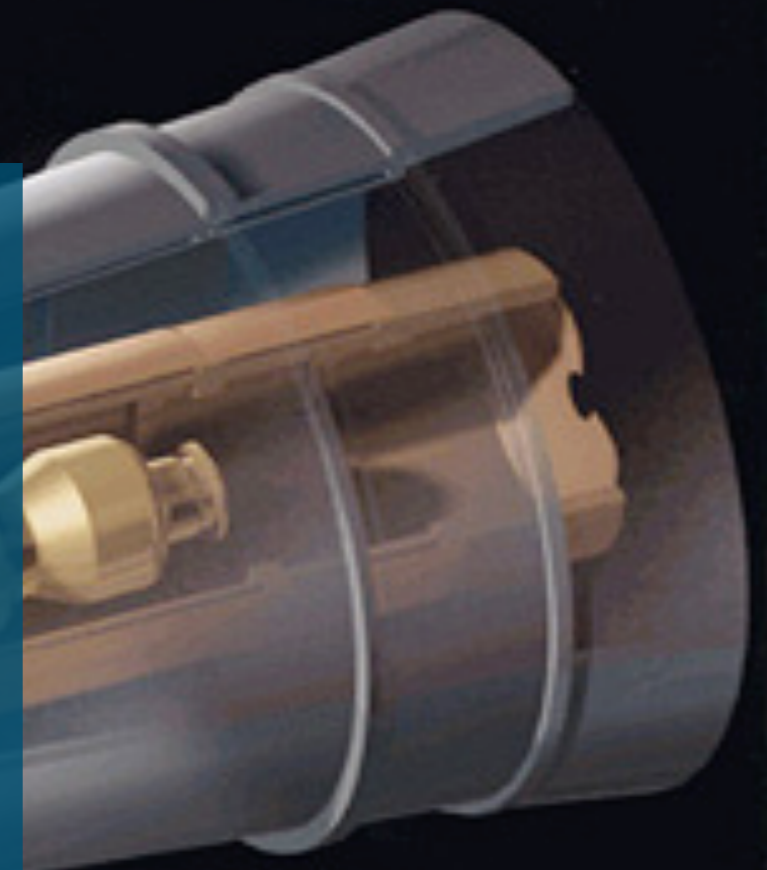
Engagement Model: Sensor Data

5 work packages

Step

| Requirements / Kickoff | Data cleansing / Sensor scoping | Statistical Analysis | Fleet bench-marking | Sensor importance assessment | Initial predictive application | Prepare for roll-out |

Detail

Understand exactly what problem the organisation is trying to address with predictive analytics and whether predictive analytics can aid	Define which sensor data can be extracted from the organisation's systems. Support IT in creating the extract and ensure data quality .	Statistical analysis to identify data quality. Gain deep data understanding and develop data stories.	Comparison across fleet members and identification of diversity and predictability of certain targets.	Key for predictive applications is the proper handling of sensor data. Sensor data have to be ordered and analysed with respect to impact and significance.	Build predictive models based on problem definitions and sensor data. Leverage domain expertise to optimize business case.	Define next steps to establish a continous predictive service. Find additional and related predictive application use cases.

Outputs

- Signed requirements document
- Business case hypothesis

- Data definition specification
- Data extract

- Quality and feasibility insights
- Data stories

- Identify diversity of the fleet

- Ranking of mandatory sensors

- Predictive analysis
- Business Case validation

- Strategy proposal
- Execution roadmap

Data Cleansing / Sensor Scoping

Data Cleansing

- Harmonize data representation (sensor metadata and engine metadata)
- Treat typical data challenges (missing values, outliers, wrong values)

Sensor Scoping

- Verify identical sensors / labels validity across engines
- Define events, triggers, decision-points, i.e. defined observation/target events
- Map to comparable time steps (e.g. 5 minutes) and frequencies

