NTNU – Trondheim
Norwegian University of
Science and Technology

IN 5210 IS theory:

Towards understanding ’digitalization’

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Content

- Background «digitalization», existing insights
- What, if any, is new – now – with digitalization ?
- Ex: IoT in oil and gas, detecting sand
- Platforms and ecosystems
- Conclusions

Background

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Manufacturing sector

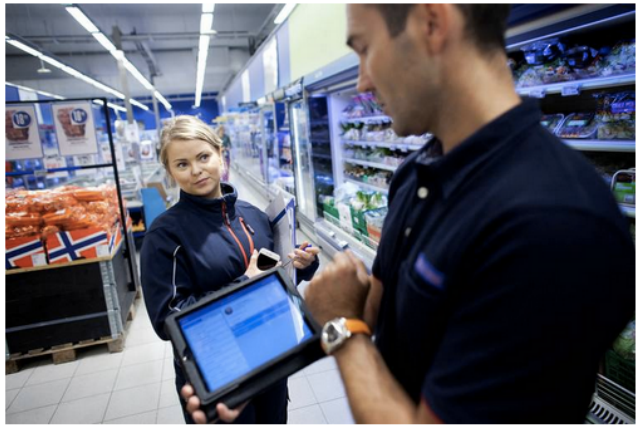
Fourth industrial revolution could unlock £445bn for UK, report reveals

Report led by Jürgen Maier says deal between government and industry could put Britain at forefront of new technologies and create th

DN Dagens Næringsliv

Oslo Børs: 13:28
Indeks: 797,28
+0,2

App gjør kontoret overflødig i Rema-butikkene



- Det er mye enklere nå, sier butikkansatt Lisa Marie Storhaug, som for eksempel lett kan bytte vakter med kolleger på mobilappen og holde kjøpmann Jone Tungland kontinuerlig oppdatert. Foto: Tomas Larsen

Nyheter Handel

– I løpet av fem-ti minutter har vi fått gjort det som tidligere tok mange dager

Bakrommet er snart overflødig i Rema-butikkene. Ansettelser, ansattdata, opplæring og arbeidsplaner styres allerede fra nettbrett og mobiltelefoner.

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What if... Robots Replaced Teachers?

DN Dagens Næring

- Det vi lærer på NHH nå, Margit Abel Grape (til ve
mer teknologi inn i utdan

Mener

UiO : Realfag og teknologi

Titan.uio.no

ENGLISH NYHETSBREV FØLG FØLG SØK

Helt nytt studium ble det vanskeligste å komme inn på

Endelig er ventetiden over for kommende studenter - opptaket til høyere utdanning er klart.

Her, i Ole-Johan Dahls hus i Forskningsparken, skal de nye informatikkstudentene holde til. Foto: Jan-Tore Egge/Wikimedia Commons

På MN-fakultetet er det - i den ordinære kvoten - aller vanskeligst å komme inn på det helt nye studiet Informatikk: digital økonomi og ledelse. Poengkravet er 62,1. Hele 19 har kjempet om hver plass på dette studiet.

For søkere med førstegangsvitnemål kreves det 51,9 poeng for å komme inn her - knepent slått av farmasi med 52,0.

– Studieprogrammet tar hensyn til ønskene fra arbeidsmarkedet og gir studentene en unik og ettertraktet utdanning, sier dekan Morten Dæhlen i sin blogg om "Dig.øk"-studiet.

Han kaller det et knallsterkt alternativ til utdanningene innen industriell økonomi ved andre læresteder.

Siden studieprogrammet er nytt, kan man ikke sammenligne med tidligere år, men flere av de andre studieprogrammene innen informatikk øker i poengkrav, for eksempel:

Informatikk: design, bruk og interaksjon øker fra 50,9 i 2016 til 53 i ordinær kvote (42,1 for primærsøkere).
Informatikk: programmering og systemarkitektur øker fra 51 i 2016 til 53,1 i ordinær kvote (42,9 for primærsøkere).

