GROWTH FROM DATA-DRIVEN INNOVATION

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The Role of R&D in Fostering Economic Performance

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ETLA

Aalto-yliopisto

strateginen TUTKIMUS

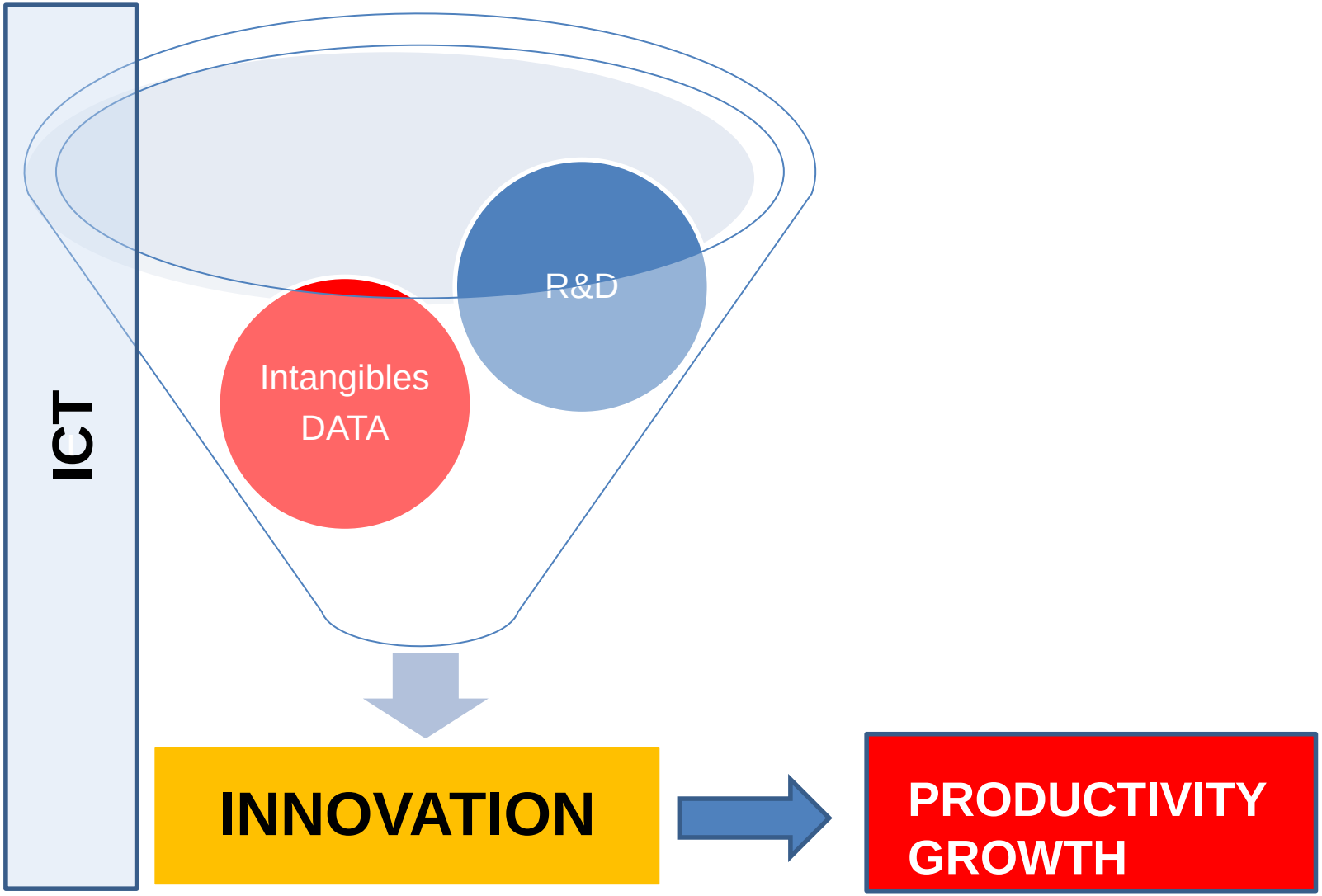
Background

- In 2000, only about one quarter of the world's data resources were stored in a digital format, while in 2013, over 98 % of the data were digitalized
- Data as complementary intangible asset (in addition to R&D, human capital etc.) generating innovation and growth
- Focus on three questions:

