On Informatics, Diamonds and T

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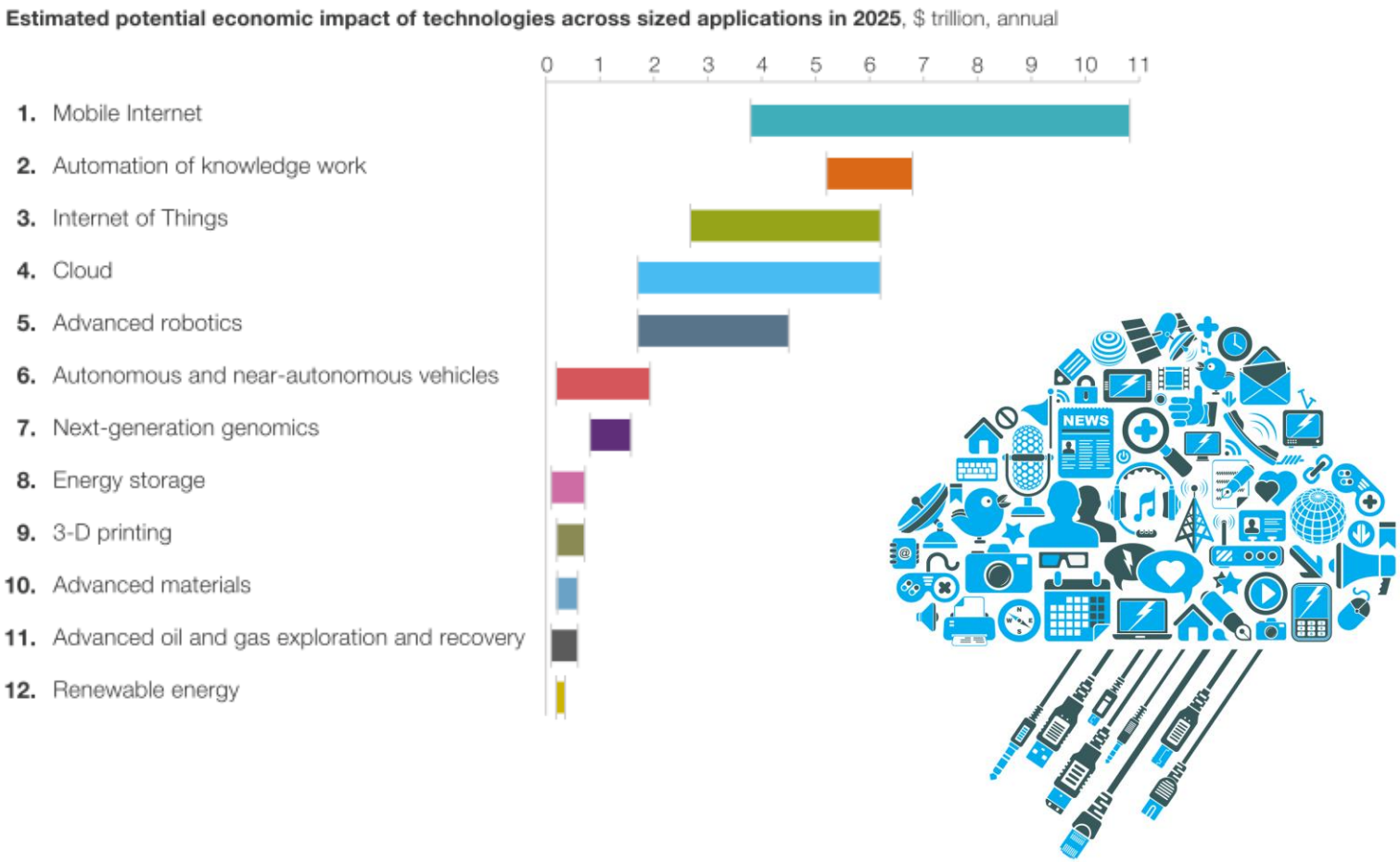
Questions

- Where does ICT stand with respect to the technology trends?
- How will it influence the way we educated ICT engineers and researchers?
- What kind of engineers and researchers do we need in future?
- Personal experiences