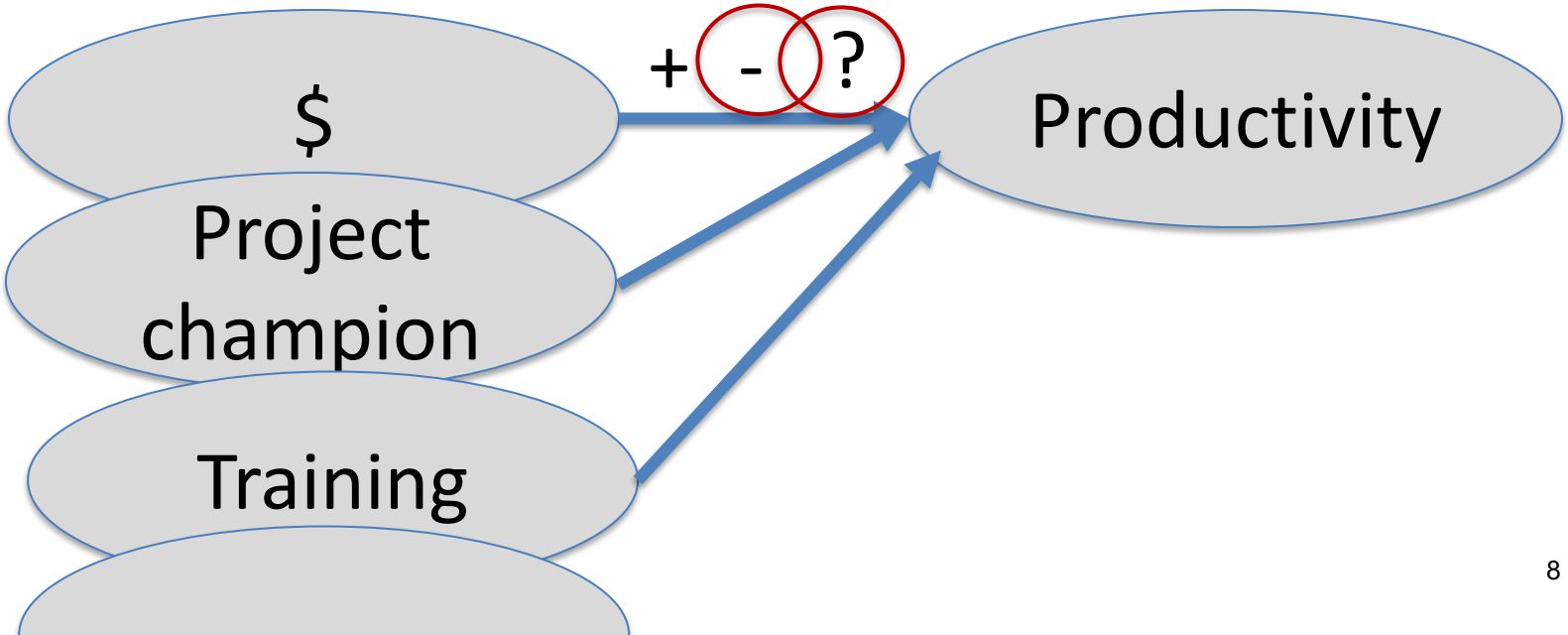
Source: DN, 3. Nov. 2016

“Digitalization”

Technological determinism?

Macro =/= micro effects

- Macro- but not micro effects and vice versa
- ’Productivity paradox’:



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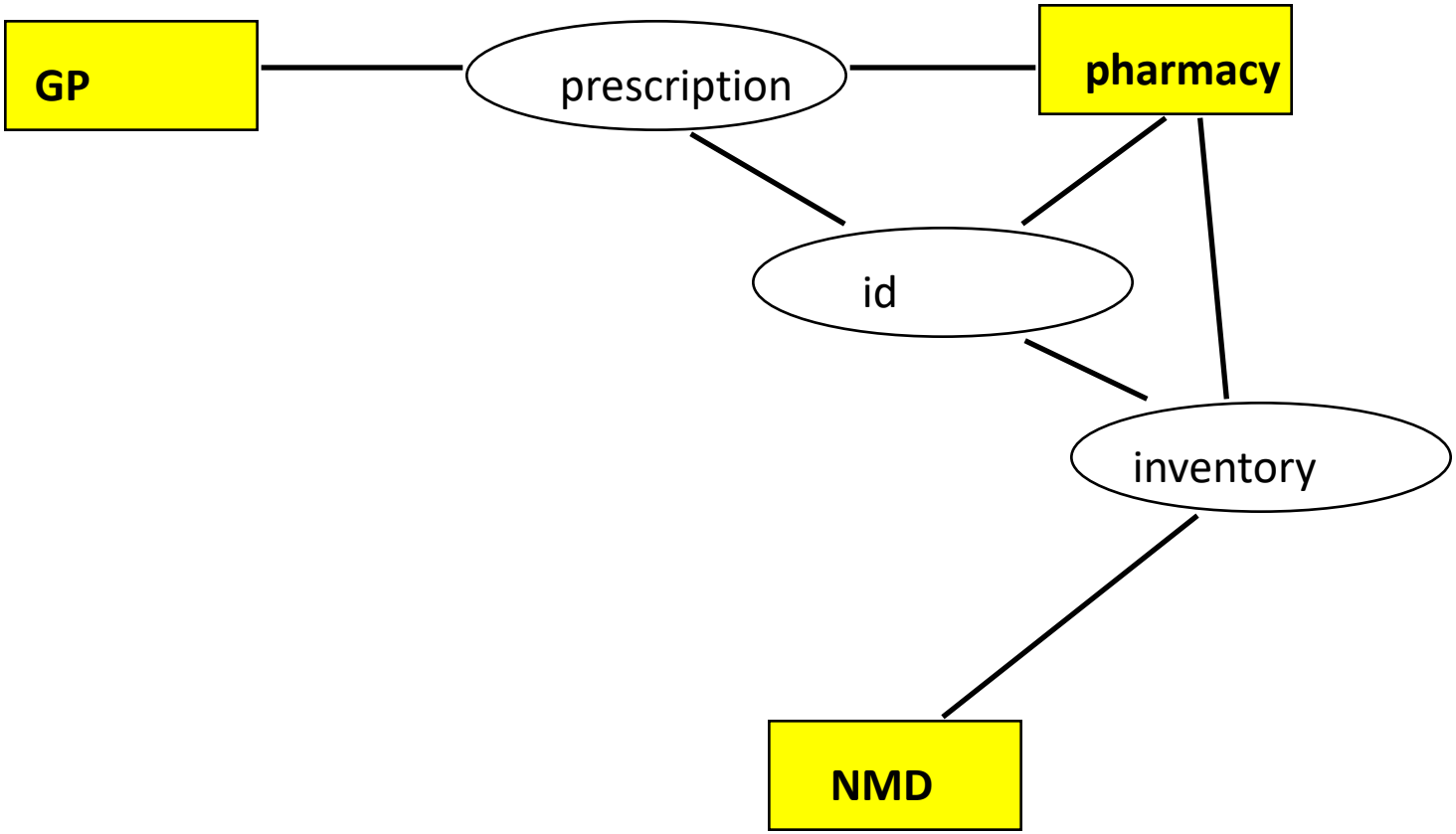

