UNIVERSITY OF HOHENHEIM

Digital Management

University of Hohenheim

Faculty of Business, Economics and Social Sciences

Institute of Marketing and Management

Chair for Digital Management (Prof. Dr. H. Gimpel)

Digital Management: Hot Topics in Practice

Chapter 0: Introduction

2023

Research Center Finance & Information Management

Fraunhofer FIT Project Group Business & Information Systems Engineering

DLA DIGITAL LEADERSHIP ACADEMY

https://digital.uni-hohenheim.de/

Briefly about us

Our team

UNIVERSITY OF HOHENHEIM

Lecture team

Pictures: private or Research Center FIM, no further use allowed

Prof. Dr. Henner Gimpel

UNIVERSITY OF HOHENHEIM

5a	Diploma	Engineering Management	University of Karlsruhe (TH)
3a	PhD Student	Business Informatics	University of Karlsruhe(TH)
1a	Postdoc	Business Informatics	University of Karlsruhe(TH)
5a	Consulting	Strategy, Marketing	McKinsey & Company, Frankfurt
2a	Postdoc	Business Informatics	Karlsruhe Institute of Technology
7a	Professor	Engineering Management Business Informatics	University of Augsburg Fraunhofer FIT, Augsburg
Since 2021	Professor	Digital Management	University of Hohenheim

Dr. Valerie Graf-Drasch

UNIVERSITY OF HOHENHEIM

3a	Bachelor	Economics	Vienna University of Economics and Business
3a	Master	Finance & Information Management	Technical University of Munich & University of Augsburg
4a	PhD Student	Information Systems	University of Augsburg
1a	Postdoc	Fraunhofer Institute for Applied Information Technology FIT	
Since 2021	Postdoc	Chair of Digital Management	University of Hohenheim

Dr. Manfred Schoch

3a	Bachelor	Business Informatics	University of Augsburg
3a	Master	Information-focused Economics	University of Augsburg
4a	PhD Student	Economics	University of Hohenheim
1a	Postdoc	Fraunhofer Institute for Applied Information Technology FIT	
Since 2021	Postdoc	Chair of Digital Management	University of Hohenheim

Your contact persons for this course

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Prof. Dr. Henner Gimpel	Dr. Valerie Graf-Drasch	Dr. Manfred Schoch	Carolin Jung
			
Educational Videos			Coordination
Live Sessions			Exercises

If you have any questions about the course, please do not hesitate to contact us.

digital@uni-hohenheim.de

Your fellow students

Benefit from the free eLeaning forum on ILIAS through mutual exchange with your fellow students.

ILIAS The Open Source Learning Management System

https://www.ilias.de

Our partners (Selection)

UNIVERSITY OF HOHENHEIM

Academia

Research Center
Finance & Information Management

Fraunhofer FIT

Universität Augsburg University

Universität Bayreuth

Hochschule Augsburg
University of Applied Sciences

Frankfurt University of Applied Sciences

MIT Center for Collective Intelligence

The University of Newcastle Australia

Indiana University

CBS Copenhagen Business School
Handelshøjskolen

Microsoft Research

University of St. Thomas

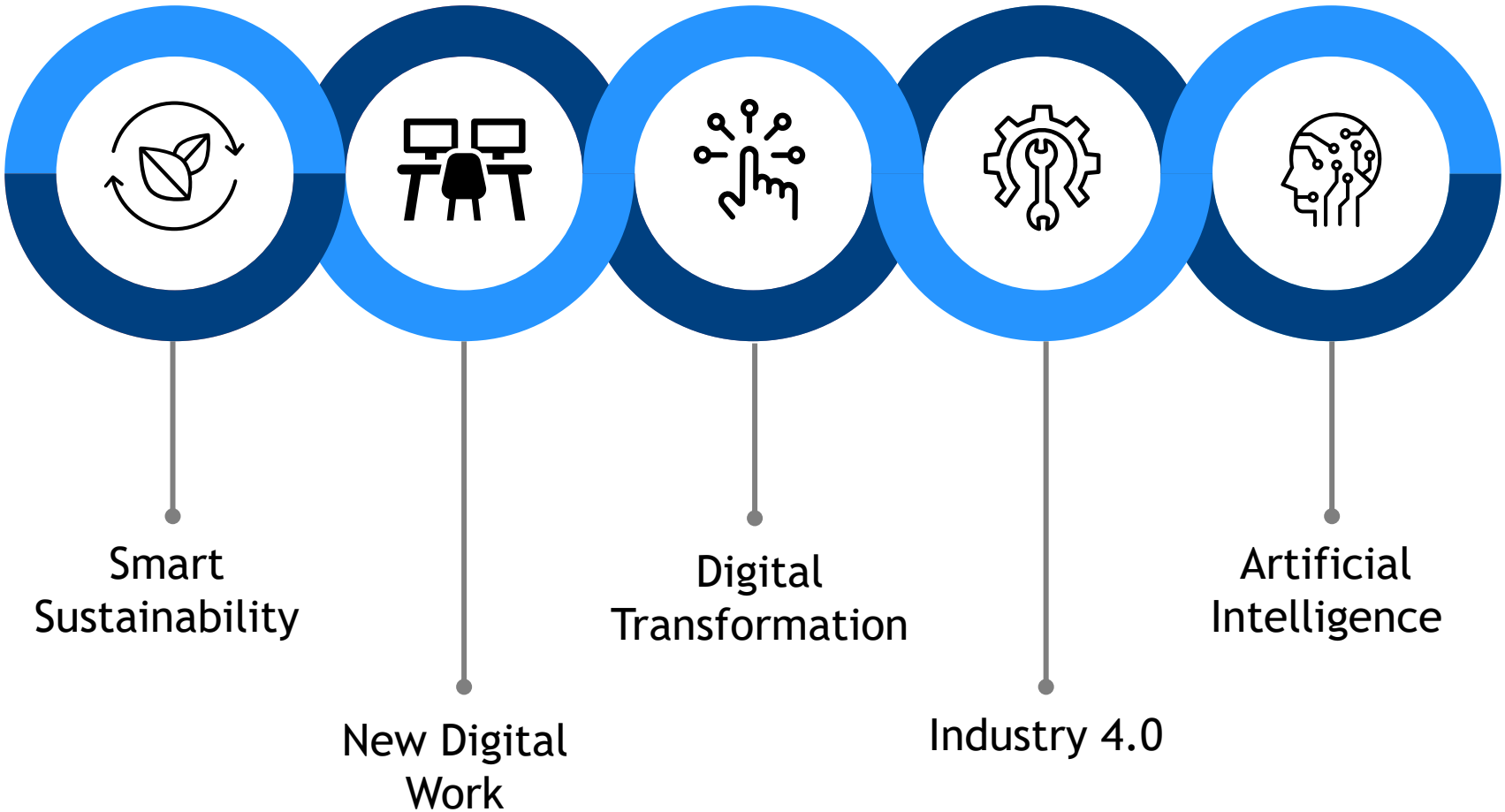
Industry

Allianz
Versicherungskammer
DB Bahn
Deutsche Bank
Augsburger Aktienbank
Flughafen München
NORD/LB
pwc
BMW Group
McKinsey & Company
Senacor
Audi
Hufschmied Zerspanungssysteme
ZF
MAN Energy Solutions
Hilti
Zeiss Seeing beyond
energieagentur
Oetker-Gruppe
puren
Stadtwerk am See
RAPS
BGÜ
Stadtwerke Stuttgart
AVS
Vonovia
Stuttgart
[at] alexanderthamm
Stadt Augsburg
1250 überlingen
inno focus
ias Gruppe
Klinikum Bayreuth GmbH
UMM Universitätsmedizin Mannheim
Martha Maria
Universitätsklinikum Augsburg

Logos are property of the respective organization

Topics covered in the course

Agenda - Hot Topics



Perspectives on teaching and learning

The aim of teaching

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“

The aim of teaching is easy, it is to facilitate student learning

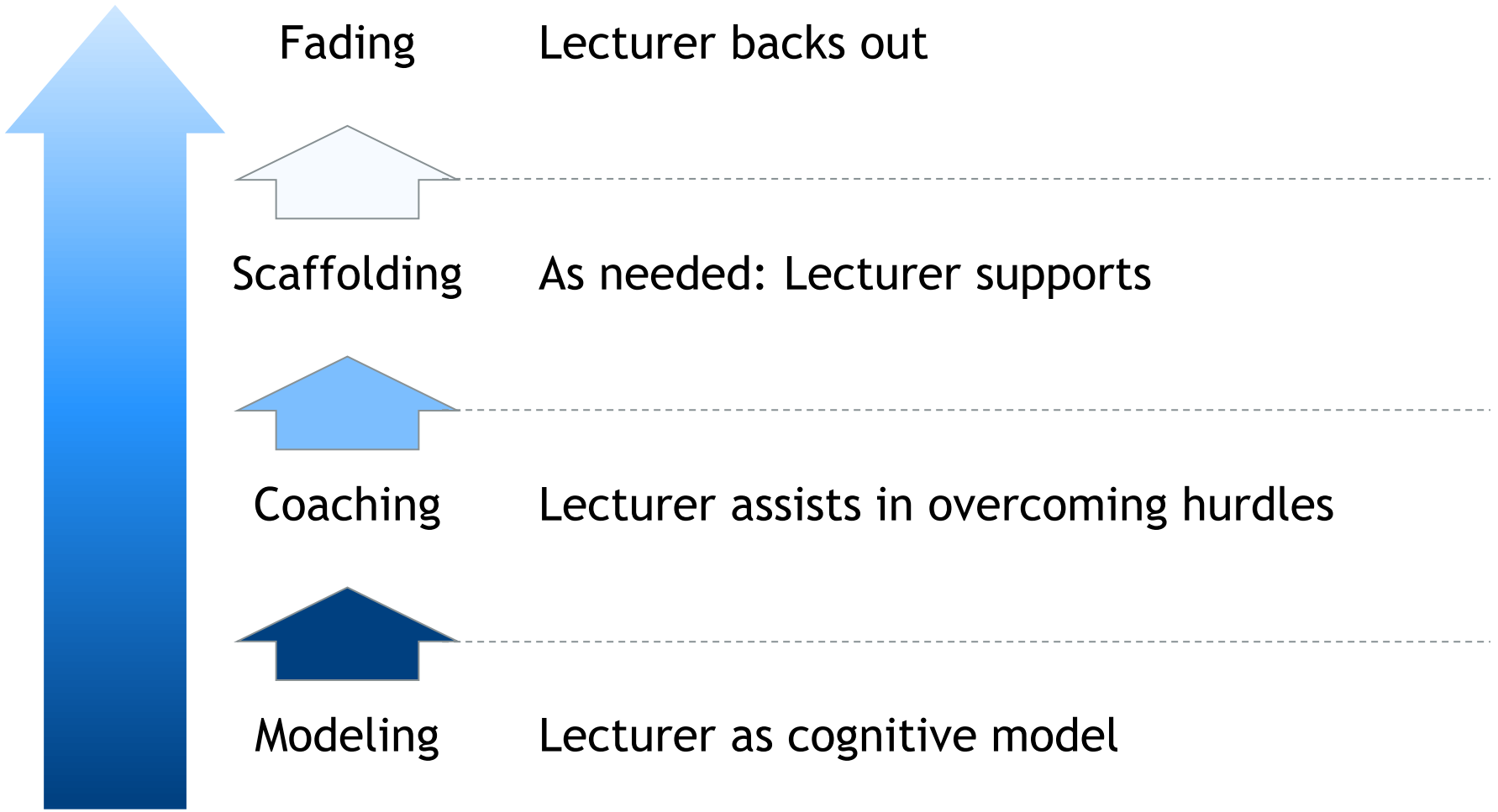
Paul Ramdsen, educational researcher, 2003

As little as one learns mountaineering, if someone carries one on the mountain, a young person becomes an expert (for whatever subject area) when he asks an expert

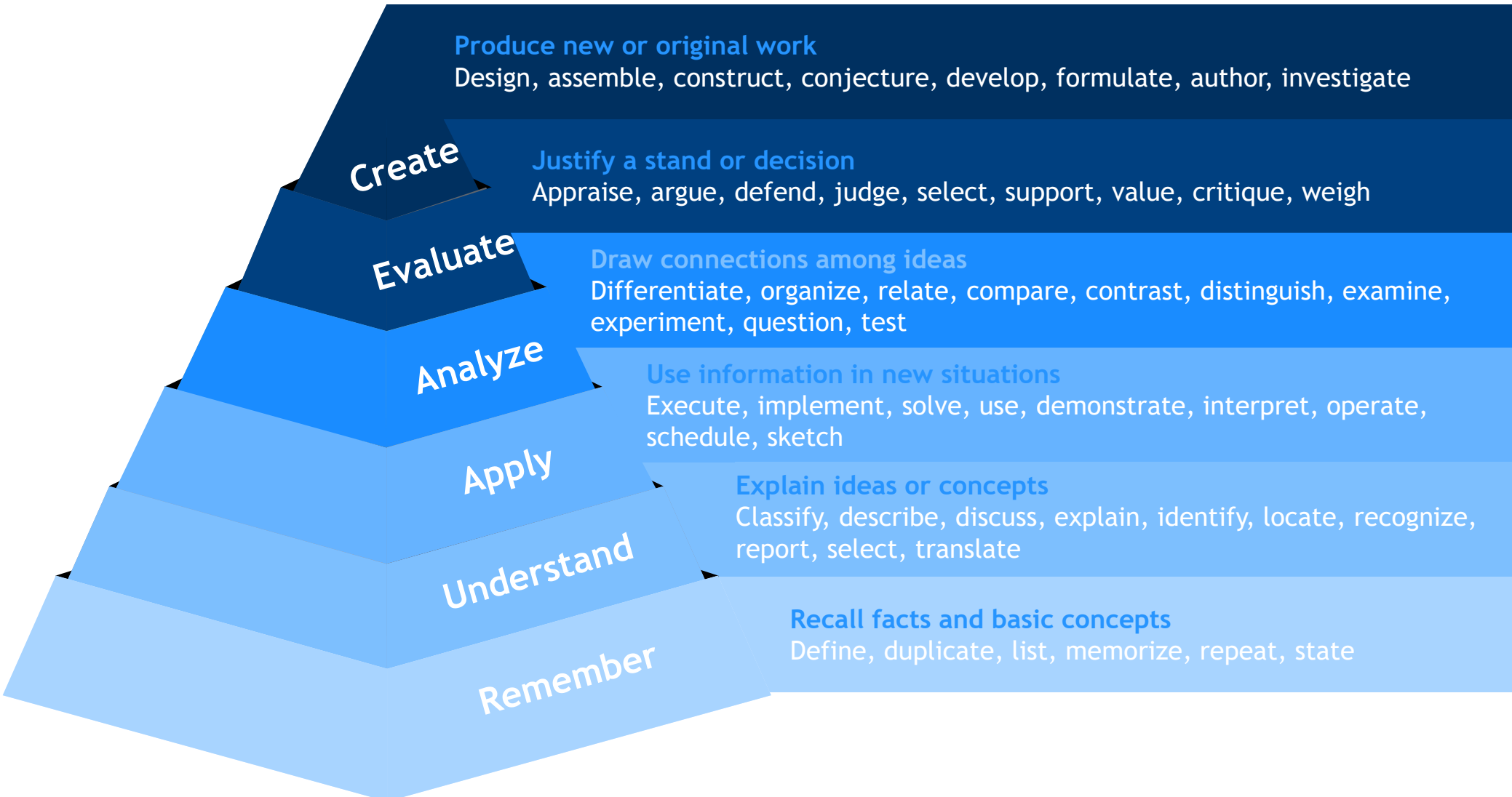
Manfred Spitzer, neuroscientist, 2012

”

Model of situated learning from the perspective of the lecturer based on Cognitive Apprenticeship



Levels of learning (Bloom's taxonomy)



Organizational details

Some general perspectives

Let‘s make sure you achieve your goals

Please provide feedback

Take notes and share your thoughts

Feel free to contact us
(digital@uni-hohenheim.de)

Learning goals

- Understand current corporate digitalization trends
- Know the technological basics of digital systems
- Analyze the potential and challenges of digital trends in different sectors of the economy
- Understand the basic building blocks of organizations and their interplay
- Understand the ethical and societal dimensions behind increasing digitalization of our economy

What else?

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LOGIC of provided contents on our website and ILIAS (public vs. more sensitive materials)

UNIVERSITÄT HOHENHEIM
Lehrstuhl für Digitales Management

Contents provided on the website

- Preparation material
- Slides of educational videos (=script)
- Generic exam information (since it is computer-based)

ILIAS
The Open Source Learning Management System

Contents provided on ILIAS

- Material for Live Sessions and Exercises
- Further announcements during the semester

Reasonable behaviors by students

In our experience, joining the live sessions correlates with better grades in the exam!

- **Join our live sessions** in the lecture room (or via Zoom)
- There, we discuss the material for better understanding

- To benefit from the live sessions, **thorough preparation is essential**
- Prior to each live session, please work through the required material thoroughly

- Engage with the content
- Engage with the lecturers
- Engage with your fellow students
- Reflect critically
- Integrate knowledge
- Take notes
- Provide feedback
- Do not multitask
- Stay engaged

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We will ask for feedback multiple times during the course

Topics

- What was most interesting?
- What was least interesting?
- What was missing?
- What do you want for the rest of the course?
- …

Style

- What should we keep up doing?
- What should we stop doing?
- What do you want for the rest of the course?
- …

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Information on the exam

Exam

- It is an elective course
  - M. Sc. Management (Focus area Marketing & Management, focus area Information Systems, Operations & Supply Chain Management, elective area)
  - M. Sc. Information Systems (Business Informatics: Business Administration elective or elective area)
  - MSc. Agribusiness (elective area)
  - Any other study programs (e.g., IBE): You should be able to take the course as a "free elective" course
- 6 ECTS
- Written 60-minute exam, **computer based (you will get detailed information on that)**
- First exam period: 17.07.23 – 04.08.23
- Second exam period: 18.09.23 – 06.10.23 (expected according to central planning)
- We will inform you about the exact exam days and time of the exam during the semester

Study programmes participating in the course

Which degree programme do you belong to?

Mentimeter

Course schedule

#Live Session	Date	Time
1	Thursday, 06.04.23	10:15 – 11:45
2	Thursday, 13.04.23	10:15 – 11:45
3	Thursday, 20.04.23	10:15 – 11:45
4	Thursday, 27.04.23	10:15 – 11:45
5	Thursday, 04.05.23	10:15 – 11:45
6 Allianz	Thursday, 11.05.23	10:15 – 11:45
	Thursday, 18.05.23	Holiday
7	Thursday, 25.05.23	10:15 – 11:45
	Thursday, 01.06.23	Holiday
	Thursday, 08.06.23	Holiday
8	**Monday, 19.06.23**	10:15 – 11:45
9	Thursday, 22.06.23	10:15 – 11:45
10	Thursday, 29.06.23	10:15 – 11:45
11	Thursday, 06.07.23	10:15 – 11:45
12	**Monday, 10.07.23**	10:15 – 11:45

#Exercise	Date	Time
1	Monday, 24.04.23	10:15 – 11:45
2	Monday, 08.05.23	10:15 – 11:45
3	Monday, 26.06.23	10:15 – 11:45
4	Monday, 03.07.23	10:15 – 11:45

Location		Duration
Thursdays	Katharinasaal	90 min
Mondays	HS1	90 min

Exercises will be held remotely (zoom only)

Guest lecture on 11.05.2023

allianz.de

Generate subtitles automatically

What is digital?

How to transform society through digital

Gerd Leonhard at https://www.youtube.com/watch?v=ystdF6jN7hc

What is digital?

"It sounded bad to me. Digital. They have digital. What is digital? And it's very complicated, you have to be Albert Einstein to figure it out ...the digital costs hundreds of millions of dollars more money and it's no good."

Donald J. Trump, 2017

at that time President of the United States

http://time.com/4775040/donald-trump-time-interview-being-president

Either digitalize or welcome failure

"There is **no alternative to digital transformation**. **Visionary companies** will **carve** out new **strategic options** for themselves — those that don't adapt, **will fail**."

Jeff Bezos,

Founder of Amazon

Quotes https://medium.com/@InnovexaSolutions/10-digital-transformation-quotes-that-will-change-the-way-you-view-it-c57fcc5fcd80, https://blog.kintone.com/business-with-heart/11-digital-transformation-quotes-to-lead-change-inspire-action;
Photo by Dan Farber in flickr.com CC BY-NC 2.0

Technology is a means, not an end

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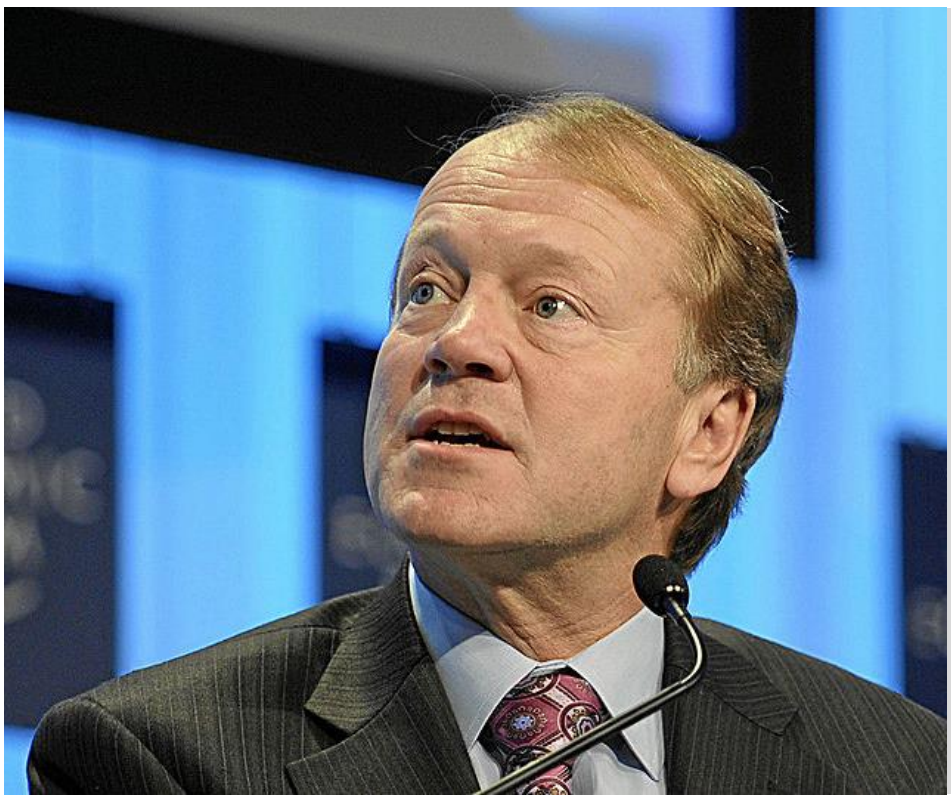
"Technology is a means, not an end. It serves the people, and not the other way around. We have the chance to make the most of the opportunities that this process offers – not just for economic growth, but for a better quality of life."

Claudia Nemat,

Member of Board of Management of Deutsche Telekom AG

Quote https://www.telekom.com/en/company/management-unplugged/claudia-nemat/details/six-theses-on-innovation-509306,
Photo https://www.telekom.com/en/company/board-of-management/profile/claudia-nemat-353058

Some businesses will die (as of 2019)



"At least 40% of all businesses will die in the next 10 years… if they don't figure out how to change their entire company to accommodate new technologies."

John Chambers,

Chairman of Cisco Systems

Quote https://medium.com/@InnovexaSolutions/10-digital-transformation-quotes-that-will-change-the-way-you-view-it-c57fcc5fcd80,
Photo by Michael Wuertenberg/World Economic Forum/swiss-image.ch CC BY-SA 2.0

Technology is transforming us

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"Clearly, the thing that's transforming is not the technology — the technology is transforming you."

Jeanne W. Ross,

Former Director at the MIT Center for Information Systems Research

Quote https://www.cgsinc.com/blog/19-quotes-digital-transformation-c-suite-executives,
Photo https://iasaglobal.org/Public/SpeakerBios/JeanneRoss.aspx

Digitalization is a philosophy, not a project

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"Don't be fooled by some of the digital transformation buzz out there, digital transformation is a business discipline or company philosophy, not a project."

Katherine Kostereva,
CEO of Creatio

"Think of digital transformation less as a technology project to be finished than as a state of perpetual agility, always ready to evolve for whatever customers want next, and you'll be pointed down the right path."

Amit Zavery,
VP and Head of Platform at Google Cloud

K. Kostereva: Quote https://chiefexecutive.net/real-meaning-digital-transformation-increased-agility/,
Photo https://twitter.com/K_Kostereva/photo;
A. Zavery: Quote https://www.forbes.com/sites/googlecloud/2020/01/22/digital-transformation-isnt-a-project-its-a-way-of-operating,
Photo https://cloud.google.com/press

Digitalisierung geht weit über die Technik hinaus

?

"Digital refers to the use of technology to create, store, and exchange information in a digital format.

Digital transformation is the process of using digital technologies to fundamentally change how organizations operate and deliver value to customers. It involves rethinking and redesigning business processes, culture, and customer experiences to drive growth and competitiveness."

??

The challenges of digital transformation

World Economic Forum at https://youtu.be/yQmdXfidrWM

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Digital Management: Hot Topics in Practice

Chapter 1: Smart Sustainability

2023

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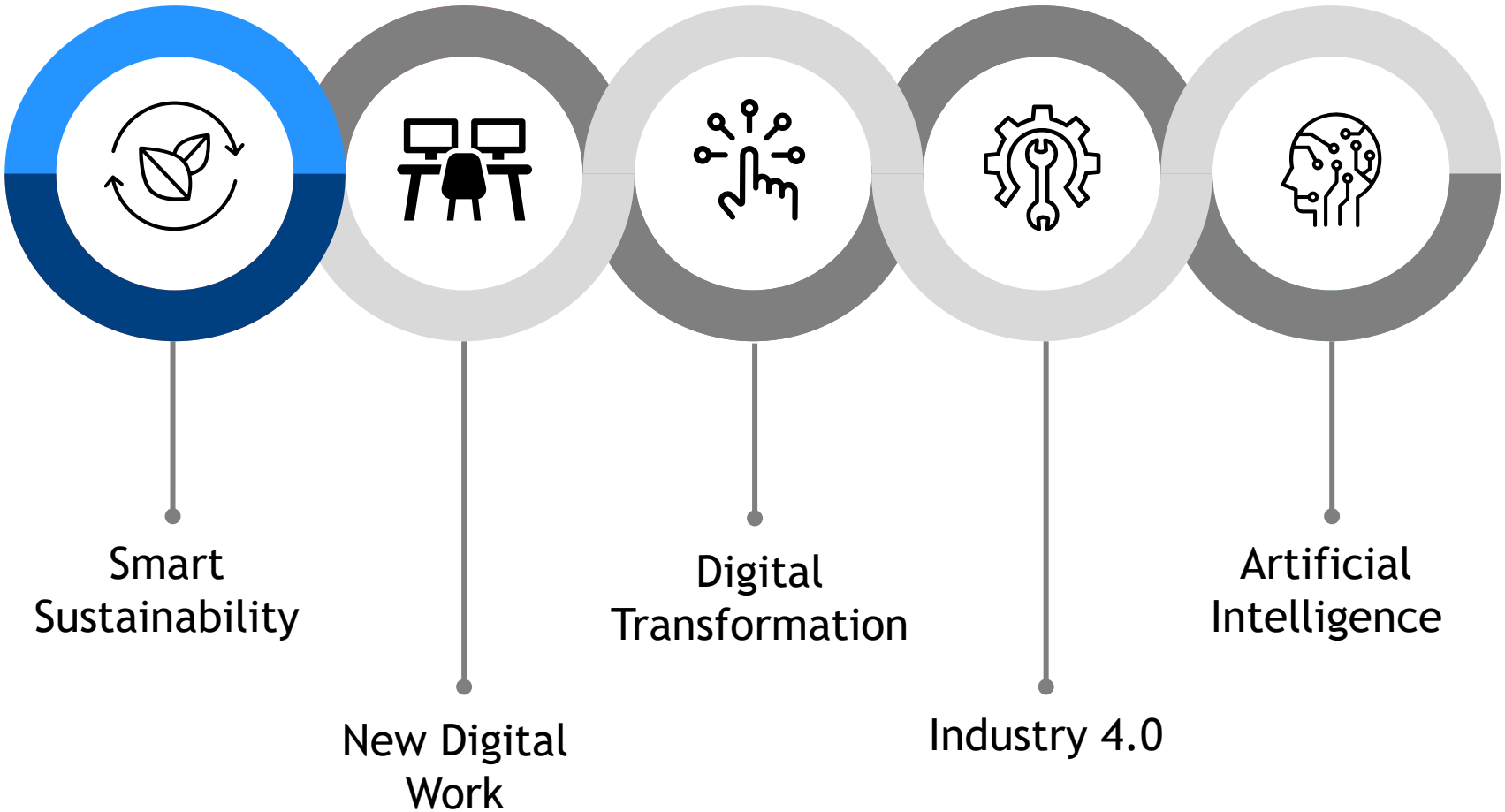
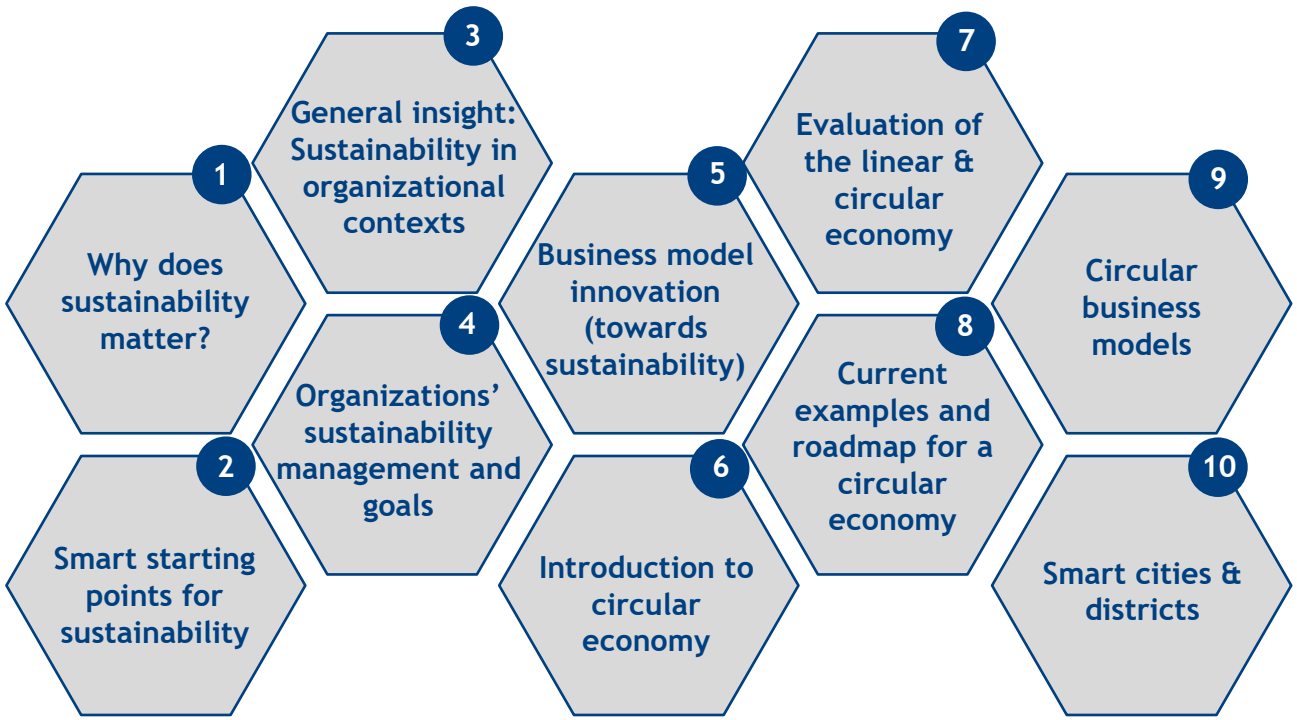
Agenda - Hot Topics



Agenda – Smart Sustainability



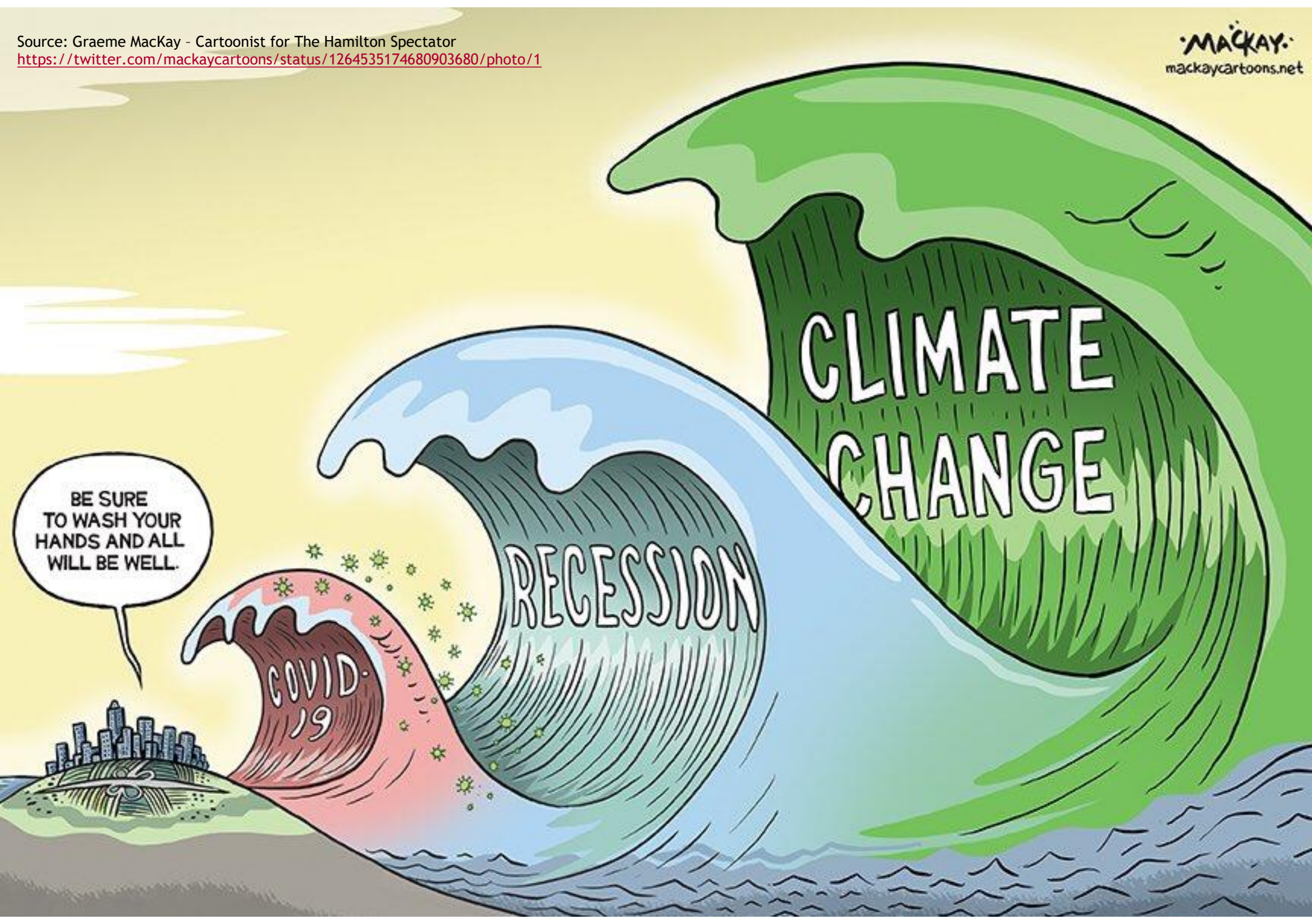
Legend:

- Relevant for the exam
- Voluntary additional material, not relevant

Why does sustainability matter?

Supporting video https://youtu.be/4jg1r303cL0

Source: Graeme MacKay – Cartoonist for The Hamilton Spectator
https://twitter.com/mackaycartoons/status/1264535174680903680/photo/1



The climate crisis increases the probability of extreme events (I)

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Lightning strikes at the North Pole

> **Meteorologists register a record number of lightning strikes in the Arctic.**
>
> SZ, August 19, 2019

- Lightning strikes around the geographic North Pole are extremely rare because the warm air masses necessary for them are usually missing
- Researchers recorded around 50 strikes in one day (previous record 6!)
- Presumed reason: Strong warming of the Arctic!

Iceland

> **Iceland declares a glacier a victim of climate change.**
>
> SZ, August 19, 2019

- Okjökull-glacier shrinks from 16 km^2 to less than 4 km^2 in recent years and is no longer moving
- It loses its glacier status and is declared "dead ice" (the ice no longer flows or breaks)
- Researchers predict the disappearance of all (approx. 300) Icelandic glaciers

The climate crisis increases the probability of extreme events (II)

> The Siberian cold is still not letting go of Europe: schools remain closed in many countries, and snow and ice continue to cause traffic chaos. The number of cold deaths (hypothermia) since Friday rose to more than 45 - in Poland alone there were 18 deaths.
>
> **Spiegel Online, February 28, 2018**

> Snow, arctic wind and ice: winter has Europe firmly in its grip. Record sub-zero temperatures were measured on the Zugspitze. In Poland, at least eight people died in freezing temperatures.
>
> **Tagesschau, February 26, 2018**

> It is expected to take 100 years for the forest to recover. […] Forest fires so close to the Arctic Circle accelerate the thawing of permafrost soils, which, according to Greenpeace Russia, contain gigantic amounts of frozen biomass. If they thaw, they release greenhouse gases into the atmosphere.
>
> **Die Zeit, August 3, 2019**

> July 2019 was the hottest month worldwide since measurements began. This is the result of an analysis by the EU's own Copernicus service [sic!] for monitoring climate change.
>
> **Focus Online, August 5, 2019**

The climate crisis increases the probability of extreme events (III)

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Dramatic floods in Germany

> Fallen trees, flooded streets, damaged roofs: In several regions, the fire department had to be called out after rain and thunderstorms. In Saxony, a man died while trying to pump out his flooded cellar.
>
> **Spiegel Online, July 26, 2021**

> The flooding on the Ahr River was exacerbated by damage to the forest - and will harm nature along the river. A district forester calls for a rethink.
>
> **Spiegel Online, July 07, 2021**

> The German Weather Service expects further heavy rainfall in the coming months. The Interior Minister of Rhineland-Palatinate is concerned about the threat of thunderstorms. And the number of fatalities continues to rise.
>
> **Spiegel Online, July 25, 2021**

Smart starting points for sustainability

Supporting video https://youtu.be/ir1rChvRk4I

Smart Starting Points for Sustainability

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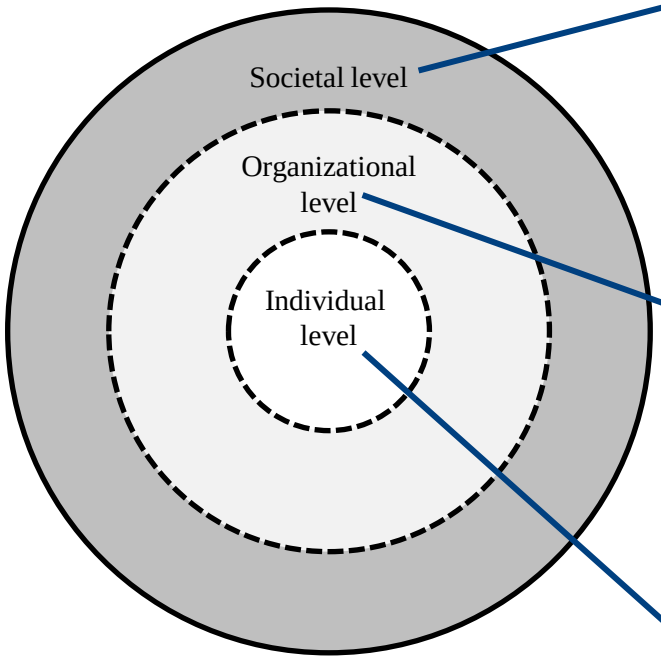
Three levels of action



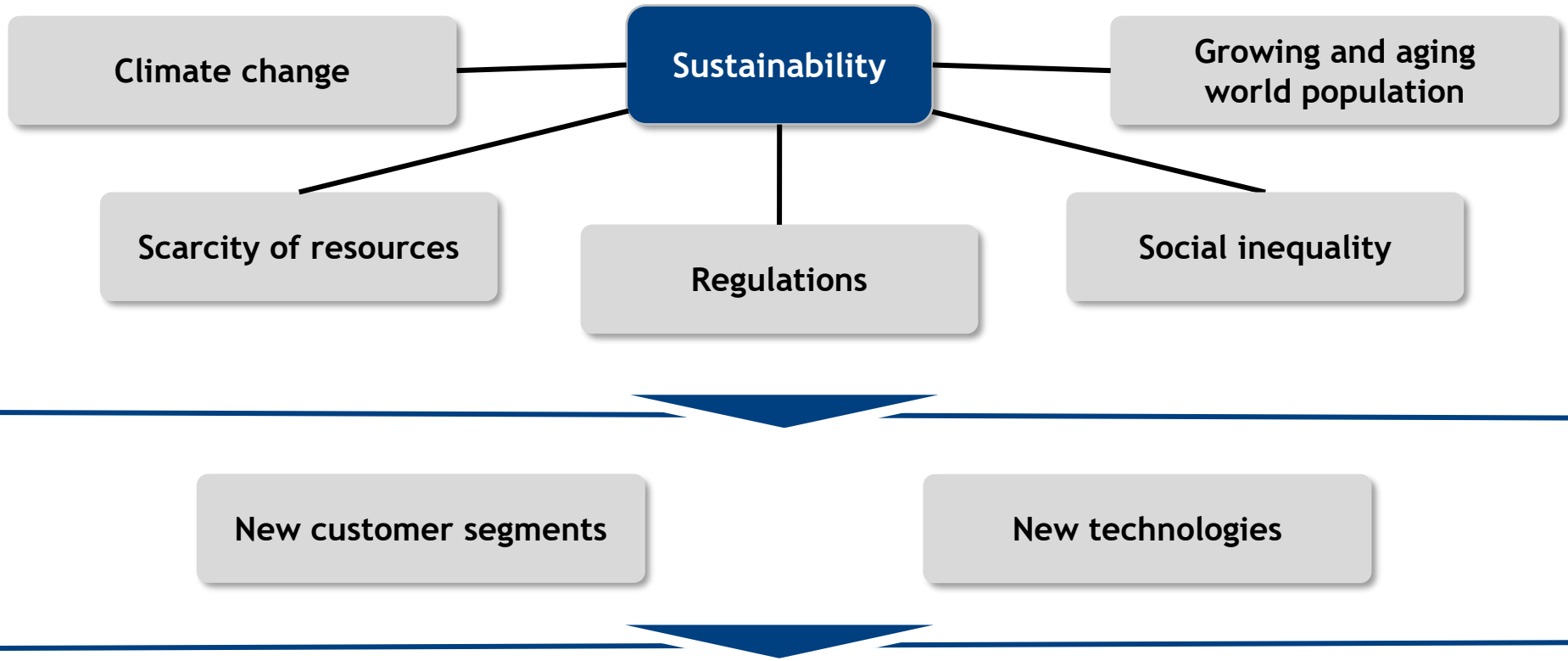
	Description	Example
Societal level	- Collective realization of the importance of smart sustainability	- Collective activities addressing sustainability issues relevant to local, national, and international societies
Organizational level	- Mitigate negative environmental impacts - Aligning core strategy with environmental sustainability objectives - Developing concrete solutions	- Triggering more sustainable organizational practices and processes - Green IS, Green IT - Crowdsourcing
Individual level	- Public acceptance of IS-supported solutions	- E-Books - E-Cars - Carbon capture and storage technologies - Smart meter technology

Graf-Drasch (2020)

General Insight: Sustainability in Organizational Contexts

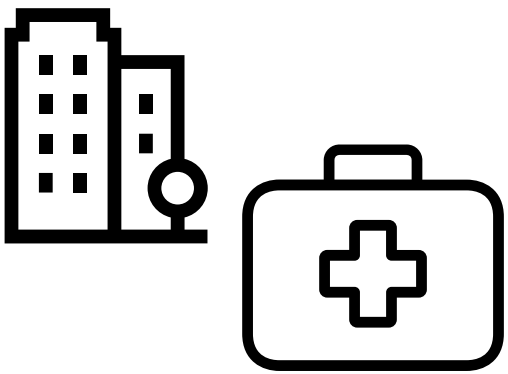
Supporting video https://youtu.be/SQBVsTTC6oM

Sustainability – a major issue also for companies

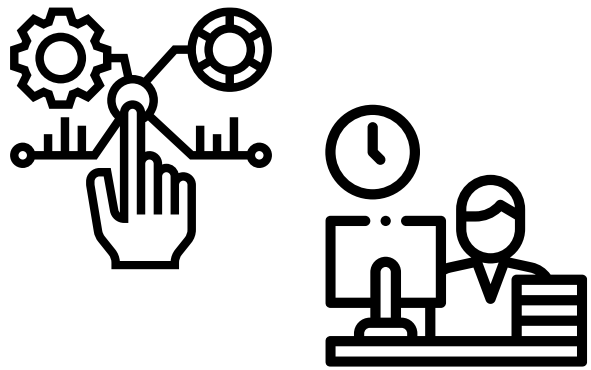


How can companies approach the transformation towards sustainability and realize it in accordance with value-based corporate governance?