i) *To what extent data is used in innovation?*

ii) *Value creation from personal data?*

iii) *How data transforms value creation in various sectors?*

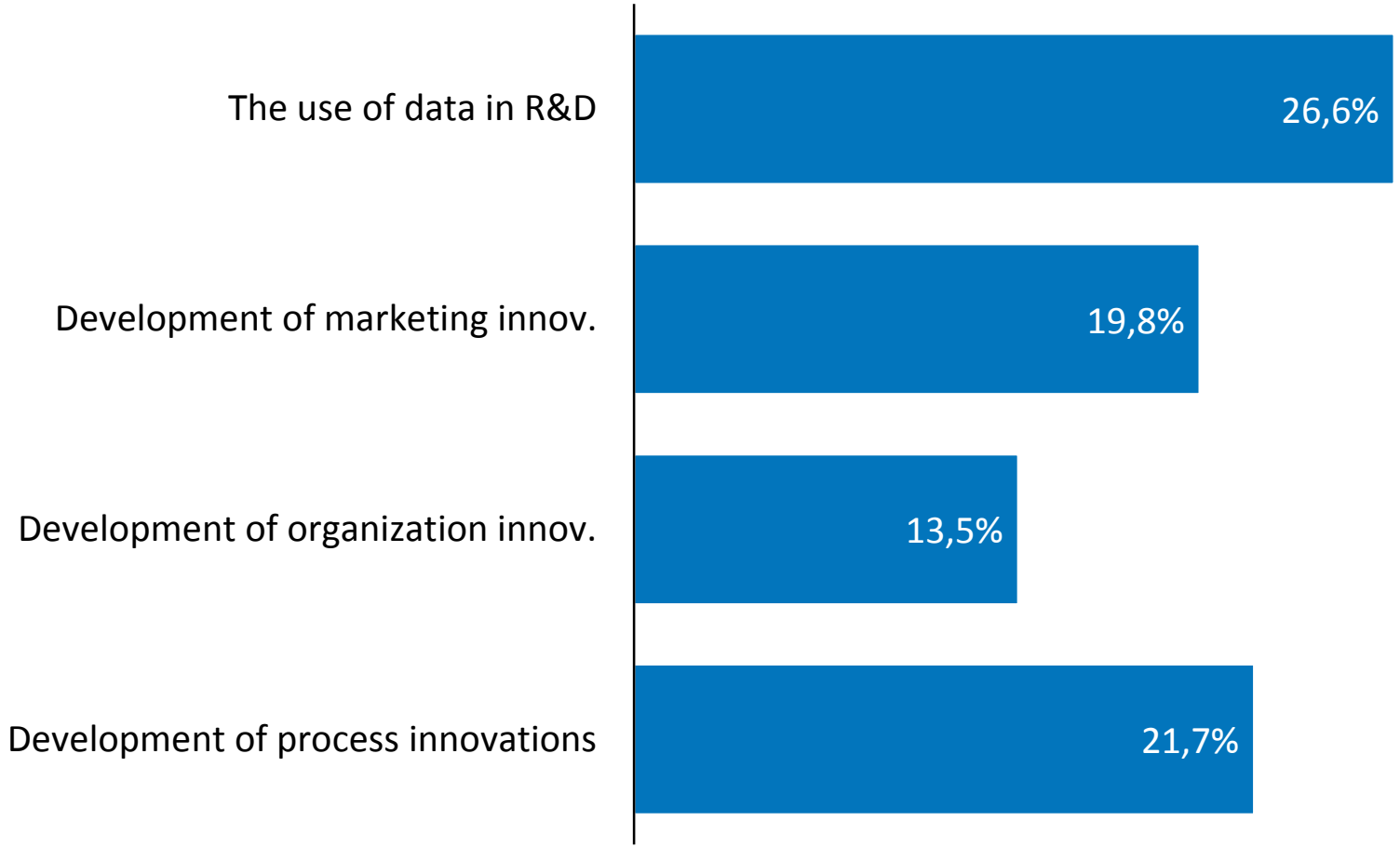

ICT
R&D
Intangibles
DATA
INNOVATION
PRODUCTIVITY
GROWTH

Data: complementary intangible asset

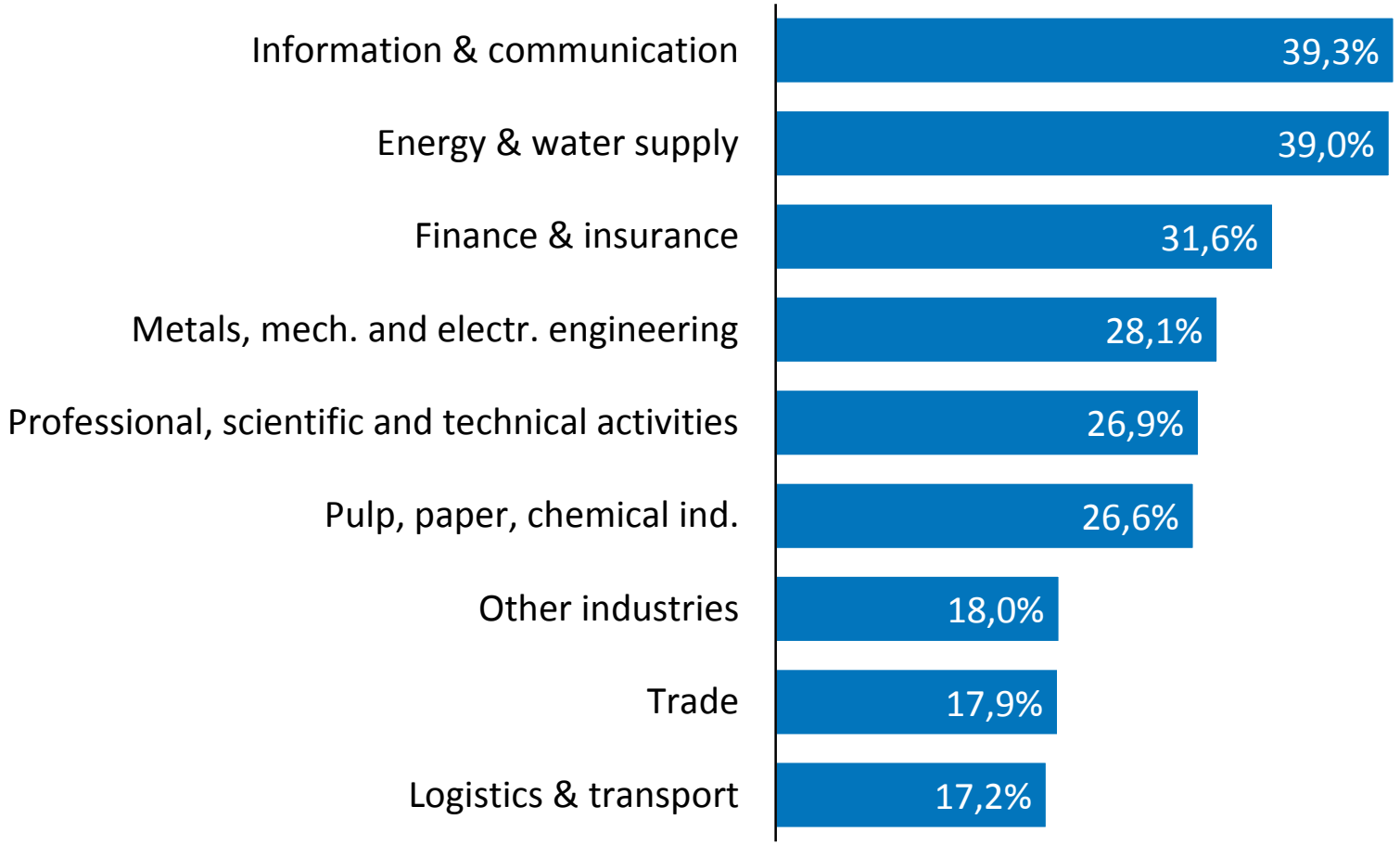
- Big data (high-volume, high-velocity and/or high-variety datasets)
  - Large data sets, e.g., about entire user groups of services
  - Collected continuously
- Open data: free for anyone to use, re-use and re-distribute
- What do we know about the role of data in firms' innovation activities?