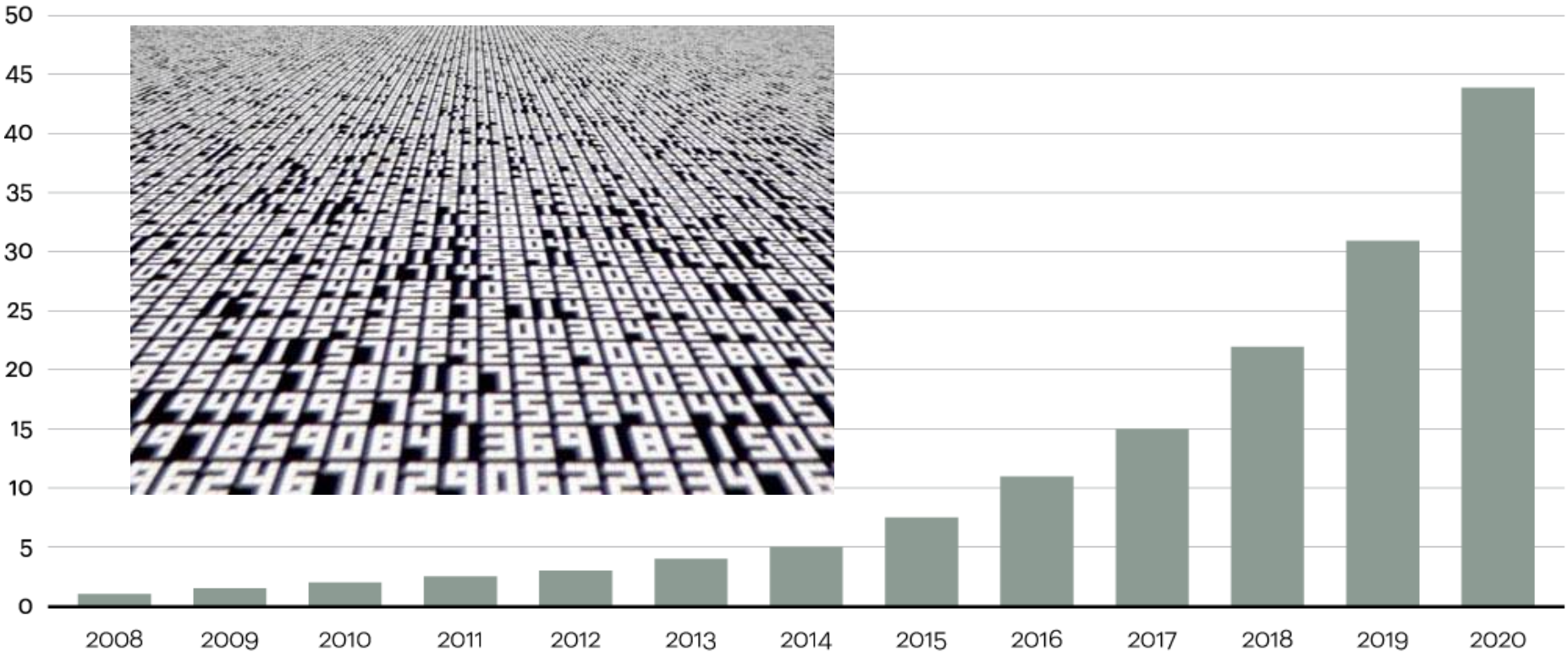
Disruptive technology forecast



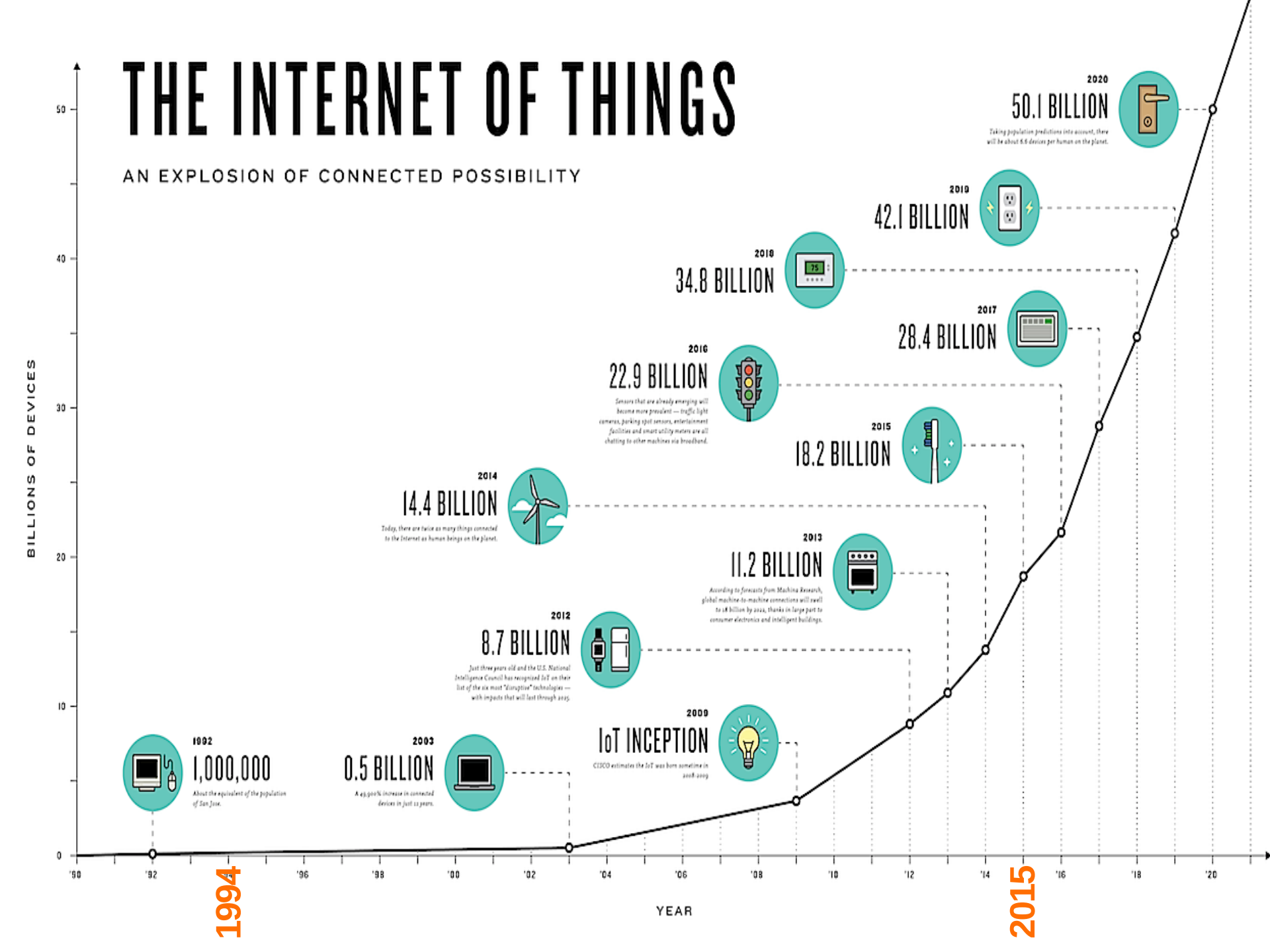
McKinsey Co. , Forbes

Figure 1

Data is growing at a 40 percent compound annual rate, reaching nearly 45 ZB by 2020



Source: Oracle, 2012


THE INTERNET OF THINGS
AN EXPLOSION OF CONNECTED POSSIBILITY
BILLIONS OF DEVICES
50
40
30
20
10
0
'90
'92
'94
'96
'98
'00
'02
'04
'06
'08
'10
'12
'14
'16
'18
'20
YEAR
1994
2015
1992
1,000,000
About the equivalent of the population of San Jose.
2003
0.5 BILLION
A 49,900% increase in connected devices in just 11 years.
2009
IoT INCEPTION
CISCO estimates the IoT was born sometime in 2008-2009
2012
8.7 BILLION
Just three years old and the U.S. National Intelligence Council has recognized IoT on their list of the six most "disruptive" technologies — with impacts that will last through 2025.
2013
11.2 BILLION
According to forecasts from Machina Research, global machine-to-machine connections will swell to 18 billion by 2024, thanks in large part to consumer electronics and intelligent buildings.
2014
14.4 BILLION
Today, there are twice as many things connected to the Internet as human beings on the planet.
2015
18.2 BILLION
2016
22.9 BILLION
Sensors that are already emerging will become more prevalent — traffic light cameras, parking spot sensors, entertainment facilities and smart utility meters are all chatting to other machines via broadband.
2017
28.4 BILLION
2018
34.8 BILLION
2019
42.1 BILLION
2020
50.1 BILLION
Taking population predictions into account, there will be about 6.6 devices per human on the planet.

MEMS and sensor shipments for wearable device

Millions of units

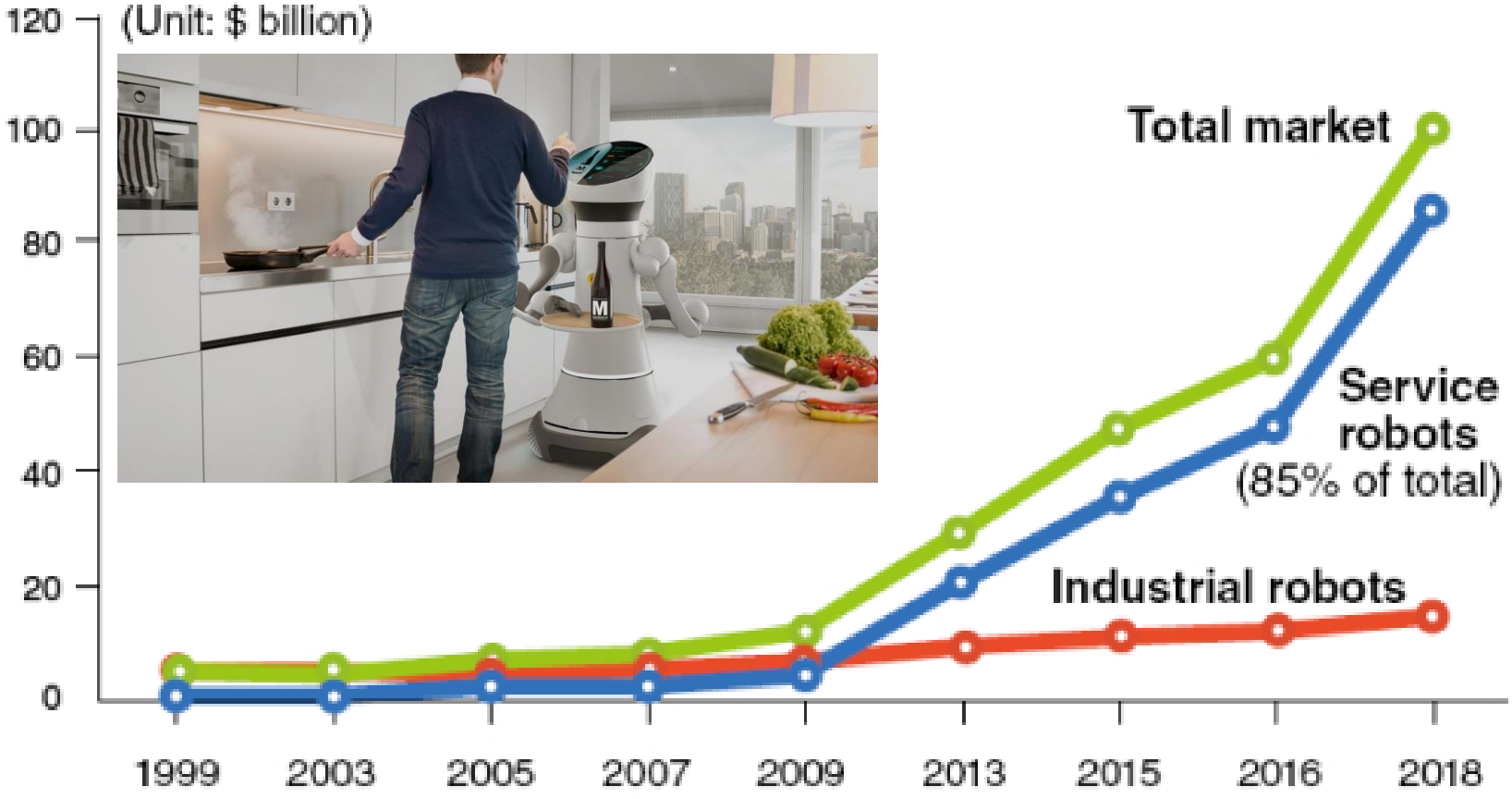
500
450
400
350
300
250
200
150
100
50
0