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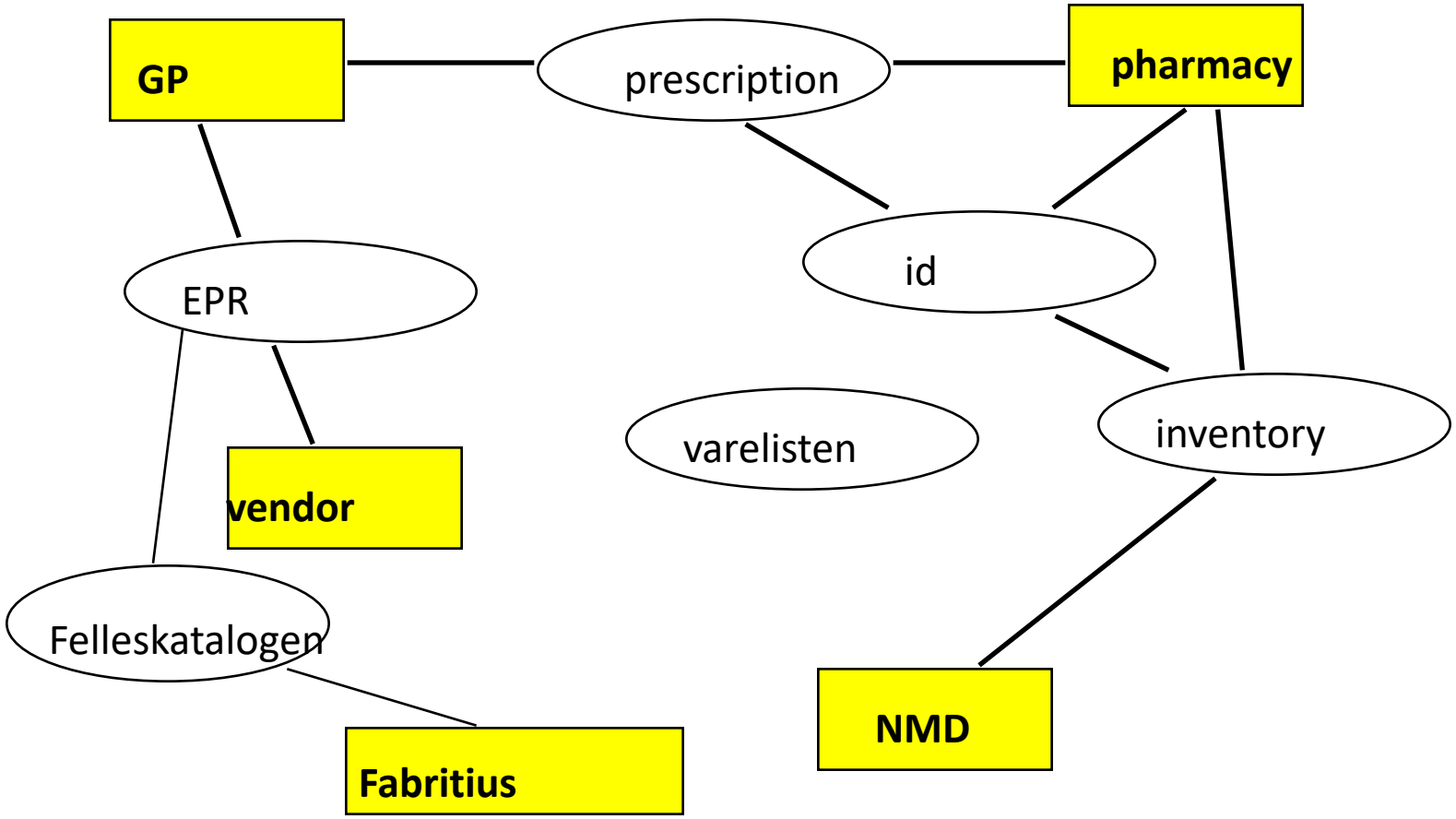


”Getting the job done”

Milkshake

Source: C Christensen on getting the job done, https://www.youtube.com/watch?v=Kjcx87JmhvM&feature=youtu.be

“[Y]ou can see the computer age everywhere except in the productivity statistics” *

1. Not automation (qua substitution)
2. Complementaries (customer interaction, internal communication)
3. Transformation
4. Exaggerate short-term, under-estimate long-term effects

- R Solow

Brynjolfsson, E., & Hitt, L. M. (2000). Beyond computation: Information technology, organizatinal transformation and business performance. *The Journal of Economic Perspectives*, *14*(4), 23-48.

Barras, R. (1990). Interactive innovation in financial and business services: the vanguard of the service revolution. *Research policy*, *19*(3), 215-237.

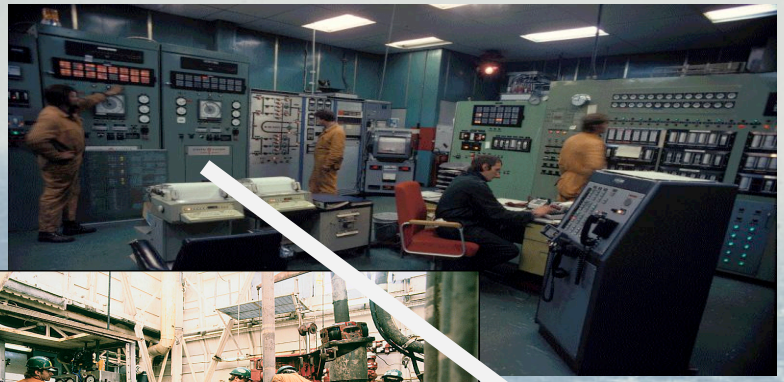
Digitalization: what, if any, is new ?