WHAT DO WE KNOW ABOUT THE ROLE OF DATA IN FIRMS' INNOVATION ACTIVITIES?

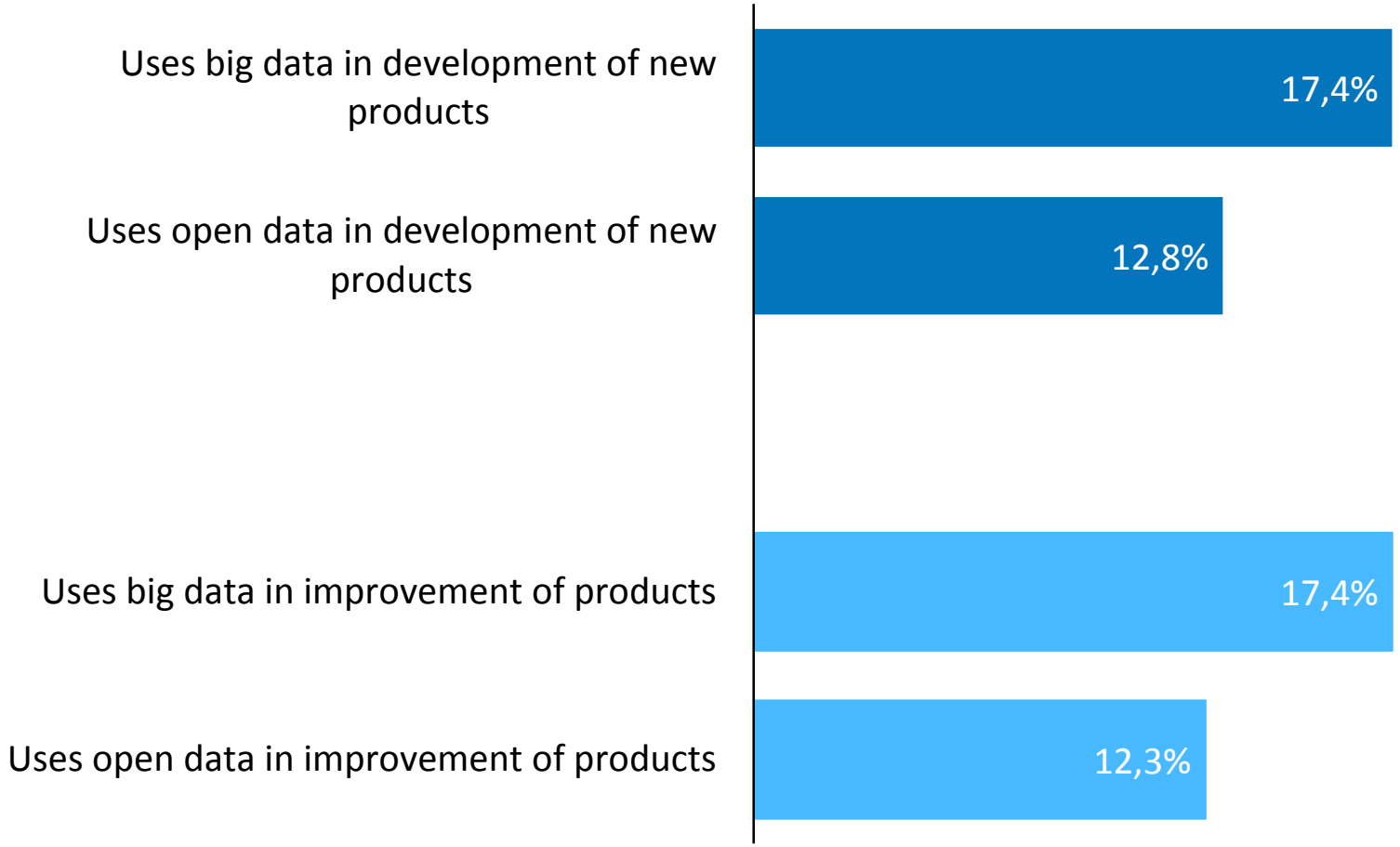
The percentage of innovating firms for which the use of data is of high or medium importance, by type of innovation activity.
Source: CIS 2014 survey for Finland



