

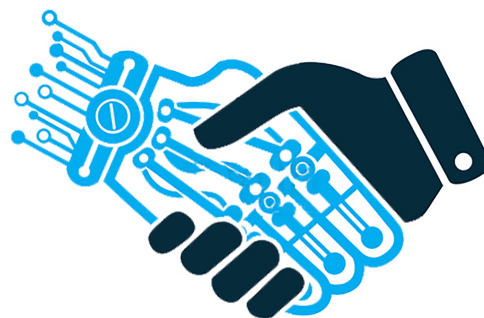
- Comprehension Questions with Solutions -

Industry 4.0 - Digital Transformation TWIE23

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INDUSTRY 4.0

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KAPITEL 1

Digital Transformation

1.1 Comprehension Questions

1. How do Big Data and Smart Data differentiate?

Big data refers to large volumes of data that are available in unstructured form. Smart data is already processed data that can be used immediately.

2. Name the three stages in which the digital transformation works from a company's perspective:

Stage 1: Digitalization of the value chain

Stage 2: Digitalization of the products

Stage 3: Introduction of new business models based on value-added data services

3. What was the start for the digital transformation?

Companies focussing on the customer and their benefits. Customer-centric solutions are pursued.

4. Give three examples of enabler technologies:

a) Internet of Things

b) Internet of Values

c) Computing Power

5. In which five steps can the digital transformation be successfully implemented in companies?

Step 1: Digital reality

Step 2: Digital ambitions

Step 3: Digital potentials

Step 4: Digital fit

Step 5: Digital implementation

6. What is predictive analytics?

**Predictive analytics is the analysis of data that
allows future events or outcomes to be predicted.**

7. Name the four levers through which the digital transformation works:

a) Digitale data

b) Automatization

c) Networking

d) Digital customer access

KAPITEL 2

Disruptive Technologies

2.1 Comprehension Questions

1. Describe in your own words the theory of disruptive technologies.

... are innovations that replace the successful run of an existing, technology, product or service, or drive it completely out of the market and obsolete the investments of the previously dominant market players.

2. According to which two types do you categorize disruptive technologies?

- Low-End Disruption
- New-Market Disruption

3. Give three examples of disruptive technologies.

- Digital camera
- VoIP (Voice over IP)
- CD and DVD

4. How can already established market players protect themselves against disruptive innovations?

- Focus on product innovation (not on profit)
- Early stage acquisitions
- Spin-Offs

5. What alternative model regarding innovation management do you know?

- S-Curve model

KAPITEL 3

Autonomous driving and risk ethics

3.1 Comprehension Questions

1. How should the term „autonomy“ be understood in the field of autonomous driving?

The term „autonomy“ describes self-determination

within the framework of a higher (moral) law.

In the field of autonomous driving, humans

determine this moral law by

programming the vehicle’s behavior.

2. How can the decline in traffic fatalities be explained? Please provide at least three examples.

Increase in safety-enhancing regulations in road traffic.

Increase in digital driver assistance systems

E.g., 100 km/h speed limit on country roads

E.g., seat belt requirement

E.g., emergency braking assistant

3. What does the concept called „Semulin“ entail?

Self-supporting concept for autonomous driving.

Multimodal input and output modalities.

Processes facial expressions, gestures, and speech.

Connects the existing MMS.

4. What question arises when considering the causes of errors in road traffic from a risk-ethical perspective with regard to the use of autonomous vehicles?

Currently, 93.5 percent of accidents result from human errors.

The question is therefore what type of errors will replace human errors.

the human ones.

5. How will the decision-making process change in autonomous driving?

The intuitive, situational decision will change into a considered, conscious decision.

This is defined by the planned programming.

6. What is meant by the term „crash optimization“?

Reaction of the autonomous vehicle

in the event of an unavoidable collision.