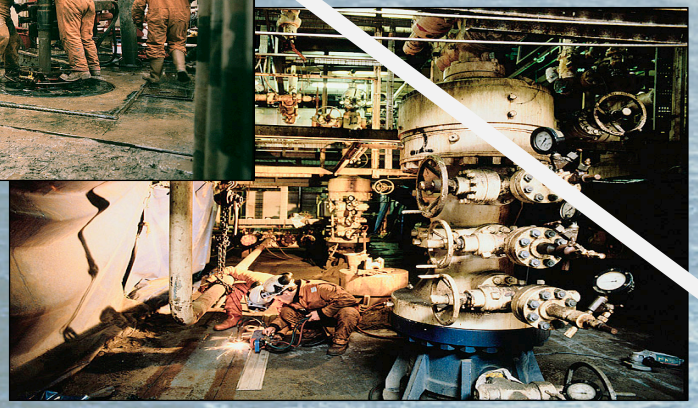
Differences that make a difference?

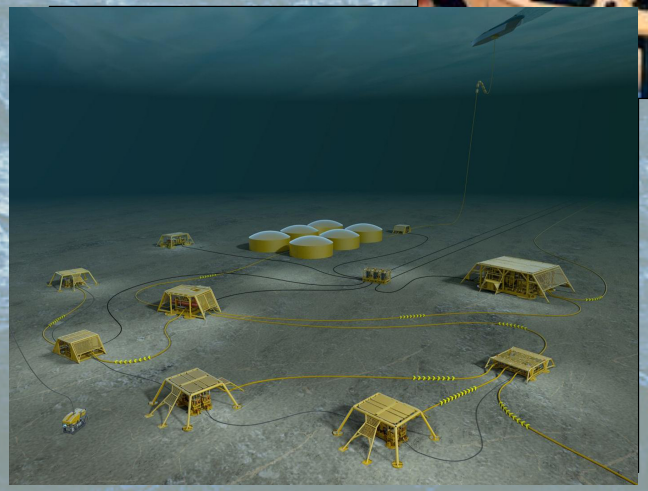
1. Liquefaction

> "I see, I touch, I smell, I hear; therefore, I know"
>
> Zuboff 1989, p. 62

   – Synthetic situation" (KK Cetina)
   – Tactile (Zuboff)
   – Sensor: referent → reference
2. Quantification of quality (data science)
   – Data driven, "everything is a vector"
   – 'Works' in practice but not in theory
   – Push, also into judgement, interpretation (Autor)
3. Platform/ infrastructure



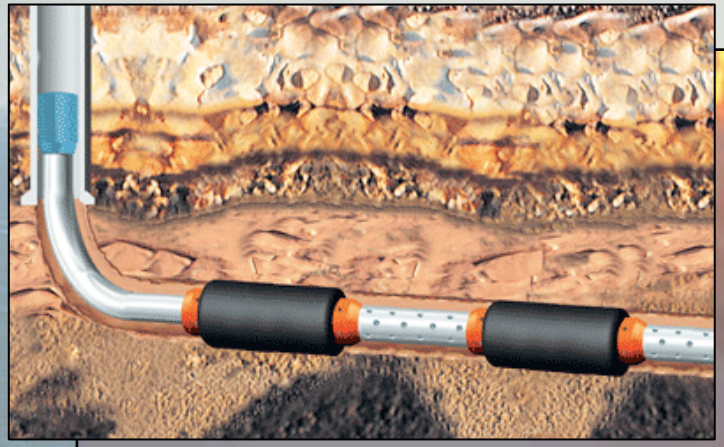


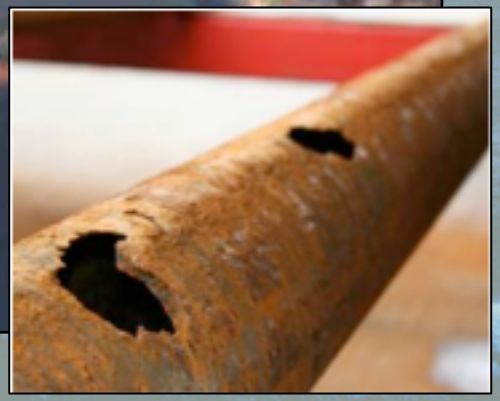


Big data & IoT

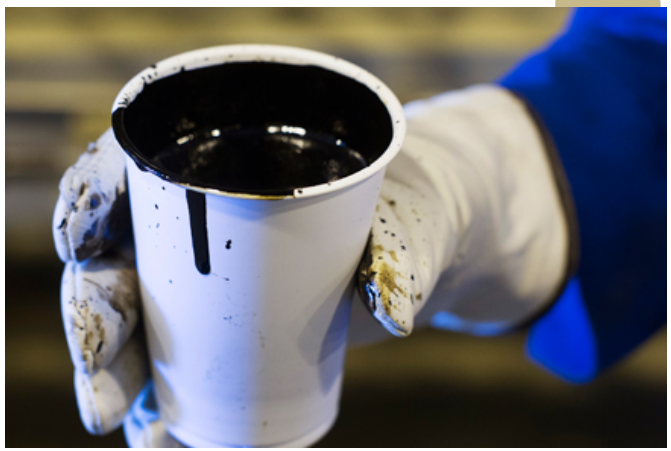
- Volume (TB: national, corporate, local)
- Variety (structured, free-text, graph, images, drawings, slides, pictures,…)
- Verasity (uncertainty, noise/ faults)
- Velocity (real-time streams)

Liquefaction by IoT: ex Sand





Sand: physical or digital – or both?



Phase 0:

physical inspection, tactile, samples

Phase 1:

sensor: sound or electro-magnetic

"We tried several approaches, but in the end we landed upon the simplest way of measuring sand content: that of grains of sand flowing across the probe every second".