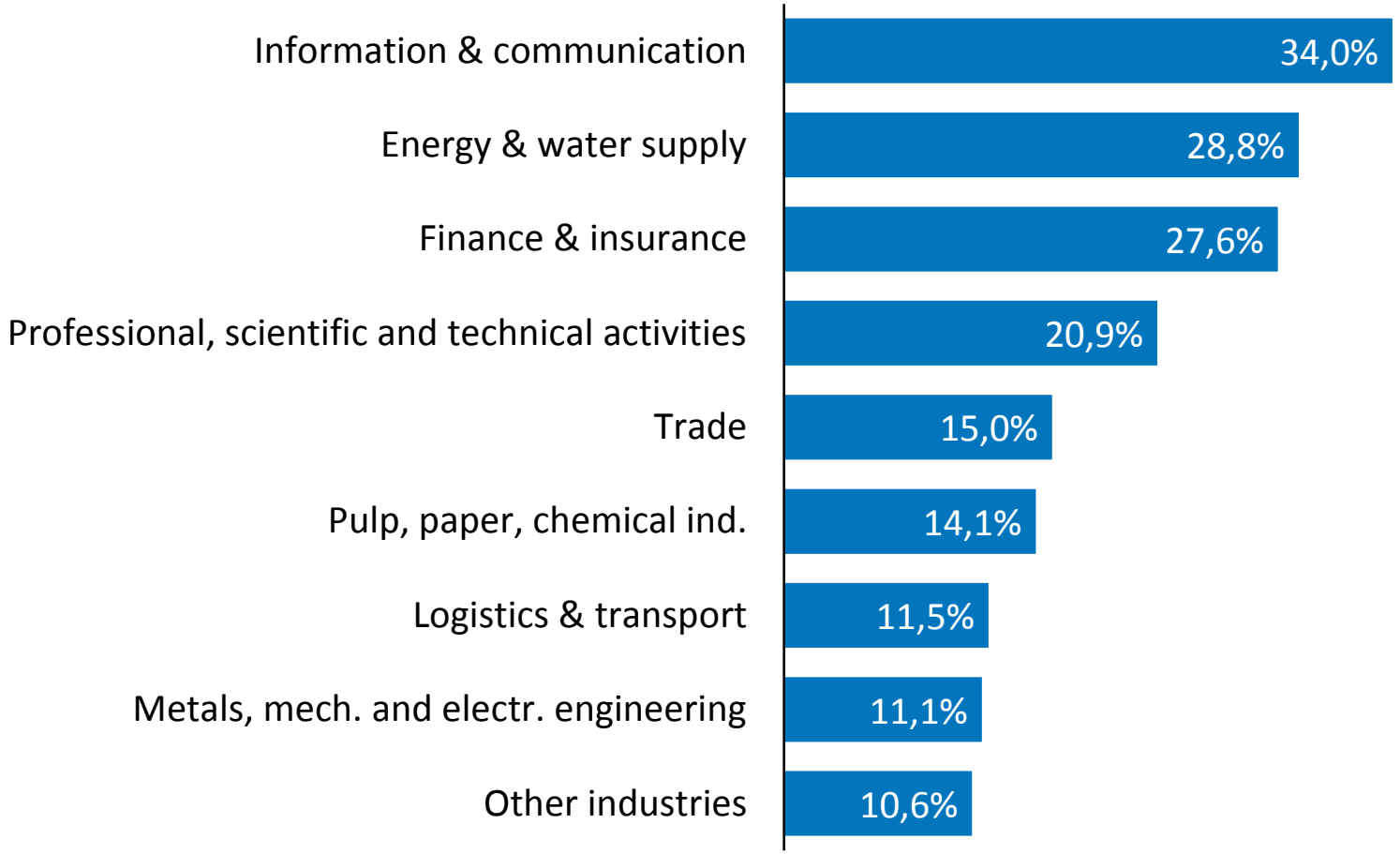
The percentage of innovating firms for which the use of data of high or medium importance in R&D, by industry.
Source: CIS 2014 survey for Finland



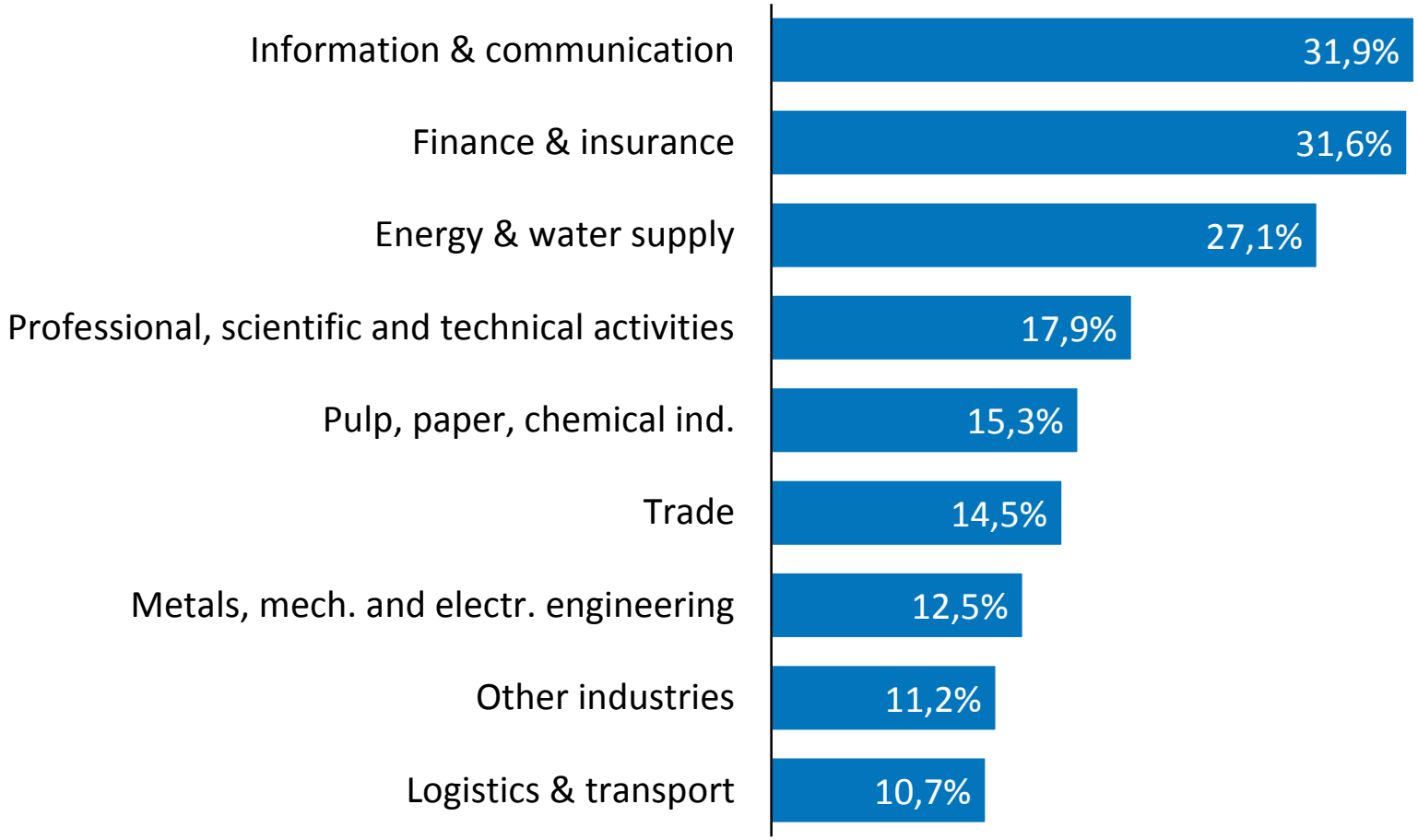
The percentage of innovating firms for which the use of big data or open data in developing product innovations is of high or medium importance.
Source: CIS 2014 survey for Finland



