JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN
ALLG. BWL UND WIRTSCHAFTSINFORMATIK
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IT Systems –
Reader of the WBT Series

Arbeitspapiere WI Nr. 10 / 2020

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Title: IT Systems – Reader of the WBT Series

Abstract: This working paper serves as a reader for the WBT series "IT Systems", which is available online on the "E-Campus Wirtschaftsinformatik".

This WBT series is an introduction to business informatics. IT systems are defined on the basis of their computer structures and computer configuration with hardware and software. Furthermore, application systems are explained with an additional example, data management and data modeling in companies are addressed. Finally, networks are explained based on their topologies, as well as data transmission over the Internet and the difference between traditional and online business.

Keywords: IT Systems, Computer Structures, Computer Configuration, Application Systems, Corporate Data Management, Data Modeling, Networks, Internet, E-Business

A   The Web Based Trainings

The learning material for the subject area "IT Systems" is conveyed through a series of Web-Based Trainings (WBT). The WBTs build on each other in terms of content and should therefore be completed in the listed order and at the scheduled time. In order to be able to fully understand a subject area, each WBT must be completed several times until the respective tests in the individual WBT are passed with success.

WBT No.	WBT Description	Duration
1	Corporate IT Systems	90 min.
2	Computer Structures – Network and Elements	90 min.
3	Computer Configuration – Central Processing Unit, Peripherals, Interfaces	90 min.
4	Computer Configuration – System Software	90 min.
5	Application Systems: Classification and Integration	90 min.
6	Corporate Application Systems: Example MS Dynamics NAV	45 min.
7	Corporate Data Management and Data Modeling	90 min.
8	Networks	90 min.
9	Internet	90 min.
10	E-Business	90 min.

Overview of the WBT Series

The contents of the individual WBT are shown below in the following document. All WBT are available online round the clock. You can work through each WBT as often as you wish. Each WBT contains examples of source code that you must copy and run.

Table of Contents

List of Figures

List of Tables

1   Corporate IT Systems

1.1   Business Informatics

1.1.1 Welcome to the FamIT

Mr. Itudium:

Hello!

I am Mr. Itudium, CEO of the family business "FamIT". My son, Sebastian, is supposed to join the IT department of our company in the long run. Therefore, he will support our IT manager Mr. Sappro in addition to his studies. In his business studies, however, he has only been able to gain little experience with IT systems so far, which is why he has enrolled in the course "IT Systems" of Prof. Dr. Etlien.

- Mr. Itudium is the CEO of FamIT and supports his son in his education. At the moment, he wants his son to help with the restructuring of the IT sector.

- Sebastian Itudium is a student of economics and wants to take over the family business. Therefore, he wants to get to know every division of the company.

- In the course of the WBT series, Mr. Sappro will discuss and illustrate the concepts explained by Mr. Etlien.

- In the following WBT series, Prof. Dr. Etlien will discuss and present schemes and concepts of IT.

1.1.2 Business Informatics from the Perspective of Computer Science

From the perspective of computer science, business informatics is assigned to the branch of "Computer Science Applications". Thus, it is placed alongside other fields such as legal, administrative or medical informatics. However, business informatics is more than just a computer science application. It is an independent discipline between business administration and computer science.
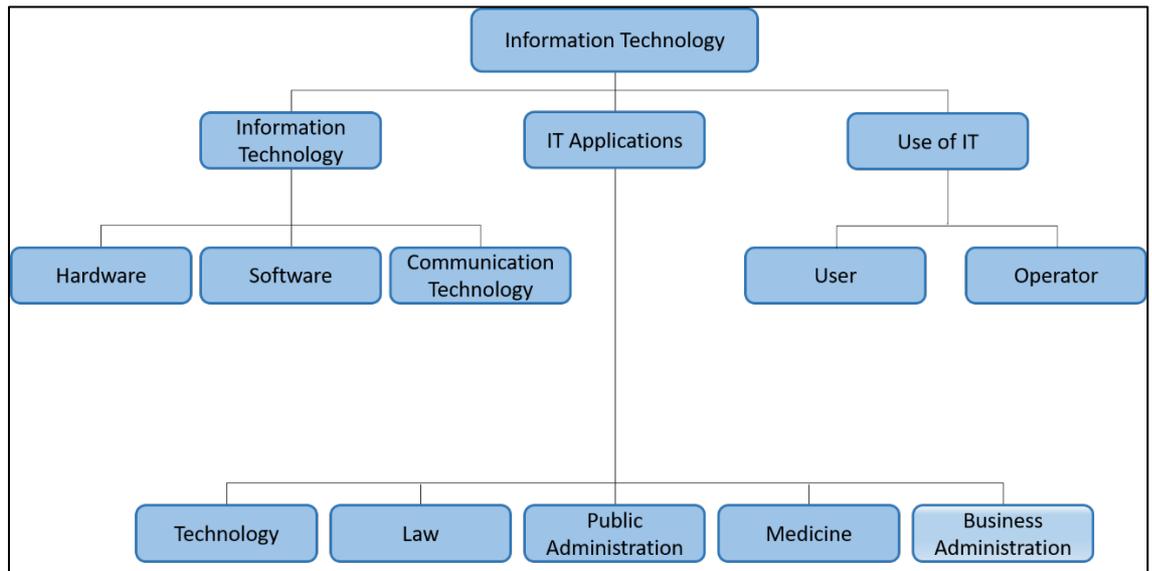
Fig. 1:   Business Informatics from the Perspective of Computer Science

1.1.3   Interdisciplinarity of Business Informatics

The field of business informatics is an intersection of the individual disciplines of business administration, computer science and technology. The so-called "Information Management" represents an additional discipline.

IT systems are the focus of business informatics. These are socio-technical systems, i.e., an organized set of people and technologies structured to serve a specific purpose. The task areas of business informatics are: conception, development, implementation, maintenance, use and operation of computer-assisted information processing systems.

The additional discipline of Information Management is covered in the separate WBT series "IT Management" and which accompanies the lecture of the same name.
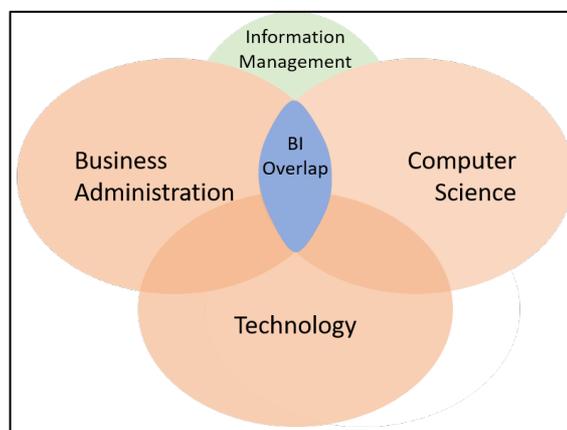
Fig. 2:   Interdisciplinarity of Business Informatics

1.1.4   Business Informatics from the Perspective of the Economic Sciences

If you look at business informatics from the perspective of economics, it becomes clear that the tasks of business informatics extend through all functional and cross-sectional areas of a company. The primary purpose of business informatics is to provide the business units with the required information, the so-called "information function". The prerequisite for this information function is an optimal information infrastructure within the company.
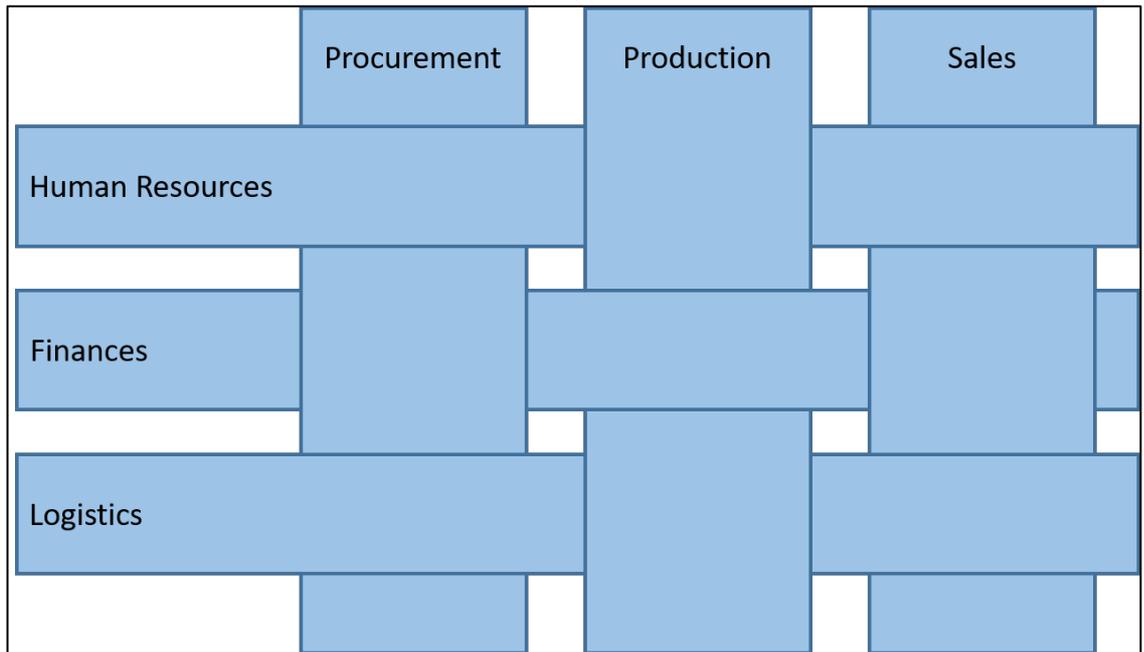
Fig. 3:   Business Informatics from the Perspective of the Economic Sciences

1.1.5   Integration of IT Systems in a Company

Along the value chain according to Porter, specific IT systems can be found for every activity of a company.
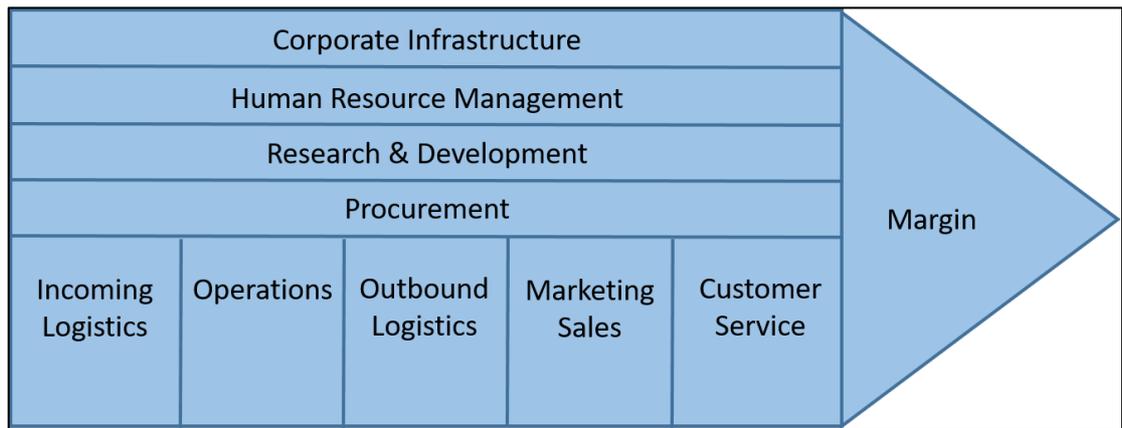
Fig. 4: Integration of IT Systems in a Company

The IT systems in a company must be technically interconnected (integrated) in a way that the actual business activities of the company can be carried out smoothly and efficiently.

1.1.6 Cross-Company Importance
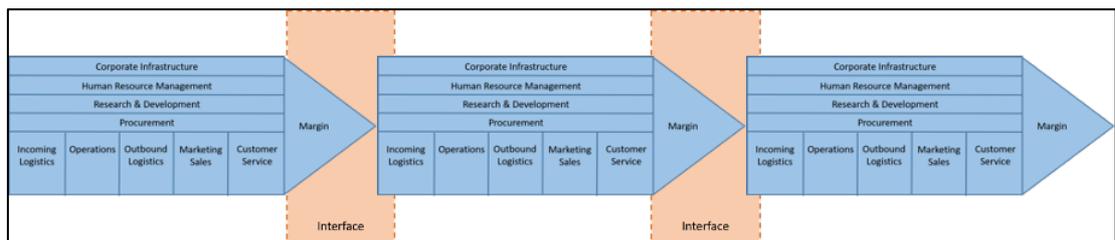
Fig. 5: Cross-Company Importance

1.   IT systems have a significant role not only within a company.

2.   The importance of IT systems becomes particularly clear when considering several companies and their interdependencies.

3.   It can be economically reasonable for companies to use the potential of joint value creation. This is partially achieved through the use of IT systems, for example, by making coordination and communication more efficient and effective.

4.   However, the interfaces resulting from joint value creation require a process and system integration into the company's internal IT systems.

5.   A process and system integration of the interfaces makes the company borders more permeable for information. When designing these interfaces, it is therefore essential to consider security aspects.

