Aspetos Profissionais e Sociais da Engenharia Informática

Big tech: the hyperscaling effect…

Rui L Aguiar, UA/IT

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Recap of the classes…

- Telecommunications ecosystem
  - Models of engineering, objective of informatics
  - ICT, IoT
  - The engineer and legal status; taxes
- Standardization, IPR and OpenSource
  - Derivative works, license models
- Ethics and conceptual problems (identities)
  - Trolly, Theseus.
- Artificial Intelligence
  - Social aspects, law
- Cybersecurity
  - Crime, social and personal responsability
  - reputation
  - Cybersec ecossystem and lawful interception
  - GPDR
- The Effect of networking **(last lecturing)**
  - Social networks
  - Scalling
- The models
  - How networks work
  - What can be this be modelled.

2

2

Today

- Hyperscalers
  - What are they
  - And why are they relevant
  - Final reflection: what is informatics?
- Pratical works
  - #3
  - #4

3

3

NETWORKING EFFECTS

4

Network Effects?

- Same-side effects
  - direct network effects that occur on the same side of a multi-sided (2-sided or N-sided) network
- Cross-side effects
- Indirect
- Critical Mass
- Assymptotic returns
  - network effects with diminishing returns
- Negative network effects

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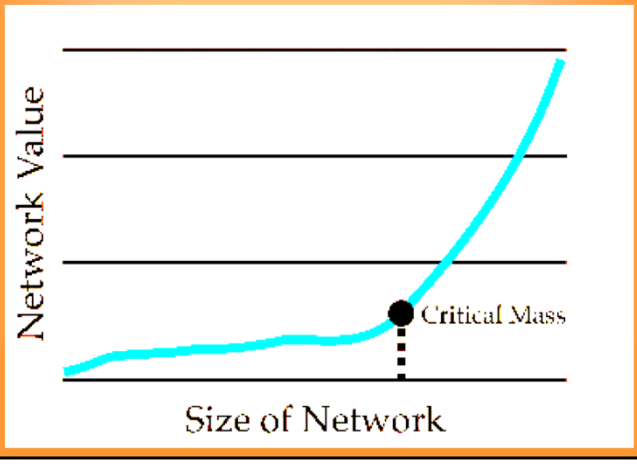
Critical mass

The critical mass of a network refers to the point at which the value produced by the network exceeds the value of the product itself and of competing products.



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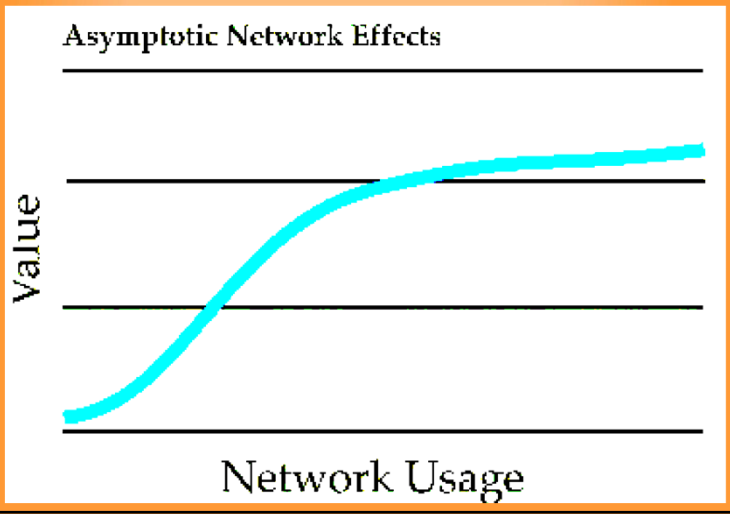
Asymptotic Effects

- Law of diminuishing returns



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Networking effects in informatics

- There are ways of looking into the networking effects
- We can model them!
  - And derive what to do to be sucessful
  - Hyperscalers explore these in terms of technology and **economics.**

Any succesfull technology in our field explores network effects in some way

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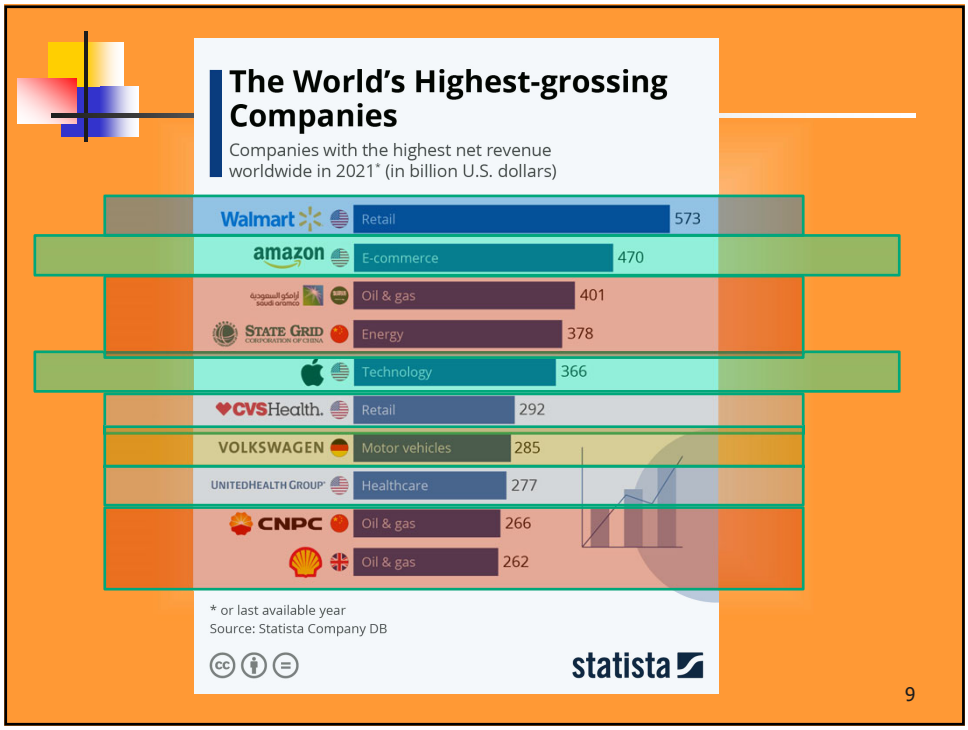
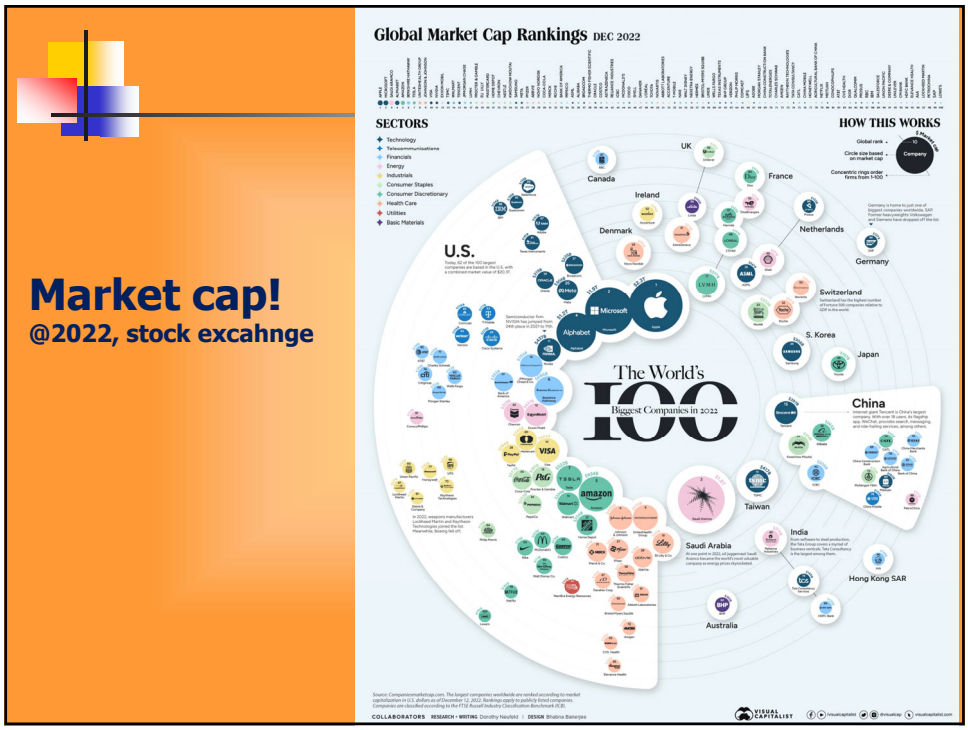
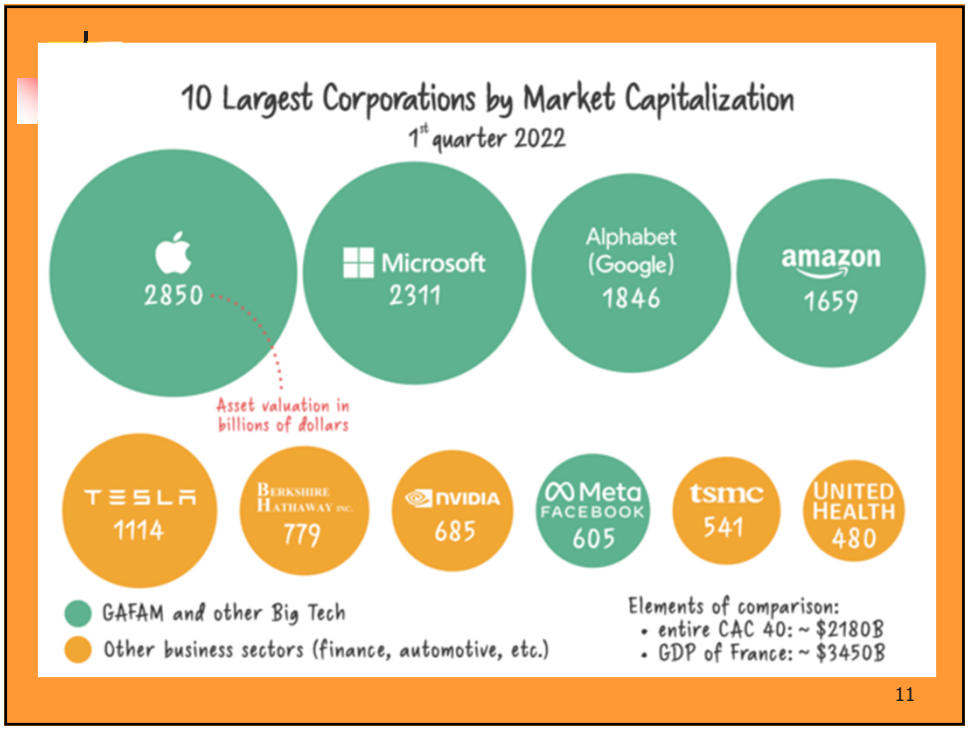