Corporate Social Responsibility



1953 first definition of the term



First approaches at the end of the 19th / beginning of the 20th century:

- Health programs for employees
- Housing for employees

Today's challenges and drivers:

- Digitalization and innovation as drivers and challenges for CSR
- Workplace quality
- Refugees and business integration

Corporate Social Responsibility is a concept for companies to integrate their social responsibility towards society and their own employees into company activities.

Bassen et al. (2005), Bundesministerium für Arbeit und Soziales (2018, 2019), Icons von Freepik, Good Ware u. Eucalyp von flaticon.com

Organizations' Sustainability Management and Goals

Supporting video https://youtu.be/87GdiUkFe5c

Three pillars of sustainability: optimization model

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Sustainable management means maximizing a target function under constraints of long-term resource availability.

Possible target function:

$$\max \sum_{i.e.\{economical,\ ecological,\ social\}} w_i \cdot t_i(\overrightarrow{PF})$$

Under the constraints:

$$V\ (Knowledge) \leq reg\ (Knowledge)$$

$$V\ (Work) \leq reg\ (Work)$$

$$V\ (Raw\ materials) \leq reg\ (Raw\ materials)$$

$$V\ (Capital) \leq reg\ (Capital)$$

$$V\ (Environment) \leq reg\ (Environment)$$

...

Possible target function:

$$\max \quad t_{i=economical}(\overrightarrow{PF})$$

Is it sustainable management if only economic success is maximized?

Notation	Explanation
w_i	Weighting factor of output
t_i	Transformation function of the production factors (PF)
$\overrightarrow{PF}$	Vector of production factors (e.g., knowledge, labor…)
$V(PF_j)$	Consumption of production factor j (PF_j)
$reg\ (PF_j)$	Regeneration of production factor j (PF_j)

Possible sustainability goals

	Ecological responsibility	Economic responsibility	Social Responsibility
Social sustainability	• Climate protection • Landscape protection • Preservation of biodiversity • Efficient use of resources • …	• Creation of long-term prosperity • Promotion of education • Creation of favorable economic policy conditions • …	• Creation of a sustainable and livable society • Individual development • Participation in the community • …
Corporate sustainability	• Low pollutant emissions • Reduced resource consumption • Recycling • Closed loop supply chain • …	• Profit maximization • Return on investment • Market share • Growth • Efficiency • …	• Good and enough jobs • Employee satisfaction • Safe workplaces • Tax payments • Social commitment • Labor protection • …

based on Ernst und Sailer (2013, S. 27)

Business Model Innovation (towards sustainability)

Supporting video https://youtu.be/3EULFeoy0nI

Innovation: Definitions and perspectives

1. The introduction of something **new** (an activity)
2. A **new** idea, method, or device (a novelty)

merriam-webster.com

Realization of a novel, advanced solution to a particular problem, …
…in particular the introduction of a **new product** or the application of a **new process**.

duden.de

Innovation is a process that is initiated irregularly and with different objectives. Important distinguishing features from routine tasks are novelty, the associated **uncertainty**, **complexity** and **interdisciplinarity** as well as potential **conflict**.

Granig, Perusch (2012)

Innovation is the implementation of **new technical, economic, organizational and social solutions** to problems in a company. It is aimed at fulfilling corporate goals in a new way.

Pleschak, Sabisch (1996)

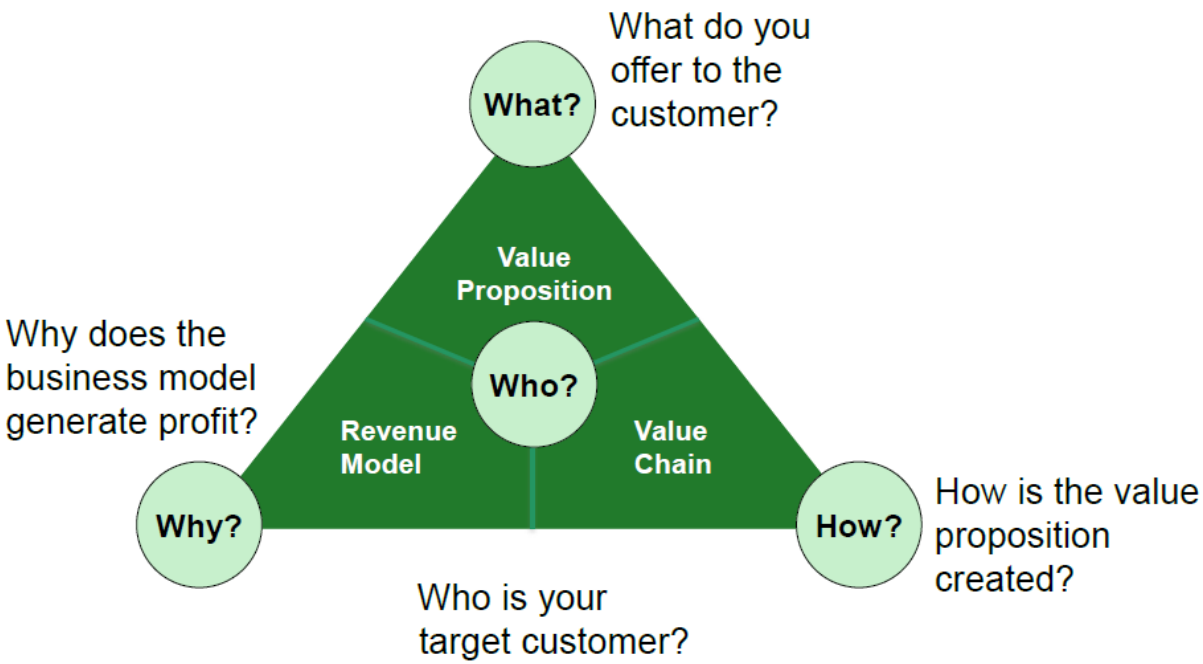
Novel means-end combinations: Technology opens up new means, the demand wants to fulfil new purposes/ends.

- Marginal innovation through market penetration (novelty lies in improved target-means ratio)
- Technical innovation: New technology for unchanged purpose
- Market innovation: New purpose satisfied with known means
- Radical innovation: fulfilling new purposes with new means

Technological innovation often creates **temporary monopolies**, allowing **abnormal profits** that can be competed away by rivals and imitators. These temporary monopolies are necessary to provide the incentive for firms to innovate.

Schumpeter (1926)

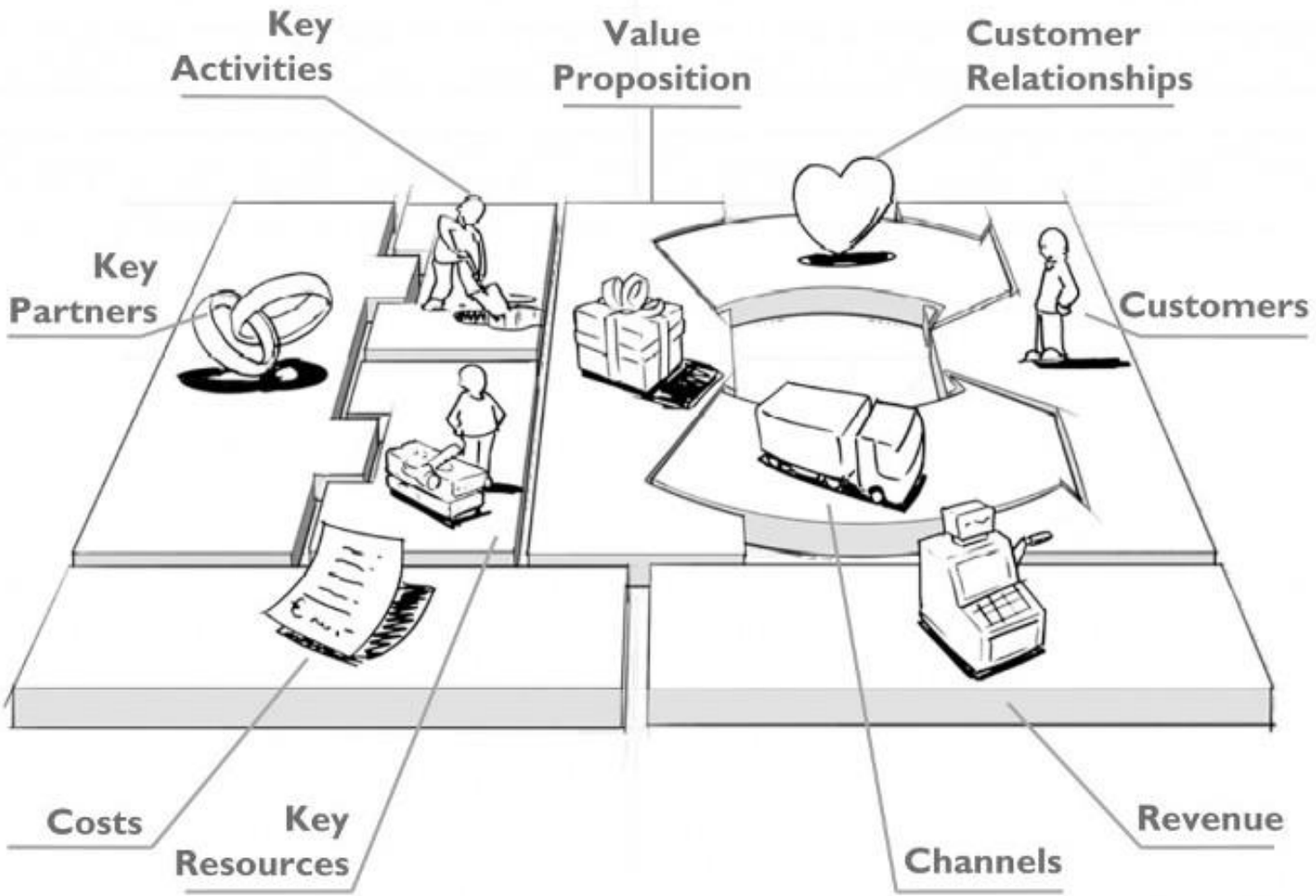
The Business Model Triangle



Business model innovation means changing at least two of a business model's dimensions

Gassmann, Frankenberger, Csik (2013)

The Business Model Canvas

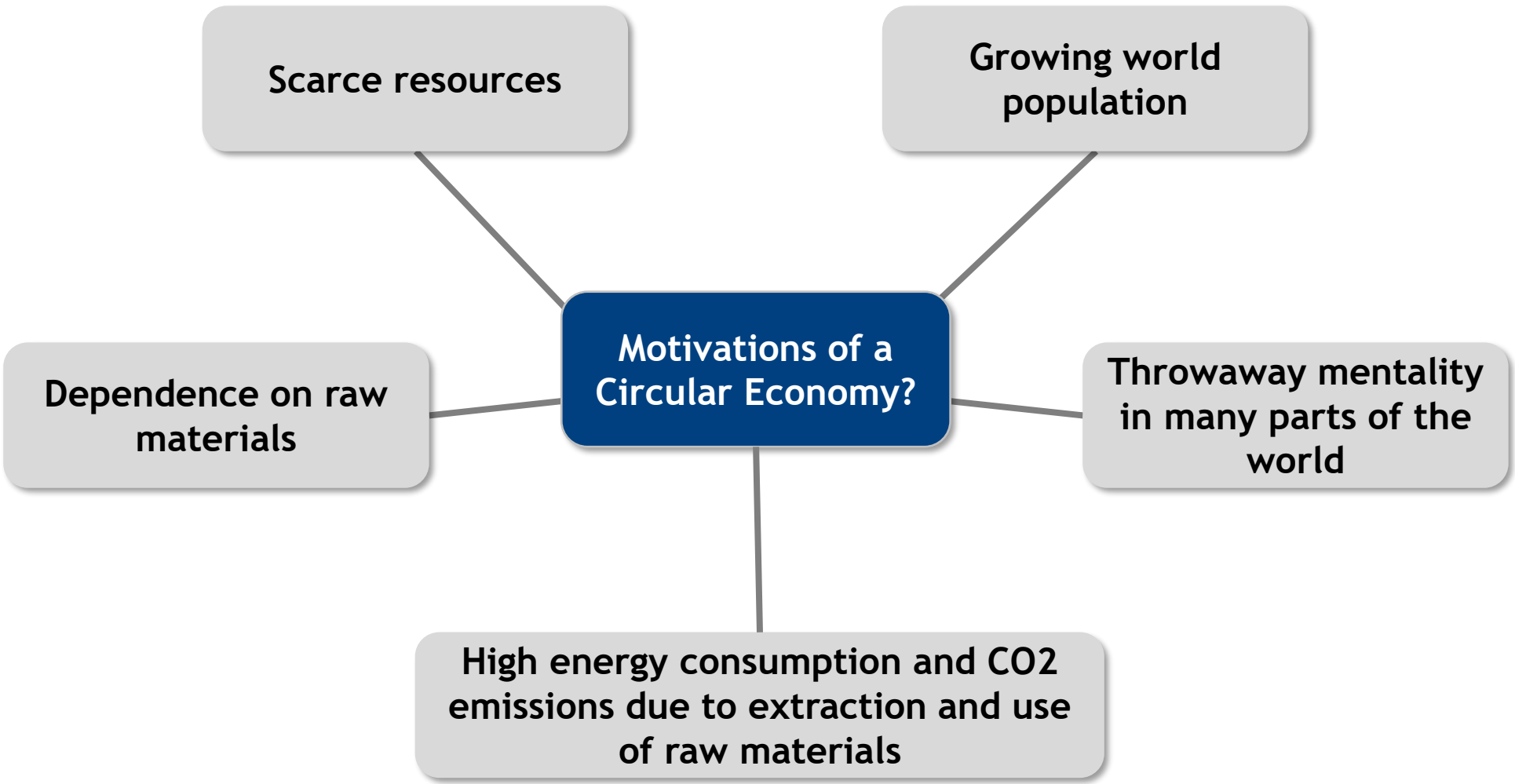


Drawing by JAM, Structure by Osterwalder, Pigneur (2010)

Introduction to Circular Economy

Supporting video https://youtu.be/HPwz8rNp_jk

What is the motivation of a Circular Economy?



europa.eu (2021a)

The three key principles of the Circular Economy

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Circulate products and materials

Design products to be reused, repaired, or remanufactured. When it comes to products like food or packaging, get the materials back so they don't end up in landfill.

Eliminate waste and pollution

Waste and pollution are the consequences of decisions made at the design stage. Harness new materials and technology, to ensure waste and pollution are not created in the first place.

Regenerate nature

There is no concept of waste in nature. Instead of trying to do less harm, return valuable nutrients to the soil and other ecosystems to enhance the natural resources.

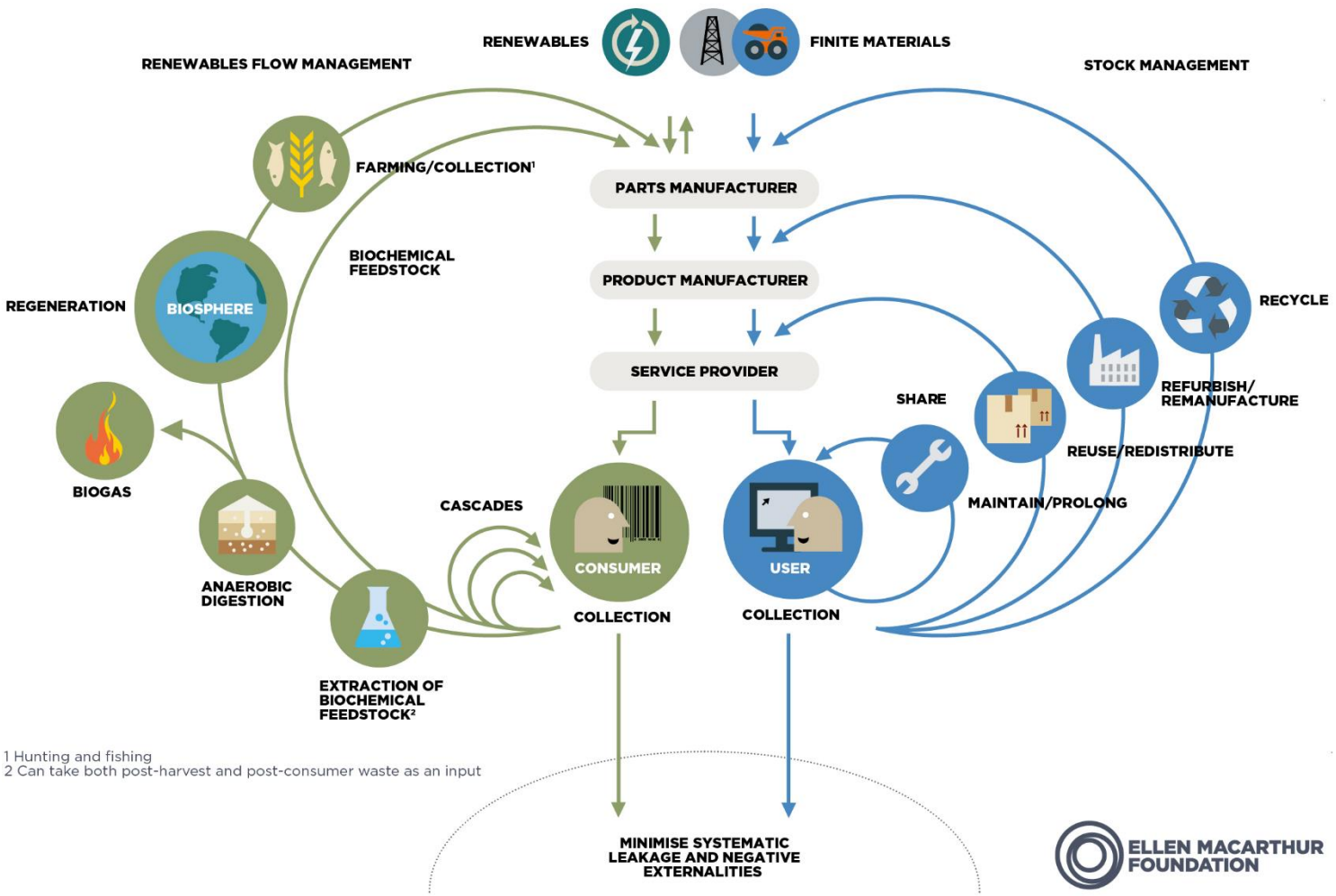
ellenmacarthurfoundation.org (2021a)

Native® Produtos da natureza

"The Balbo Group grows organic sugar. […] The Group developed a harvester with low pressure tyres to avoid harmful compaction. It cuts cane and shreds by-products at the same time to return 20 tonnes of previously unused organic material per hectare each year."

ellenmacarthurfoundation.org (2021b)

The circularity of renewable and finite materials



1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input

Reuse

The repeated use of a product or component for its intended purpose without significant modification.

Refurbish

Return a product to good working order. This can include repairing or replacing components and improving cosmetic appearance.

Remanufacture

Re-engineer products and components to as-new condition with the same, or improved, level of performance as a newly manufactured one.

Recycle

Transform a product or component into its basic materials or substances and reprocessing them into new materials.

ellenmacarthurfoundation.org (2019) ellenmacarthurfoundation.org (2021c)

Sources of value creation in a Circular Economy

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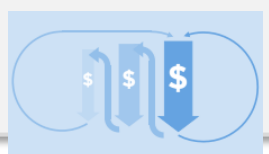
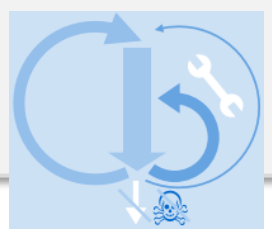
Inner circles > outer circles:
The tighter the circles, the larger the savings of a Circular Economy (in terms of ,e.g., material, labor, energy and capital, as well as greenhouse gas emissions or toxic substances)

Circling longer:
Keeping products, components, and materials in use longer within the Circular Economy (by more consecutive cycles (e.g., multiple consecutive refurbishments of an engine core) or by spending more time within a cycle (e.g., extending the use of a washing machine from 1,000 to 10,000 cycles)

Cascaded use and inbound material substitution:
Opportunity in the cascading of products, components or materials across different product categories (e.g., transforming cotton-based clothing into fiberfill for furniture and later into insulation material)



Non-toxic and easier-to-separate designs:
Improvements in the original design of products (e.g., ease of separation and material substitution to enable lower scrap rates during reprocessing and reduced contamination of material streams during and after collection)

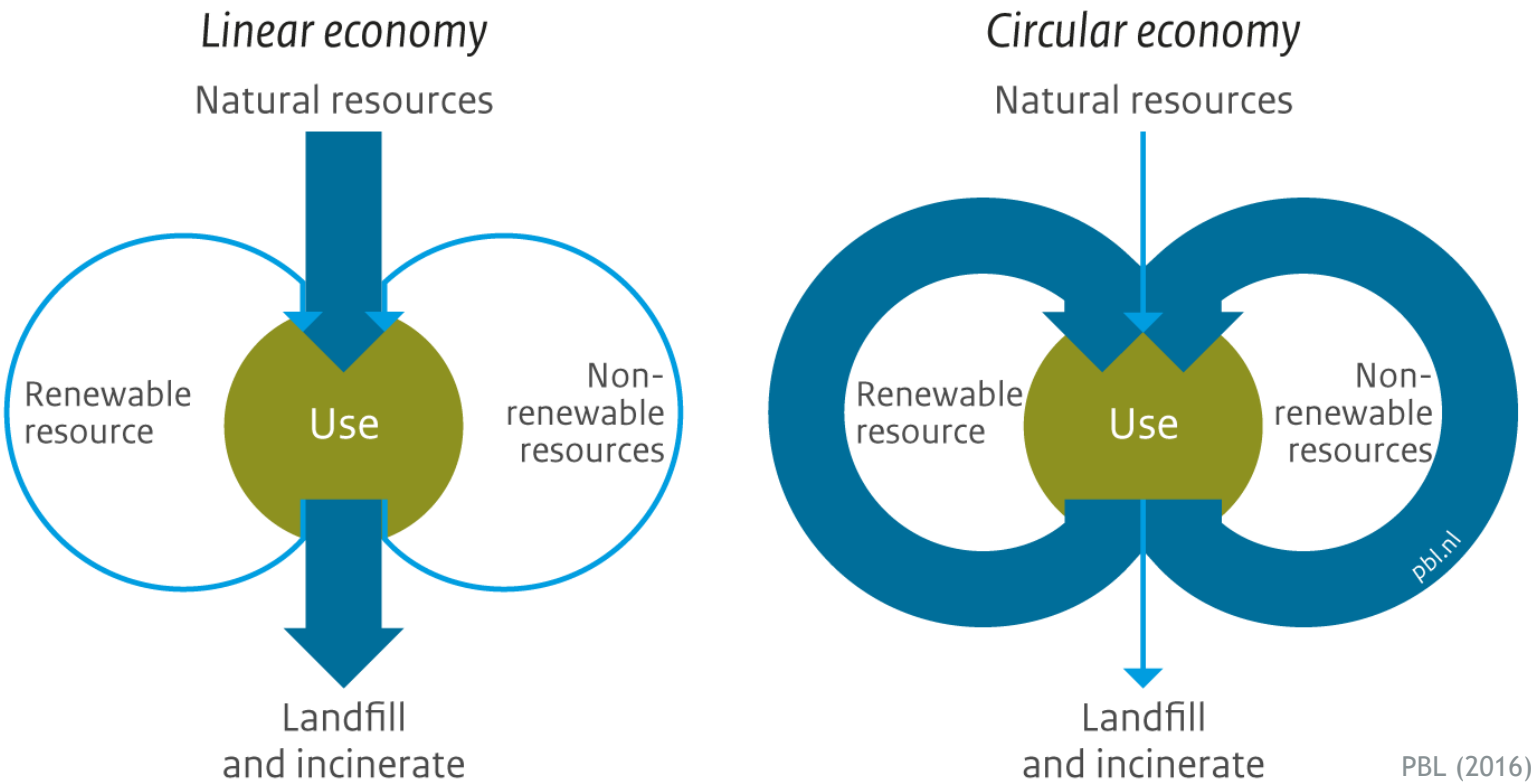


Ellen MacArthur Foundation (2013)

Evaluation of the Linear and Circular Economy

Supporting video https://youtu.be/I6tFPBQFZNw

Difference between a Linear and Circular Economy



PBL (2016)

! "The circular economy is seen as a logical alternative to a linear economy. In a linear economy, natural resources are **extracted** for producing materials that are **manufactured** in products to be **incinerated or landfilled after use**. The essence of a circular economy is to preserve natural resources by **retaining the quality and value** of products and their parts, and the materials."

PBL (2017)

Disadvantages of the Linear Economy

Ecological disadvantages

Take-make-dispose mentality

- High energy and water consumption, emission of toxins and destruction of natural capital such as forest and lakes due to **extraction of raw materials**
- Often high energy and water consumption and emissions of pollutants during **manufacturing** of products
- Space-consuming and pollutant emitting **disposal**

Economic disadvantages

Uncertainty in supply of materials

- **Increase in level and fluctuation** of raw material prices
- **Limited availability** of critical materials used in various industries
- Geopolitical **dependence** on materials
- **Increase in material demand** due to population and welfare growth

kenniskaarten.hetgroenebrein.nl (2021)

bmz.de (2019)

"Electronic and electrical waste, or e-waste, covers a variety of different products that are thrown away after use. […] **Less than 40%** of all e-waste in the EU is **recycled**. […] Discarded electronic and electrical equipment contains potentially harmful materials that pollute the environment and increase the risks for people involved in recycling e-waste."

europa.eu (2020a)

Advantages of a Circular Economy

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Ecological advantages

- **Conservation** of resources
- **Reduction** of pollutant and greenhouse gas emissions

Maga et al. (2018)

Social advantages

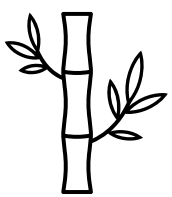
- **Reduced consumer costs** through Circular Economic Model in the electronics and electrical sector
- **More jobs** in the Circular Economy created through new business models and e-waste entrepreneurs

World Economic Forum (2019)

Economic advantages

- Increased raw material supply **security**
- Increased **competitiveness**
- Fostered **innovation**, **growth** and **employment**

europa.eu (2021a)



European Commission

"The circular economy will have net positive benefits in terms of GDP growth and jobs' creation, since applying ambitious circular economy measures in Europe can **increase the EU's GDP** by an additional **0.5%** by 2030 **creating around 700,000 new jobs**."

europa.eu (2020b)

Challenges and criticism

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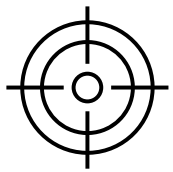
Achievability and desirability

- **No infinite** reusing, remanufacturing and recycling of materials
- Possibly, high recycling rate **more expensive** than value of the recovered material
- In some cases, a lot of **produced waste** and **high energy consumption** through recycling, remanufacturing, etc.
- **Rebound effects**, so that increased consumption diminishes environmental gains

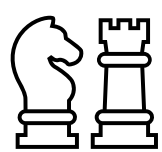


Missing social sustainability

- **More human labor** needed for additional processes such as refurbishing or recycling, but jobs may **not be created locally**
- Created jobs possibly under **inadequate conditions** (e.g., toxins in the textile industry)

Lack of strategic guidelines

- **Difficult to provide general guidelines** for implementation of a Circular Economy because of need for individualized or sectoral approaches
- Environmental **advantages of not fully recyclable materials** (e.g., lightweight components) could outweigh the disadvantage of non-recyclability



Korhonen et al. (2018), circular.academy (2019)

Current Examples and Roadmap for a Circular Economy

Supporting video https://youtu.be/06-DLFlDyWU

Examples for Circular Economy

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Gerrard Street

Subscription service for modular headphones: **Extended lifetime** because of easy order of module, disassembly and reparation

- **Recovery** and **recycling** of headphones at the end of their life through a subscription model
- **Reuse** of 85% of components

ellenmacarthurfoundation.org (2021d)

BioPak

Compostable foodservice packaging made from **renewable** plant-based materials

- Circular model through **collection** and **composting service**
- Contribution of the compost to the **preservation** of **healthy soils**

ellenmacarthurfoundation.org (2021e)

Hilti

"Our first steps to improving our ecological footprint are: placing focus on reducing CO2 emissions and introducing the ideas of a **circular economy**. […]

- We already consider the ability to **recycle** the materials we use in the development stage of our products.
- During production, we **minimize the use of water and energy** and continuously reduce the amount of **production waste**.
- The quality, **durability** and **repairability** of our products are central to this.
- The "**use instead of own**" approach for a wide range of Hilti equipment is becoming increasingly popular with our customers."

hilti.group (2021)

Current regulations in Europe

European Green Deal

Set of policy initiatives presented from 2019 regarding the transformation of the EU to a **modern**, **resource-efficient** and **competitive economy** that

- emits **zero net greenhouse gases** by 2050,
- **decouples** its growth from **resource use**,
- **leaves no one**, human or region, **behind**.

europa.eu (2021b)

international.tum.de (2020)

Circular Economy Action Plan

One of the main building blocks of the European Green Deal

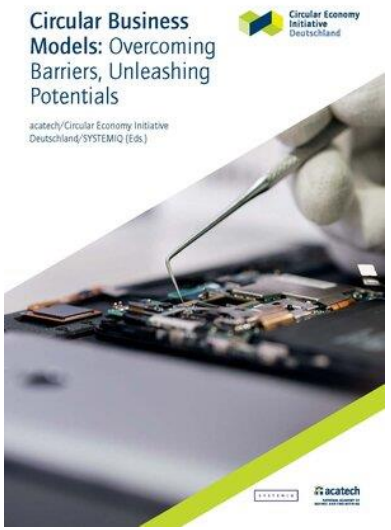
- **Make sustainable products the norm**: Products designed to last longer, easier to reuse, repair and recycle, and use of as much as possible recycled material
- **Ensure less waste**: Avoidance of waste, transforming it into high-quality secondary resources
- **Focus on sectors using the most resources and where the potential for circularity is high**: Electronics and ICT, batteries and vehicles, packaging, plastics etc.
- **Empower consumers**: Access to reliable information regarding the reparability and durability of products for environmentally sustainable choices

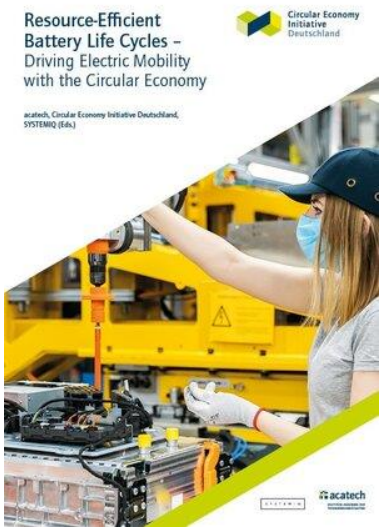
europa.eu (2020c)

Current action in Germany

Circular Economy Initiative Germany

- Initiative established in 2019 with funding from the Federal Ministry of Education and Research
- More than 50 institutions from business, science and civil society involved
- Development of a **Circular Economy Roadmap** including concrete recommendations for action focusing on:
  - Circular business models and **digital technologies as innovation drivers**
  - New value networks for traction batteries
  - New value networks for packaging





circular-economy-initiative.de (2021)

The role of digital technologies

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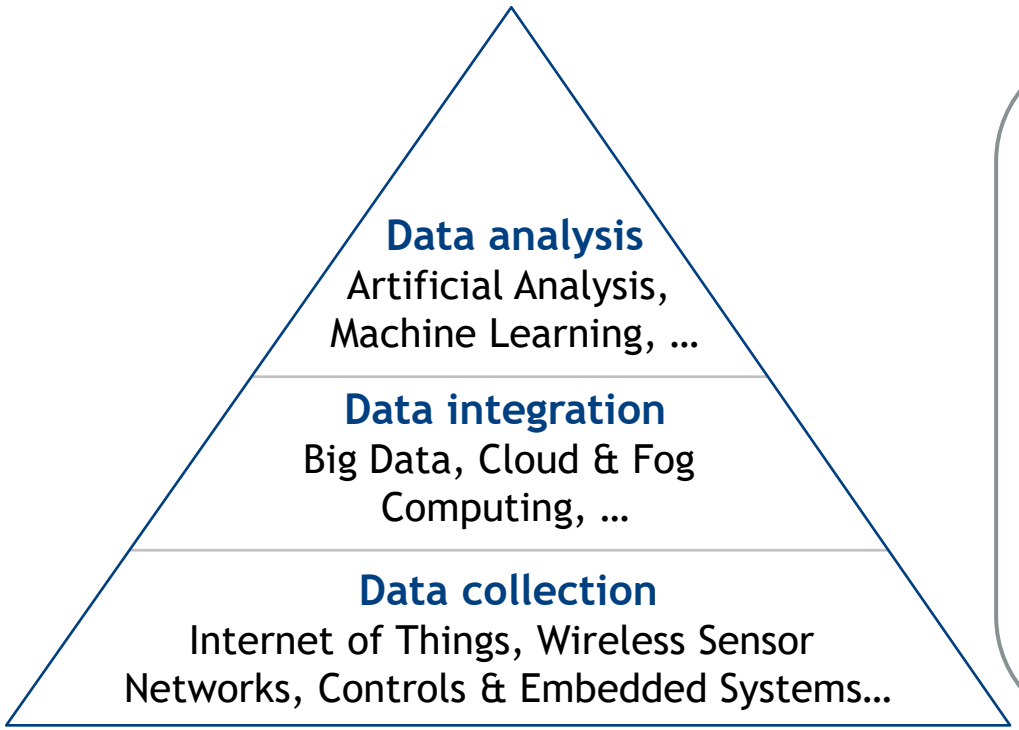
Digital Circular Economy

- Based on **strong integration** and **connection** of the value chain
- High degrees of **transparency** and **information** required



Smart Circular Economy framework

Different levels of **implementing digital technologies** for decoupling value creation from the consumption of finite resources

- **Data collection** to describe use of material resources or status of product
- **Data integration** (aggregation and contextualization) to provide concise overview (“What happened to the resource?”)
- **Data analysis** to set up predictive or prescriptive management of materials and products (“How can use of the resource be optimized?”)

Digital technologies as enabler for the upscaling of the Circular Economy

Kristoffersen et al. (2020), European Circular Economy Research Alliance (2020)

Examples for the use of digital technologies

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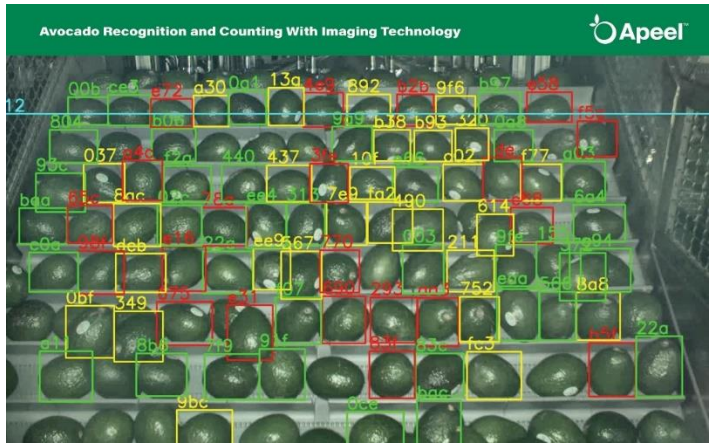
Startup ImpactVision

- Use of **machine learning** and **hyperspectral imaging**
- Automatic **assessment of the quality** of food (ripeness, freshness, nutritional density)
- **Information of the suppliers** about the ripening window, enabling the according sorting and shipping

→ **Reduction** of post-harvest **loss**, optimized distribution, and **lengthened shelf-life**

→ **Waste reduction** and **increased quality** and safety for consumers

agfundernews.com (2018), venturebeat.com (2021)



freshfruitportal.com (2021)

agrarheute.com (2021)

Suez

- Sludge from wastewater treatment **reused** as **fertilizer material** in agriculture
- Use of **blockchain** for **secure traceability** of fertilizer materials
- Better **control** of the quality of agricultural inputs

→ Enabling the agricultural sector to **reduce** its **consumption of chemical** of **fossil inputs** (pesticides, fertilizers, phytosanitary products, etc.)

→ **Reuse of sludge** from wastewater treatment plants

suez.com (2021)

Logos are the intellectual property of the individual organizations.

Circular Business Models

Supporting video https://youtu.be/-tu1PI_ciHY

Strategies for circularity

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Retain product ownership (RPO)

- **Lease or rental** of the product instead of sale
- **Producer's responsibility** for the product at the end of customer's use
- Companies required to invest in **after-sales** and **maintenance** capabilities

BOSCH

Refurbishment of used tools, enabling to compete with low-cost producers

bosch-professional.com (2021)

Design for recycling (DFR)

- **Redesign** of products and manufacturing processes
- Maximization of **recoverability** of involved materials
- Partnership with company with **technological expertise** to use recovered materials

xerox

Lease and full service rental of printers and photocopiers to corporate customers

xerox-leasing.de (2021)

Product life extension (PLE)

- Design of products to **last longer**
- **Durability** as a key competitive differentiator justifying premium pricing
- Opening **secondary markets** (for used products)

adidas PARLEY

Use of reworked plastic waste to manufacture shoes and clothes

adidas.de (2021)

hbr.org (2021)

Choosing the right strategy

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Assessment of feasibility of the circularity strategy by answering two questions

1 How easy is it to get my product back?

- **Willingness** of customers as well as **infrastructure** to return product (e.g., plastic bottles)
- Existence of **secondary markets**: Difficulty to get back products that have a high resale value

→ **Leasing** as a possibility to recover products more easily

2 How easy is it to recover value from my product?

- Difficulty to move and recondition **heavy or bulky products** (e.g., washing machines)
- Difficulty to recover value of products with a **complex design (**e.g., small components of smartphones)
- Availability of **cost-effective** solutions for reformulating products

hbr.org (2021)

The Circularity Matrix

TWO central questions before transformation toward circularity:

1. Access: How easy can I get my product back?
2. Process: How easy can I retrieve value from my product (regarding effort, costs, infrastructure, …)?

ONE additional question:

3. What is the embedded value of my products?

(= The value that can be **economically** recovered from the product once it was used)

Three dominant (non-exclusive) strategies for creating a circular business model are:

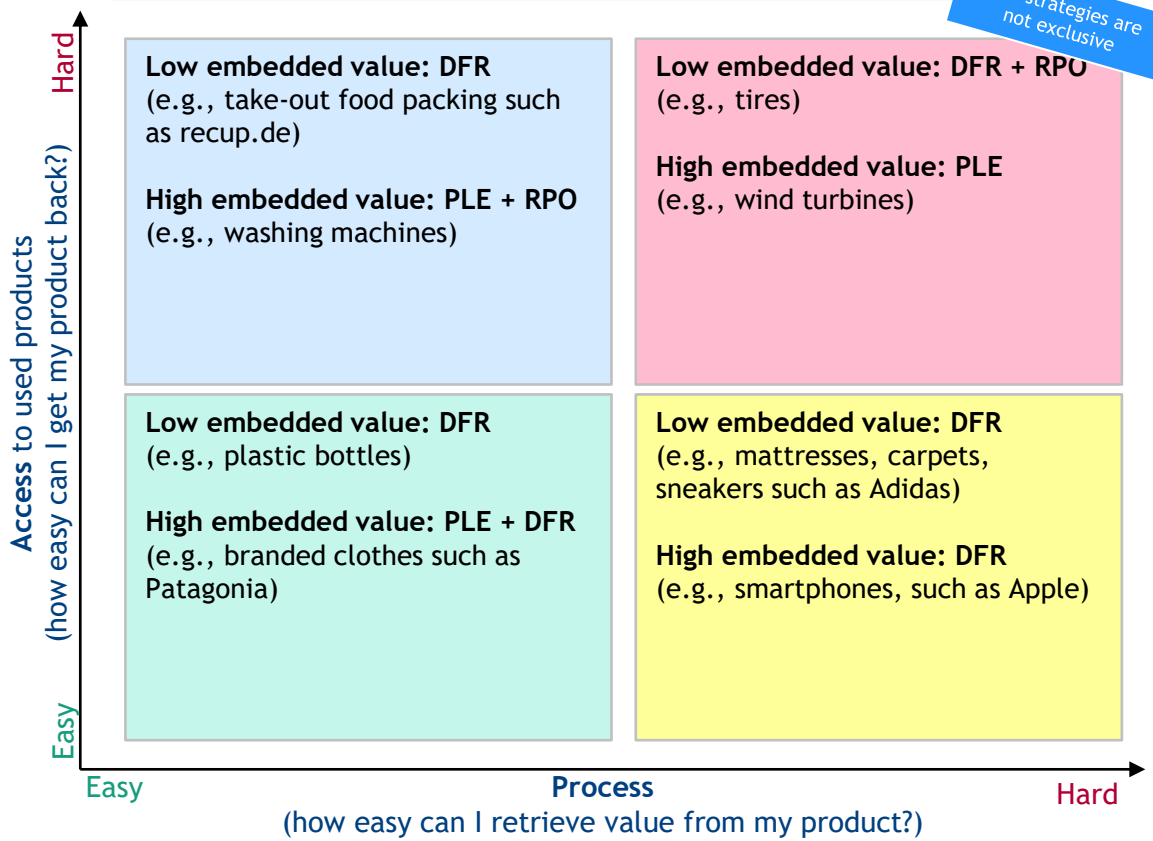
RPO: Retain product ownership

DFR: Design for recycling

PLE: Product life extension

Which strategic option for creating a circular business model should businesses choose? **Well, it depends…**

The strategies are not exclusive



Link for further optional & voluntary further reading: https://hbr.org/2021/07/the-circular-business-model

Smart Cities & Districts

Supporting video https://youtu.be/iBpWFA-w0UM

Urbanization is a major driver of climate change which makes cities one focal point for counteraction

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Consequences of climate change

- Since **1880s,** the globe's **surface temperature** has risen by about **1 degree Celsius**
- According to weather records, the years from **2015-2019** have been the **warmest of** the **last 140 years**
- This **warming trend** contributes to the "**tipping point**" beyond which we **cannot reverse** the **effects** of **global warming** and other massive environmental shifts

Urbanization as a driver of climate change

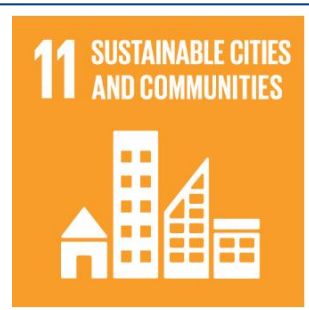
Half of the **global** human **population** lives in **cities**

By **2050**, the proportion of city-dwellers will have increased to **two-thirds**

~75% of global **energy consumption** in **cities**

Cities produce **~80%** of **carbon emissions**

Mitigate the environmental downsides of urbanization



Source: https://sustainabledevelopment.un.org/?menu=1300

Sources: Von Borries (2019); Gholami et al. (2016); Harjanne and Kohrhonnen (2019); Hollands (2015); NASA (2020); Sengupta (2019); The World Bank Group (2014a, 2014b); United Nations (2018); United Nations (UN) Department of Economic and Social Affairs (2018).

Smart cities are a focal concept for addressing climate related problems

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History

Dates back to **early 1990s**

Silicon Valley put advanced information systems in place

Transformation of local communities, governments, businesses

First smart city "**Smart Valley**"

Definition

"***Development and use of digital technologies in almost all areas at the municipal level***" (Bundesministerium des Innern, für Bau und Heimat 2020)

Smart city **comprised of 6 central components**, whereas recent **literature** particularly **stresses** its role in tackling **environmental degradation**

1. Smart Economy
2. Smart Governance
3. Smart Mobility
4. Smart Living
5. Smart People
6. **Smart Environment**

Smart Energy Technologies

Use of technologies to serve at least one of two system goals:

1. Increasing energy efficiency
2. Increasing the integration of renewable energy sources

Sources:(Bundesministerium des Innern, für Bau und Heimat 2020); Goebel et al. (2014); Hosseini et al. (2018); Lombardi et al. (2012).