6.   The management of cross-company interfaces through IT systems is thus one of the core tasks of business informatics.

1.1.7 Global Value Net

The cross-company significance of business informatics becomes all the more apparent when the relationships between several companies are considered. Business relations are primarily established via purchase and sales sides (buy/sell side). Here, the Internet plays a crucial role as a global information medium. Partnerships are promoted through which added value ("Global Value Net") is created.

Example: Imagine that you work for a car manufacturer. You have been assigned to organize a new supplier for the upcoming model's new wheels. So, you tender an order on a purchasing platform on the Internet. Various suppliers then contact you, who can produce the new wheel model with the help of their sub-suppliers. In doing so, the supplier to be selected also involves his sub-suppliers, who, for example, supply him with raw materials for the rubber of the tyres. The purchasing platform thus enables you to select suppliers according to certain characteristics and integrate them into your own value chain using business information technology applications. A company with many (pre-)suppliers is at the center of a close-knit corporate network. It becomes clear that most IT systems are connected via the purchasing or sales side.
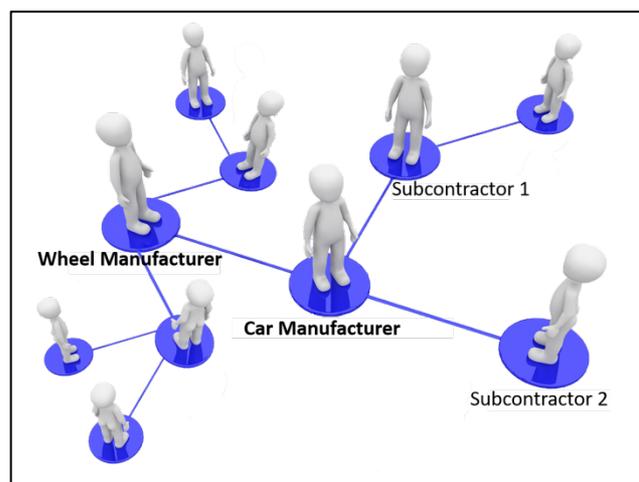
Fig. 6:   Global Value Net of an Automobile Manufacturer

1.1.8 Skills of Business Information Systems Specialists

Business IT specialists must master specific skills (their "tools of the trade") in their everyday work in order to be able to perform the tasks assigned to them.

Here are some examples:

- Word processing, spreadsheets, presentations, relational database systems, web publishing, web applications and web content management systems,

- networks, Internet services and multimedia technologies,

- knowledge in design, development and coding of programs,

- equipment and ergonomics of computer workstations

- types of IT systems, components and configuration options, and

- basic forms of operating modes and usage forms of operating systems.

1.1.9 Skills of Business Information Systems Specialists

Tasks that are handled by business information systems specialists require intellectual skills such as:

- Evaluating and using information technology in business and administration from the perspective of the manager, organizer and user,

- strategy, organization, management and competitive relevance of information processing,

- project management, development and operation of IT systems,

- analysis, modeling, design and implementation of IT systems,

- analysis, structuring and modeling of business processes,

- analysis, structuring and modeling of data sets,

- cost/benefit analysis and economic evaluations and

- prioritization, selection and adaptation of standard/industry software.

1.2   IT Systems

1.2.1 Information and Communication Systems

Information and communication systems can be defined by their characteristics. In general, these are hardware/software systems for supporting tasks in a company. Traditionally, IT systems serve to rationalize or increase efficiency in a company. The various tasks in the company are closely linked (basic principle of division of labor). Therefore, the various IT systems should form a system network. Synergy effects through this IT system network open up extensive potentials for achieving competitive advantages in addition to rationalization. In practice, different terms are used for these systems. "ICT systems", "ICS", "IT systems", "IS" but also "application systems" are common terms.

1.2.2 Elements of IT Systems

IT systems are composed of various elements. There are four levels of elements:

- 1st level: Hardware, peripherals and networking

Hardware, peripherals and networking form the basis of IT systems. "Hardware" is the general generic term for the technical equipment of a system. Therefore, peripherals and networking are strictly speaking also part of hardware. Some examples of the element's hardware, periphery and networking are:

Hardware: Server, mainframe, workstation

Peripherals: Keyboard, mouse, printer

Networking: Cable, router, hub

- 2nd level: Operating systems (system software)

Operating systems are part of the system software. An operating system is a software that enables the use (operation) of hardware. The operating system of a computer manages the individual hardware components and controls the execution of programs (e. g. application software). There are many different operating systems. Among the most important are:

Stationary operating systems: Windows, Mac OS, Linux

Mobile IT Systems: Windows Phone, iOS, Android

- 3rd level: Application systems (application software and data)

Application systems (application software and data) support humans in the execution and solution of technical tasks, such as, writing letters and e-mails, performing financial calculations, controlling production machines, creating order, delivery and invoice documents, etc. Typical application systems for processing some of these tasks are:

Microsoft Word, Outlook and Excel.

- 4th level: User

Users represent another element of IT systems. They can be considered a critical factor. The efficiency and effectiveness of IT systems rises and falls with them, since the user must be able to operate IT systems. This makes it obvious how important it is that application and system software is easy to use.

1.2.3   Isolated IT Systems

In reality, isolated IT systems are often encountered. These isolated IT systems can be called "isolated IT solutions" or "island systems". This means that no integrated software product is used in the various functional areas and management levels of a company. Instead, the divisions use individual software solutions to manage their tasks. Interface problems arise, because it is often not possible to network the systems. The consequences are media disruptions. Especially in function-oriented organizational structures, department boundaries become process boundaries.
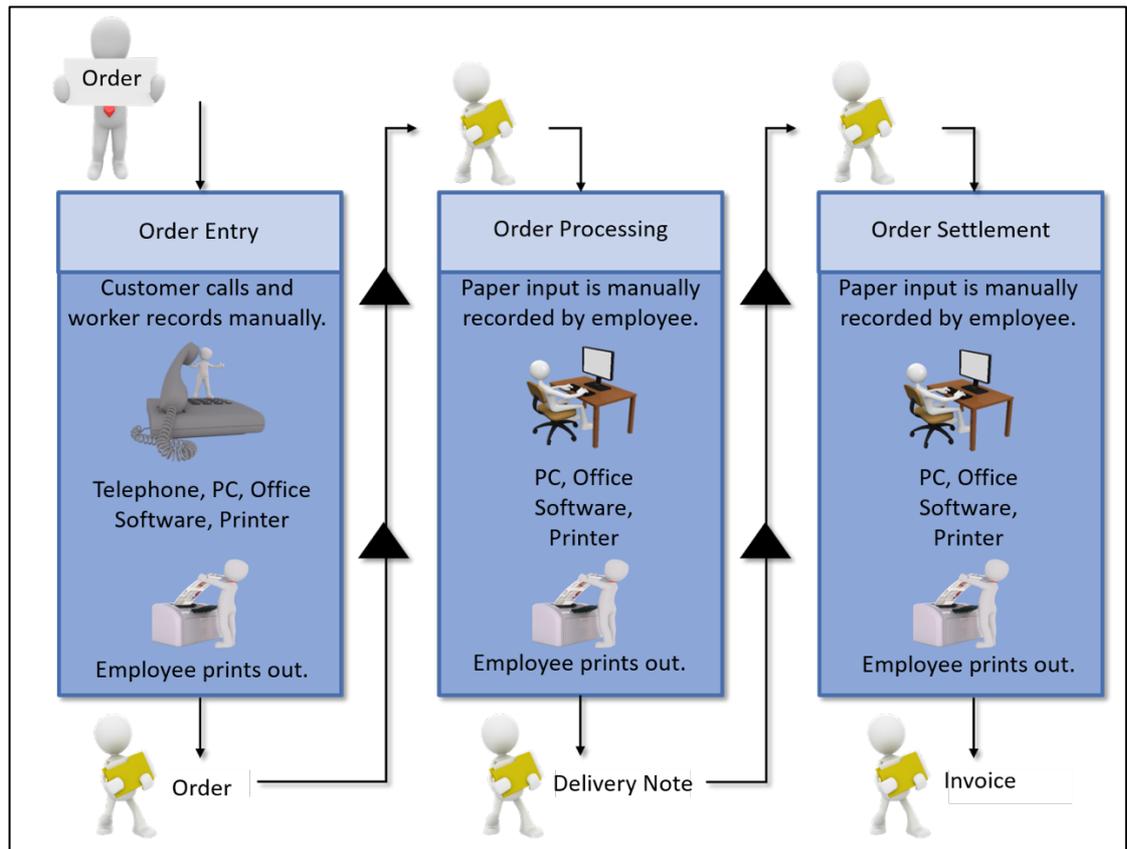
Fig. 7:   Order Processing for Isolated IT Systems

1.2.4   Problems of Isolated IT Systems

Isolated IT systems have the following disadvantages/problems:

- The high degree of division of labor results in many interfaces in the processing sequence.

- These interfaces lead to longer processing times due to the interrupted information flow.

- The consequences are a high need for coordination with low flexibility.

- Hierarchy boundaries often prove to be process boundaries.

- The result is less customer proximity and high redundancy in data storage.

1.2.5   IT System Network

An "IT system network" is a term used to describe integrated IT systems. Both horizontal and vertical integration would be ideal. Horizontal integration ensures that information can be processed throughout the company from procurement to production and sales without media disruption. Vertical integration enables information to be aggregated from the

bottom up, for example, to support decision-making at management level, and information to be detailed from the top down for the purpose of efficient coordination.

The previously described process of order processing with isolated IT systems is changed by an IT system network as follows:

1.   The customer will process their order themselves via the website. The order information is processed centrally by the system.

2.   The order is digitally forwarded to the order processing department. This automatically creates the delivery note, which is transmitted digitally to the dispatch department.

3.   The order settlement department now creates the invoice using the centrally stored data and sends that e-mail to the customer.
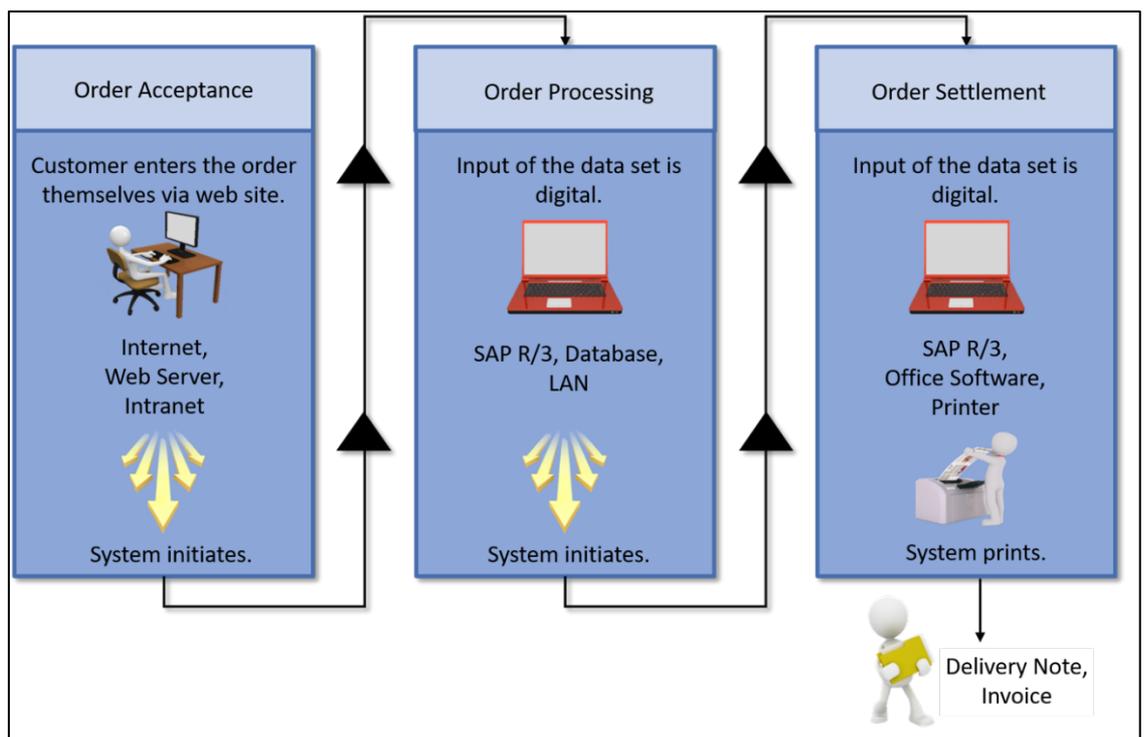
Fig. 8:   Order Processing in an IT System Network