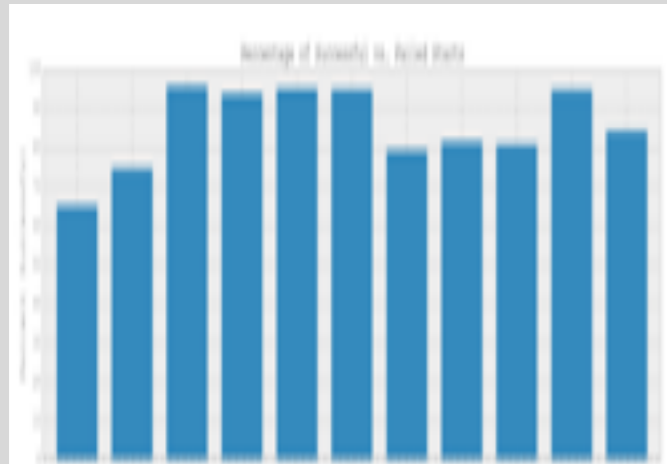Data foundation to work with: Smart data instead of big data

Analytics

descriptive analytics
discover the right drivers for ROI

predictive analytics
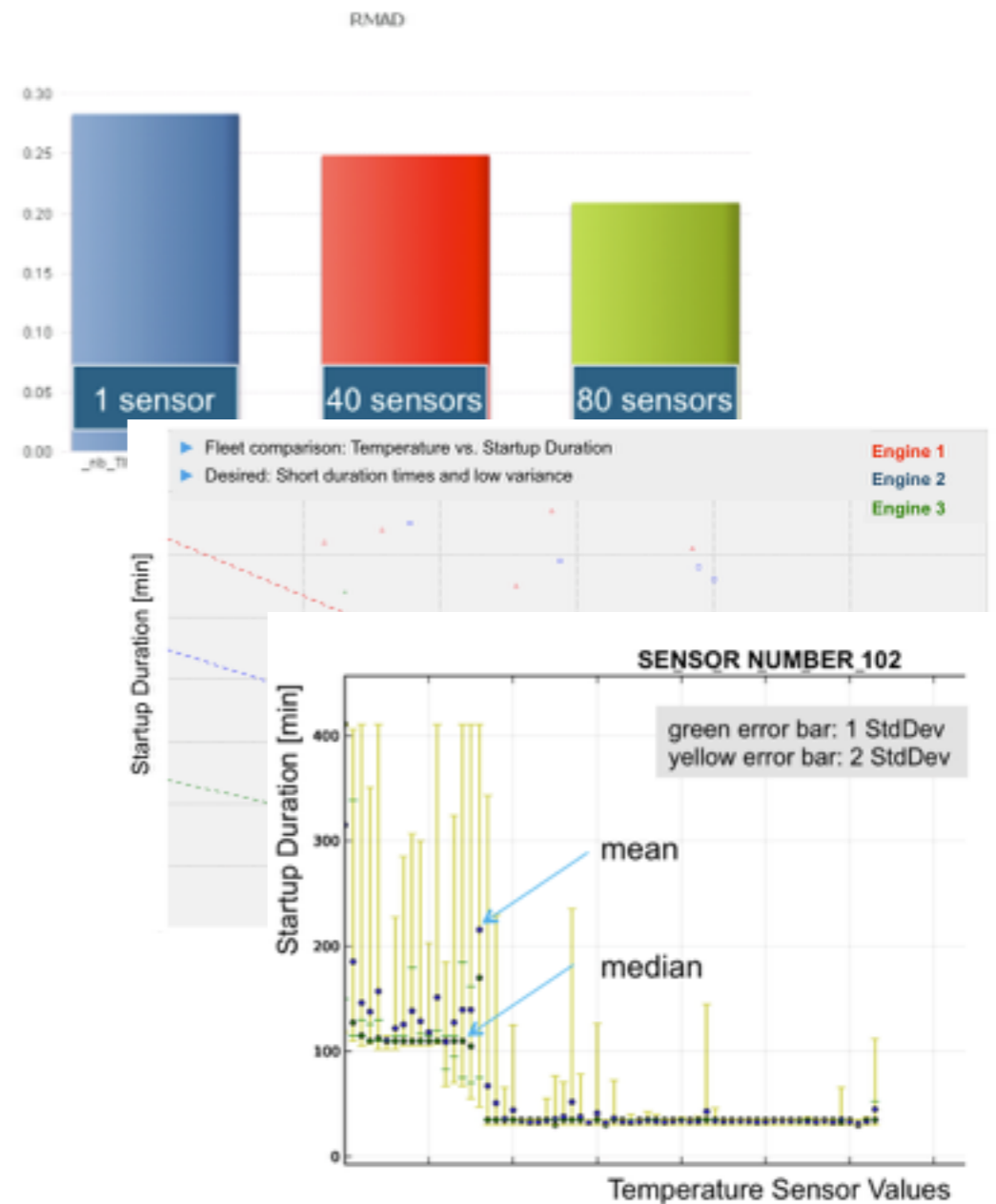valuable action suggestions