2012 2013 2014 2015 2016 2017 2018 2019

- Smart earbuds / headsets
- Sports & Running Computers
- Outdoor Pursuits Computers
- Foot Pods & Pedometers
- Activity Monitors
- Smart clothing and other wearables
- Action cameras
- Fitness & Heart Rate Monitors
- Smart Glasses
- Smart Watches

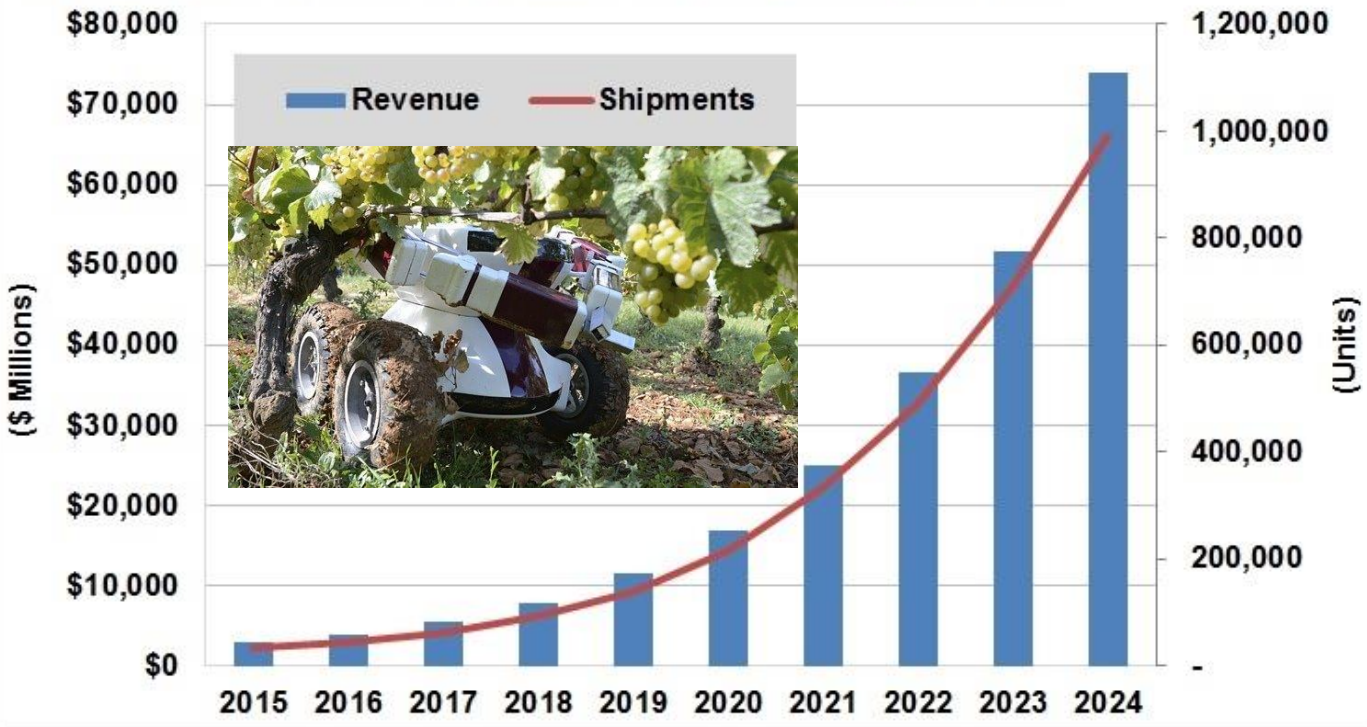
Source: IHS MEMS & Sensors for wearables report - 2014

