FH | JOANNEUM
University of Applied Sciences

WARUM SIND KÜNSTLICHE INTELLIGENZ UND SERVICE ENGINEERING UNSERE ZUKUNFT?

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CURRENT SITUATION

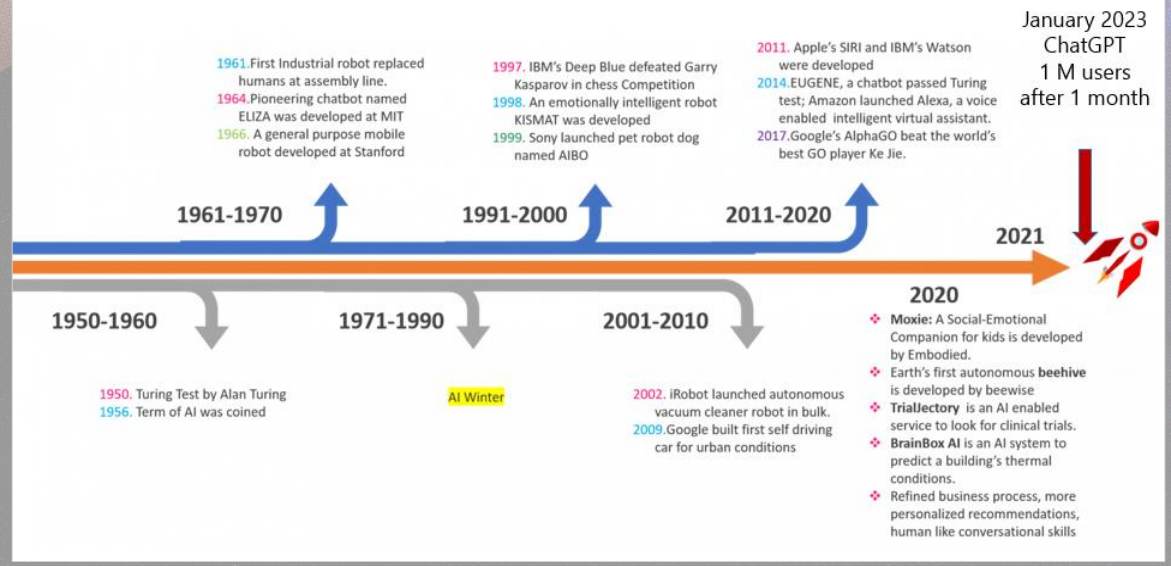
AGEING ASSETS	SHRINKING WORKFORCE	MARGIN PRESSUE
Underperforming asset utilization	2.4 M production jobs out of 16 M will not be filled in the USA in 2028 Source: Deloitte	EBITDA declined from 11.2% in 2015 to 8.6% in 2018 Source: Forbes

SERVICES MATURITY MATRIX

Input / Performance focused	product related	functional service
Performance focused	Measure productivity by sensors Vendor managed spares Design breakage out Leasing	Result oriented Numbers of cars painted Power by the hour Compressed air by the hour Energy per hour
Input	Productlife cycle Parts & labor	Use oriented DHL cold chain Zn revenue in real time Hilti BIM building information

Uniqueness →

AI FROM REVOLUTIONARY TO FOUNDATIONAL



SMART ASSET BEISPIEL – KRANHERSTELLER

SMART SOFTWARE STATT TEURER SENSOREN

1 ZIEL

Vorhersage der Alterung von Getriebeöl & Vermeidung von Schaden am Getriebe

2 AUSGANGSLAGE

Verschiedene Hersteller, ~ 30 Parameter, Offline Labortests ~ 50 € Sensor für ~ 2000 €

3 SF PLATTFORM

Daten: OPC UA & MQTT
Datenmanagement mit inkrementeller Anpassung
Basic Analytics von Viskosität, Permittivität, Durchlässigkeit, Feuchtigkeit, etc.

4 ML & AI LÖSUNG

SW statt teurer Ölalterungssensoren
ARIMA zur Vorhersage von Feuchtigkeit & Viskosität
Wavelets zur Vorhersage der Getriebealterung

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Source: Deloitte

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VALUE CREATION TRHOUGH AI & ML

LESS DOWNTIME	BETTER DESIGN	BETTER SERVICE	NEW BUSINESS MODELS
			
CBM Benchmarking Predictive Maintenance	Overengineerung Design errors Learn from Better user experience	Proactive Service Less spare parts Customer complaint Remote installation Root cause analysis	Automation Pay per use

FROM SELLING TO SERVING

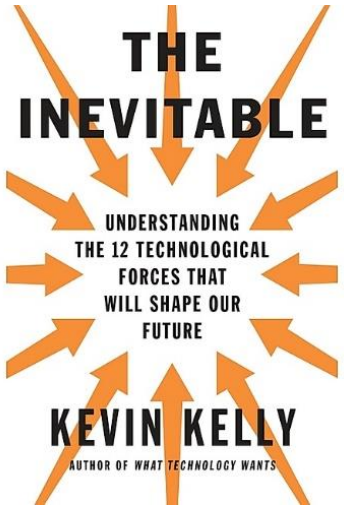
/ Products become services
- **Uber, Gropius, Kuenz, BASF**

→*reduce risk*

/ Everything requires maintenance
- Endless upgrades

/ Objects become partners

/ AI will help us to serve & improve
- The Inevitable by Kevin Kelly



WHY SERVICES

/ More resilient

- 2008 -> 2009 55% less orders in manufacturing vs. 20% less for services

/ Hardware + software bigger market cap

- Apple, IBM, CISCO
- Tesla: create value from generated data
- ***> 5% of EBIT attributable to AI -*** 22% of respondents in McKinsey The state of AI in 2020
- AI adoption is 24% within the product- or service-development & service-operations functions