Sustainable intelligent urban district

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> A sustainable smart quarter comprises a subarea of a city in which forward-looking solutions are applied for the areas of economy, society, administration, mobility, the environment, energy and habitation. These solutions are based on an intelligent ICT infrastructure* that ensures benefits for all stakeholders and, in particular, enables a high quality of life for every citizen/resident.
>
> **based on Keller et al. (2019)**

Image: Jude Joshua on pixabay.com

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Digital Management

University of Hohenheim

Faculty of Business, Economics and Social Sciences

Institute of Marketing and Management

Chair for Digital Management (Prof. Dr. H. Gimpel)

Digital Management: Hot Topics in Practice

Chapter 2: New Digital Work

2023

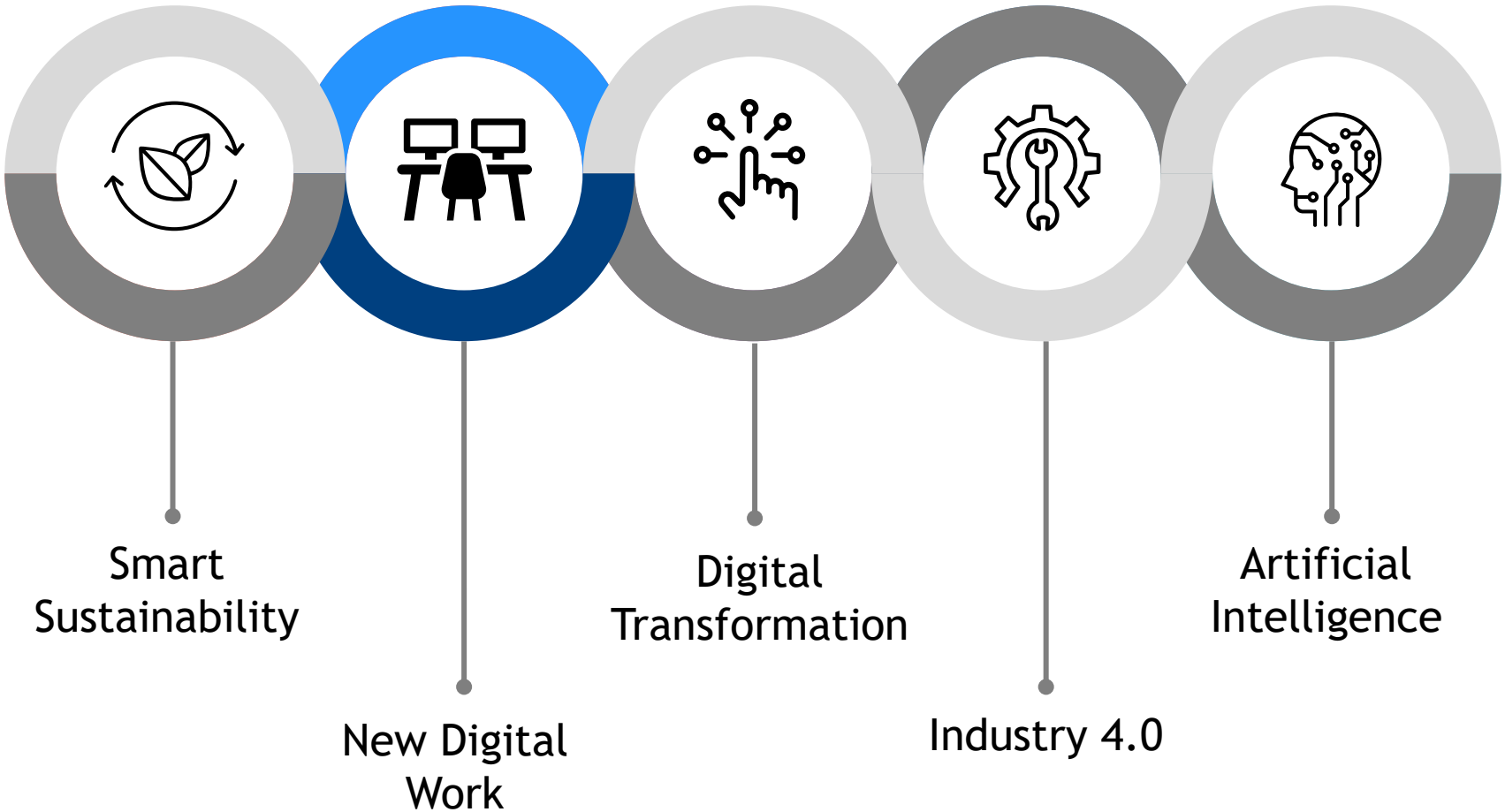
Research Center Finance & Information Management

Fraunhofer FIT Project Group Business & Information Systems Engineering

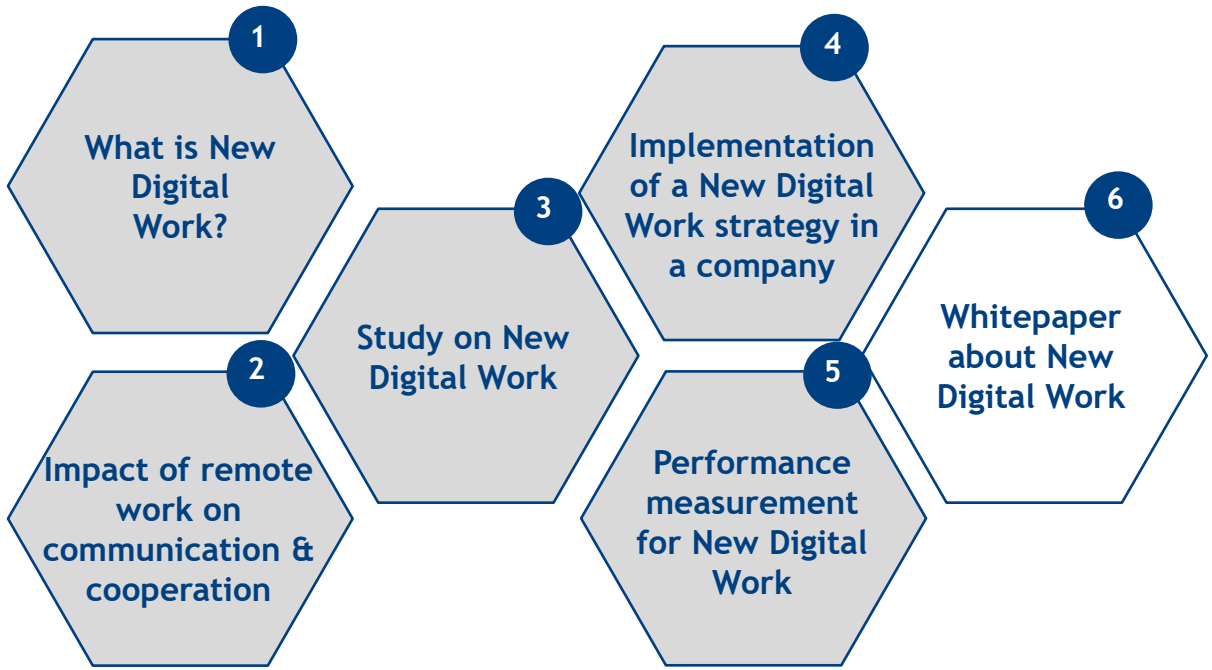
DLA DIGITAL LEADERSHIP ACADEMY

https://digital.uni-hohenheim.de/

Digitalization is everywhere and tomorrow



Agenda – New Digital Work



Legend:

- Relevant for the exam
- Voluntary additional material, not relevant

What is New Digital Work?

Supporting video https://youtu.be/JnUeMkGS4RE

The experience of the COVID 19 pandemic has made work more digital and flexible in many ways

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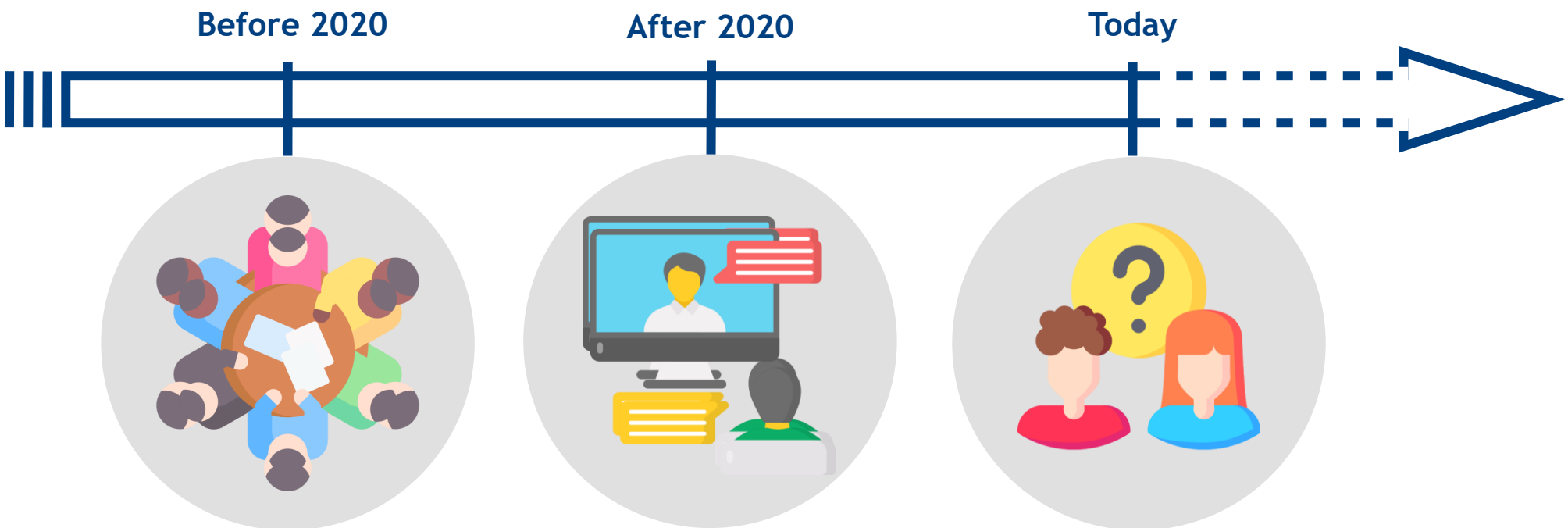
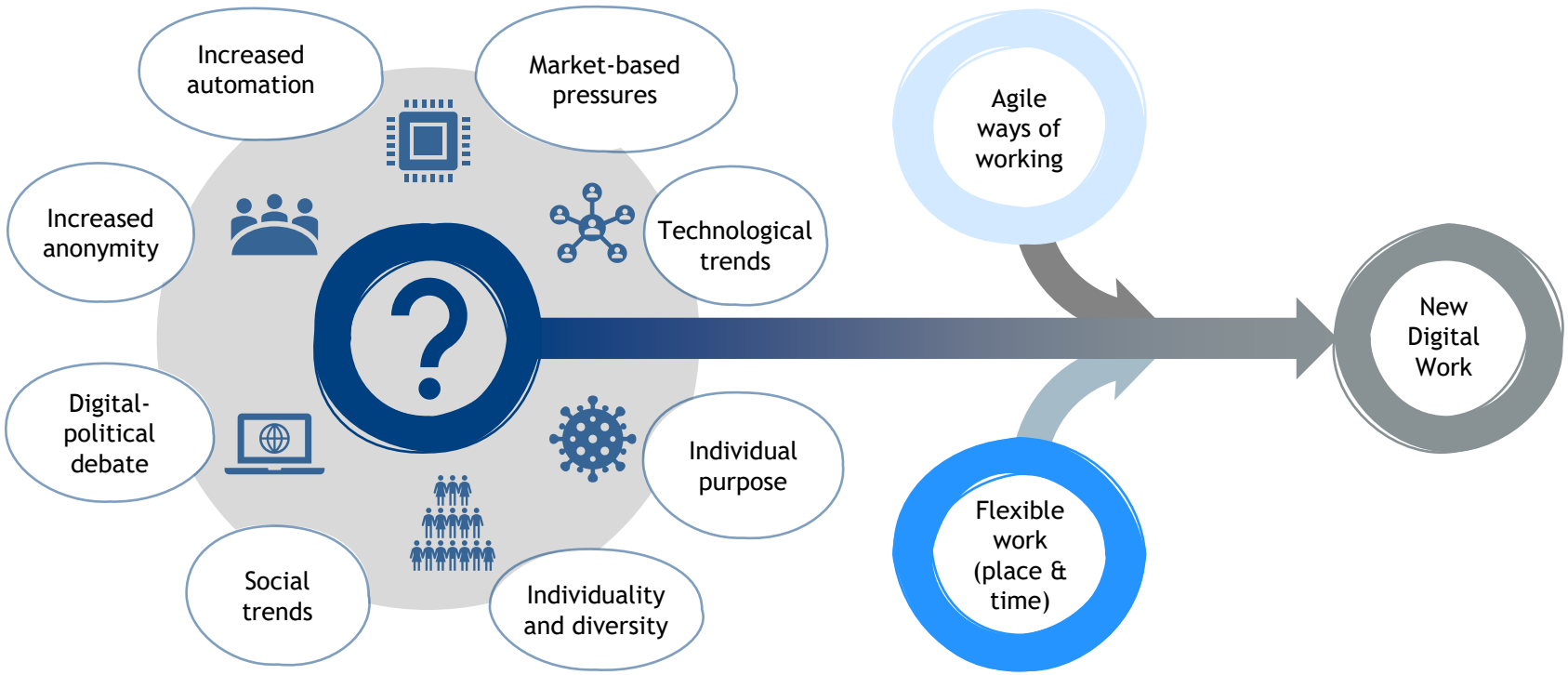


Physical work in the office as standard

Up to 60% of employees working from home

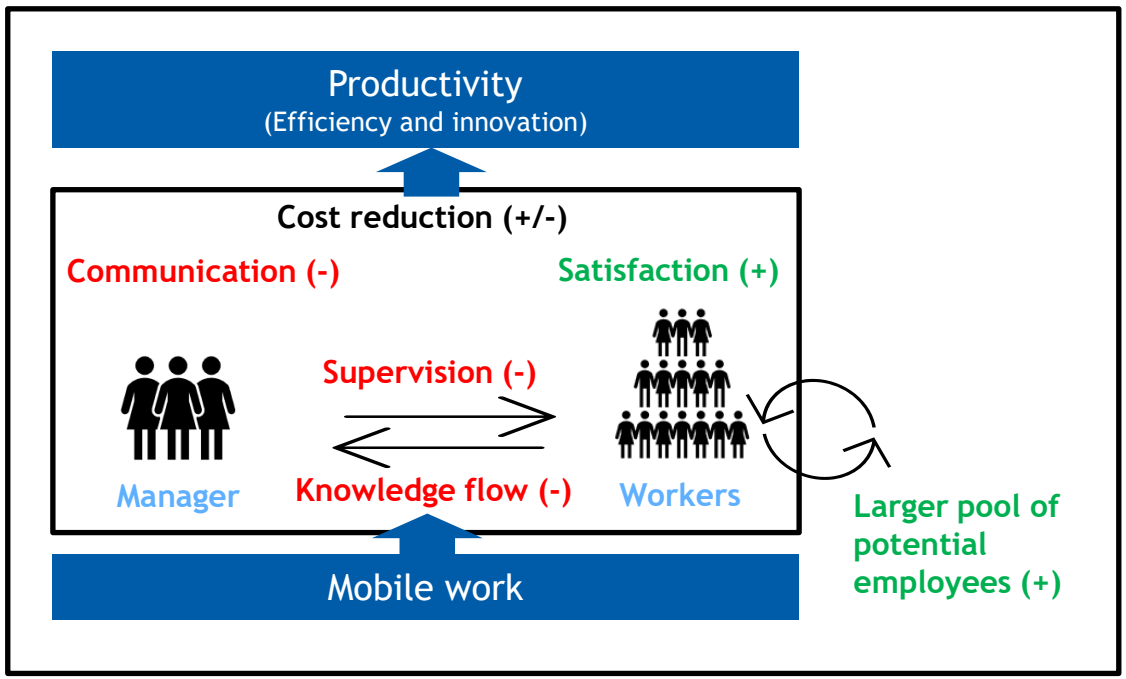
... but where do we go from here?

Quo-Vadis Work?
New Digital Work is the result of several developments



New Digital Work is the transformation to a modern work routine characterized by self-determined, networked and human-centered work supported by digital technologies, media and processes.

What does research say about mobile work and productivity?



Key study findings

- Mobile work was **hardly associated with any productivity restrictions**
- The working model of the future is **hybrid**
- Opportunities and risks of mobile work are to be balanced with a **company-specific approach**
- According to the results of various research studies, the optimal number of remote working days is **two to three days per week**

The OECD clearly states that companies that do not participate in the transformation will be left behind. At the same time, more mobile work is not always better, but it is a necessary component that needs to be reasonably balanced.

Source: Criscuolo et al. 2021

Thinking Outside Boundaries: Change beyond the world of work

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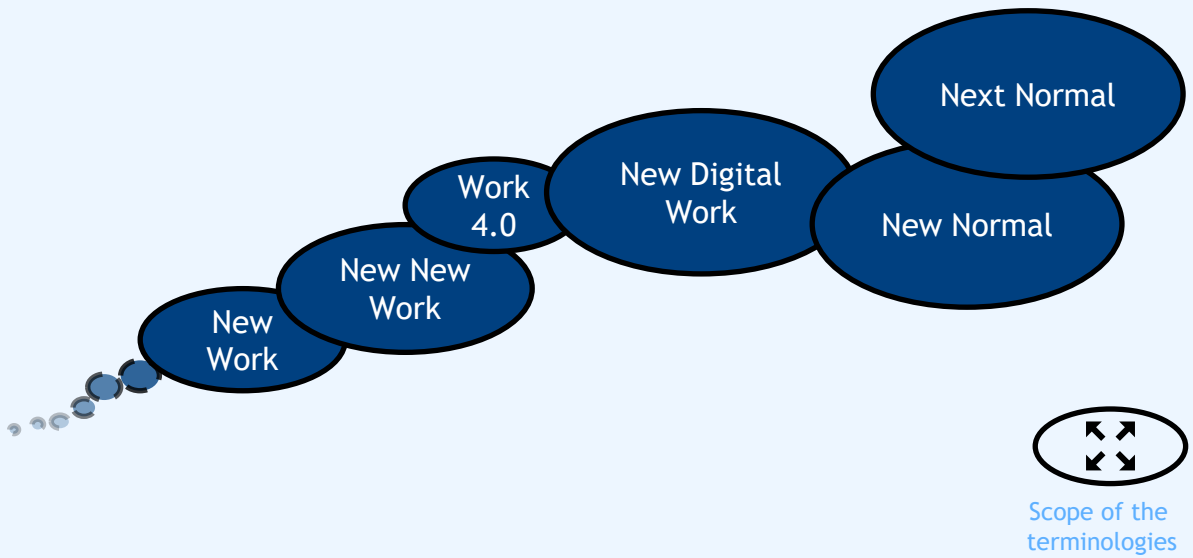
Work forms

Transformation of work



The work environment is changing. Influencing factors are social and technological. The common terms emphasise different facets.

An overview of the different terms can be found in the whitepaper "New Digital Work"

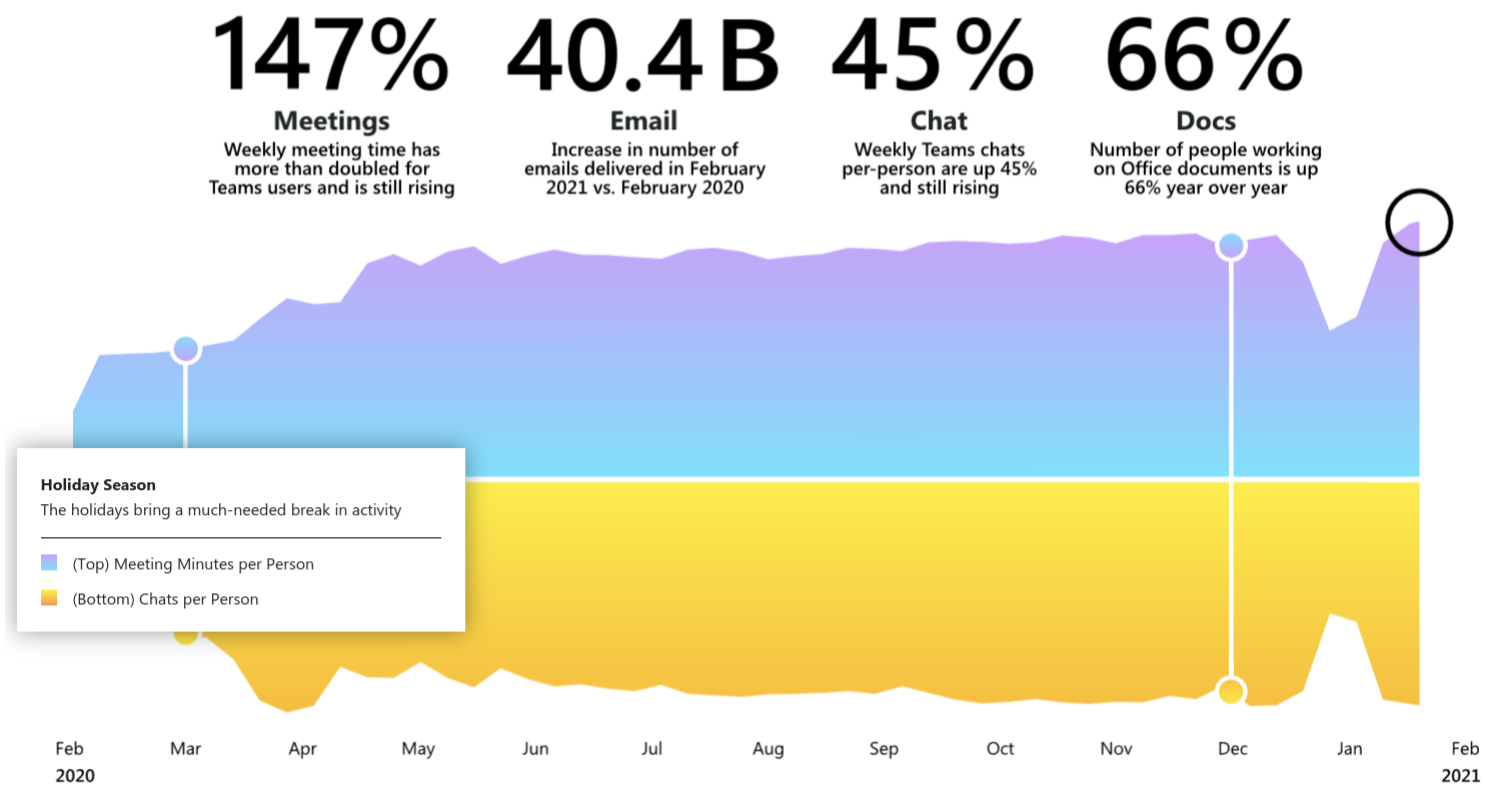
The study can be downloaded via the following QR code:

Which of the terms capture future ways of working best?

Impact of Remote Work on Communication and Collaboration

Supporting video https://youtu.be/EOE41_as92s

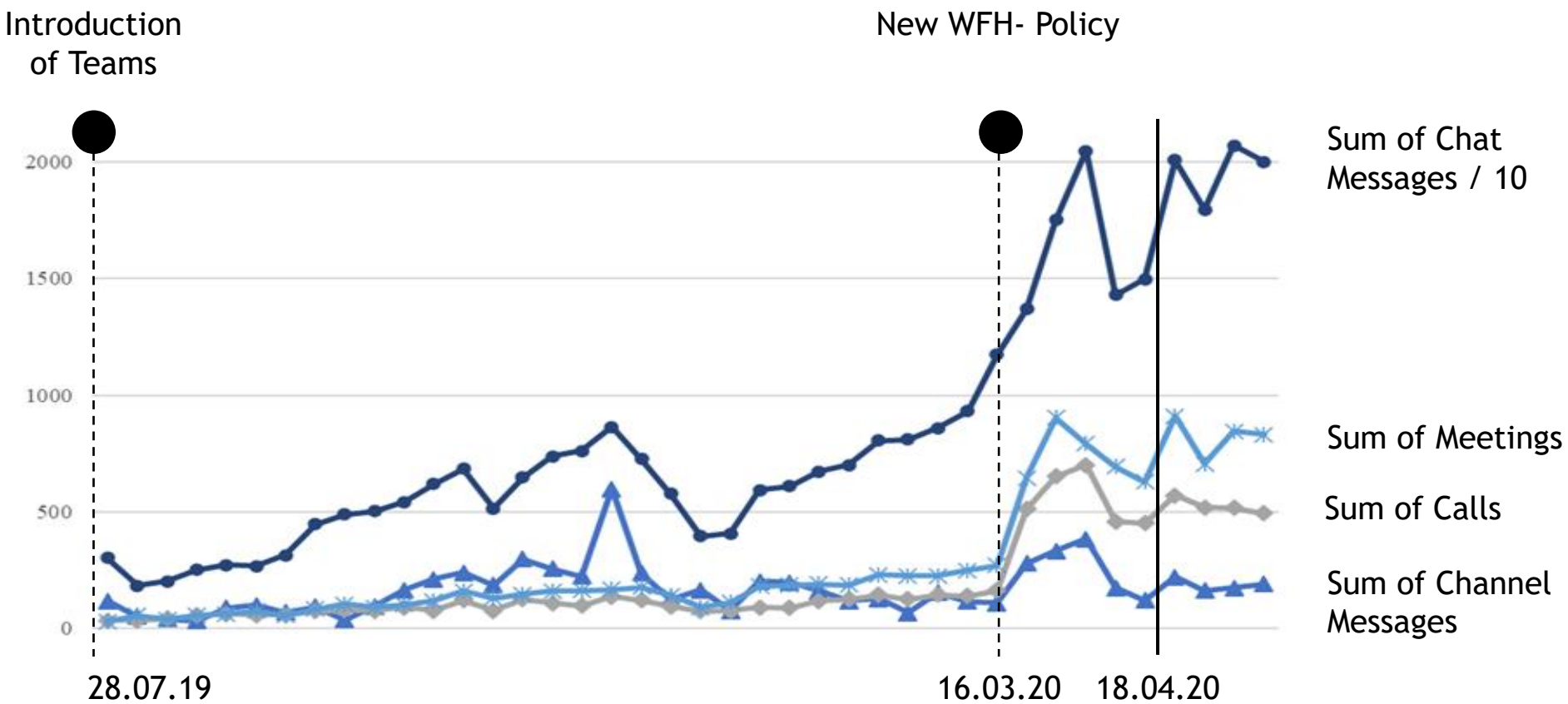
The pandemic changed the communication behaviour of employees



Source: Microsoft 2021

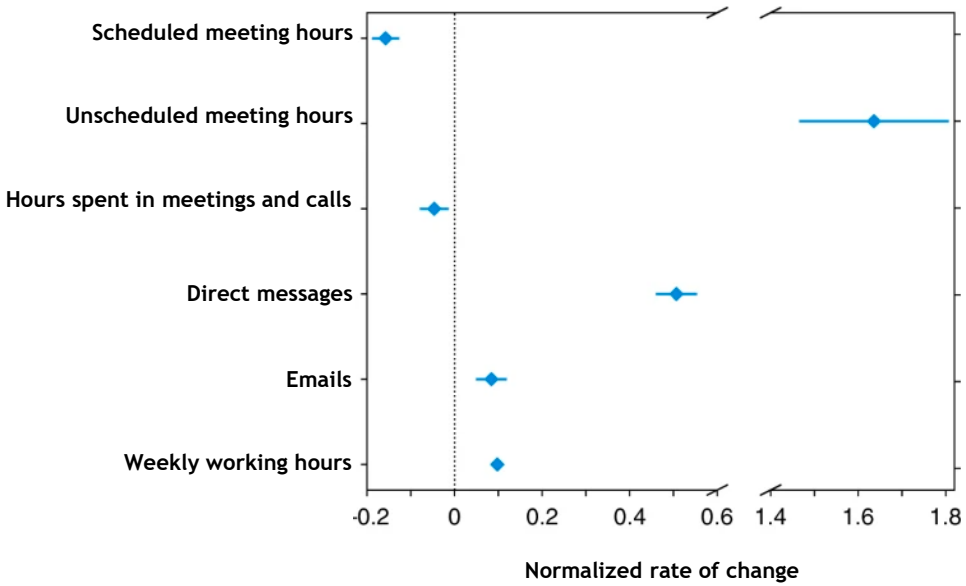
Similar trends are visible in other organizations

Microsoft Teams Usage Data of a German Service Organization



Source: Schoch et al. 2022

A study by Microsoft shows changes in communication behaviour



Tendency towards more asynchronous instead of synchronous communication

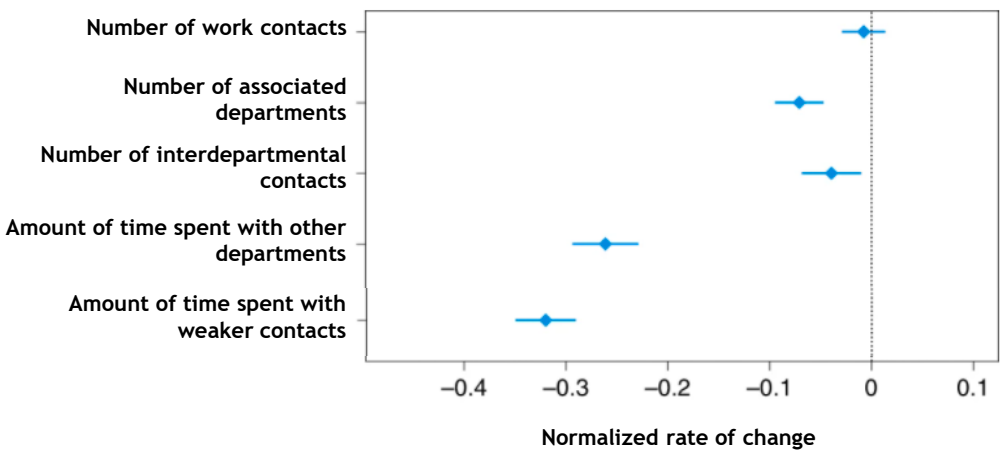
Remote work has removed the need for face-to-face communication. This has not only been replaced by video and/or voice calls, but has also led to increased asynchronous communication.

Possible complication of asynchronous communication

The theory of media richness suggest that the choice of asynchronous communication media makes the transfer of complex information more difficult.

Source: Yang et al. 2021

A study by Microsoft shows changes in communication behaviour



Transition leads to changes in relationships between employees

Connections between different departments became fewer. Especially the number of contacts in the informal cooperation network between employees decreased.

Strengthening strong relationships between departments and employees

The transition resulted in employees spending much of their collaboration time with their existing strong ties, which are better for information exchange.

Reduction of the weak or looser relationships

Significantly less time was spent by employees with looser contacts (e.g. employees from other departments). However, these contacts are important for accessing new information.

Source: Yang et al. 2021

Remote work does work - but the physical office remains an important aspect of work

Work can be completely detached from the physical office.

- Many meetings can be replaced by virtual meetings.
- Unscheduled exchanges also work through digital channels.
- Concentration on single tasks (monotasking) might work better away from colleagues.

BUT: remote work also has its negative aspects.

- The transfer of complex information becomes more difficult.
- Interpersonal relationships and contacts are partly lost or displaced by closer ties.
- Informal exchange and organisational culture become less or weaker with remote communication.

The office is no longer the only workplace, but it still offers advantages that remote work cannot.

Source: Fayard et al. 2021, Yang et al. 2021

The office of the future takes on various new functions and meanings

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The office as a social anchor

- Face-to-face interactions in the office lead to more engagement, support and collaboration between employees.
- Short face-to-face conversations serve to solve problems efficiently.

The office as a school house

- New employees learn important basics more quickly and become familiar with the organisational culture.
- The inhibition threshold for questions is lower in personal exchanges than by e-mail.

The office as a place for unstructured collaboration

- Employees from different functions and departments can work together better through personal exchange and thus often solve complex problems.
- Initial discussions on new topics are more likely to take place in the office.

Source: Fayard et al. 2021, Yang et al. 2021

Drivers and Dimensions of New Digital Work

Supporting video https://youtu.be/9b4buAY4s0c

Whitepaper: Details of the study "New Digital Work" by Fraunhofer FIT

- What are drivers of New Digital Work?
- What are obstacles to New Digital Work?
- How can the transformation towards New Digital Work be successful?

- Sample of n = 65
- Persons in high-level positions of leadership (e.g. CEO, CIO, division heads)
- Ø Time in current role: 5.9 years
- Focus on IT, HR, management

For the following slides: → Survey results

The importance of the topic is increasingly driven by changing expectations of employees

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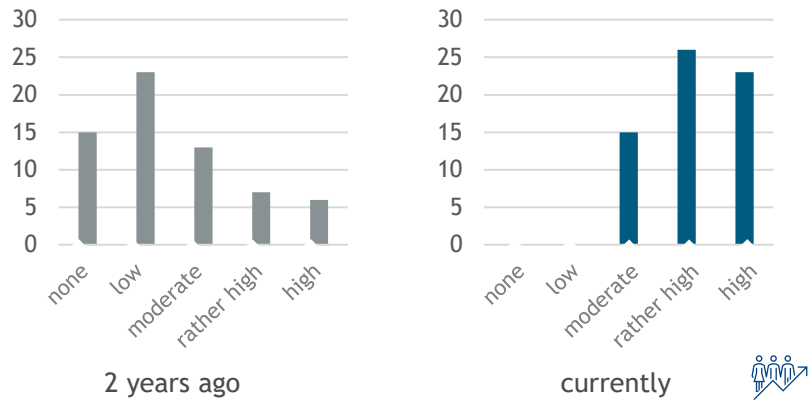
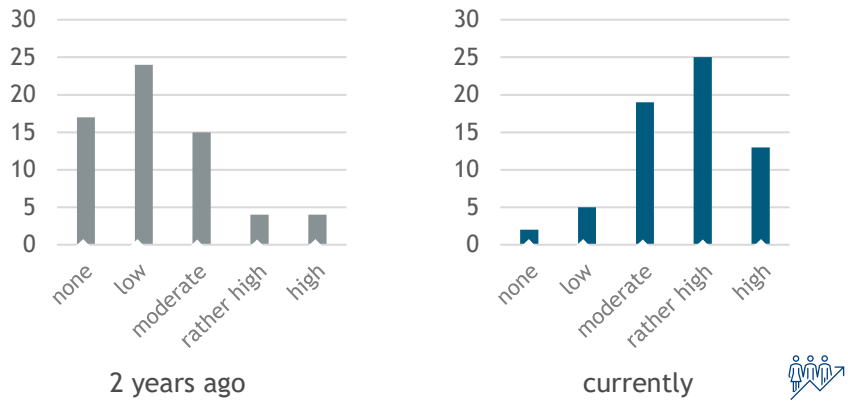
Priority of the topic



Personnel capacities and financial resources



Drivers

- Employees become more demanding (e.g., purpose and flexibility)
- Experience that productive work is also possible outside the office

Reaction of the companies

- Increasing attractiveness for new and existing employees in the "war for talent"
- Executives are increasingly willing to accept and integrate flexible working models

Source: Lanzl et al 2023

The study identified numerous obstacles and challenges to the transformation to New Digital Work

Source: Lanzl et al 2023

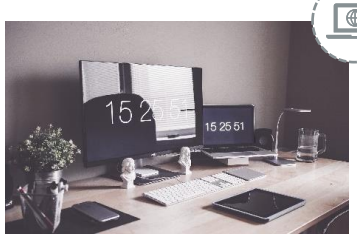
From the results, three dimensions for the transformation to New Digital Work can be derived

Work Design & Processes
How is work done and from which place?

- Designing the office in line with its new meaning
- Office use primarily as a place for collaboration and social interaction
- Agile organisation and flexibilisation of work through increasing autonomy
- Digitalisation of business processes for home office and office work

Corporate Culture
How is corporate culture developing?

- Shared will of management and employees to embrace new models
- Involving employees in the transformation through communication
- Increasing autonomy and agility require transformational leadership
- Considering individuality of employees and diverse teams



Sociotechnical Dimension
Are the necessary standards and capabilities in place?

- Provision of the necessary infrastructure and software for digital collaboration
- IT security and cyber security guidelines must be met
- Empower and train employees to use IT effectively
- Establish standards for healthy digital collaboration

Source: Lanzl et al 2023

Implementation of a New Digital Work strategy in a company

Supporting video https://youtu.be/uwFeMHRmkvI

New Digital Work combines the advantages of office and remote work

Back to the office?

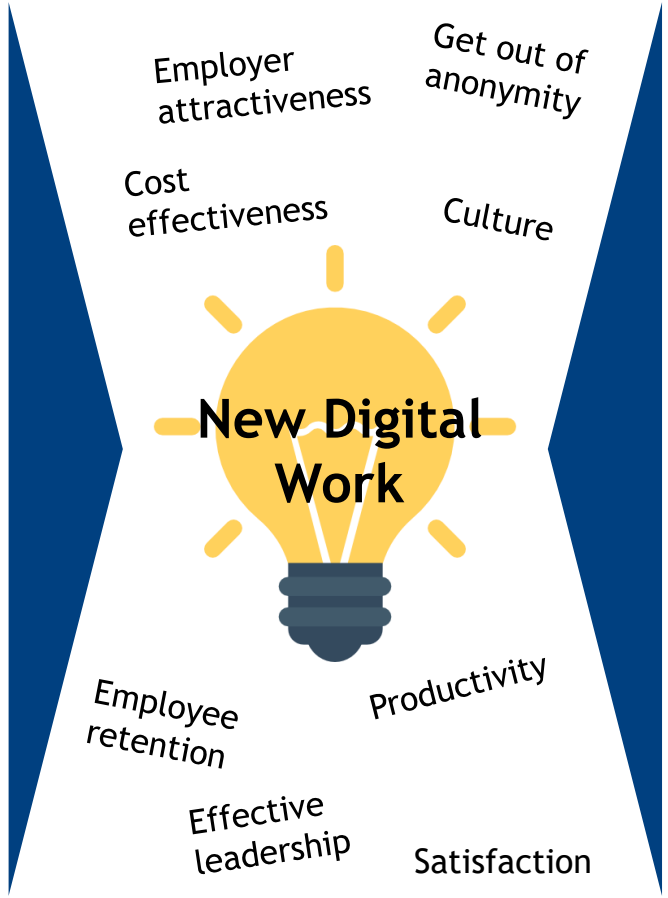
Elon Musk against home office: If you don't come to the office, you're fired?

Tagesschau.de

Goldman Sachs CEO calls home office an "aberration" that must be ended as soon as possible

Business Insider Deutschland

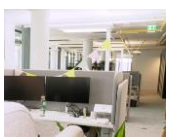
50% of US workers would rather quit than return to full-time office work



Completely remote?

Companies doubling down on remote work

BBC.com



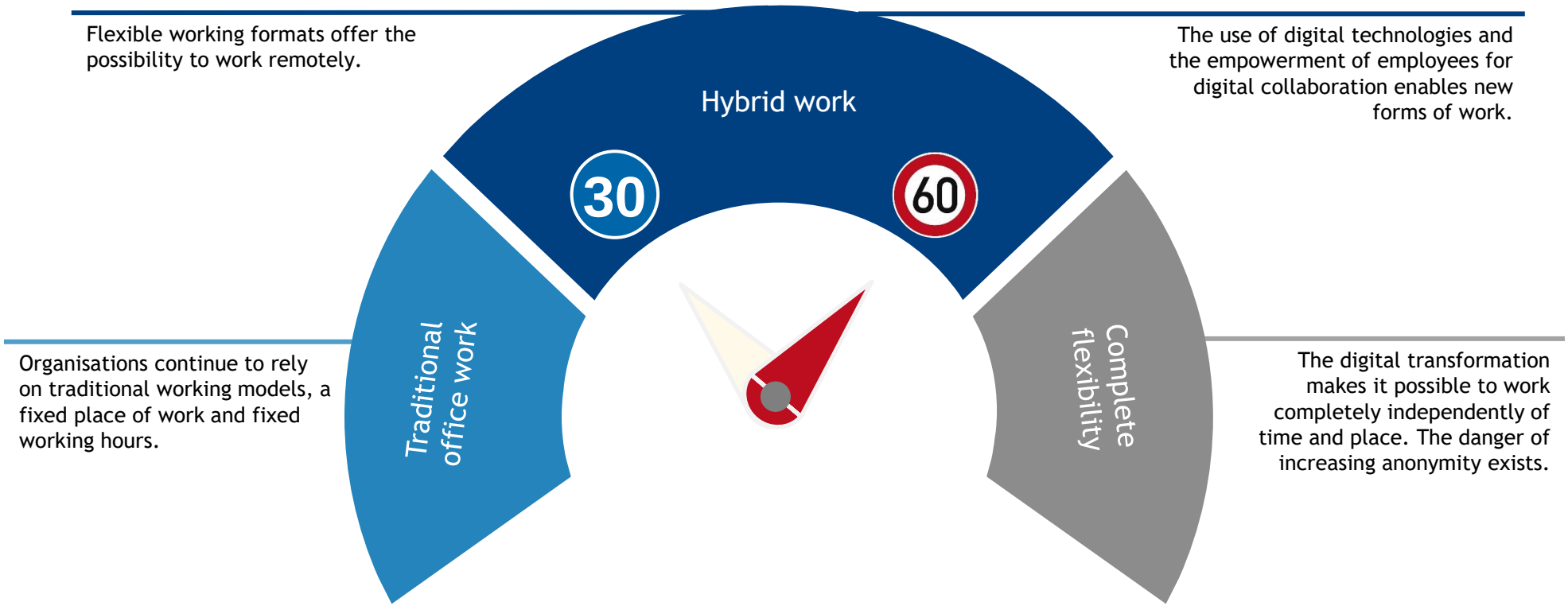
Home office obligation ends: But many offices remain empty

NDR.de

"Quiet quitting": up to 50% of US workers are now "not engaged" (highest level since 2013).

Sources: Cohen (2022), Göpfert (2022), Harter (2022), Lufkin (2022), NDR.de (2022), Robert Half (2022),

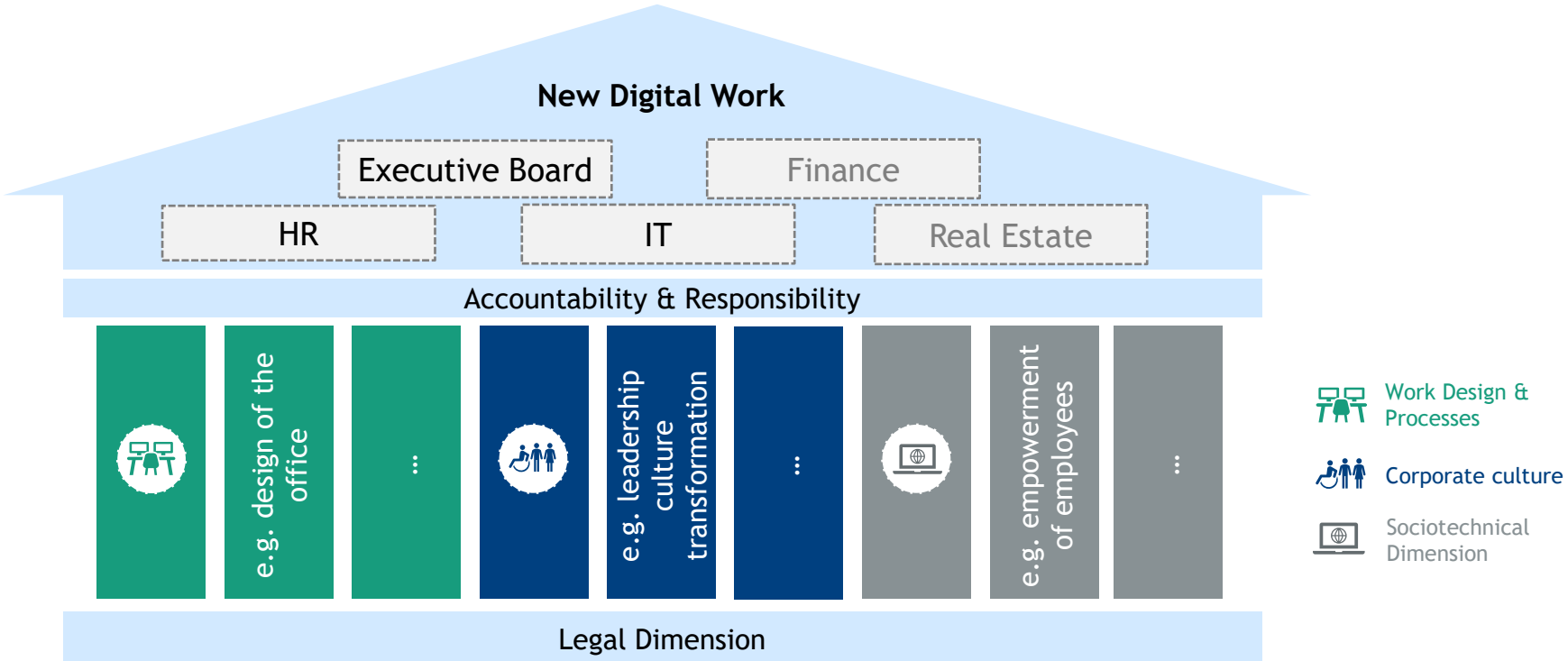
The company management must make a strategic decision on the direction to be taken



Companies need to develop strategic decisions and set guidelines at the management level. Different company divisions should be involved in the decision-making process.

Source: Lanzl et al 2023

The operationalisation of the structure of New Digital Work takes place along various fields of action



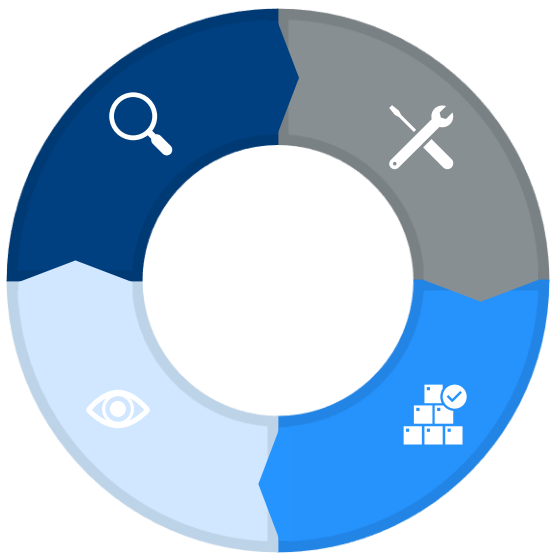
Depending on the branch, competences and focus of the strategy, companies have to decide which fields of action they want to address and where they require outside support.

Source: Lanzl et al 2023

A basic process model: Diagnose, Design, Deliver, Monitor

Diagnose

Identification of fields of action for New Digital Work and the degree of maturity of the topics within the company.



