

Robotik \Leftrightarrow R/Cobotics

@ Ist künstliche Intelligenz gefährlich?

PD Dr. Ullrich Köthe - SS 2017

By: Bernd Rößler - 170531

Agenda

> Robotics:

- >> Introduction: >>> History; >>> Reality

- >> Robotics Technologies: >>> Cyber Focus; >>> Enablers

> Key Challenges:

- >> Collaboration: >>> Asimov's Laws; >>> Human Dominance; >>> Franka Emika

- >> Competitive Collaboration: >>> Games

- >> Cyber: >>> Contributions

> ‚Danger-Zones‘:

- >> Ethics: >>> Philosophy; >>> Reality

- >> Economics: >>> Market; >>> Impact;

Robotics: <Introduction>

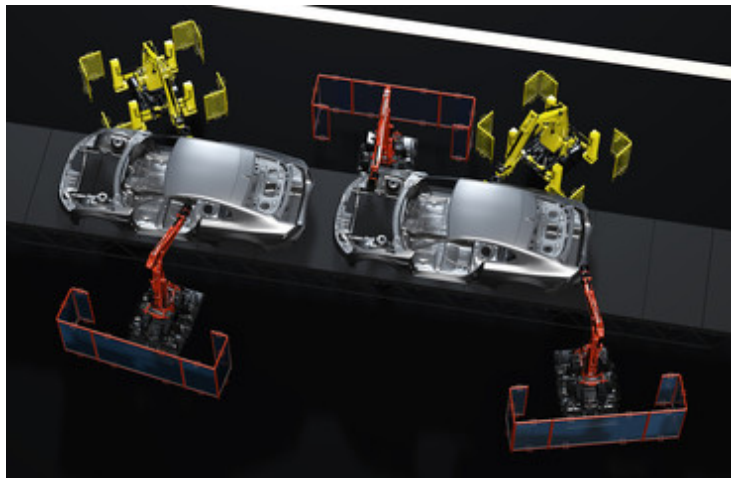
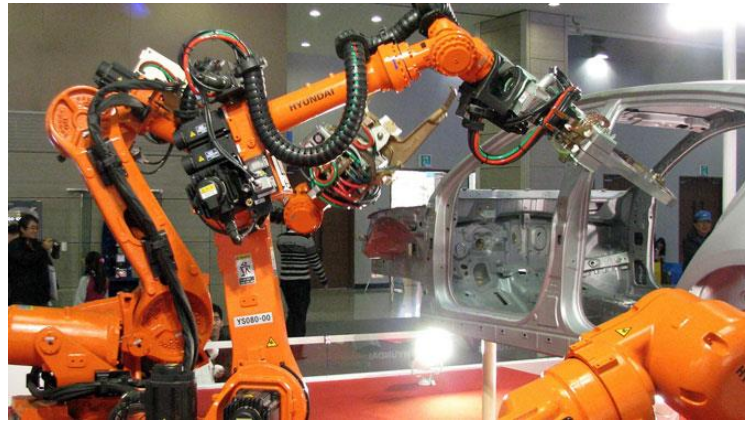
>> History

- **Origination:**
The term “robot” has been created by Karel Capek 1921 in his Science-Fiction-Play *R.U.R.* (Rossum's Universal Robots) and morphed from the slavic term for (forced) work.
- **Definition (early):**
 - **RIA** (Robot Institute of America) (1979):
a robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks.
 - **VDI** (Richtlinie 2860):
Industrieroboter sind universell einsetzbare Bewegungsautomaten mit mehreren Achsen, deren Bewegungen hinsichtlich Bewegungsfolge und Wegen bzw. Winkeln frei (d.h. ohne mechanischen Eingriff) programmierbar und gegebenenfalls sensorgeführt sind. Sie sind mit Greifern, Werkzeugen oder anderen Fertigungsmitteln ausrüstbar und können Handhabungs- und/oder Fertigungsaufgaben ausführen.
- Evolving **DEFINITION** due to rapid **INNOVATION**



Robotics: <Introduction>

>> Robots >>> Automation & Danger Zones



Robotics: <Introduction>

>> Key Technologies

- ✓ engineering,
- ✓ electronics,

- ✓ **computer science,**
- ✓ **artificial intelligence,**

- ✓ mechatronics,
- ✓ material technology,
- ✓ nanotechnology,
- ✓ bioengineering,
- ✓ psychology,
- ✓ medicine,.....