/ Own product lifcycle → align design and maintenance

- Design maintenance issues out
- Closer to the customer → Understand how customer harvests value

/ Increased asset productivity

- Incentives are aligned

/ Solution locks competition out

SERVICES MATURITY MATRIX

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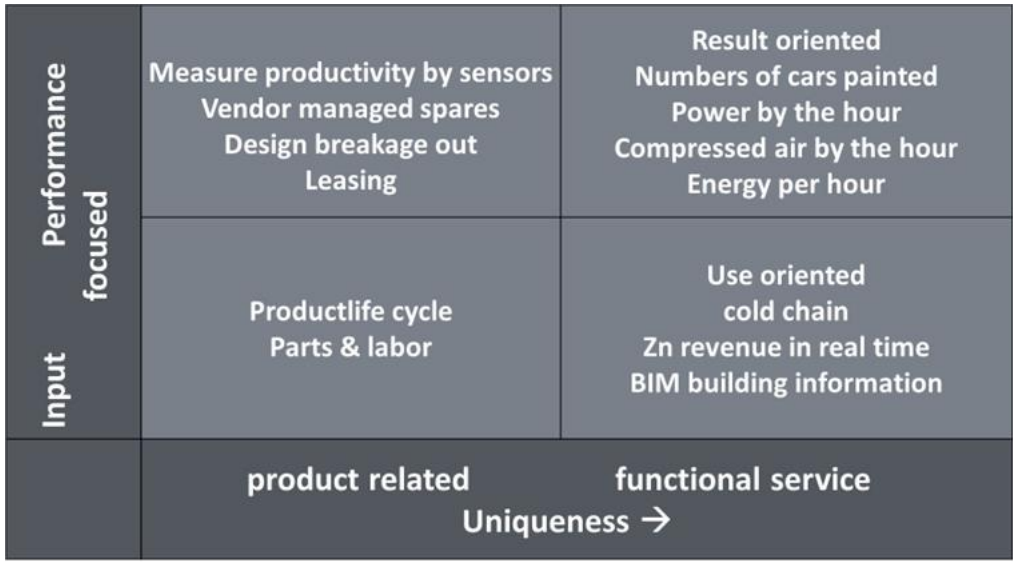
Uniqueness →

EXAMPLE ROLLS ROYCE



/ Sell engine power per hour
  - $1 engine → $7 repair maintenance

/ From data to value
  - Gather the data → add sensors & connectivity (satellite)
  - Create value with analytics, AI & ML