% successful startups

% cold/warm/hot startups

engines

Business impact

Optimize startup fuel efficiency by		2.5	%
Savings/yr	1 Turbine	10,229	Euro
	Fleet	1,022,853	Euro

Number of turbines in fleet	100	turbines
Avg. starts/yr	80	starts/yr
Avg. fuel/start (to MSL)	40,000	kg/start
Avg. start fuel/yr per turbine	3,200,000	kg/yr
Fleet avg. start fuel/yr	320,000,000	kg/yr
Natural Gas fuel heating value	45	MJ/kg
	0.043	mmbtu/kg
Price	3	Euro/mmbtu
Avg. cost start fuel/yr per turbine	409,141	Euro/yr
Fleet avg. cost start fuel/yr	40,914,128	Euro/yr

Predictive Applications on a chip

The next frontier:

Require decision every 5 ns, whether data is important enough to be read out to a computer
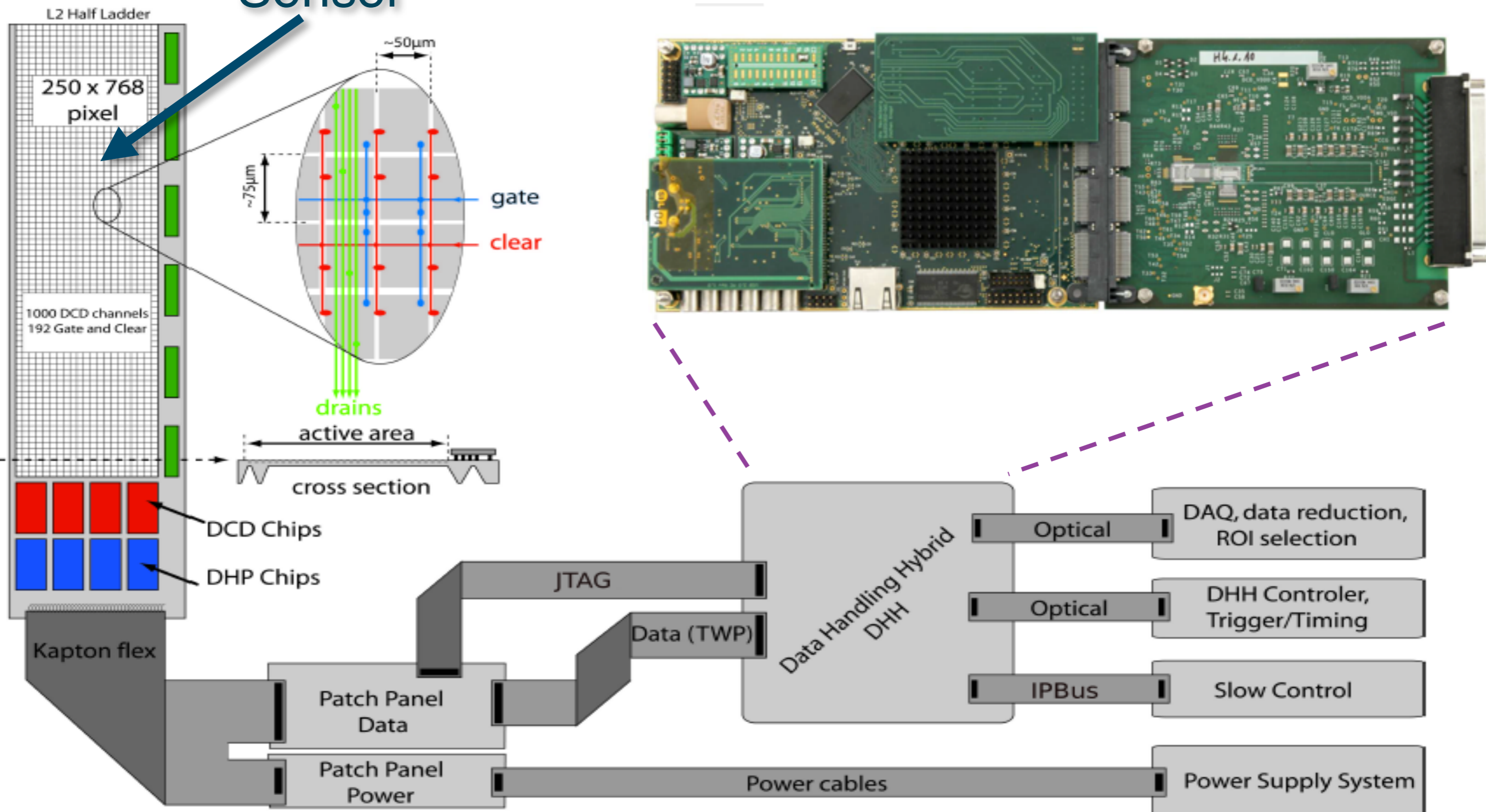
NeuroBayesExpert@Hardware - Chip