Design

Conception and design of action plans, as well as a transformation roadmap, which combine the advantages of flexible working and the physical office and take into account the needs of the employees.

Monitor

Continuous comparison of requirements, measures and impact as well as the establishment of a progress and success monitoring of the measures and their target achievement.

Deliver

Testing and implementation of the action plans with active involvement of teams, managers and employees.

Source: Lanzl et al 2023

Performance measurement for New Digital Work

Supporting video https://youtu.be/uZL3-wjInF4

Systematic and effective monitoring of New Digital Work measures is often not implemented

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> You can‘t manage what you can‘t measure

Which KPIs are potentially problematic to track?

At the moment, suitable measurement of the success of New Digital Work measures is not comprehensive in many companies, although digital work offers numerous opportunities for tracking through digital trace data.

Digital communication and collaboration create trace data that may contain valuable insights

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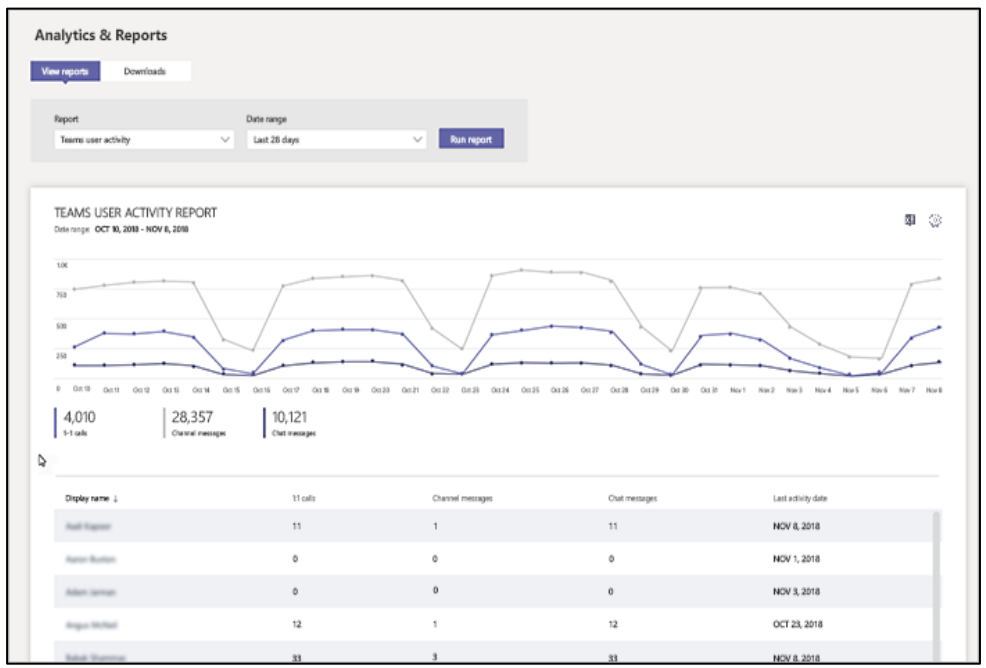
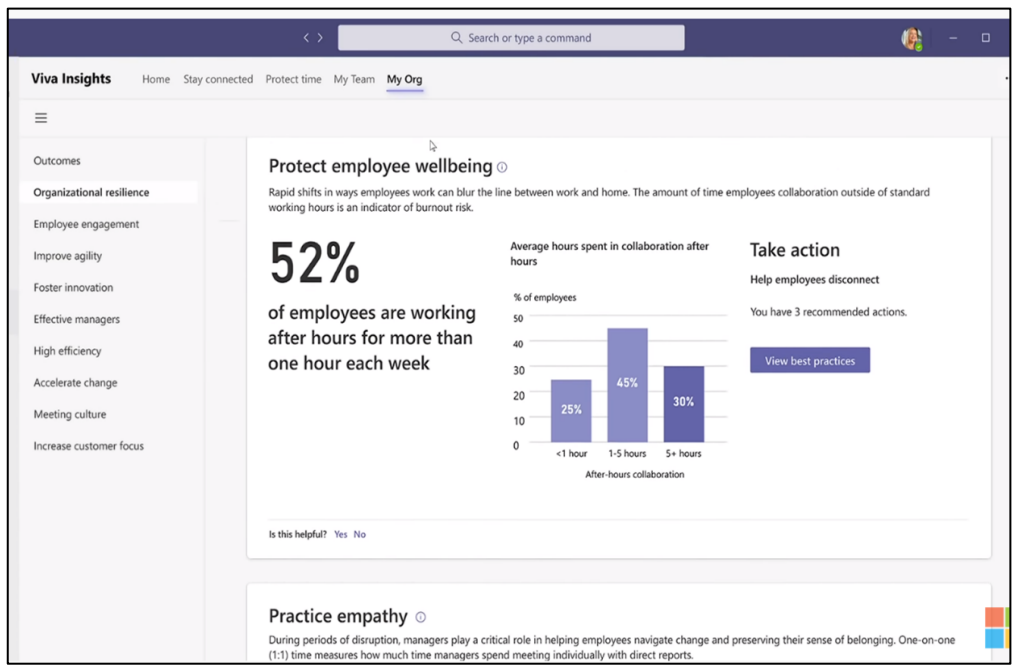
Dashboard Office 365



Microsoft Viva



Source: Microsoft

People Analytics comes with opportunities and risks that need to be taken into account

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Themes	Definitions	Key Aspects
Opportunities	Opportunities refer to the promises, benefits and expectations of organisations regarding the use of people analytics	▪ diverse areas of application (such as recruitment, development, retention) ▪ improvement of performance and efficiency ▪ improved work experience and job satisfaction
Barriers to adopting	Barriers describe the obstacles and reasons hindering or slowing the adoption of people analytics	▪ lack of analytical skills ▪ lack of an integrated data basis ▪ lack of collaboration with other functions ▪ technical barriers
Idiosyncrasies	Idiosyncrasies relate to the particularities and distinctive characteristics of people analytics	▪ ethical and moral implications ▪ invasiveness ▪ consideration of human complexity ▪ far-reaching consequences
Risks	Risks refer to likely sources of dangers of people analytics and their negative consequences for organisations and employees	▪ privacy and data protection concerns ▪ surveillance and constant tracking ▪ algorithmic biases

Source: Giermindl et al 2022

How can performance be measured? Possible influence on transformation & scope of performance measurement

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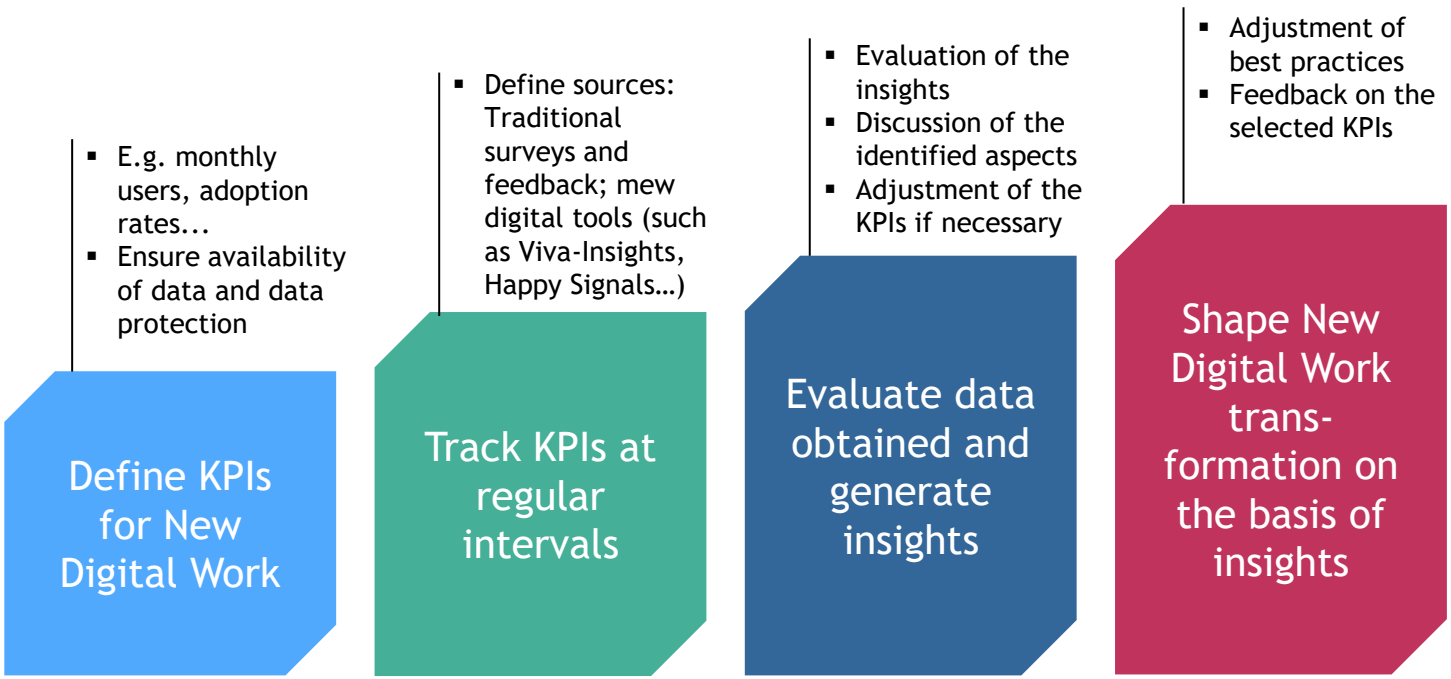
> Managers define their own information requirements



Digital work offers numerous opportunities for monitoring and tracking new digital work initiatives as well as company-wide collaboration. With a systematic approach, this potential can be realised.

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Digital Management

University of Hohenheim

Faculty of Business, Economics and Social Sciences

Institute of Marketing and Management

Chair for Digital Management (Prof. Dr. H. Gimpel)

Digital Management: Hot Topics in Practice

Chapter 3: Digital Transformation

2023

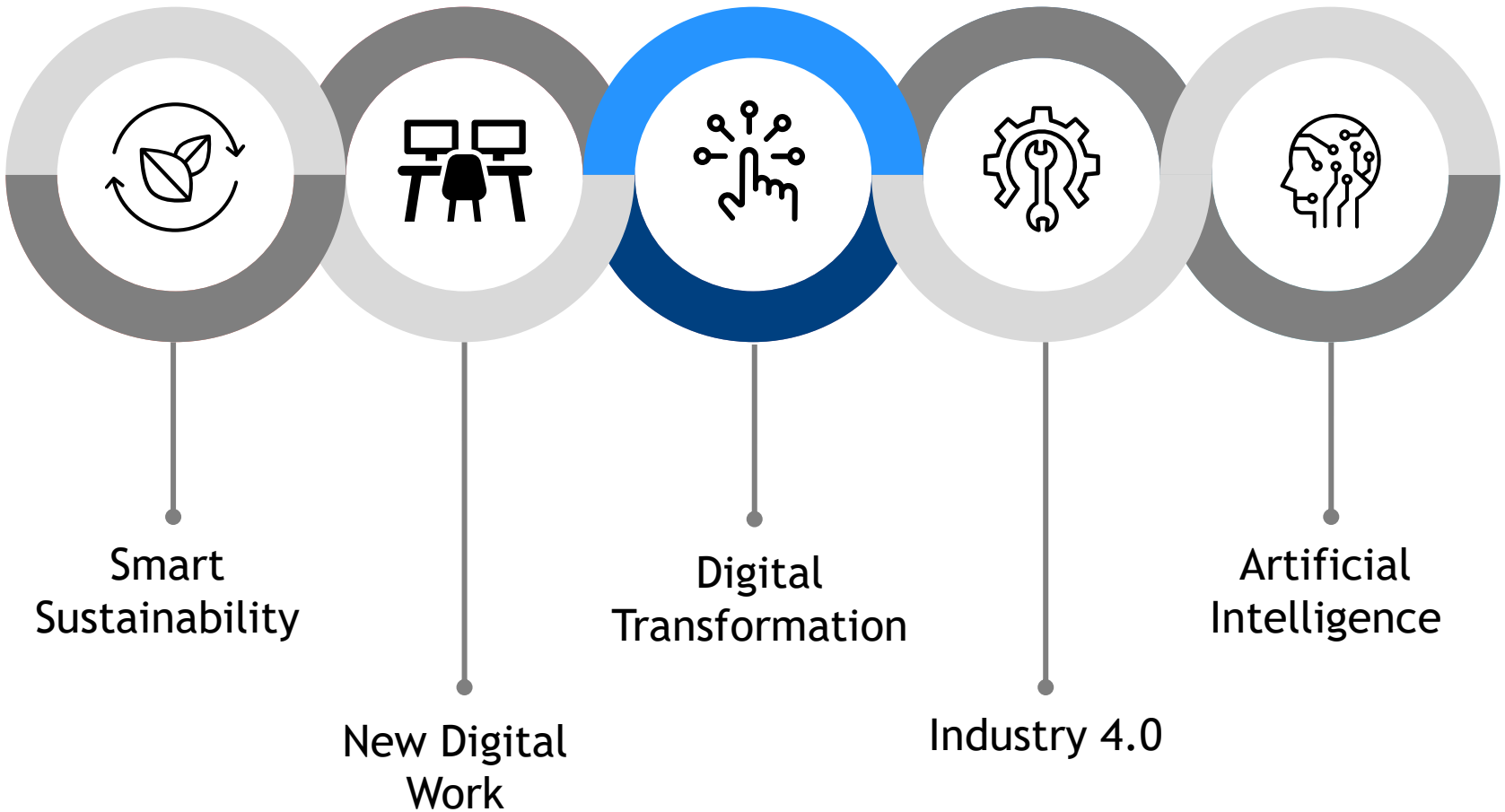
Research Center Finance & Information Management

Fraunhofer FIT Project Group Business & Information Systems Engineering

DLA DIGITAL LEADERSHIP ACADEMY

https://digital.uni-hohenheim.de/

Agenda - Hot Topics



Agenda – Digital Transformation

Digitalization twists established business rules

Supporting video https://youtu.be/Qzc58KHWWBs

Digitalization twists established business rules: In the digital and the physical world

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UBER	The world‘s largest taxi company owns no vehicles
	The world‘s most popular media owners create no content
Alibaba.com	The world‘s most valuable retailer has no inventory
airbnb	The world‘s largest accommodation provider owns no real estate
WeChat	The world‘s largest phone companies own no telco infrastructure
Google	The world‘s largest software vendors don‘t write the apps
NETFLIX	The world‘s largest movie house owns no cinemas

Business models | End-user interface | Industry structure | digital/physical | B2C/B2B

Two related but less common perspectives

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Technology is not the real disruptor. Not being customer-centric is the biggest threat

- Netflix did not kill blockbuster. Ridiculous late fees did
- Uber did not kill the taxi business. Limited access to taxis and fare control did
- Apple did not kill the music industry. Being forced to buy full-length album did
- Amazon did not kill other retailers. Bad customer service experience did
- Airbnb isn't killing the hotel industry. Limited availability and pricing options are

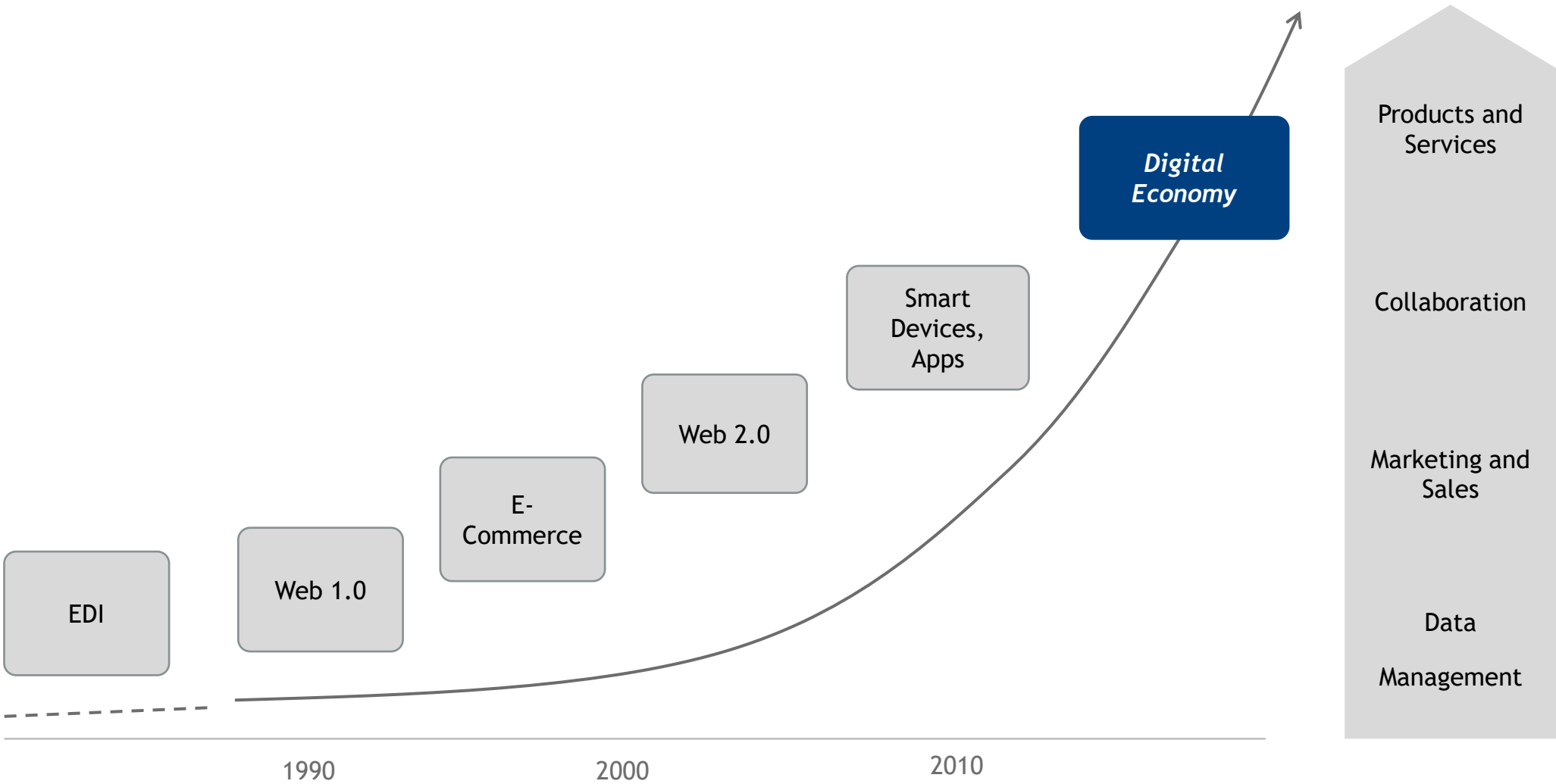
First seen in a presentation by Anja Stolz, Commerzbank

Silicon Valley entrepreneurs innovate. So do states

- What would Uber be without GPS? GPS was and is state financed
- What would Amazon be without the Internet? The Internet was state financed
- U.S. government invested more money in Tesla and SpaceX than Elon Musk did (e.g., Tesla received $3.5bn in subsidies)

Freakonomics Radio interview with Mariana Mazzucato, http://freakonomics.com/podcast/mariana-mazzucato/

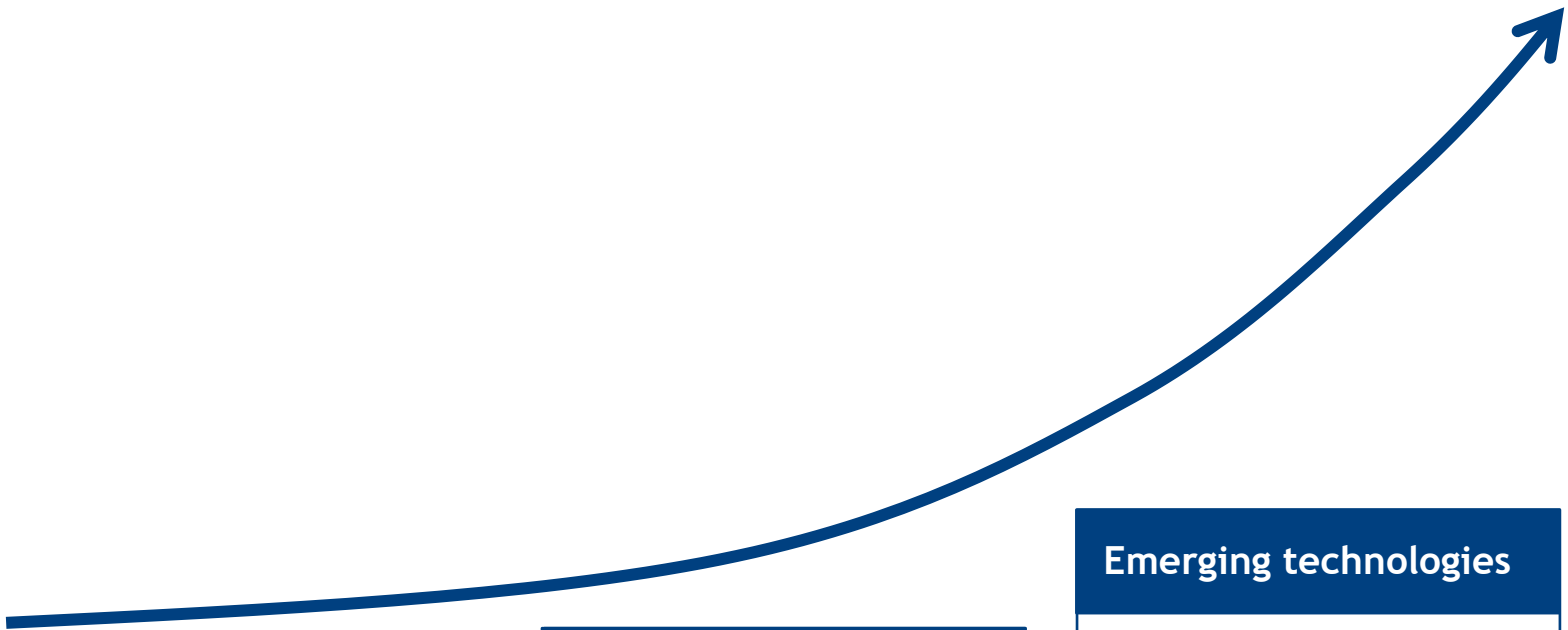
The digital economy is the result of successive development



Digital technologies and systems

Supporting video https://youtu.be/0EF24JnoA6Q

Digital technologies are a key driver of digital transformation



Early ICT

ERP / MES
EDI
Web 1.0
E-Commerce
…

Common technologies

Social
Mobile
Analytics
Cloud
…

Emerging technologies

Artificial intelligence
Internet of Things (IoT)
Wearables / Nearables
Augmented Reality
Blockchain
3D / 4D printing
…

…

Which digital technologies are next?

Digitalization is driven by the rapid growth and commoditization of digital technologies

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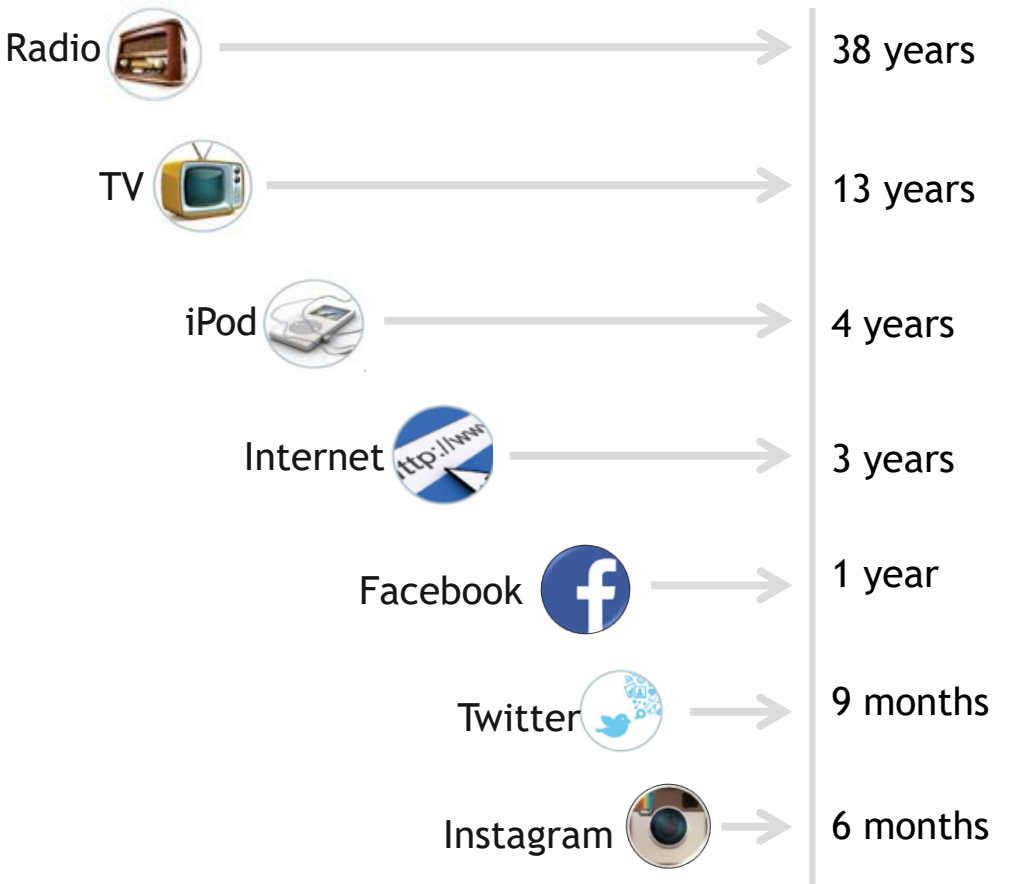
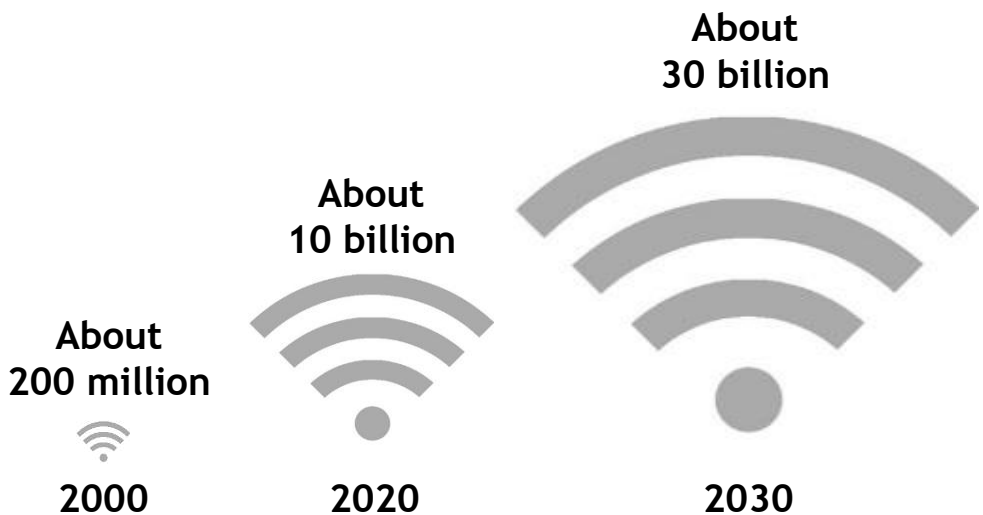
Time by which 50 million users were reached



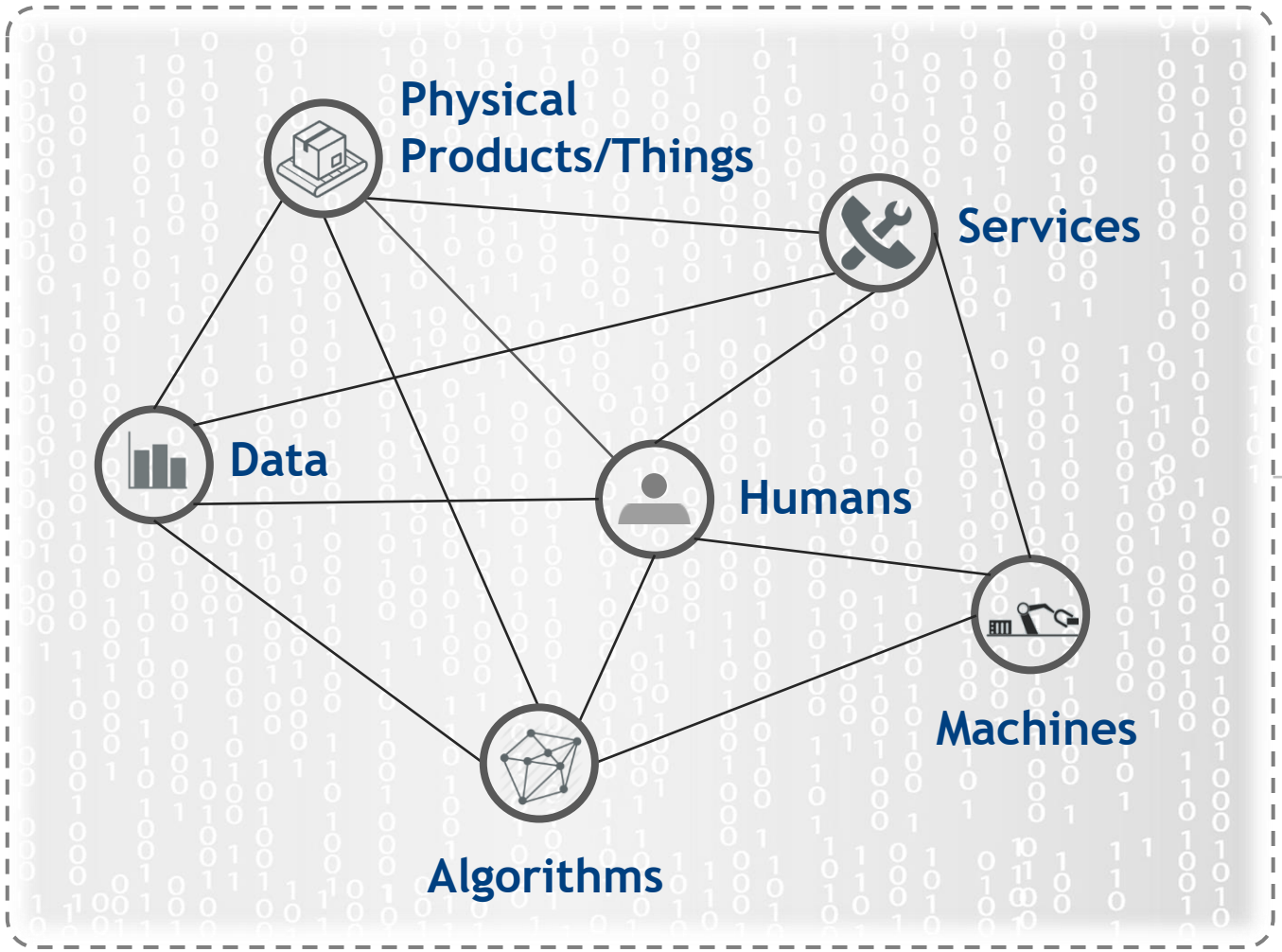
Adapted from Mattern et al. (2012)

Number of connected devices



Statista based on various sources

The digital economy converges towards cyber-physical-human systems



System Characteristics

Volatility

Uncertainty

Complexity

Ambiguity

Some terminology around digitalization

Supporting video https://youtu.be/jPBIPLX4Amg

Terminology around digitalization

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Digital	Relating to calculation with discrete units, typically with binary digits (based on merriam-webster.com/dictionary/digital)
Digital technologies	Combinations of information, computing, communication, and connectivity technologies based on calculation with discrete units (Bharadwaj et al. 2013)
Digital technologies and media	The totality of all electronic devices (hardware) and applications (software) that use information in the form of numerical codes (usually binary codes), and the totality of all media (means and channels of general communication in society) that are encoded in formats that can be processed by these devices and applications.

More terminology around digitalization

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Digitization	Technical process of converting analog signals into a digital form (Legner et al., 2017)
Digitalization	The manifold sociotechnical phenomena and processes of adopting and using digital technologies in broader individual, organizational, and societal contexts (Legner et al., 2017)
Digital transformation	Organizations' managed adaptation as they capitalize on digital technologies to change business models, improve existing work routines, explore new revenue streams, and ensure sustainable value creation (Gimpel et al. 2018)

Structuring digital transformation

Supporting video https://youtu.be/Qd6ig0honM4

The digital economy forces and enables many companies to transform

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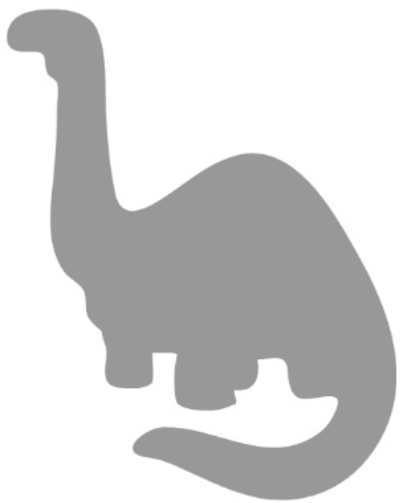
Digital Naives



Digital Transformers

Digital Natives

Google

UBER

PayPal

zalando

Crossroads image: ccPixs.com CC BY 2.0; Logos are property of the respective organization

Change vs. conservation

What is your perspective on this statement?

"In the eye of globalization and computerization, the beautiful things of life such as potatoes or stew boil must not be neglected. Such centuries-old abilities must not be lost."

Angela Merkel,
former Chancellor of Germany

June 24, 2004; Image: Marketing 2.0

Over 50 companies participated in our study

Revenue	10 mn EUR ⟷	70 bn EUR
Employees	<100 ⟷	>300.000
Nationality	German ⟷	International
Customer Focus	B2C ⟷	B2B
Sector	Service ⟷	Manufacturing

Typical interview partners

- CIO / Chief Digital Officer / Chief Innovation Officer
- Managing Director / Head of IT
- Program Lead Digitalization
- Strategy, Business Development, Communication

Sources

- Interviews
- Workshops & discussion forums
- Applied research projects

Gimpel et al. (2018)

The study results are presented in two publications

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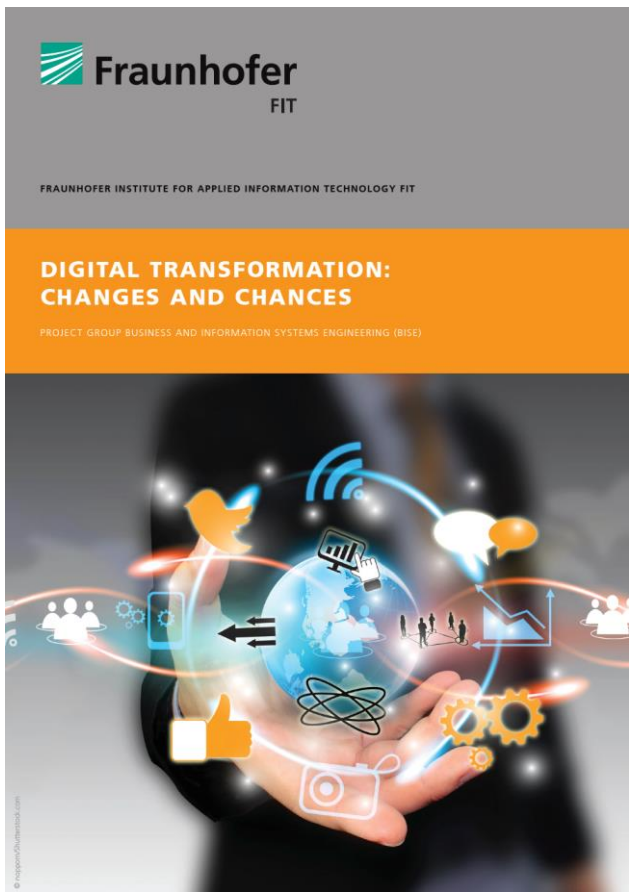
Practice-oriented presentation: Gimpel und Röglinger (2015)



- Customer
- Value Proposition
- Data
- Organization
- Operations
- Transformation Management

Science-oriented presentation: Gimpel et al. (2018)

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ISSN: 1532-3416

Structuring Digital Transformation: A Framework of Action Fields and its Application at ZEISS

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Ulrich Faisst[1]
Served as Digital Transformation Officer at Carl Zeiss AG during the creation of this paper

Abstract:

Digital products and services are an integral part of everyday life for both individuals and organizations. Further, given that digitalization greatly impacts our society and in particular how customer and organizations interact, organizations need to react to changing business rules and to leverage opportunities associated with digital technologies. Accordingly, the chief information officer (CIO) role is frequently a flexible one in the sense that it encompasses a much broader perspective on organizations than before. Most of the CIOs or newly appointed chief digital officers (CDOs) whom we interviewed in the course of our study recognized the need for change catalyzed by emerging digital technologies, but they typically lacked comprehensive knowledge on how to scope digital transformation initiatives. Against this background, we develop and validate a holistic framework of action fields for digital transformation. Our framework builds on extant literature and a series of exploratory interviews with over 50 organizations, and we have validated it in numerous contexts. In this paper, we present our framework and demonstrate its application at ZEISS, one of the organizations that participated in our study.

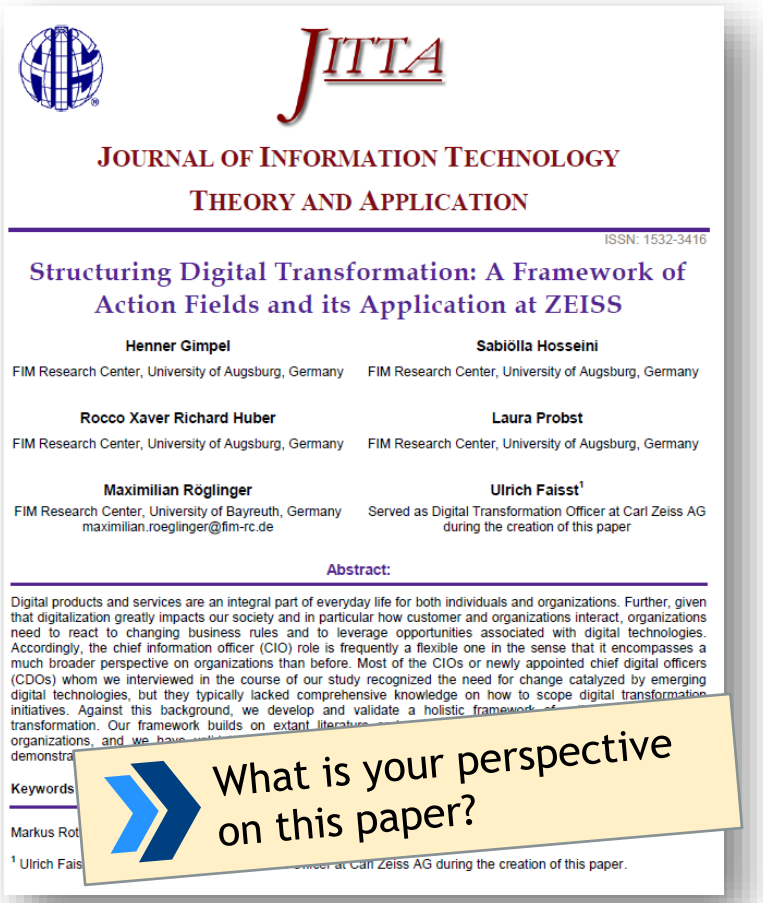
Keywords: Digital Transformation, Digital Strategy, Digitalization, Digital Economy, Framework.

Markus Rothenberger acted as the Senior Editor for this paper.

[1] Ulrich Faisst served as Digital Transformation Officer at Carl Zeiss AG during the creation of this paper.

What is your perspective on this paper?

Structuring digital transformation - Guiding questions for paper discussion



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demonstra

Keywords

Markus Rot

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Carl Zeiss AG during the creation of this paper.

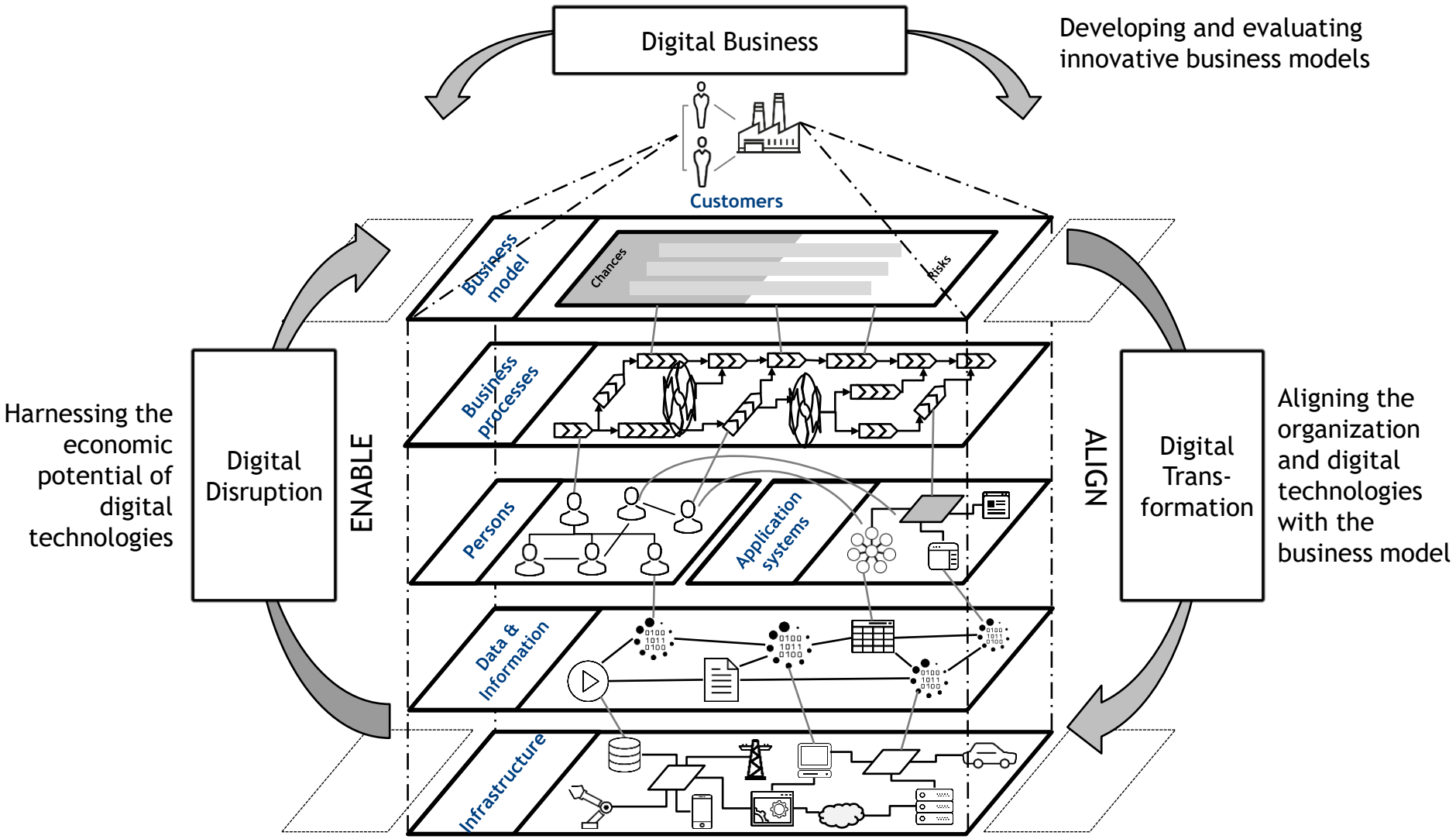
What is your perspective on this paper?

1. What is the **structure of the paper?** What functions do the individual sections have?
2. What is the **research approach** that the authors chose? What could be the advantages and disadvantages of this method?
3. In a nutshell, what are the **key findings** of the paper?
4. In which field is the **greatest need for action** for industrial companies in Germany?
5. Discuss critically the **practical implications.** What should managers learn from this paper?