  → predictive maintenance & schedule optimization

/ Design improvement → less failures

/ Process enhancement → global scale
  - Offer engineer on premise

/ Asset productivity 99,9% uptime

EXAMPLES OF SOLUTIONS

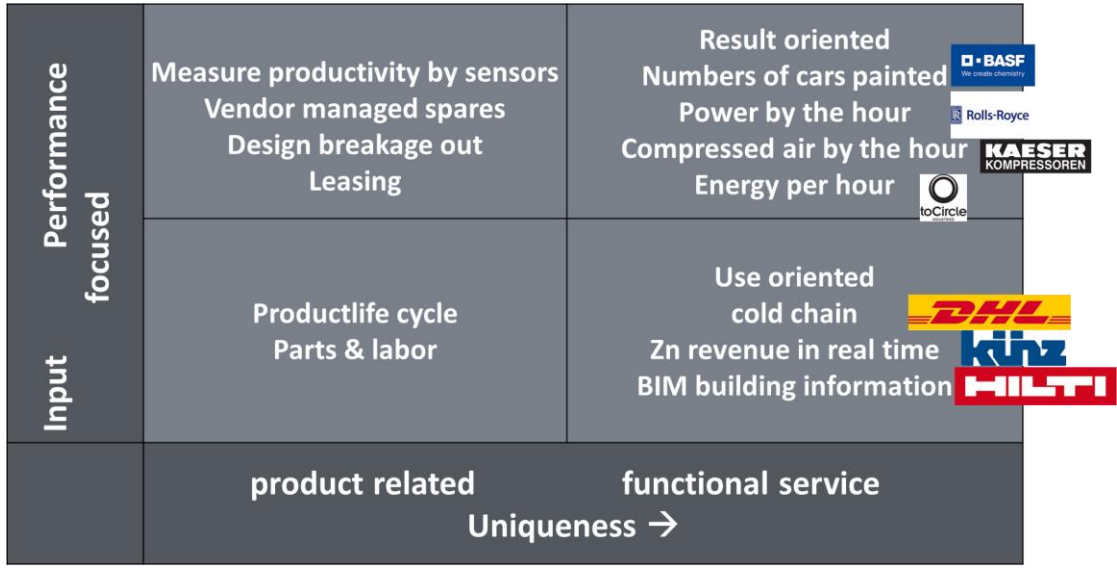
/ Rolls Royce
- Power by the hour

/ BASF
- Painted cars

/ Dow-Dupont
- Fructose per kg enzyme

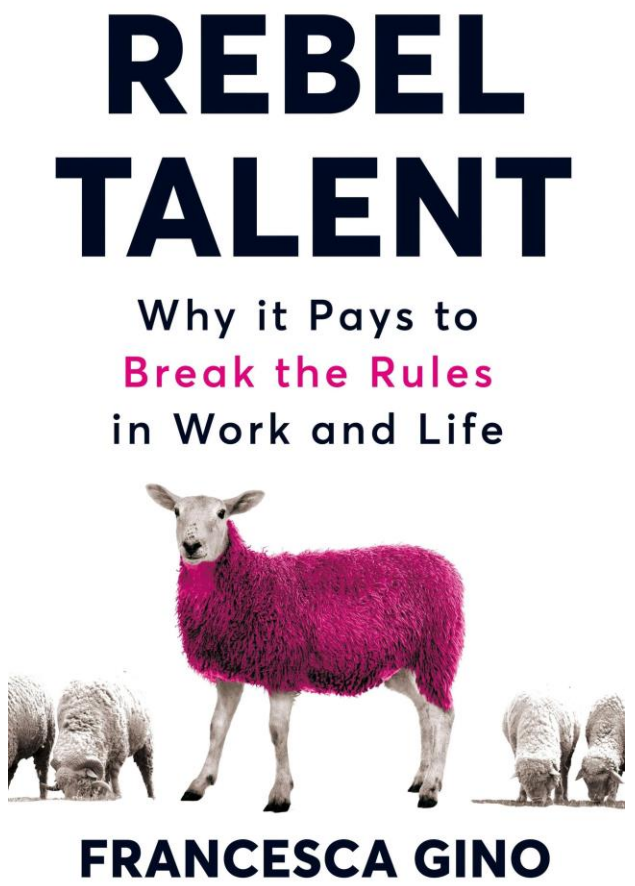
/ Hilti
- Construction solution with BIM (building information modeling)

/ Kuenz
- Containers moved per hour
- Revenue per hour for Zn producer



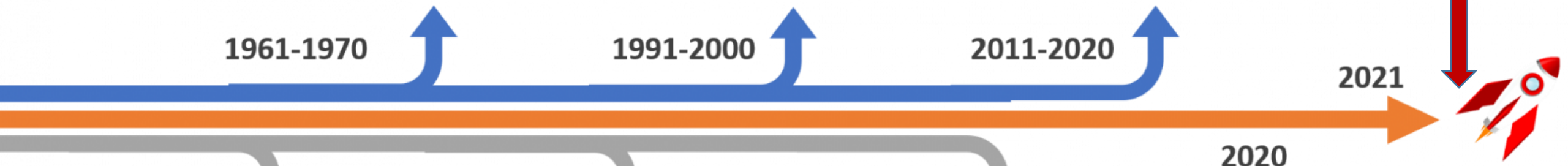
INNOVATION

Innovation is not focusing on the loss due to change, but realizing the opportunity in front of us



AI FROM REVOLUTIONARY TO FOUNDATIONAL

January 2023
ChatGPT
1 M users
after 1 month



1961-1970

1961.First Industrial robot replaced humans at assembly line.
1964.Pioneering chatbot named ELIZA was developed at MIT
1966. A general purpose mobile robot developed at Stanford

1991-2000

1997. IBM's Deep Blue defeated Garry Kasparov in chess Competition
1998. An emotionally intelligent robot KISMAT was developed
1999. Sony launched pet robot dog named AIBO

2011-2020

2011. Apple's SIRI and IBM's Watson were developed
2014.EUGENE, a chatbot passed Turing test; Amazon launched Alexa, a voice enabled intelligent virtual assistant.
2017.Google's AlphaGO beat the world's best GO player Ke Jie.

2021

2020

- **Moxie:** A Social-Emotional Companion for kids is developed by Embodied.
- Earth's first autonomous **beehive** is developed by beewise
- **TrialJectory** is an AI enabled service to look for clinical trials.
- **BrainBox AI** is an AI system to predict a building's thermal conditions.
- Refined business process, more personalized recommendations, human like conversational skills