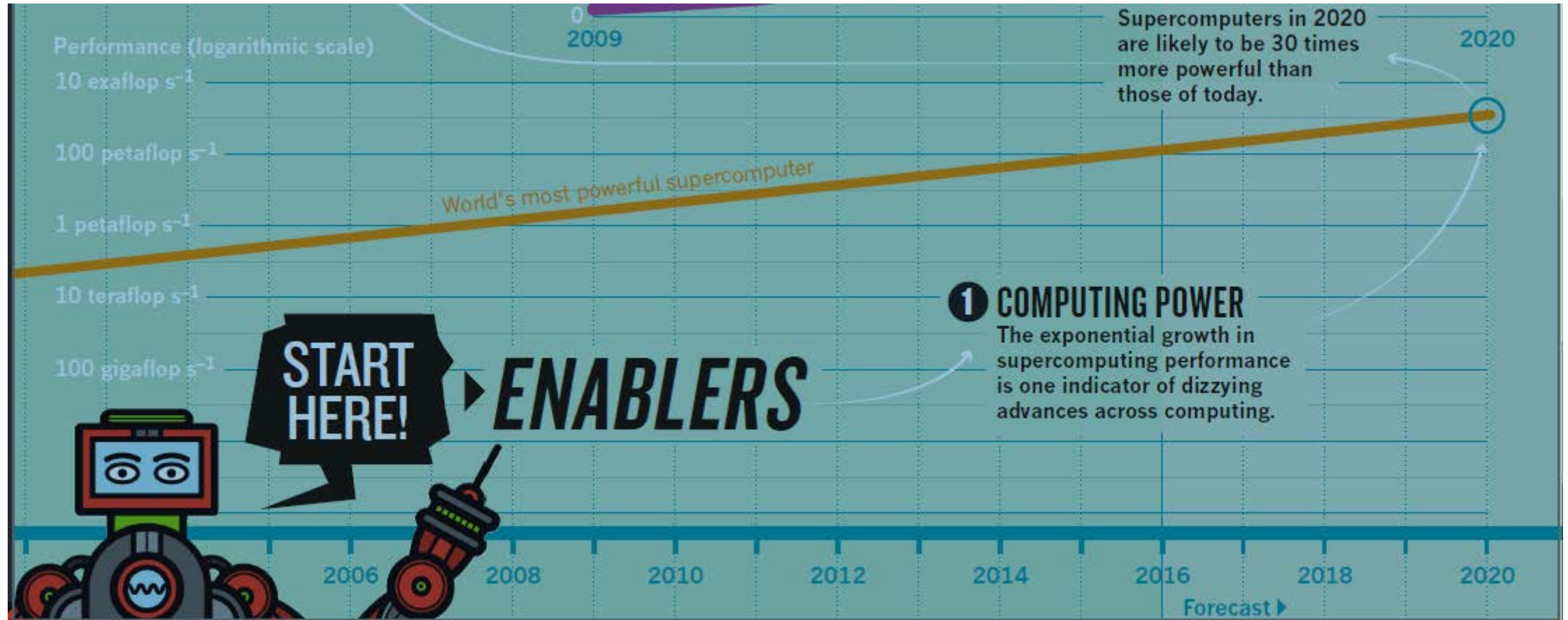
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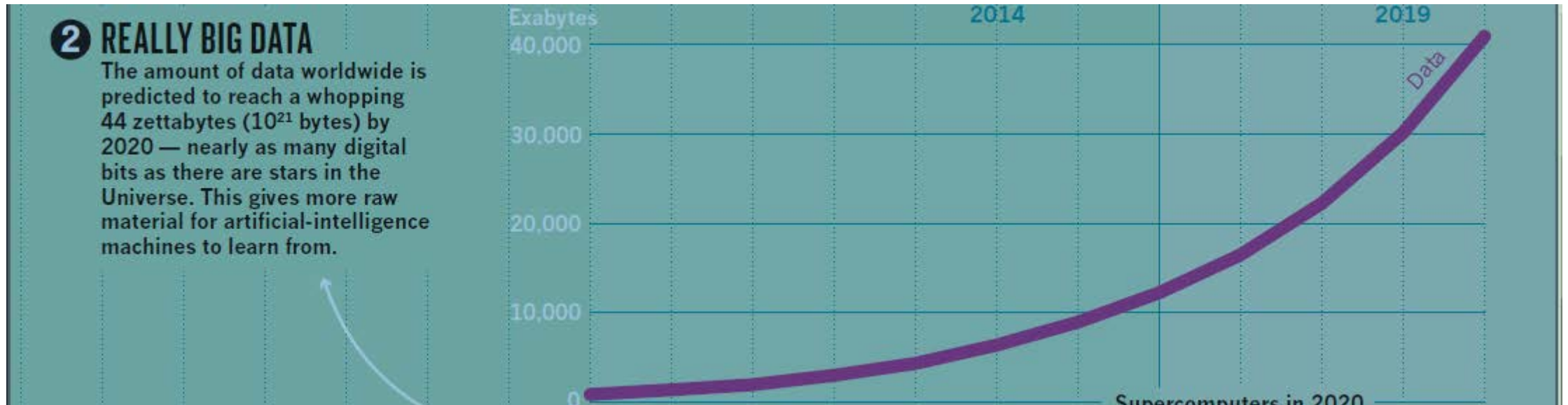
CYBER