A layered model of an organization

Supporting video https://youtu.be/1G_bjls_2j8

A layered model of an organization



Gimpel and Röglinger (2017)

Fields of action for digital transformation

Supporting video https://youtu.be/z4FitPUgzdk

There are six fields of action for digital transformation

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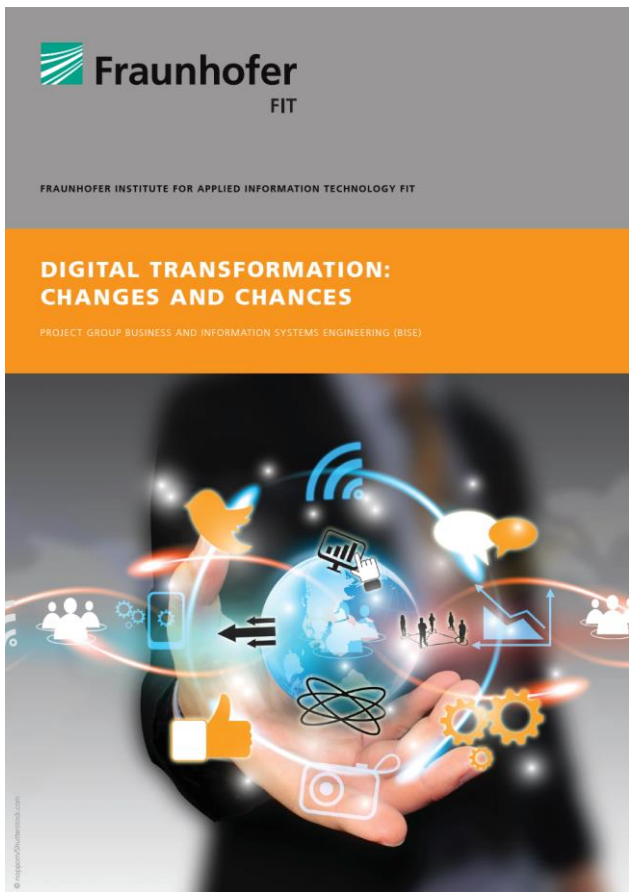
Practice-oriented presentation: Gimpel und Röglinger (2015)



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Need for action in the course of digitalization along the corporate architecture

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- Generate customer insights
- Design customer experiences
- Enable omni-channel interaction

- Regularly update digital strategy
- Allocate responsibility for digital transformation
- Actively manage change and value contribution

- Offer smart products and services
- Establish data-driven business models
- Act in ecosystems and value networks

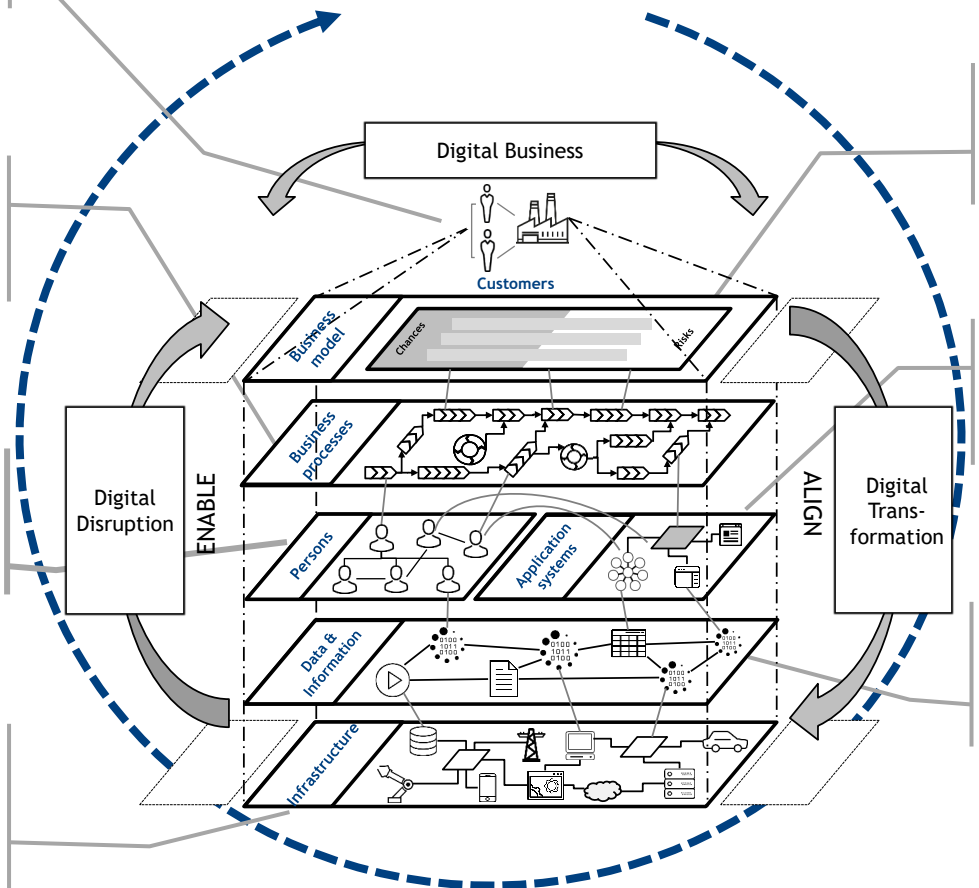
- Improve processes continuously
- Rethink processes radically
- Enable ambidexterity

- Integrate heterogeneous systems
- Realize high usability
- Design the workplace of the future

- Enable flexible cooperation
- Develop digital competencies
- Establish digital culture

- Link heterogeneous data
- Manage data privacy and security
- Exploit data systematically

- Realize standardized interfaces
- Ensure scalability
- Integrate information and production technology



Gimpel and Röglinger (2015), Gimpel et al. (2018)

Group work: layered model of an organization

Case work: layered architecture

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Build teams

Select a case

- Digitalization case example (either from the list on known or from your own experience)
- Potentially: Consider the solution provider and the customer

Analyze the case

- Set the scene
  - Industry and company background
  - What is the trigger or key aim for going after Industry 4.0
- Go deep: use the layered architecture as guiding framework
  - What changes? Why?
  - What is constant? Why?
  - By layer: are there key success factors or obstacles?
  - If in doubt, make transparent assumptions
- Add your assessment: Innovativeness, maturity, scalability, …

Discussion

- Plenary discussion and synthesis

- What do we learn about the cases?
- What do we learn about the layered architecture?
- Which open questions arise?

Potential cases (not exhaustive)

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- Bosch et al. Track and Trace
  (Potential starting point: https://www.iiconsortium.org/track-and-trace.htm)
- Hilti On!Track Construction Equipment Management
  (Potential starting point: https://www.hilti.group/content/hilti/CP/XX/en/services/tool-services/on-track.html)
- CAT Connect Technology and Services
  (Potential starting point:
  https://www.cat.com/en_US/support/operations/technology.html;
  https://www.forbes.com/sites/bernardmarr/2017/02/07/iot-and-big-data-at-caterpillar-how-predictive-maintenance-saves-millions-of-dollars/#43c32afb7240)
- Kaeser Sigma Air Utility
  (Potential starting point: https://us.kaeser.com/services/compressed-air-as-utility-service/)
- Thyssenkrupp Elevator Maintenance
  (Potential starting point: https://blogs.windows.com/devices/2016/09/15/microsoft-hololens-enables-thyssenkrupp-to-transform-the-global-elevator-industry/)

What is a digital ecosystem?

Supporting video https://youtu.be/H6TUsWg5djg

Examples of ecosystems and their value?

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Google's revenue and profit with Android

- Timeframe: 2008 to 2016:
- USD 31 bn, revenue
- USD 22 bn, profit

Isn't Android free?

Standard search in Firefox

- 2007: USD 81 m,Google
- 2012: USD 280 m,Google
- 2014: USD 375 m,Yahoo
- 2017: USD ~542 m, Google

Google search in iOS-devices

- 2014: USD 1 bn
- 2020: USD ~ 9-12 bn

Why is search so valuable?

iOS

https://www.bloomberg.com/news/articles/2016-01-21/google-s-android-generates-31-billion-revenue-oracle-says-ijor8hvt,
http://www.spiegel.de/netzwelt/netzpolitik/mozilla-und-yahoo-schliessen-partnerschaft-fuer-fuenf-jahre-a-1003951.html,
https://www.cnet.com/news/google-firefox-search-deal-gives-mozilla-more-money-to-push-privacy/,
https://www.nytimes.com/2020/10/25/technology/apple-google-search-antitrust.html,
Logos are property of the respective organization

What is a digital ecosystem?

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> A digital ecosystem includes a platform that serves as a core on which others can build modules that are designed to extend the service possibilities of the platform.
>
> It also includes various social actors who build the platform and various modules and a regulatory regime including standards that bind these heterogeneous actors together.
>
> **Eaton et al. 2011, p.2**

Other conceptions

- Single party ecosystem (e.g., "Apple ecosystem" with only Apple hardware, software, services
- Ecosystem without a single actor setting the regulatory regime (e.g., Start-up ecosystem in Munich)

http://cruxx.co/why-ecosystem/

What is a digital platform?

- Digital platforms are Internet-based forums for digital interaction and transaction.
- The platforms include
  - Search engines
  - Comparison and rating portals
  - Marketplaces/trading platforms
  - Media and content services
  - Online games
  - Social networks
  - Communication services.
- Platforms have created new rules for doing business
  - Growth and size are more decisive than short-term profitability
  - The direct interface with customers and manufacturers gives the new players considerable market power and an information advantage

Logos are intellectual property of the companies; Bundesministerium für Wirtschaft und Energie (2017)

Digital platforms: A characterization in three perspectives

Do you know examples for these types?

Perspective	Economic	Technical	Organizational
Understanding	Digital platforms as markets …	Digital platforms as technical artifacts …	Digital platforms as an approach to innovation …
Description	… breaking down traditional markets and facilitating efficient interactions between consumers and producers.	… with a modular architecture consisting of a stable core component and many changing peripheral components.	… in which actors organize and coordinate innovations enabled by technical mechanisms and social agreements.

Rolland et al. (2018)

Digital control points

Supporting video https://youtu.be/M6qPT_wIn00

Digitalization recasts the relevant points that control a market

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From disparate, industry-specific control points

- Intellectual property
- Distribution network
- Expertise
- Production capacity
- …

to a series of critical digital control points

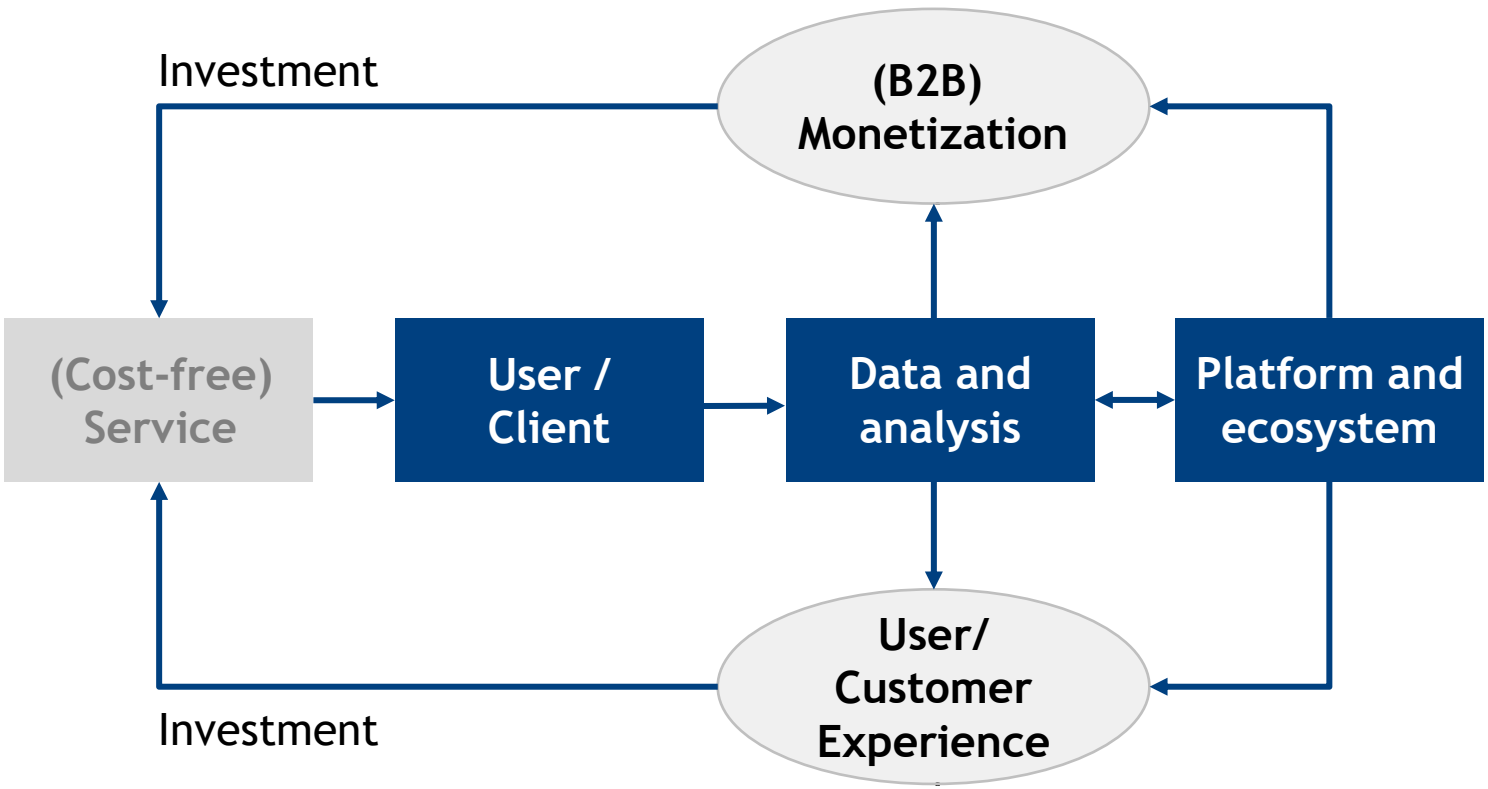
- **User / Client**
- +
- **Data and analysis**
- +
- **Platform and ecosystem**

Explanation

- Connection with the user/client generates lock-in and improves validated learning
- Typically, proprietary detailed data. Advanced analytics to obtain sound knowledge (e.g., regarding clients‘ behavior)
- A platform enables interaction between the clients and third parties, in order to generate quick multiplier- and scale-effects

Adapted from Hehner et al. (2015)

Construction of a self-reinforcing system along the three digital control points



- Each successful digital business proposition has a strong emphasis on data
- Most digital champions succeeded in building an ecosystem around their platform

N26 ...

Content adapted from Hehner et al. (2015); Logos are property of the respective organization

Digital ecosystems are spreading

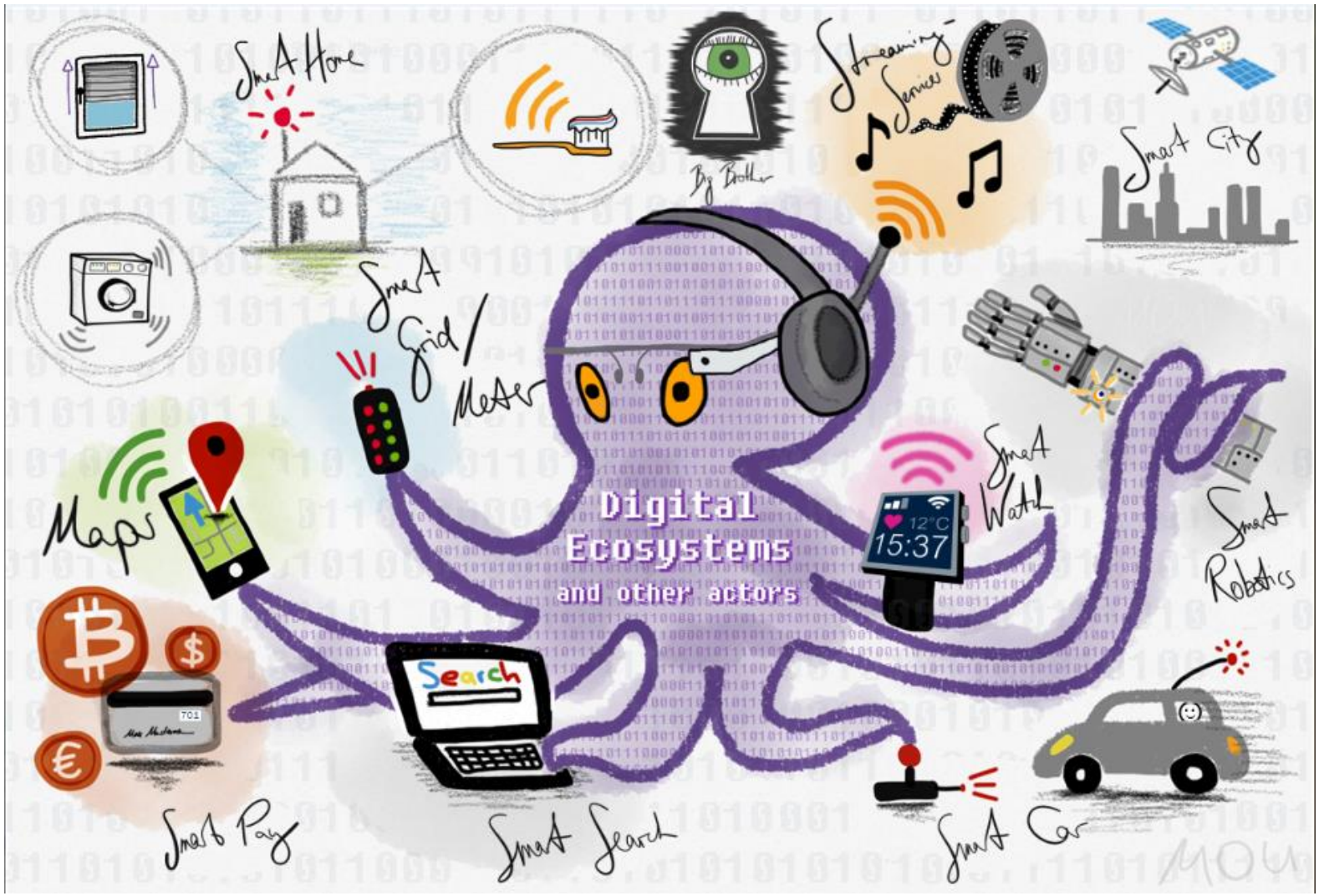
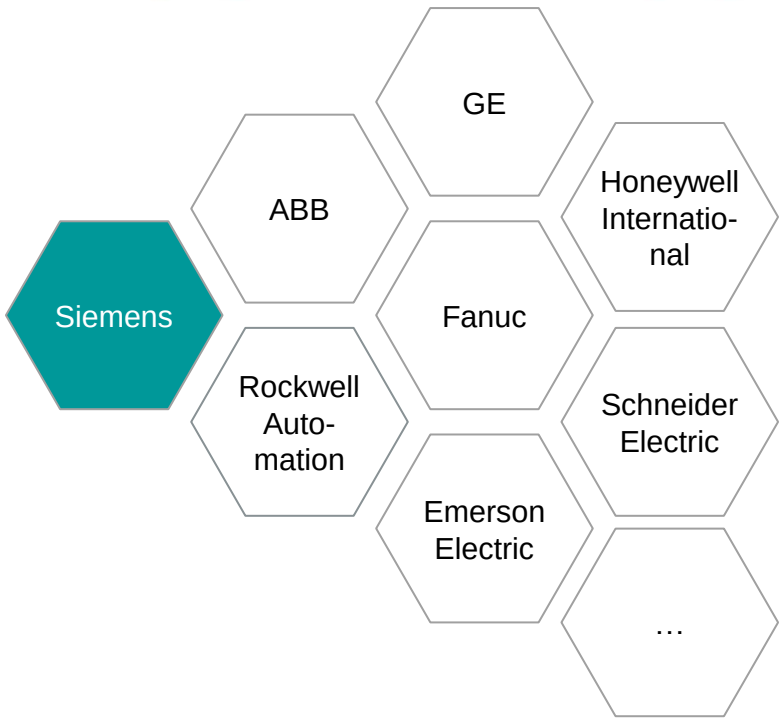
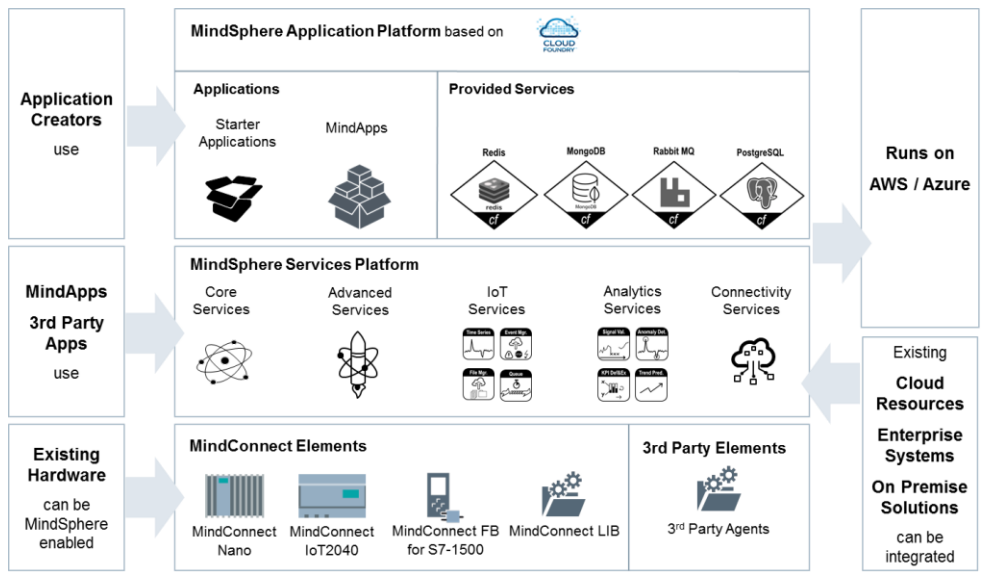


Image by Oliver Ullmann, Deutsche Bank Research

In Industry 4.0, different platforms and ecosystems emerge





Images by Siemens

Additional material,
likely not to be covered in the course

Who leads digital transformation?

Supporting video https://youtu.be/5ZxwEODvSO0

Digital transformation requires a leader

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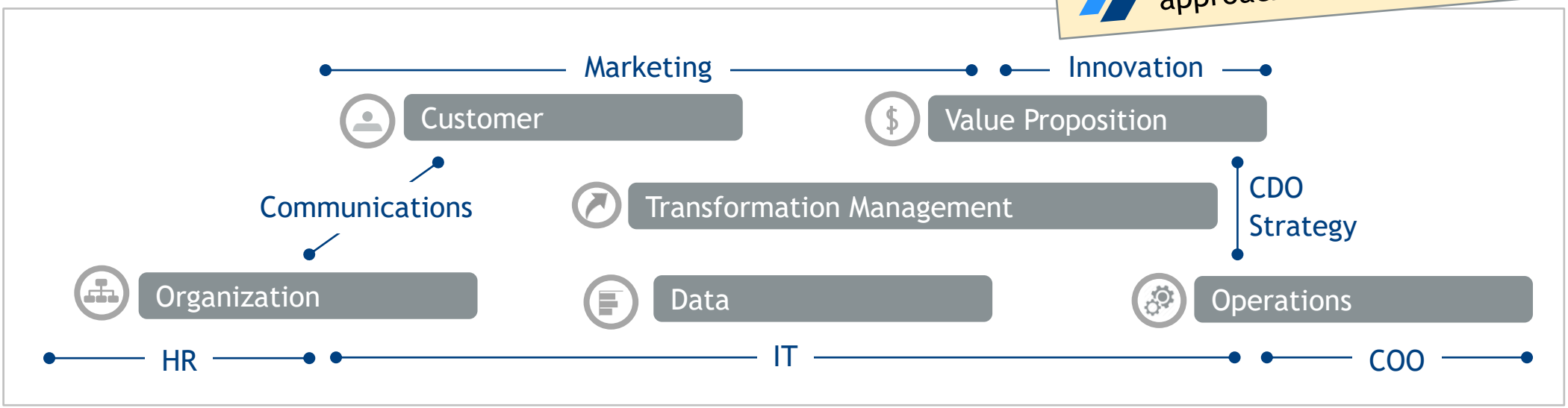
Challenges

- Redefine the roles of the CIO and the IT department. Identify sponsor of digital transformation
- From alignment to enabling
  - Traditionally viewed as cost driver and hygiene factor
  - Digitalization is not only about technology: business & customer perspective becomes more important for IT

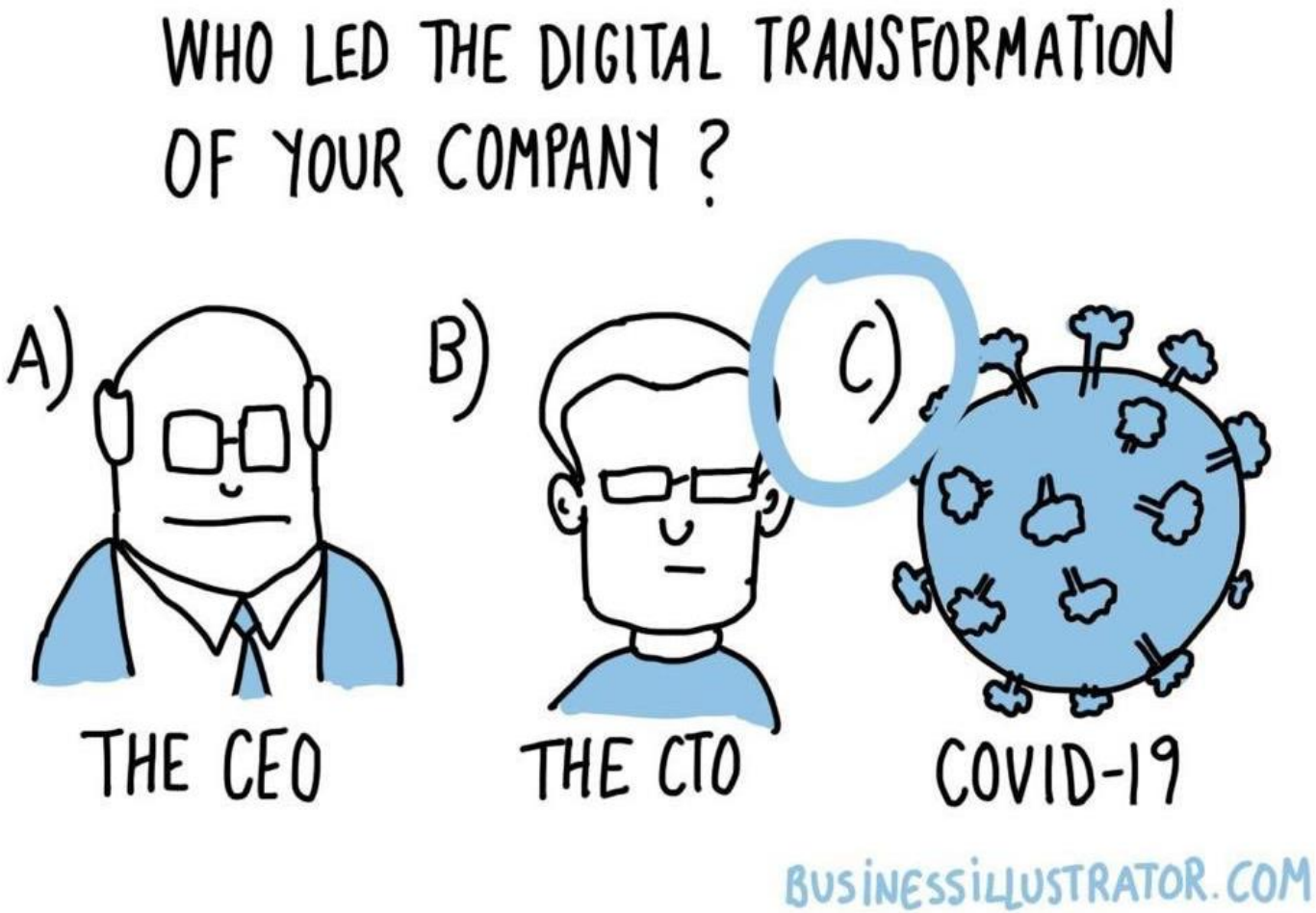
Possible Approach

- Role and responsibility of the IT department
  - Internal service provider?
  - Equal partner?
  - Driver of digital transformation?
- Novel interfaces to other business units
- Cross-disciplinary teams
- New skill profiles

Is there an optimal approach?



Gimpel et al. (2018)



(https://www.businessillustrator.com, May 28, 2020)

Additional material,
likely not to be covered in the course

Hybrid physical-digital services

Supporting video https://youtu.be/7AU-KLl4lls

Successful value propositions are becoming increasingly hybrid

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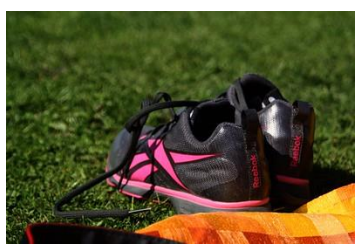
Product-service bundling in sports

»Hybridity«

Physical product (Running shoe)

»Traditional service« (Work-Out monitor)

Digital service (training plan and monitoring)



Time

Images: Shoes by Blondinrikard Fröberg CC BY 2.0; Fitness Tracker by guccio@文房具社 CC BY-NC 2.0; Smartphone by Forth Edge CC BY 2.0

Innovative business models combine digital services and lot size 1 production

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Product and production at adidas

Smart service

In-store production?

A “local boomerang”?

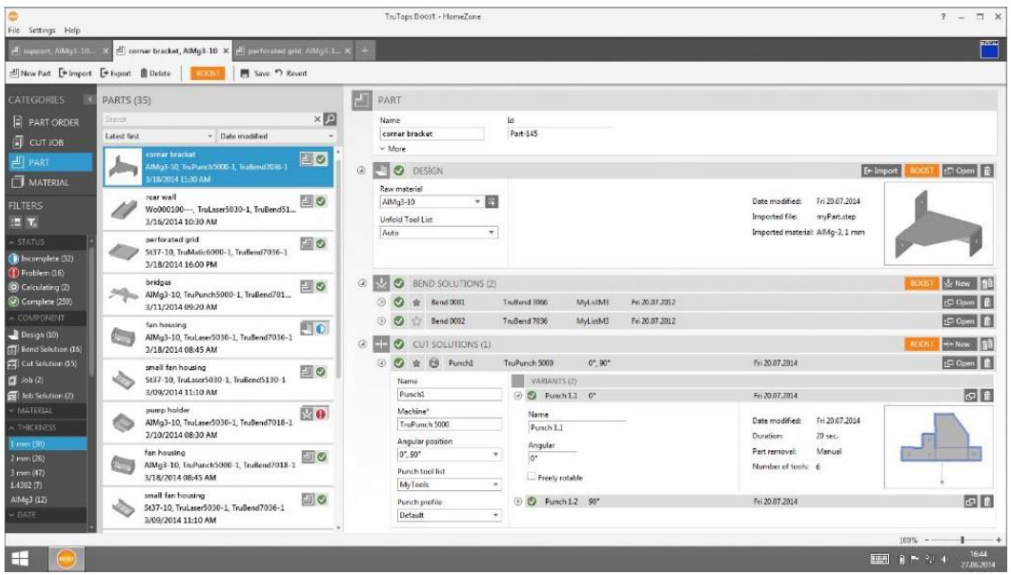
Images: Smartphone by Forth Edge CC BY 2.0; Robot photo by Adidas

The trend also applies in B2B

Hybrid products in machinery industry

Tool machine as tangible product

Digital value-added services (app store)



Images: Welding by TRUMPF GmbH + Co. KG CC BY-SA 3.0, screenshort silicon.de

Service is the fundamental basis of exchange

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"Power by the Hour"

In which ways is such a model beneficial for the partners?

Image: Mark Hillary CC BY 2.0

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Digital Management

University of Hohenheim

Faculty of Business, Economics and Social Sciences

Institute of Marketing and Management

Chair for Digital Management (Prof. Dr. H. Gimpel)

Digital Management: Hot Topics in Practice

Chapter 4: Industry 4.0

2023

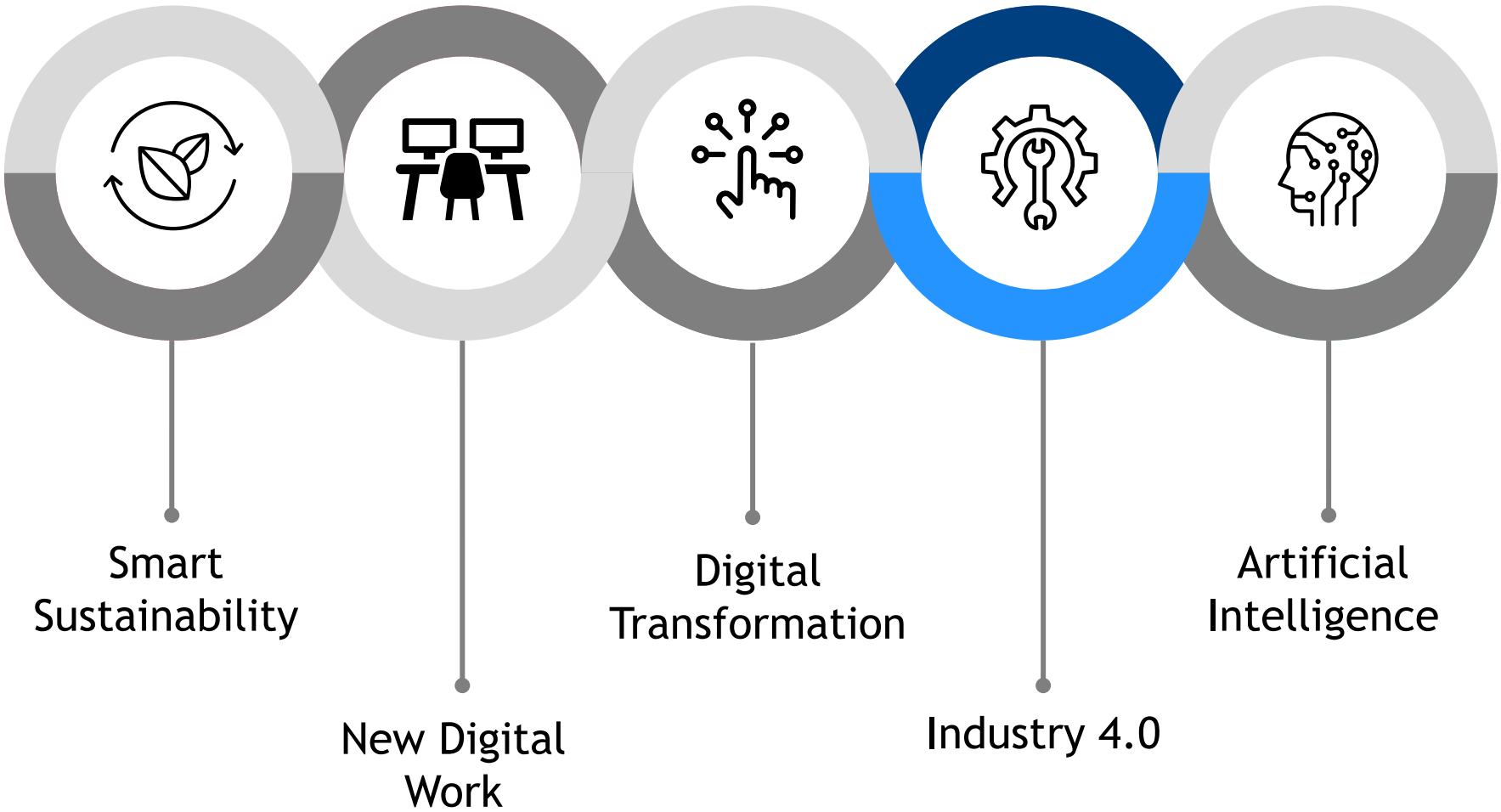
Research Center Finance & Information Management

Fraunhofer FIT Project Group Business & Information Systems Engineering

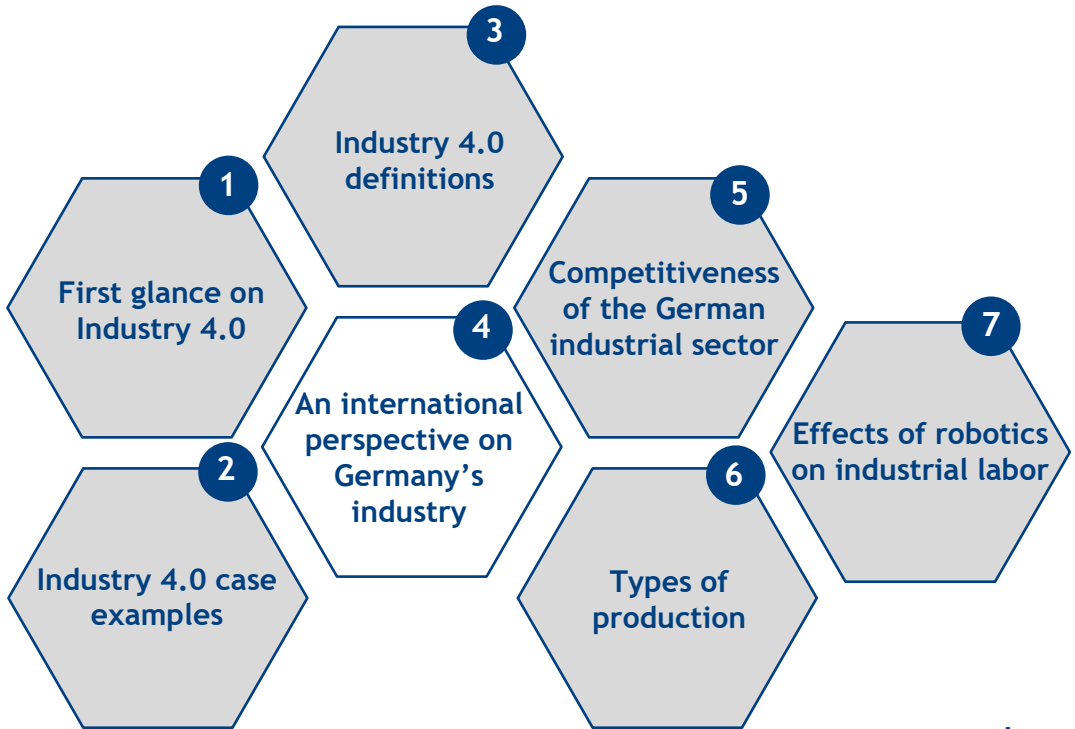
DLA DIGITAL LEADERSHIP ACADEMY

https://digital.uni-hohenheim.de/

Agenda - Hot Topics



Agenda – Industry 4.0



Legend:

- Relevant for the exam
- Voluntary additional material, not relevant

First glance on Industry 4.0

Supporting video https://youtu.be/hzae-S_fBV8

Industry 4.0 -
The fourth stage of industrial revolution

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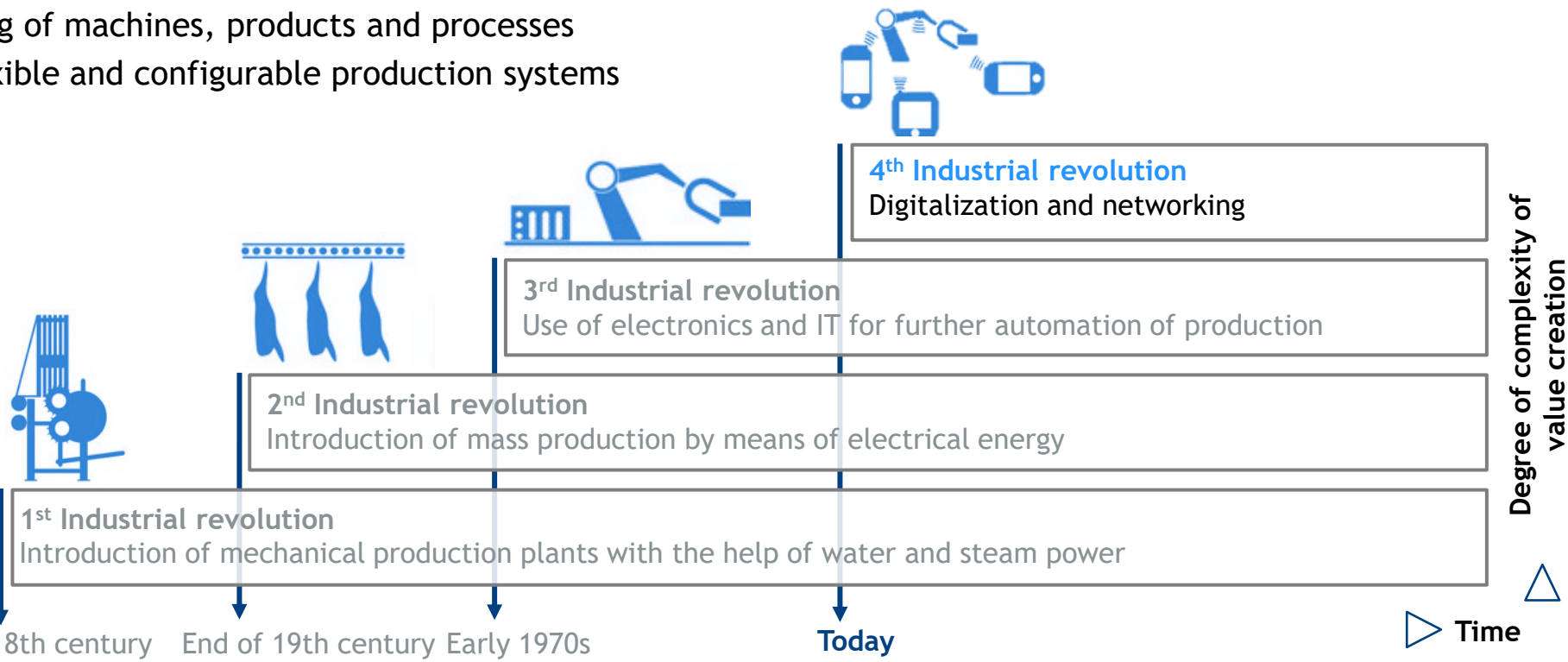
Central features of Industry 4.0

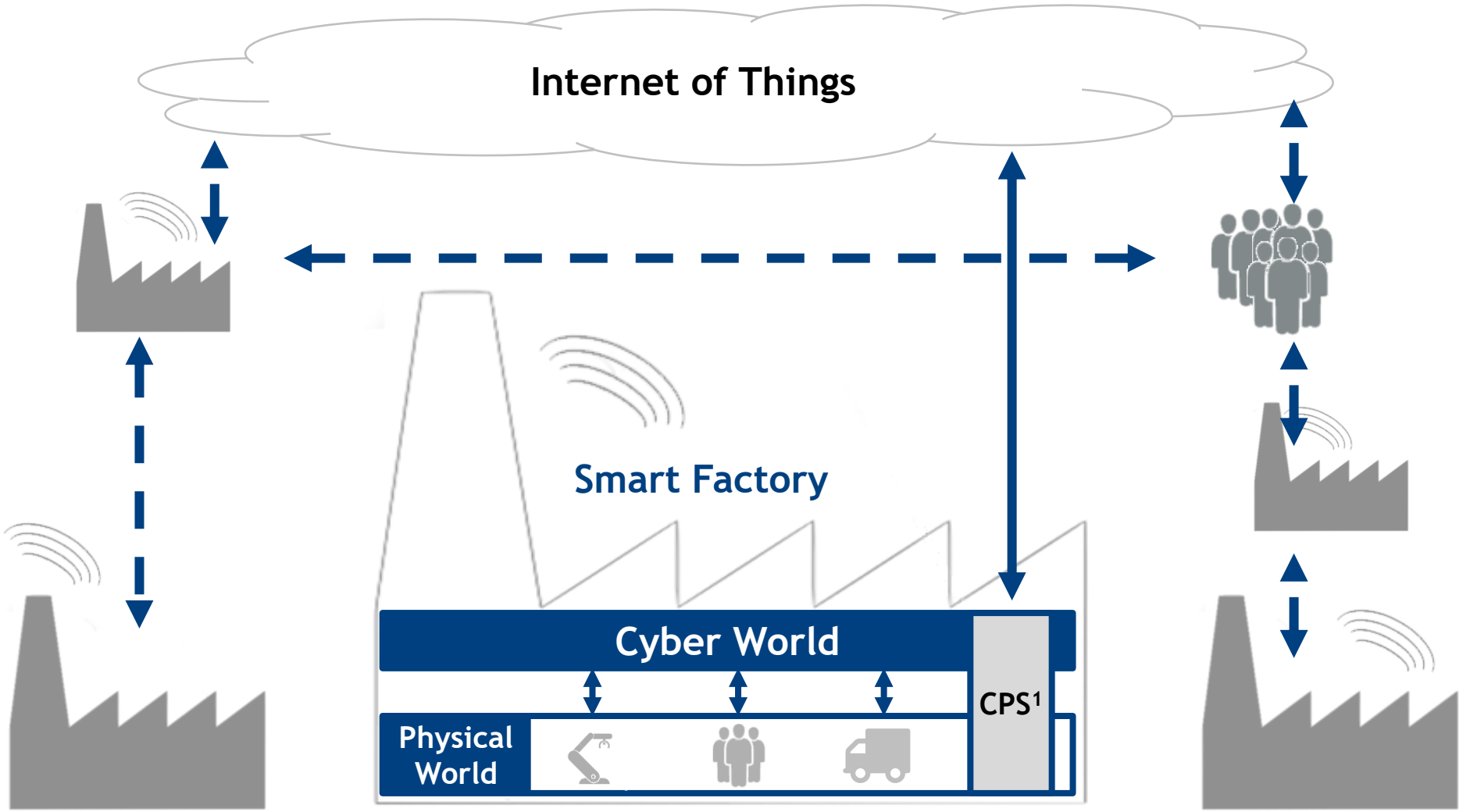
- Automation of value creation
- Establishment of value chains and networks across company boundaries
- Real-time, intelligent, and decentralized processes
- Digitally integrated engineering
- Networking of machines, products and processes
- Highly flexible and configurable production systems

Is it truly a revolution?



