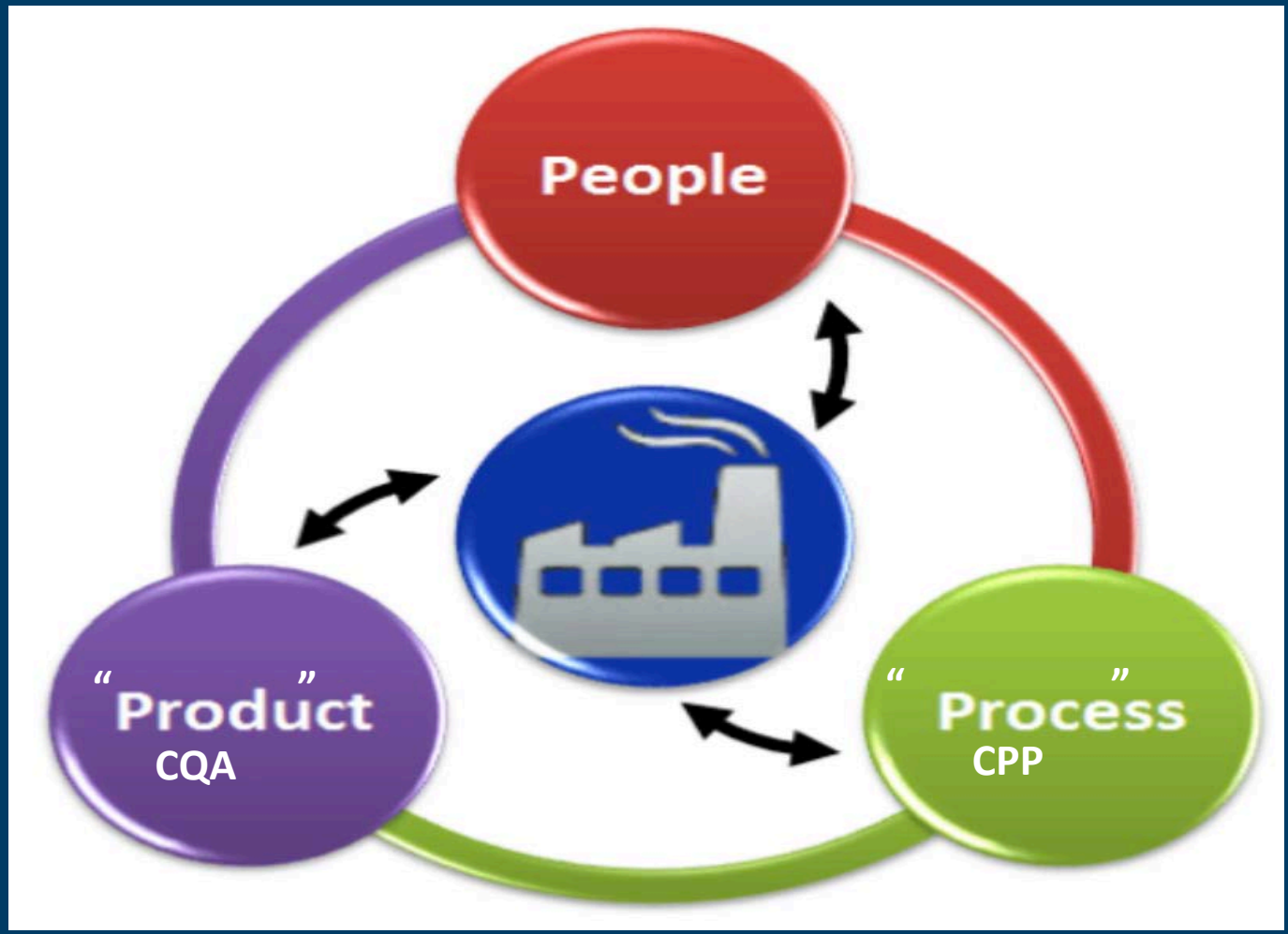
Getting value from data

– some examples and thoughts for future

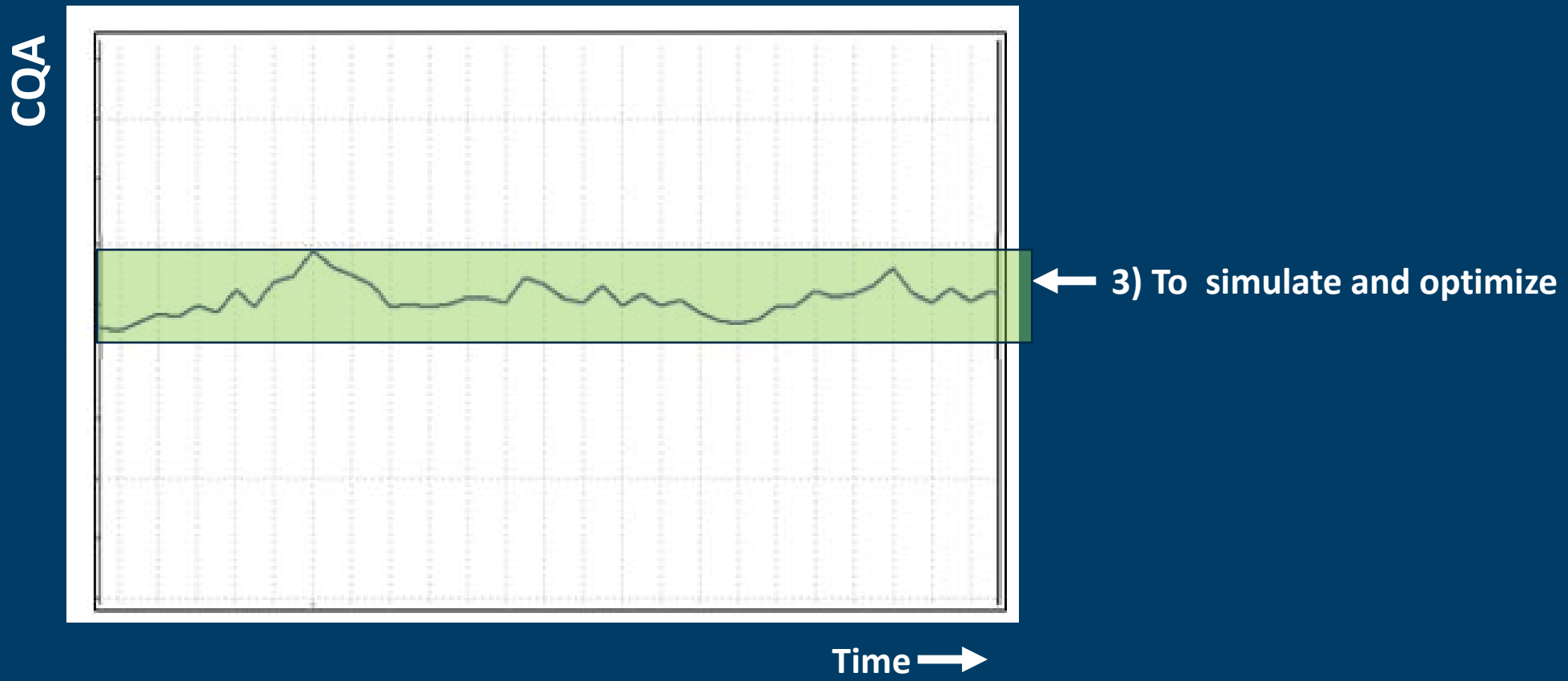
Frode Brakstad, SINTEF Industry

Digitalisation in Chemical Engineering
2nd European Forum on New Technologies - organised by DECHEMA
1st March 2019, Frankfurt