The World's Highest-grossing Companies
Companies with the highest net revenue worldwide in 2021* (in billion U.S. dollars)
Walmart Retail 573
amazon E-commerce 470
Saudi Aramco Oil & gas 401
State Grid Corporation of China Energy 378
Technology 366
CVSHealth. Retail 292
VOLKSWAGEN Motor vehicles 285
UNITEDHEALTH GROUP Healthcare 277
CNPC Oil & gas 266
Oil & gas 262
* or last available year
Source: Statista Company DB
statista
9

9


Market cap!
@2022, stock excahnge
Global Market Cap Rankings DEC 2022
SECTORS
HOW THIS WORKS
U.S.
Canada
UK
Ireland
France
Denmark
Netherlands
Germany
Switzerland
S. Korea
Japan
China
Taiwan
India
Saudi Arabia
Hong Kong SAR
Australia
The World's 100 Biggest Companies in 2022

10



11

FANG

- Facebook
- Amazon
- Netflix
- Google
- Later…
  - Apple

12

12

FANG

- Facebook
- Amazon
- Netflix
- Google
- Later…
  - Apple

MAMAA

- Meta
- Alphabet
- Amazon
- Apple
- Microsoft

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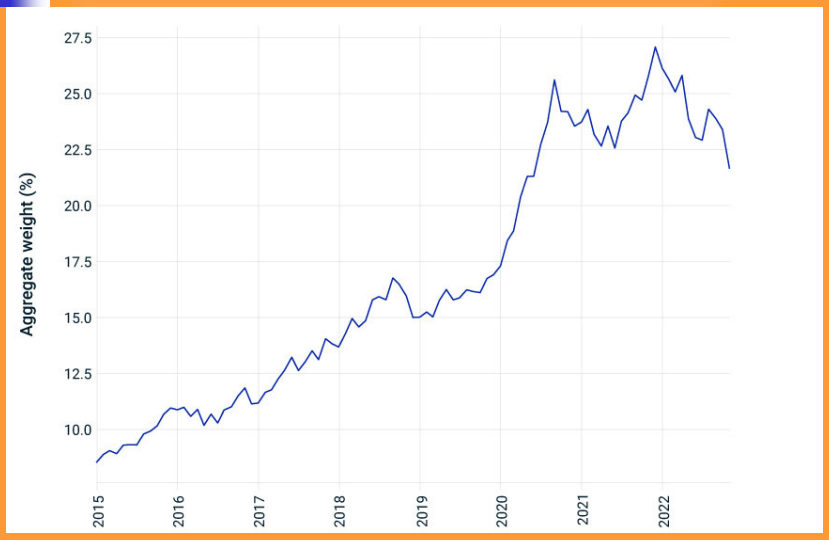
Hyperscalers (big tech) in financial markets



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Big tech

- Meta
  - Facebook, Instagram
  - WhatsApp, Messenger
  - Virtual reality (Metaverse)
- Amazon
  - E-commerce giant
  - Prime, AWS
- Apple
  - Phone
  - AppStore ecosytem: vídeo, music streaming, cloud
- Netflix
  - Dominant vídeo streaming
    - Large competition appearing: Disney+, HBO, etc..
- Alphabet
  - Google
  - Android, PlayStore
  - Google Cloud, Waymo, etc..
- Microsoft
  - Windows, Office
  - Xbox
  - Azure, LinkedIn, … openAI

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15

Big tech

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  - Google
  - Android, PlayStore
  - Google Cloud, Waymo, etc..
- Microsoft
  - Windows, Office
  - Xbox
  - Azure, LinkedIn, … openAI

Stock/Index	Total Return since March 1, 2009
META	307%
Amazon	877%
Apple	578%
Netflix	1,530%
Google	638%
Microsoft	729%
S&P 500	181%

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Largest Tech Companies by Revenue

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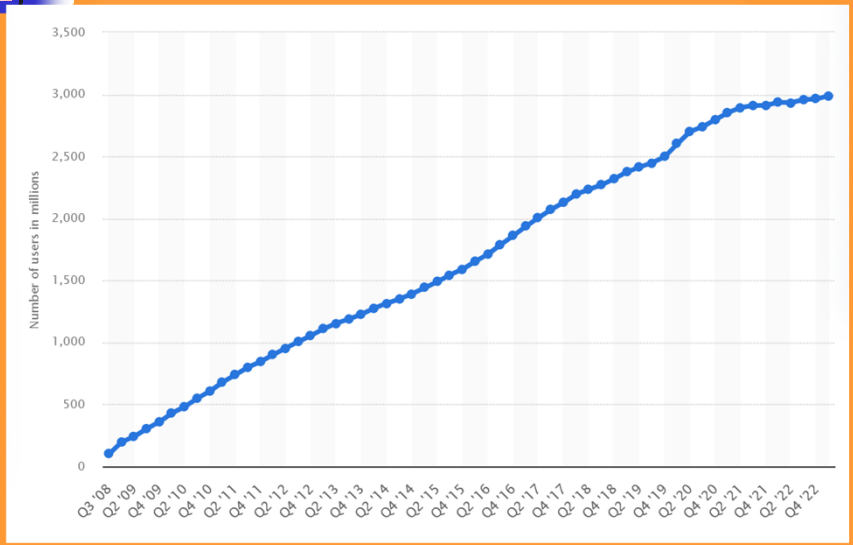
17

Facebook growth



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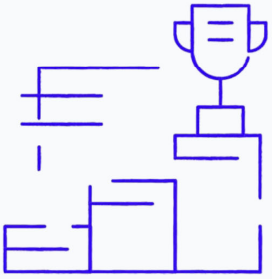
Google Dominates
the Search Engine Market

Google has

91.9%

of the market share
as of January 2022.

(GS Statcounter, 2022)



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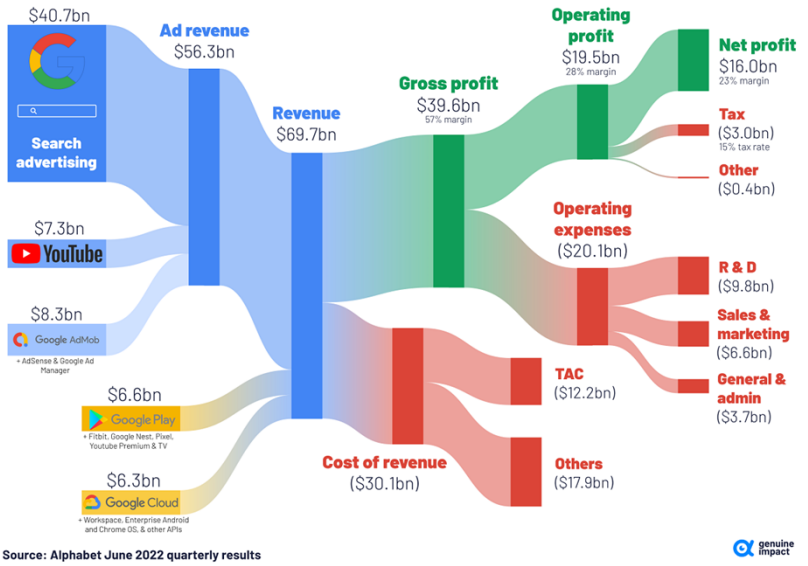
Alphabet June-2022 Quarterly Income Statement