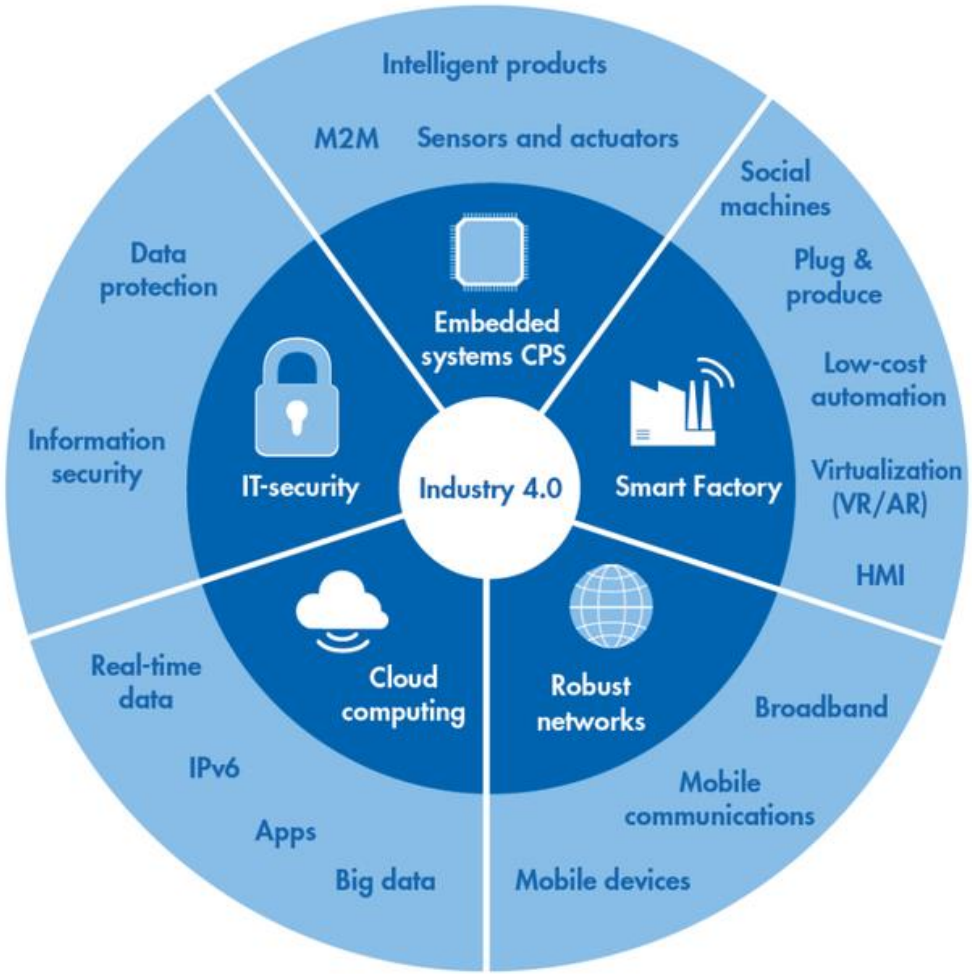
BITKOM 2014

Industry 4.0 includes the interlinking of physical world and cyber world



1. Cyber-Physical System

Components and technologies of Industry 4.0



BITKOM, Fraunhofer IAO

The term “Industrie 4.0“ was coined in 2011

International competitiveness of high wage manufacturing location Germany

- High-Tech
- SME / Mittelstand
- Shift from hardware to (adjacent) software and services
- Focus not only on production but also on products
- “Joint venture” of industry, politics, academia
- …

2 MEINUNG VDI nachrichten · 1. April 2011 · Nr. 13

Industrie 4.0: Mit dem Internet der Dinge auf dem Weg zur 4. industriellen Revolution

STRUKTURWANDEL: Zur Hannover Messe tritt die Initiative „Industrie 4.0“ an die Öffentlichkeit. Henning Kagermann, Wolf-Dieter Lukas, Wolfgang Wahlster, drei Vertreter aus Wirtschaft, Politik und Wissenschaft, zeigen im nachfolgende Beitrag, wie der Paradigmenwechsel in der Industrie ablaufen wird. In der nächsten Dekade werden auf der Basis Cyber-Physischer Systeme neue Geschäftsmodelle möglich. Deutschland könnte hierbei „die erste Geige“ spielen.

VDI nachrichten, Berlin, 1. 4. 11, ms

Sich als Produktionsstandort auch in einer Hochlohnregion behaupten zu können wird zunehmend zu einer Schlüsselfrage im globalen Wettbewerb.

Im Gegensatz zu anderen Industrieländern ist es Deutschland in den letzten zehn Jahren gelungen, die Anzahl der Beschäftigten in der Produktion weitgehend stabil zu halten. Nicht zuletzt wegen des stark mittelständisch geprägten, aber hoch innovativen produzierenden Gewerbes hat Deutschland auch die wirtschaftlichen Auswirkungen der Finanzkrise besser gemeistert als viele andere.

Die Entwicklung und Integration neuer Technologien und Prozesse haben dazu wesentlich beigetragen.

Produktionsstandort bleiben heißt

heute, sich fit zu machen für die vom Internet getriebene 4. industrielle Revolution.

- Die erste industrielle Revolution, die Einführung mechanischer Produktionsanlagen Ende des 18. Jahrhunderts, und
- die zweite industrielle Revolution, die arbeitsteilige Massenproduktion von Gütern mit Hilfe elektrischer Energie (Fordismus, Taylorismus) seit der Wende zum 20. Jahrhundert, mündeten ab Mitte der 70er Jahre in die bis heute andauernde
- dritte industrielle Revolution mit der durch den Einsatz von Elektronik und IT getriebenen weiteren Automatisierung von Produktionsprozessen.

Auf dem Gebiet der softwareintensiven eingebetteten Systeme hat sich Deutschland bereits eine führende Stellung insbesondere im Automobil- und Maschinenbau erarbeitet. Nun gilt es, den nächsten Schritt zum Internet der Dinge im industriellen Umfeld zu machen, damit Deutschland bis 2020 Leitanbieter auf diesem neuen Markt wird.

Durch die digitale Veredelung von Produktionsanlagen und industriellen Erzeugnissen bis hin zu Alltagsprodukten mit integrierten Speicher- und Kommunikationsfähigkeiten, Funksensoren, eingebetteten Aktuatoren und intelligenten Softwaresystemen entsteht hier eine Brücke zwischen virtueller („cyber space“) und dinglicher Welt bis hin zur wechselseitigen feingranularen Synchronisation zwischen digitalem Modell und der physischen Realität.

Bei der Entwicklung dieser Cyber-Physischen Systeme wird in Deutschland bereits auf die Ergebnisse mehrerer erfolgreicher Forschungsprojekte zurückgegriffen (Digitales Produktgedächtnis), deren Zielsetzung die Erforschung und Nutzung des Technologietrends für innovative Produkte und Lösungen ist.

In diesem Transformationsprozess

tritt jetzt zusätzlich zur noch stärkeren Automatisierung in der Industrie (3. industrielle Revolution) die Entwicklung intelligenterer Überwachungs- und autonomer Entscheidungsprozesse neu hinzu, um Unternehmen und ganze Wertschöpfungsnetzwerke in nahezu Echtzeit steuern und optimieren zu können.

In der Industrie führt dieser Ansatz zu einem Paradigmenwechsel, bei dem das entstehende Produkt erstmals eine aktive Rolle übernimmt: Nicht eine zentrale Steuerung, sondern quasi der Rohling für ein Produkt „sagt“, wie er in den einzelnen Fertigungsschritten bearbeitet werden muss.

Das entstehende Produkt steuert somit den Produktionsprozess selbst, überwacht über die eingebettete Sensorik die relevanten Umgebungsparameter und löst bei Störungen entsprechende Gegenmaßnahmen aus – es wird gleichzeitig zum Beobachter und zum Akteur.

Die vertikale Vernetzung eingebetteter Systeme bietet mit betriebswirtschaftlicher Anwendungssoftware neben völlig neuartigen Geschäftsmodellen erhebliche Optimierungspotentiale in Logistik und Produktion. Durch die lokale Autonomie aktiver digitaler Produktgedächtnisse, die direkt am Ort des Geschehens in der Produktions- und Logistikkette installiert sind, ergeben sich kürzeste Reaktionszeiten bei Störungen und eine optimale Ressourcennutzung in allen Prozessphasen.

Die Produkte selbst erhalten so unmittelbaren Zugang zu allen übergeordneten Prozessdaten und können detailgenau „entscheiden“ – und dies unter Vermeidung des Informationsverlusts, der häufig bei zentral organisierten Systemen aufgrund der (notwendigen) Verdichtung von Information erfolgt. Damit ist es beispielsweise möglich, nicht nur den ökonomischen, sondern auch den besonderen ökologischen Anforderungen einer „grünen Produktion“ für eine CO_2-neutrale, energieeffiziente Stadt besser gerecht zu werden.

Die Geschäftspotenziale der 4. industriellen Revolution liegen jedoch nicht nur in der betrieblichen Prozessoptimierung sondern auch in ihren Dienstleistungen für vielfältige Anwendungsbereiche. Komplementiert wird das Internet der Dinge daher durch das sogenannte „Internet der Dienste“, denn Smart Products bieten ihre Fähigkeiten als intelligente Dienste an. Diese neue Generation von Produkten kann über das Internet durch Maschine-zu-Maschine-Kommunikation (M2M) eigenständig Informationen austauschen, Aktionen auslösen und sich wechselseitig steuern.

Erst durch semantische Technologien wird die Interoperabilität aller Dienste, die auf den neuartigen Cyber-Physischen Systemen aufsetzen, auch in offenen Regelkreisen sichergestellt.

Für den Zugriff auf die aktiven Produktgedächtnisse werde neue multimodale Interaktionsparadigmen notwendig, um den Anwendern die Mehrwerte des Internet der Dinge und der Dienste möglichst einfach zu erschließen.

Die dritte industrielle Revolution, die durch neue Materialen, Roboter-einsatz und zentrale Steuerungssysteme geprägt war, wird in der nächsten Dekade mit dem Internet der Dinge auf der Basis Cyber-Physischer Systeme abgelöst: Deutschland sollte hierbei die erste Geige spielen.

Daher hat die Promotorengruppe Kommunikation der Forschungsunion Wirtschaft-Wissenschaft der Bundesregierung am 25. Januar 2011 in ihren Handlungsempfehlungen das Zukunftsprojekt Industrie 4.0 vorgeschlagen. Das Zukunftsprojekt wurde mittlerweile verabschiedet, mit der Umsetzung haben Wirtschaft, Wissenschaft und Politik bereits begonnen.

HENNING KAGERMANN
WOLF-DIETER LUKAS
WOLFGANG WAHLSTER

Wolfgang Wahlster, Chef des Deutschen Forschungszentrums für Künstliche Intelligenz, **Henning Kagermann**, Präsident der Deutschen Akademie der Technikwissenschaften, und **Wolf-Dieter Lukas**, Abteilungsleiter Schlüsseltechnologien im Bundesforschungsministerium, planen die Zukunft: Sie sehen Geschäftspotenziale der 4. industriellen Revolution nicht nur in der betrieblichen Prozessoptimierung, sondern auch im Dienstleistungsbereich. Smart Products bieten ihre Fähigkeiten als intelligente Dienste an.

Foto: acatech/staffan welsgaard

Henning Kagermann

- ist Präsident der Acatech, Deutsche Akademie der Technikwissenschaften e.V.
- Prof. Dr. Dr. E. h. Henning Kagermann, bis 2009 Vorstandssprecher der SAP AG, ist zudem Mitglied der Forschungsunion Wirtschaft-Wissenschaft der Bundesregierung, Aufsichtsrat der BMW AG, der Deutschen Bank AG, der Deutschen Post AG, der Münchener Rückversicherungs-Gesellschaft AG sowie von Nokia Corp. (Finnland) und Wipro Technologies (Indien).

Wolf-Dieter Lukas

- leitet die Abteilung „Schlüsseltechnologien – Forschung für Innovationen“ im Bundesministerium für Bildung und Forschung.
- Prof. Dr. Wolf-Dieter Lukas ist Honorarprofessor an der Technischen Universität Berlin und Kurator der Alcatel-Lucent Stiftung für Kommunikationsforschung.

Wolfgang Wahlster

- ist Vorsitzender der Geschäftsführung des Deutschen Forschungszentrums für Künstliche Intelligenz (DFKI GmbH).
- Prof. Dr. Dr. h.c. mult. Wolfgang Wahlster ist Inhaber des Lehrstuhls für Informatik an der Universität des Saarlandes, Mitglied der Forschungsunion Wirtschaft-Wissenschaft der Bundesregierung, Sprecher des Feldafinger Kreises und Mitglied der schwedischen Nobelpreis-Akademie.

ww/rus

http://www.wolfgang-wahlster.de/wordpress/wp-content/uploads/Industrie_4_0_Mit_dem_Internet_der_Dinge_auf_dem_Weg_zur_vierten_industriellen_Revolution_2.pdf

Industry 4.0 case examples

Industry 4.0 case examples

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1. **Adidas knit for you** (https://youtu.be/nost7D7kwgE)
2. **DB Schenker smart warehouse** (https://youtu.be/udr0OOxmPbc)
3. **Construction Robotics bricklaying robot** (https://youtu.be/2-VR4IcDhX0)
4. **KUKA smart factories** (https://www.youtube.com/watch?v=SHNyByL6JXE)
5. **Robotic milking** (https://youtu.be/J0D8tTj0SRM)
6. **CNH tractors** (https://youtu.be/T7Os5Okf3OQ)
7. **Siemens Electronic Works Amberg** (https://www.youtube.com/watch?v=rsMEMNh9ejw)
8. **ZVEI on implementing Industry 4.0** (https://www.youtube.com/watch?v=ZCLHojIj7eA)
9. **Audi smart factory** (https://youtu.be/sqCbYd8O8MU)
10. **Peri 3D printed houses** (https://youtu.be/ZUVoQdUYyFo)

Perspectives to consider when watching the videos

- Use cases / application scenarios
- Technologies
- Value propositions
- Challenges
- …

Industry 4.0 definitions

What is Industry 4.0?

Perspective by Plattform Industrie 4.0

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"Industrie 4.0 refers to the intelligent networking of machines and processes for industry with the help of information and communication technology."

- There are many ways for companies to use intelligent networking. The possibilities include, for example
  - Flexible production: In manufacturing a product, many companies are involved in a step by step process to develop a product. In being digitally networked, these steps can be better coordinated and the machine load better planned
  - Convertible factory: Future production lines can be built in modules and be quickly assembled for tasks. Productivity and efficiency would be improved; individualized products can be produced in small quantities at affordable prices
  - Customer-oriented solutions: Consumers and producers will move closer together. The customers themselves could design products according to their wishes—for example, sneakers designed and tailored to the customer's unique foot shape. At the same time, smart products that are already being delivered and in use can send data to the manufacturer. With this usage data, the manufacturer can improve his or her products and offer the customer novel services
  - Optimized logistics: Algorithms can calculate ideal delivery routes, machines independently report when they need new material—smart networking enables an optimal flow of goods
  - Use of data: Data on the production process and the condition of a product will be combined and analyzed. Data analysis provides guidance on how to make a product more efficiently. More importantly, it's the foundation for completely new business models and services. For example, lift manufacturers can offer their customers "predictive maintenance": elevators equipped with sensors that continuously send data about their condition. Product wear would be detected and corrected before it leads to an elevator system failure
  - Resource-efficient circular economy: The entire life cycle of a product can be considered with the support of data. The design phase would already be able to determine which materials can be recycled

Do you have questions or comments regarding this perspective?

https://www.plattform-i40.de/I40/Navigation/EN/Industrie40/WhatIsIndustrie40/what-is-industrie40.html

What is Industry 4.0?

Perspective by BDI (The Federation of German Industries / Budesverband der Deutschen Industrie e.V.)

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"Industry 4.0 refers to the fourth industrial revolution. After mechanisation (Industry 1.0), mass production (Industry 2.0) and automation (Industry 3.0), now the "internet of things and services" is becoming an integral part of manufacturing."

- Industry 4.0 technologies have the potential to create extraordinary growth opportunities and competitive advantages for Germany as a business location. Experts forecast that businesses will be able to increase their productivity by about 30 percent using Industry 4.0
  - Social machines: Intelligent machines share information with one another and IT systems in the company. They organize themselves and work together to coordinate processes and deadlines. This makes production more flexible and efficient and enables an uninterrupted flow of information to areas such as sales or development
  - Global facilities: A company's machines are connected to supplier and customer systems. This enables them to react independently to any changes that occur
  - Augmented operators: People still play a critical role in the production process. They control and monitor production sequences in the production network. IT-based assistance systems such as data glasses can virtually extend an augmented operator's view of a real factory
  - Smart products: Smart products hold data about operating conditions and product statuses. This data is stored on things like tiny RFID chips, and it provides a virtual copy of each smart product. Such information is collected, updated and evaluated throughout the life of the product as needed. A smart product can tell machines what shape it needs to have or whether it is supposed to be painted red or blue
  - Virtual production: Smart factories have a digital twin with all of the same products and resources. This digital copy allows for virtual simulations of all production processes. These display alternative production sequences and potential for optimizing production lines. The system also allows engineers to remotely control and monitor production in real time
  - Smart services: Intelligent products serve as a platform for new business models. All that data intelligent products collect can be used to optimize products. Smart algorithms provide a foundation for offering customers personalized, data-based services (smart services) in addition to the physical product

Do you have questions or comments regarding this perspective?

https://english.bdi.eu/article/news/what-is-industry-40/

What is Industry 4.0?
Perspective by Bitkom, VDMA, ZVEI (1/2)

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Definition

- The term Industrie 4.0 stands for the fourth industrial revolution, the next stage in the organization and control of the entire value stream along the life cycle of a product
- This cycle is based on increasingly individualized customer wishes and ranges from the idea, the order, development, production, and delivery to the end customer through to recycling and related services
- Fundamental here is the availability of all relevant information in real-time through the networking of all instances in value creation as well as the ability to derive the best possible value stream from data at all times
  Connecting people, objects and systems leads to the creation of dynamic, self-organized, cross-organizational, real-time optimized value networks, which can be optimized according to a range of criteria such as costs, availability and consumption of resources

Strategy and goals

- …
- The path towards Industrie 4.0 is an evolutionary process
  - Existing basic technologies must be developed further to accumulate experience and gain insight with respect to optimizing the entire value stream
  - Implementing new business models via online services has a disruptive element
- Successful companies with good products or services and growing demand in their sales markets should adequately prepare themselves for change that may disrupt. Specifically, this refers to
- The further development of existing processes within the company as well as
- The development of new business models

Do you have questions or comments regarding this perspective?

Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e. V.; Verband Deutscher Maschinen- und Anlagenbau e.V.; Zentralverband Elektrotechnik- und Elektronikindustrie e.V.; https://www.bitkom.org/NP-Themen/Branchen/Industrie-40/20160107-implementation-strategy-industrie40-en.pdf

What is Industry 4.0?
Perspective by Bitkom, VDMA, ZVEI (2/2)

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Benefits

- The ability to accommodate individualized customer wishes is improved and the production of single units and very small quantities becomes more profitable
- Flexibility increases through the dynamic design of business processes via the Internet in different dimensions, well as through responsive engineering processes
- The information made available by Industrie 4.0 combined with e.g., Big Data, Social Media and Cloud Computing permits optimal decision-making, early determining of design solutions and flexibility when responding to disruptions, as well as global optimization of all resources across locations
- Production efficiency will increase – on the one hand through increased productivity and, on the other, through the efficient use of resources (machines, energy etc.)
- New potential associated with new forms of value creation and employment arises; for example, downstream services, that is, services offered to users to complement the actual product after the product has left the production plant
- In view of the demographic changes, there are also benefits for structuring the way people work. Industrie 4.0 concepts can add value by supporting physical and mental abilities. In order to retain the knowledge and experience of employees with a high level of training in knowledge-based companies, Industrie 4.0 enables flexible and diverse career models in addition to management and specialist career paths. Social media will add flexibility to production and working-time planning
- Production capacity will be optimized and resources will be used more effectively. It will also be possible to quickly respond to customer wishes. Last but not least, employees will be able to more effectively balance their work, family and leisure time through increased involvement in staff scheduling
- Industrie 4.0 increases Germany's competitiveness as a centre for high-wage jobs while making it possible for companies to position themselves as a leading provider, transforming Germany into the leading market for Industrie 4.0 solutions. In Germany, our knowledge within the industrial sector, we have a decisive advantage, whether as leading companies, well established small and medium sized businesses, industry automation suppliers, IT companies, or toolmaking/ machine-building - to name just a few

Do you have questions or comments regarding this perspective?

Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e. V.; Verband Deutscher Maschinen- und Anlagenbau e.V.; Zentralverband Elektrotechnik- und Elektronikindustrie e.V.; https://www.bitkom.org/NP-Themen/Branchen/Industrie-40/20160107-implementation-strategy-industrie40-en.pdf

What is Industry 4.0?
Perspective by Forbes

UNIVERSITY OF HOHENHEIM

For a factory or system to be considered Industry 4.0, it must include:

1. Interoperability: machines, devices, sensors and people that connect and communicate with one another.
2. Information transparency: the systems create a virtual copy of the physical world through sensor data in order to contextualize information.
3. Technical assistance: both the ability of the systems to support humans in making decisions and solving problems and the ability to assist humans with tasks that are too difficult or unsafe for humans.
4. Decentralized decision-making: the ability of cyber-physical systems to make simple decisions on their own and become as autonomous as possible.

Challenges inherent in adopting an Industry 4.0 model:

- Data security issues are greatly increased by integrating new systems and more access to those systems. Additionally, proprietary production knowledge becomes an IT security problem as well
- A high degree of reliability and stability are needed for successful cyber-physical communication that can be difficult to achieve and maintain
- Maintaining the integrity of the production process with less human oversight could become a barrier
- Loss of high-paying human jobs is always a concern when new automations are introduced
- And avoiding technical problems that could cause expensive production outages is always a concern
- Systemic lack of experience and manpower to create and implement these systems
- Reluctance from stakeholders and investors to invest heavily in new technologies

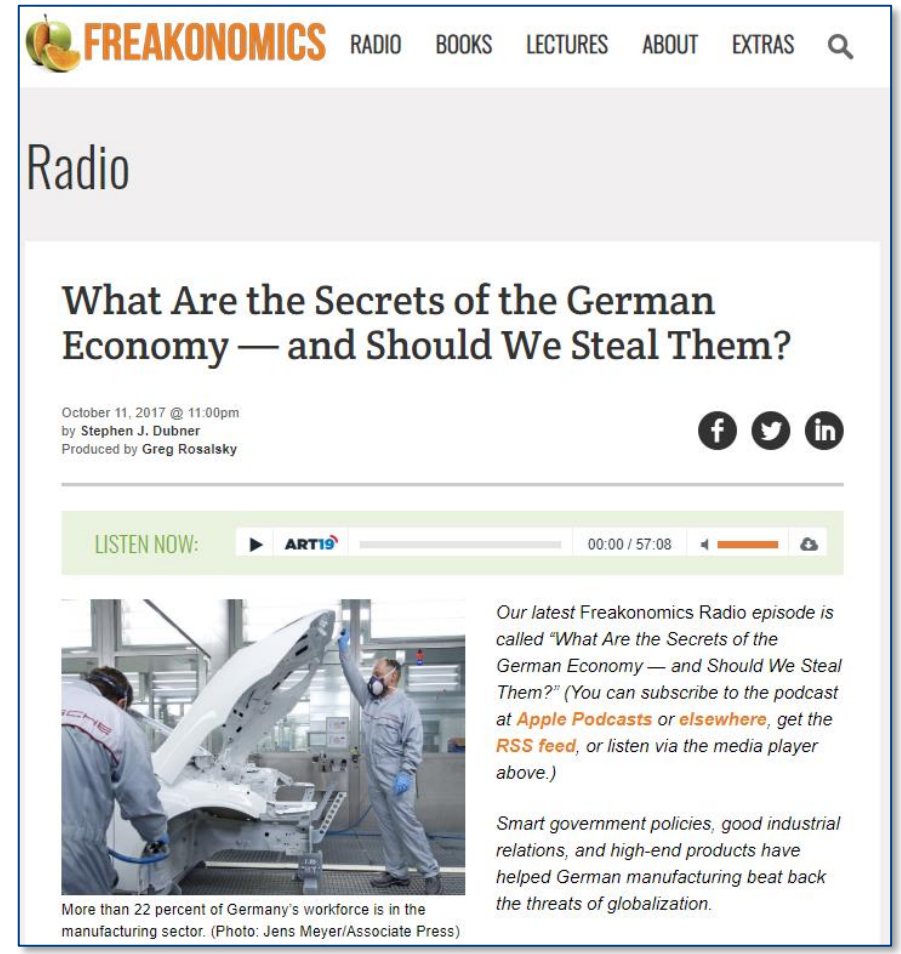
Do you have questions or comments regarding this perspective?

https://www.forbes.com/sites/bernardmarr/2016/06/20/what-everyone-must-know-about-industry-4-0/#7f611cdf795f

Recommended voluntary listening material

An international perspective on Germany's industry

Supporting podcast
https://freakonomics.com/podcast/what-are-the-secrets-of-the-german-economy-and-should-we-steal-them/

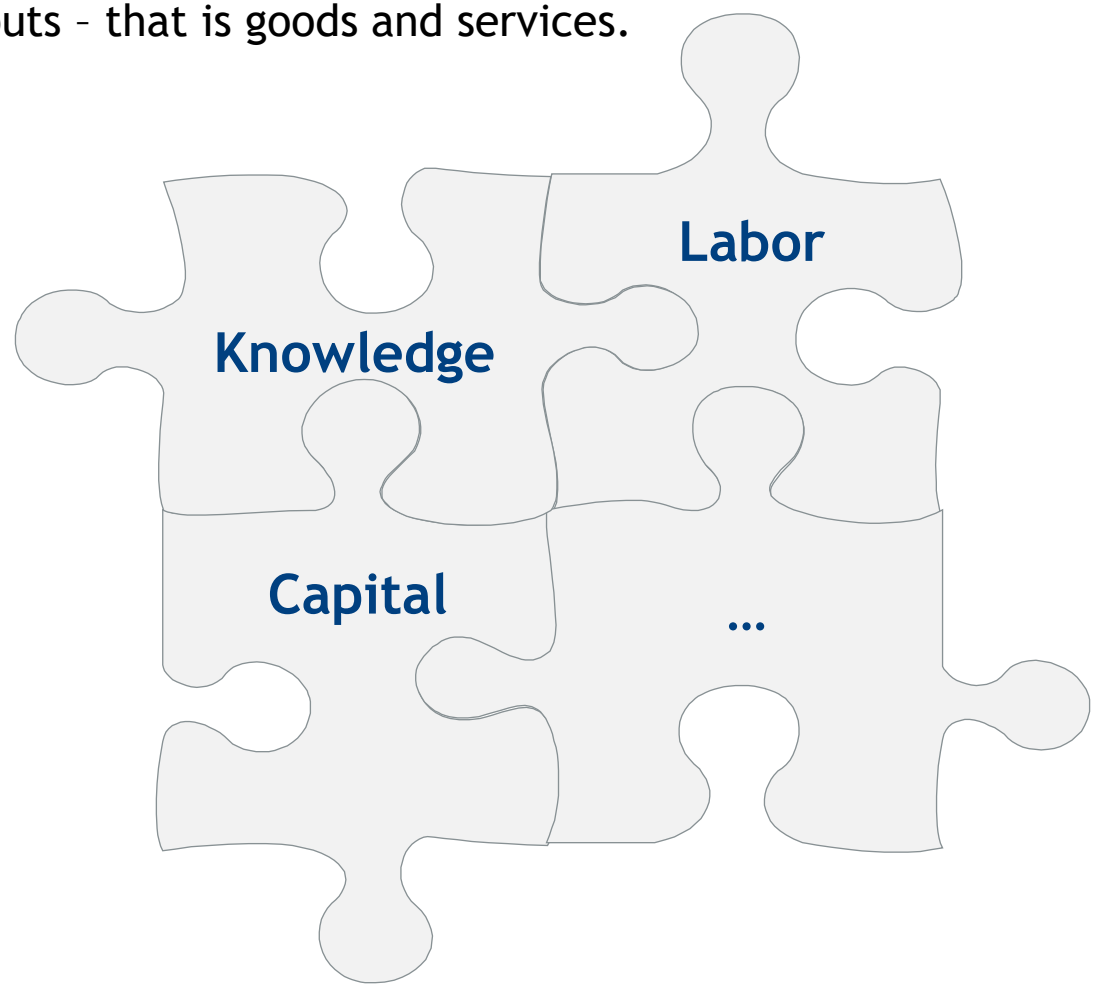


Competitiveness of the German industrial sector

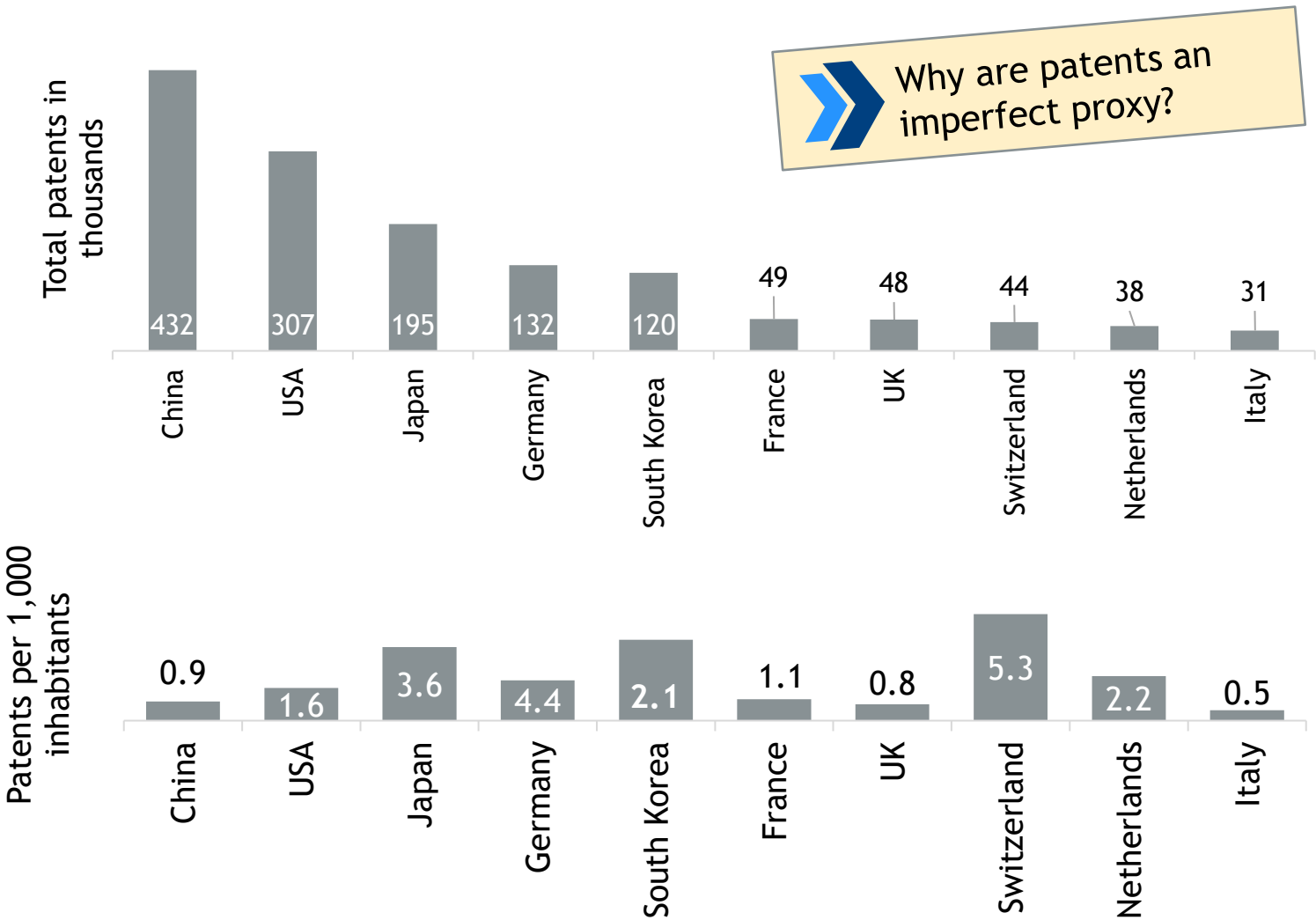
Supporting video https://youtu.be/PEUz_0Ed6UQ

Production Factors

Factors of production are the resources and inputs used in the production of outputs – that is goods and services.



Production Factor Knowledge (1/2)



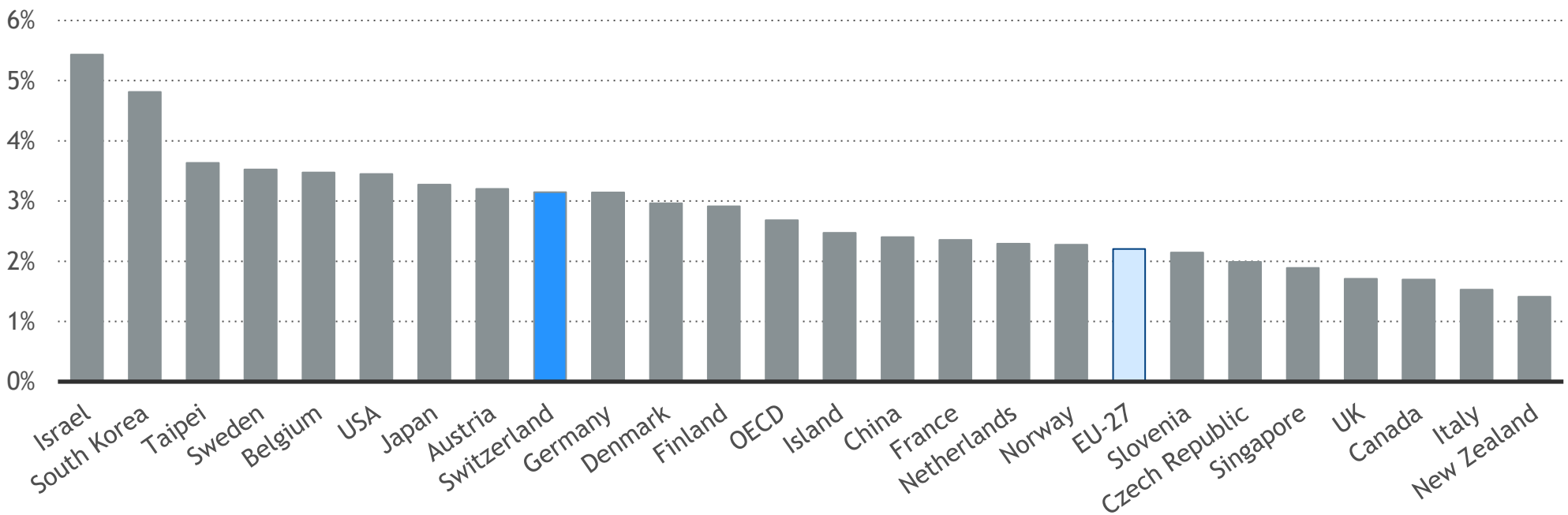
Patent

- The expression patent refers to an intellectual property right, granted for the protection of technical inventions.
- Patents are granted based on Patent Law.
- The goal of patents is to stimulate innovation. Hence, the number of patents can serve as a characterization of a country‘s innovative power

wirtschaftslexikon.gabler.de 2017, World Intellectual Property Organization 2019, European Patent Office 2020, wipo.net (2020)

Production Factor Knowledge (2/2)

R&D expenditure as share of GDP, 2020



OECD 2022

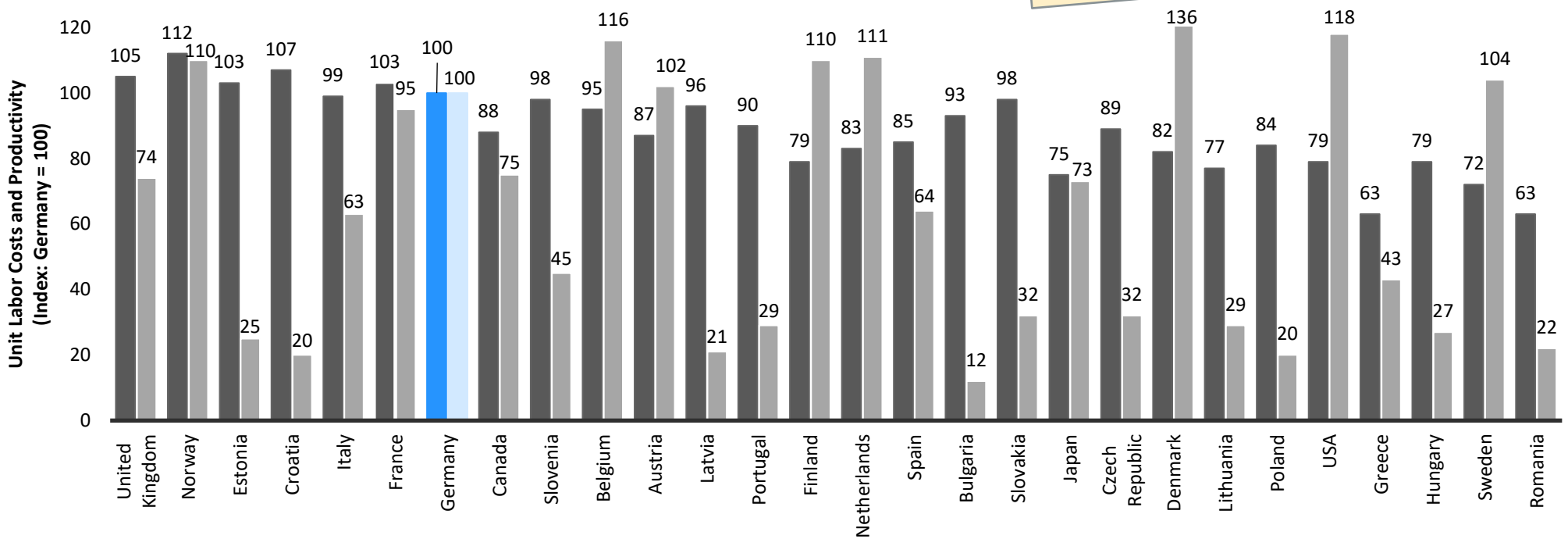
Production Factor Labor

Unit Labor Costs

Amount of labor costs per unit of output. Used as a benchmark of a country‘s cost competitiveness

$$Unit\ Labor\ Costs = \frac{labor\ costs\ per\ employee}{Productivity\ (delivered\ economic\ output\ per\ worker)}$$

What does an hour of labor cost in Germany and in other European countries?



iwkoeln.de 2018, iwd.de 2021

Production Factor Capital (1/2)

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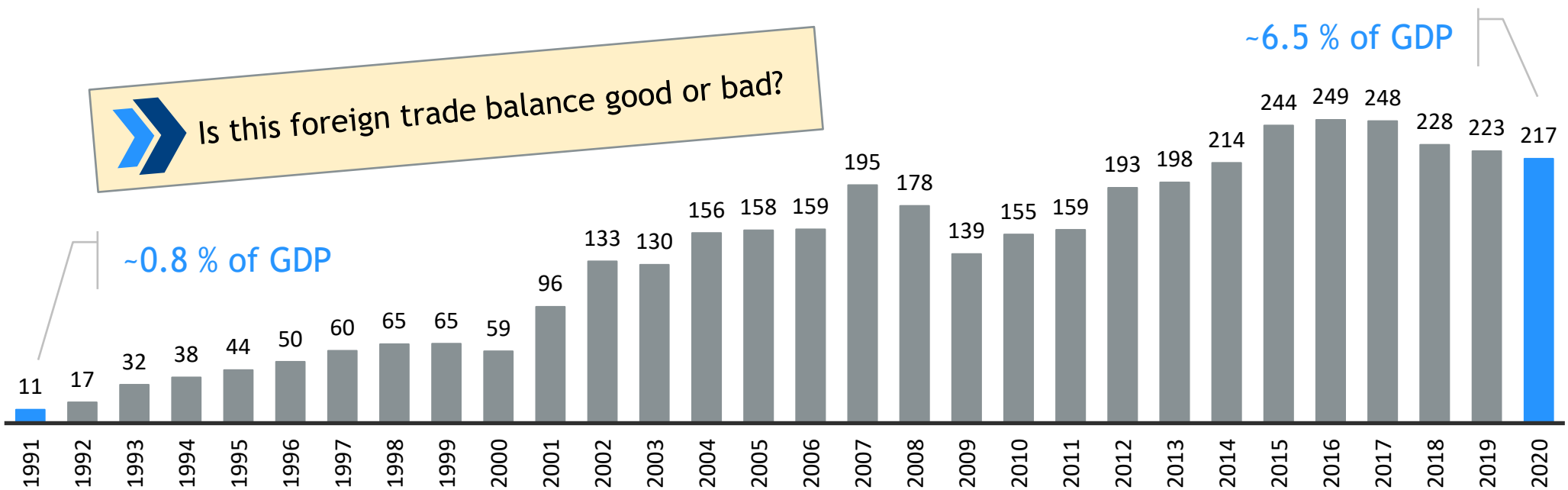
Foreign Trade Balance

Depicts the cross-border trade of a national economy, by comparing the goods imported and exported to/from other countries. Also referred as Balance of Trade

Germany's Foreign Trade Balance in bn €



Federal Office for Statistics 2016, de.statista.com 2019, destatis.de 2021

Which country is the main competitor of Germany, regarding its attractivity for investors?

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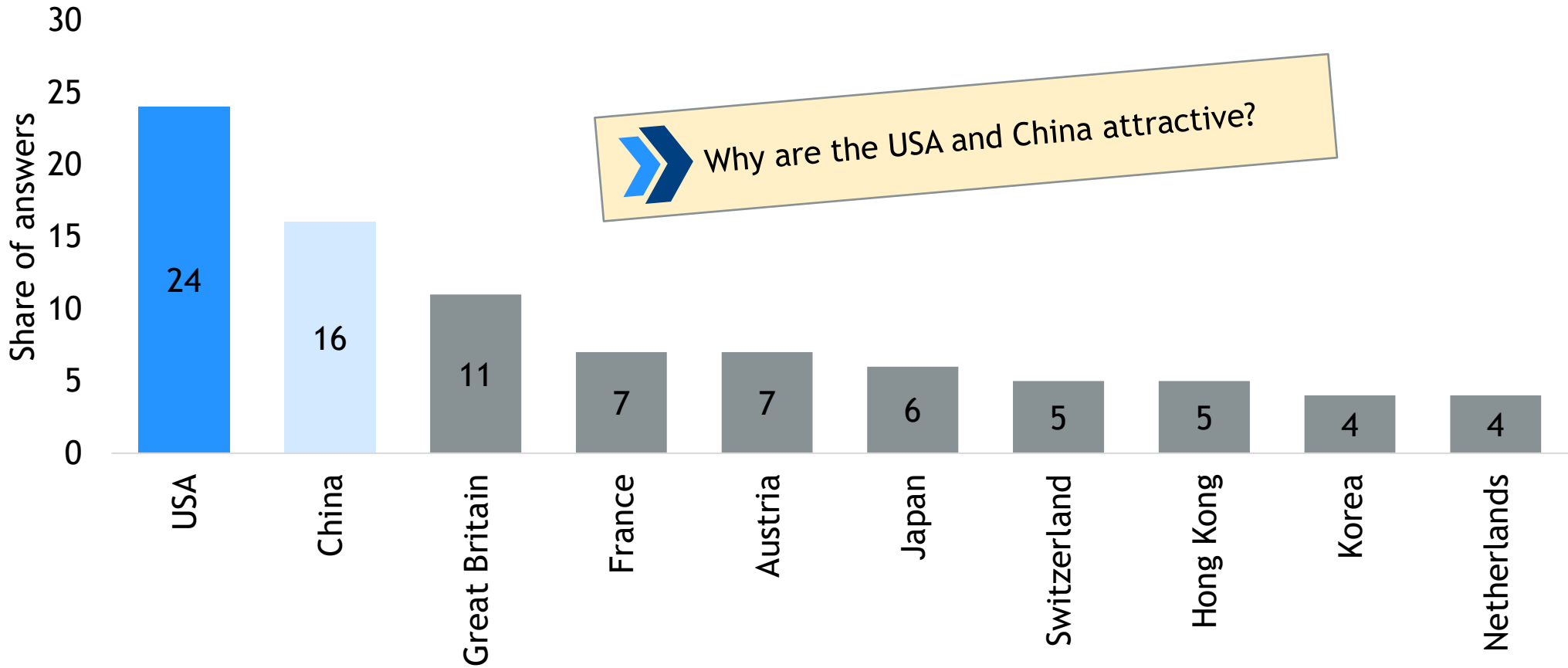
Survey on Germany‘s main competitors regarding location (%)



de.statista.com 2017

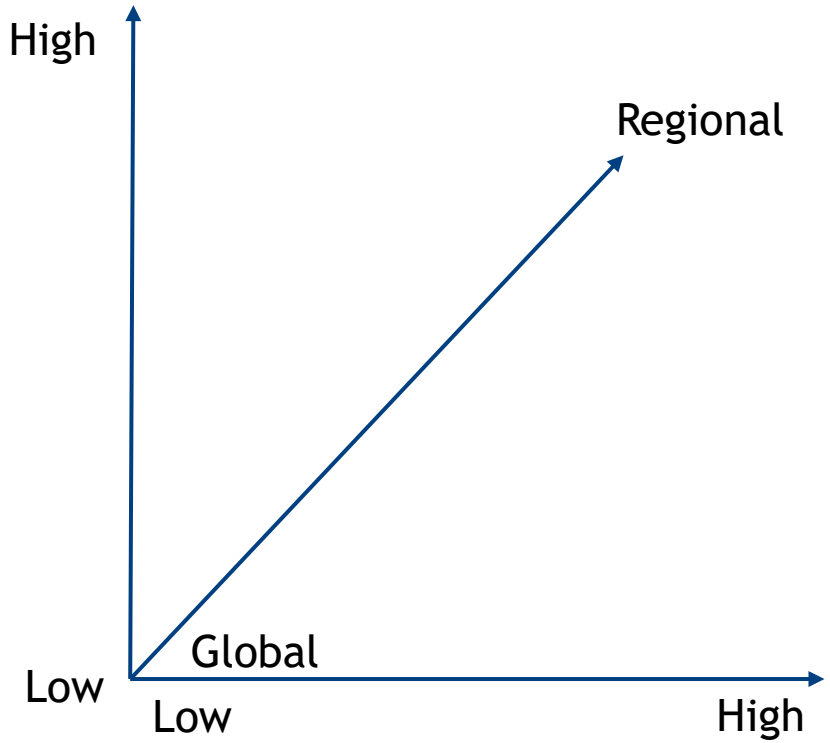
Types of production

Supporting video https://youtu.be/L57PHsb_la8

Three dimensions of production

Technological Intensity

Technological intensity describes the research and development effort required for (further) development and production of products.