Global robot market outlook



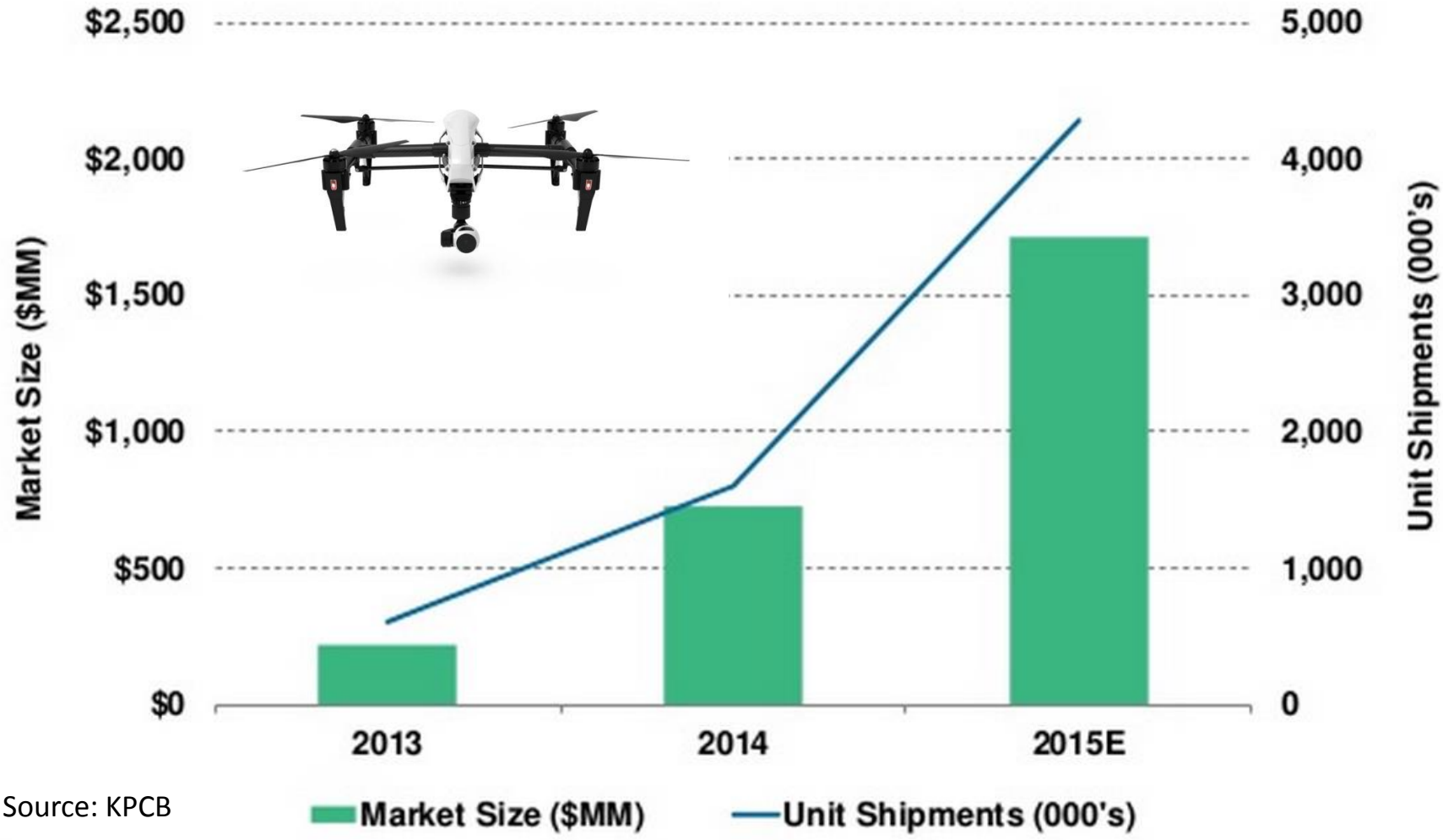
Tractica

Agricultural Robot Revenue and Shipments, World Markets: 2015-2024



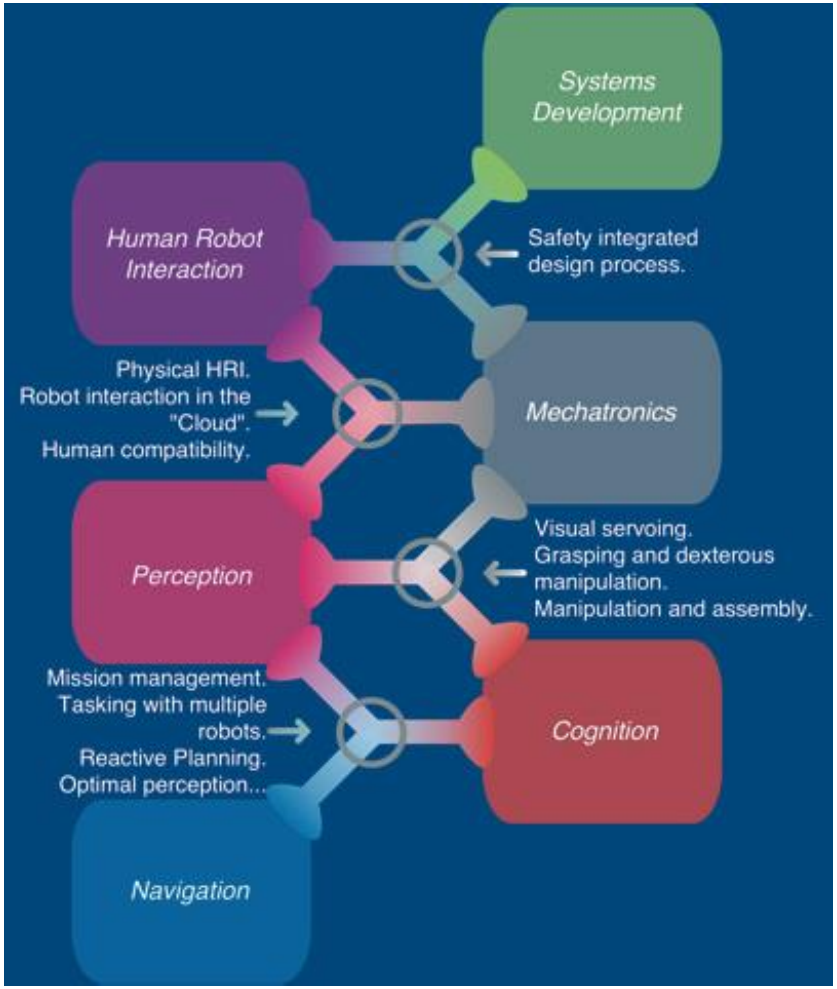
Source: Tractica