Data Analytics
(Process Analytical Technology - PAT)



Un-intentional variation is still normal in process industry



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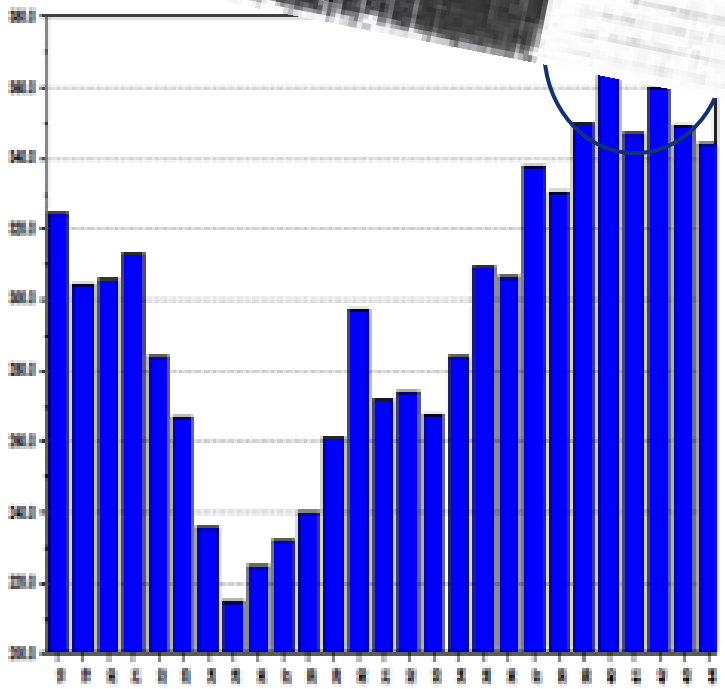
Real example from a plant – Magnesium production Norway



time (90s):

Use of Data Analytics and Smart Sensors to reduce un-wanted variations and stabilize process within the optimal production window

Each ton had a price of 400 Euro
We raised the average production from 320 to 400 t/day
Annual increase: 80 x 365 x 400 = 11.7 mill. Euro

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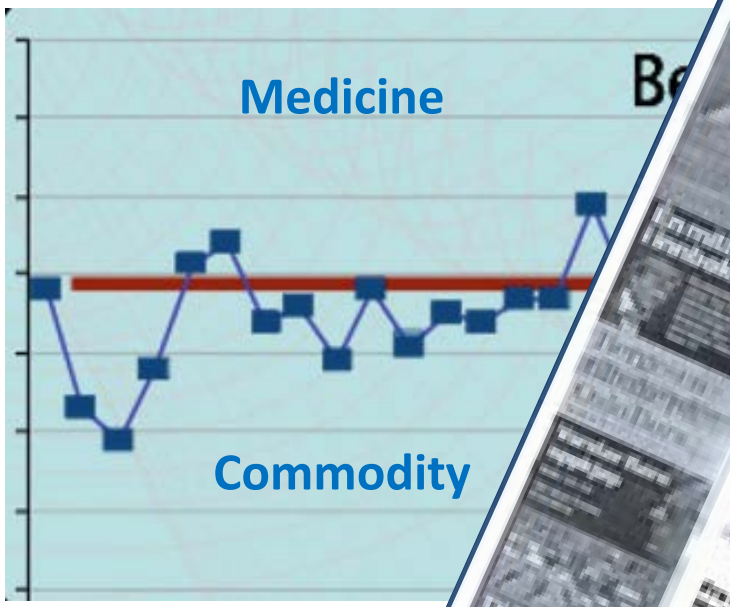
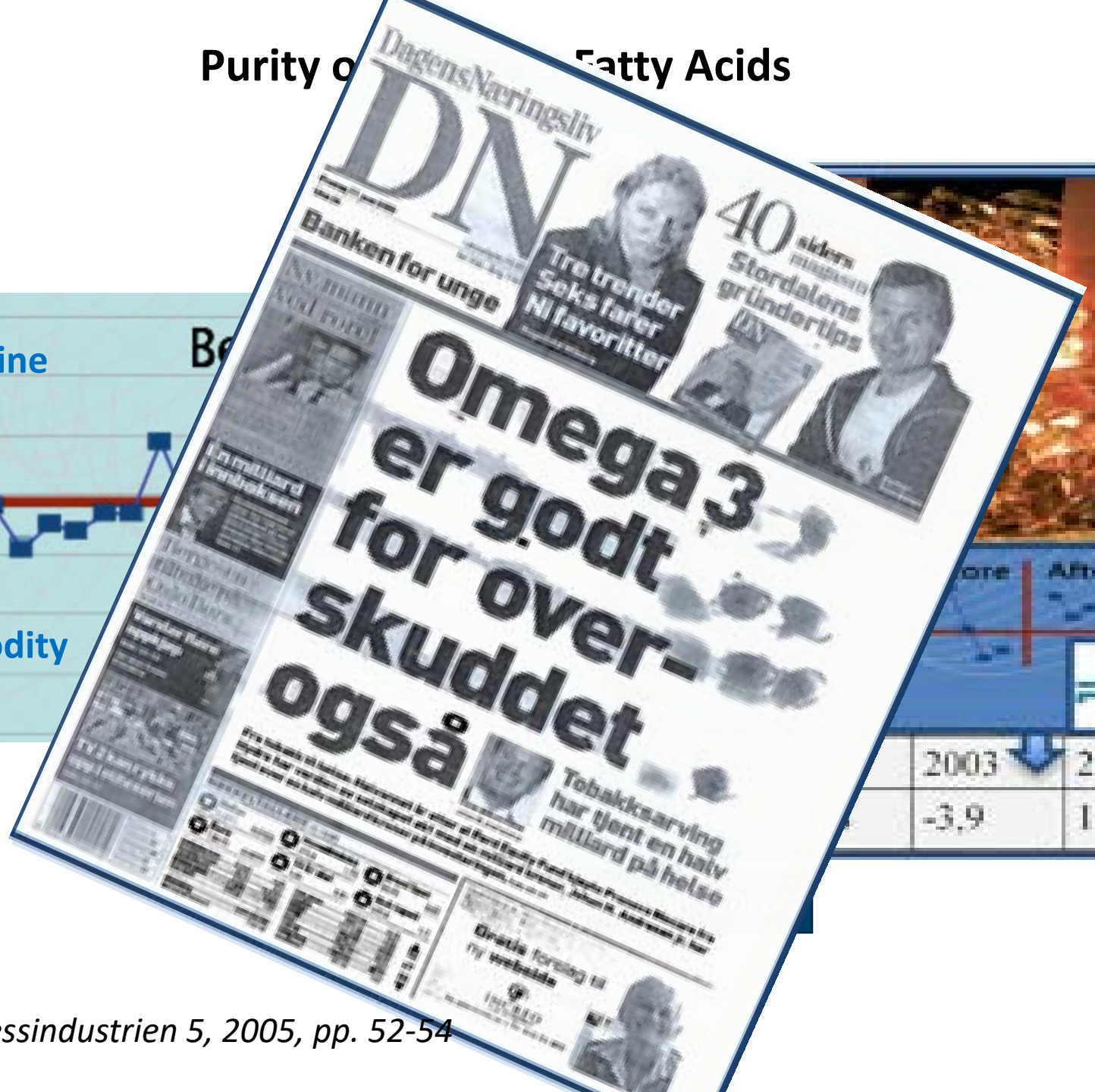
Reference: Anvendelse av Kjemometri innen forskning og industri (1995), pp.481 -498