– False alarms, on- vs offshore operators

Phase 2: trends, not numbers

”I'm quite certain we have sand entering the well,” he continues, ”but then I look at the down-hole pressure here,” pointing at a green trend line plotted in the same coordinate system. "I realize that almost no fluids are streaming through the well. I would normally ask the control room operators to choke down [that is, reduce the flow rate on the well] to prevent sand from damaging the production equipment. In this case, however, I am asking them to choke up. We are dangerously close to a shut-in pressure where sand will simply flow back down the pipeline."

”It [the information] was just [presented as] a number, but what does that number mean? They needed to see trends, and be aware of the system's limitations. They needed to consider factors that affected the measurements, but which were not sand related. So, if they had an alarm, they had to manually assess whether the alarm was an actual incident."

Phase 3:

predictive algorithm

” We quickly realized that input data comes with a lot of uncertainties. (…)
When the quality of the input data varies the visualized output is basically meaningless.
So we had to implement a way of visualizing the input data, too."

Phase 4:

calibration by tethering simulation to post-hoc measurement

”Say we monitor 100 wells. For 80 of these wells this sand rate will have no erosion consequence [that is: it will not, within the set time period result in erosion that is outside safe levels]. For these there is no problem. But for the remainder 20 wells erosion may be an issue, and the production engineers need to pay particular attention to them.

Stages of digitalization, summarized

Phase	Focus	Key technologies	Central actors
Phase 1: Monitoring sand content in well flow (mid-1990s-early 2000s)	Real-time measurement of sand content as characteristic of the well flow to replace manual and time-consuming sand monitoring practices. Operational principle of zero sand tolerance implemented as immediate shut-in of sanding well.	Digital sand sensors (acoustic, electrical resistance) Algorithms transforming acoustic/electrical resistance data into measure of sand content in well flow Simple user interface to sensor measurements	Digital sand mitigation within offshore control room operators' production control practices for minimizing disruptions to offshore processing plant. Onshore production engineers supported control room operators in investigating sand alarms.
Phase 2: Monitoring events within reservoir (early 2000s)	Combining real-time measurements with geomechanical theory with geo-mechanical knowledge on causes of sand influx transforms digital sand from characteristic of well flow to an indicator of events unfolding within the reservoir. Zero sand tolerance policy implemented through diversification of sand mitigation strategies fitted with the kinds of sand event causing sand influx.	Visualizations of sand content data development over time in trends Inclusion of data points from other sensors (temperature, pressure) to better identify false alarms Dashboard aggregating alarms across all wells on the oil field	Sand mitigation nominally within offshore control room operators' production control practices. I Sand mitigation handled in practice by onshore production engineers to limit the impact of sand incidents on optimizing daily production volumes.
Phase 3: Predictive sand monitoring (2005 and onwards)	From zero sand tolerance policy towards predicting the effect of producing with limited amounts of sand in the well flow.	Algorithm for predicting erosion on pipeline bends and valves	Sand monitoring exclusively in the domain of optimizing daily production volumes by coordinating erosion of production equipment with bi-annual maintenance shutdowns of the offshore plant.

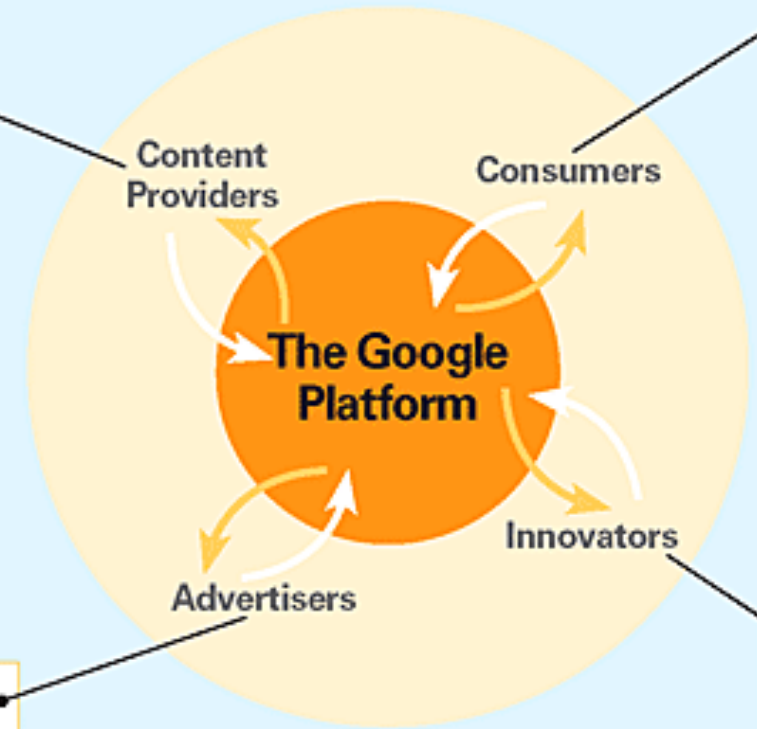
Platforms & ecosystems

A ’platform’

- What is it?
- Why does it matter?


the
Coca-Cola

Google's Innovation Ecosystem



Media companies, individuals

- Create information
- Stimulate consumer interest; foster community
- Provide delivery mechanism for targeted ads

132 million unique visitors per day (as of 11/2007)

- Search for information and reveal interests
- Consume targeted advertising
- Validate appeal and test performance and marketing of innovations
- Contribute ideas for improvements
- Become new products' commercial users