1.2.6 IT Landscape of a Company

If you look at a company as a whole, a landscape of many IT systems becomes apparent. The company will be all the more efficient and successful, the more integrated and goal-oriented the IT landscape is structured with a "master plan". Therefore, the IT landscape of a company is also called "IT architecture".
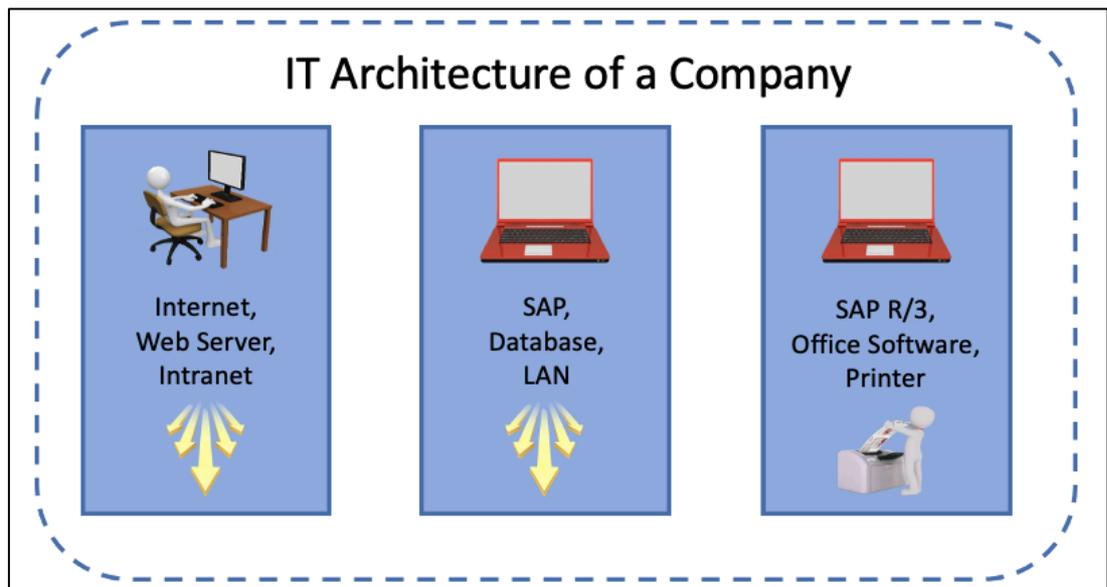
Fig. 9: IT Architecture of a Company

1.3   Final Test

No.	Question	True	False
1	**An IT system is:**		
	A hardware / software system to support a task in a company.		
	A system for rationalizing or increasing the efficiency of the tasks to be performed.		
	A single system that is ideally integrated with the various other IT systems of a company (IT system network).		
	A single system, which must necessarily be integrated with the various other IT systems of the company (IT system network).		
	Are the following statements true or false?		

2	ERP systems follow the approach of combining all types of application systems and all business-related functional areas in a central application system.		
3	The so-called "information management" is an intersection of business administration, computer science and technology.		
4	The tasks of business informatics are the conception, development, implementation, maintenance and use of computer-aided information processing systems.		
5	Production planning and control systems are personnel planning systems which are used in the HR department of a company.		
6	Isolated IT systems have the advantage that the information flow is not interrupted.		
7	Integrated IT systems (IT system network) are characterized by the fact that information flows through the company without media disruption.		
8	Business Informatics is an interdisciplinary, now largely equal discipline between business administration and computer science with a broad range of interfaces to technology.		
9	Business Informatics exclusively deals with the functional areas of a company.		
10	CRM systems (Cash Return Management Systems) are used in the finance department of a company.		
11	The main task of business informatics is considered to be the occupation with information management. This is understood as the task of providing all positions (and thus levels) in a company with the required information in an up-to-date and appropriate form.		
12	The integration of the cross-company value-added chain in the field of business informatics opens up opportunities for joint value creation. However, a process and system integration of the interfaces is not necessary.		
13	Management information systems process exclusively internal company information.		

Tab. 1:   Questions WBT 1 - Corporate IT Systems

2   Computer Structures - Network and Elements

2.1   IT System Network

2.1.1   Introduction

<u>Sebastian Itudium</u>: Good morning! It's me again, Sebastian. Today, you will learn about IT design, computer classes and the von Neumann architecture. In this WBT, you will learn basic facts about the cluster of computers in companies and the elements in this cluster. Here, too, we are actively supported by the professor and my family's company.
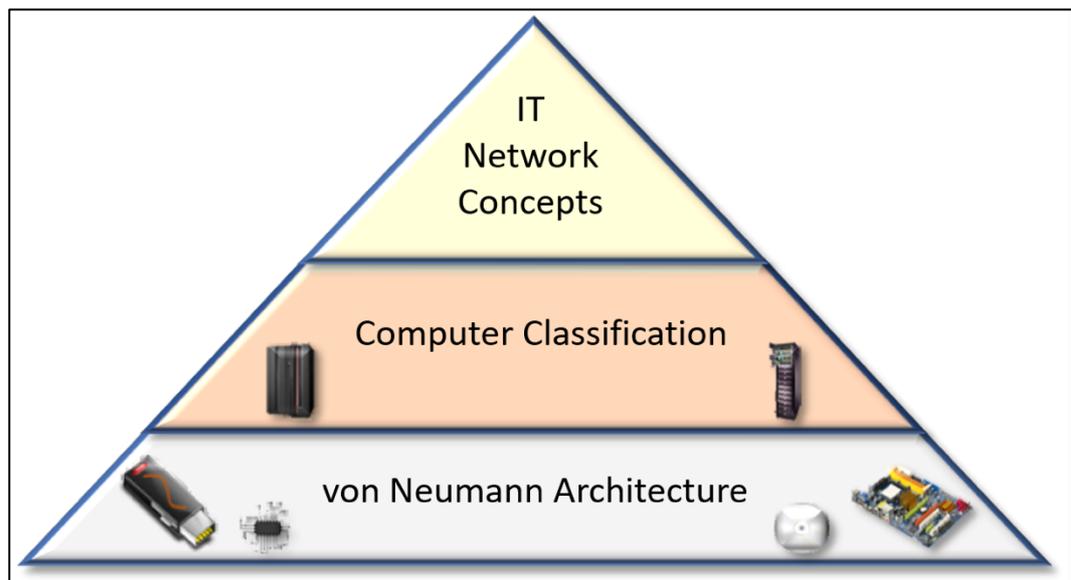
Fig. 10: Level-Pyramid of the Computer Structure

- <u>IT Network Concepts</u>: Ideally, the IT systems in a company cooperate with each other. An essential pre-requisite for efficient cooperation is the networking of the IT systems. The networking of IT systems can be achieved by a central computer concept, a level concept or a client/server concept.

- <u>Computer Classification</u>: Typically, the company's internal IT cluster comprises computers from different classes. These include: microcomputers, minicomputers, mainframe computers and supercomputers.

- <u>von Neumann Architecture</u>: All these computer classes have in common that they are based on the von Neumann Architecture, which will be covered in the third chapter of this WBT.

2.1.2 Timeline: Interconnected Systems
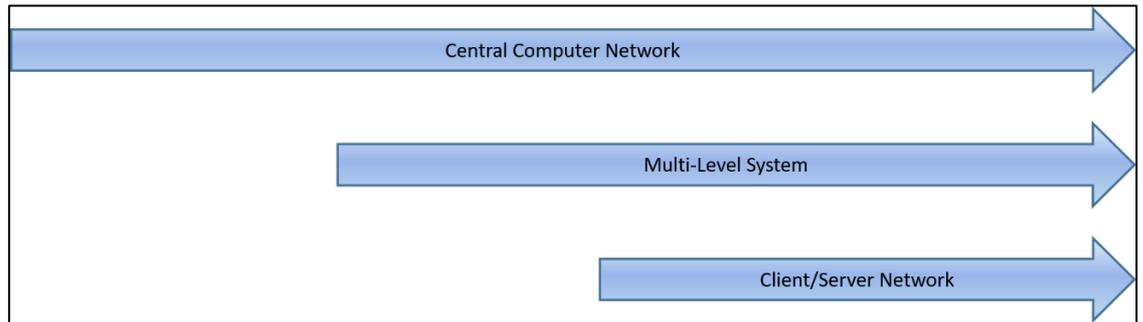
Fig. 11: Timeline of the Interconnected Systems

<u>Prof. Dr. Etlien</u>: Dear students, today we will look at the evolution over the time of IT interconnected systems. Above, you can see three time axes on which three different IT interconnected systems are plotted. Please click on the terms above to get more information about the interconnected systems.

- <u>Central Computer Network</u>: The central server network has been implemented in companies since the beginning of EDP. Applications and data are stored centrally in a mainframe computer. The employees in a company access the applications and data on the mainframe computer through so-called "data viewing stations".

- <u>Multi-Level System</u>: In the multi-level system, not only the central computer, but also less powerful computers in the various departments of a company are used. In the multi-level system as well, the employees access the central computer with the help of data viewing stations.

- <u>Client/Server Network</u>: In client-server networks, the personal computers, available since the mid-1980s, supplement the central and departmental computers with a third level, the workstation level. In contrast to data viewing stations, personal computers have their own processors and data storage media.

2.1.3 Central Computer Network

<u>Prof. Dr. Etlien</u>: The central computer network is characterized by the fact that the IT architecture has a central, hierarchical and rigid character. According to the principle "IT follows organization", data is stored centrally in a mainframe to which "dumb" terminals are connected, the so-called "data viewing stations". Accordingly, the task of IT was to rationalize by means of mass data processing.
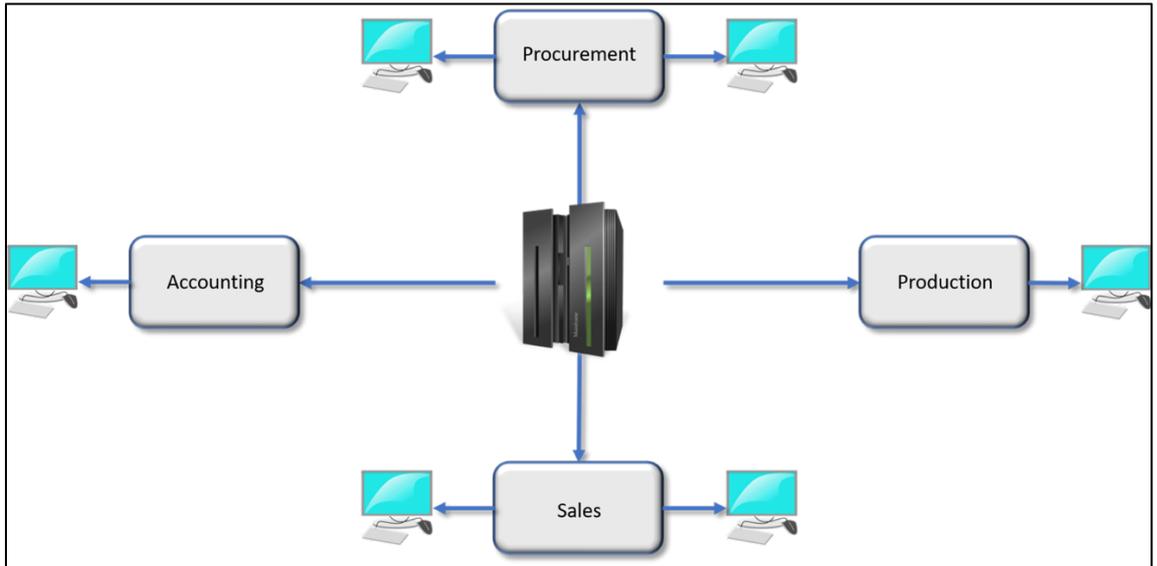
Fig. 12: The Central Computer Network

2.1.4   Multi-Level System

<u>Prof. Dr. Etlien</u>: The multi-level system was created by the decentralization of businesses. The IT had to adapt to the new organization as well. Data was still stored centrally in a mainframe, but departmental or branch servers were interposed between the mainframe and the terminals. In addition, there was an extended range of tasks. In addition to rationalization, planning and control tasks were now required, which resulted in an upgrade of the IT department.
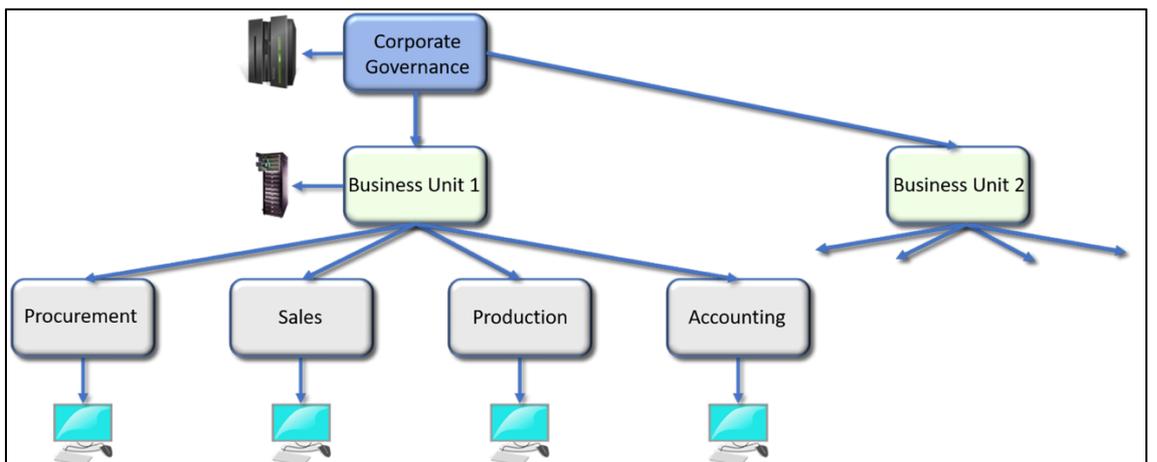
Fig. 13: Multi-Level System