Global Consumer Drones – Revenue & Unit Shipments, 2013 – 2015E



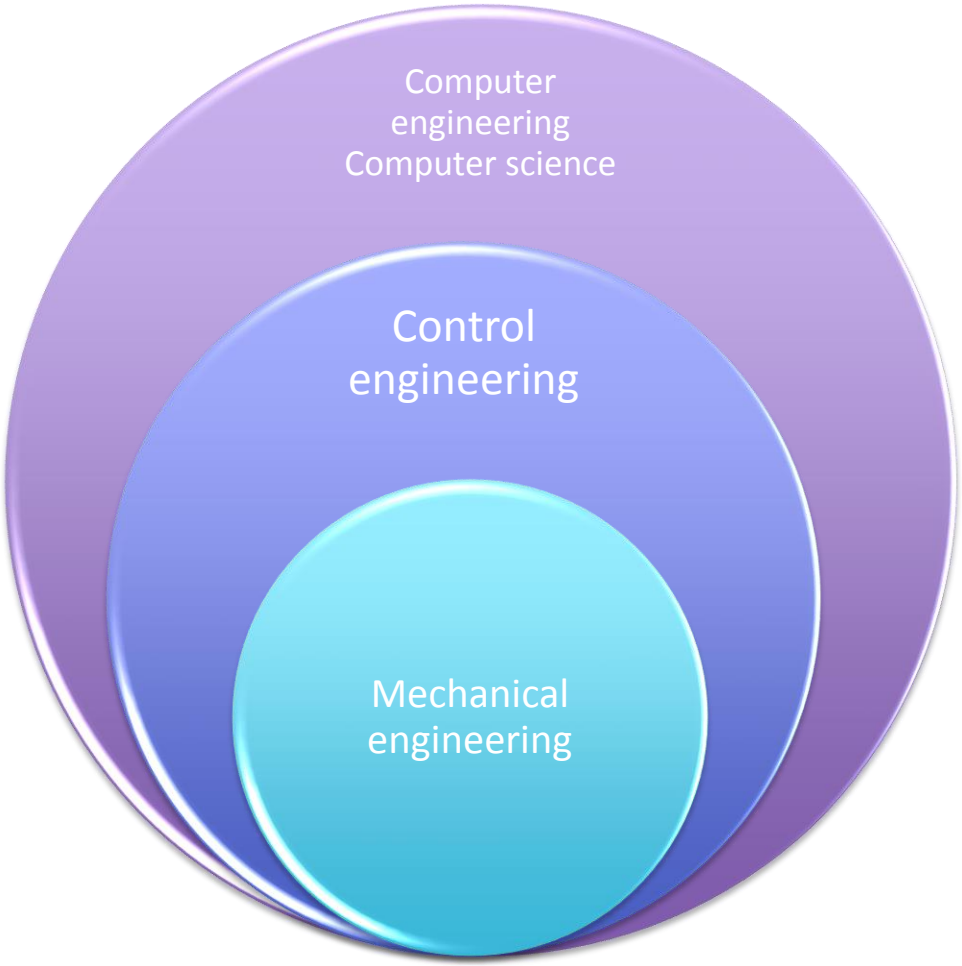
Source: KPCB

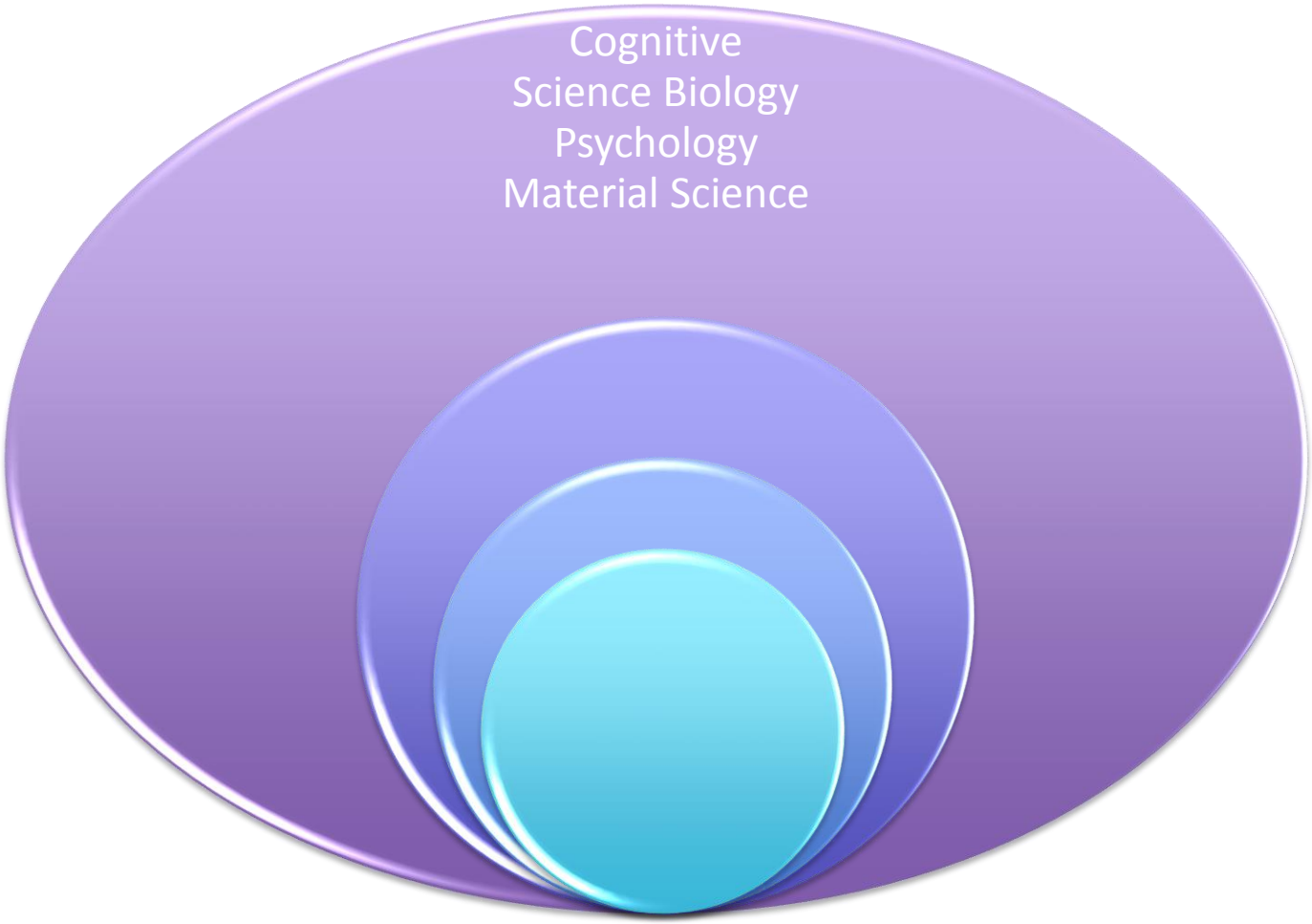
Robotics as an interdisciplinary field of research/education