Robotics: < Introduction > >>Enabler-1 >>> Computing Power



Robotics: < Introduction > >>Enabler-2 >>> Really Big Data

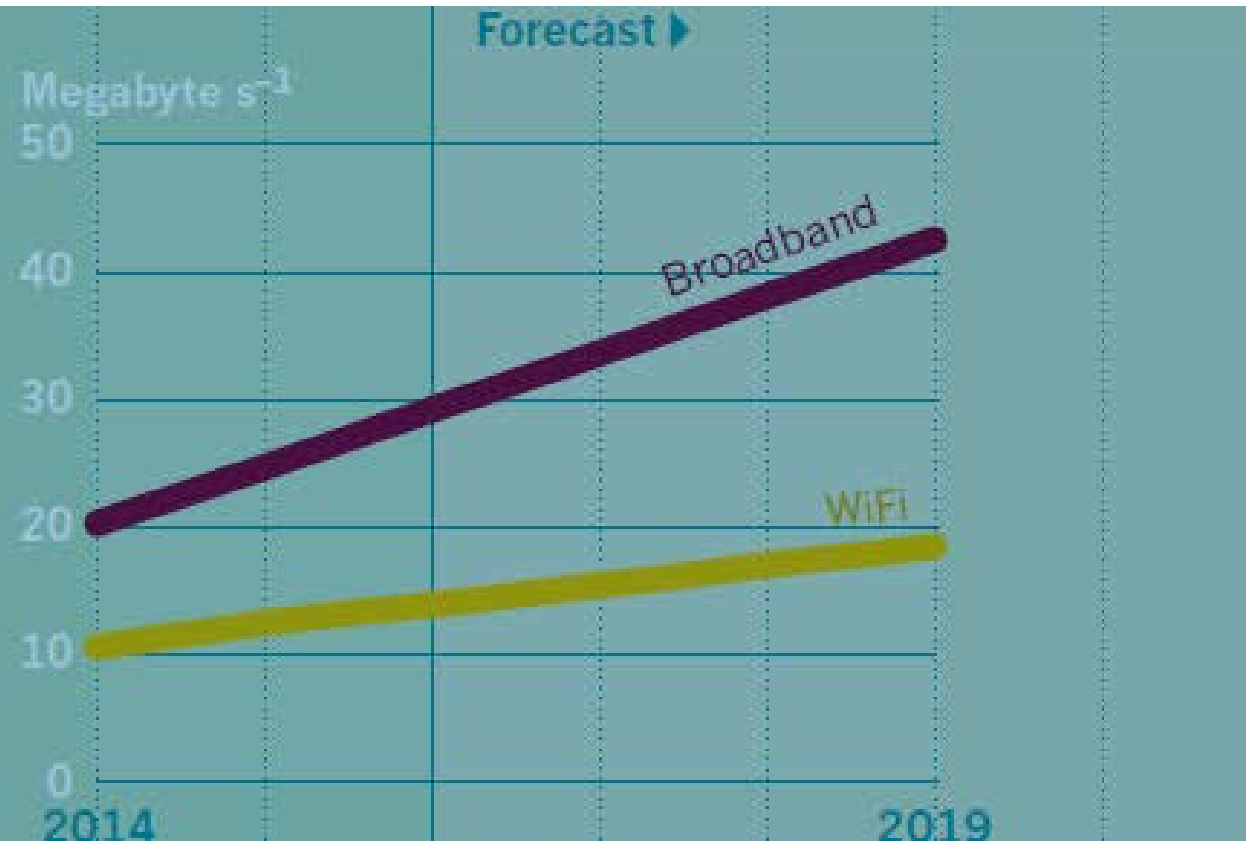


Robotics: < Introduction >

>>Enabler-3 >>> Communication Speed

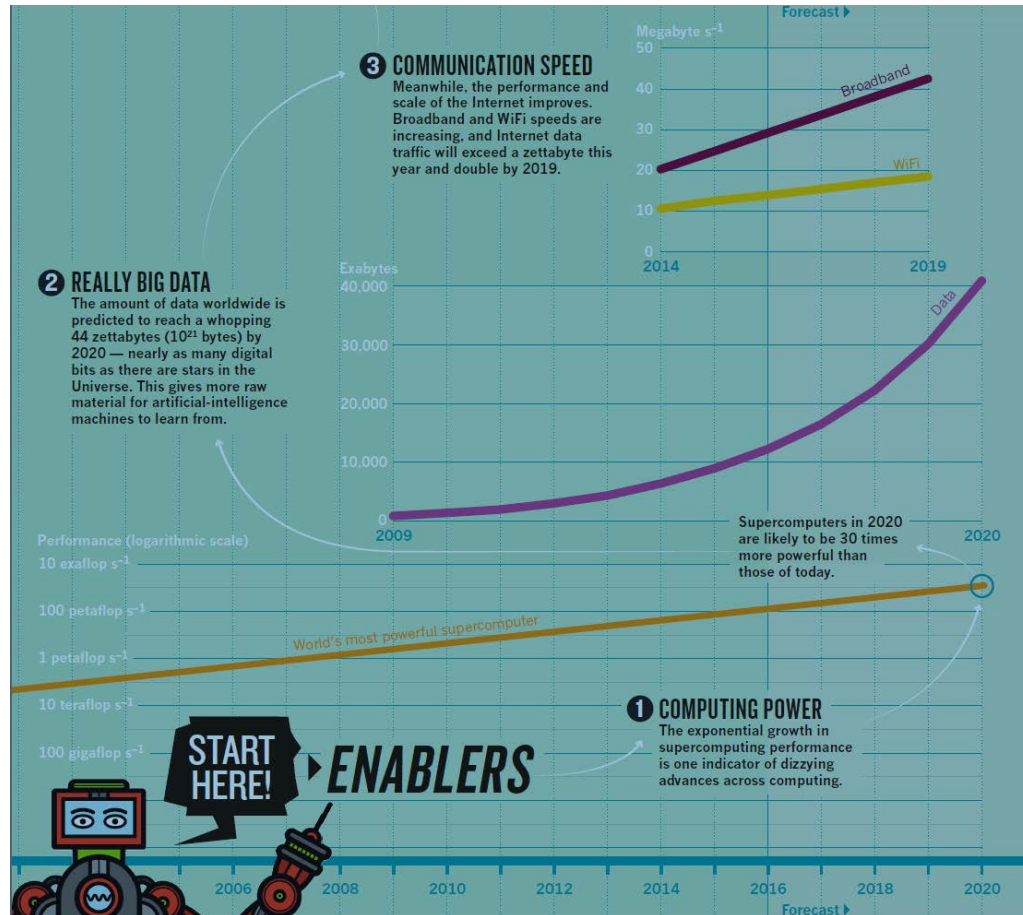
3 COMMUNICATION SPEED

Meanwhile, the performance and scale of the Internet improves. Broadband and WiFi speeds are increasing, and Internet data traffic will exceed a zettabyte this year and double by 2019.



Robotics: <Introduction>

>> Computer Science/AI >>> Enablers



1. Computing power

1. supercomputing performance as indicator
2. **30 times more powerful by 2020**

2. Really big data

1. **amount of data worldwide : 44 zettabytes (10²¹ bytes) by 2020**
2. **raw material for artificial-intelligence machines to learn from.**

3. Communication speed

1. performance and scale of the Internet improves.
2. Broadband and WiFi speeds are increasing, and
3. Internet data traffic will exceed a zettabyte this year and double by 2019.

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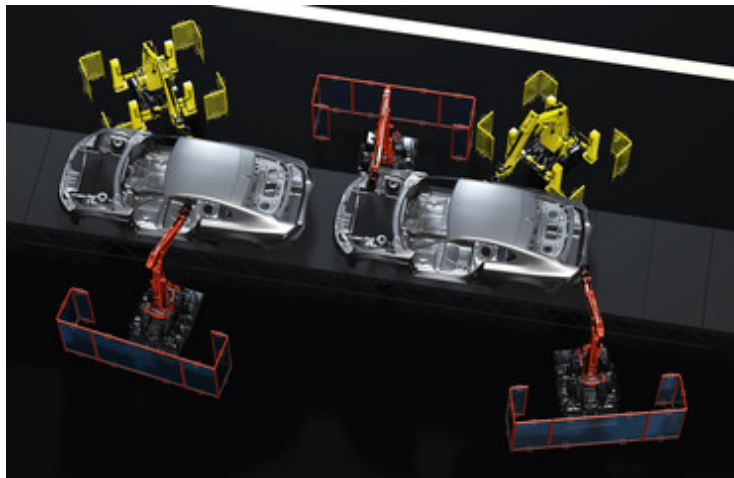
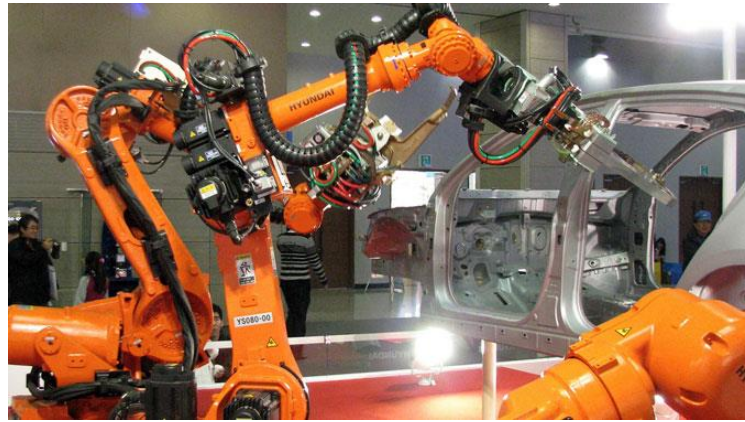
> ‚Danger-Zones‘:

- >> Ethics: >>> Philosophy; >>> Reality

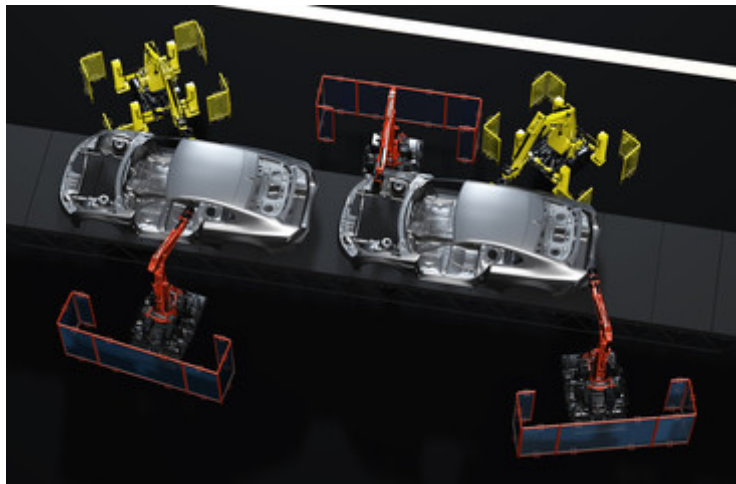
- >> Economics: >>> Market; >>> Impact;

Robotics: < Key Challenges >

>> Industry Robots >>> What's UP?



Robotics: < Key Challenges > >> OOPS! HUMANS? >>> COBOTICS



Robotics: < Key Challenges > >> R/Cobotics >>> Asimov's Laws



- # 1: A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- # 2: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- # 3: A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.
- # 0: A robot may not harm humanity, or, by inaction, allow humanity to come to harm.

OR

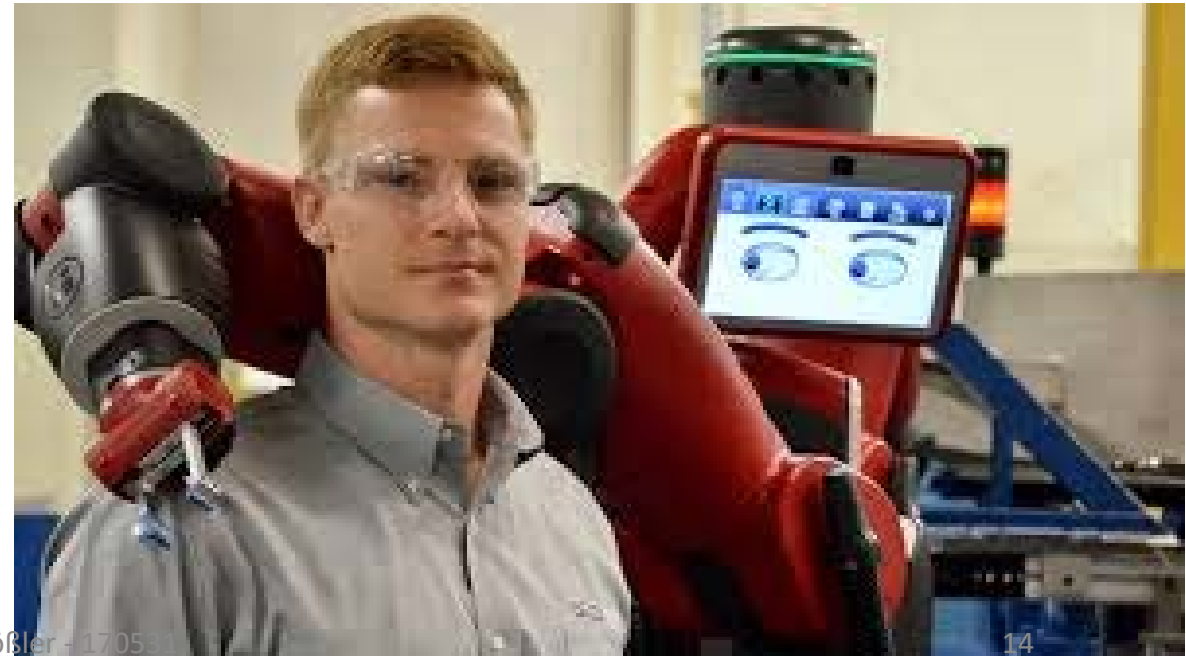
"A robot may not harm a human being, unless he finds a way to prove that ultimately the harm done would benefit humanity in general!"

Robotics: < Key Challenges > >> R/Cobotics >>> Cobotics

Challenges for Robot–Human Interaction in Co-Habitation (-WORK):

#1 **Safety for Humans** (>>> Assimov's First Law of Robotics)

- robot physics/mechanics/material
- perception/reaction
 - Sensor/Actor
 - Algorithm
 - Communication



Robotics: < Key Challenges >

>> R/Cobotics >>> Safety Assurance Design

1. Collaboration with Human Safety Priority Dominance

- Physical/mechanical redesign:
 - Size matters – reduction of roboter weight
 - Function adapted – focus on ‚arm-related‘ functions with upper limit of handling weight
 - Flexibility – joint flexibility and obstacle/contact priority
 - Sensoric/actoric reaction prioritication for safety
- Some cyber design requirements:
 - Algorithm design priority for Safety >>> CONTROL
 - Motion planning and obstacle avoidance
- Example: What the hack is Franka Emika?