2.1.5 Client/Server Network

<u>Prof. Dr. Etlien</u>: Due to the ongoing decentralization and interconnections within and outside companies and departments, the IT architecture also had to adapt. As illustrated below, the different classes of computers are interlinked. In addition, IT has been recognized as an important factor for gaining competitive advantages. Accordingly, the client/server network follows the principle "technology enables organization".
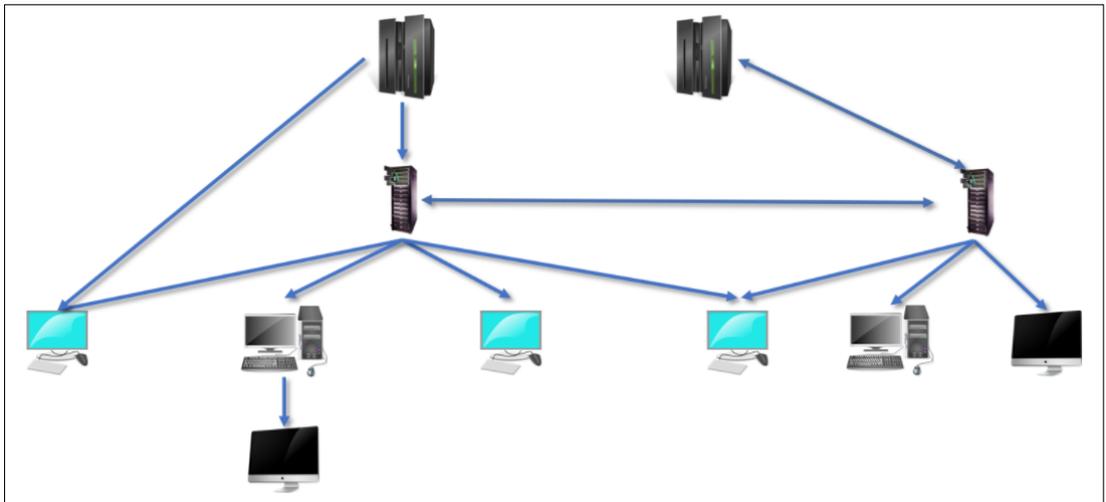
Fig. 14: Client/Server Network

2.2   Computer Classification

2.2.1 Overview: Computer Classification

<u>Prof. Dr. Etlien</u>: Dear students, we have now seen what network systems a company can implement. The network systems consist of computers that we can assign to different classes:

- Microcomputer,

- minicomputer,

- mainframe computer and

- supercomputer.

We differentiate the computer classes according to price, complexity, number of installations and computing power. The individual computer classes are examined in more detail on the following pages.
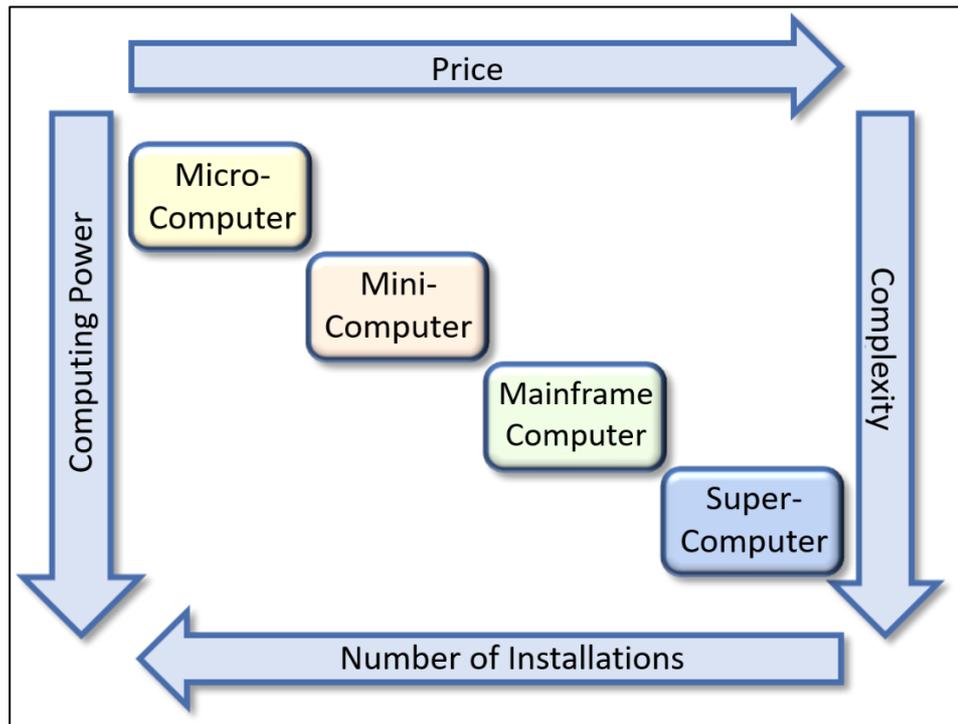
Fig. 15: Overview of the Computer Classification

2.2.2 Microcomputer

- PC: since the early 80s

- Further computer examples: notebooks, tablets, smartphones

- Standardized operating system

- User-oriented software

- Price: a few hundred Euros

- Complexity: low

- Number of installations: tens of millions

- Performance: lower third

2.2.3 Minicomputer

- Multi-user and multi-tasking capability

- Used in entire departments

- Standardized server operating systems (Linux, Microsoft, etc.)

- Centralized application software for several workstations

- <u>Price</u>: average price range

- <u>Complexity</u>: middle third

- <u>Number of installations</u>: common in larger companies

- <u>Performance:</u> middle third

2.2.4 Mainframe Computer

- Synonym: mainframe

- Central data storage

- Computing intensive application software

- Mass data processing

- <u>Price</u>: six to seven-digit Euro figures

- <u>Complexity</u>: very complex

- <u>Number of installations:</u> only in large companies

- <u>Performance:</u> upper third

2.2.5 Supercomputer

- Synonym: number cruncher

- Field of application: Big Data

- Special application area, e.g. scientific calculations like weather forecasts

- CPU-intensive tasks

- <u>Price</u>: top prices

- <u>Complexity:</u> maximum

- <u>Number of installations:</u> a few hundred

- <u>Performance:</u> upper end

2.3   von Neumann Architecture

2.3.1 Overview: The von Neumann Architecture

Prof. Dr. Etlien: All the computers we introduced work according to the von Neumann architecture. When we talk about different types of computers that we have integrated into a concept, we also need to understand how these computers themselves work. We will explain this with the help of the diagram and also take a closer look at it in the following WBT. As shown below, a computer is divided into the central processing unit, which itself contains various elements. Connected to this unit is the so-called "periphery", to which external memory as well as input and output devices belong. Between those elements there are interfaces for connecting these units.
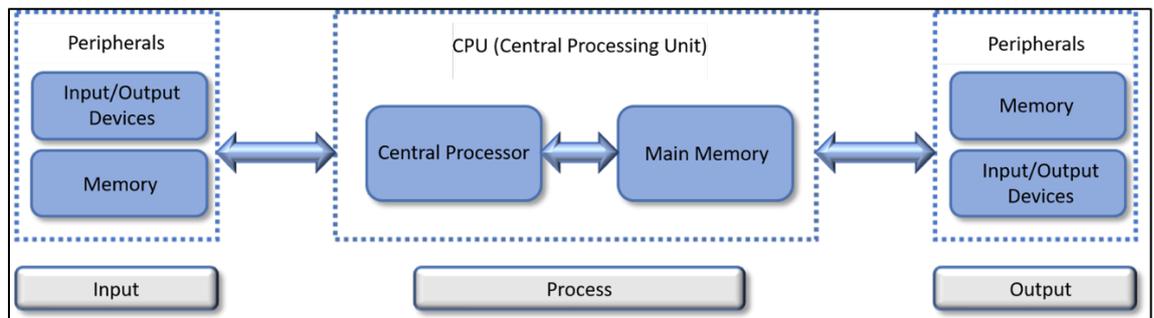
Fig. 16: Overview: The von Neumann Architecture

2.4   Final Test

No.	Question	True	False
1	The level concept follows the approach:		
	"Technology extinguishes organisation"		
	"Technology follows organisation"		
	"Technology enables organisation"		
2	There are various concepts for networking the hardware infrastructure. These are:		
	The Multi-Level Concept		
	The Client/Server Concept		
	The ITC Concept		
	The Central Computer Concept		
3	RAM and ROM are components...		
	Of the periphery		

	Of the main memory		
	Of input and output		
4	The circuit concept of the von Neumann Architecture contains the following components:		
	ALUs - calculator		
	Memory - storage device		
	Central Processing Unit		
	I/O Unit - Input/Output Unit		
	Bus - connection system		
5	Number Cruncher …		
	Can be found at almost every university		
	Can also be run privately		
	Can perform simulation calculations.		
	Are the following statements true or false?		
6	One goal of IT systems is that access to data and programs must be possible from different locations.		
7	The networking of IT systems should enable rapid data exchange between all components.		
8	The central computer concept was mainly pursued until the early 1990s.		
9	With the level concept, the primary task of the technological use of "rationalization" was supplemented by planning and controlling tasks.		
10	The computing power of a desktop PC is greater than that of a minicomputer.		
11	Due to their complexity, supercomputers are less common than microcomputers.		
12	The main task of mainframes is mass data processing.		
13	Minicomputers are often used as "link computers" with a pre-processing function between micro- and mainframe computers.		
14	The "Central Processing Unit" belongs to the von Neumann Architecture.		
15	Only computers up to about 1990 are based on von Neumann Architecture.		

Tab. 2:   Questions WBT 2 - Computer Structures - Network and Elements

3   Computer Configuration - Central Processing Unit, Peripherals, Interfaces

3.1   Overview of the von Neumann Architecture

3.1.1   Introduction

Sebastian Itudium: In the last WBT, we got to know IT system networks, computer classes and the von Neumann Architecture. Now, we will look at the von Neumann Architecture again and focus on its individual components: central processing unit, peripherals and interfaces. The von Neumann Architecture describes how a computer works and is structured in general. After we will have discussed the components and elements of a computer, we will have a look at a workstation computer.

3.1.2   von Neumann Process: IPO

Prof. Dr. Etlien: Before we will have a look at the individual components, we have to understand how a computer processes data. This also explains the purpose of the individual components of the von Neumann Architecture. The "IPO principle" is a process that takes place within the von Neumann Architecture during data processing. Data processing takes place in the central processing unit. Each computer works according to the IPO principle:

- Input,

- process and

- output.

The chart on the right is for clarification purposes. Following is a description of the individual activities of the von Neumann components.
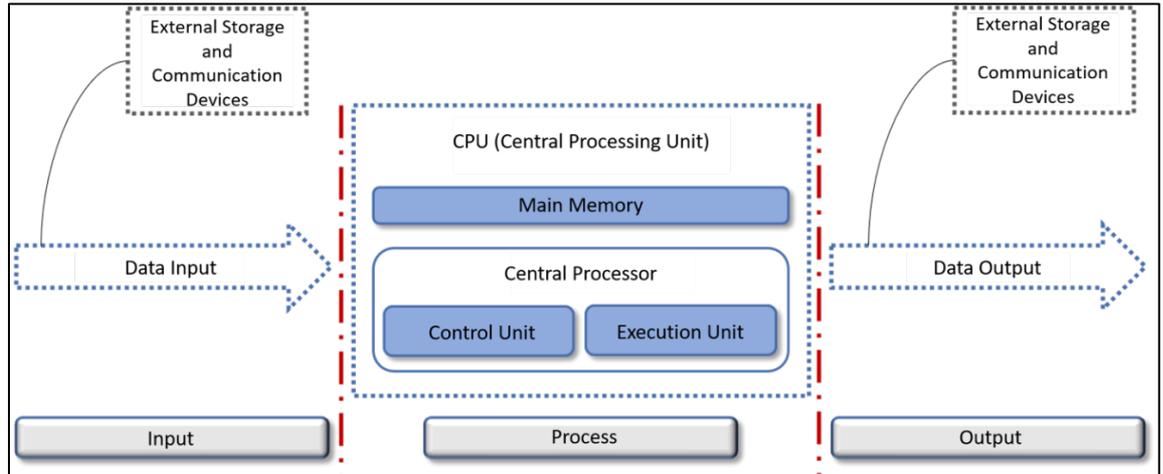
Fig. 17: von Neumann Process: IPO

3.2   Central Processing Unit

3.2.1 Central Processing Unit

<u>Prof. Dr. Etlien</u>: In the CPU, a distinction can be made between the central processor and the main memory. The central processor is responsible for the processing of tasks. The interaction of two components is important here:

- The <u>arithmetic logic unit</u> carries out logical and arithmetic operations.