Purity o… Fatty Acids





	2003	2004	2005
	-3,9	19,5	Ca.200

+20 mill. Euro

5Refere nce

Reference: Prosessindustrien 5, 2005, pp. 52-54

Data analyse og implementering

forskning.no

Legger gullegg for industrien

Årlig taper norsk prosessindustri enorme summer på produksjonsfeil. Avansert dataanalyse og bedre forståelse av kjemiske prosesser kan gi enorme besparelser.

Øystein Rygg Haanæs
frilansjournalist

I samarbeid med De regionale forskningsfondene

Tel-Tek har gjennomført et prosjekt sammen med GC Rieber Oils i perioden 2011-2014 hvor prosjektet bedret utbyttet med vel 40%, beholdt produktkvaliteten og senket produksjonstiden med 50%.
Referanse:
Hanne Solvang Felberg: 932 78 922.

PORSGRUNN: Forskningsbedriften Tel-Tek melder om stor interesse fra norsk industri for deres Smart-produksjon.

LARS RAVN
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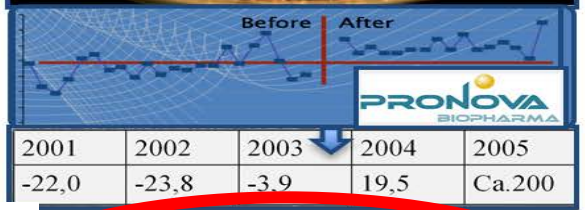
TEMA EFFEKTIVISERING

Vil produsere smartere

JOTUN

Jotun i Sandefjord er i full gang med samarbeidsprosjektet «Smart Produksjon». Målet er å øke produksjonskapasiteten for bindemiddel i et produksjonsanlegg med 15 prosent. I tillegg skal det bli jevnere produktkvalitet og jevnere prosesstider.



2001	2002	2003	2004	2005
-22,0	-23,8	-3,9	19,5	Ca.200

Lærer industrien å bli smartere

Tel-Tek i Porsgrunn, Universitetet i Bergen og Forskningsrådet vil sette en ny kvalitetsstandard for norsk industri.

Morten Lie-Hagen
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Lover godt

De lanserer «Smart Produksjon» basert på analyseverktøy Kvalbein utviklet allerede på begynnelsen av 1980-tallet.

Systemet har vært utprøvd ved flere prosessbedrifter, og resultatet er lovende: Enkelte bedrifter har forbedret produksjonskapasiteten med 25 prosent – uten ekstra kostnader.

Liten variasjon med smart produksjon

PRODUKSJON: Forskningsinstitusjonen Tel-Tek mener at det er mye å hente ved å innføre smart produksjon. – Det reduserer kvalitetsvariasjon i sluttproduktene og øker lønnsomheten, forteller seniorforsker Frode Brakstad.

Pronova Biocare har økt inntjeningsevnen ved hjelp av multivariat analyse. Kvaliteten på fiskeoljen i omega 3-kapslene blir stabilisert ved hjelp av kjemometri, som har blitt et viktig verktøy i forståelsen av prosessene.

Marvin Bugge
Senior Advisor
Hydro Aluminium

Hydro

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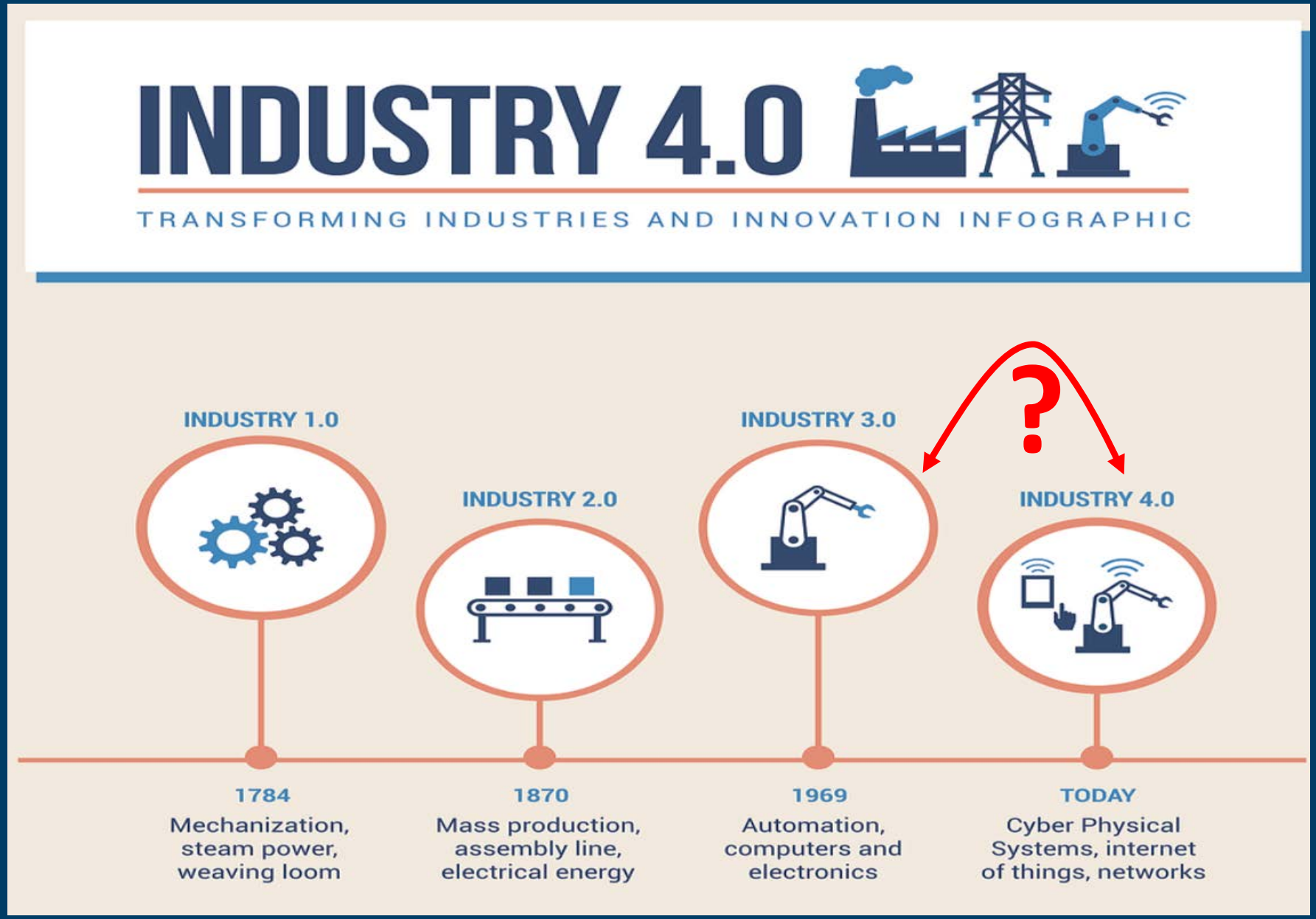
INDUSTRY 4.0
TRANSFORMING INDUSTRIES AND INNOVATION INFOGRAPHIC
INDUSTRY 1.0
INDUSTRY 2.0
INDUSTRY 3.0
INDUSTRY 4.0
?
1784
Mechanization, steam power, weaving loom
1870
Mass production, assembly line, electrical energy
1969
Automation, computers and electronics
TODAY
Cyber Physical Systems, internet of things, networks