1950-1960

1950. Turing Test by Alan Turing
1956. Term of AI was coined

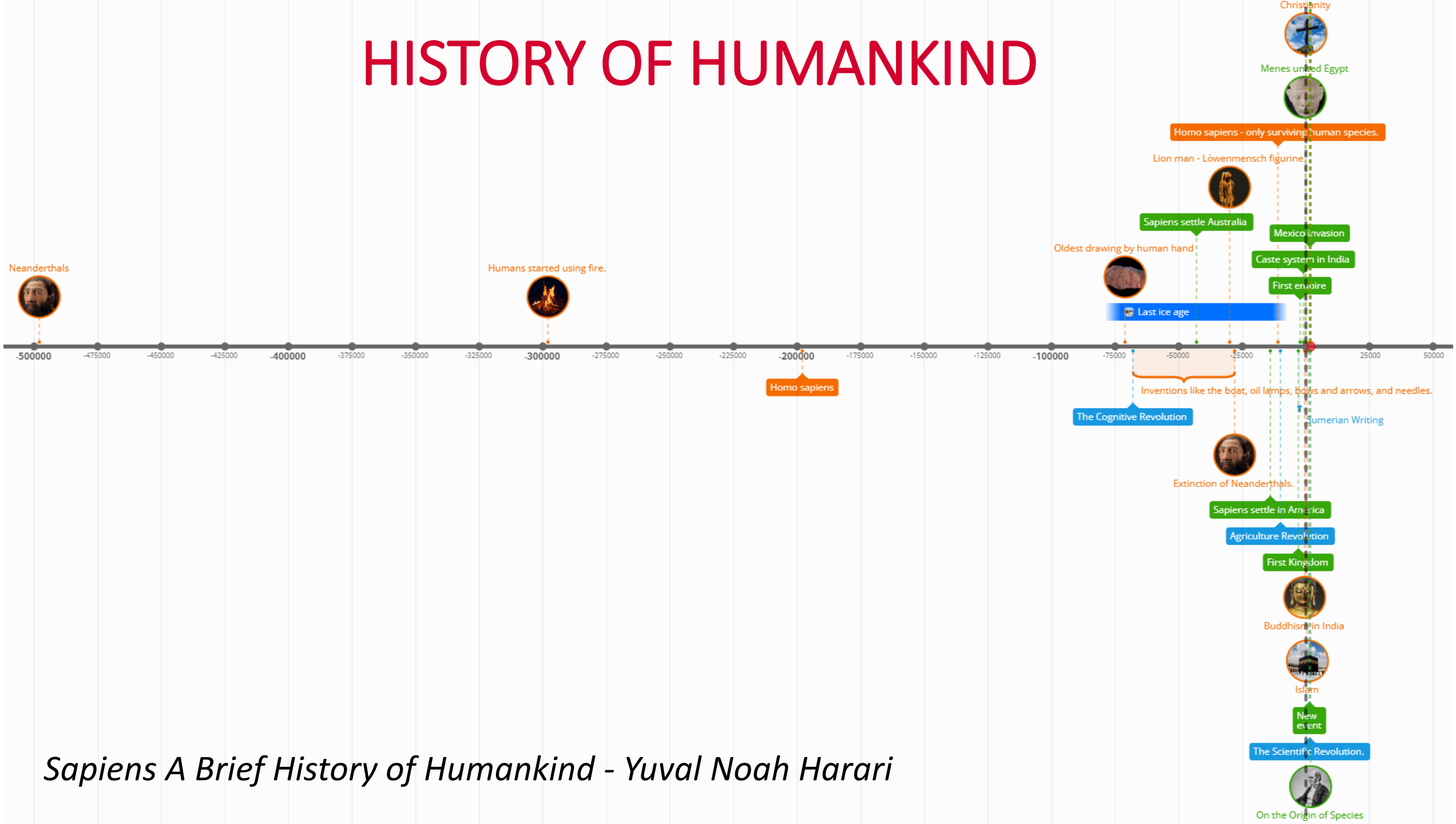
1971-1990

AI Winter

2001-2010

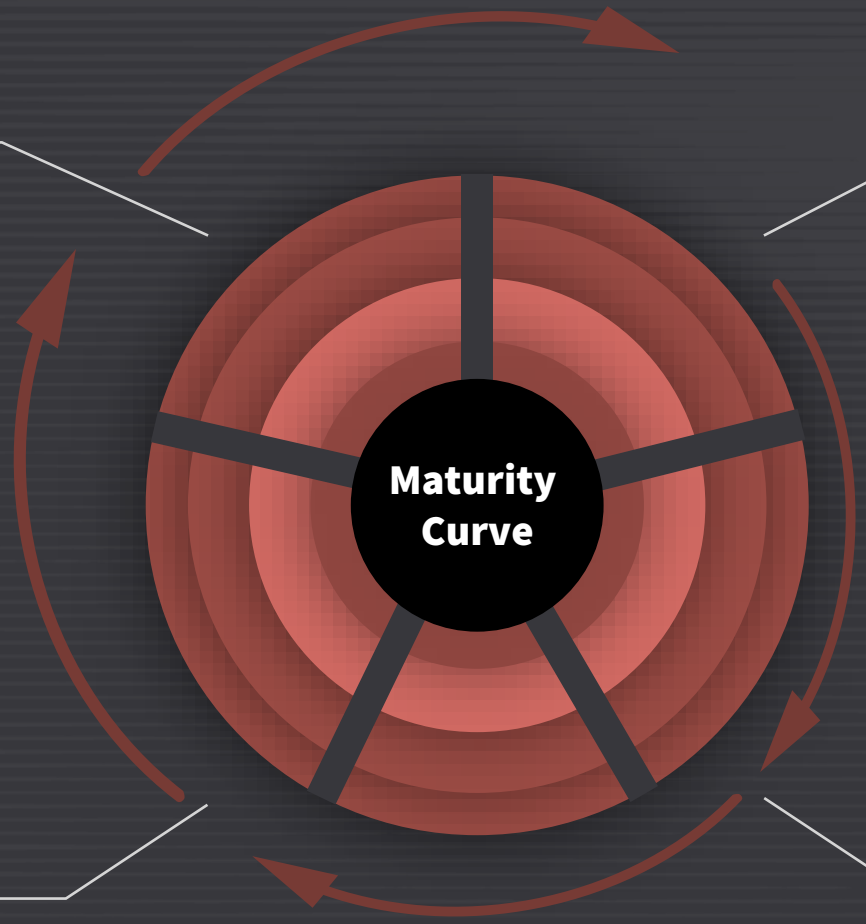
2002. iRobot launched autonomous vacuum cleaner robot in bulk.
2009.Google built first self driving car for urban conditions

HISTORY OF HUMANKIND



Sapiens A Brief History of Humankind - Yuval Noah Harari

AI/ML MATURITY CURVE



New Business Modell

Remote Access

Applications

Data Analytics
Predictive Maintenance
Condition Monitoring
Machine Learning/Teaching