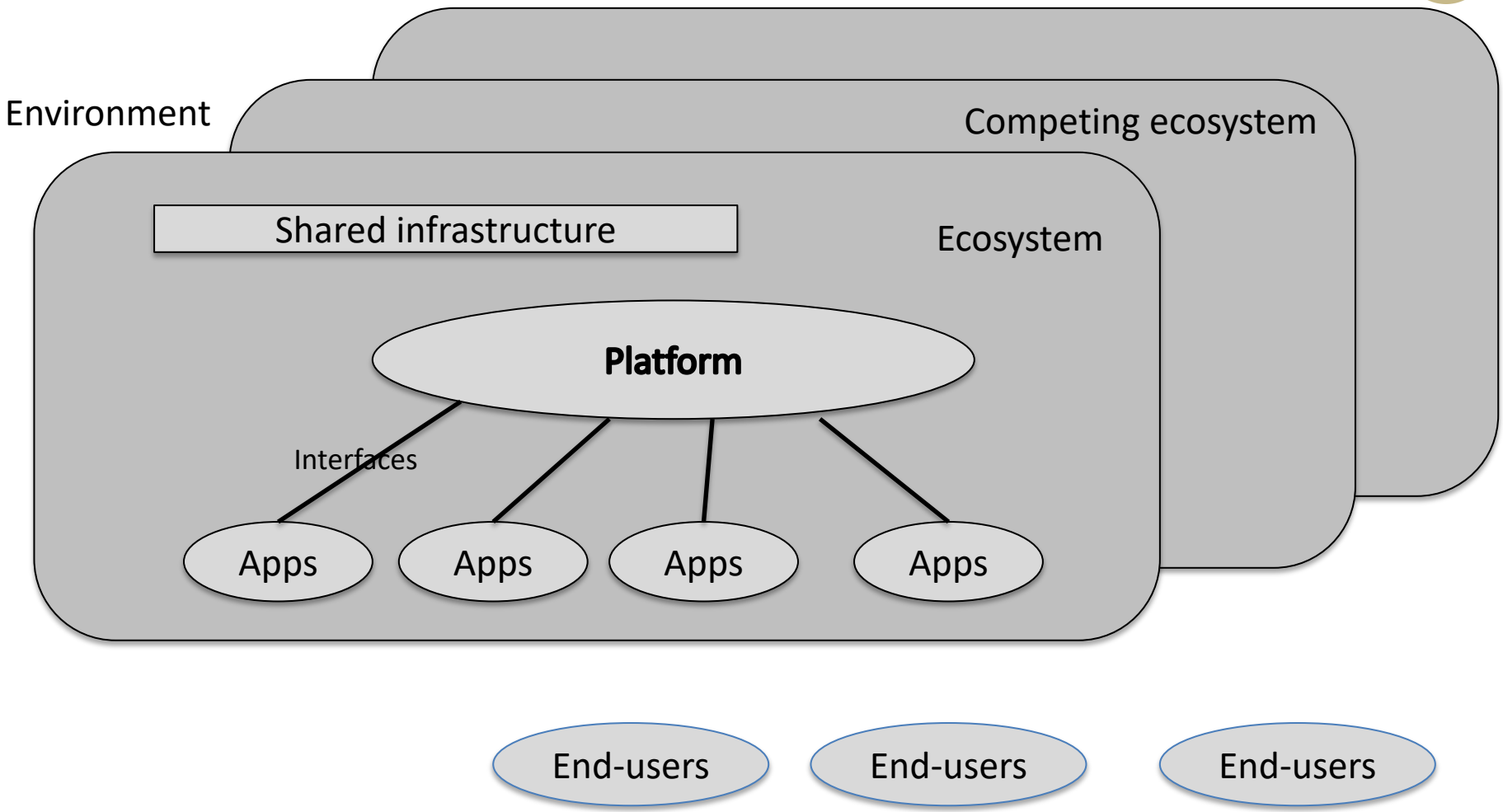
Over 1 million companies and individuals

- Deliver relevant ad content to search-identified users
- Generate vast revenue stream that supports Google
- Help monetize innovators' new offerings

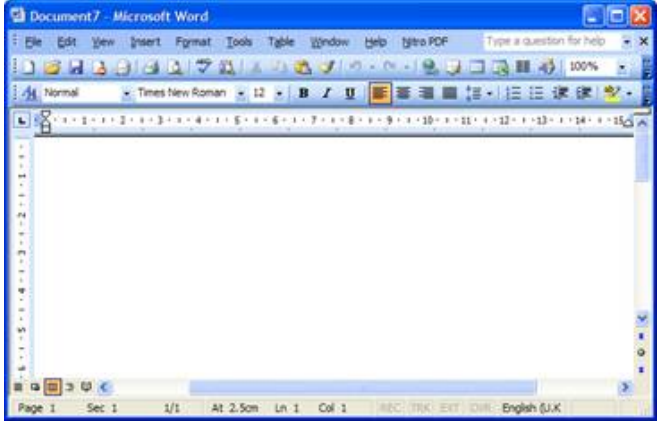
Mashup creators, independent software vendors, Google engineers, open source community

- Together, make up a diverse product-development network
- Develop new offerings that help keep consumers engaged and Google "sticky"
- Generate revenue for themselves and for Google
- Extend value of Google's tools and technology

Elements of a platform ecosystem



Network externalities



- External to user/technology relation

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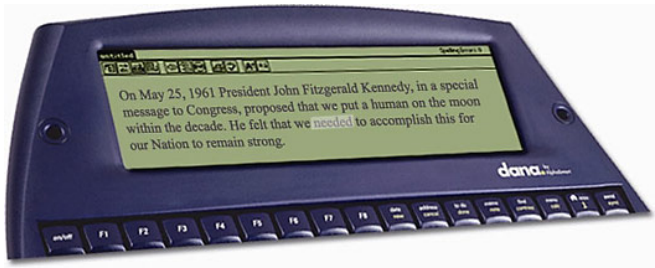