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Robotics: < Key Challenges >

>> R/Cobotics >>> Franka Emika - DataSheet

- **USP: Designed-In Safety Dominance**
- Price:
 - < 10.000 Euro -> ½ to 1/3 of price of comparable designs
- Simplicity:
 - ‚learning by doing‘ – motion based functional learning
 - Programmable

BUT: moving forward:

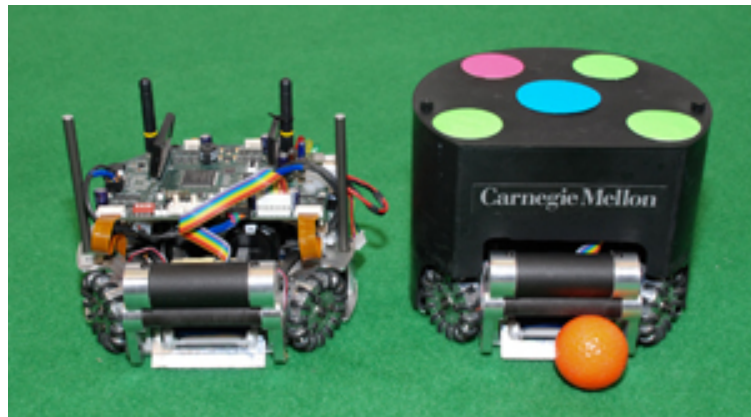
- HUMANOID concepts (like Elisa @ DKI)
- Competitive Collaboration

Robotics: < Key Challenges > >> R/Cobotics >>> Safety Assurance Design

1. Collaboration with Human Safety Priority Dominance

2. Competitive Collaboration (with Human Safety Priority -> Asimov!!!)

Example: SOCCER



C/Robotics - Bernd Rößler - 170531



By 2050 Robots will beat the World Champion TEAM in Soccer according to the FIFA rules

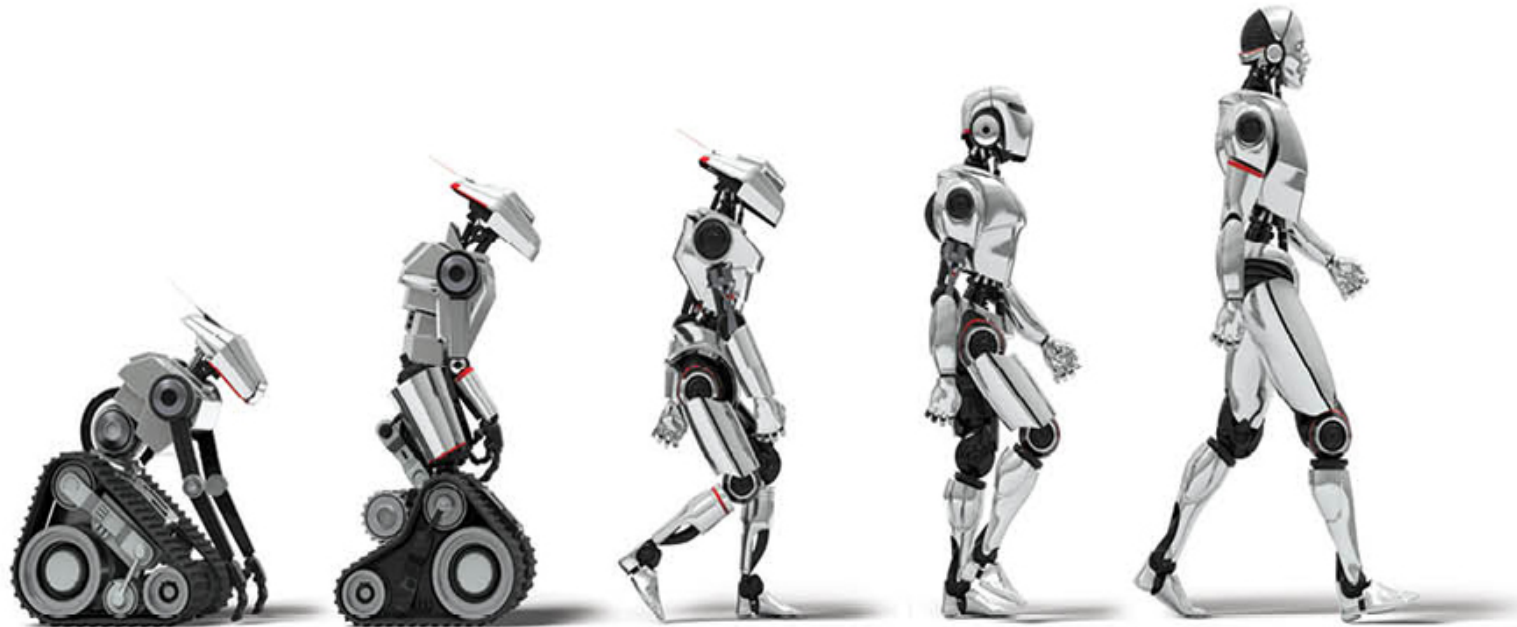
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Robotics: < Key Challenges > >> R/Cobotics >>> Cyber Capabilities

- Robot advancements require higher cyber capabilities:
 - Complex 4D sensor/actor infrastructure
 - Situational and sustainable adaption (incl. degrees of autonomy)
 - Multi-level modelling and optimization
 - Function/task and related motion planning and execution
 - Continous learning + level of specialization
 - Parts vs. individual vs. System (uniqueness dimension)
- Major focus is on AI (and computer science)
- Limited to ‚human‘ capabilities & WHO/WHAT is the limit?

Robotics: < Key Challenges >

>> R/Cobotics >>> Summary, ähh Evolution



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Robotics: < ‚Danger-Zones‘ > >> ‚ETHICS‘ >>> Philosophy and beyond

Can ‚humanoid‘ robots deal with the following and if HOW?