Monitoring

Visualization
Alarm Management

Big Data

Data Collection
Data Storage

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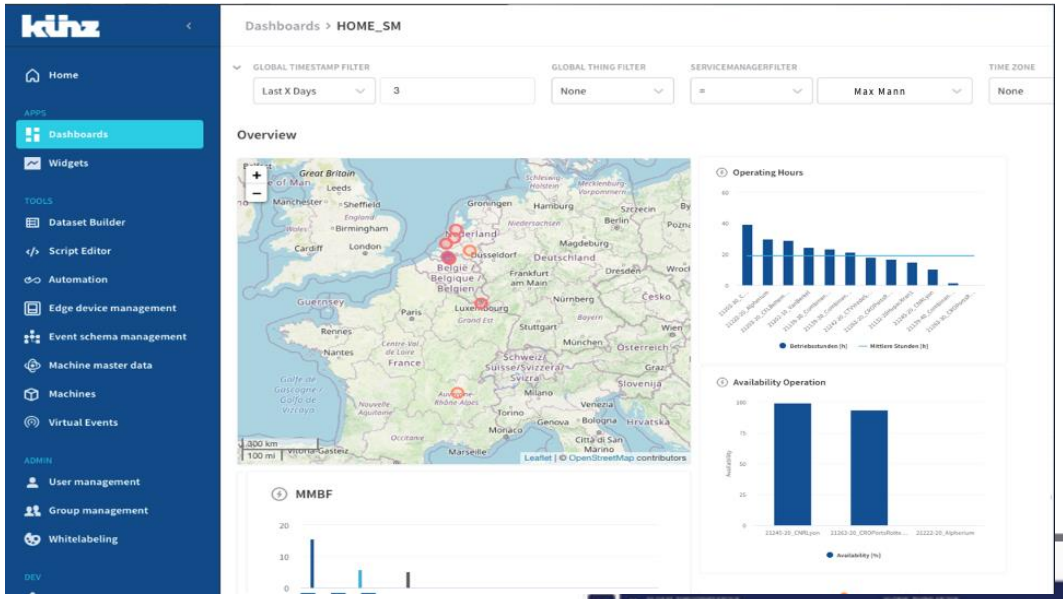
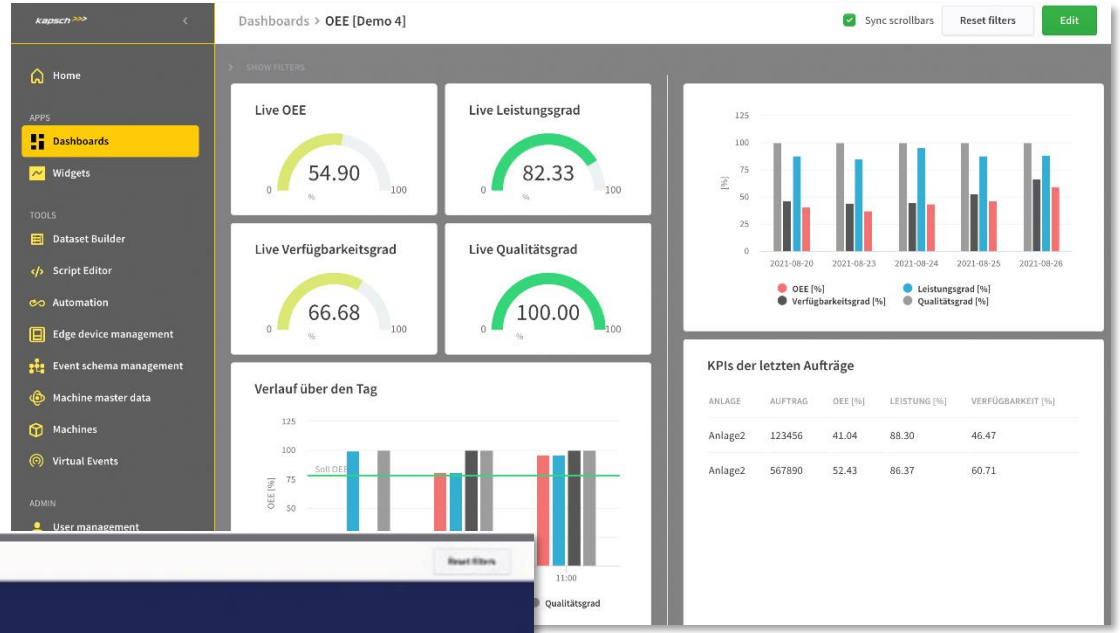
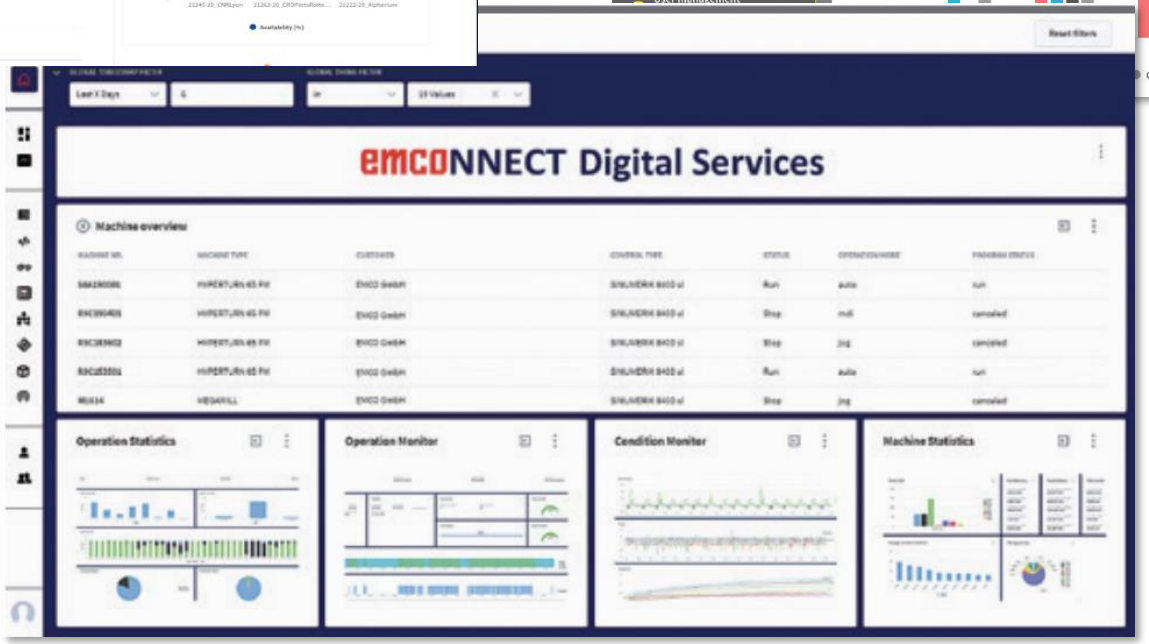
CONTROL TOWER - Gartner 2023 Applied Observability







PAY PER ALCOHOL YIELD

UNDERSTAND PROCESS OF ALCOHOL FROM CORN

1

OBEJCTIV

Understand alcohol yield in detail to controll production process in order to sell alcohol yield instead of enyzme per kg

2

SITUATION

No deep understanding of customer production processes, yield varies by plant and no transparency into market demand

3

ACN AI PLATFORM

Collect data via MQTT and transmit into Cloud.