R&D: KIT / Blue Yonder:

First massively parallel
NeuroBayes-Hardware-Implementation
runs with 2 billion decisions per second!

Predictive Applications on a chip:
Decide before data can be processed by computers

Sensor

L2 Half Ladder

250 x 768 pixel

1000 DCD channels
192 Gate and Clear

~50μm

~75μm

gate

clear

drains

active area

cross section

DCD Chips

DHP Chips

Kapton flex

JTAG

Data (TWP)

Patch Panel Data

Patch Panel Power

Data Handling Hybrid DHH

Optical

Optical

IPBus

Power cables

DAQ, data reduction, ROI selection

DHH Controler, Trigger/Timing

Slow Control

Power Supply System

Platform Engagement with Industry Clients

Blue Yonder

scientific excellence

blue yonder
Data Science Experts
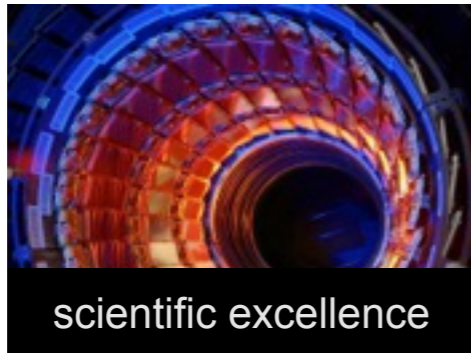
DATA SCIENCE
A C A D E M Y

BY Data Science Platform

Infrastructure
- ▶ secure
- ▶ high availability
- ▶ fast
- ▶ (hosted in Germany)

joint development
- ▶ BY data scientists
- ▶ Client data scientists
- ▶ modern development stack
- ▶ predictive applications

operations
- ▶ predictions as a service
- ▶ performance monitoring
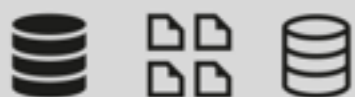- ▶ model improvements
- ▶ different SLAs

Platform Client

Data

Data Scientists

Subject Matter Experts
Business Owners

Blue Yonder Platform

Flex Storage
Relational, Flat File and In-Memory Storage Service

Auto APIs
RESTful APIs for easy integration and data access

Job Control & ML Toolkit
Pluggable machine learning pipelines

Application Runtime
HTML5 based Web UI and API Builder

Data Services
Public data prepared for machine learning

Multi-Tenant Runtime Environment

Secure Micro Cloud Infrastructure

BY Platform for industry

All in-one platform

Joint Development

Machine Data

one platform for
- ▶ data collection
- ▶ processing
- ▶ decisions

- ▶ batch/streaming
- ▶ proprietary algorithms

joint development
- ▶ BY data scientists
- ▶ client know-how
- ▶ scalable apps

- ▶ combine the best of both worlds

customized solutions
- ▶ broad set of customizable functionality
- ▶ steady development and adjusting to client needs
- ▶ industry focus

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