The percentage of innovating firms for which the use of big data in <u>developing</u> new products is of high or medium importance, by industry.
Source: CIS 2014 survey for Finland

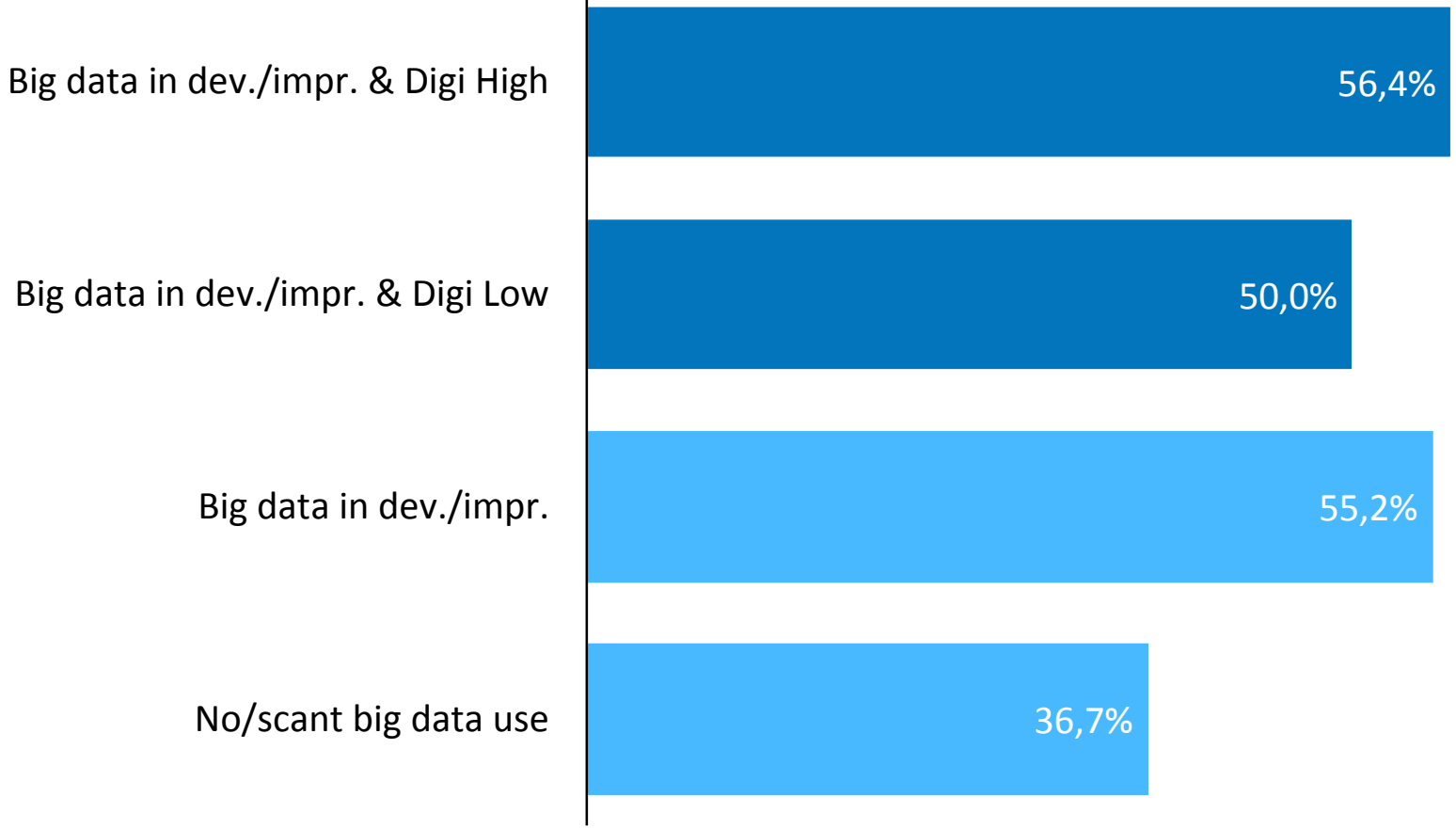


The percentage of innovating firms for which the use of big data in <u>improving</u> products is of high or medium importance, by industry.
Source: CIS 2014 survey for Finland