- The <u>control unit</u> ensures that instructions and data are fed from the main memory to the arithmetic and logic unit at the right time and in the right function.

The main memory can also be divided into two components and is responsible for storing commands and data during processing:

- <u>Random Access Memory</u> (RAM) is a random access memory that can be both, read and changed.

- Data in the <u>Read-Only Memory</u> (ROM), can only be read, but not changed.
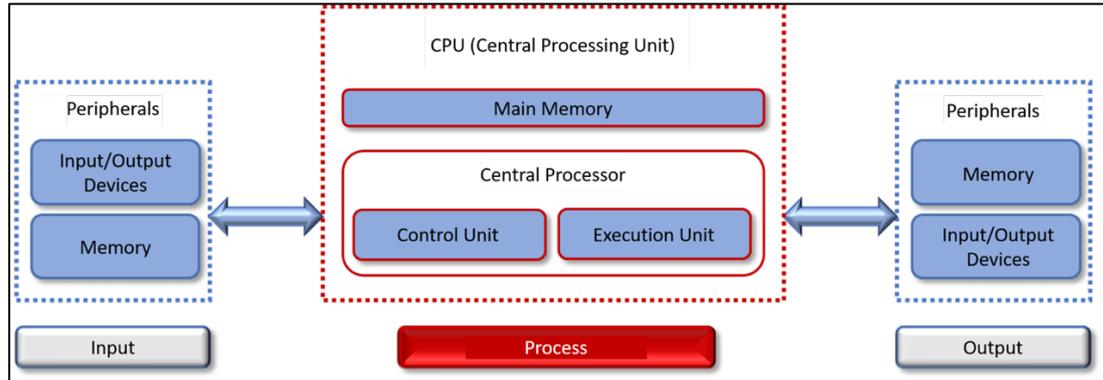
Fig. 18: The Central Processing Unit

3.2.2   How Does the Central Processing Unit Work?

<u>Sebastian Itudium</u>: Let's review an example of how the IPO principle works. In the following, I will specifically talk about the data processing of the CPU. The central processing unit (CPU) receives the order to add 3 and 5. To do this, the order is first sent to the main memory. Then the control unit takes the necessary information one after the other and passes it on to the arithmetic logic unit. The arithmetic logic unit now calculates the result and transfers it to the control unit, which then sends the result back to the main memory. Finally the result (8) is output by the main memory.

3.3   Peripherals

3.3.1 Overview: Peripherals

<u>Prof. Dr. Etlien</u>: Now that we have learned how the central processing unit works, let's look at the computer peripherals. Besides the central processing unit and the interfaces, the peripherals are the third component of the von Neumann Architecture. In this chapter, we will look at the individual components of the peripherals and provide an overview of these components. The peripherals can be divided into:

- Input devices,

- external storage and

- output devices.
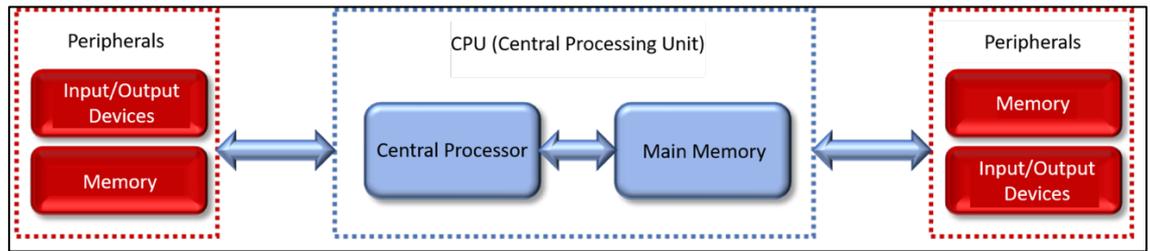
Fig. 19: Peripherals

3.3.2   Input Devices

<u>Mr. Sappro</u>: Welcome back to my department. As you have already noticed, the peripherals include a large amount of devices. We will therefore limit ourselves to a few that you will probably find at your future workplace. Input devices are devices that can be used to enter control, text or image information. Here are some examples for each conventional input device:

- <u>Mice</u>: A so-called "mouse" can be used to feed control information into a computer and reproduce it on the screen. A mouse has function keys with which objects on the screen can be activated or edited by clicking on them. An optical mouse, for example, registers movements using a light-emitting diode (LED) or a laser that scans the underlying surface.

- <u>Keyboards</u>: A keyboard is an input device with a large number of keys arranged in a specific way. Each key is assigned a specific meaning. A microprocessor in the keyboard recognizes which key has been pressed or released and forwards a corresponding code to the computer. A distinction is made between numeric, alphanumeric, combined and superimposed keyboards.

- <u>Scanner</u>: A scanner uses light to scan a document and measures the corresponding brightness and color value for each pixel. This digital image information is sent to the computer.

3.3.3   External Memories

<u>Mr. Sappro</u>: External memories are used to permanently store data. A distinction is made between:

- Sequential storage: On a sequential storage device (e.g. magnetic tapes), data is stored in blocks one after the other. To access a particular block of data, the magnetic tape must be rewound to the relevant position. During this process, the tape data must be continuously read to check whether the relevant point on the tape has already been reached. Direct access to a specific data block is not possible without continuously reading and checking the previous data blocks.

- Direct access memory: In contrast to sequential memories, direct access memories (e.g. hard drive) can be used to access a specific data block without having to check other data blocks. Thus, a hard drive is "formatted" before it is used for the first time. This means that sectors and tracks are marked on the disk by magnetization. The control software of the hard drive keeps a directory showing which data blocks are stored in which sectors and tracks on the disk and where free space is still available. To access a particular data block, the read/write head of the hard disk can be placed directly at the correct position on the rotating magnetic disk with the aid of the directory information.

Sequential storage is still used today for larger, outsourced backups because it can store a considerable amount of data and is cost-effective.

Direct access memory is further divided into:

- Magnetic: Conventional hard drives with rotating disks and read/write heads are typical magnetic random access memories. A hard drive consists of magnetic disks and movable read/write heads. The movable read/write head and the rotation of the disk allow all sectors and tracks to be directly accessed. Depending on the storage capacity, a hard disk consists of several magnetic disks and corresponding read/write heads.

- Optical: The operating principle of optical data carriers, is the same as that of hard drives. Optical data storage media use light or laser-generated thermal energy to write and read data on optically reactive material. The data is represented by the microscopic pits in the storage unit. Typical storage sizes for a CD are up to 900 MB, for a DVD up to 8.5 GB and for a Blu-ray up to 128 GB.

- Semiconductor data carriers: Semiconductor data carriers include all carrier media that hold data on memory chips. These semiconductors sometimes include SSDs, USBs, smart cards, microSDs, etc. For a few years now, SSDs in particular have

been replacing conventional hard disks, which are particularly sensitive due to their mechanics. In addition, the access time on data with chip-based storage is much shorter than that on optical and magnetic conventional storage media.

3.3.4 Output Devices

Mr. Sappro: For output devices, you can differentiate between indirect and direct output. "Indirect output" refers to machine-readable codes, such as the barcode on a product package or the QR code, which can be read with the help of a smartphone. The direct output can, in turn, be differentiated into the visual output, which includes printed output, monitors and projectors. On the other hand, you can distinguish the acoustic output, which includes voice output.
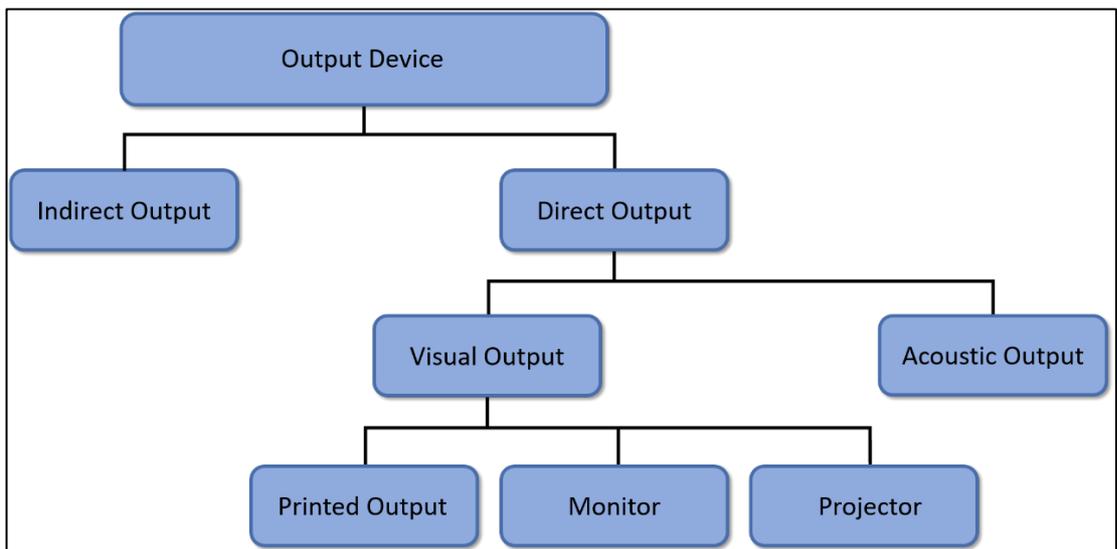
Fig. 20: Overview of the Main Types of Output Devices

- Printed output: The most widely used printers today are inkjet and laser printers. In addition to two-dimensional printouts on paper, 3D printers are increasingly used to output objects and shapes.

- Monitors: Monitors are differentiated according to:

  o **Screen size:** The screen size is measured diagonally and is specified in inches. Up to 27 inches are common in office environments. For special purposes, much larger and smaller screens are also used.

  o **Frame refresh rate:** The refresh rate of a monitor, also called "frame rate" or "refresh rate", indicates how often the image is rebuilt per second. The

higher the refresh rate of a monitor, the smoother the picture appears to the viewer.

- o **Resolution:** "Image resolution" refers to the number of pixels (picture elements). Usually, the image resolution is given by the number of pixels in width and height of the monitor. For the most accurate rendering, the image must then be scaled to the resolution of the display device.

- Projectors: Digital projectors are used to present data (e.g. PowerPoint or films) in enlarged form on a projection surface. Projectors can be used to produce high-quality images up to a diagonal of more than two meters in private and office environments.

- Voice output: In addition to visual output, acoustic output devices are increasingly becoming popular. Today, typical acoustic output devices are echo, minihome, etc. These devices output both, speech and music, serve also as input devices as well. Acoustic output and input devices have always been used to enable barrier-free operation of computers.

3.4   Interfaces

3.4.1 What Are Interfaces?

How does the central processing unit communicate with the peripheral devices or parts of the central processing unit with each other? This task is performed by interfaces. Interfaces can also be called "data paths"; they transfer data as internal data paths between the components of the central processing unit on the motherboard and as peripheral data paths between the central processing unit and peripheral devices.
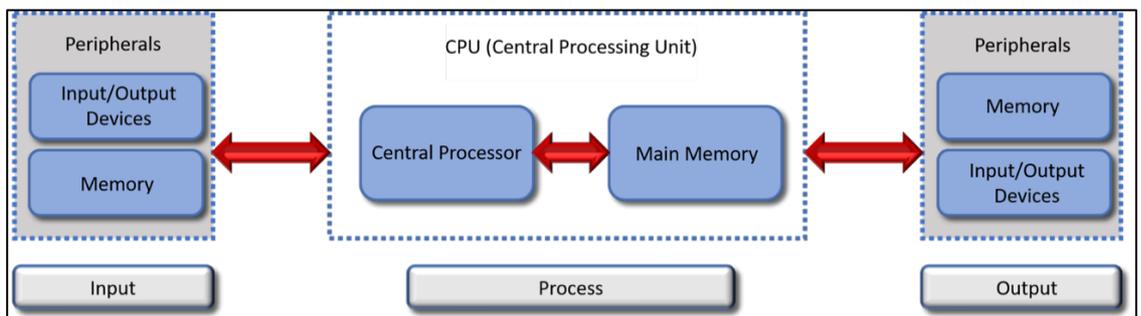
Fig. 21: Interfaces in the von Neumann Architecture