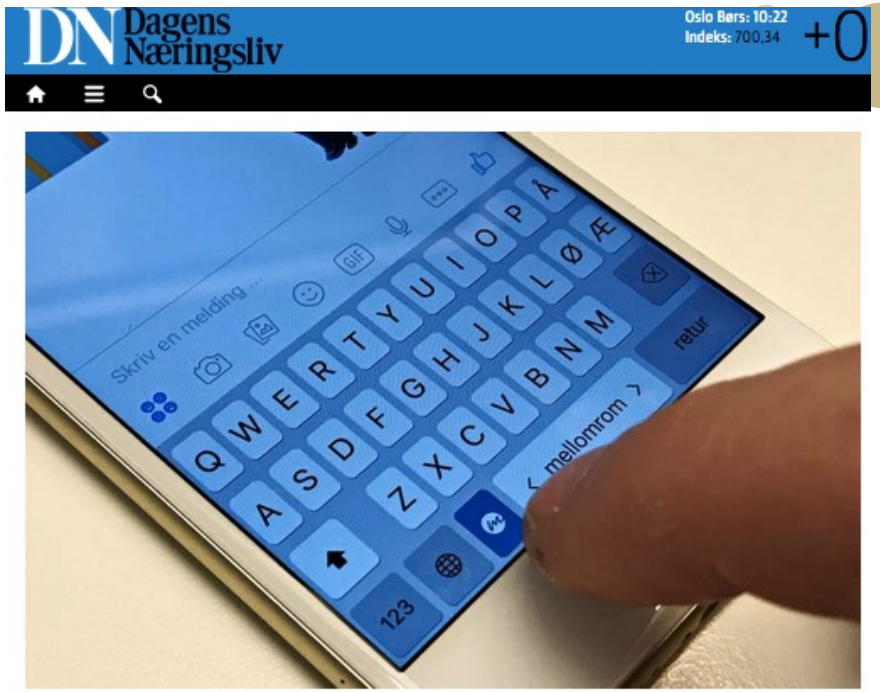
- Tied to network of other users

http://www.computerhope.com

Lock-in

Ex.: payment platforms

- Banks:
  - Accounts/ transactions
  - Debit cards
- Credit card companies
  - Digitalization of the card
- Telecom
  - Charged as teleservices
- Mobile phone
  - In-app payment
  - mCash, Vipps, ...



Betalingstjenesten Mcash fra Sparebank 1 lanserer et eget tastatur som lar deg overføre penger fra alle apper.
Foto: Magnus Eidem

Nyheter Teknologi

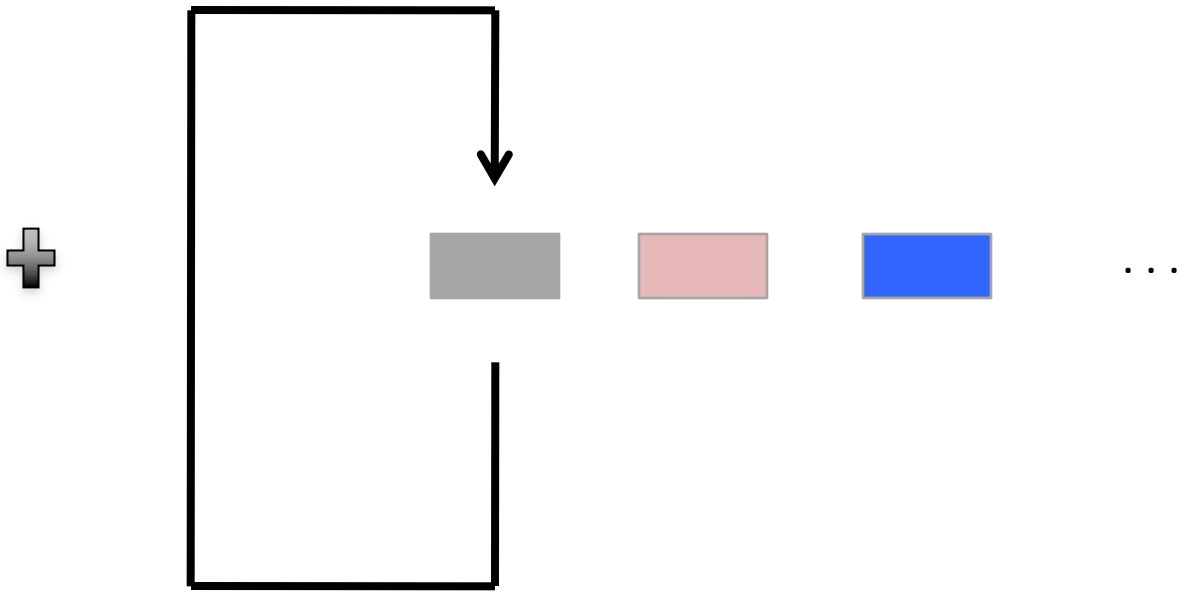
Mcash med nytt trekk i mobilbetalingskampen

Ny funksjon lar deg sende penger fra alle meldingsapper.

Magnus Eidem
Publisert: 16.12.2016 – 12:15 Oppdatert: 16.12.2016 – 12:15

Network externalities

- Same-side vs cross-side effects



- Ex.: iOS & Apps (cross-side)
- Ex: traffic, cars (same-side)

Chicken-or-egg

- How to bootstrap?