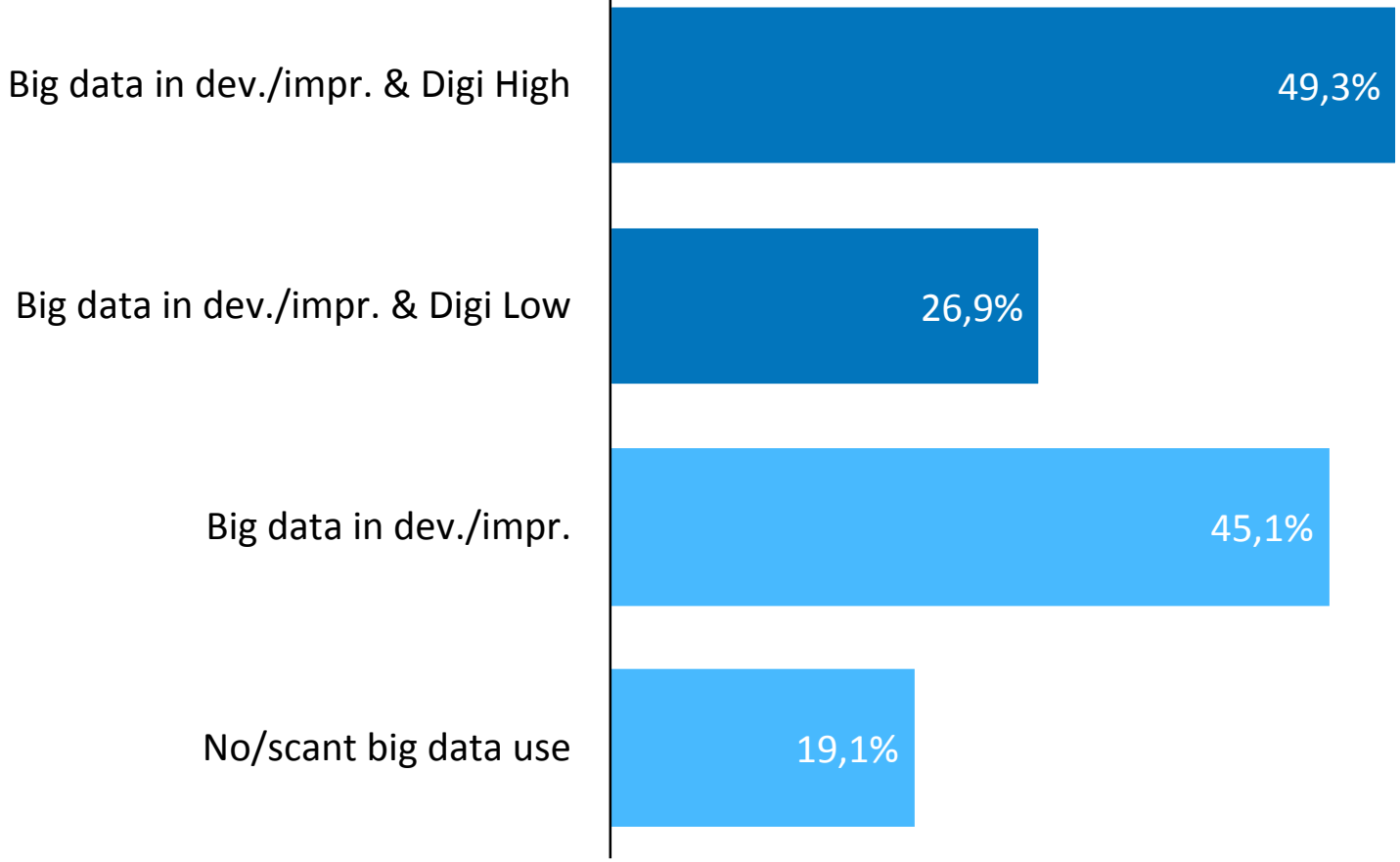
The percentage of firms that have introduced new or significantly improved products that were new to the market by the use of big data and significance of digitalization in firm's business.

Source: CIS 2014 survey for Finland (notes: reported results are non-weighted sample averages of the share of firms having innovation activities in which the significance the use in question is substantial or moderate).



The percentage of firms that have introduced new or significantly improved services that were new to the market by the use of big data and significance of digitalization in firm's business.

Source: CIS 2014 survey for Finland (notes: reported results are non-weighted sample averages of the share of firms having innovation activities in which the significance the use in question is substantial or moderate).