Train operators on control tower and establish service hotline for second level support

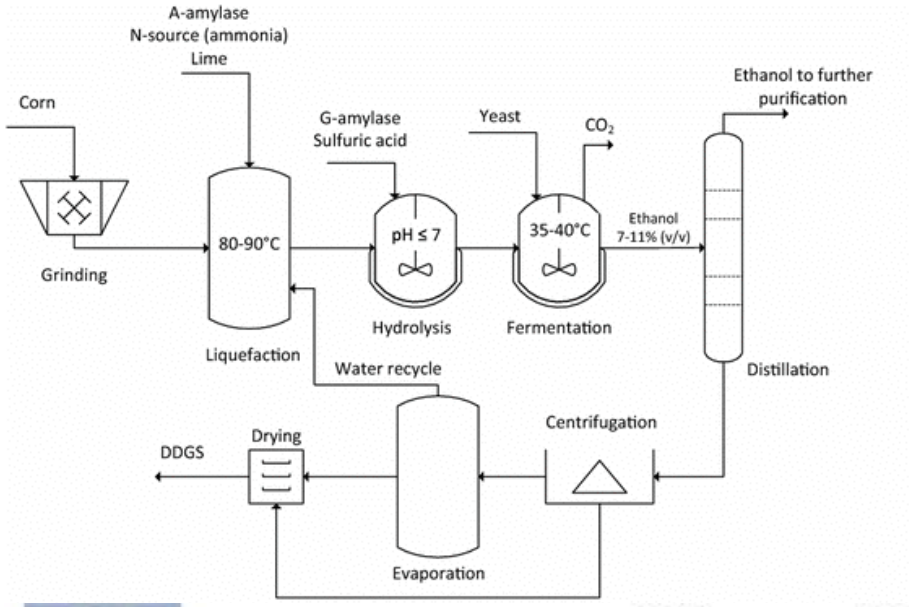
4

ML & AI SOLUTION

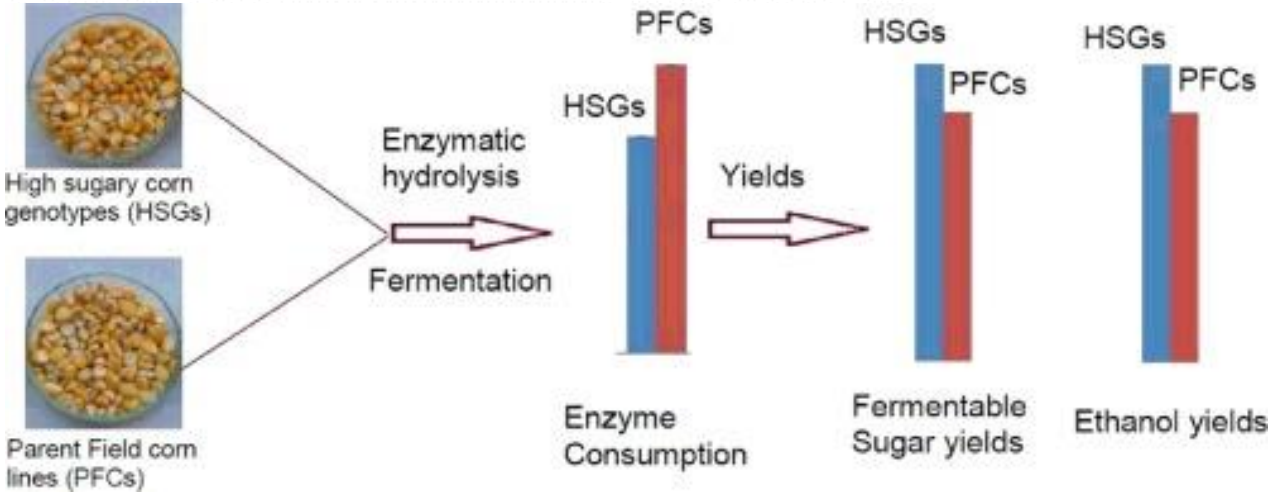
Establish a **pay per alcohol yield business model**

Use genetic algorithm from DataRobot to solve geometric regression using about 200 machines.