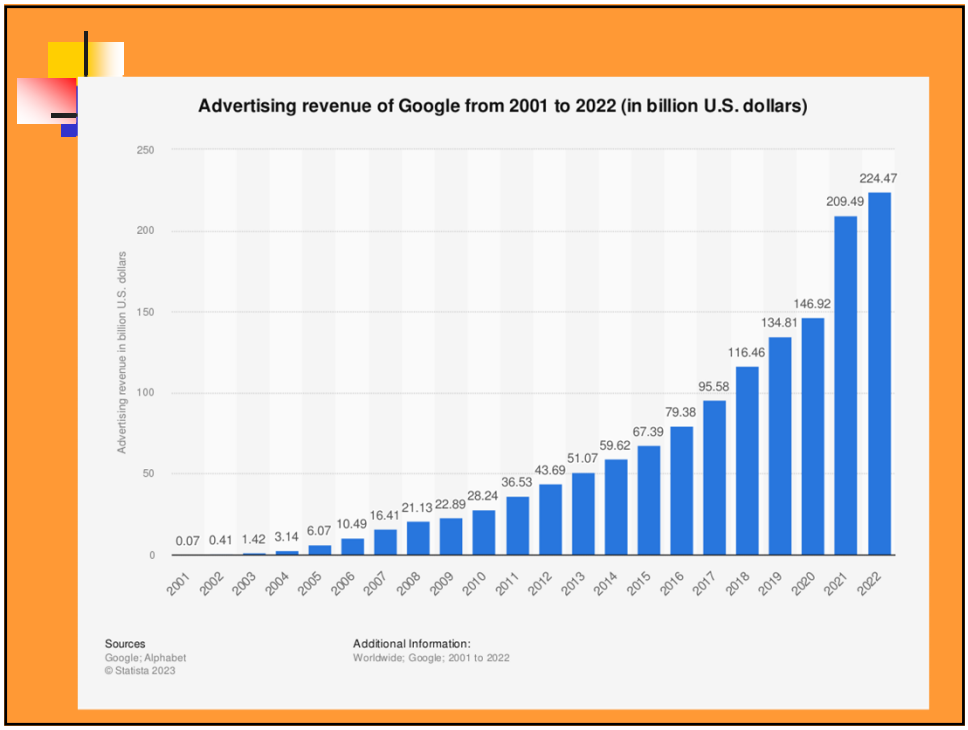


Source: Alphabet June 2022 quarterly results

genuine impact

20

20


Advertising revenue of Google from 2001 to 2022 (in billion U.S. dollars)
Advertising revenue in billion U.S. dollars
250
200
150
100
50
0
0.07
0.41
1.42
3.14
6.07
10.49
16.41
21.13
22.89
28.24
36.53
43.69
51.07
59.62
67.39
79.38
95.58
116.46
134.81
146.92
209.49
224.47
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Sources
Google; Alphabet
© Statista 2023
Additional Information:
Worldwide; Google; 2001 to 2022

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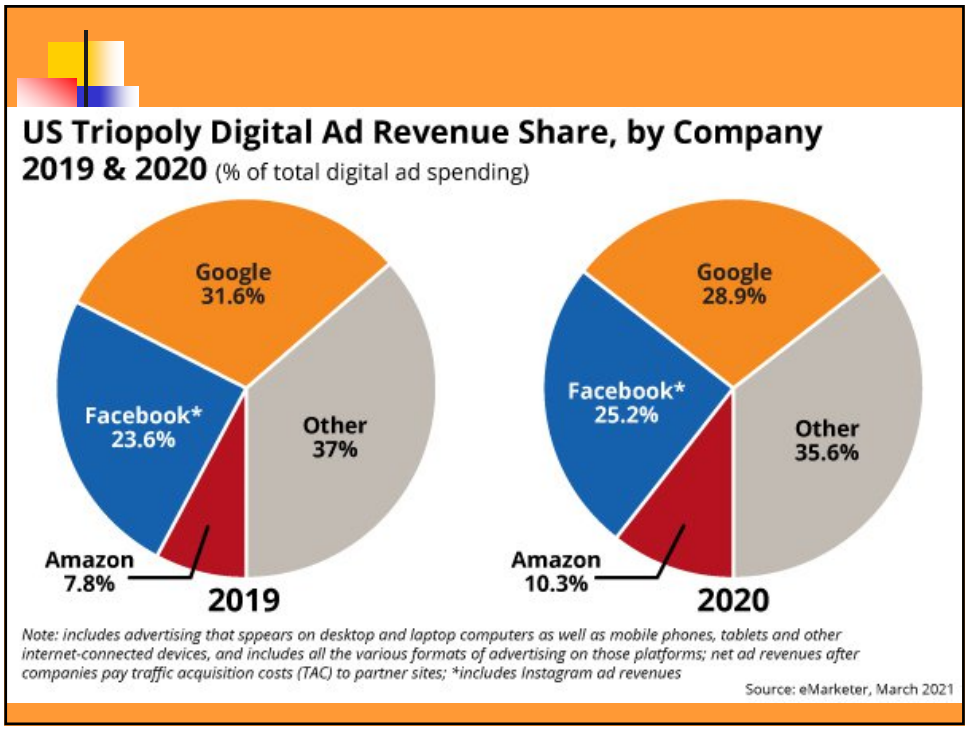
US Triopoly Digital Ad Revenue Share, by Company
2019 & 2020 (% of total digital ad spending)
Google
31.6%
Facebook*
23.6%
Other
37%
Amazon
7.8%
2019
Google
28.9%
Facebook*
25.2%
Other
35.6%
Amazon
10.3%
2020
Note: includes advertising that sppears on desktop and laptop computers as well as mobile phones, tablets and other internet-connected devices, and includes all the various formats of advertising on those platforms; net ad revenues after companies pay traffic acquisition costs (TAC) to partner sites; *includes Instagram ad revenues
Source: eMarketer, March 2021

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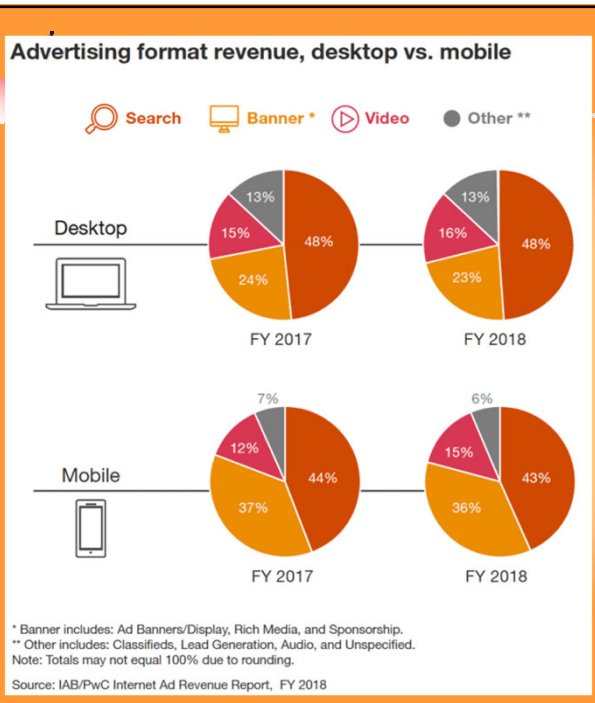

When you do not see what the product is, you are part of the product

… more on this later…

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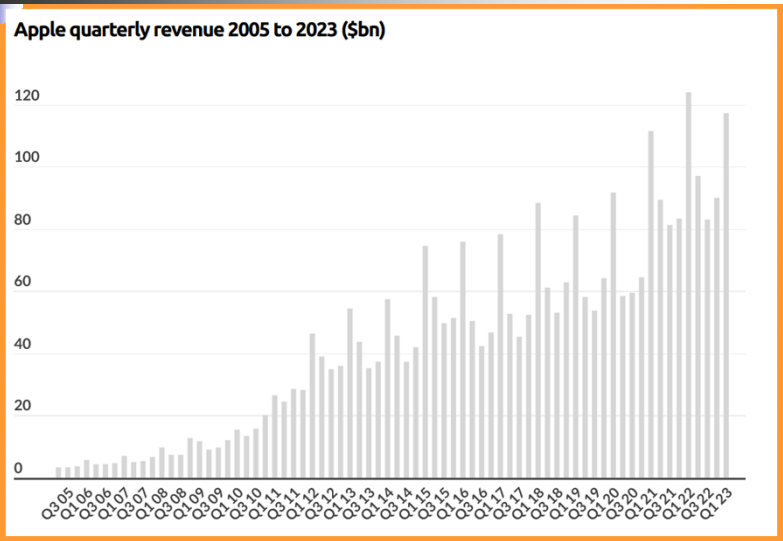