Market Radius

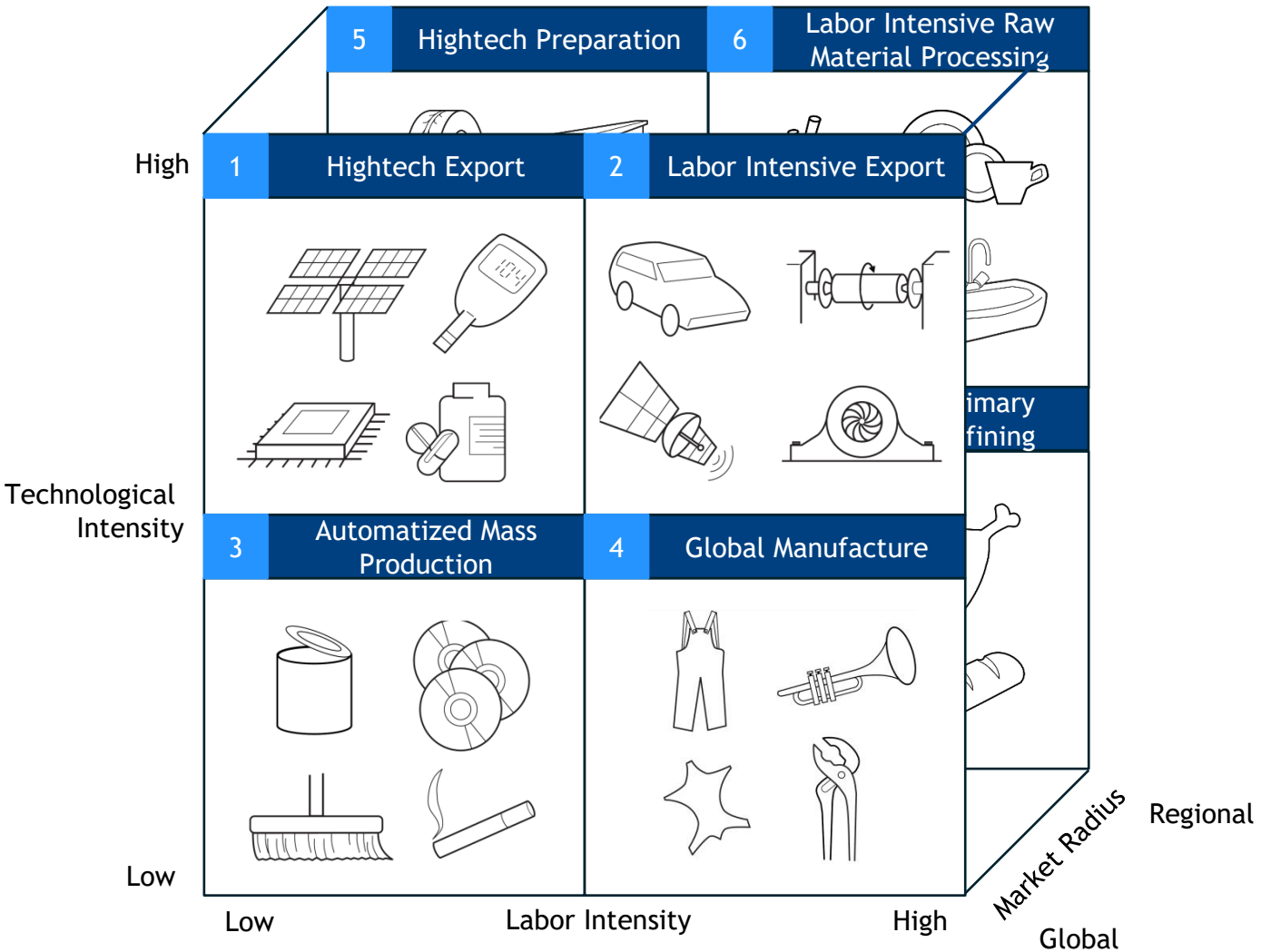
The market radius shows how far a product can be transported from the production site to the customer while remaining economically viable. The decisive question being if the value of a product is worth the investment of distributing it to the regional market

Labor Intensity

Labor intensity is the amount of manual labor required in the production or in separate production processes in order to generate a product. Automatized (parts of) processes have a low labor intensity.

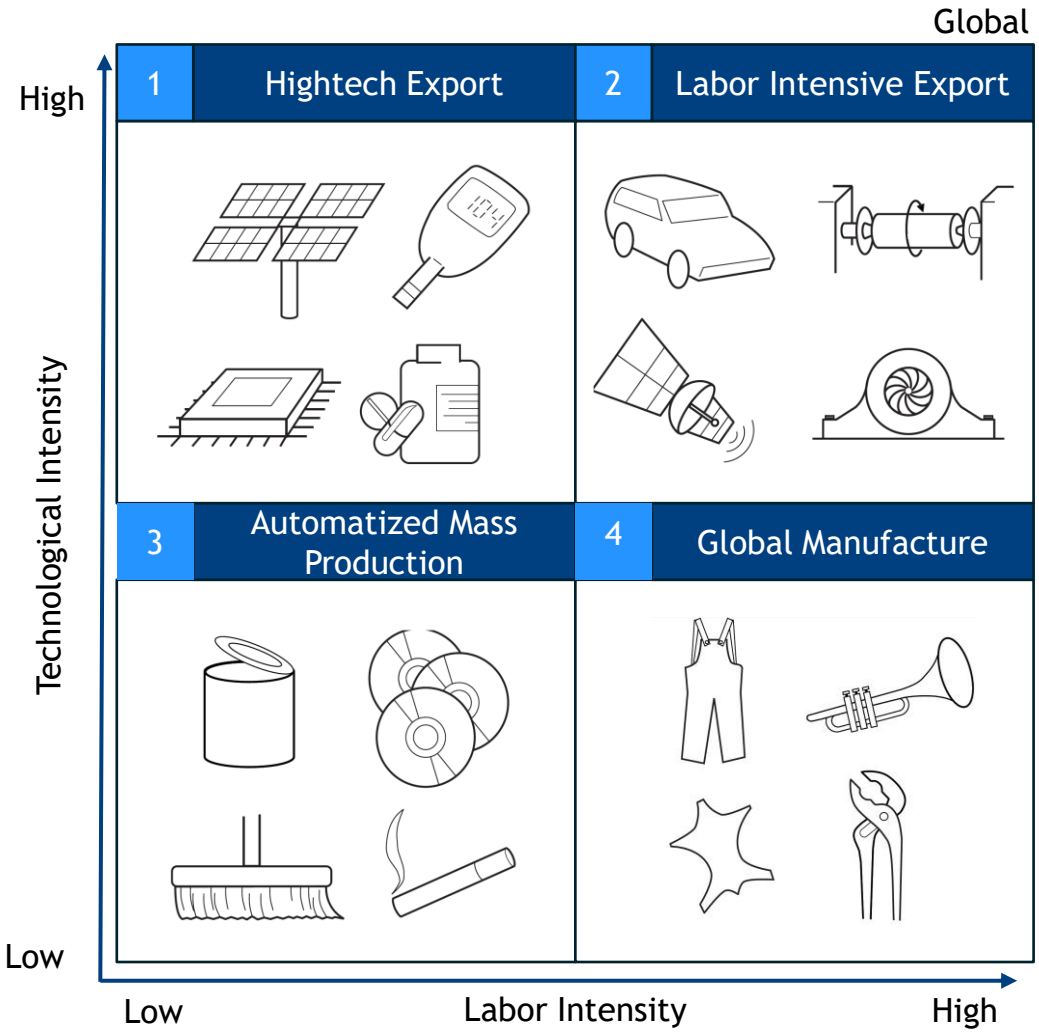
McKinsey & Company 2009

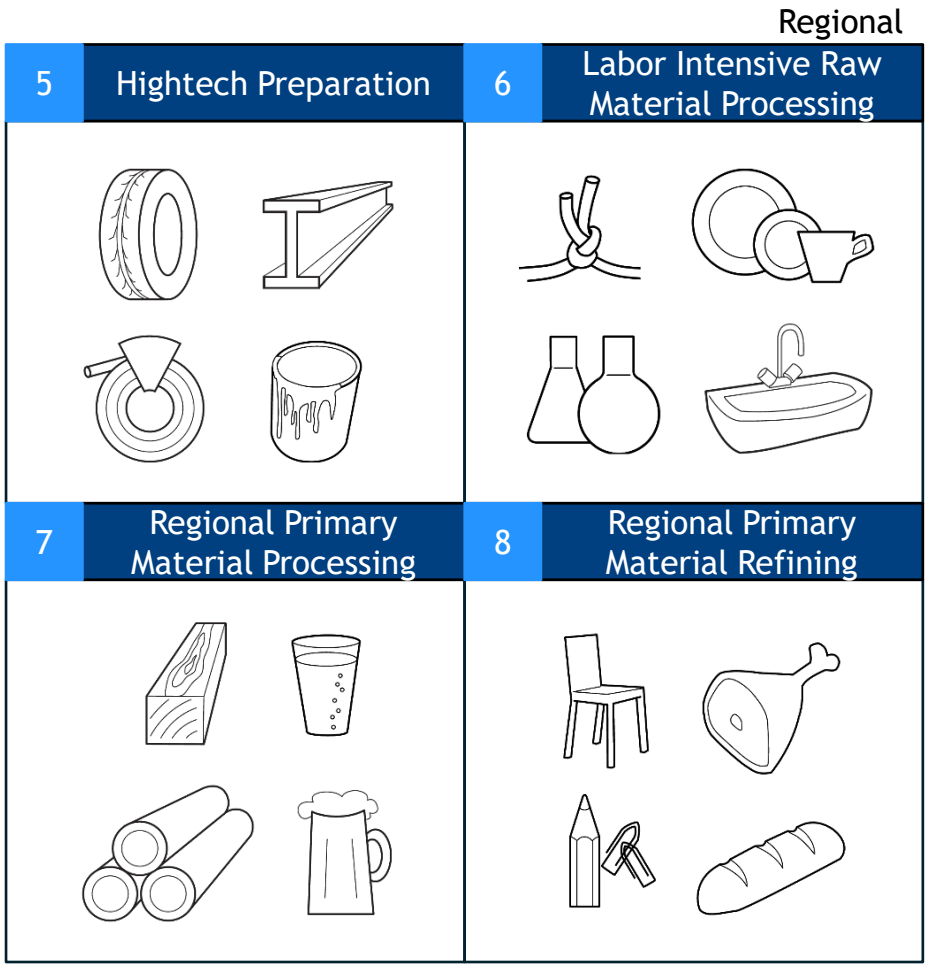
Eight types of production (1/2)



McKinsey & Company 2009

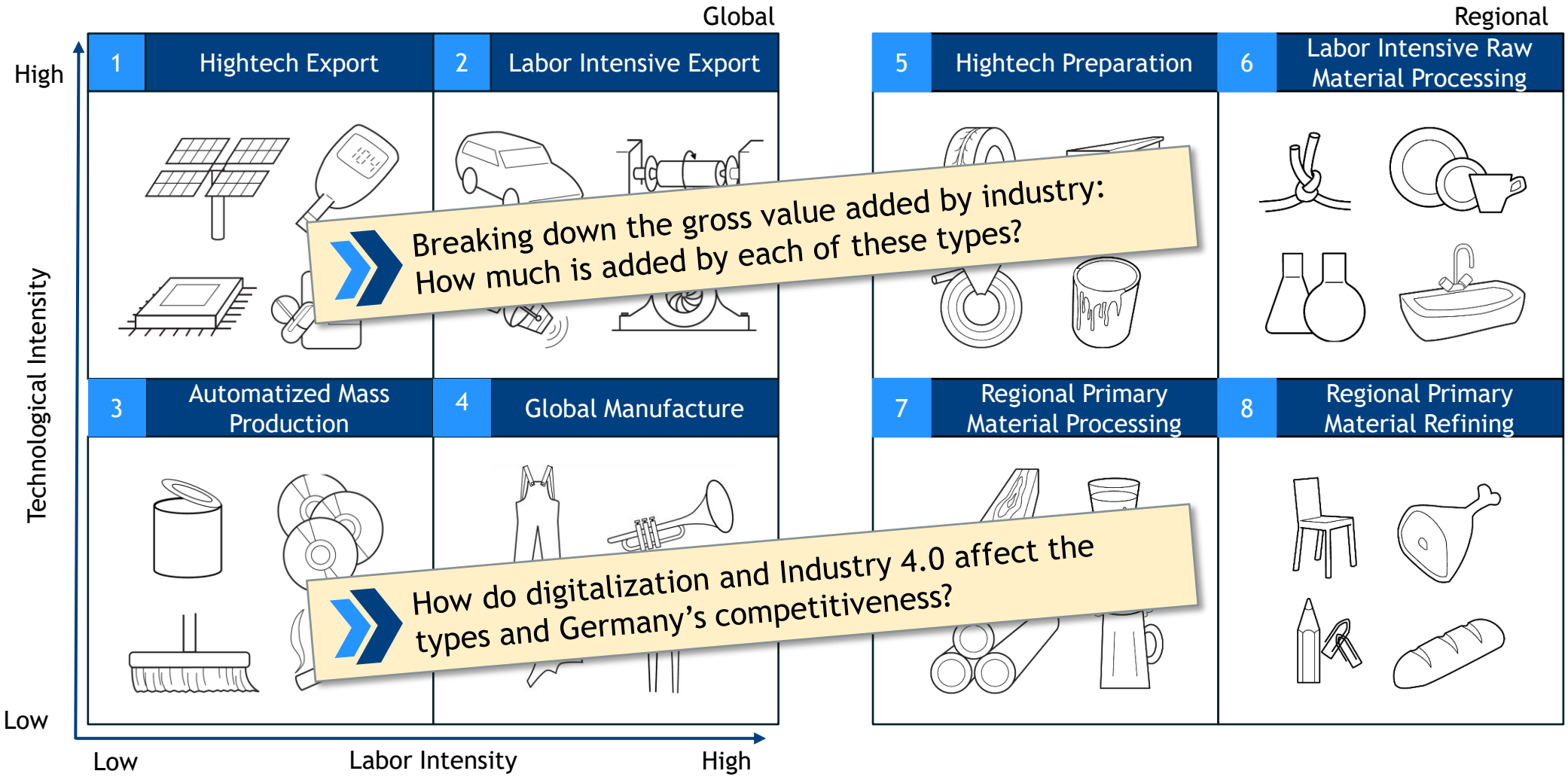
Eight types of production (2/2)





McKinsey & Company 2009

Eight types of production (2/2)



McKinsey & Company 2009

Effects of robotics on industrial labor

Supporting video https://youtu.be/NHK9GyAgyvs

Offshoring has cost jobs in Germany – is robotics bringing them back?

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- Gigaset produces mobile phones in Germany (Bocholt) … after Nokia closed down the last German phone factory in 2008

- Märklin restarted toy train production in Germany (Göppingen) … after offshoring it to China and bankruptcy

- Adidas restarted shoe production in Germany (Ansbach) … 30 years after offshoring it.

Opened 2017, closed 2020. Relocated to Asia, closer to suppliers and know-how

"China was a classic mistake"

Wolfgang Bächle, Technical Director, Märklin

1/3 of European textile purchasing managers expects more reshoring due to automation

McKinsey survey study

The most active "reshorers" tend to be the ones with the highest level of digitalization

Fraunhofer ISI

Robots per 1000 employees: (1) South Korea 63, (2) Singapore 49, (3) Germany 31, … (7) US 19

Dalia Marin, Professor, LMU Munich

Labor costs in China rise by about 14% p.a. (long-term trend)

Worldbank

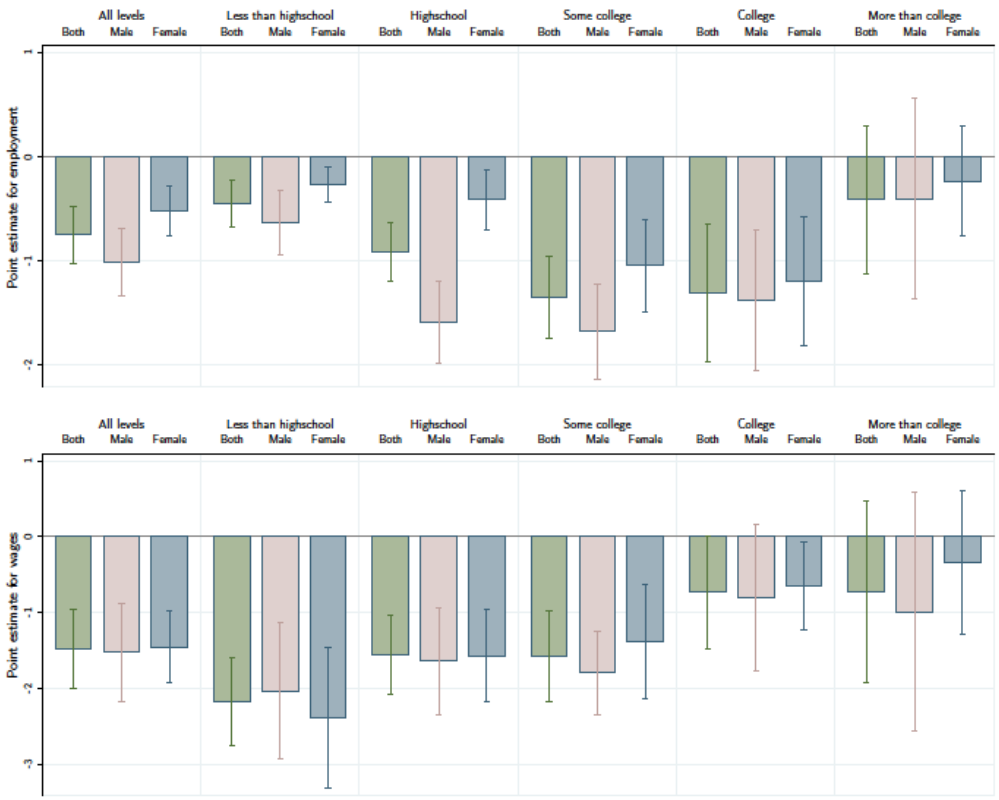
Key reasons for reshoring: Flexibility / delivery, quality, capacity utilization, transport costs

Fraunhofer ISI

Der Spiegel, 40/2018:60-62; Photos: Gigaset, Märklin, Adidas

The effect of robotics on wages and employment

Relationship between the exposure to robots[1], and Census employment and log of hourly wages by education group, 1993-2007, US



> We believe as well that the negative effects we estimate are both interesting and surprising, because of the small offsetting employment increases in other industries and occupations.
>
> […] BCG (2015) has an 'aggressive' scenario in which the world stock of industrial robots would quadruple by 2025. In our estimates, that would imply a 0.94-1.76 percentage points lower employment to population ratio, and 1.3-2.6% lower wage growth between 2015 and 2025. These are sizable effects. But it should also be noted that even under the most aggressive scenario, we are talking about a relatively small fraction of employment in the US economy being affected by robots
>
> There is nothing here to support the view that new technologies will make most jobs disappear and humans largely redundant

1. Exposure is defined as the sum over industries of the national penetration of robots into 19 industries, multiplied by the employment share of that industry in that labor market.

Acemoglu and Restrepo (2017); https://voxeu.org/article/robots-and-jobs-evidence-us

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Digital Management

University of Hohenheim

Faculty of Business, Economics and Social Sciences

Institute of Marketing and Management

Chair for Digital Management (Prof. Dr. H. Gimpel)

Digital Management: Hot Topics in Practice

Chapter 5: Artificial Intelligence

2023

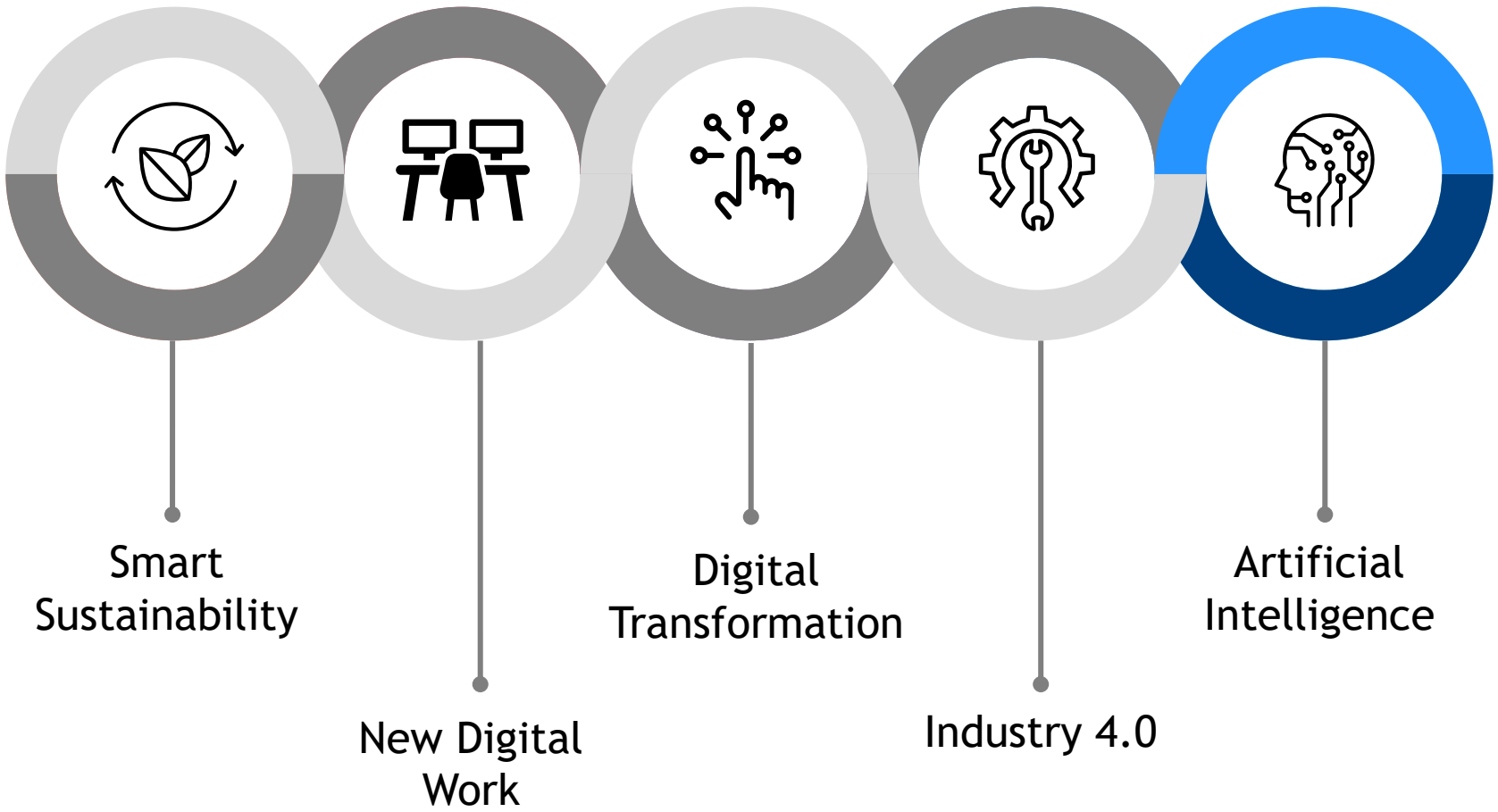
Research Center Finance & Information Management

Fraunhofer FIT Project Group Business & Information Systems Engineering

DLA DIGITAL LEADERSHIP ACADEMY

https://digital.uni-hohenheim.de/

Agenda - Hot Topics



Agenda – Artificial Intelligence

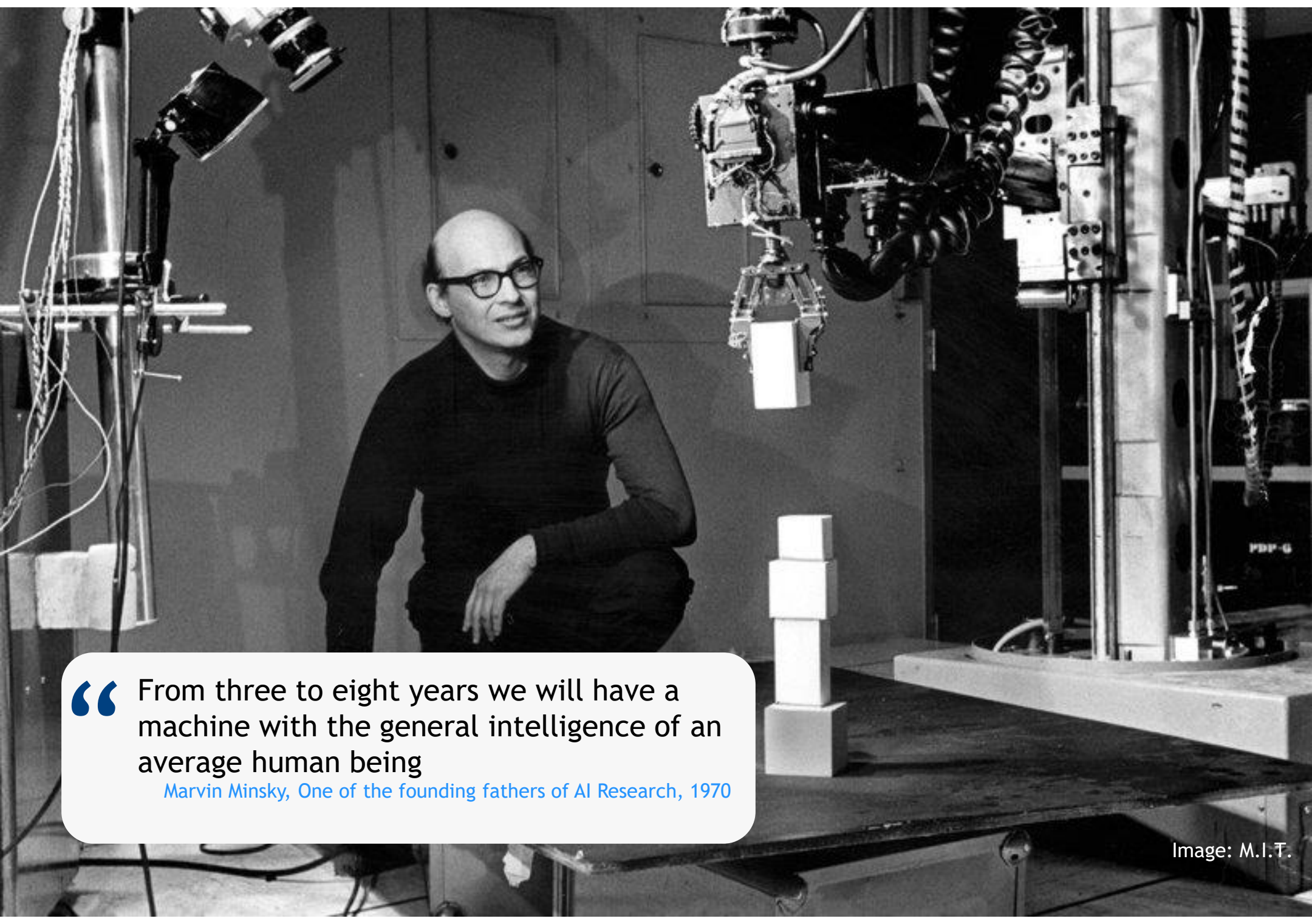
1. A short history of AI
2. Artificial intelligence: why now?
3. What is artificial intelligence?
4. Types of machine learning
5. Select challenges of artificial intelligence
6. An example of artificial neural networks
7. Work task: Generative AI using the example of ChatGPT

Legend:

- Relevant for the exam
- Strongly recommended
- Voluntary additional material

A short history of AI

Supporting video https://youtu.be/6QNOQrenue8


“ From three to eight years we will have a machine with the general intelligence of an average human being
Marvin Minsky, One of the founding fathers of AI Research, 1970
Image: M.I.T.

> It's probably better than a person right now (at driving)
>
> Tesla CEO Elon Musk

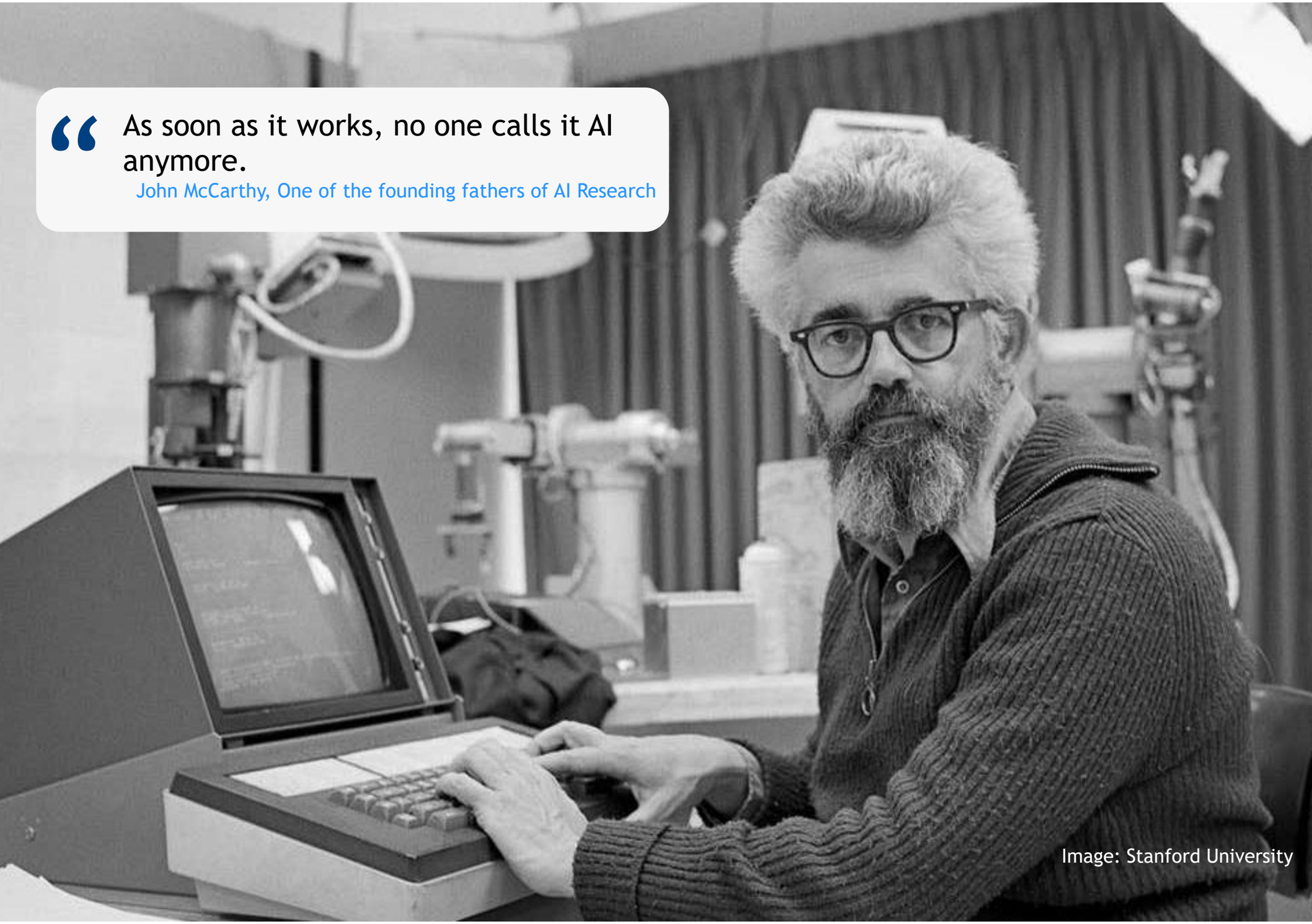
Image: https://www.youtube.com/watch?v=_1MHGUC_BzQ

The history of artificial intelligence in brief

- During its long history, artificial intelligence has not only experienced triumphs
- Recent triumphs in computer vision, speech processing, natural language processing etc.

What are the most valuable contemporary AI systems you know or use?

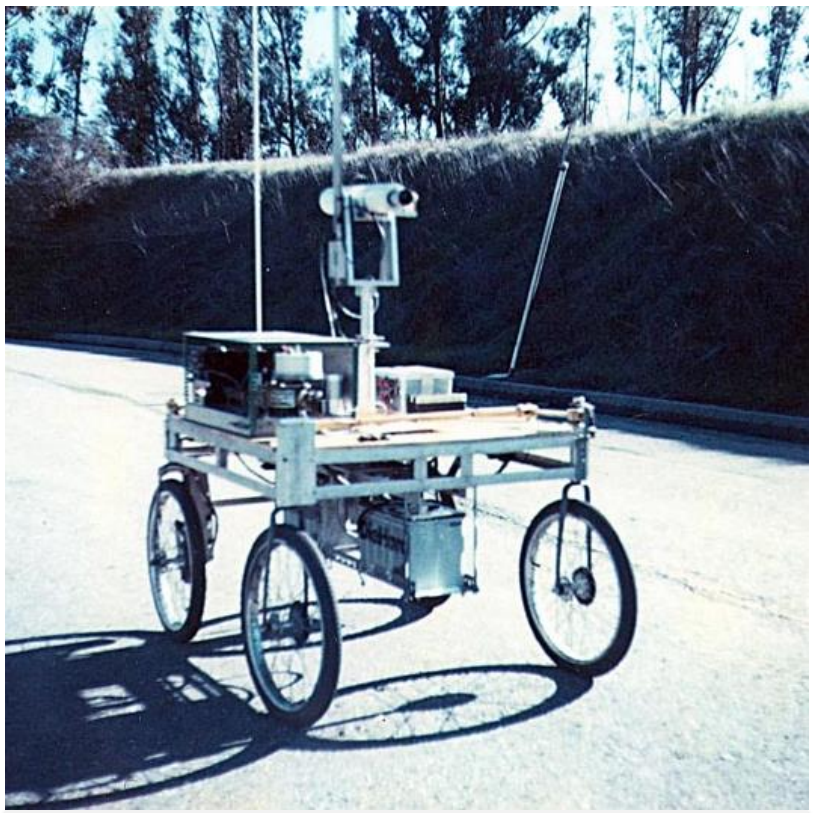
Images: digitaljournal, Wikimedia, Wikipedia, Jeopardy, Wired, Forbes, Zeit online


“ As soon as it works, no one calls it AI anymore.
John McCarthy, One of the founding fathers of AI Research
Image: Stanford University

Artificial intelligence: why now?

Supporting video https://youtu.be/QmoK07dvPZY

Artificial intelligence – why now?



Stanford Cart (1971)

Tesla Autopilot (2018)

Images: Stanford University, Tesla

Why now? Four major developments enable the use of AI

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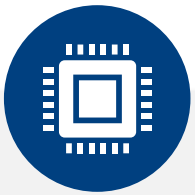
Necessary data is available and usable

Digitalization creates data that can be used for AI applications through big data technologies

Machine learning algorithms have been improved

In recent years, significant progress has been made, primarily through deep learning algorithms



Cloud services deliver the required computing power

Cloud services enable fast, flexible and affordable use of computing resources without major investment

The application of AI is not rocket science (anymore)

High-performance (open source) toolkits and libraries are available

What is artificial intelligence?

Supporting video https://youtu.be/zrmf-2rK0yo

Compare to the course:
Multivariate Data Analysis

What is artificial intelligence?

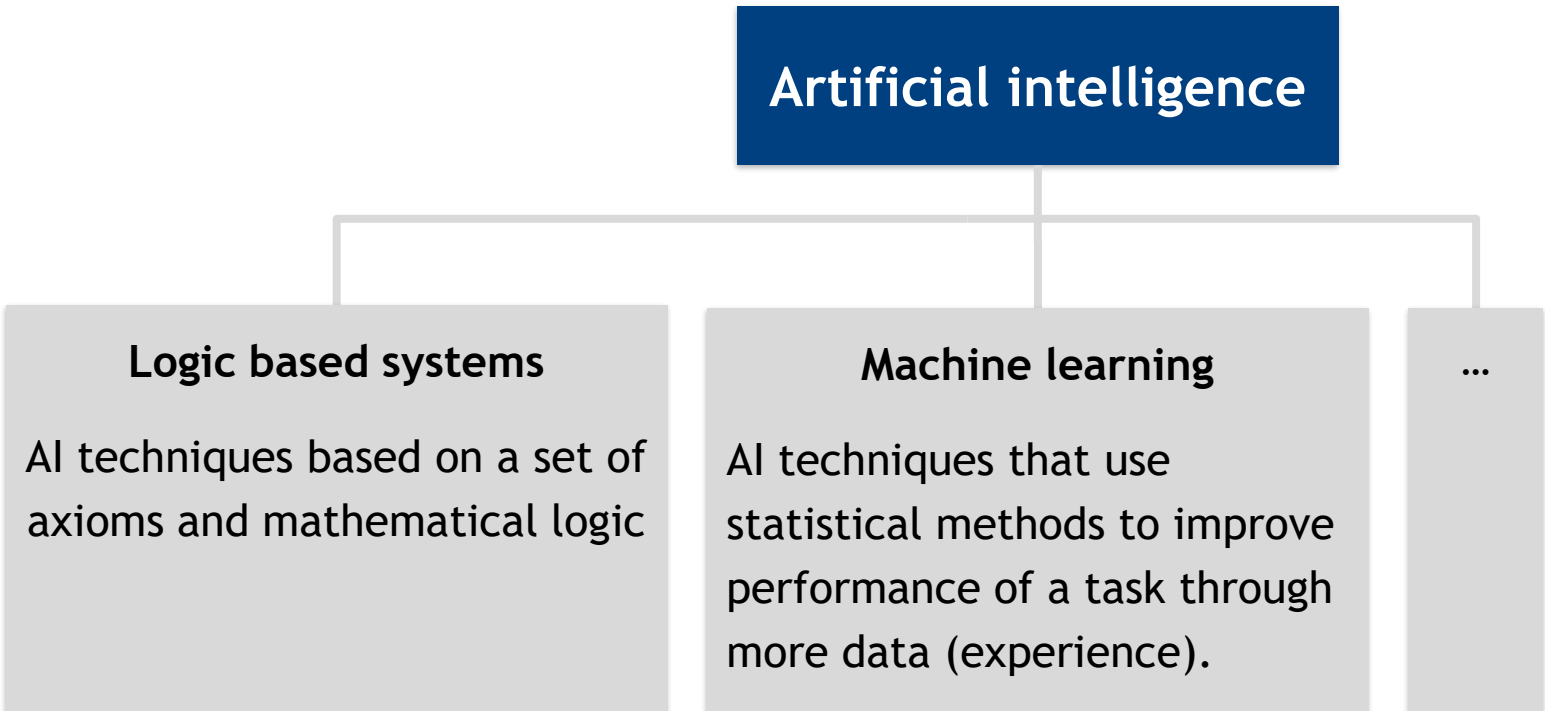
Thought Processes & Conclusion	Humans as reference performance	Rationality as reference performance
	Human thinking Cognitive modeling e.g., Haugeland (1985), Bellman (1978)	**Rational thinking** Laws of thought e.g., Charniak und McDermott (1985), Winston (1992)
Behavior	**Human action** Turing test approach e.g., Kurzweil (1990), Rich und Knight (1991)	**Rational action** Rational agent e.g., Poole et al. (1998), Nilsson (1998)

There are a variety of different interpretations and definitions of artificial intelligence

What is your perspective: Which of these types is the most reasonable perspective on AI?

Russell and Norvig (2016)

Relationship between artificial intelligence and machine learning



Definition machine learning: A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E. Mitchell (1997)

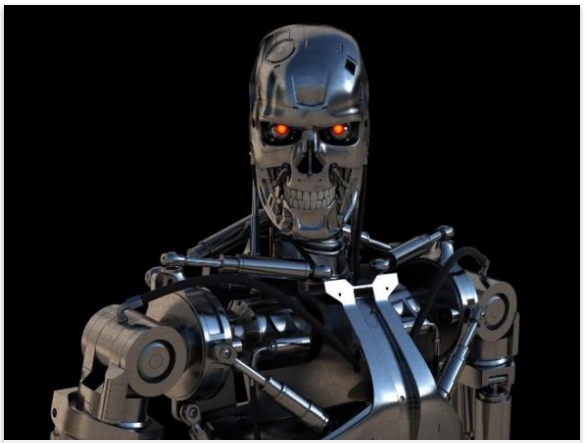
A look at the potential of weak and strong artificial intelligence

Too pessimistic

The next AI winter is already upon us

Realistic

AI cannot do everything, but it will have an impact on all industries



Too optimistic

Superintelligent AI is the solution to all problems (and creates new problems)

Images: Johannes Plenio, StockSnap, Djon

Types of machine learning

Supporting video https://youtu.be/6l8FyebMElk

Dog, fried chicken, or a mop?

What rules can be used to distinguish dogs from fried chicken and mops?

Images: Twitter (Karen Za

Chihuahuas and muffins show the paradigm shift behind machine learning

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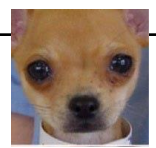
Experience E

Task T

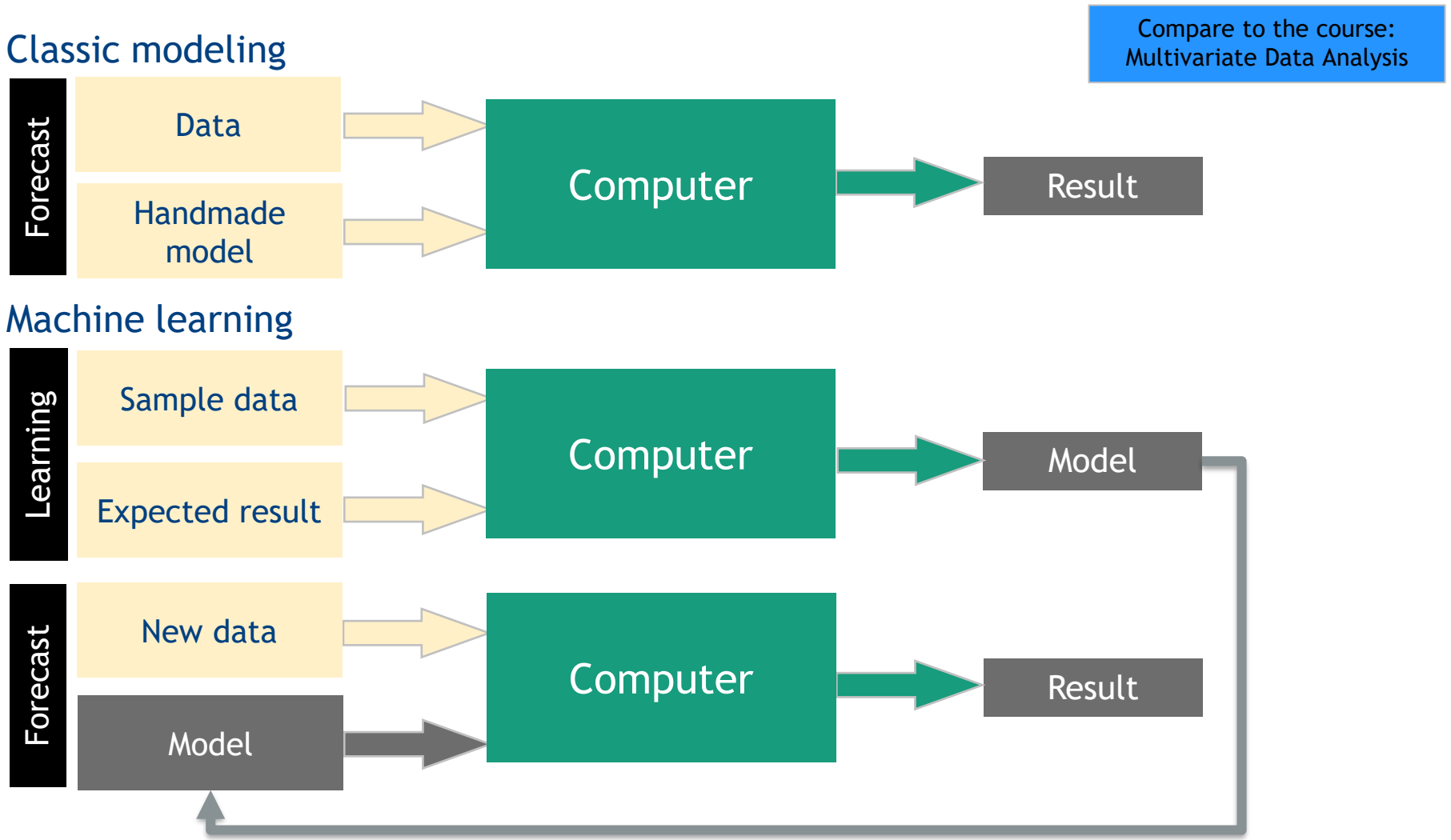
Performance P

Object	Classification	Accuracy
	Muffin	0.977
	Chihuahua	0.962
...		...