CONTROLL ALCOHOL YIELD



$$\text{Yield} = \frac{-PFC \pm \sqrt{PFC^2 - 4HSG * T^2}}{2HSG}$$



Glucose ($C_6H_{12}O_6$)

+

Fructose($C_6H_{12}O_6$)

Enzyme → Fermentation + Distillation

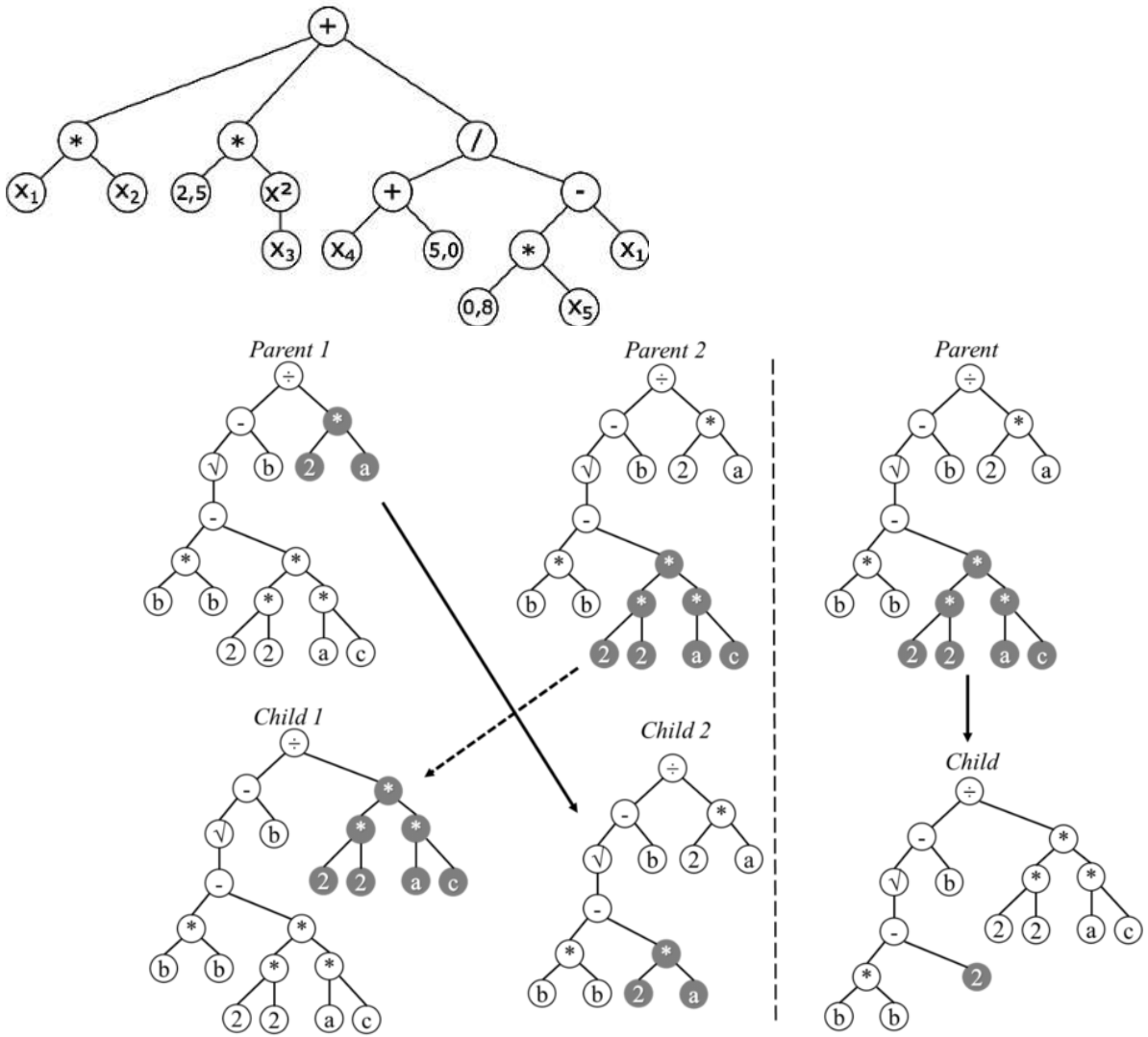
Ethyl alcohol ($2C_2H_5OH$)

+

Carbon-di-oxide ($2CO_2$)

SYMBOLIC REGRESSION

$$f(x) = x_1 x_2 + 2.5\, x_3^2 + \frac{x_4 + 5.0}{0.8\, x_5 - x_1}$$



- Random equations are generated to reproduce the data using evolutionary search.
- Most of the equations do not fit but a few of the equations will fit the data better

→ used as the basis of a new round of several billion more equations until a sufficiently good fit is reached.