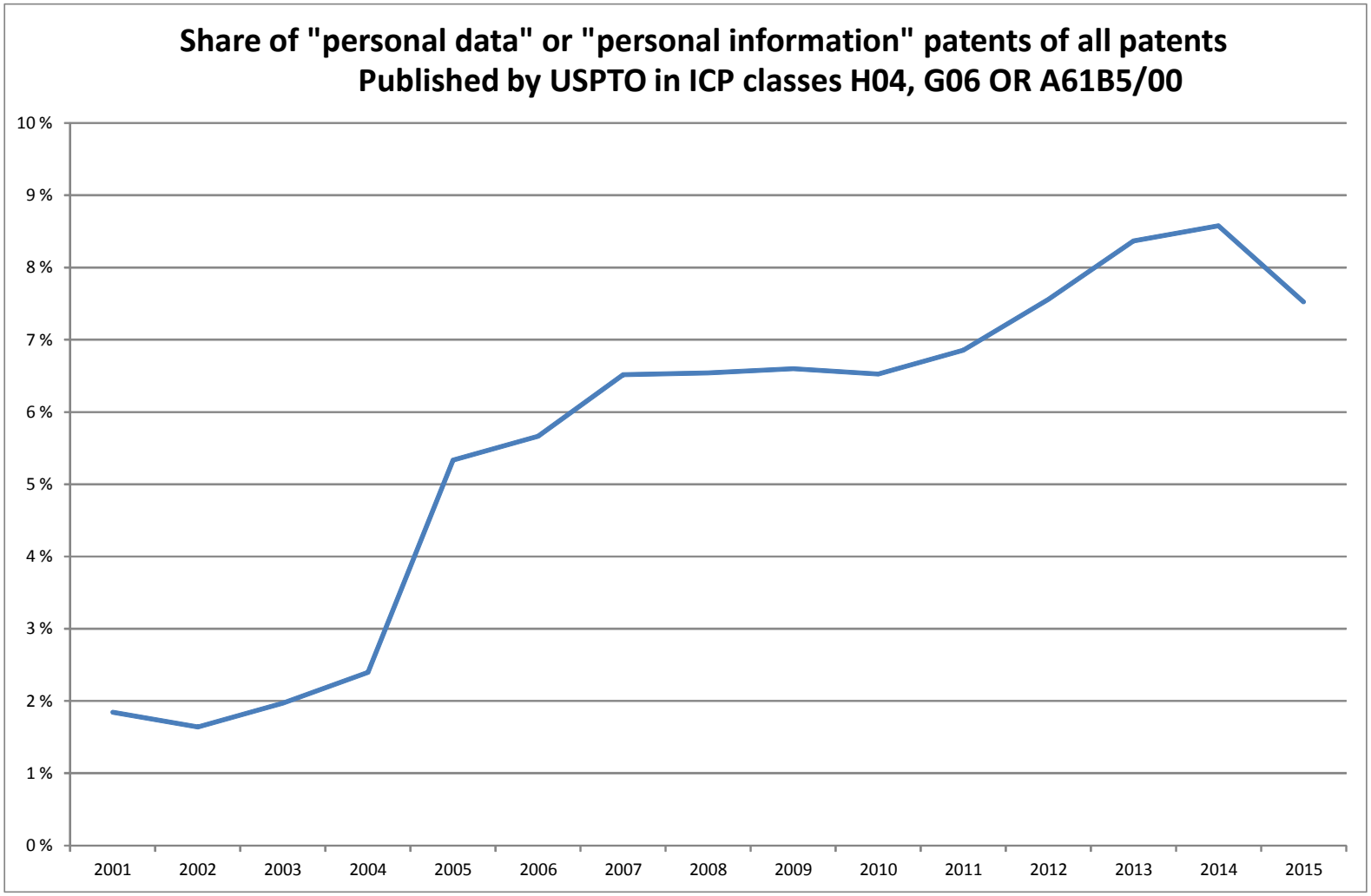


VALUE CREATION FROM PERSONAL DATA?

Value creation from personal data

- Returns from R&D and ICT use increasingly rely on personal data use
- Firms hold about 80 % of all data, while 70 % of data is produced by individuals (search engines, social media, online shops, sensors etc.)
- Number of personal data related patents granted by USPTO has more than doubled (from about 3500 to 7000) between the years 2010 and 2015.
- Technology giants (e.g., Google, Apple, Facebook, Amazon, Microsoft) among the largest “personal data” patentees
- Reflect substantial growth expectations on the markets for technologies related to personal data use

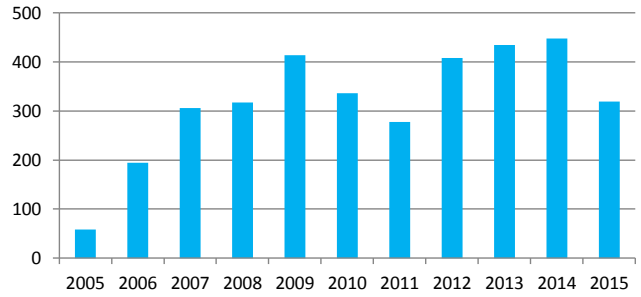
Ideas related to personal data increasingly protected by patents