- Innovation
- Creativity
- Aesthetics, Culture >
- Phenomenology
- Emotions
- Identity, Individuation
- Personality
- Autonomy (Evolution, Morphology,...)
- ...

➤ ...e.g. - beyond the concept of cognitive science

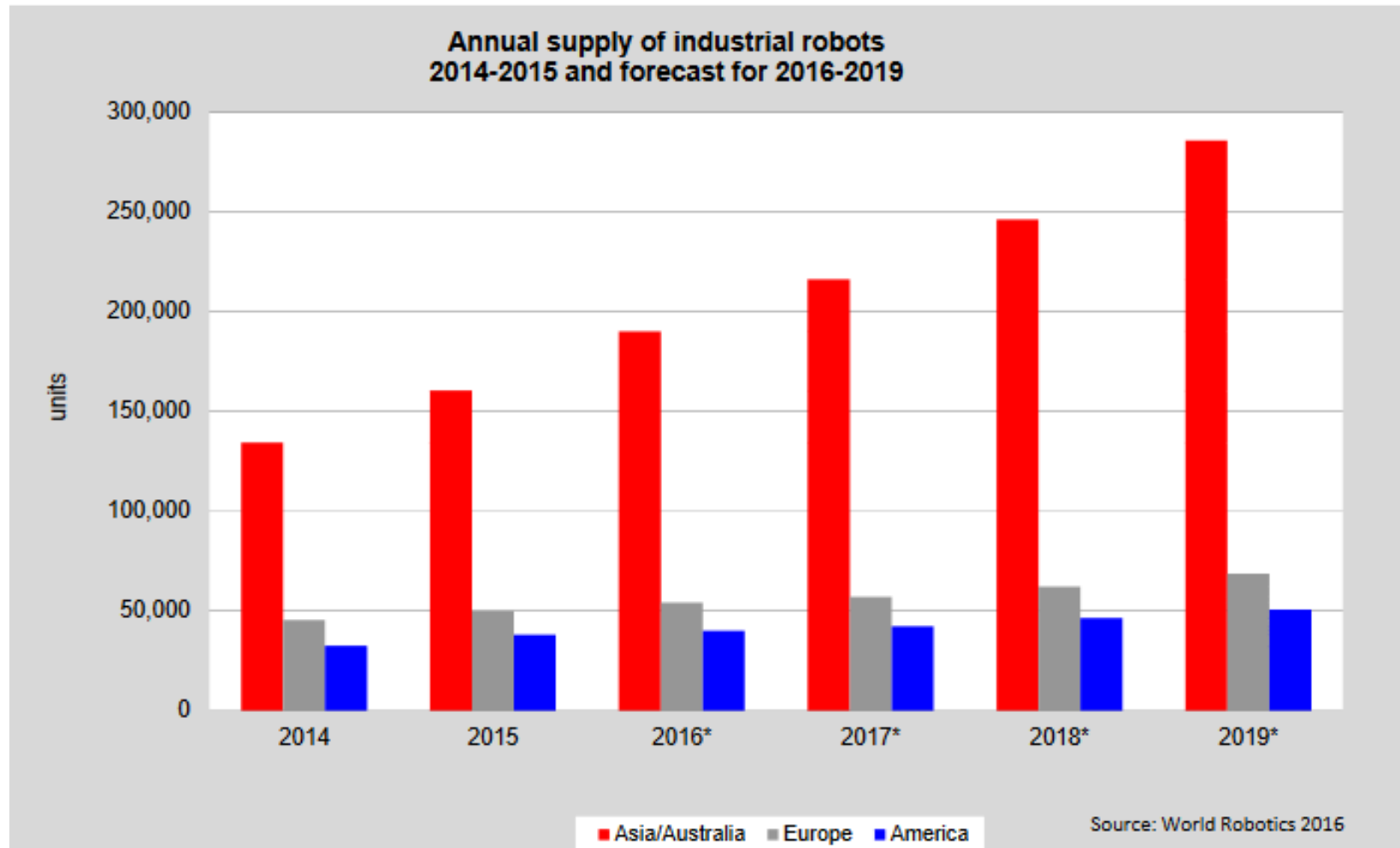
Robotics: < ‚Danger-Zones‘ > >> ‚ETHICS‘ >>> Real World

- FACT: Humanoid R/Cobots <> Human Individuals

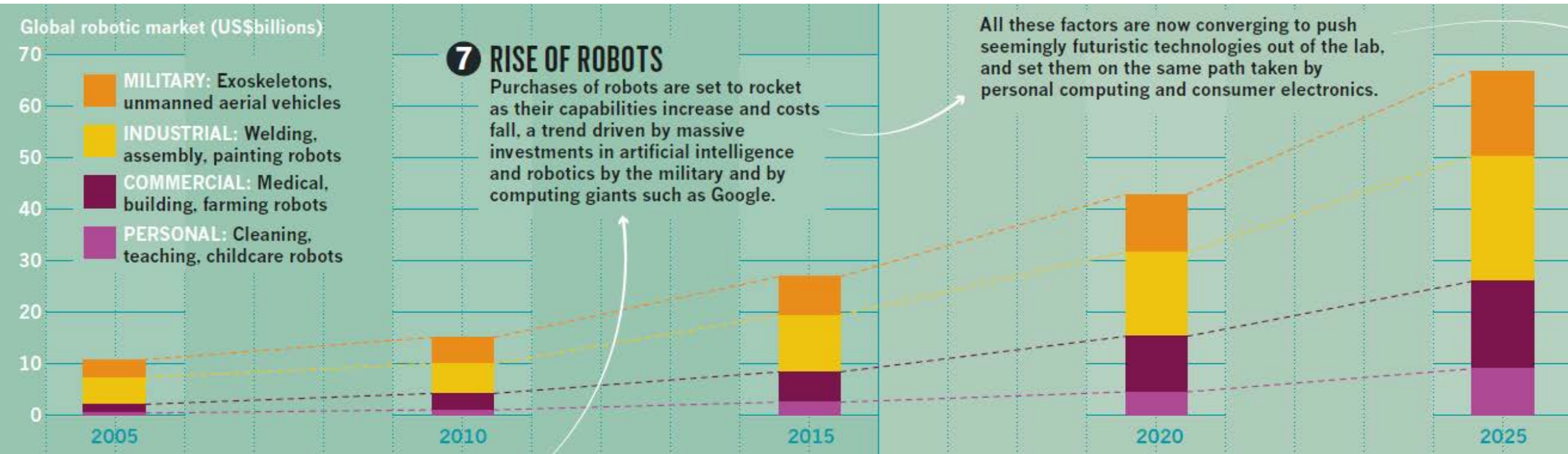
- Reality:
 - Legal -> liability, legal category: Robot -> new legal consequence
 - Regulation -> safety, security
 - Political -> taxation, system adaptation, education
 - Value Creation -> who owns what, business models,
 - Value Distribution -> base income,
 -