→ "invariant relationships“ like laws of nature

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/ Products become services

→ *reduce risk*

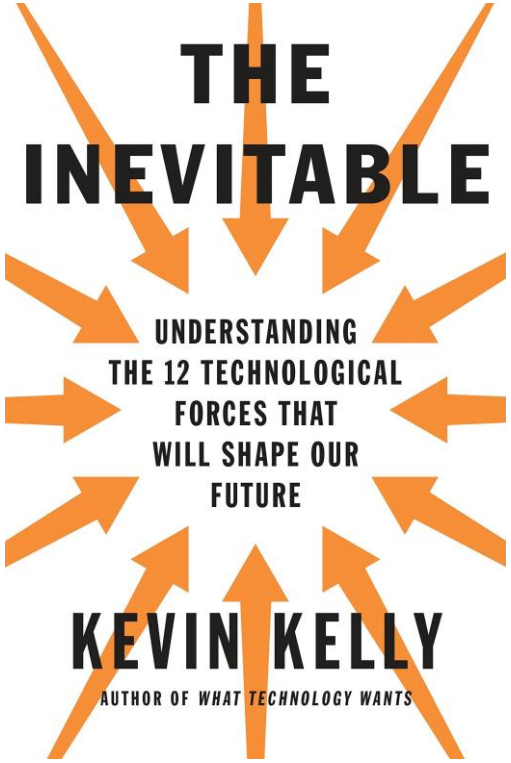
/ Everything requires maintenance

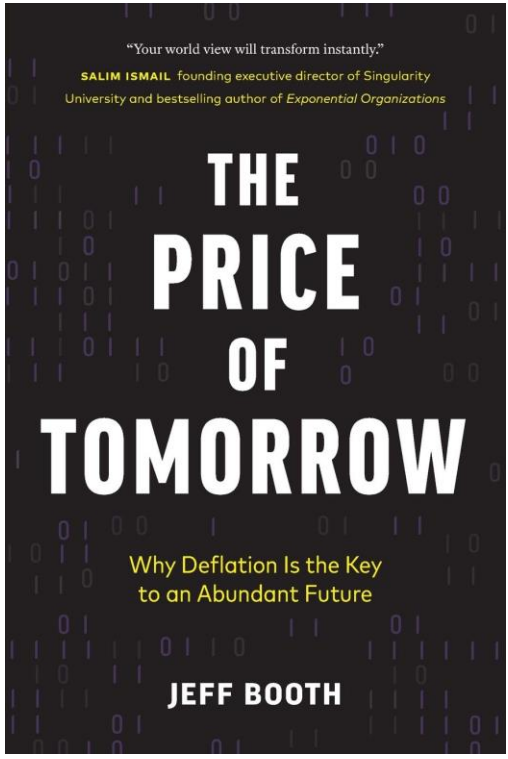
- Endless upgrades

/ Objects become partners

/ AI will help us to serve & improve

- The Inevitable by Kevin Kelly
- The Price of Tomorrow - Technology is Deflantionary by Jeff Booth





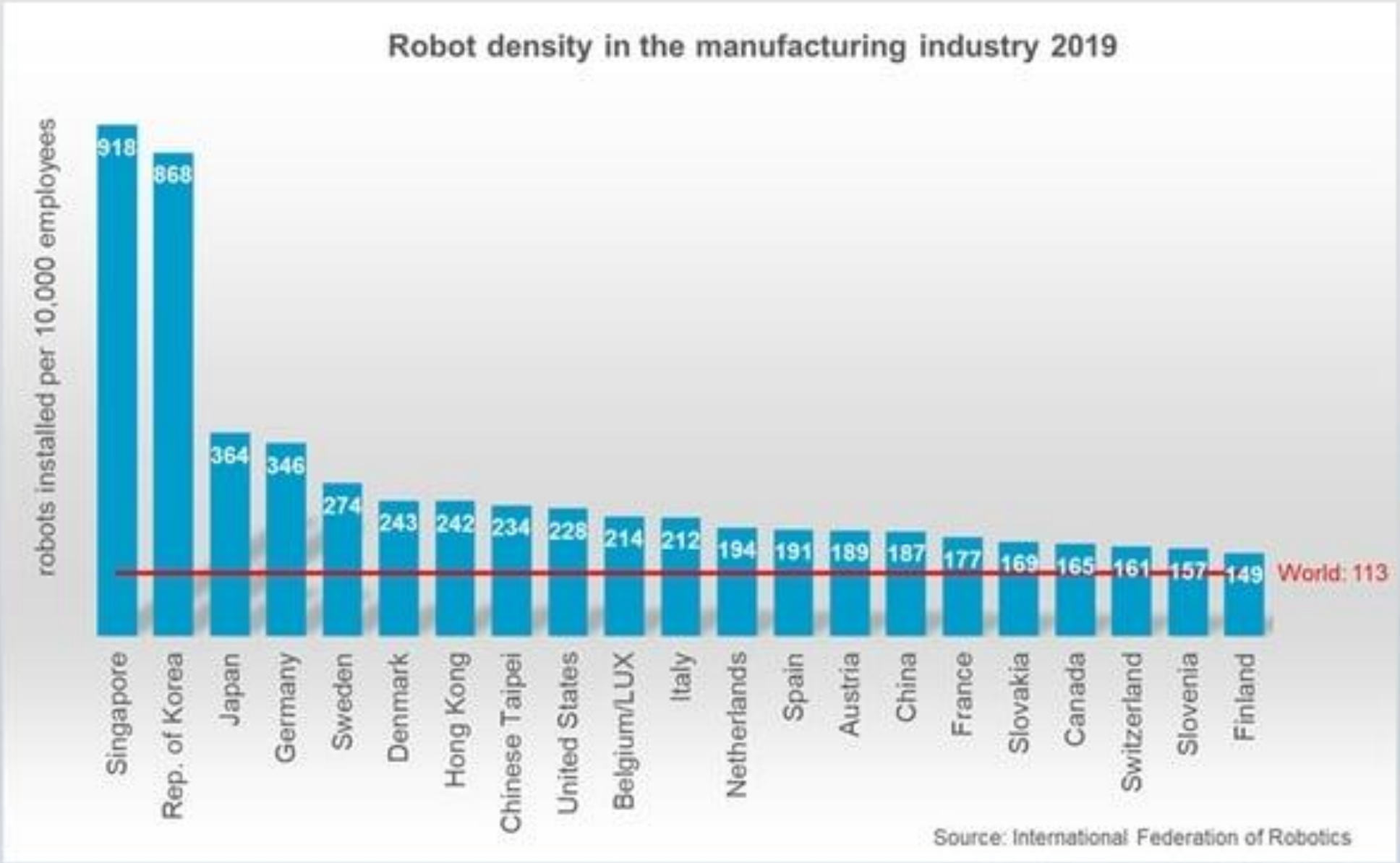
BACKUP

CLOUD IST DIE ZUKUNFT

/ Weltweite Datenerzeugung und -replikation 181 Zettabyte in 2025*

* IDC-Studie Global DataSphere Forecast 2021-2025

IFR International Federation of Robotics



VISUAL ANALYTICS MATURITY MODEL

EXAMPLE NIKE

/ What do own?

/ Say selling $100 sneacker

- 60% margin
- 40% shoe → 10% COGS 30% design & marketing
- From data to value

What do Nike and retailer owe?

- Brand, POS and customer relationship

→ Move closer to customer

→ Hard to copy solution