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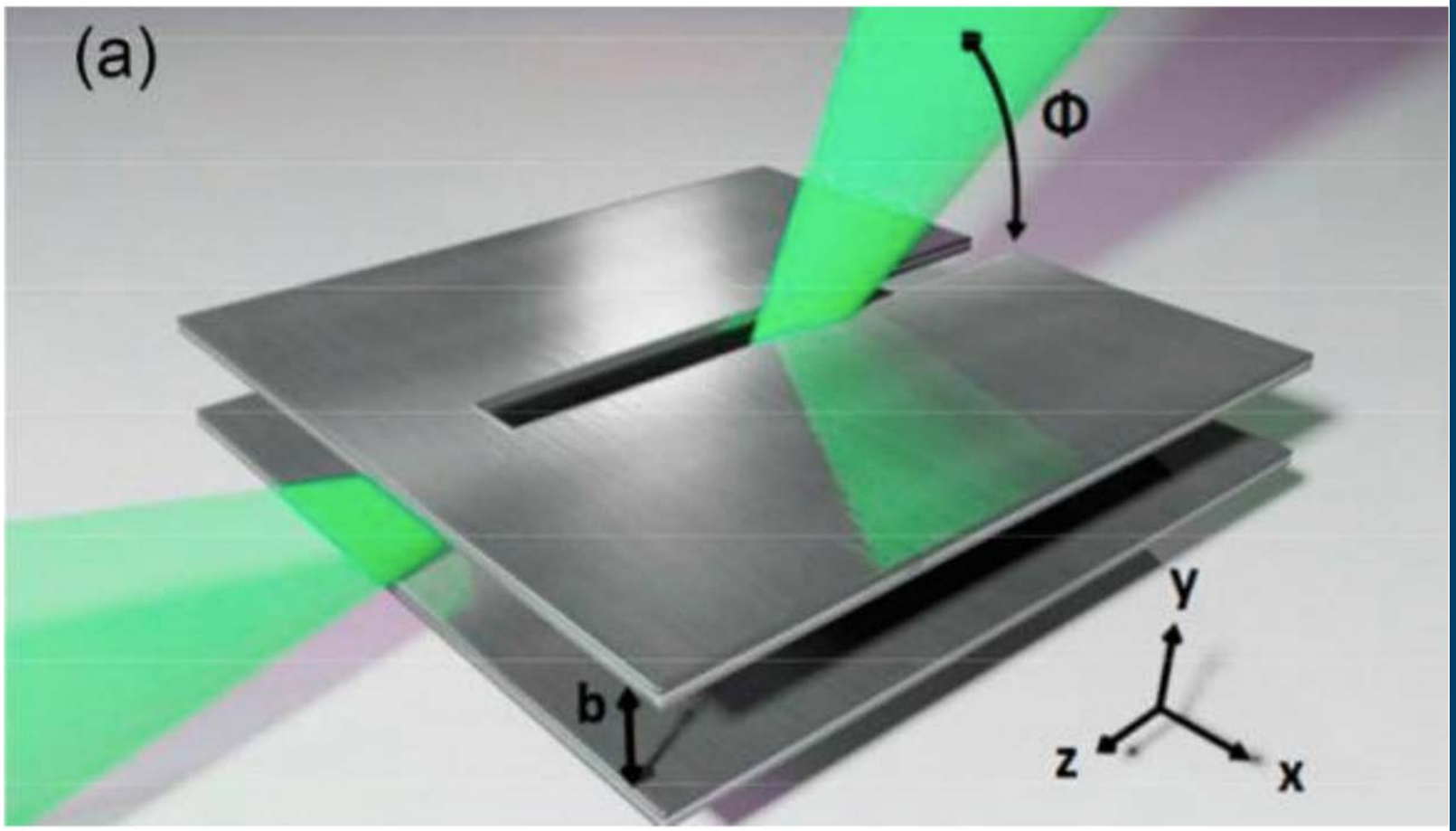


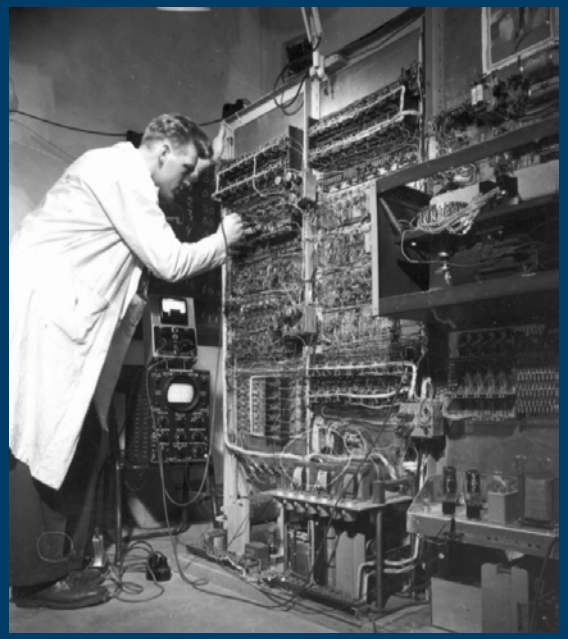
Forskere fra Brown-universitetet har utviklet en antenne som demultiplekser datastrømmer i THz-området. (Bilde: Mittleman lab/Brown University)