3.4.2 Where Are Interfaces?
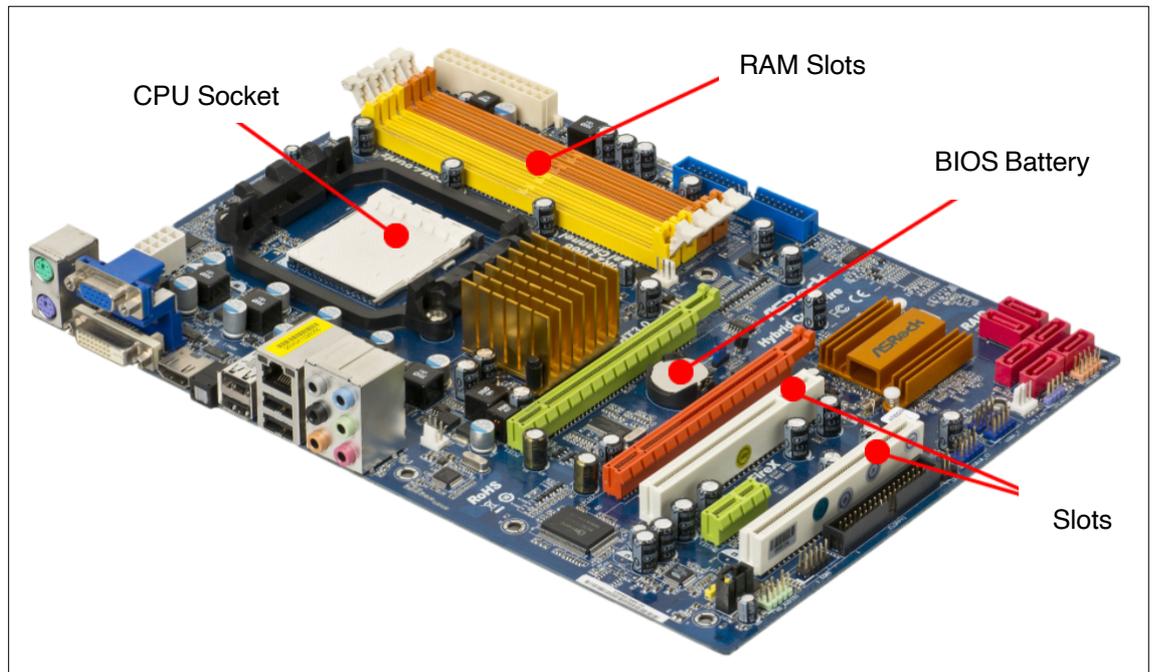
Fig. 22: Internal Interfaces

This main board of a PC is used to show the internal and external interfaces:
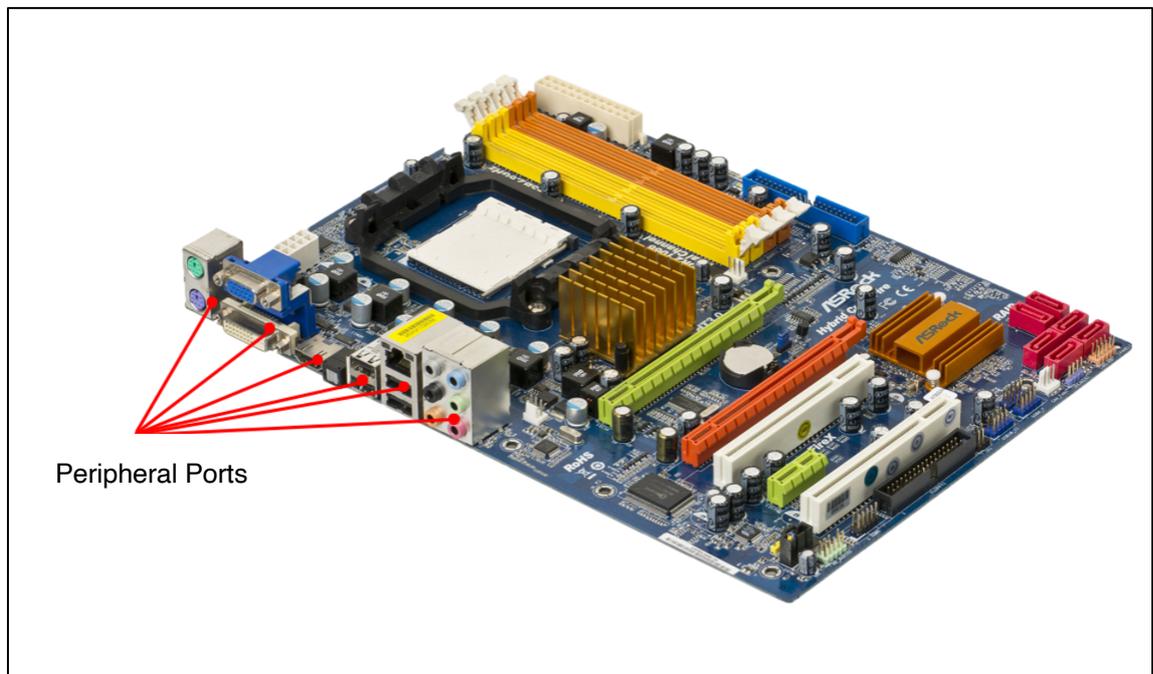
Fig. 23: External Interfaces

3.5 Workstation Computer

3.5.1 Performance Characteristics

<u>Mr. Itudium</u>: Now that you have learned how the individual components of the von Neumann architecture interact, let's take a look at the performance characteristics of a typical workstation computer in our company:

- An inkjet printer with Wi-Fi connection.

- A monitor with 21 inches, 60 Hertz and 5120 × 2880 px resolution.

- One hard drive with 2 TB of storage.

- The optical drive is available with a Blu-ray player.

- A multi-card reader that can read micro SD, CF and SD cards.

- Each of our computers has HDMI, USB and Ethernet interfaces.

3.6 Final Test

No.	Question	True	False
1	The monitor resolution...		
	Is measured in width x height.		
	Is measured in width x depth.		
	Is measured in depth x height.		
2	Select all image input devices.		
	Scanner		
	Keyboard		
	Webcam		
	Graphics tablet		
	Touchpad		
3	A USB flash drive is a...		
	Direct access memory		
	Magnetic memory		
	Optical memory		
	Semiconductor memory		

	Sequential memory		
	Are the following statements true or false?		
4	The advantage of sequential storage compared to direct access storage is the shorter access time.		
5	With sequential storage, the storage medium is divided into so-called "memory blocks".		
6	The von Neumann Architecture describes solely the peripherals of a PC.		
7	The mouse is an input device that follows three-dimensional movements with a position marker on the screen.		
8	"Sequential memory" means that data is stored sequentially and can only be read in this order.		
9	A smart card can only be used as an alternative payment method.		
10	The advantage of a USB flash drive is the standard interface.		

Tab. 3:   Questions WBT 3 - Computer Configuration

4   Computer Configuration: System Software

4.1   Basics of Operating Systems

4.1.1   Definition of Software

<u>Sebastian Itudium</u>: "Software" is a collective term for programs that are available for the operation of computers, including the corresponding documentation.

"Software" refers to the non-apparatus functional components required to operate a computer. In contrast, the apparatus components of a computer are referred to as "hardware".

4.1.2   Two Categories of Software

- <u>System software</u>: The system software of a computer is the software that controls the hardware of a computer and its basic functions. The entire system software of a computer is called its "operating system".

- <u>Application software</u>: Application software refers to programs that are not part of an operating system. Application software is used by the user of a computer to perform certain technical tasks.

Examples: Word processing MS-Word for writing letters, spreadsheet MS-Excel for making financial calculations, web browser Firefox for surfing the World Wide Web.

4.1.3   The Operating System

<u>Prof. Dr. Etlien</u>: You can open the programs of the operating system on your computer directly by entering operating system commands via the so-called "command prompt" (console). You can also enter programs of the operating system via ready-made user interfaces. The Windows Explorer, for example, is one of these user interfaces. If you delete a file in Windows Explorer, Windows Explorer causes the operating system command "delete" to be executed. When you save a file in an application program, such as Microsoft Word, Microsoft Word causes the operating system command to save the file. Operating system programs are thus not only used directly by humans, but are also used by application software or other operating system programs. This principle applies not only to Windows, but also to all other operating systems.

4.1.4 Command Prompt

<u>Sebastian Itudium:</u> The command prompt can be accessed by using the search command "command prompt", "console" or "cmd". The console provides access to the operating system and operates it by entering certain commands in the console.

Here are some example commands:

- shutdown

- ipconfig

- tasklist

- cd

- dir

- help

- color

Fig. 24: Console Command "tasklist"

4.1.5   User Interfaces

<u>Sebastian Itudium</u>: You can also enter programs of the operating system via ready-made user interfaces. The Windows Explorer, for example, is such a user interface. If you delete a file in Windows Explorer, Windows Explorer causes the operating system command "delete" to be executed. In addition, files can be created, copied, cut and moved.
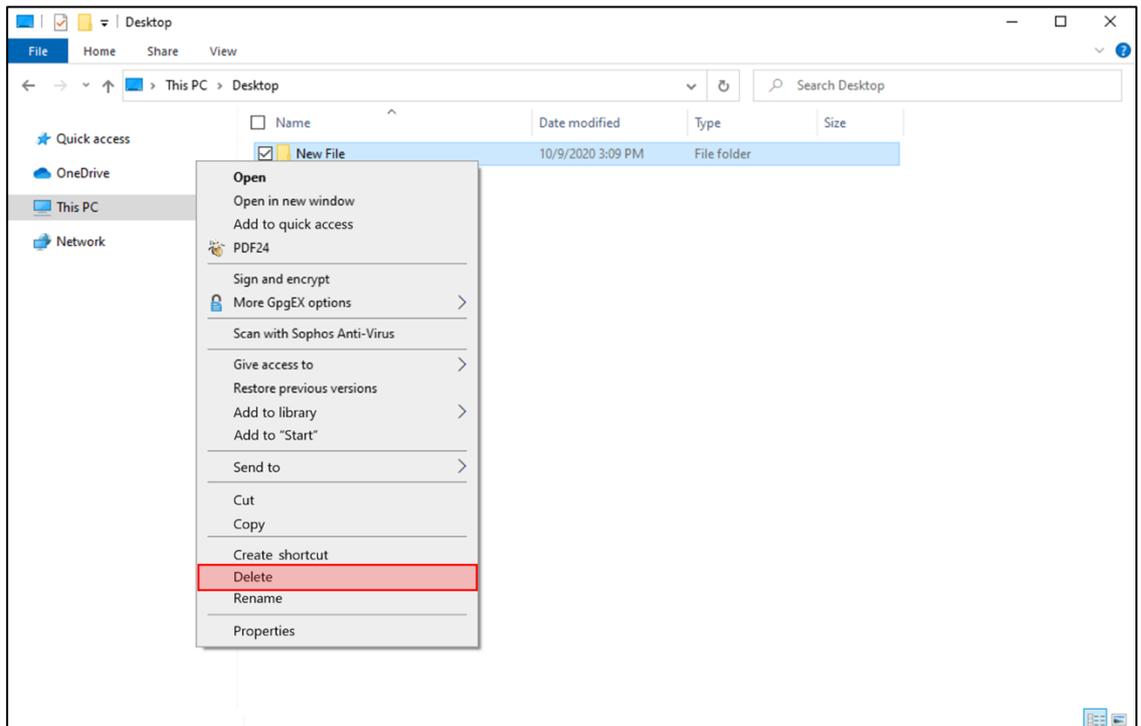
Fig. 25: Delete File in Windows Explorer

4.1.6   Application Programs

<u>Sebastian Itudium</u>: There are numerous application programs installed on a computer. Such applications include Microsoft Word and Excel, Skype and the web browser Chrome. With these applications, files can be created and saved in a directory. In addition, the programs often have access to the device control and can, for example, initiate the printing of a Word document. This represents a direct interface to the operating system.
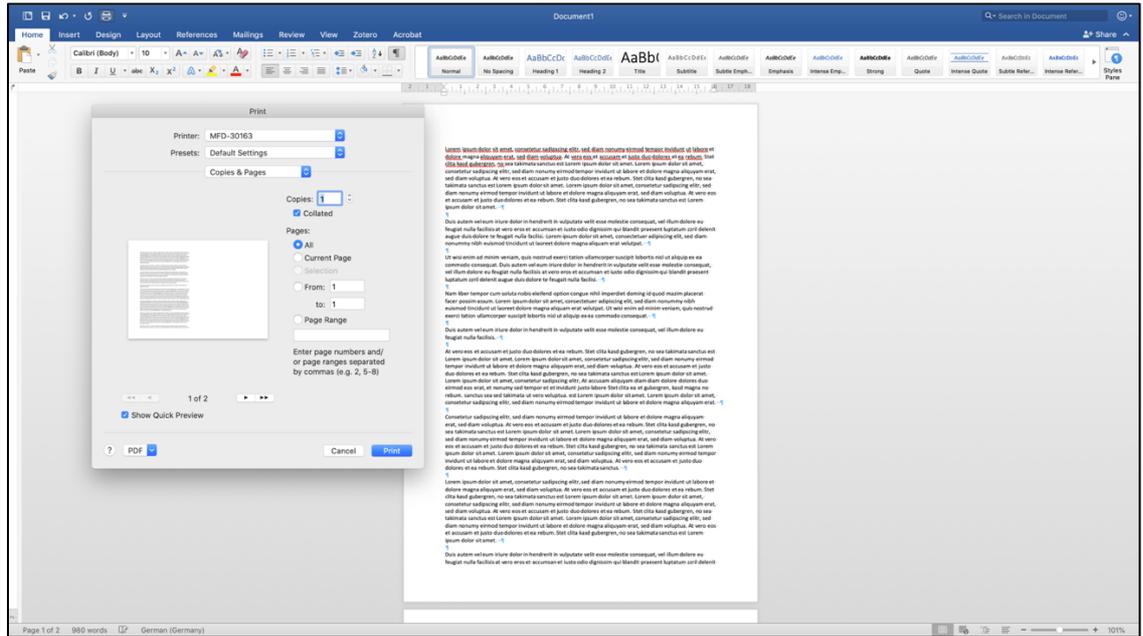
Fig. 26: Print Menu in Microsoft Word

4.1.7 Proprietary Operating Systems

Prof. Dr. Etlien: From a technical point of view, operating systems can basically be distinguished by whether they are open source or proprietary. "Proprietary" means that the operating system can only be used with the computer hardware of a certain manufacturer. Proprietary operating systems are usually protected by and for their owners by copyright and license law.