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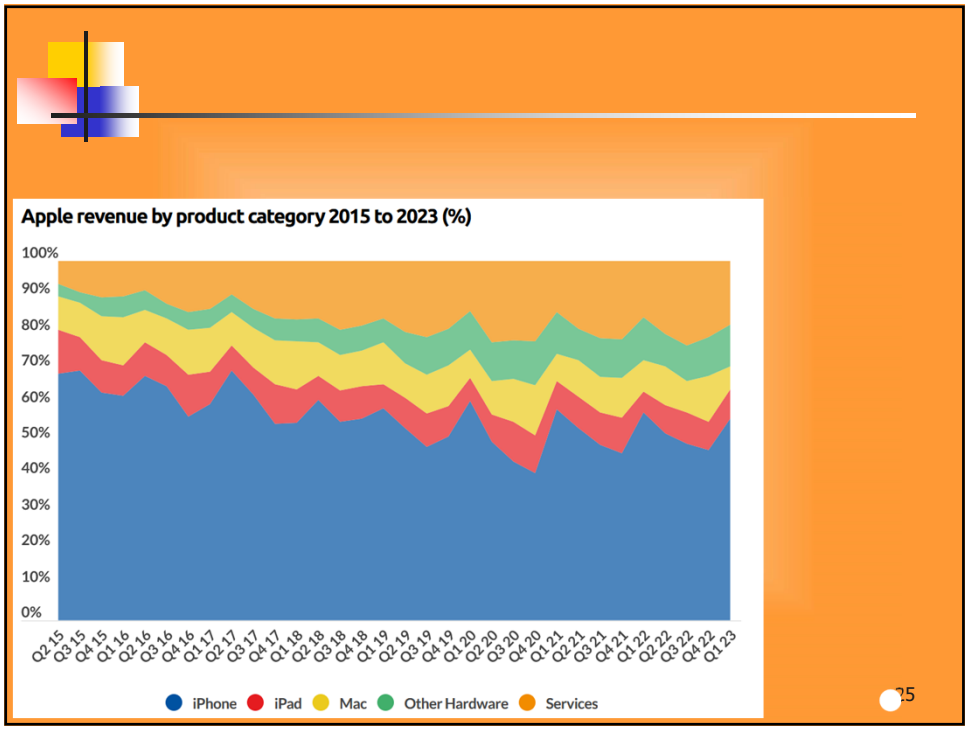
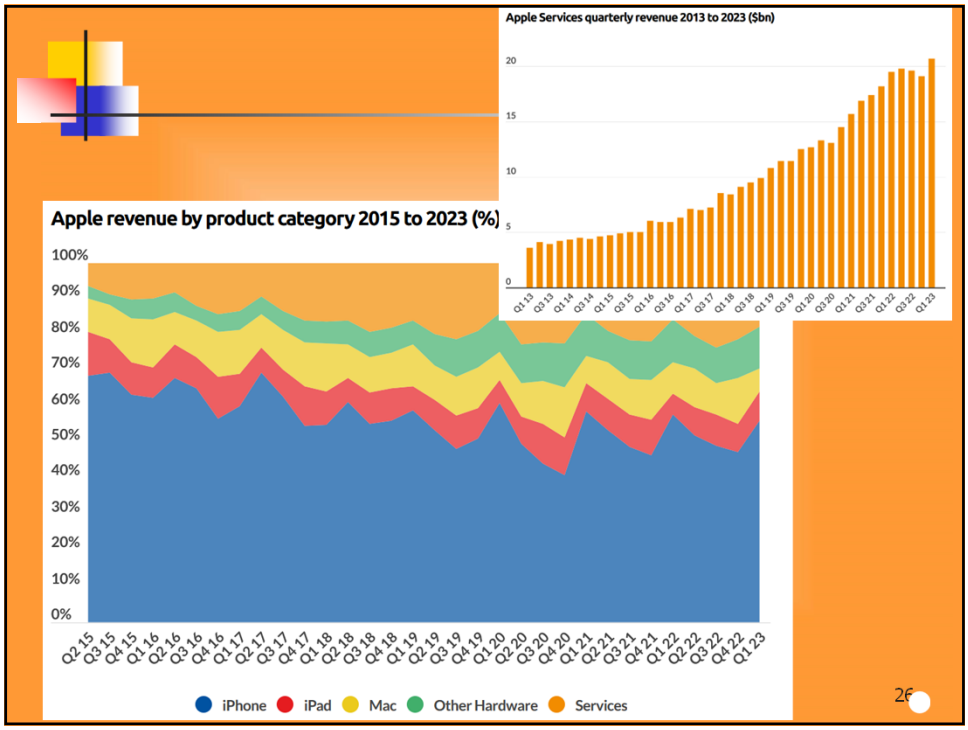
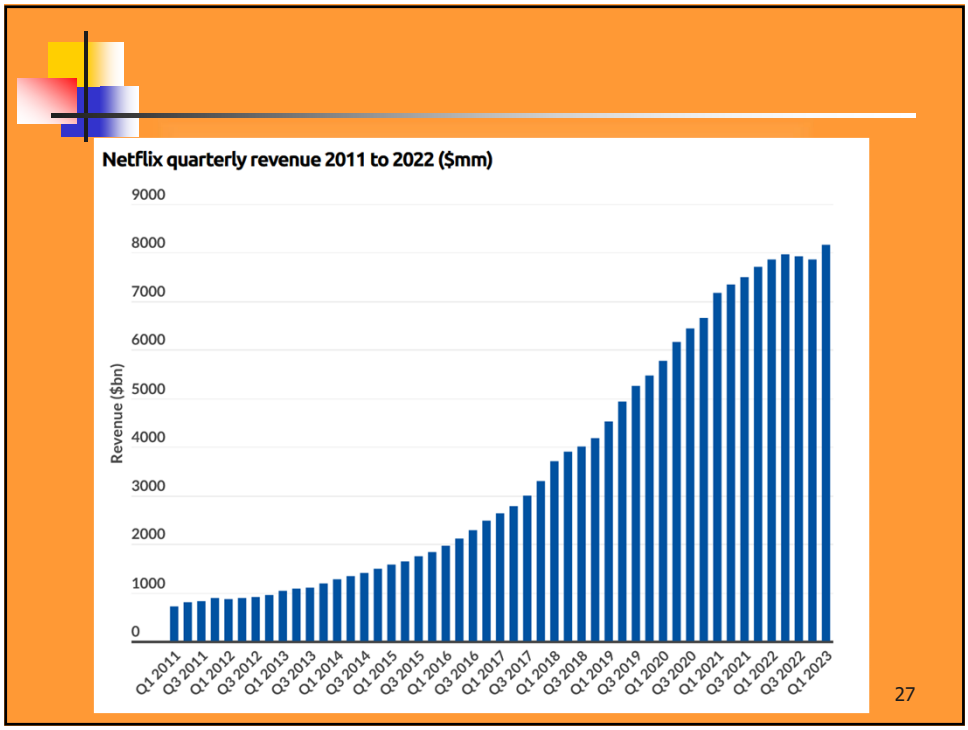

Apple revenue by product category 2015 to 2023 (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Q2 15 Q3 15 Q4 15 Q1 16 Q2 16 Q3 16 Q4 16 Q1 17 Q2 17 Q3 17 Q4 17 Q1 18 Q2 18 Q3 18 Q4 18 Q1 19 Q2 19 Q3 19 Q4 19 Q1 20 Q2 20 Q3 20 Q4 20 Q1 21 Q2 21 Q3 21 Q4 21 Q1 22 Q2 22 Q3 22 Q4 22 Q1 23
iPhone
iPad
Mac
Other Hardware
Services
25