Example: collision with the safest road user

SUV vs. small car

KAPITEL 4

Artificial Intelligence

4.1 Comprehension Questions

1. What are the main subfields of artificial intelligence?

Machine Learning

Deep Learning

Neural Networks

Data Mining

2. What does the “Turing Test“ state?

In this test, artificial intelligence is attributed to the machine

as soon as a human cannot distinguish whether he or she is

communicating with another human or a machine

3. At what point is a system considered intelligent according to Ertel?

A system is considered intelligent if it can solve problems

independently and efficiently.

4. How does a weak AI differ from a strong one?

A weak AI acts intelligently in a narrowly defined and specific context.

A strong AI has at least human-like intelligence in all domains.

5. What are the three ways of learning in machine learning?

Supervised learning; Unsupervised learning; Reinforced learning

6. When is deep learning preferred over machine learning?

Deep Learning is primarily used with large, multi-dimensional data sets.

7. What does the research field of neural networks take as a model?

The model for neural networks comes from nature.

Neuronal networks provide for adaptivity in complex interconnections

as well as for a wide variety of motor and intellectual abilities.

KAPITEL 5

Extended Reality (XR)

5.1 Comprehension Questions

1. What is meant by the term “immersion“?

The term “immersion“ describes the effect of complete immersion of the user in virtual reality.

The user perceives the simulated reality as “real.“

2. What do “AR“ and “VR“ mean, and how do the representations of objects differ between these technologies?

“AR“ is the abbreviation for Augmented Reality. “AR“ involves a projection of virtual objects into the real environment.

“VR“ stands for Virtual Reality. With “VR“ technology, the real environment is completely replaced by a computer-generated 360° environment.

3. How is the term reality defined, from which language does the term derive, and how does it differ from virtuality?

Reality means “that which actually is“ or “the totality of the real“ and is derived from the Greek “res“ for „thing, matter.“

Reality encompasses everything that a person can see with their own eyes and interact with without being additionally influenced

by technology, whereas the virtual environment is computer-generated.

4. What area does XR technology come from, and what factors have enabled its wider use?

The origins of XR technology lie in the field of multimedia and gaming. Through continuous technological advances,

VR technology has become increasingly affordable and thus a marketable product for the consumer market.

5. Name a commercial use of AR and a benefit that results from its use.

A car's head-up display can project data such as speed and navigation instructions onto the windshield.

The driver doesn't have to look at their phone while driving and look away from the road to keep an eye on the route safety is increased.

6. Name one application area in industry for each of VR, MR, and AR technology and explain three advantages of each of the three application areas.

AR: Production Controlling, MR: Maintenance, VR: Product Development:

1. Costs can be saved because no physical prototype needs to be created.

2. The product can be analyzed and tested early on. Errors are identified and corrected promptly.

3. The customer can participate intensively and from the very beginning in the development of their product and influence the design.

7. Explain a specific example from the industry where the company has benefited from implementing XR technology.

Bell Helicopter designed a helicopter using VR technology and needed just under half a year for the design instead of the usual five to seven years. Using XR technology enabled the company to save both time and money.

8. Name two opportunities that arise from the use of XR and one risk. Provide a suggestion for how the risk could be counteracted.

Opportunities: Increase efficiency and reduce travel/travel costs, Risk: Low acceptance. Employees may have problems with the new technology, do not want to change and reject the new possibilities. Action: Employees involve employees early on, offer training, and show employees the benefits that will result from the implementation of the technology.

KAPITEL 6

Blockchain Technology

6.1 Comprehension Questions

1. What is a blockchain and how does it ensure digital trust?

A blockchain is a secure, distributed chain of data blocks.

2. What is a Distributed Network?

A distributed network consists of nodes that communicate with each other and store the data of the blockchain redundantly.

Independent computers communicate with each other

and a failure of a computer does not affect the other computers.

3. In which areas is blockchain used?

Smart Contracts (Finance, Politics, Insurances)

M2M Machine to Machine

Smart Grids - decentralized energy supply

Smart Identity

4. How can transactions be authorized and identified?

Through asymmetric encryption and digital signatures.

Transactions are signed with the help of the private and public key.

5. Which two concepts are most commonly used to build consensus?

Proof of Work

Proof of Stake

6. How is a new block created in the cryptocurrency Bitcoin?

By random trial and error, the miners

try to find the nonce (=random number).