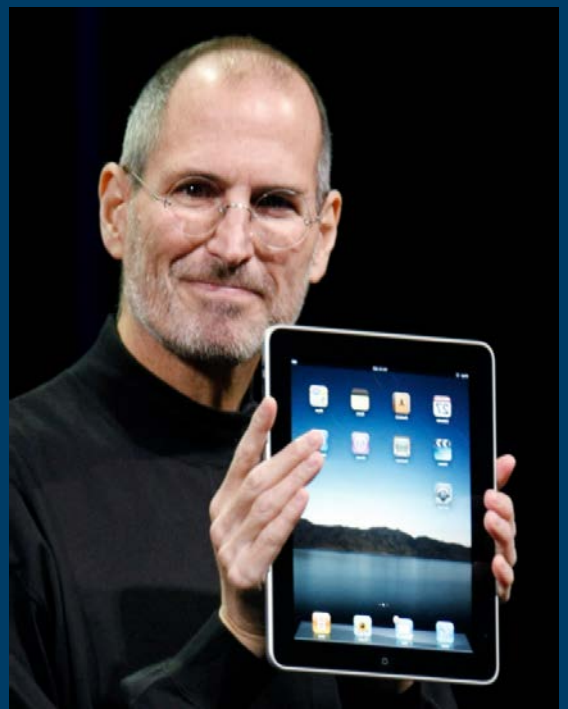
TERAHERTZBØLGER

The wireless nets of the future may be 100 times faster

Ved å ta i bruk terahertzstråling.

www.digi.no





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Data Storage Technologies

1920s
Magnetic tape

1960s
Music tape

1970s
Floppy disks

1990s
DVDs

TODAY
Cloud-data

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*Development of computer capacity **FLOP** - Floating Point Operations Per Second*

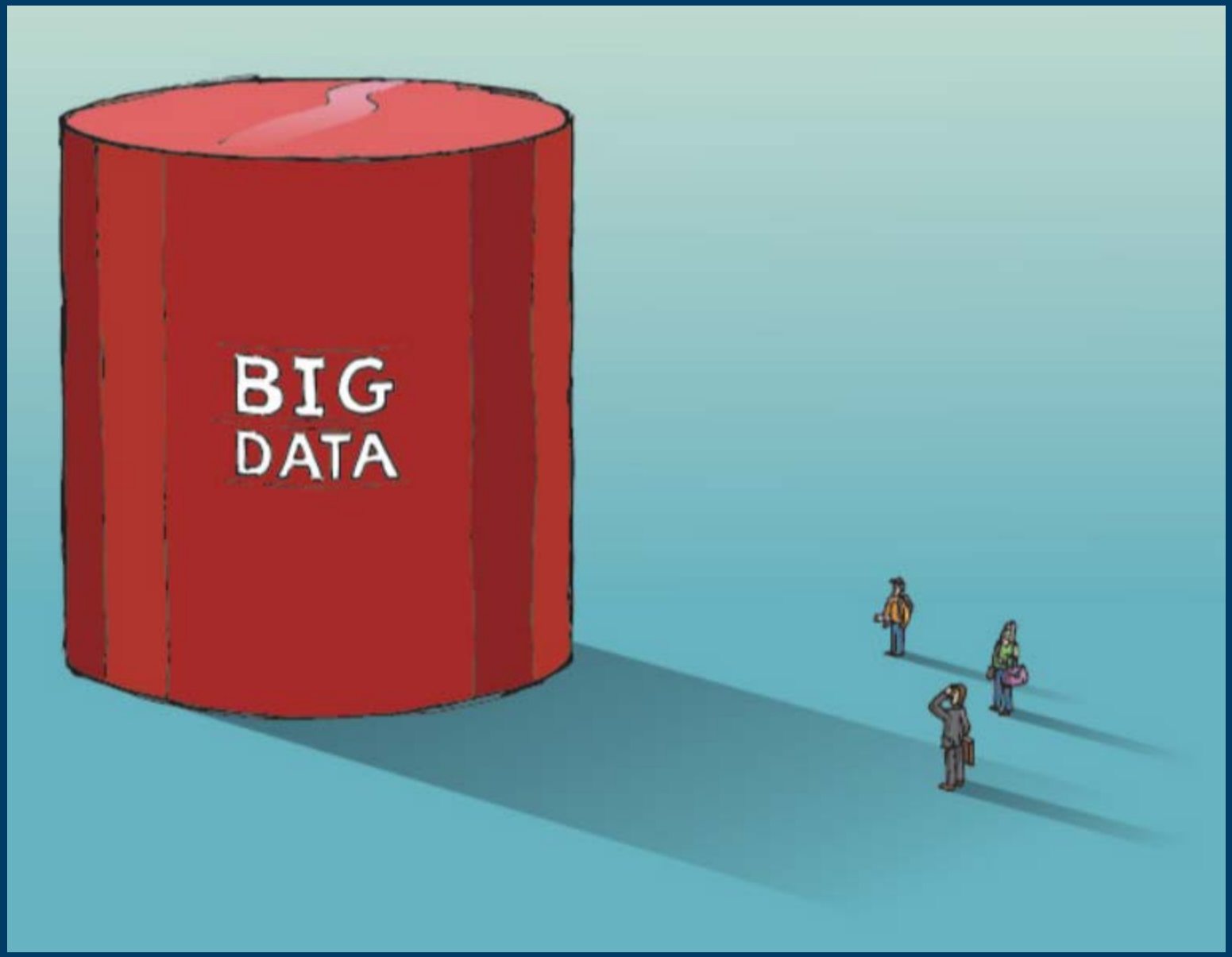
1906 - Babbage Analytical Engine (Essex, Enland):0.3OPS

2007* - IBM Blue Gene/L USA 478.2 TFLOPS **(TERRA: 10^12)**

2010 - Tianhe-1A L Kina 2566 TFLOPS

2017 - Sunway TaihuLight Kina 93 PFLOPS **(PETA: 10^15)**

*A typical office computer had 4-8 Giga FLOPS (GFlops) – **GIGA: 10^9**



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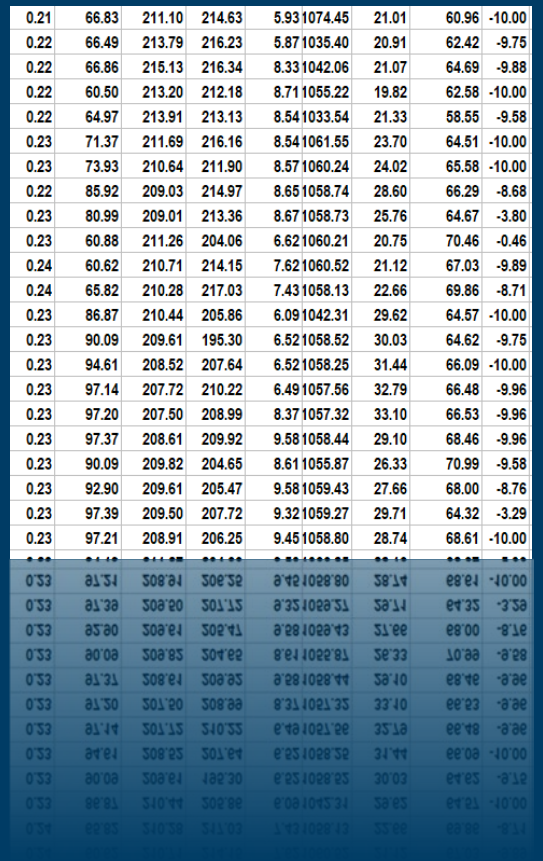
Introduction to Big Data

Xiaomeng Su, Institutt for informatikk og e-læring ved NTNU
Learning material is developed for course IINI3012 Big Data

Is it more important to work with big data than with traditional data? Reading a lot of hype around big data, one may start to think that just because big data has high volume, velocity and variety, it is somehow better or more important than other data. This is not the case. The power of big data is in the analysis you do with it and the actions you take as the result of the analysis. Big data or small data does not in and by itself possession any value. It is valuable only when you can get some insight out of the data. And that insight can be used to guild your decision making.