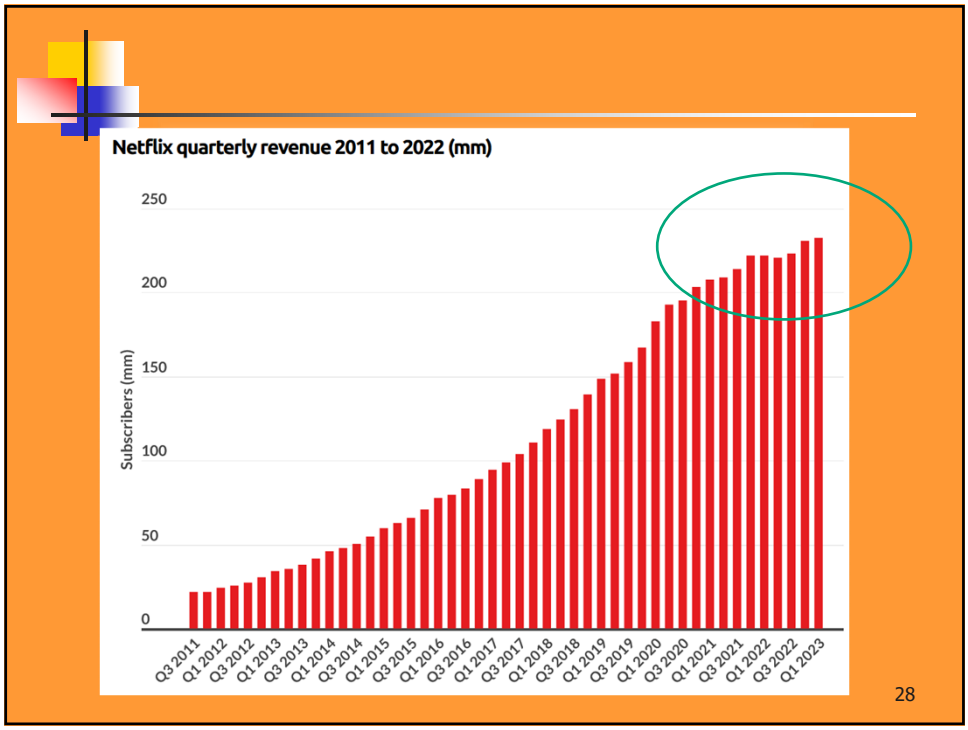
25


Apple Services quarterly revenue 2013 to 2023 ($bn)
20
15
10
5
0
Apple revenue by product category 2015 to 2023 (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Q2 15 Q3 15 Q4 15 Q1 16 Q2 16 Q3 16 Q4 16 Q1 17 Q2 17 Q3 17 Q4 17 Q1 18 Q2 18 Q3 18 Q4 18 Q1 19 Q2 19 Q3 19 Q4 19 Q1 20 Q2 20 Q3 20 Q4 20 Q1 21 Q2 21 Q3 21 Q4 21 Q1 22 Q2 22 Q3 22 Q4 22 Q1 23
iPhone
iPad
Mac
Other Hardware
Services

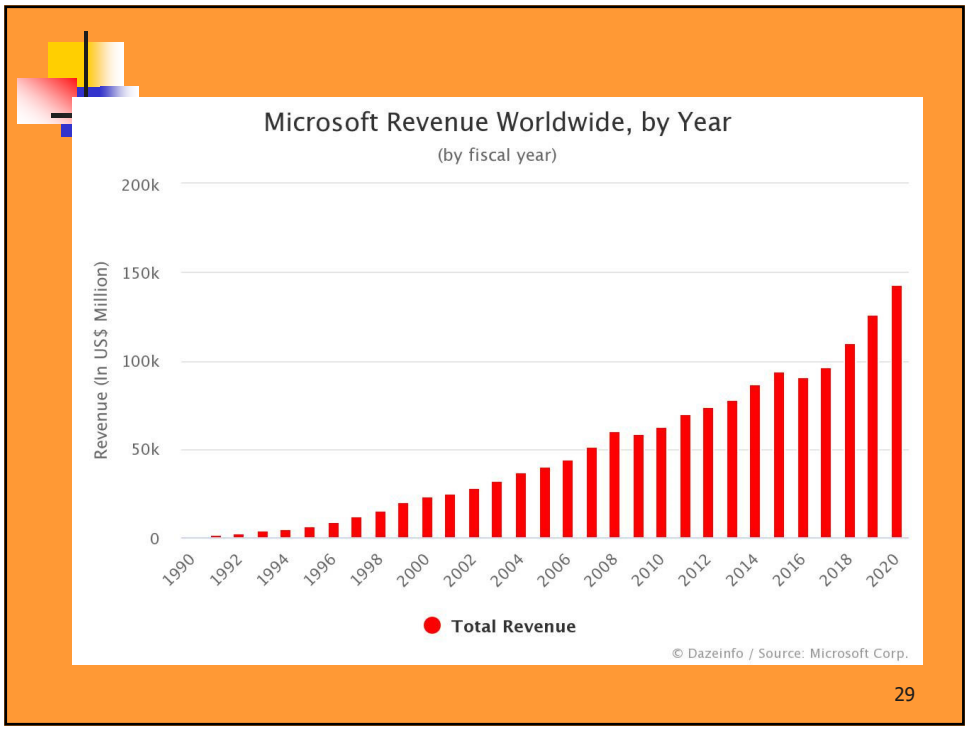
26


Netflix quarterly revenue 2011 to 2022 ($mm)
Revenue ($bn)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Q1 2011
Q3 2011
Q1 2012
Q3 2012
Q1 2013
Q3 2013
Q1 2014
Q3 2014
Q1 2015
Q3 2015
Q1 2016
Q3 2016
Q1 2017
Q3 2017
Q1 2018
Q3 2018
Q1 2019
Q3 2019
Q1 2020
Q3 2020
Q1 2021
Q3 2021
Q1 2022
Q3 2022
Q1 2023
27

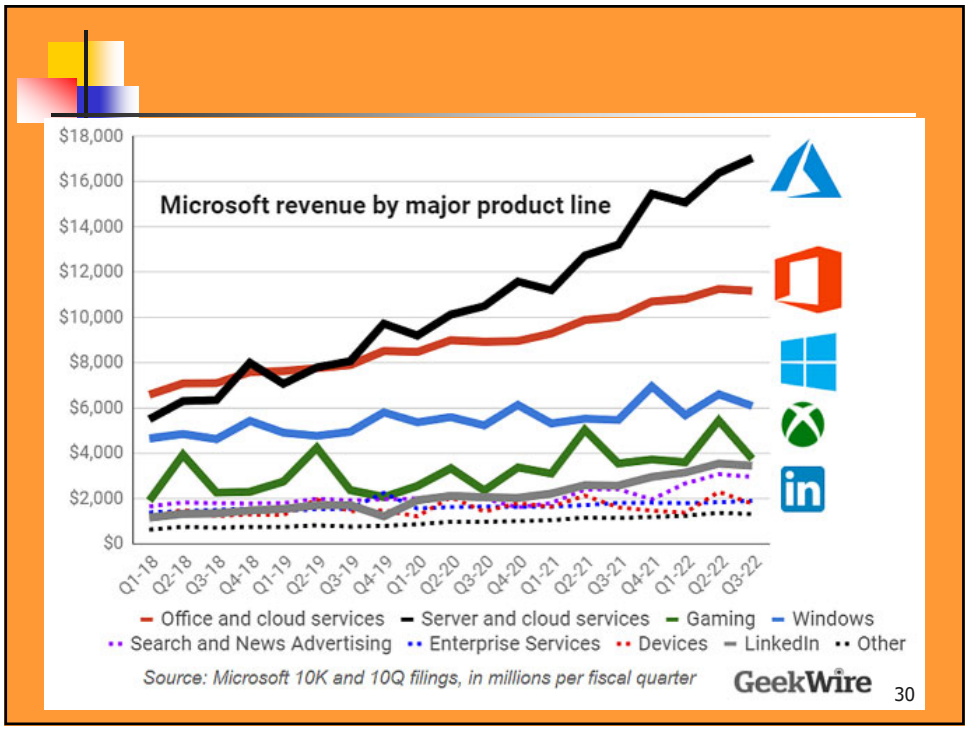
27


Netflix quarterly revenue 2011 to 2022 (mm)
Subscribers (mm)
250
200
150
100
50
0
Q3 2011
Q1 2012
Q3 2012
Q1 2013
Q3 2013
Q1 2014
Q3 2014
Q1 2015
Q3 2015
Q1 2016
Q3 2016
Q1 2017
Q3 2017
Q1 2018
Q3 2018
Q1 2019
Q3 2019
Q1 2020
Q3 2020
Q1 2021
Q3 2021
Q1 2022
Q3 2022
Q1 2023
28

28


Microsoft Revenue Worldwide, by Year
(by fiscal year)
Revenue (In US$ Million)
200k
150k
100k
50k
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Total Revenue
© Dazeinfo / Source: Microsoft Corp.
29

29


Microsoft revenue by major product line
$18,000
$16,000
$14,000
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
Q1-18
Q2-18
Q3-18
Q4-18
Q1-19
Q2-19
Q3-19
Q4-19
Q1-20
Q2-20
Q3-20
Q4-20
Q1-21
Q2-21
Q3-21
Q4-21
Q1-22
Q2-22
Q3-22
Office and cloud services
Server and cloud services
Gaming
Windows
Search and News Advertising
Enterprise Services
Devices
LinkedIn
Other
Source: Microsoft 10K and 10Q filings, in millions per fiscal quarter
GeekWire
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Reaching out to other sectors

FINANCIAL SERVICE OFFERINGS BY BIG TECH COMPANIES

Big tech	Main business	Banking*	Credit provision	Payments	Crowdfunding	Assetmanagement	Insurance
Google	Internet Search/advertising			■			
Apple	Tech/producing hardware			■			
Facebook	Social media/advertising			■			
Amazon	E-commerce/online retail		■	■	■		■
Alibaba (Ant Group)	E-commerce/online retail	■	■	■	■	■	■
Baidu (Du Xiaoman)	Internet search/advertising	■	■	■	■	■	■
JD.com (JD Digits)	E-commerce/online retail	■	■	■	■	■	■
Tencent	Tech/gaming and messaging	■	■	■	■	■	■
NTT Docomo	Mobile Communications	■	■	■	■		
Rakuten	E-commerce/online retail	■		■		■	■
Mercado Livre	E-commerce/online retail		■	■		■	

■ Provision of financial service through big tech entity and/or in partnership with financial instituitions outside big tech group in at least one jurisdiction.