Until the middle of 2006, for instance, Apple had been building its computers according to its very own hardware standards. The Apple operating system MAC-OS was pro-grammed to control exactly this hardware. Starting in 2007, Apple built Intel hardware into its computers. The Mac OS versions have since been programmed to control exactly this Intel hardware.

The Microsoft operating systems of the Windows family are also proprietary. They only control computers that are built according to hardware standards specified by Microsoft, for example, by the manufacturer Intel or AMD.

In addition to the proprietary operating systems of Microsoft and Apple, there are spe-cially developed operating systems, especially in the mainframe and server area.

4.1.8 Open Source Operating Systems

<u>Prof. Dr. Etlien</u>: The source code of the Windows operating system can only be changed by the owner Microsoft itself. This also applies to the source code of the Mac operating system owned by Apple. Linux, on the other hand, is a so-called "open source operating system" with source code that can be changed by anyone. The Unix operating system is also based on this basic idea of open source code. These operating systems are therefore portable. Open operating systems can be adapted by every developer to control normal PCs, server computers or even mainframe computers.

4.2   Main Tasks of the Operating System

4.2.1 Main Tasks of the Operating System

- <u>Device control:</u> "Device control" refers to the entire control of the computer hardware: the central processing unit, but especially the peripheral devices, such as keyboard, mouse and screen.

- <u>User administration:</u> If different people (users) use a computer (multi-user operation, multiusing), the operating system manages who is allowed to use which programs and data of the computer and in what form. Each user is therefore assigned certain rights by the operating system.

- <u>File system:</u> The operating system organizes the storage of data on external storage media such as hard drives, Blu-ray, memory drives and also external storage media located in the cloud.
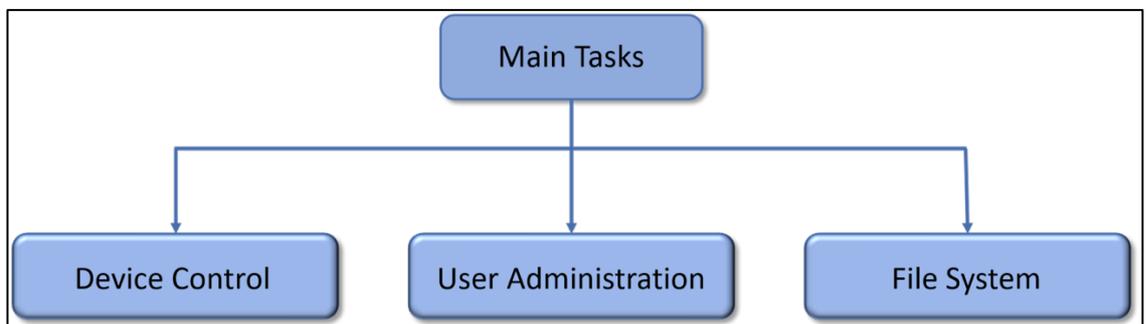
Fig. 27: Main Tasks of an Operating System

4.2.2 Device Control

Prof. Dr. Etlien: "Device control" means the entire control of the computer hardware: the central processing unit, but in particular also the peripheral devices, such as keyboard, mouse and screen. However, in order for the operating system to control these devices correctly, each device needs a so-called "driver". Drivers are programs of a particular device that provide information about its status, activation process and availability to the operating system.

4.2.3 User Administration

Prof. Dr. Etlien: Through user administration, it is possible to give users of a computer various authorizations to enable them to access the entire system or subsystem.

Personal computers use a combination of user ID and password to authenticate the respective user in order to deny access to unauthorized persons and to restrict authorizations. These rights are assigned by the administrator. Furthermore, the administrator is responsible for assigning the user ID and can precisely allocate authorizations.

He can assign a user to read only certain parts of the system, read and create new ones, as well as full access to all files and the possibility to revise and delete them. Furthermore, certain application programs and device controls can also be assigned.

4.2.4 File System

Prof. Dr. Etlien: File systems (also known as file management systems) organize data as files on storage media. These files are usually stored with a name, their size, modification date and authorization information. In order to make it clear to the respective user which data blocks are already occupied and which are still unused, a so-called "occupancy directory" is kept.

In order to show the user where the files are stored, so-called "directories" (directory folders) are created as a table of contents to organize the files. These directories are usually displayed in a tree diagram. To prevent the loss of files due to program crashes or system errors, SAN (storage area network) or NAS (network attached storage), systems are installed as company-wide storage systems.
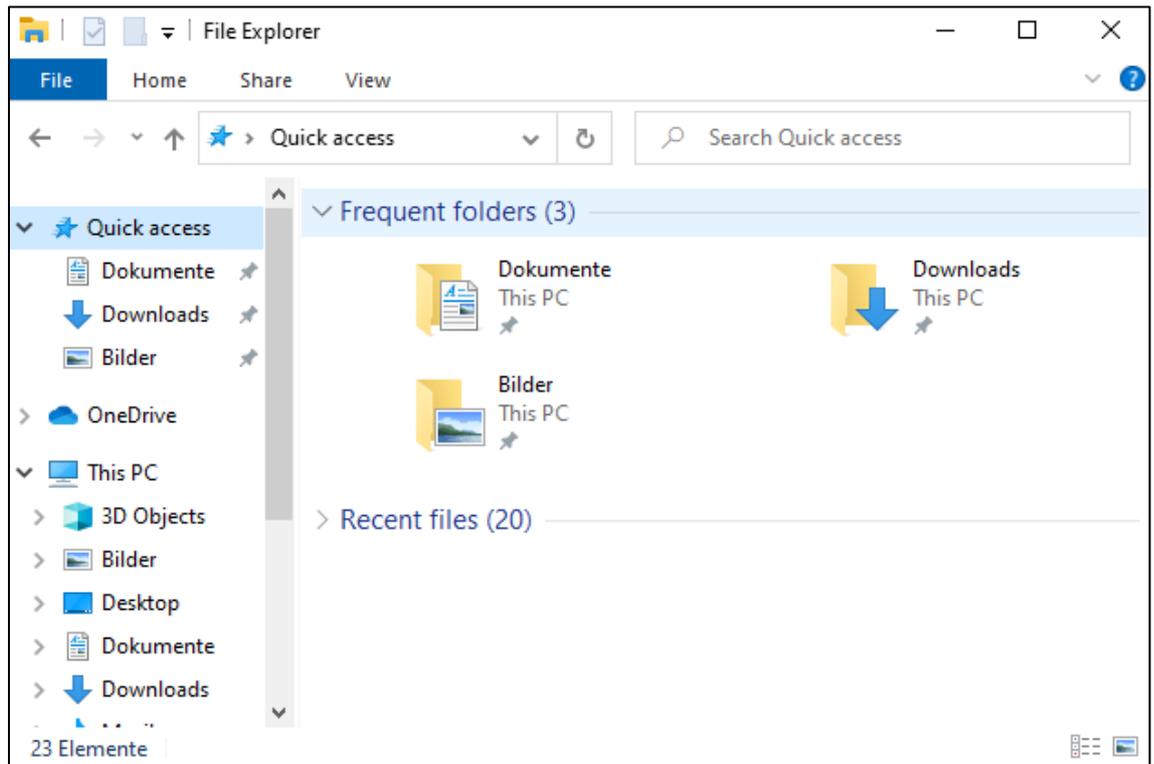
Fig. 28: Table of Contents of the Windows-Explorer

4.3   Overview Operating Systems

4.3.1 Microsoft Windows

<u>Prof. Dr. Etlien</u>: The Microsoft Corporation was founded in 1975 by Bill Gates and Paul Allen and initially did not produce operating systems, but programmed for various computer platforms using BASIC. The operating system MS-DOS was only developed through the cooperation with IBM in 1981. After the cooperation ended, a separate operating system series, Windows NT (NT - new technology), was developed.

With the release of the Windows XP series, support for the DOS operating systems was also discontinued. As early as the 1990s, Microsoft became the market leader for graphical operating systems and for their office software package. In addition, Microsoft develops operating systems not only for personal computers, but also for server computers and, since 2002, for mobile devices.
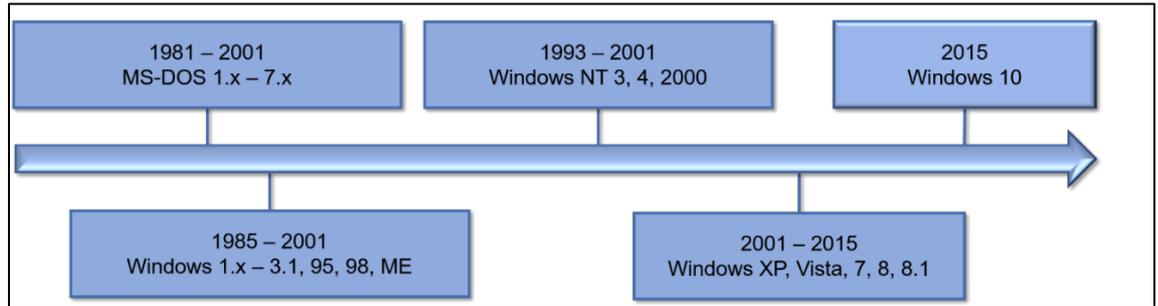
Fig. 29: Timeline of the Windows Operating System

4.3.2   UNIX-Based Operating Systems

Prof. Dr. Etlien: The development of the UNIX operating system began in 1969 in the Bell Laboratories of the US telecommunications group AT&T. UNIX is a registered brand name of the X Open Group and developed into a whole family of systems for various hardware platforms, including Linux and its distributions. Today, the Unix operating system is usually used on servers.
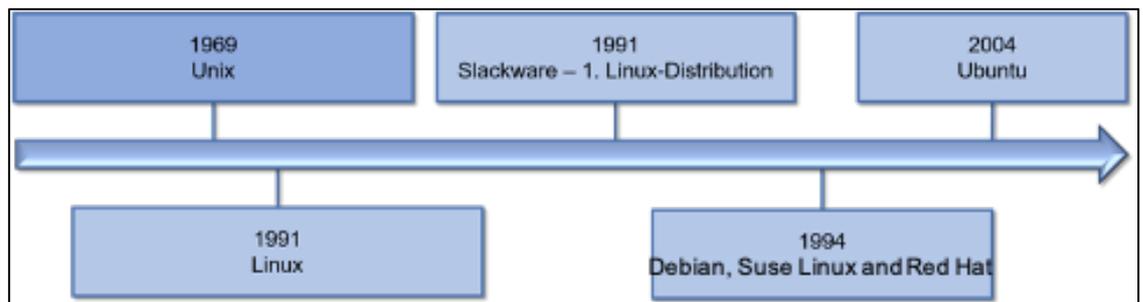
Fig. 30: Timeline UNIX and Linux Distributions

4.3.3   Apple MAC OS

Prof. Dr. Etlien: Since the 1980s, the company Apple with its operating system MAC OS was considered to be the "pacemaker" in the development of graphical user interfaces and has always placed special emphasis on the easy and consistent usability of the Apple computers offered. Compared to the Windows and UNIX world, the available range of application software for Mac OS is much smaller, but Apple has an established market segment and a loyal customer base, especially in the area of graphics and multimedia applications. Through additional products in the form of hardware and software (e.g. iPod and iTunes), Apple has been able to further expand its customer base. In 2006, Apple switched to Intel standards for hardware. The newer Apple computers (Mac Book Pro) are equipped with Intel processors.
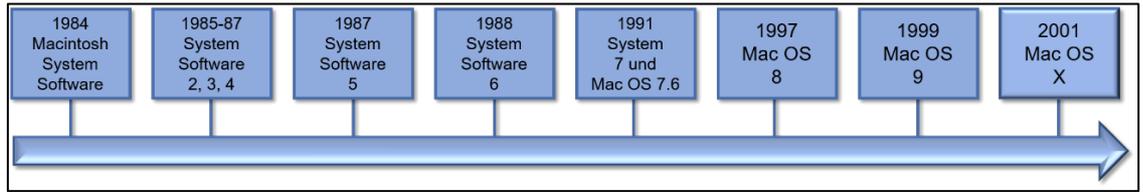
Fig. 31: Timeline MAC OS Operating System