7. Name two opportunities and risks of blockchain technology each?

Opportunities: availability of data, integrity of data

Risks: scalability, legal framework

KAPITEL 7

Cryptocurrencies

7.1 Comprehension Questions

1. Why are cryptocurrencies not a currency by definition?

The term currency describes the sovereign monetary system of a state or currency area. Cryptocurrencies neither originate from nor are controlled by a state authority.

2. Explain the term scalability in relation to cryptocurrencies in your own words. Why is scalability important?

Scalability describes the ability of a cryptocurrency to maintain functionality as usage increases. An operational payment instrument must be able to process a high number of transactions without loss of performance.

3. Explain the possibilities of M2M transactions using a self-selected example.

In the IoT, machines can not only communicate with each other, but also pay each other using blockchain technology. An example of this could be a refrigerator that knows its own contents and can reorder them in advance.

4. List four possible areas for the application of self-sovereign identity management:

**a) Access management for buildings
b) Education certificates
c) E-Voting
d) Finance**

5. Assign the associated unique selling proposition to the cryptocurrency.

- | | |
|------------|--------------------------------------------------------------|
| 1.Bitcoin | a) Developed according to academic standard |
| 2.Tether | b) Private operator that finances itself by issuing new XRP0 |
| 3.Cardano | c) Rooted in real values |
| 4.IOTA | d) Soon changeover of the consensus algorithm |
| 5.Ethereum | e) maximum 21 Mio. units possible |
| 6.Ripple | f) Focus on M2M communication |

1e 2c 3a 4f 5d 6b

6. What is the time limit for taxing the profit from trading cryptocurrencies?

Holding period < 1 year: Offset against income tax

Holding period ≥ 1 year: capital gains are tax-free

7. Name one risk of cryptocurrencies and explain it.

Volatility: Many cryptocurrencies are subject to strong

fluctuations in value → unsuitable as a means of payment

KAPITEL 8

The Working World of the Future - Work 4.0

8.1 Comprehension Questions

1. What are the challenges resulting from demographic change?

Demographic change refers to a shortage of human capital due to the aging of the workforce in society.

Occupational fields that are not substitutable will have to fight for a smaller number of possible employees in the future.

2. Which areas of activity are least affected/threatened by automation and digitalization?

Occupations that rely on creativity and social interaction, or that require complex cognitive activities.

3. How can the concept of social partnership help to facilitate a socially acceptable transition to the world of work 4.0?

In the context of the transition to the world of work 4.0, technologically induced unemployment is to be expected at least in some areas, and not all of those affected will be able to make a smooth transition to subsequent employment.

In the spirit of the existing social partnership, employers and employee associations as well as the state can offer mutually acceptable solutions, e.g., through compensation, compensatory payments, further training opportunities or similar.

4. What are the disadvantages of the unconditional basic income?

- Too high costs**
- No incentive to continue working**
- No more interest in only low-paid activities**

5. Name two positive consequences of automation in the context of Work 4.0.

- Relieving workers from physically heavy tasks**
- Potentially more efficient production**

KAPITEL 9

Big Data

9.1 Comprehension Questions

1. How is Big Data defined?

Big Data refers to the use of large amounts of data from diverse sources at a high processing speed to generate economic value.

2. What is an algorithm?

An algorithm is a solution prescription for the solution of a problem or for the completion of a certain task.

3. What are the benefits of Big Data? Name two with a short explanation.

- Acquisition of customer understanding
- Optimization of business processes
- Help with decision making
- Optimal use of resources

4. What is the biggest risk that Big Data brings? (short explanation)

Privacy and data protection:
Individuals can be associated with the data through decryption and analysis of the traces, losing any kind of anonymity

5. What is predictive analytics?

By analyzing data from memory rather than disk, insights can be derived immediately from the data and acted upon quickly.

6. Give three examples of where Big Data is being used.

- Networked cars
- Smart Grids
- Credit card fraud

KAPITEL 10

Medicine 4.0

10.1 Comprehension Questions

1. Explain why digitalization of the healthcare system is essential in the future.

Due to demographic change and increasing life expectancy, costs in the healthcare system will continue to rise in the future.