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Reaching out to other markets

- Different approach to the same market

ILLUSTRATION OF VALUE CHAIN FOR APPLE CARD

PRODUCT DESIGN	FINANCIAL RESOURCES	INFRASTRUCTURE & FULFILMENT	PRODUCT DELIVERY	CUSTOMER ANALYTICS	CUSTOMER INTERFACE
Application approval decision	Balance sheet	Card issuance	Payment authentication and approval	Credit assessment	Branding and naming
Card offerings *(merchant discount)*		Card network			Customer portal (Apple Pay)

GOLDMAN APPLE MASTERCARD

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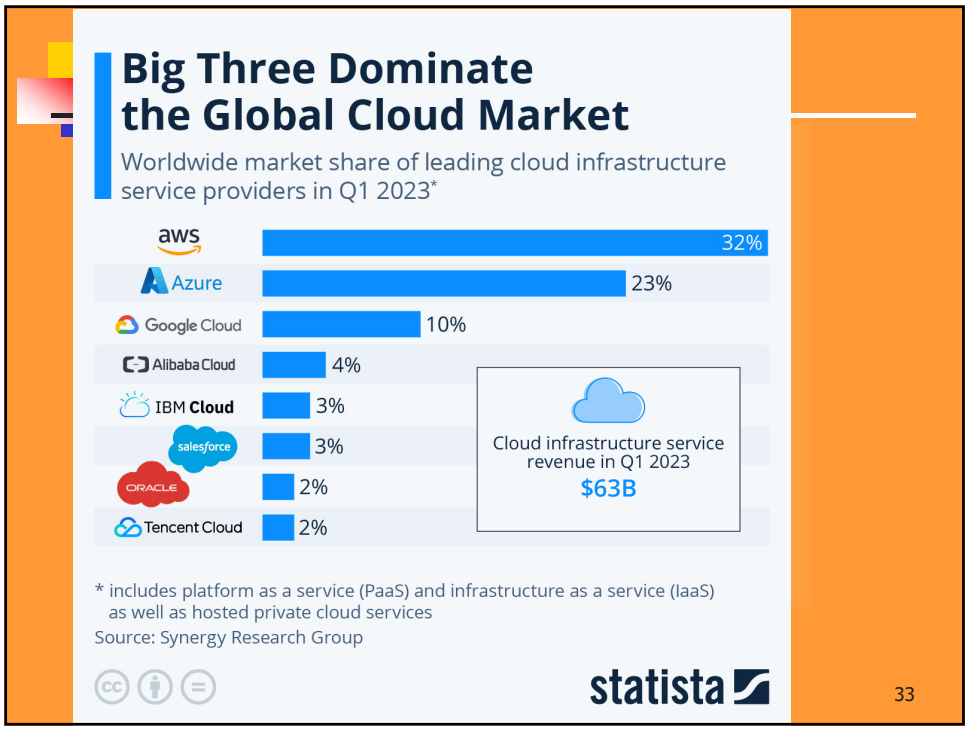

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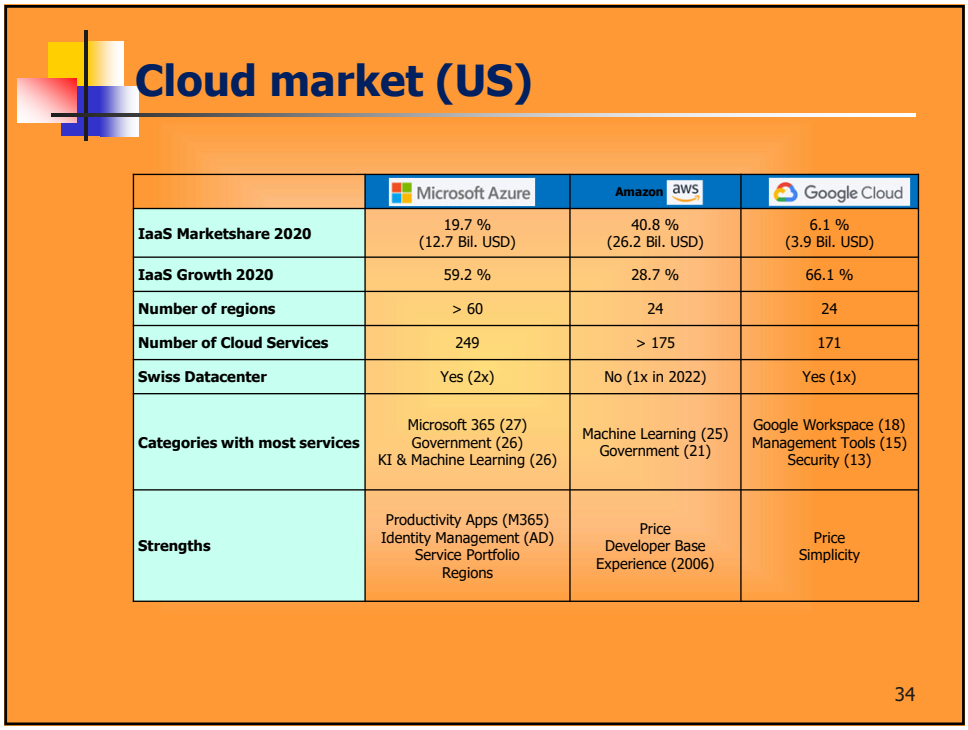

	Microsoft Azure	Amazon aws	Google Cloud
IaaS Marketshare 2020	19.7 % (12.7 Bil. USD)	40.8 % (26.2 Bil. USD)	6.1 % (3.9 Bil. USD)
IaaS Growth 2020	59.2 %	28.7 %	66.1 %
Number of regions	> 60	24	24
Number of Cloud Services	249	> 175	171
Swiss Datacenter	Yes (2x)	No (1x in 2022)	Yes (1x)
Categories with most services	Microsoft 365 (27) Government (26) KI & Machine Learning (26)	Machine Learning (25) Government (21)	Google Workspace (18) Management Tools (15) Security (13)
Strengths	Productivity Apps (M365) Identity Management (AD) Service Portfolio Regions	Price Developer Base Experience (2006)	Price Simplicity