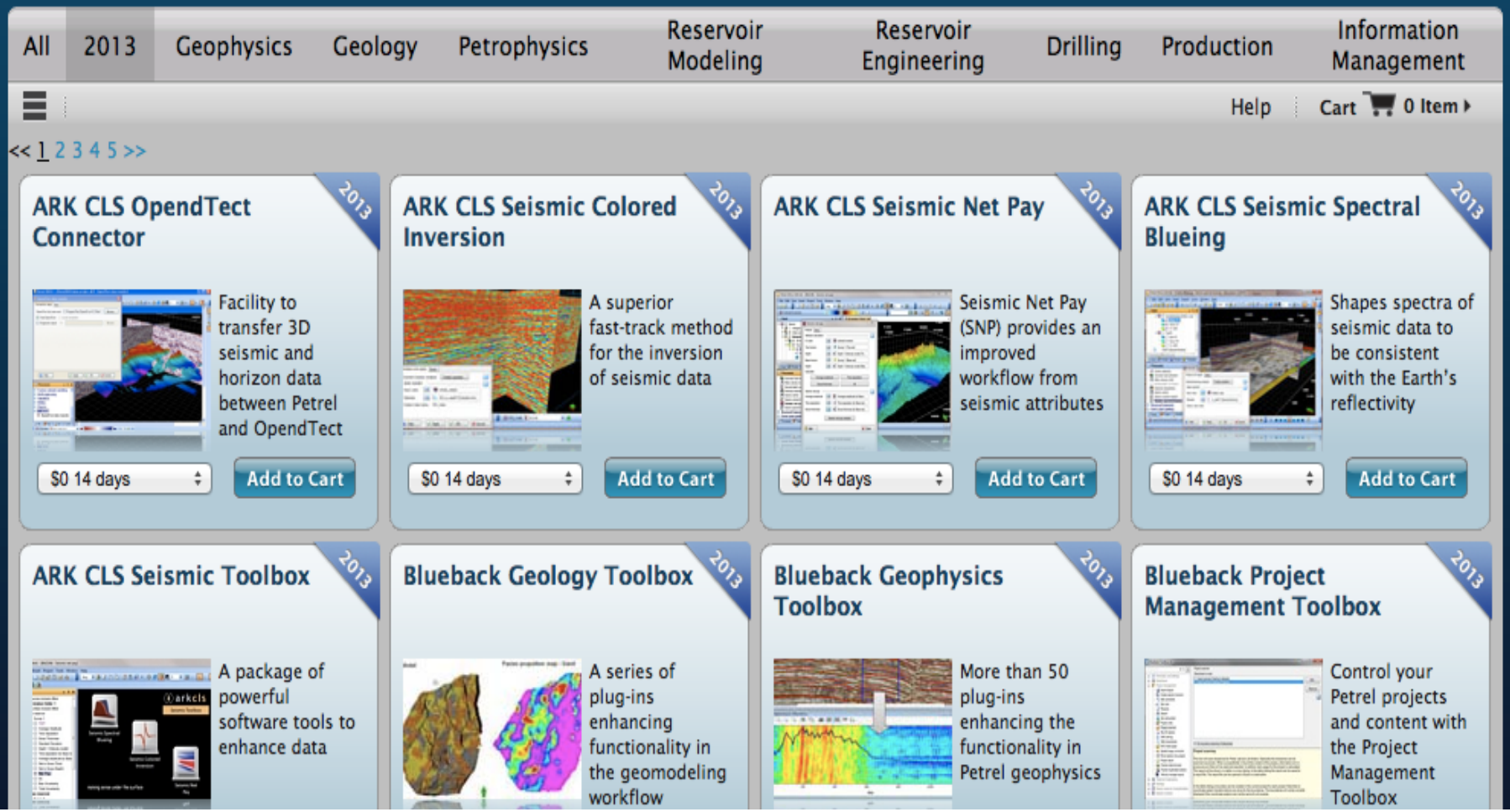
- Non-linear effects
- Collective action: 1 + 1 = 2 ?
  - Bandwagon effect
  - game theory
    - Ex: crossing a street (non-linearity)
    - Ex: traffic junction (coordination)
- Subsidize?
- Ex 1.: Public goods (=platforms) paid by government (roads, infrastructure,…)
- Ex 2.: cross-side network externalities

Evoluton in platforms

- Differentiate from competitors

- Create value
  - Valuable?
  - Rare?
- Sustain value
  - Inimitable?
  - Non-substitutable?
- Resources: capabilities, functionality, user base, apps, patents, reputation, ...

Ex.: Schlumberger's Ocean platform



Subsidizing: how much, how long?

- Pdf: readers for free, premium for editing/ sharing/ commenting/..
- Logic of network externalities: size is everything
- Facebook ”growth is everything”
- Content is king (youtube)

New business models, from ‘liquefaction’

The building stones of economic exchange transformed :

- The object, shifting from product to services
- The means, from physical to digital (platforms, markets)

As there arises

- New actors
- New roles
- New forms of value

Ex.: largest taxi service owns no taxies, largets house rental owns no houses ...

Conclusion

Learning outcomes

- Historic background of ICT/ digitalization
- Effects of ICT on employment, investments: transformation
- Sociotechnical understanding of use, uptake, diffusion of ICT
- Novelty with digitalization:
  - Liquefaction (IoT key)
  - Data science (mentioned but not covered here)
  - Platform/ ecosystems

Readings

Mandatory:

Østerlie, Thomas, and Eric Monteiro. "Digital sand: The becoming of digital representations." *Information and Organization* 30, no. 1 (2020): 100275.

Recommended:

Brynjolfsson, Erik, and Lorin M. Hitt. "Beyond computation: Information technology, organizational transformation and business performance." *Journal of Economic perspectives* 14, no. 4 (2000): 23-48.

Tiwana, Amrit. *Platform ecosystems: Aligning architecture, governance, and strategy*. Newnes, 2013.