The digitalization of the healthcare system can reduce these costs again.

2. Name three challenges of digitalization in the healthcare system.

1. Digital supply network

2. Interoperability & Isolated Systems

3. Numerous Paper Documents & System Disruptions

4. Telemedicine

5. Market Consolidation & Skilled Labor Shortage

6. Patient Focus & Complexity

3. Define the term **interoperability**.

Interoperability is the ability of a system to work together with other systems.

4. Name the 5 areas into which eHealth can be divided.

a) eCare (health care)

b) eAdministration (administrative processes)

c) ePrevention (prevention)

d) eResearch (research)

e) eLearning (teaching)

5. How much money could be saved annually in Germany through a digitized healthcare system?

In Germany, approximately 42 Mrd. euros could be saved annually.

6. Describe the changes that have taken place from Hospital 1.0 to Hospital 4.0.

a) Clinic 1.0: New processes (anesthesia)

b) Clinic 2.0: New technologies (X-rays)

c) Clinic 3.0: Information processing and information-storage machines

d) Clinic 4.0: Introduction of networked technologies and real-time communication

Explain how the role of the doctor will change in Hospital 4.0.

The role of the doctor will evolve from that of a general practitioner to that of a specialist.

They will become a team player who works closely with other doctors.

7. Nennen Sie 4 Systeme, die in der Pflege eines digitalisierten Krankenhauses vorhanden sind.

1. Mobile documentation systems

2. Tracking systems

3. Electronic order entry systems

4. Hospitality entertainment

5. Mobile identity access

6. Nursing documentation via voice bot

7. IoT sensors for hygiene management

8. Describe the risks associated with the digitalization of the healthcare system.

The greatest risk is computer viruses. These can manipulate data or make it inaccessible. Further risks exist in the area of data protection. The liability risk must be clearly clarified in advance to avoid ethical issues.

9. Name the three areas of telemedicine.

a) Teleconsultations

b) Telemonitoring

c) Teletherapy

10. How will the digitalization of healthcare develop in the future?

In order to utilize all the advantages of the digitized healthcare system, intelligent networking

is required. Medical findings can

be obtained faster and more precisely through AI.

Robots will support care.

All stakeholders in the healthcare system must work together.

KAPITEL 11

Digital Administration

11.1 Comprehension Questions

1. Describe in your own words what is meant by digital administration.

Digital administration, also known as e-government, refers to digital processes in government institutions, which are carried out using information and communication technology.

Examples of this would be:

applications of any kind, as well as digital voting

2. What advantages does e-government offer the population?

It offers citizens much more flexibility, as they can access services regardless of time and location.

3. Name two laws that enable digitalization?

OZG – Online Access (Zugang) Act

E-Government Act

4. How can the transition to a fully digital administration in Germany be successful?

The recommendation pyramid must be implemented.

1. Develop a unified strategy

2. Allow innovations in administration

3. Create interfaces so that all offices can use the same resources

4. The legal framework must be created

5. What technologies do you know that are transferable to government administration?

Blockchain

Machine Learning and Artificial Intelligence

Augmented & Virtual Reality

Internet of Things

6. Explain the extent to which blockchain is of interest to government.

There are two major topics in government:

Notarization and registry maintenance.

Both can be perfectly replaced by blockchain technology,

because blockchain is predestined for this

to secure data tamper-proof and forever.

KAPITEL 12

Cultural Digitization

12.1 Comprehension Questions

1. What is "Kultur Digital"?

It is a program that supports cultural institutions and wants to help shape digital opportunities and challenges

2. What are digital serious games?

They are games that take place in a hardware- and software-based virtual environment and aim to encourage the learning of specific and desired content.

3. How do NFTs behave with their value?

An NFT cannot be sold for the same price after it has been purchased. It behaves like an investment, the value increases/decreases depending on the market situation.

4. What can be said, in simple terms, about the ownership of a digital work of art?

It belongs exclusively to the artist, provided they have minted it.