Some fundamental challenges related to process data analytics



0.21	66.83	211.10	214.63	5.93	1074.45	21.01	60.96	-10.00
0.22	66.49	213.79	216.23	5.87	1035.40	20.91	62.42	-9.75
0.22	66.86	215.13	216.34	8.33	1042.06	21.07	64.69	-9.88
0.22	60.50	213.20	212.18	8.71	1055.22	19.82	62.58	-10.00
0.22	64.97	213.91	213.13	8.54	1033.54	21.33	58.55	-9.58
0.23	71.37	211.69	216.16	8.54	1061.55	23.70	64.51	-10.00
0.23	73.93	210.64	211.90	8.57	1060.24	24.02	65.58	-10.00
0.22	85.92	209.03	214.97	8.65	1058.74	28.60	66.29	-8.68
0.23	80.99	209.01	213.36	8.67	1058.73	25.76	64.67	-3.80
0.23	60.88	211.26	204.06	6.62	1060.21	20.75	70.46	-0.46
0.24	60.62	210.71	214.15	7.62	1060.52	21.12	67.03	-9.89
0.24	65.82	210.28	217.03	7.43	1058.13	22.66	69.86	-8.71
0.23	86.87	210.44	205.86	6.09	1042.31	29.62	64.57	-10.00
0.23	90.09	209.61	195.30	6.52	1058.52	30.03	64.62	-9.75
0.23	94.61	208.52	207.64	6.52	1058.25	31.44	66.09	-10.00
0.23	97.14	207.72	210.22	6.49	1057.56	32.79	66.48	-9.96
0.23	97.20	207.50	208.99	8.37	1057.32	33.10	66.53	-9.96
0.23	97.37	208.61	209.92	9.58	1058.44	29.10	68.46	-9.96
0.23	90.09	209.82	204.65	8.61	1055.87	26.33	70.99	-9.58
0.23	92.90	209.61	205.47	9.58	1059.43	27.66	68.00	-8.76
0.23	97.39	209.50	207.72	9.32	1059.27	29.71	64.32	-3.29
0.23	97.21	208.91	206.25	9.45	1058.80	28.74	68.61	-10.00

Quality of data

-CQA: Measurement Analysis are often missing (what is noise and what is real?)

-CPP : Sensors may drift or fail

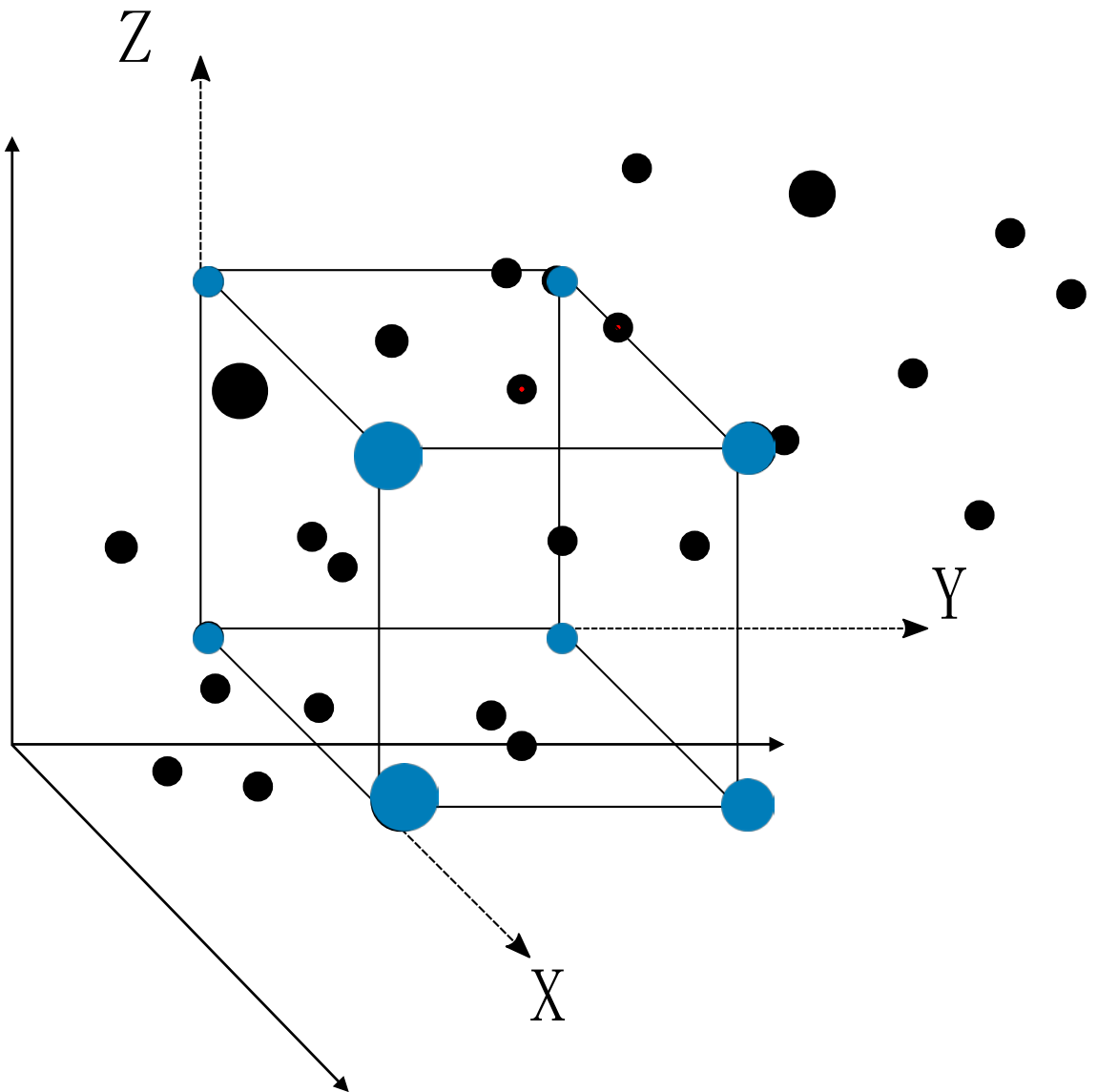
Quality of Data-driven models

-Critical measurements may be missing

- Time –lags not fully compensated (How does CQA relate to CPP in time?)