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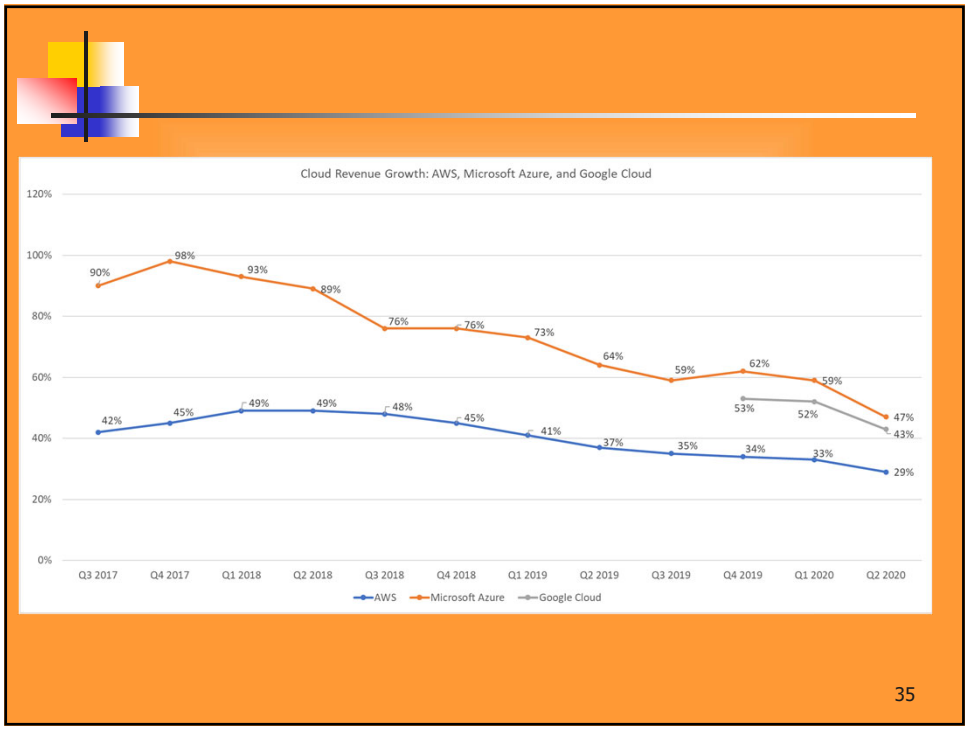
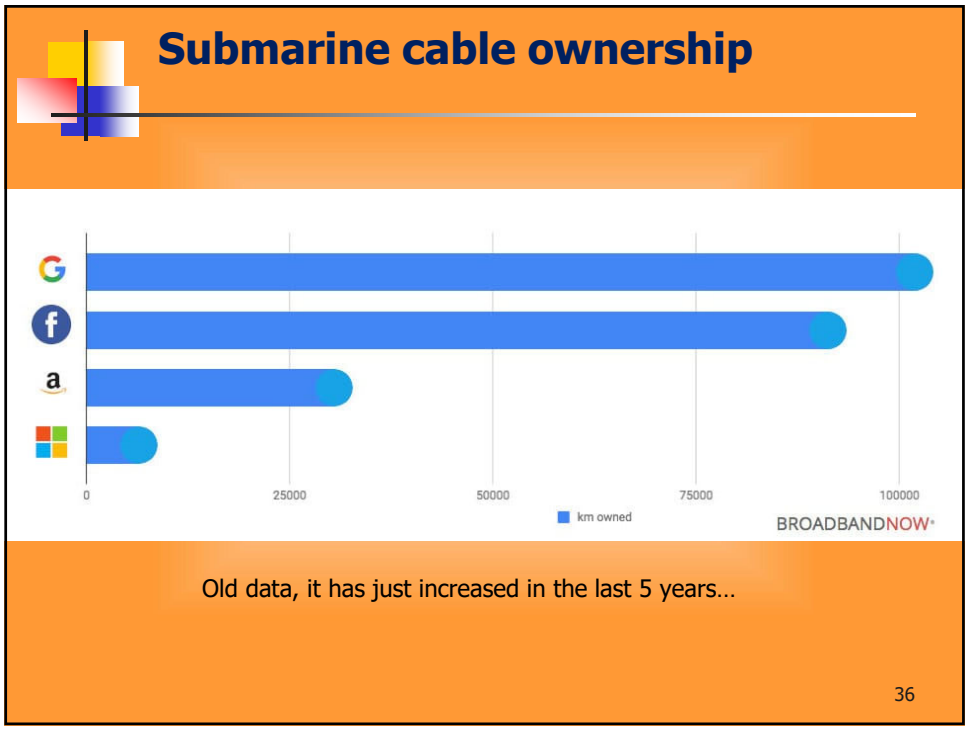
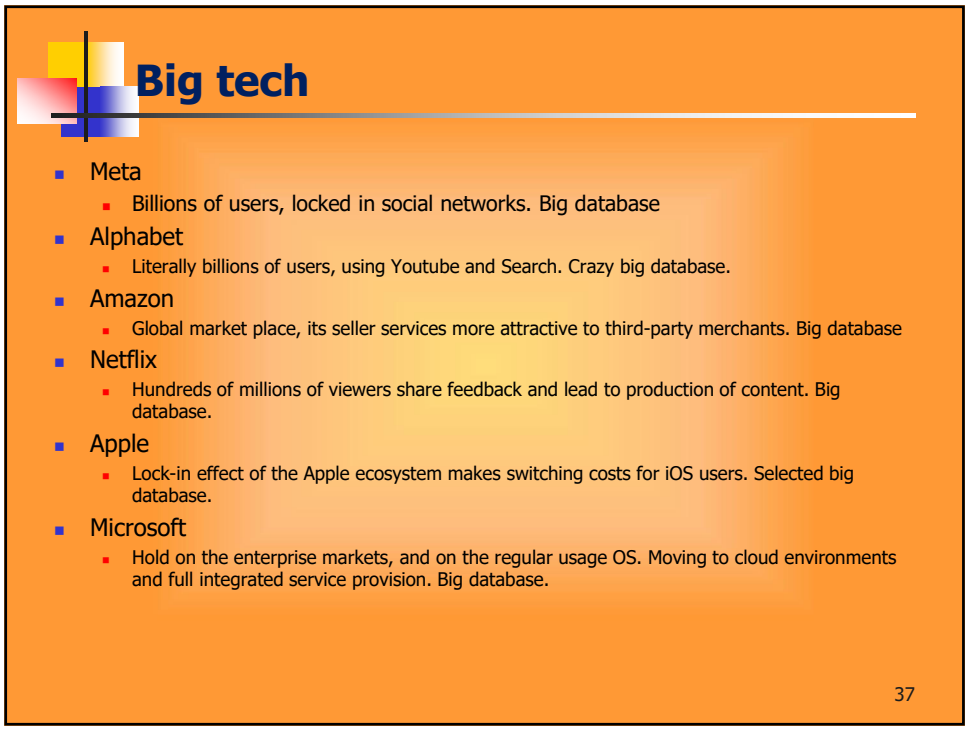

Cloud Revenue Growth: AWS, Microsoft Azure, and Google Cloud
120%
100%
80%
60%
40%
20%
0%
90%
98%
93%
89%
76%
76%
73%
64%
59%
62%
59%
47%
42%
45%
49%
49%
48%
45%
41%
37%
35%
34%
33%
29%
53%
52%
43%
Q3 2017
Q4 2017
Q1 2018
Q2 2018
Q3 2018
Q4 2018
Q1 2019
Q2 2019
Q3 2019
Q4 2019
Q1 2020
Q2 2020
AWS
Microsoft Azure
Google Cloud
35

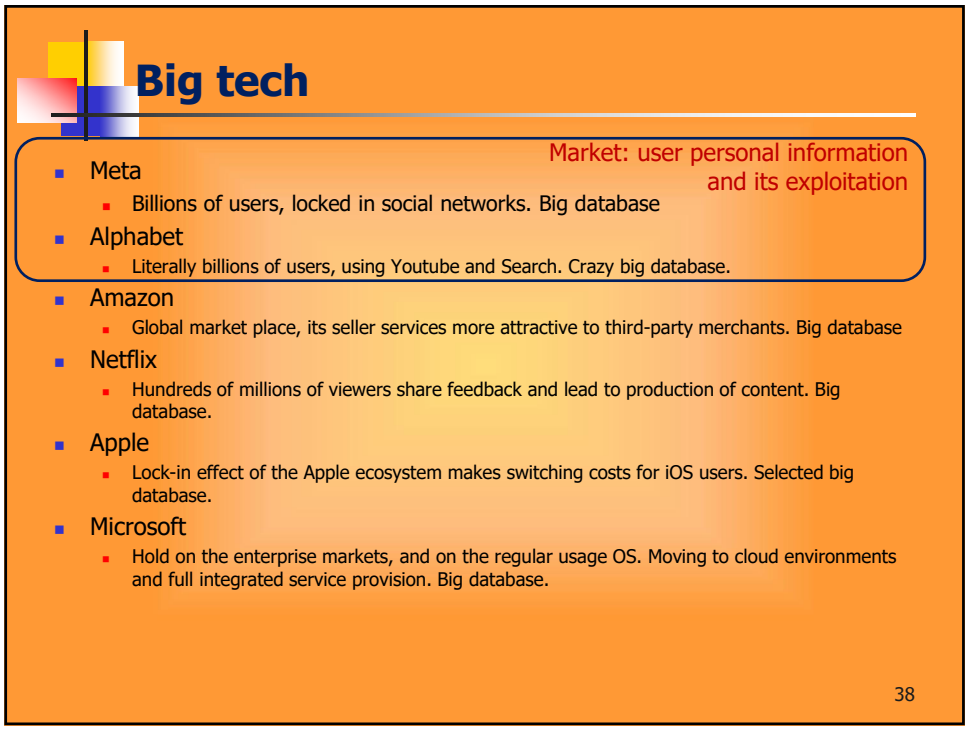
35


Submarine cable ownership
0
25000
50000
75000
100000
km owned
BROADBANDNOW
Old data, it has just increased in the last 5 years…
36

36


Big tech
Meta
Billions of users, locked in social networks. Big database
Alphabet
Literally billions of users, using Youtube and Search. Crazy big database.
Amazon
Global market place, its seller services more attractive to third-party merchants. Big database
Netflix
Hundreds of millions of viewers share feedback and lead to production of content. Big database.
Apple
Lock-in effect of the Apple ecosystem makes switching costs for iOS users. Selected big database.
Microsoft
Hold on the enterprise markets, and on the regular usage OS. Moving to cloud environments and full integrated service provision. Big database.
37

37


Big tech
Market: user personal information and its exploitation
Meta
Billions of users, locked in social networks. Big database
Alphabet
Literally billions of users, using Youtube and Search. Crazy big database.
Amazon
Global market place, its seller services more attractive to third-party merchants. Big database
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Big tech

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Market: shoppers

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Big tech

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- Alphabet
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Market: movie goers

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Big tech

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  - Lock-in effect of the Apple ecosystem makes switching costs for iOS users. Selected big database.
- Microsoft
  - Hold on the enterprise markets, and on the regular usage OS. Moving to cloud environments and full integrated service provision. Big database.

Market: professional or quasi-professional services

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What to conclude?