5. What was the question that arose at the end of the experiment #change of ideas?

Is the idea of theater taking place in separate rooms already long since passé?

6. What types of funding are available from the Federal Cultural Foundation?

General project funding, program funding, cultural lighthouses

7. What is Soundgraph 3.0?

It is a project of the Fonds Digital, which visualizes a digitally composed piece.

KAPITEL 13

Cloud-Computing

13.1 Comprehension Questions

1. What are the 5 technology characteristics that define cloud computing?

self-service on demand

broad network access

shared resource pool

fast elasticity

measured performance

2. What is the meaning of the abbreviation SaaS / PaaS / IaaS?

Software as a Service (SaaS)

Platform as a Service (PaaS)

Infrastructure as a Service (IaaS)

3. How is cloud computing structured?

**One way to divide the cloud is to divide it into three layers,
with each layer representing a level of abstraction.**

• **Application**

• **Platform**

• **Infrastructure**

**The layers of the cloud can be used to classify
the different models of cloud computing.**

4. What other technologies are available besides cloud computing?

Grid-Computing

Edge-Computing

Fog-Computing

5. What means the abbreviation ADV?

Auftragsdatenverarbeitung

KAPITEL 14

Roboter in der Smart Factory

14.1 Comprehension Questions

1. What is meant by additive manufacturing??

Additive manufacturing is a process for the layer-by-layer production of

2. What is the central role of robotics in the smart factory?

Robots make production processes more efficient, flexible, and high-quality, enabling close collaboration between humans, machines, and digital systems.

3. In which decade were the first industrial robots introduced?

In the 1960s.

4. How does ISO 8373:2021 define an industrial robot?

As an automatically controlled, reprogrammable, multipurpose manipulator that can be programmed in three or more axes and is used either stationary or mobile in industrial automation applications.

5. How many degrees of freedom does a rigid body have in three-dimensional space, and what movements are these?

Six degrees of freedom: three translations along the x-, y-, and z-axis, and three rotations around these axes.

6. Name three typical tasks of industrial robots in industry.

Welding, palletizing, transporting, painting, assembly, deburring, gluing.

7. Which type of robot is particularly suitable for high-speed pick-and-place tasks in the food industry?

Delta robot.

8. What advantages do cobots offer in industrial production?

Cobots work directly with humans, do not require safety fences, relieve workers from physically demanding tasks, and enable flexible manufacturing processes.

KAPITEL 15

Additive Fertigung in der Industrie 4.0

15.1 Comprehension Questions

1. What is meant by additive manufacturing??

Additive manufacturing is a process for the layer-by-layer production of three-dimensional objects, where material is only applied where it is needed. It enables resource-efficient, flexible, and customized production.

2. How does additive manufacturing differ from subtractive processes?

In subtractive processes, material is removed (e.g., milling or turning), whereas in additive manufacturing, material is added layer by layer to create the component.

3. Which file forms the basis for additive manufacturing?

A digital STL file (Standard Tessellation Language).

4. Name two advantages of additive manufacturing compared to traditional manufacturing processes.

Flexibility in product design and reduction of material waste through layer-by-layer deposition.

5. What is meant by Rapid Prototyping (RP)?

RP is the fast and cost-effective production of prototypes to perform design and functional tests in early development stages.

6. Briefly describe the working principle of Material Jetting.

Material Jetting deposits tiny droplets of build or support material layer by layer onto a platform. The droplets solidify immediately, e.g., through UV curing or cooling, and support material is removed afterward.

7. What role does the powder bed play in Binder Jetting and Powder Bed Fusion?

The powder bed acts as a natural support for overhangs and complex geometries during the printing process, often eliminating the need for separate support structures.

8. What challenges exist in industrial serial production with additive manufacturing?

Long printing times, high production costs for large quantities, post-processing of surfaces, limited build volume, and high investment costs for machines.

9. How does additive manufacturing support Industry 4.0?

Through digital networking, automated process chains, digital warehousing, on-demand production, and flexible manufacturing, which shortens development times and reduces inventory costs.