- Data are very correlated – interaction term may be overlooked

Unmasking interaction terms by finding an orthogonal sub-set in correlated process data



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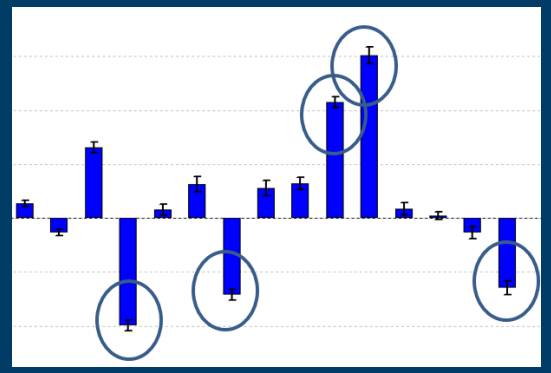
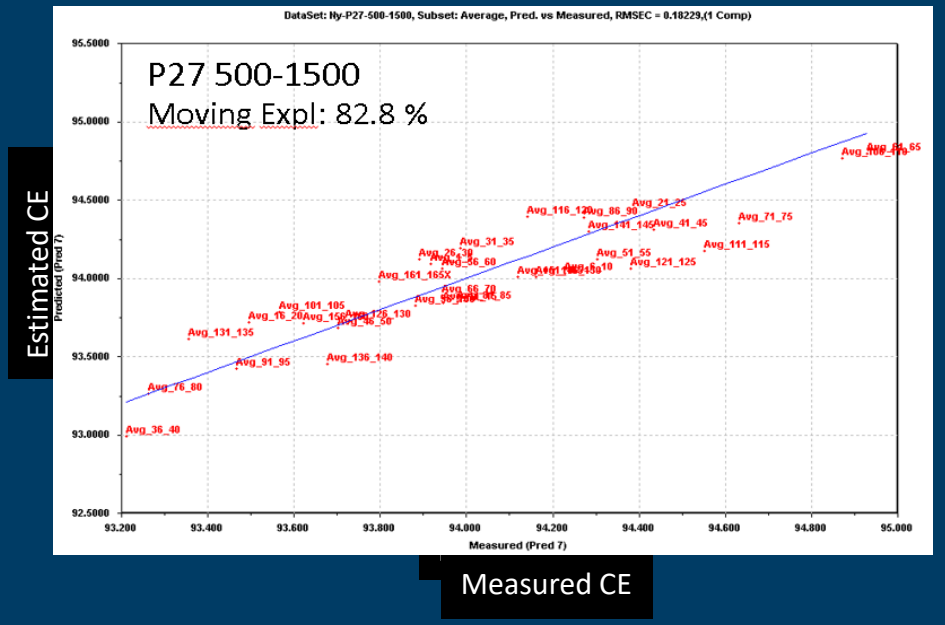
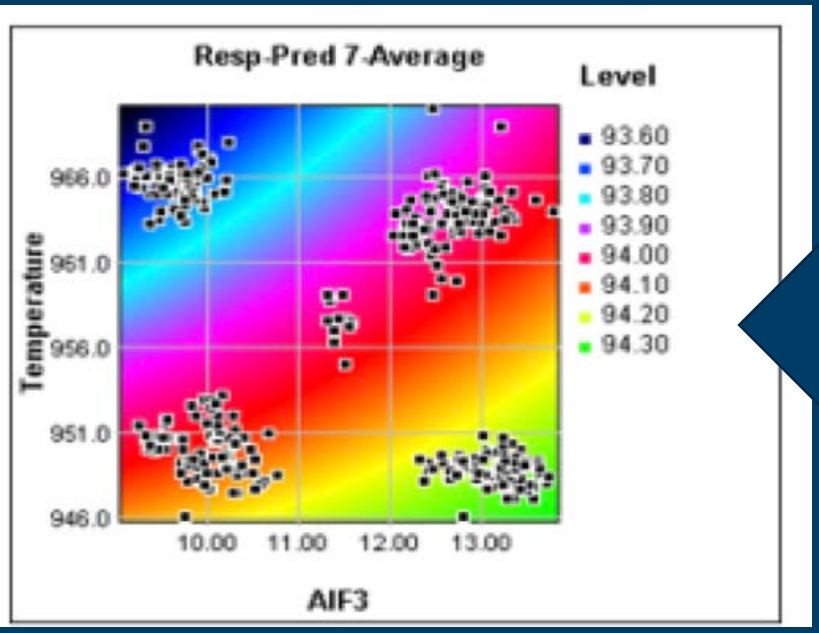


Five *most important* process variables

New method !



Measured CE



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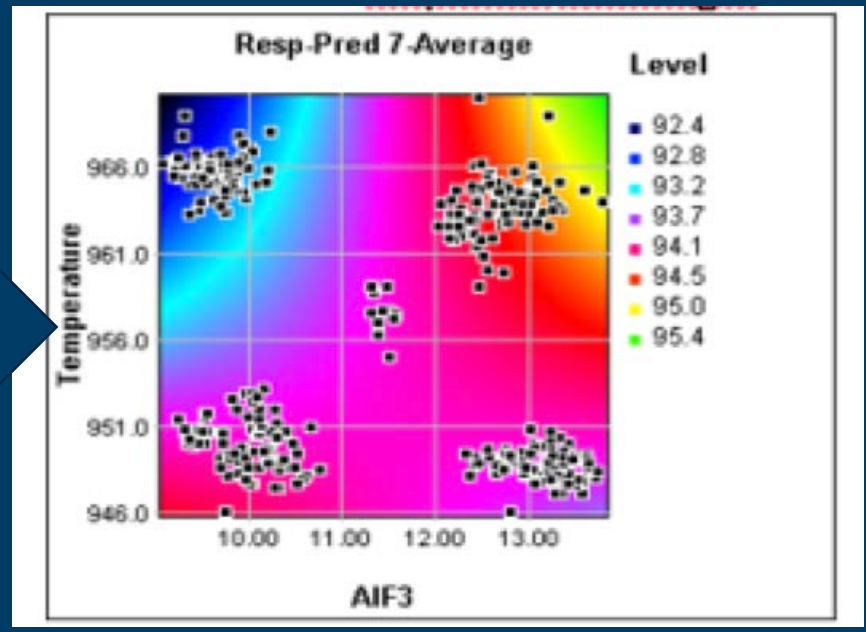

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FUTURE- Strategiske digitale teknologiområder for SINTEF

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Prosess Industry for Future

Big Data

Service by design

Mixed Reality

Cyber Security

Digital Twin

Artificial Intelligence

Sensors

Connectivity

Autonomy

Digital Platforms

Human Factors

- Big Data
  -gathering, -platform/storage, -cloud security, tracking through the value chain
- Data Analytics – Big Data incl. meta data (Velocity, Variety, Volume)
- Circular economy
- Cognitive Plants
- Automation -Robotics
- Digital twins – hybrid and cognitive models
- Process autonomy incl. IoT and communication
- Smart sensors (self-calibration)
- Smart models(self-adapting)
- Process Intensification