- A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E.
- This leads to a paradigm shift in software development.

Mitchell (1997), Buxmann und Schmidt (2018)

What distinguishes machine learning from classical modeling?



https://blogs.zeiss.com/digital/the-relation-between-computer-vision-and-machine-learning/machine-learning/

Typically, three main classes of machine learning are distinguished

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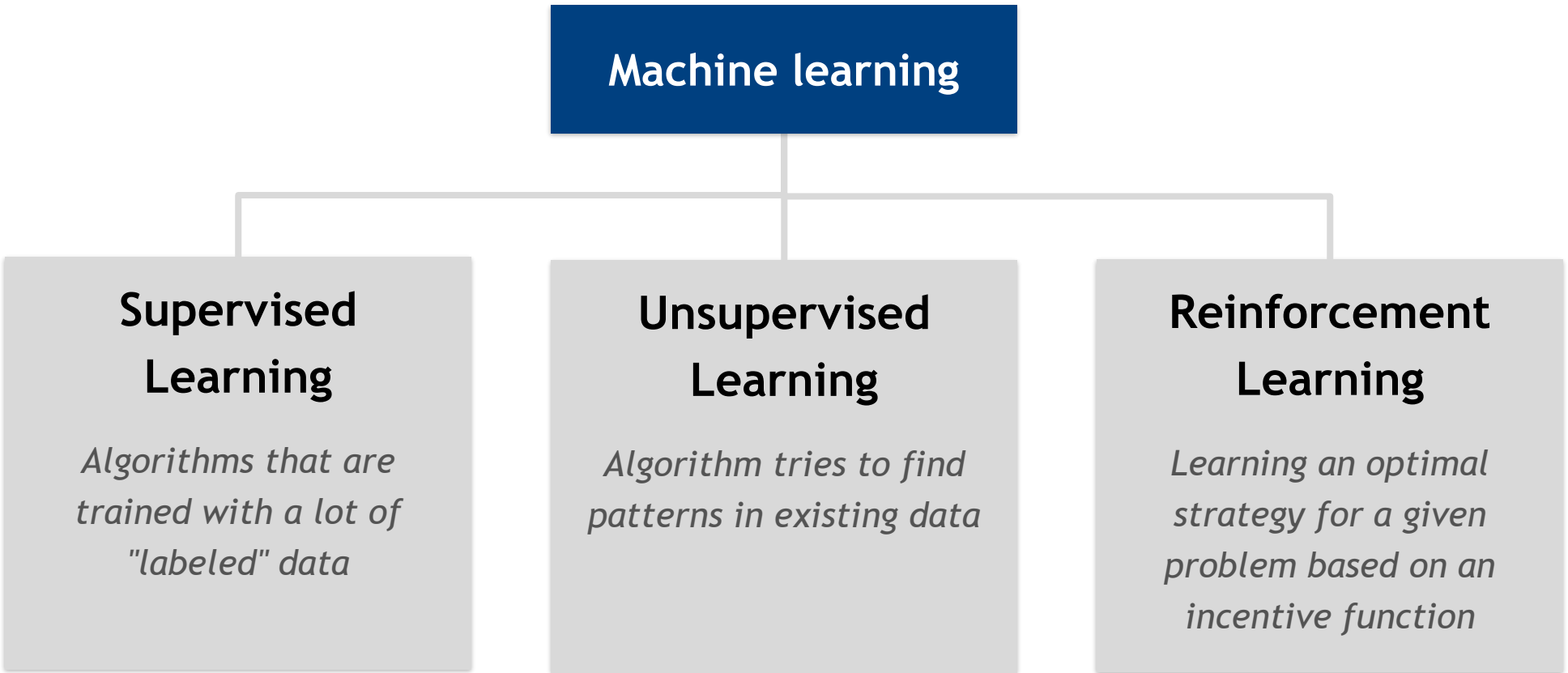
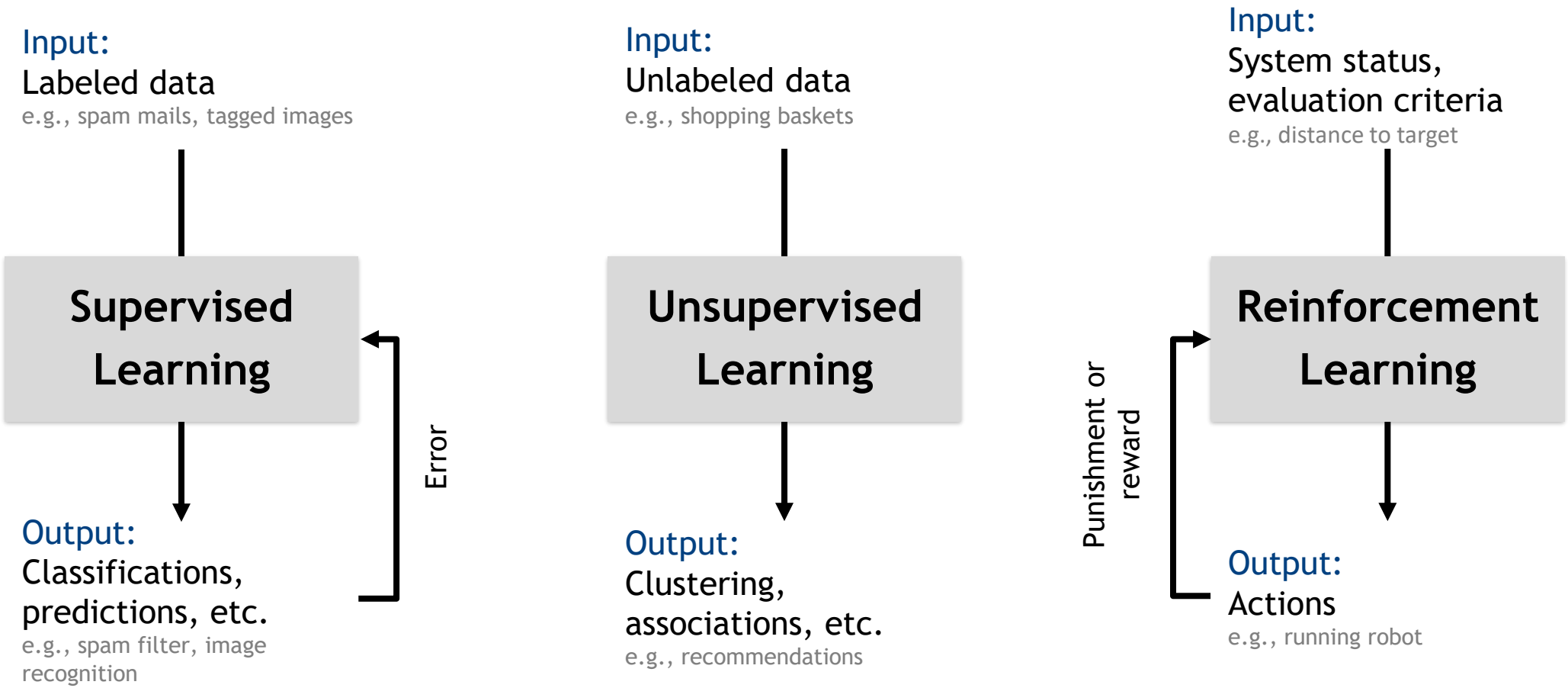
Compare to the course: Multivariate Data Analysis



Learning from data with different strategies



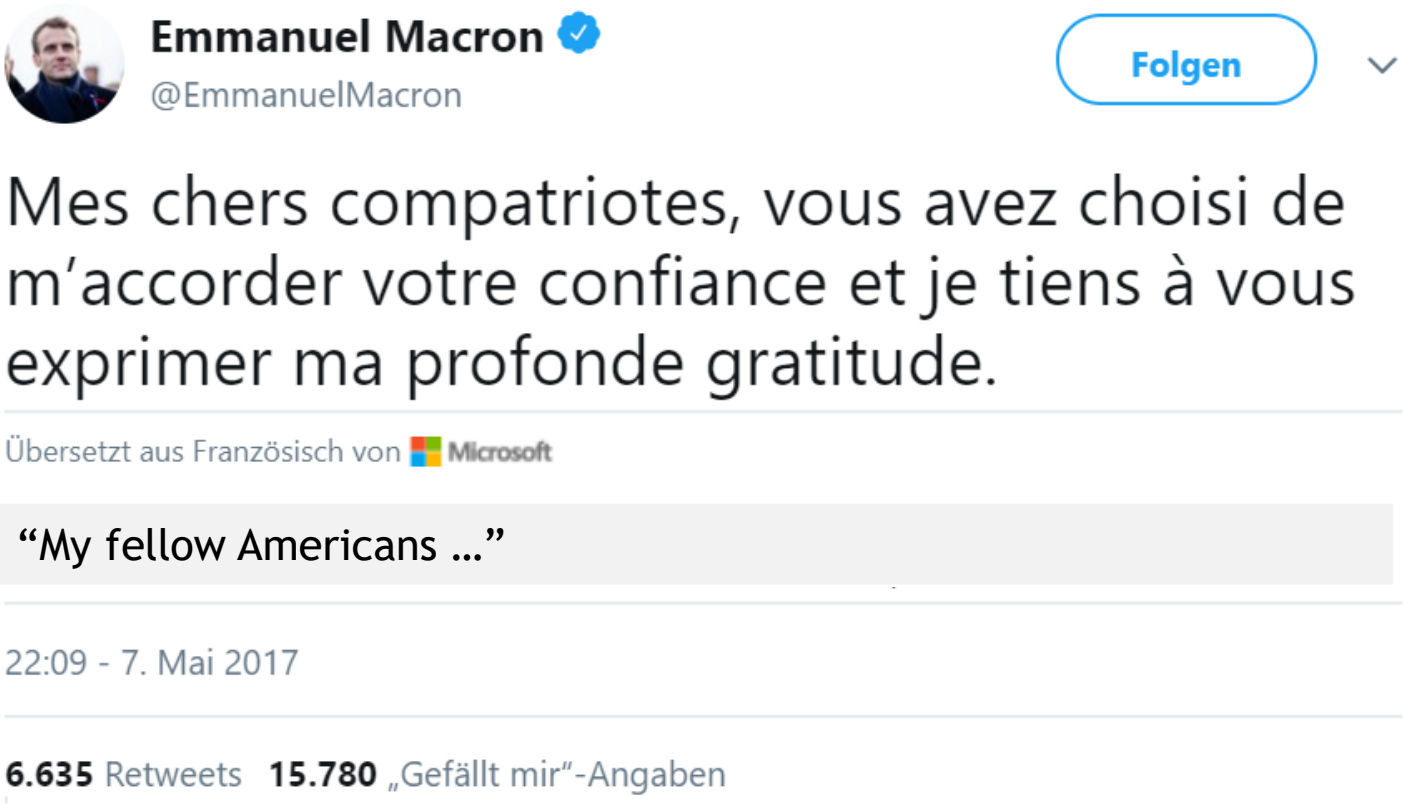
Lux Research

Select challenges of artificial intelligence

Supporting video https://youtu.be/SpZkYjqFmQA

Deepfake example: AI manipulates media content

Incorrect translation of Macron's tweet after his 2017 election victory



- Machine learning does not knows causalities, only frequencies.
- The machine doesn't know what is right, just how something has been used so far.
- When politicians address the people in English, they often mean "fellow Americans".

Die Zeit 2017, Twitter 2

Apple Pay Card example:
AI discriminates against women in credit decisions

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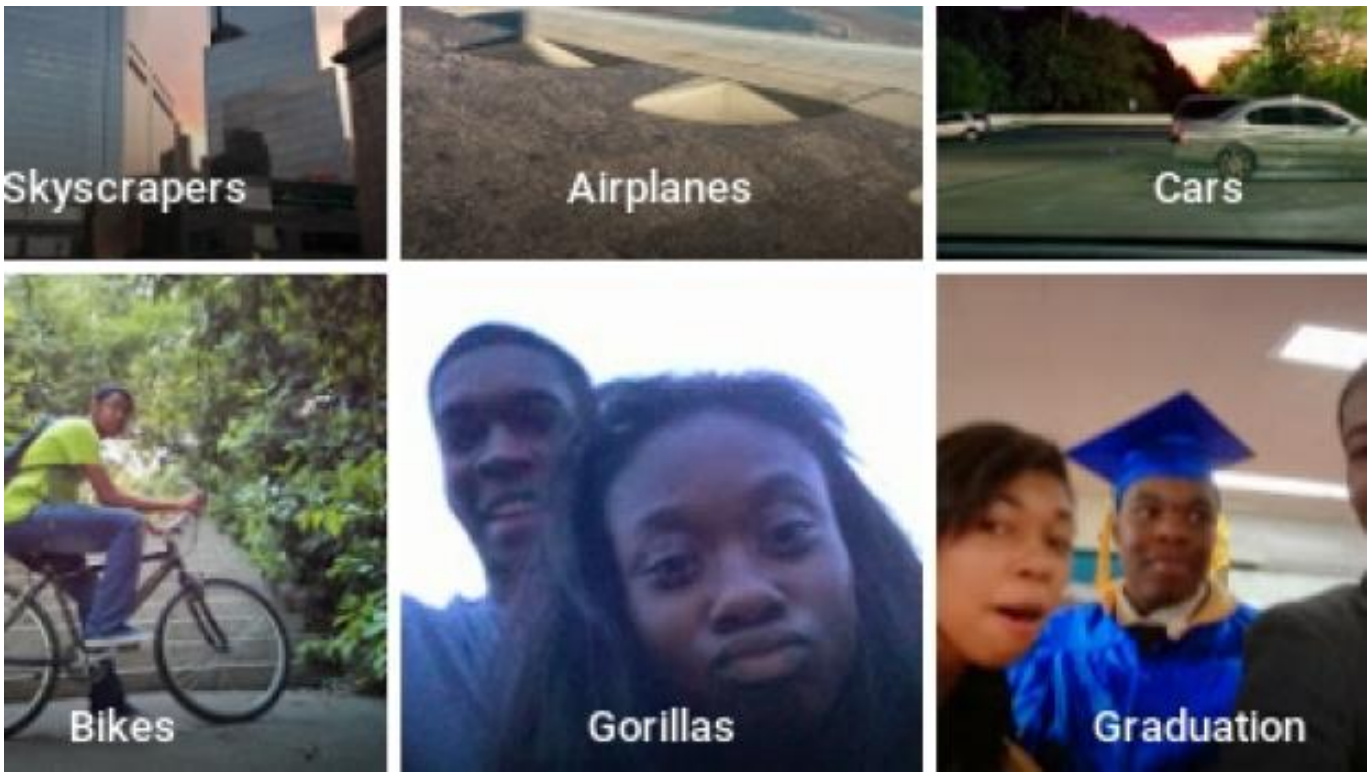
Apple Pay Card's Credit Determining AI: Gender Biased?

Apple and Goldman Sachs came under fire because the algorithm responsible for deciding customers' credit lines appeared to illegally discriminate against women.

- Machine learning algorithms are characterized by the search for latent variables and interrelations (not directly observable).
- It is possible that a model is able to infer gender through a single variable or combination of included variables.
- In addition, historical bias may have influenced the algorithm's decision. As recently as the 1970s, women in the U.S. could be denied credit cards if they did not have a man to co-sign, which may have limited the amount of data available.

Medium.com (2019)

Error with Google’s automated image tagging



Google's facial recognition system made an embarrassing mistake. A dark-skinned couple was accidentally tagged as gorillas. The company has since apologized.

How can such incidents be prevented?

Image: twitter.com/jackyalc

Further examples of biased algorithms

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Automated discrimination in the labor market

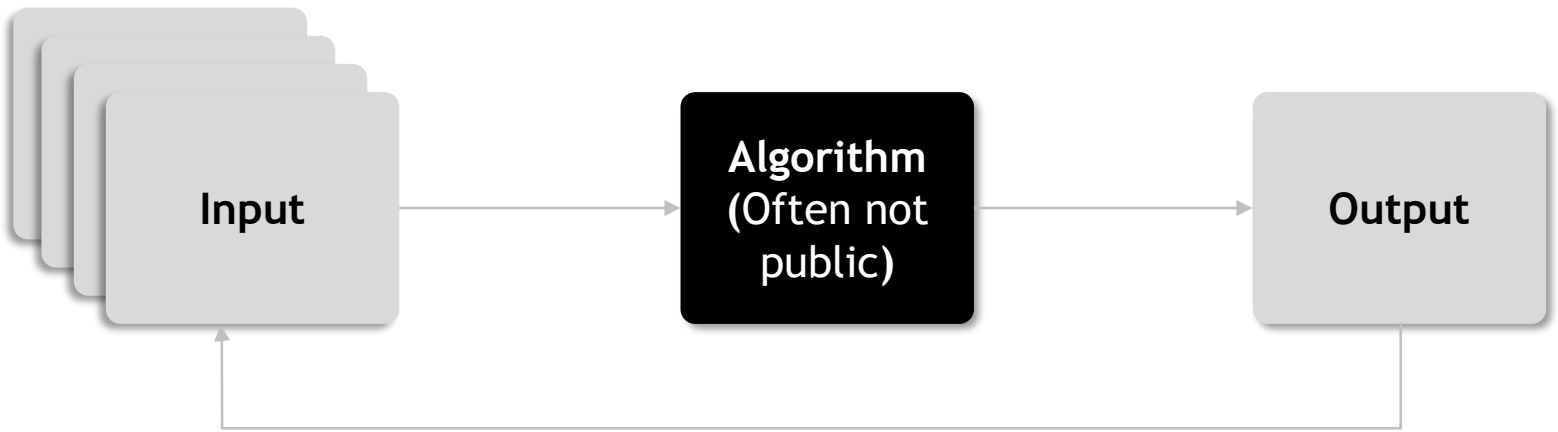
Recidivism scores: prediction of recidivism

COMPAS Score: 3 – low COMPAS Score: 8 – high

Data-based predictions and reality are mutually dependent

Patel (2015), ProPublica

Data-based predictions and reality are mutually dependent



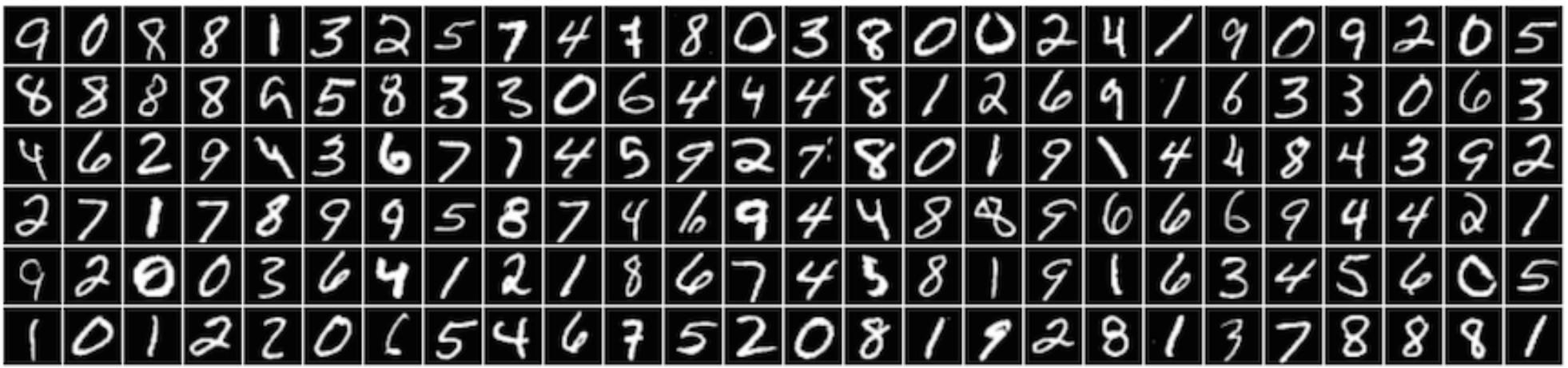
Discrimination carries over into the future without us actively programming it, simply because the algorithm learns from distorted, bad, discriminatory data. It learns through statistics and is not able to question the content of the data.

Additional voluntary material

An example of artificial neural networks

Supporting video https://youtu.be/O7LwGk58v4E

The “Hello World” of machine learning

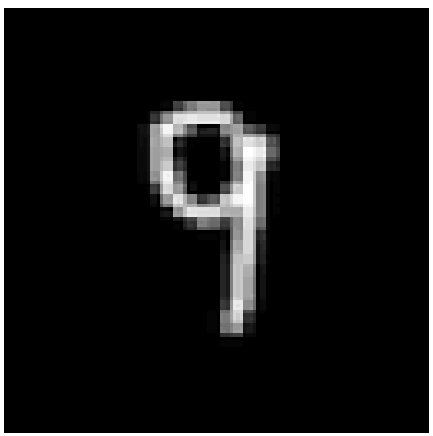


How can I recognize a handwritten number?

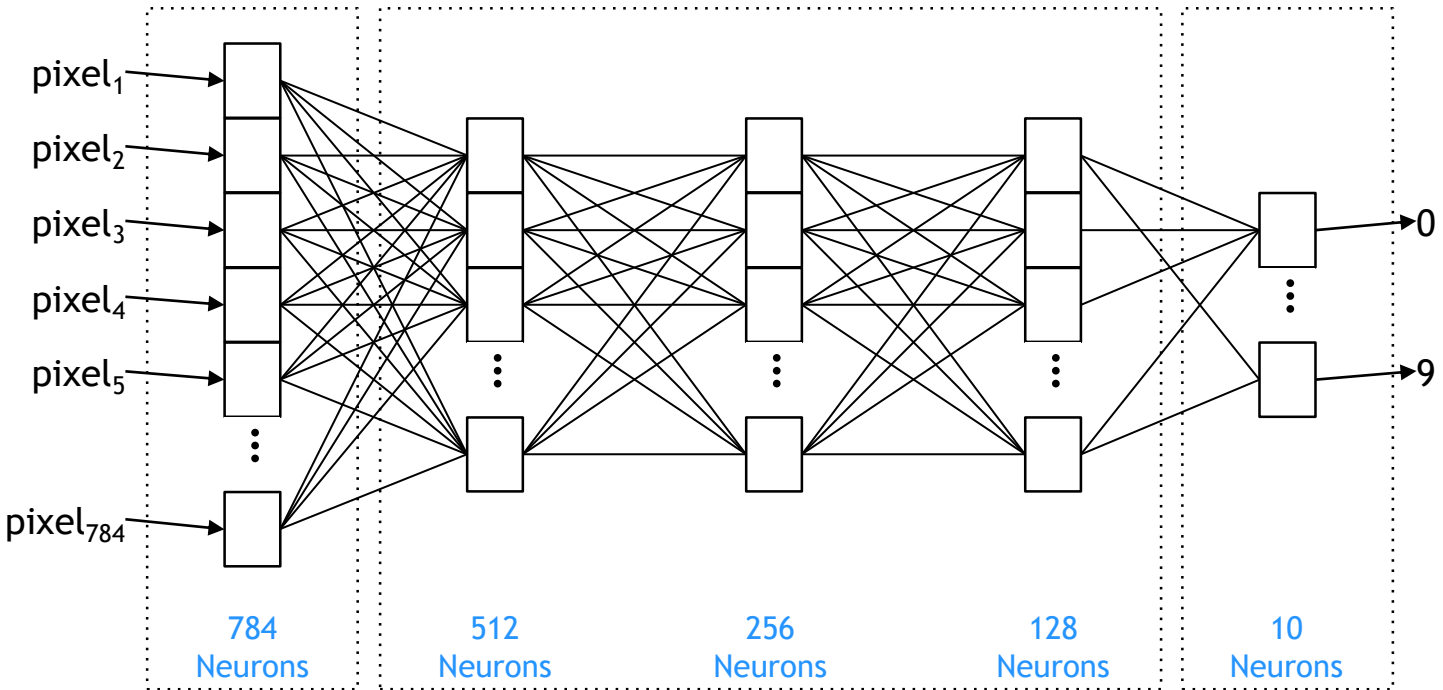
MNIST dataset

Compare to the course:
Multivariate Data Analysis

Neural networks explained (1/4)



28 x 28 (=784) pixels
with gray values



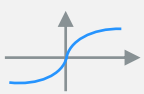
- In a "neuron", an activation function transforms the set of inputs (often the sum of inputs) into an output
- Only nonlinear activation functions allow to compute nontrivial problems
- Exemplary activation functions

Identity

$$f(x) = x$$

Logistic (aka sigmoid, soft step)

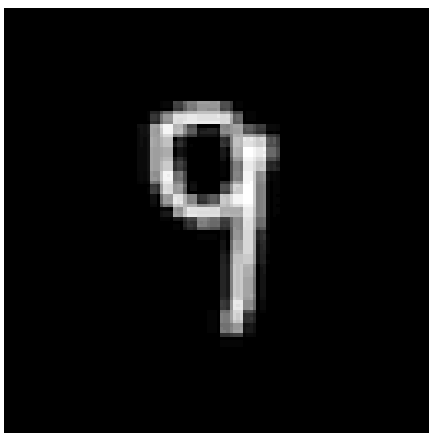
$$f(x) = \frac{1}{1 + e^{-x}}$$



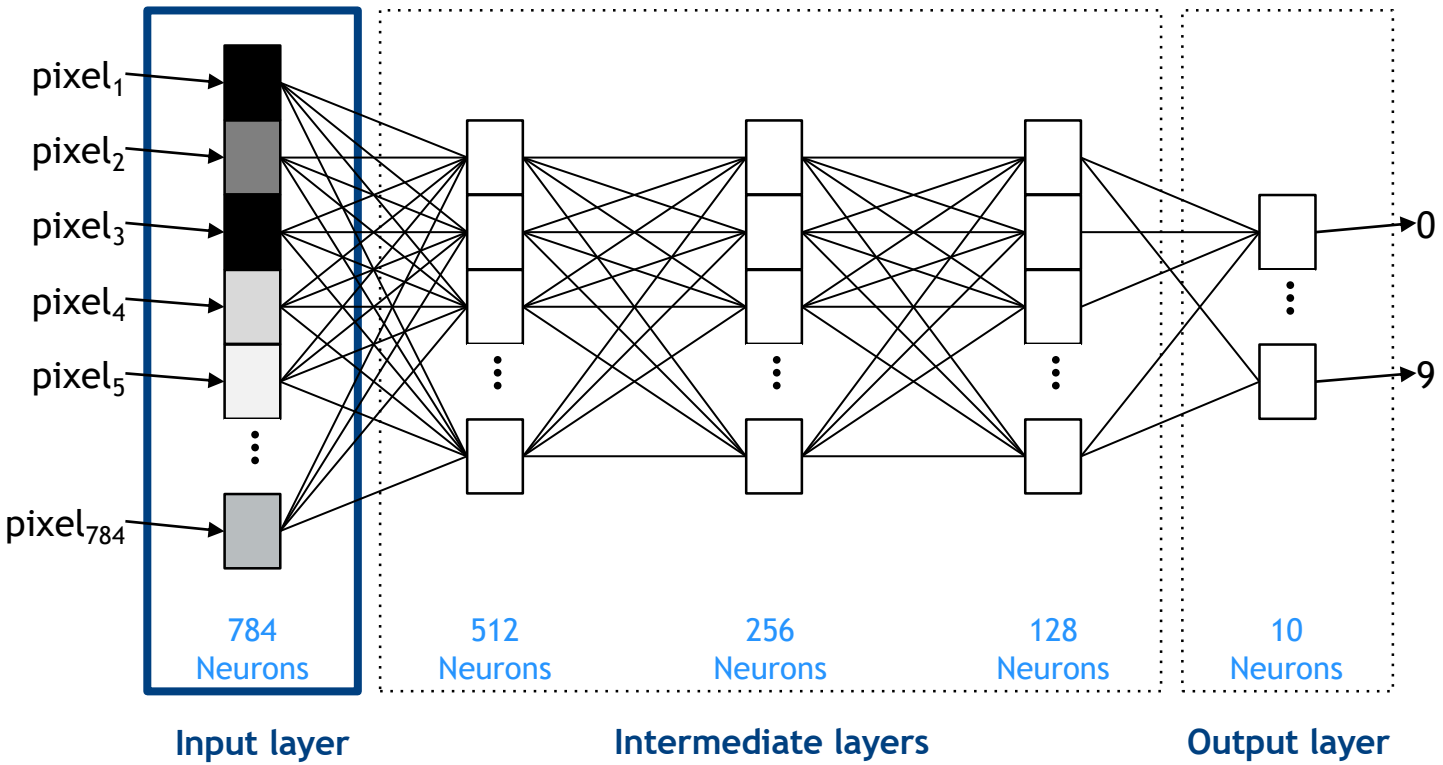
Rectified linear unit (ReLU)

$$f(x) = max\{0, x\}$$

Neural networks explained (2/4)

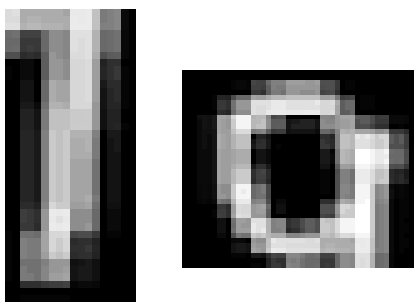


28 x 28 (=784) pixels with gray values



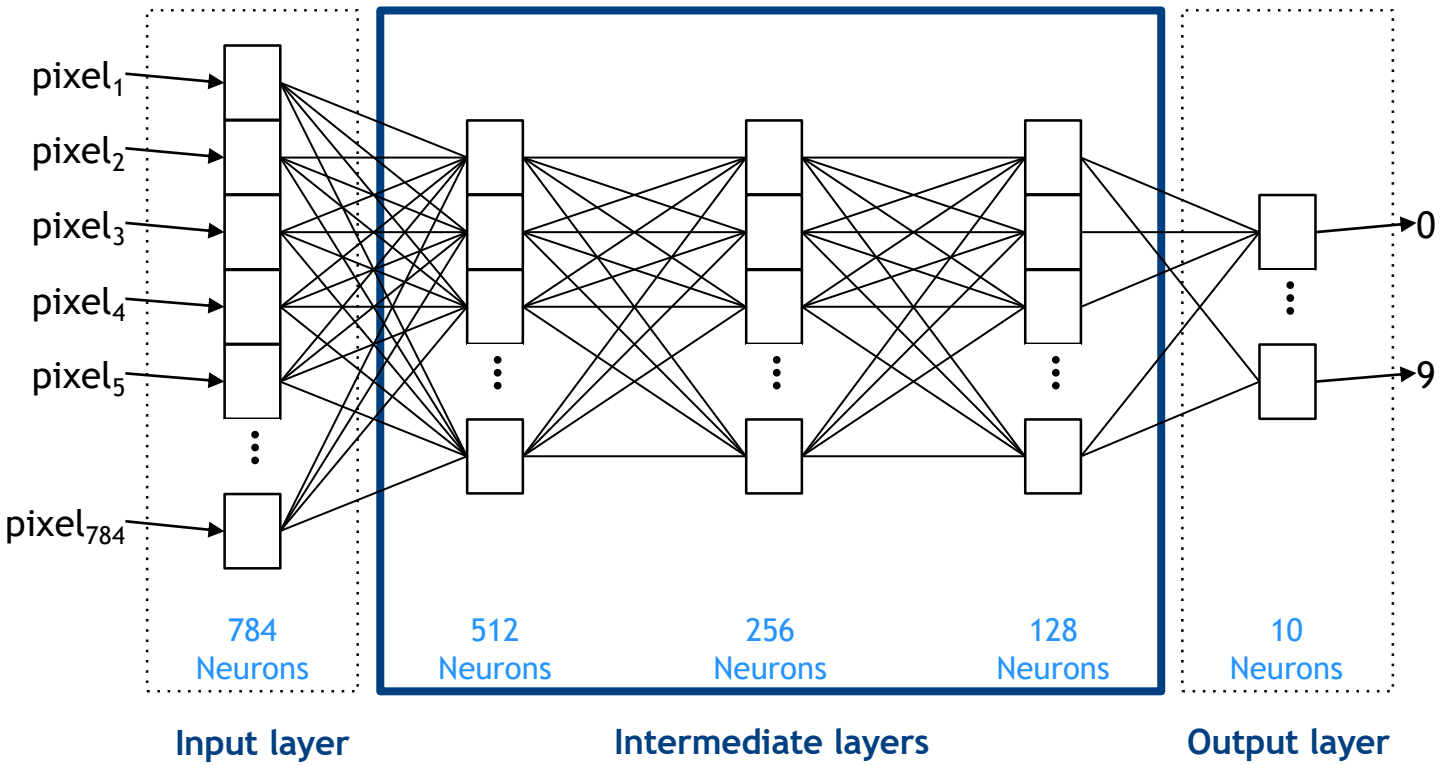
In the input layer, the gray values of the image (0-255) are read pixel by pixel

Neural networks explained (3/4)



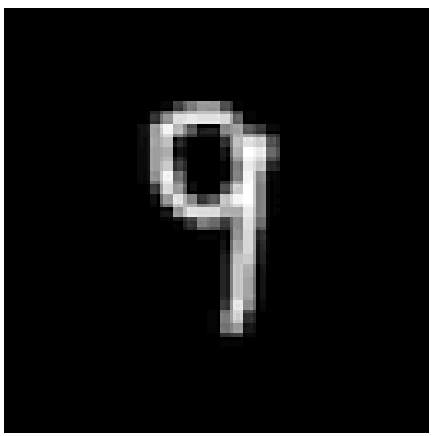
"Edge"

"Circle"

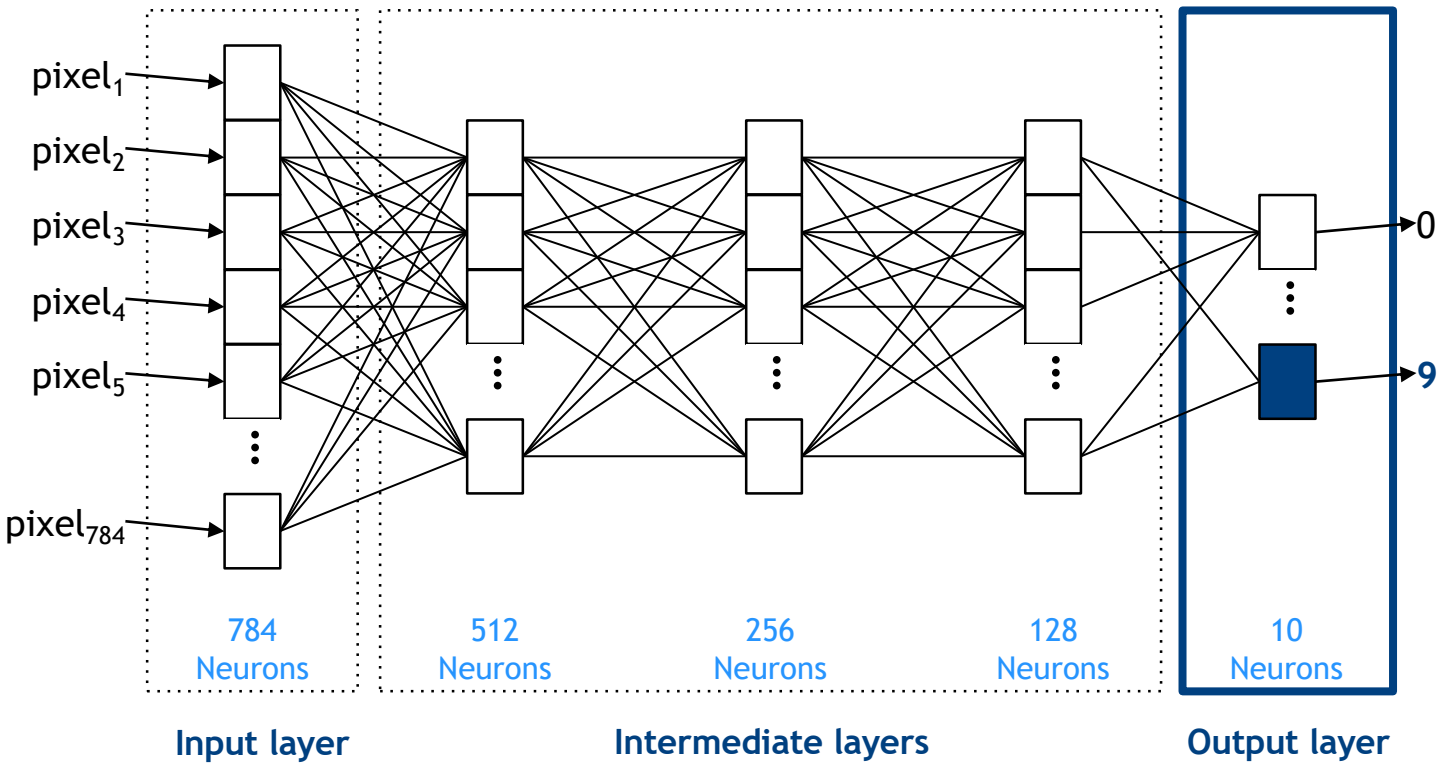


It can be assumed that abstract features, such as edges, are first recognized in the intermediate layers, and shapes are derived in the following layers

Neural networks explained (4/4)



28 x 28 (=784) pixels with gray values



- In our example, the output consists of the 10 possible digits. The output layer is now reduced to these possibilities.
- If you want to learn more, you should visit https://www.digitalocean.com/community/tutorials/how-to-build-a-neural-network-to-recognize-handwritten-digits-with-tensorflow

Another example: AI learns to see at night

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Image recorded by a camera in low light and processed traditionally

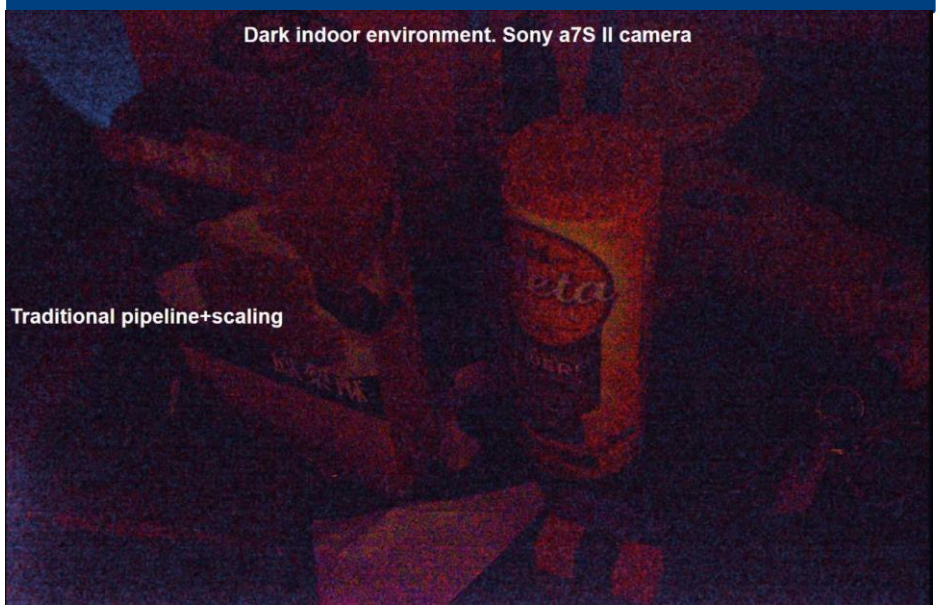
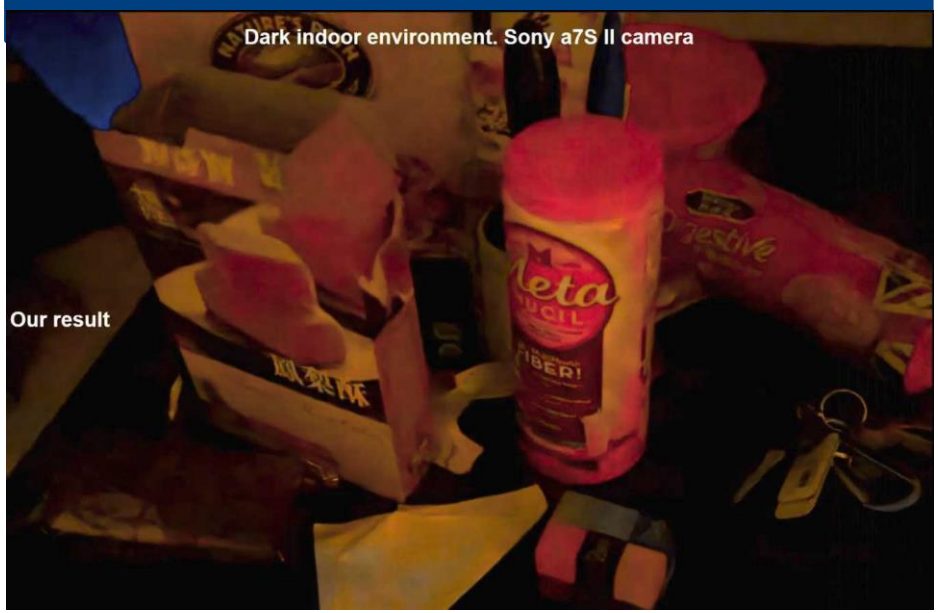


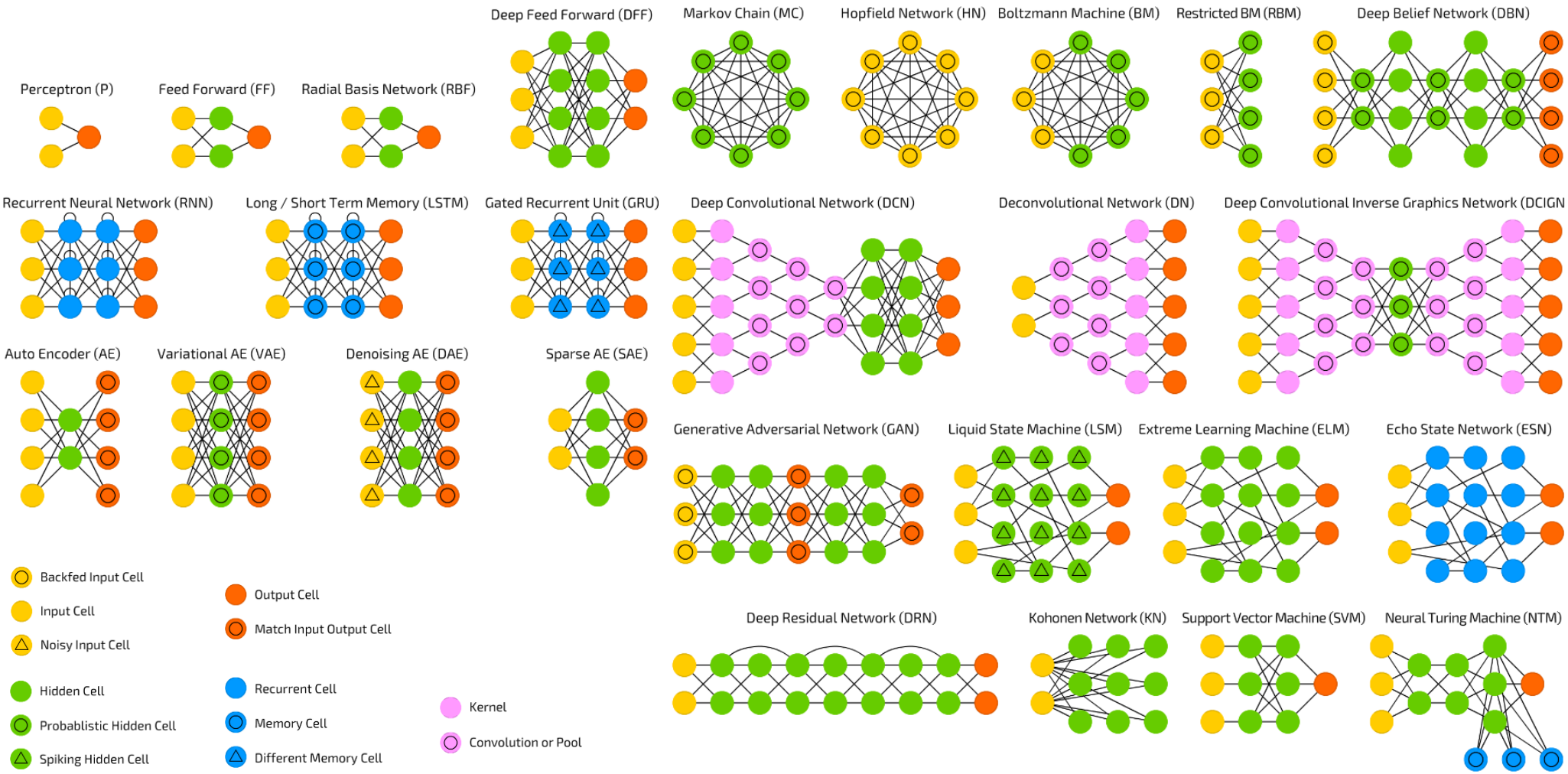
Image processed with machine learning



The trained “full convolutional neural network” uses a dataset of raw, short exposure night images with corresponding long exposure reference images. This efficiently yields enhanced results from extreme scenarios, such as night photography.

Towardsdatascience.com (2018)

An overview on the variety of neural networks



https://towardsdatascience.com/the-mostly-complete-chart-of-neural-networks-explained-3fb6f2367464

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Good luck for the exam!