- Market dominance has a power per itself
- Large numbers dominate
  - Better service provision
  - Network effects
  - Several problems when reaching a plateau
- The issue is not the product
  - The issue is the market being sought for
  - The technology is just the tool

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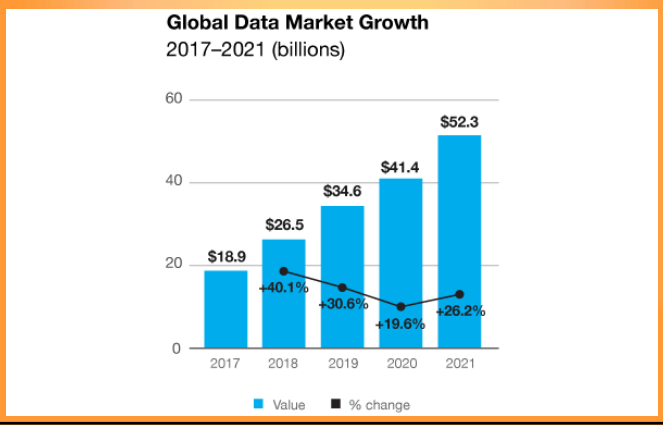
Data

- All these systems explore the massive databases they create
  - Data is a market per itself



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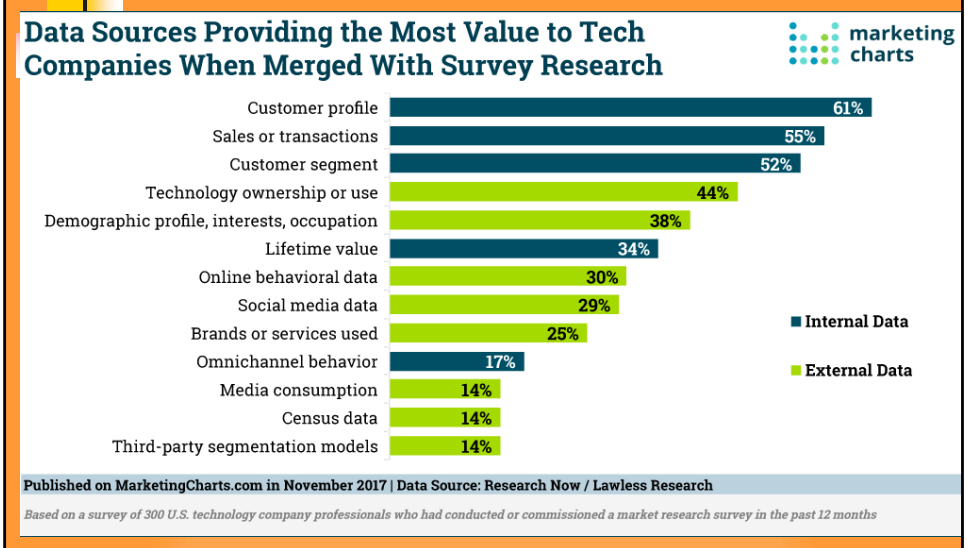

Remember the advertising market?
Data is highly value for market penetration (which is more than advertising!)

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Creating a single European market for data

European Data Strategy
- Adopted Feb 2020
- *Genuine* internal data market
- Built on EU values and rules

A cross-sectoral legislative framework
- Data Governance Act – in force July 2022
- Data Act – Proposal Feb 2022
- Implementing Act on High-value datasets (Open Data Directive) – draft Act May 2022

Common European data spaces
- Staff Working Document – Feb 2022
  Overview development data spaces, at request European Council
  - ✓ Horizontal aspects + sectoral initiatives
  - ✓ EU funding, programmes

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European Commission

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More market-more data-more market

The difficulty in Pricing Data

Data trading as a constantly growing field and a key sector in Digital Economy

The amount of data has increased

The reliance of companies on data has grown

New technologies allow the collection, storage, processing and dissemination of data

Data Trading is becoming a blooming business

SIEMENS Atos guardtime IBM GFT

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What is informatics here for?

SCALE

- Ecosystem creation
  (how many companies in the business stack?)
- Full exploration of networking effects
  - Data is a tool for this – so much more that it creates a separate market per itself.
  - Leading to new market explorations from a dominant position
  - Huge societal impact, not because of the technology, but because of the market size
    - And this is replicated on the data market

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PRACTICAL WORKS

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#3

- Comentários principais:
  - Não entregarem material…
  - Em muitos casos, parece que não foram capazes de compreender o que se pretendia
    - Não era uma app
    - Não era um sistema simples
    - Erros técnicos.
  - Não responderam aos diferentes pontos identificados
  - Muitas apresentações mal feitas (presença no quadro)

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#4 – baseado em PI

A) **Assumindo que o TB seria comercializado, como seria o ecossistema em que se posicionaria?**
   a. Que empresas teria como fornecedores (serviços, software, equipamento)
   b. Quais seriam os seus clientes? Que perfil teriam?
   c. Qual seria a sua competição, e que fatores diferenciadores teria o TB?
   d. Qual o enquadramento regulatório associado?
   e. A noção de efeito de escala, no seu projecto, iria traduzir-se de que forma?

B) **-Identifique aspetos de propriedade intelectual, marcas registradas ou afins. Que patentes** seriam necessárias para usar no seu produto? Como as descobre?

C) **Requer open source software**? Sob que licenciamento? Qual o impacto que isto terá no seu produto?

D) Que problemas **de cibersegurança** terá de ultrapassar?
   a. Quais são os maiores ataques que poderá ter de enfrentar?
   b. Qual a legislação de cibersegurança que terá de cumprir?
   c. Em detalhe, como implementará as suas soluções de cibersegurança, quer em termos de tecnologias, quer em termos de processos?

E) Que processos irá implementar se tiver de **recuperar de um ataque bastante publici**tado na Internet?

F) **Proteção de privacidade** – explique de que forma estes aspetos podem afectar o seu projecto, e como iria minimizar potenciais problemas? Descreva as soluções técnicas que iria implementar. Como será a implementação de um sistema de resposta a pedidos legais, e de que forma isso afetará o desenvolvimento do seu TB?

G) Há **aspetos éticos a considerar** no seu projecto? Quais? Que regulamentação terá de cumprir?

H) Há **aspetos de AI** no seu projecto? Quais? Que problemas é que terá em termos de dados? Que problemas tem de evitar para adquirir esses dados de forma adequada?

I) **Irá estabelecer relações com Hyperscaler**s? De que formato? Como é que a legislação europeia sobre os mesmos irá afectar estas relações?

J) **Externalidades**: que tipos de efeitos de rede pensa que poderia explorar para aumentar o sucesso da sua solução? Que efeitos negativos de rede teria de ter cuidado?

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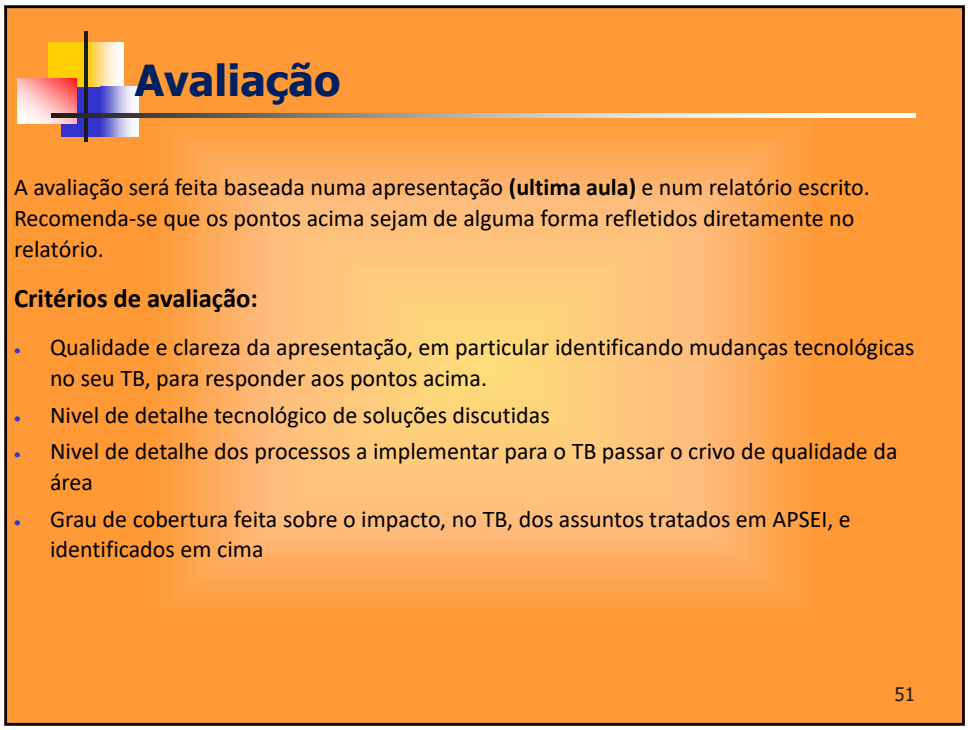
Avaliação
A avaliação será feita baseada numa apresentação **(ultima aula)** e num relatório escrito. Recomenda-se que os pontos acima sejam de alguma forma refletidos diretamente no relatório.
Critérios de avaliação:
- Qualidade e clareza da apresentação, em particular identificando mudanças tecnológicas no seu TB, para responder aos pontos acima.
- Nivel de detalhe tecnológico de soluções discutidas
- Nivel de detalhe dos processos a implementar para o TB passar o crivo de qualidade da área
- Grau de cobertura feita sobre o impacto, no TB, dos assuntos tratados em APSEI, e identificados em cima
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