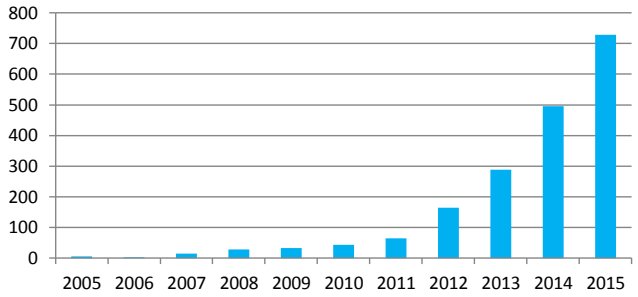
Personal data patenting of tech giants

"Personal data" patents published by the USPTO

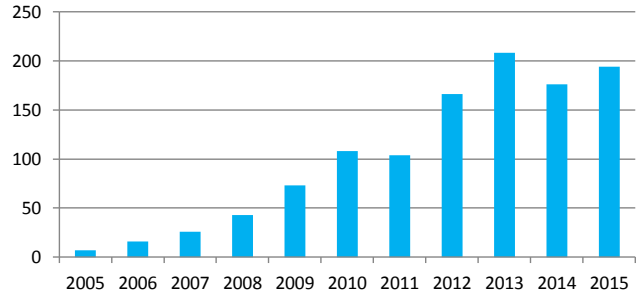
Microsoft



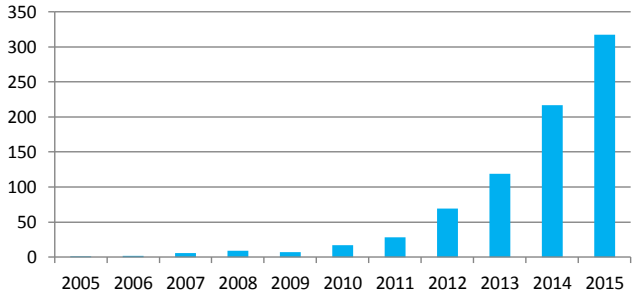
Google



Apple



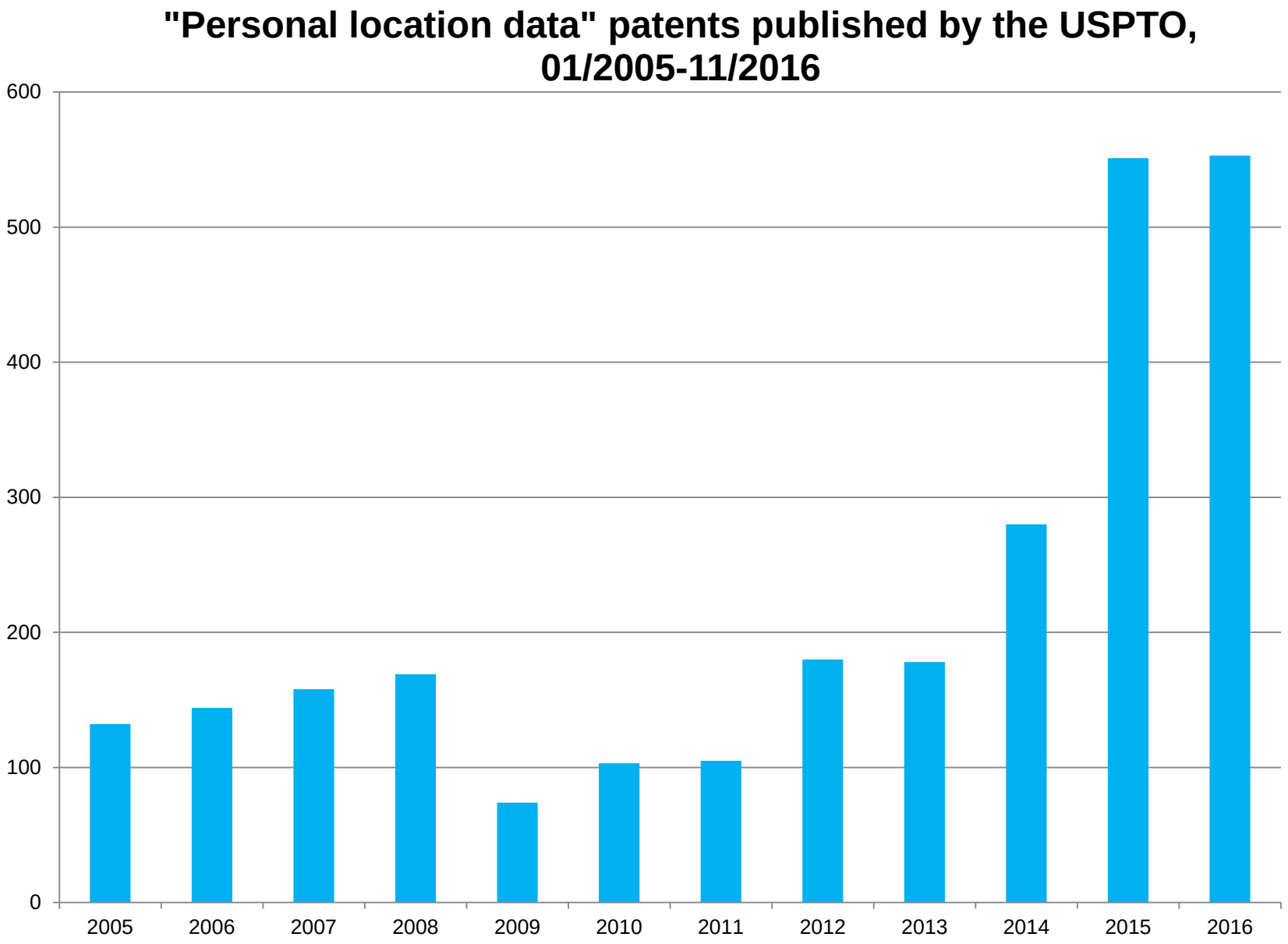
Amazon



Location-based personal data

- Amount increasing rapidly alongside with the diffusion of smartphones.
- Individual location data has substantial potential to generate value in various sectors, e.g., via location-based advertising and service provision.
- Example: convergence of robotics and surveying

→ decentralized, distributed collection of geographic data by vehicles equipped with point cloud generation mapping sensors


"Personal location data" patents published by the USPTO, 01/2005-11/2016
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016

HOW DATA TRANSFORMS VALUE CREATION IN VARIOUS SECTORS?

Datafication of manufacturing

- Software and data that first transformed provision of services now leads innovation in manufacturing: production of smart, connected products (IoT)
- Value creation increasingly relies on consumer data collected 24/7 via smart and connected products and is also shared and utilized in novel open innovation practices with firms' business partners.
- Data from, e.g., use patterns, user needs and preferred product features are used for product improvements in a similar manner as Internet service providers use algorithms to analyze user data for service improvements.

Datafication of health care

- Image data (e.g. X-ray and CT scans) dominate stored data volume-wise but increasing trend to develop technological solutions for individuals to monitor, collect and analyze their own personal health data.
- Robots initially developed for industrial use applied for health care: care/service robotics
- New business models change the ways personal data are gathered, used and transmitted in robot-human interactions.

  - Future robots likely to use highly sensitive personal data for personalization of care services.

Datafication of energy sector

- Increasing share of consumers use real time pricing based contracts and assemble new types of home automation combining user preferences, real time data and forecasts of the spot prices and energy related weather conditions.
- Consumers actively reacting with their consumption to spot price data cut peak-demand electricity prices and flatten the load and price curves of electricity.
- Smart grid technology may also help lowering emissions globally

Some policy implications

- Data-driven innovation shaking various sectors may challenge existing institutions.
- For instance, contemporarily national mapping agencies (e.g., National Land Survey of Finland) are responsible for centralized production of topographic maps and geographic information.
- Decentralized, distributed collection of geographic data by vehicles equipped with point cloud generation mapping sensors may make such institutions obsolete.

Some policy implications

- Data-driven innovation challenges regulation
- EC's Better regulation Agenda aiming at simplifying legislation and regulation may face new regulatory questions arising, e.g., from new business models in health care changing the ways personal data are gathered, used and transmitted in robot-human interactions.
- Data controllers have responsibility to comply with data protection regulation
- EU data protection directive defines that 'controller' is "*natural or legal person, public authority, agency or other body which, alone or jointly with others, determines the purposes and means of the processing of personal data*".
- Who is data controller when intelligent and learning robots gather and use highly sensitive personal data in health care?

Some policy implications

- Data-driven innovation challenges economic value assessment and measurement
- Digital products which have value to users offered at zero price are excluded from GDP; partially counted as their provision funded, e.g., by advertising (i.e. personal data use)
- Role of households as value creators (sharing economy, e.g. Airbnb) not taken into account

→ Underestimation of value generated by data-driven innovation or digital economy

→ How to use data to accurately reflect changing economy in the statistical measurements of value creation?