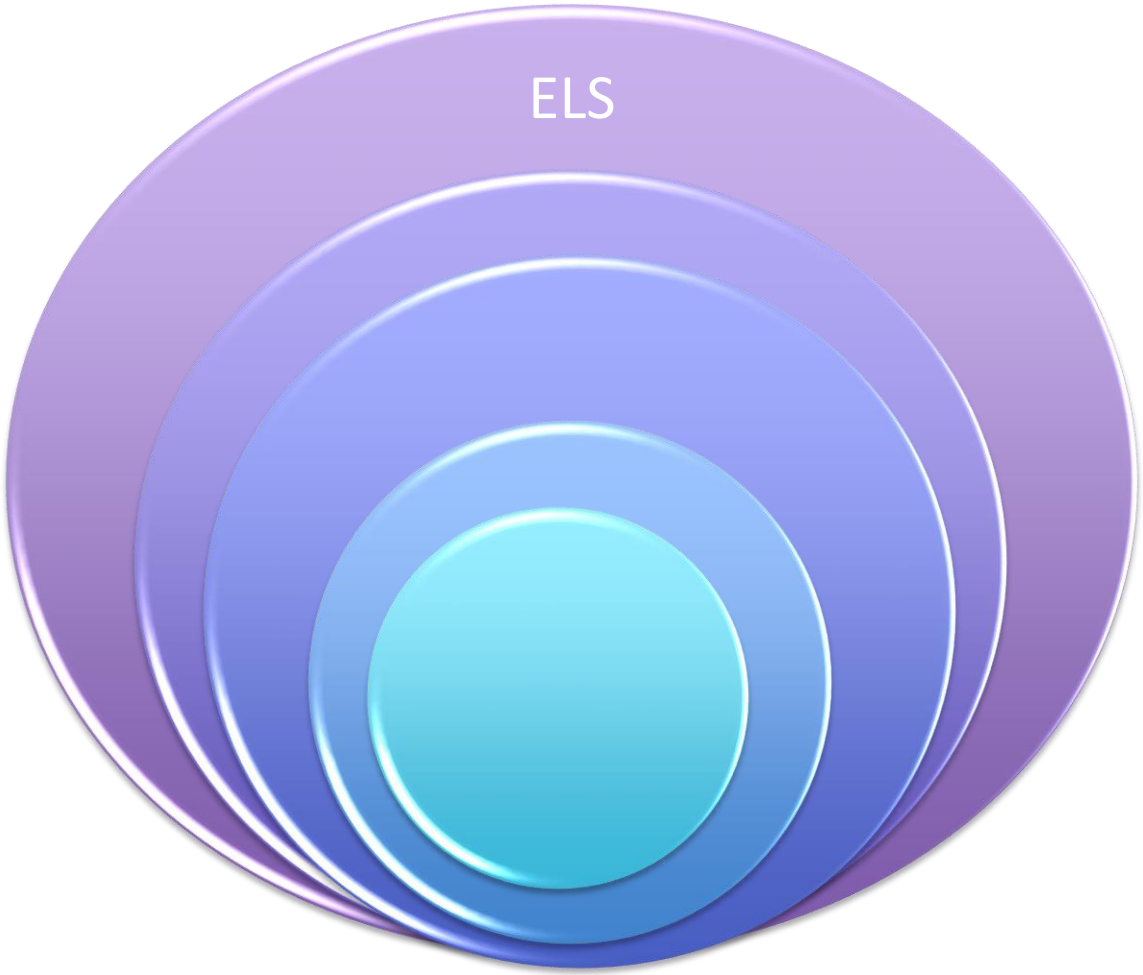
EuRobotics

Core disciplines in robotics

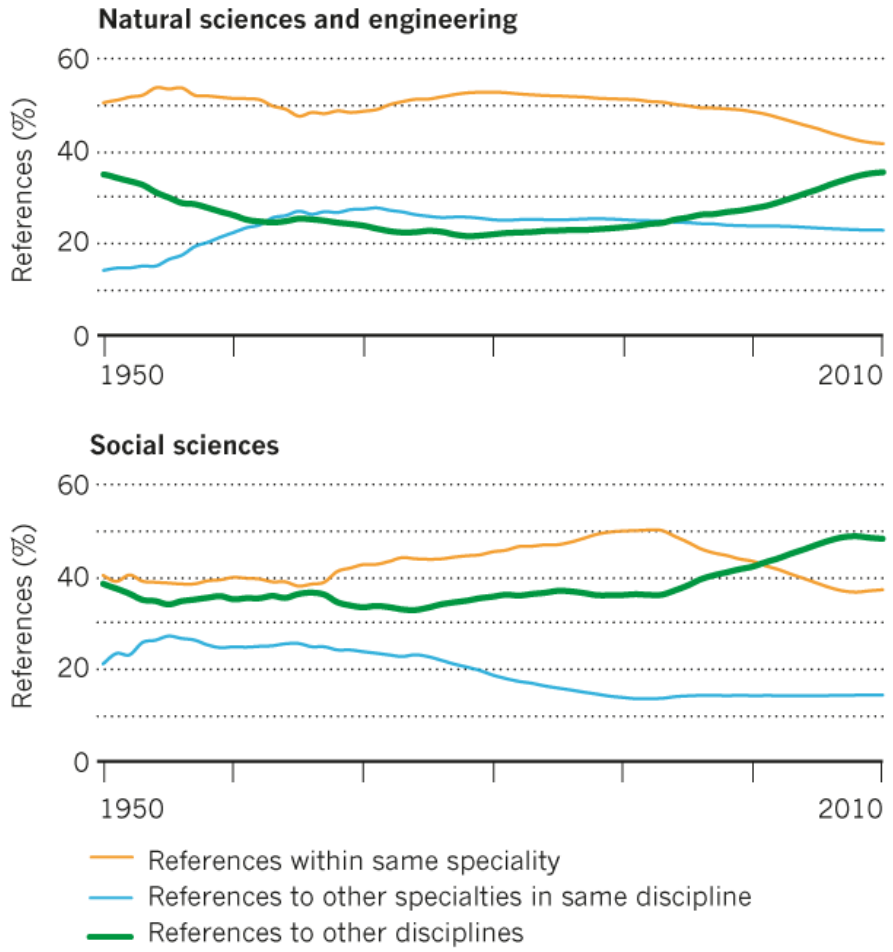



Cognitive
Science Biology
Psychology
Material Science

ELS – Ethical, Legal and Societal Issues



Interdisciplinarity: a growing trend

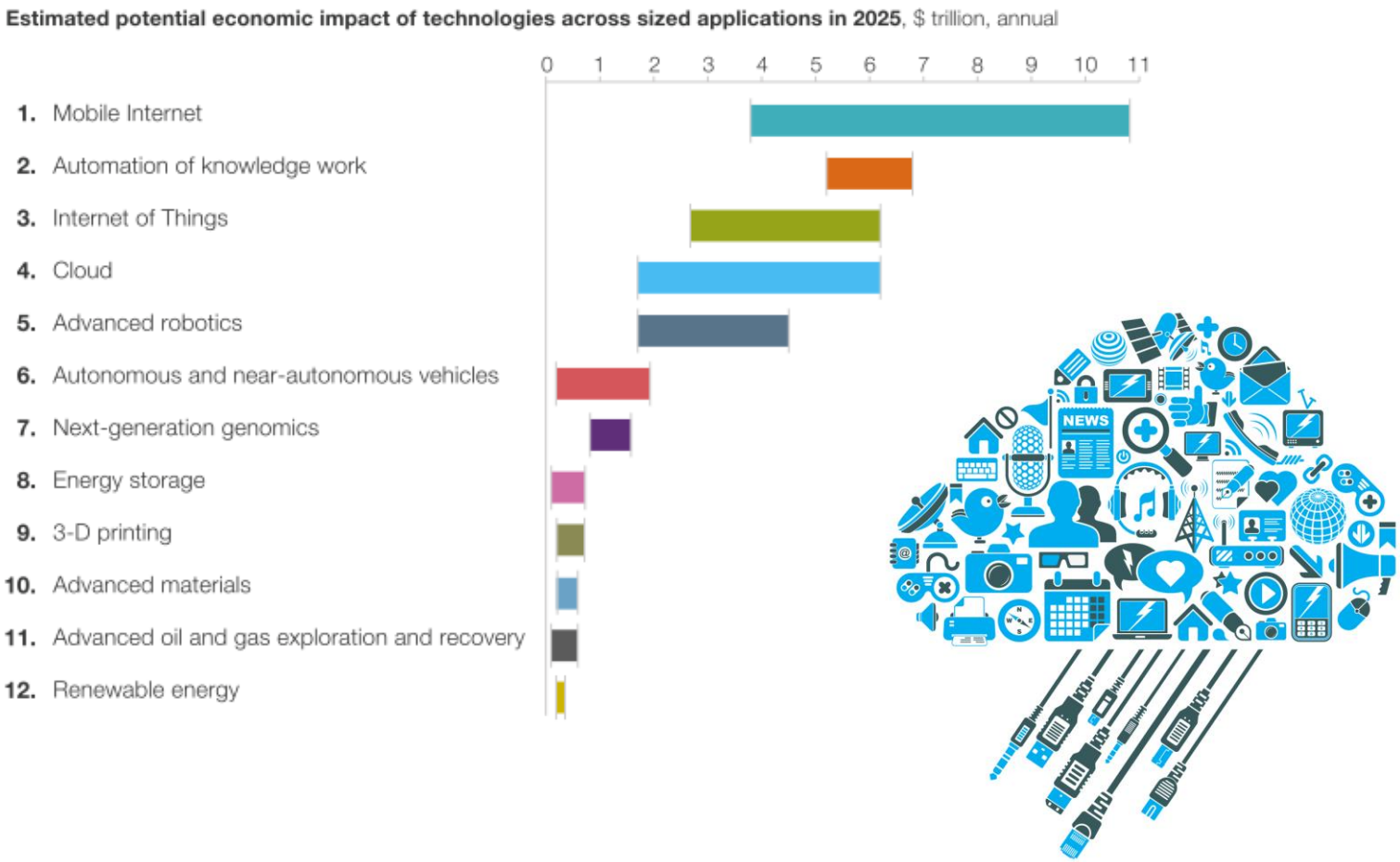


Richard Van Noorden, Interdisciplinary research by the numbers. Nature 16 September 2015

Finding the balance

- There is no interdiciplinarity without disciplines
- How to balance breadth and depth in ICT research and innovation?