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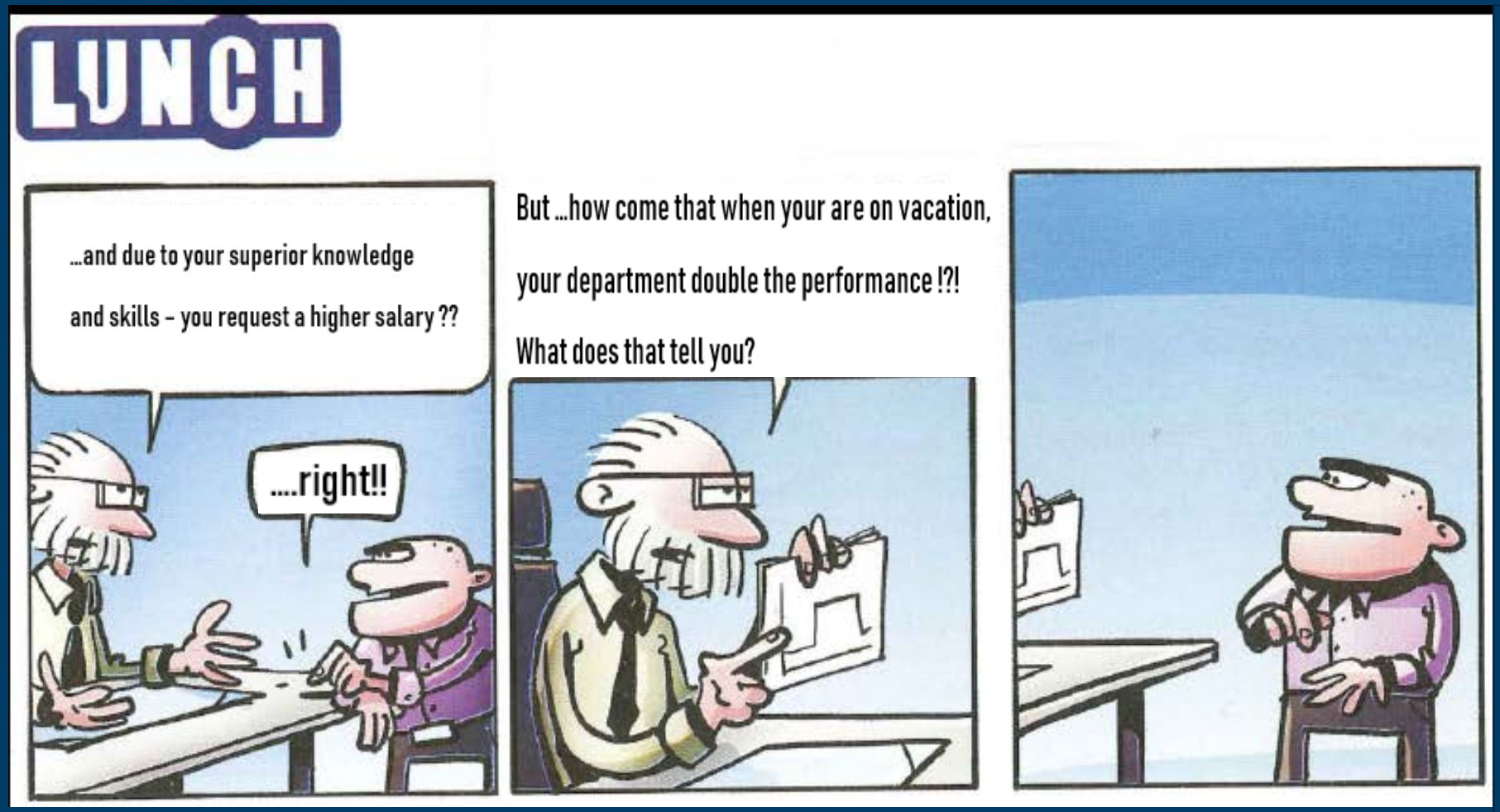
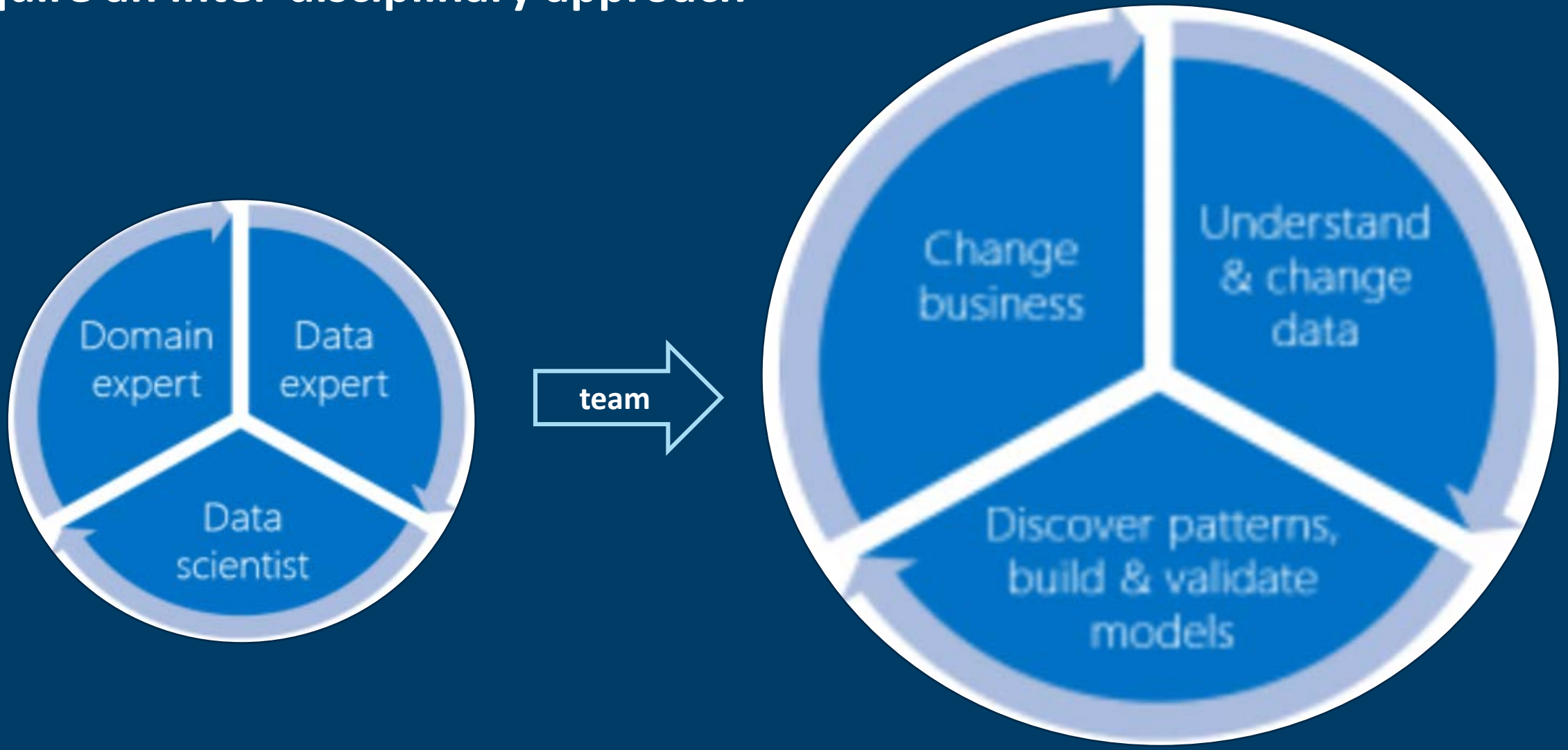
Data interpretation



Successful data interpretation and modelling require an inter-disciplinary approach



https://www.capgemini.com/no-no/2015/06/a-arbeide-med-maskinlaering/

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Technology for a better society