Robotics: < ‚Danger-Zones‘ >

>> Economics >>> Huge Market -> Geography

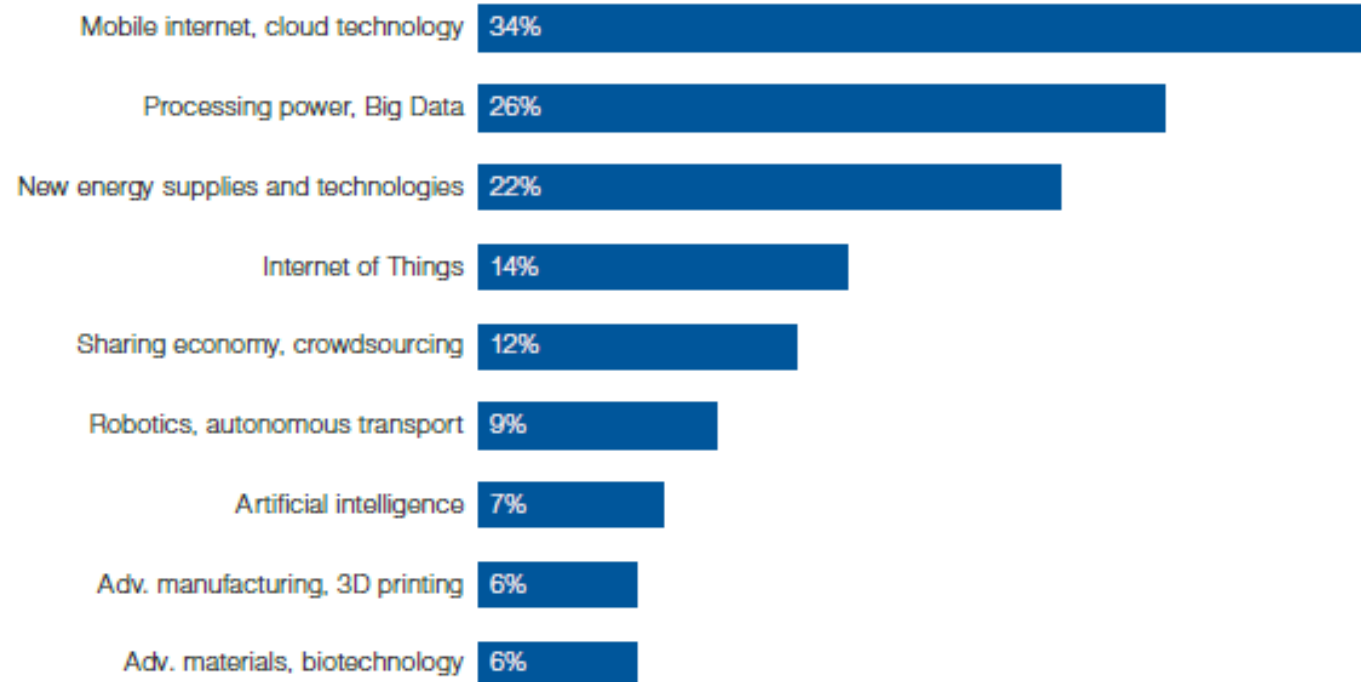


Robotics: < ‚Danger-Zones‘ > >> Economics >>> Huge Market



Robotics: < ‚Danger-Zones‘ > >> Economics >>> Automation Technologies

TECHNOLOGICAL



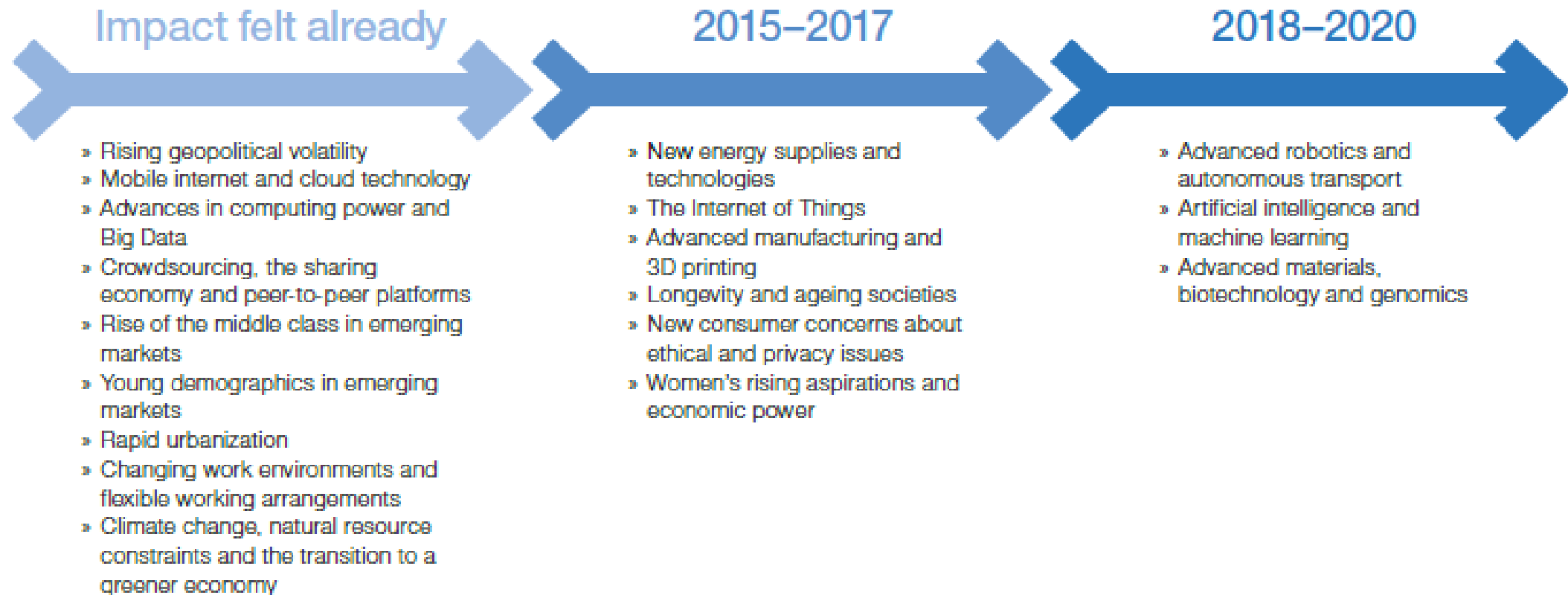
Source: Future of Jobs Survey, World Economic Forum.
Note: Names of drivers have been abbreviated to ensure legibility.