Disruptive technology forecast



McKinsey Co. , Forbes

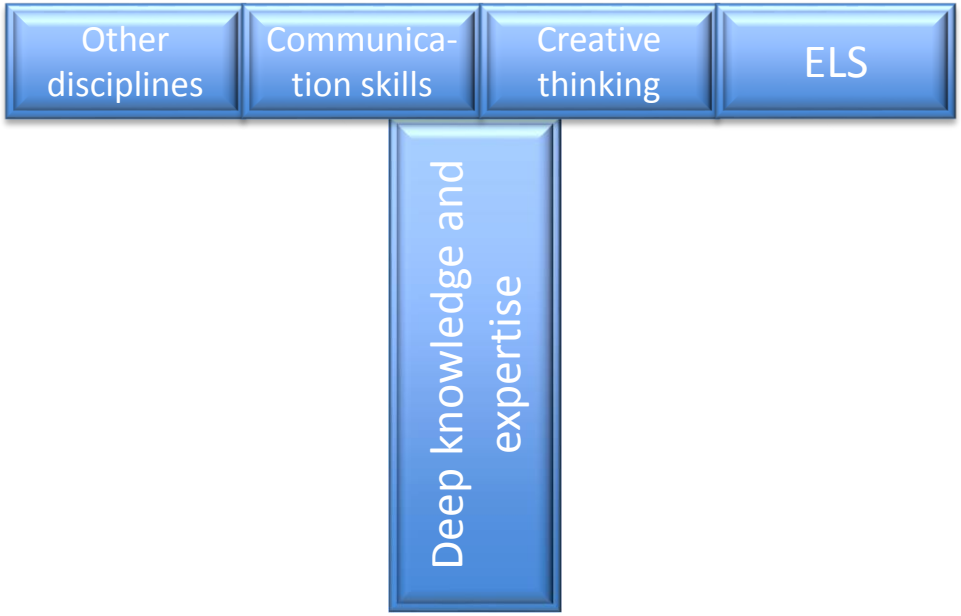
ICT and Paradox of value

T-shaped people

- The authors suggest another approach, something they call T-shaped management, which requires executives to share knowledge freely across their organization (the horizontal part of the "T"), while remaining fiercely committed to their individual business unit's performance (the vertical part).

- Hansen, M. & von Oetinger, B. *Harvard Bus. Rev.* ***79, 106–116 (2001).***

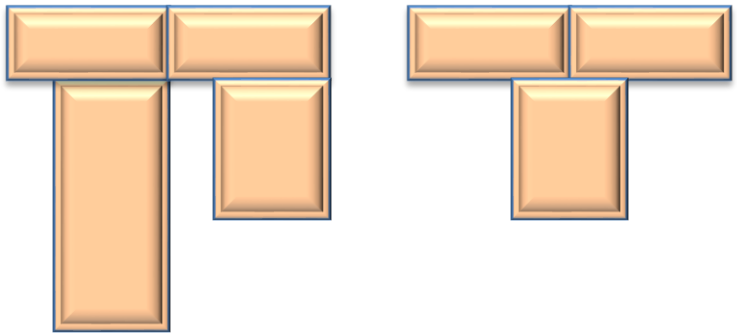
T-shaped person



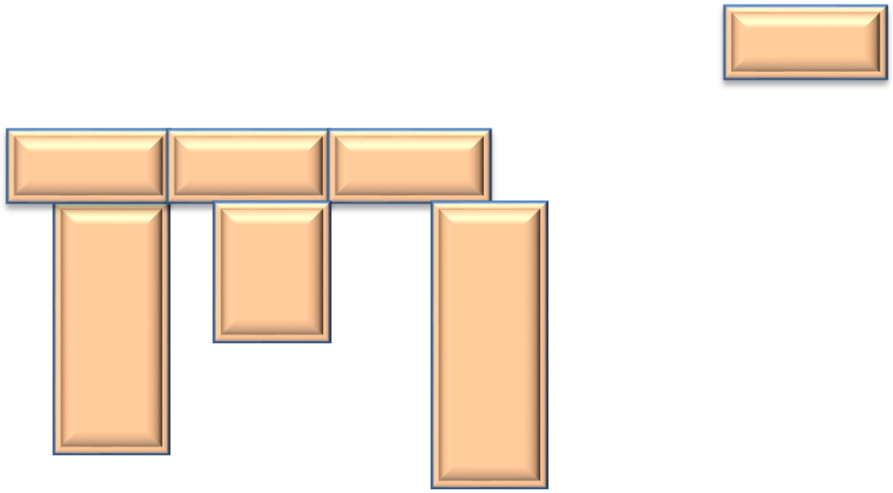
Multidisciplinary teams


centre for
biorobotics
www.biorobotics.ttu.ee

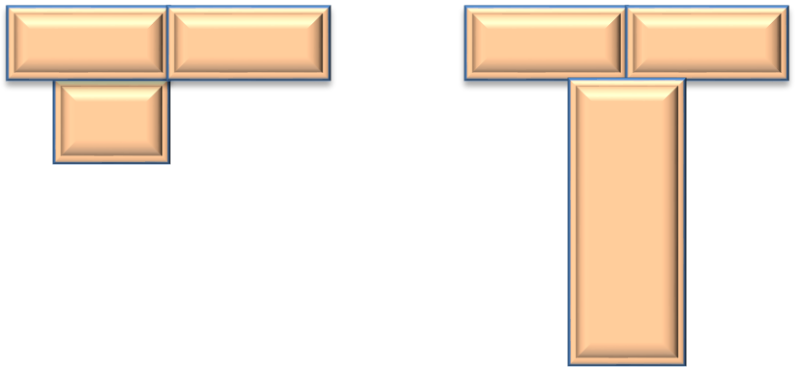
2008



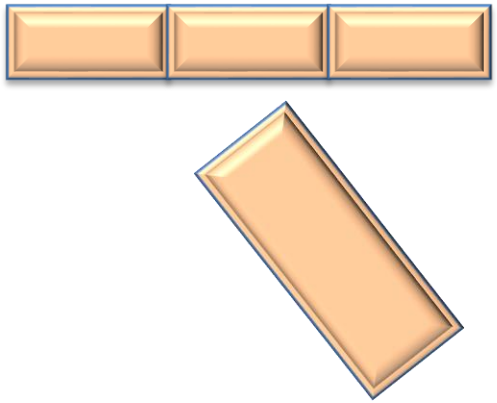
2009



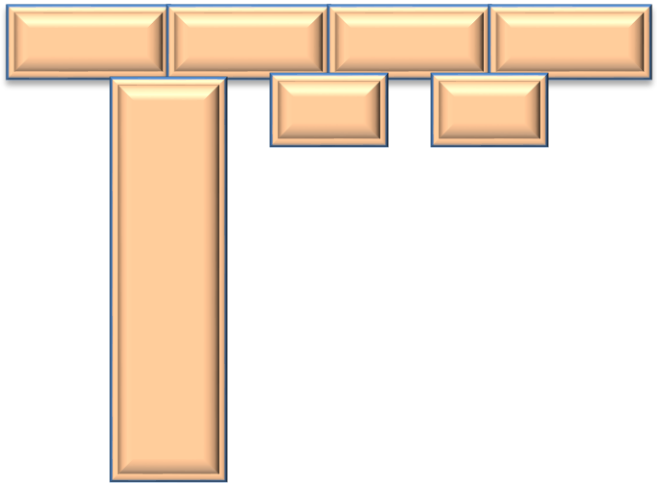
2011

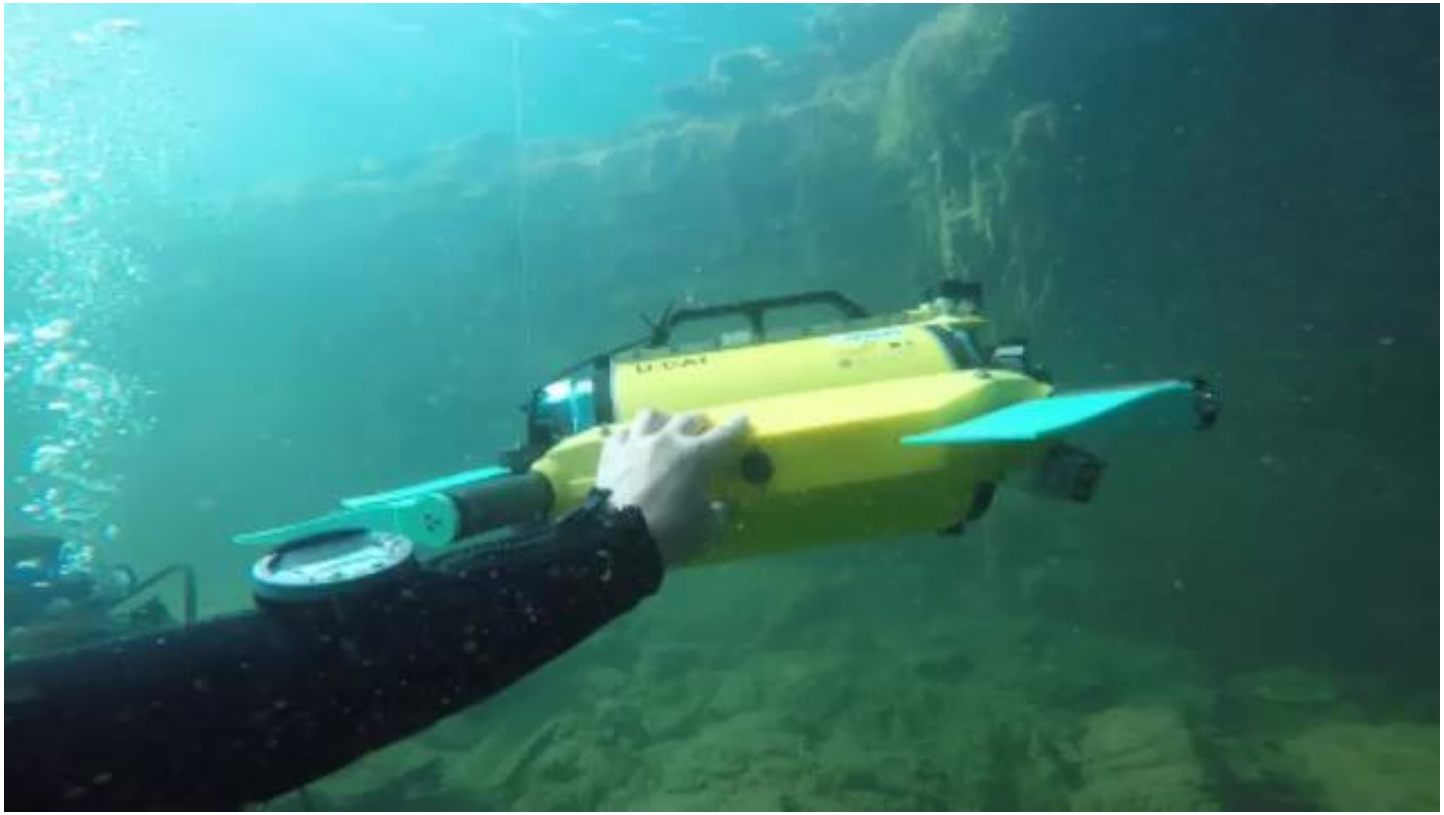


2012

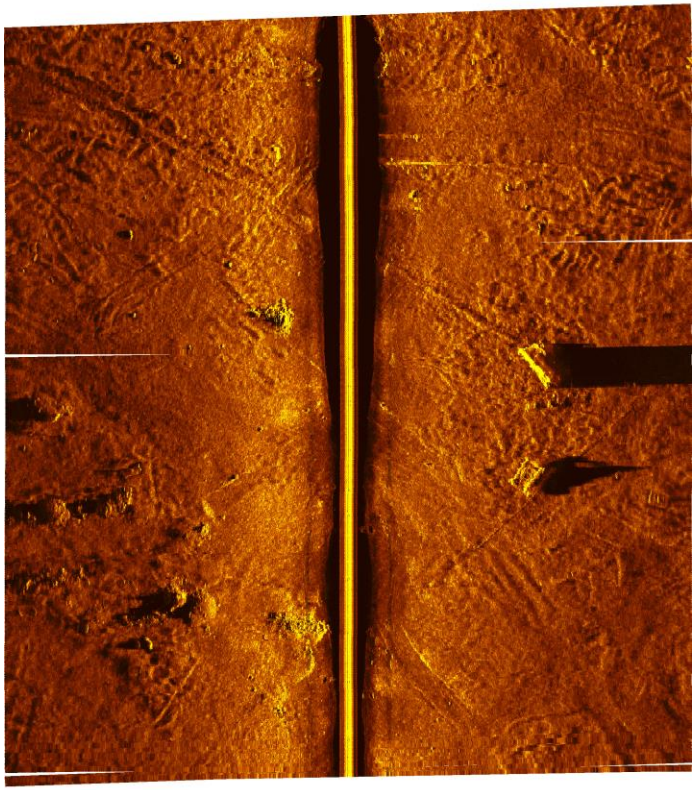


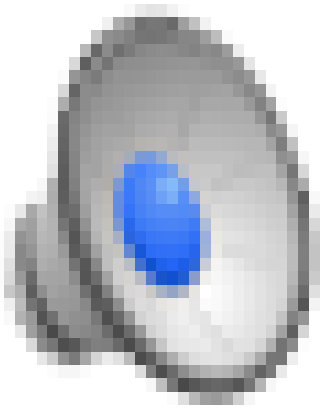
2015

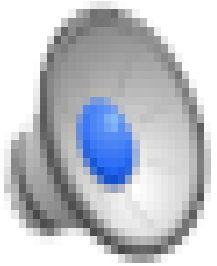




FP7 ARROWS







FP7 FILOSE

BONUS FISHVIEW

H2020 LAkHsMI

Building multidisciplinary teams: lessons learned

- Find common goal
- Search until you find right (T-shaped) people
- Listen
- Accept that multidisciplinary work takes more time
- Respect the standard and culture of other disciplines
    - Special request: don’t take data for granted

- Forge a shared mission
- Develop T-shaped researchers
- Nurture constructive dialogue
- Give institutional support
- Bridge research, and policy and practice

  - R. Brown, A. Deletic, T.H.F. Wong “Interdisciplinarity: how to catalyse collaboration”,
  - Nature (16. september 2015)

Summary

- Current trends in ICT: merging the physical and virtual worlds
- Robotics is an example of such a cyber physical system
- ICT may get diluted because of value paradox
- We should maintain and keep developing expertise of ICT
- Build T-shaped people with
  - deep knowledge in some of the ICT fields and
  - Breadth in close and far disciplines
- Build multidisciplinary teams of T-shaped people

- I wish it would dawn upon engineers that, in order to be an engineer, it is not enough to be an engineer.

  – Jose Ortega Y Gasset