- ✓ engineering,
- ✓ electronics,
- ✓ **computer science,**
- ✓ **artificial intelligence,**
- ✓ mechatronics,
- ✓ material technology,
- ✓ nanotechnology,
- ✓ bioengineering,
- ✓ psychology,
- ✓ medicine,....

Robotics: < ‚Danger-Zones‘ >

>> Economics >>> AUTOMATION and DELEGATION

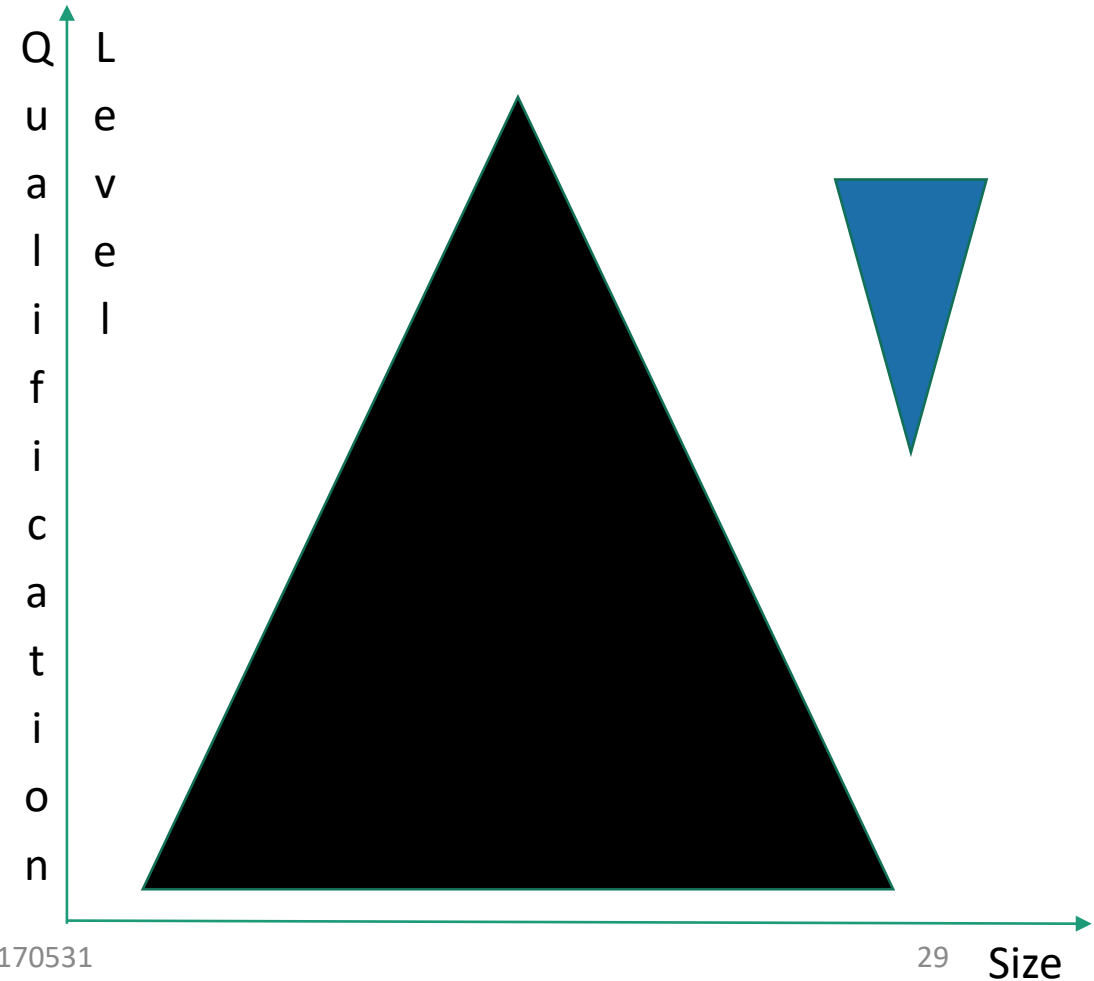
Timeframe to impact industries, business models



Robotics: < ‚Danger-Zones‘ >

>> Economics >>> Significant Net Job Losses

Net employment outlook by job family, 2015–2020
Employees (thousands, all focus countries)



Robotics: < ‚Danger-Zones‘ > >> Summary >>> What to do?

- C/Robotics is a MAJOR new market delivering the DIGITIZATION to the reality of everyone
- The key outcomes:
 - AUTOMATION
 - *DELEGATION (not covered: e.g. Military, Medicine)*
- The impacts to manage:
 - Work and information distribution
 - Speed and complexity of change
 - New ‚ethics‘ for C/Robots, better DIGITIZATION

< Evolution of life-purpose for Humans () >

Robotics: < ‚Danger-Zones‘ >
>> our future >>> in our hands ???