4.3.4   Operating Systems for Mobile Devices

<u>Prof. Dr. Etlien</u>: Just like personal computers and server computers, mobile devices such as smartphones and tablets, also need an operating system. In most cases, a certain mobile phone model is bound to a certain operating system, like the iPhone is bound to Apple iOS. Mobile operating systems have been around since 1993 when AT&T launched its first PDA (personal digital assistant). However, the market leader for smartphone operating systems is Google's Android, which is largely based on an open operating system.
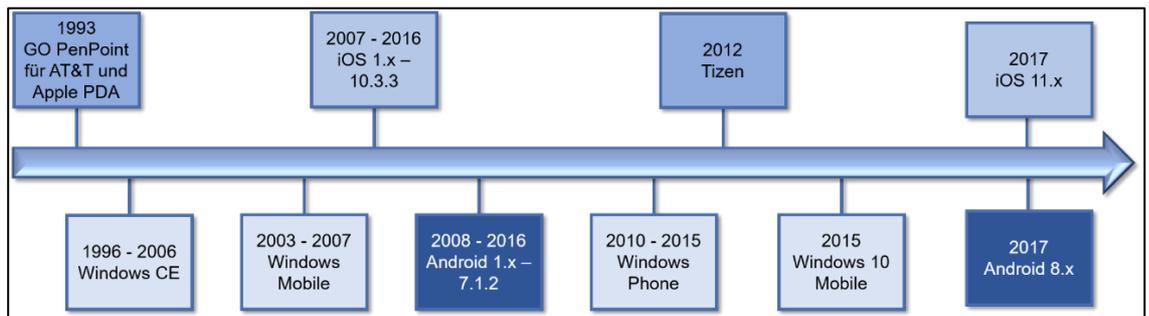
Fig. 32: Timeline of Operating Systems for Mobile Devices

4.4   Final Test

No.	Question	True	False
1	Software is differentiated into ...		
	... application software		
	... system software		
	... and hardware		
2	The main tasks of the operating system are:		
	Device control, user administration and file system management.		
	Device control, user administration and data formatting.		
	User administration, file system management and programming language development.		
	Are the following statements true or false?		
3	Apple's hardware standards are not compatible with Intel.		
4	Unix is a Linux distribution.		
5	The hardware of a computer is controlled by the device control.		
6	Operating system commands can be executed via the console, user interfaces and application programs.		
7	Software are programs for operating computers.		
8	Linux can also be an operating system for a phone.		
9	Linux is an open source software.		

Tab. 4:   Questions WBT 4 - Computer Configuration: System Software

5   Application Systems: Classification and Integration

5.1   Application Systems in a Company

5.1.1   The FamIT

As an IT consulting firm for medium-sized companies, we are responsible for planning and establishing IT systems in corporations. We know that IT systems consist of hardware and system software, on the one hand, and application software on the other. The decision on the implementation of such application systems requires careful consideration, as the management is confronted with various questions when introducing application systems:

- What types of application systems are used in the company?
- How are application systems effectively integrated in the company?

5.1.2   What Is an Application System?

<u>Mr. Sappro</u>: Application systems are used in companies to support employees in the execution of technical tasks. Application systems provide the company and its surrounding environment with important corporate information, such as business processes, pricing procedures and employee plans. An IT system consists of the following elements:

- <u>The application system:</u> The term "application system" in the narrower sense means the term "application software". The term "application" is often used as a synonym.

- <u>The IT infrastructure:</u> The IT infrastructure is the technical system (e.g. server computer, personal computer, operating system software, network) application software is running on.

- <u>And data:</u> Data is used by the application systems to work on the corporate application area and is the base of the company-relevant information.
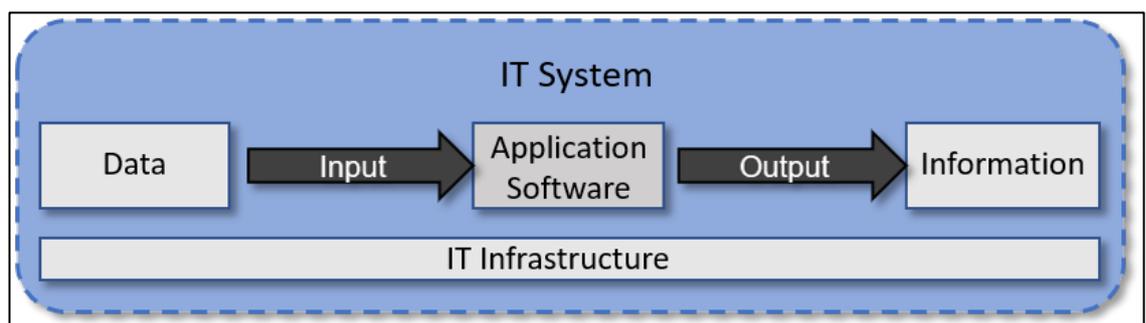
Fig. 33: Components of the Application System

5.1.3   Types of Application Software

Sebastian Itudium: We distinguish between two types of application software: standardized software and custom software. In the following part, Mr. Sappro will explain what is considered "standard" and "common" software and how to distinguish between them.

5.1.4   What Is Standardized Software?

Mr. Sappro: "Standard software" is understood to be ready-made computer programs that are used by many various companies for the same technical tasks. Standard software can be introduced into a company relatively quickly and cost-effectively. The company using the software usually has no influence on the maintenance and further development of the software. Standard software products are ready-made and can be purchased by any company at a predefined price. The functional scope of standard software is the same for all buyers.

Characteristics of standard software:

- Has a broad target group,

- predetermined, standard price,

- standardised range of functions,

- developer is responsible for further development,

- quick implementation in a company possible and

- relatively inexpensive.

5.1.5   What Is Custom Software?

Mr. Sappro: Custom software are "tailor-made" computer programs for a single company. Custom software is developed to meet the individual requirements of that company. Custom software is mainly used when no adequate standard software is available on the market. With custom software, a company can gain a competitive advantage.

Examples of custom software: A company can either develop its custom software "in-house" with its own developers, or have it developed by external service providers who charge a fee. In both cases, the entire development and follow-up costs of the custom software must be paid by the company using it.

Example KUKA: There are many companies that need a specific software solution for the production of their product, e.g., for the operation of a production line in the automotive industry. KUKA is a leading industrial robot manufacturer. KUKA robotics offers customized automation solutions using robots. These are controlled by custom software. This means that the software is developed precisely for a specific product.

Example Amazon: When it was founded, the online mail order company amazon.com had the vision of differentiating itself from other existing online shops through a user review system. However, the existing standard shop software did not support a review function. Therefore, Amazon needed a custom software that supported its business model. Amazon's current success could only be realized to a large extent by implementing custom software.

Characteristics of custom software:

- Has a special application,

- price is based on production costs,

- individual functional range,

- personal responsibility for further development,

- increased time required for implementation and

- relatively cost-intensive

5.1.6 Advantages and Disadvantages of Application Software

Sebastian Itudium: We have learned what types of application software exist. However, I still wonder what the advantages and disadvantages of these types are? That's why I asked my father to make a simple comparison.

<u>Mr. Itudium:</u> Each of our customers must be aware of the possibilities and limitations of standard and custom software.

5.1.7 Advantages and Disadvantages of Standard Software

Advantages:

1. High technical and professional quality

   - Due to specialized developers and the inclusion of the expertise of many users, standard software has a high technical and professional quality.

2. Low risk of failure

   - Standard software can be tested and evaluated before purchase.

3. Immediate availability

   - Standard software is ready-made and can be immediately implemented in a company.

4. Low acquisition costs

   - Acquisition costs are reduced, because many buyers share the development effort.

5. Continuous development and maintenance

   - Standard software is generally constantly being further developed by the manufacturer and usually also offers customer service.

6. Documentation and training available

   - In general, there are training offers for standard software by the manufacturer or by third parties.

Disadvantages:

1. Dependence on the software manufacturer

   - Standard software products depend on the manufacturer for their maintenance and further development.

2. Expensive adaptation costs may occur

   - If the functions of a standard software product do not sufficiently meet the individual requirements of a company, expensive adjustments are necessary.

5.1.8 Advantages and Disadvantages of Custom Software

Advantages:

1.   Low training requirements

   - Because in-house users have participated in the development.

2.   Customized solutions for the company

   - All specific requirements and expansion requests can be considered.

3.   Limited adaptation and consultation costs

   - Both, consultation and adjustments, can be done by the customer himself in case of self-developed individual software and do not have to be purchased externally.

4.   No over- or undersupply of program functions

   - Functions are developed that are specifically needed in the company.

5.   Competitive advantages over the competition

   - Specialized knowledge in a company can be converted into competitive advantages.

Disadvantages:

1.   High risk of costs

   - The client bears the entire development costs alone.

2.   Potential dependency risk

   - If the individual software was developed by an external service provider, the client is dependent on the external service provider for further developments and adjustments.

5.2   Classification of Application Software Based on Organizational Levels

5.2.1 Organizational Levels

Mr. Itudium: Most of our customers are organizationally divided into functional areas and management levels. Due to the complexity of different tasks and goals, different types of application systems are used on the different organizational levels:

- Executive Support System (ESS) and Decision Support System (DSS)

- Management information system (MIS) and Decision Support System (DSS)

- Transaction Processing Systems

5.2.2 Operational Level

<u>Sebastian Itudium</u>: On the operational level, operational application systems are used. These support employees in the execution of daily routine tasks (e.g., purchasing of goods, payroll accounting, warehousing, sales orders). Order processing is carried out horizontally by the company from the supplier to the shipment to the customer. It is important that the application systems in use are integrated, meaning that they are technically linked with each other.

5.2.3 Management Level

<u>Mr. Sappro</u>: Middle management is responsible for short- to medium-term planning and controlling within the company. The application systems for these tasks are often called "decision support systems" (DSS) and "management information systems" (MIS). However, the most frequently used application system in middle management is the spreadsheet (e.g., with MS Excel). Typical short and medium-term planning tasks are, pricing, production capacity utilization and advertising campaigns.

5.2.4 Strategic Level

<u>Mr. Sappro</u>: Corporate management is at the strategic level. Strategic tasks are tasks with long-term effects for the company. These include product development, market development or the decision between organic growth or company acquisitions. So-called "executive support systems" (ESS) and "decision support systems" (DSS) help the management to solve these rather unstructured decision problems. In addition to company-related information, DSS also use external information for decision making.

5.3   Classification of Application Systems Based on Functional Areas

5.3.1 Application Systems According to Functional View

<u>Mr. Itudium</u>: We have learned that different application systems are operated at different organizational levels. But, you can also distinguish application systems based on the functional areas in which they are used in. The traditional functional areas include

Production, Sales, Accounting and Human Resources. We will discuss these on the following pages. However, there are also other functional areas within a company, such as IT, Research & Development and Logistics.
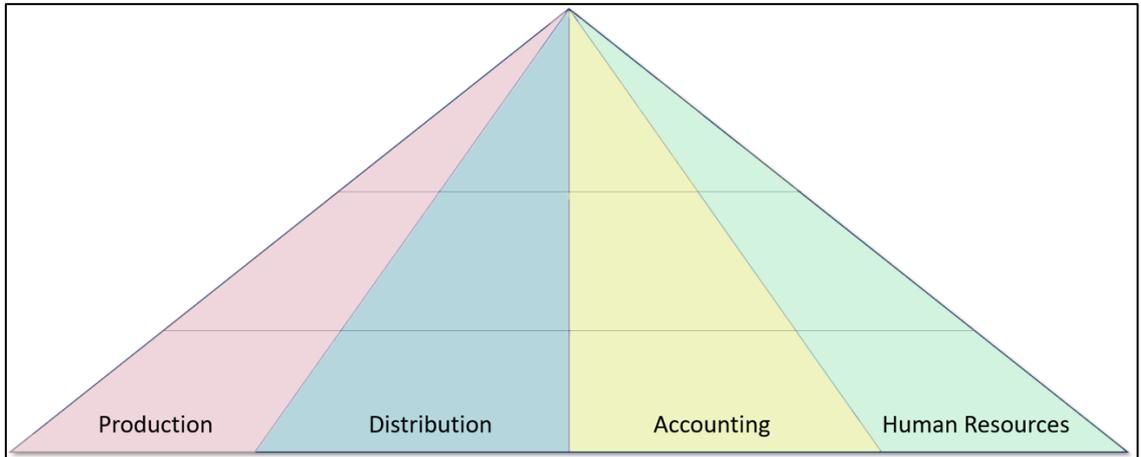
Fig. 34: Functional Areas in the Company

5.3.2   Application Systems for Production

Production Planning and Control Systems (PPC systems) are used in the production departments of companies. PPC systems support employees in their tasks on three different organizational levels.

• Medium and long-term production capacity utilization	• Calculation by decision support system of efficiencies of plants, production lines and production facilities • Calculation of Key Performance Indicators (KPI) of assets
• Investment planning of new production facilities	• Total Productive Maintenance Systems (TPM) to monitor problems, deadlines, losses in plants and production lines and facilities
• Location analyses of new production facilities	
• Planning of production quantities, processes	• Electronic control station for measuring downtimes and planning maintenance intervals • Optimization of the utilization of machines through cycle analyses
• Material demand planning	• Calculation of order points, order quantities and order frequency
• Machine maintenance	
• Production monitoring	• Electronic control station monitors machine sensors for failures and scrap production • Time logging for employees at production facilities
• Assignment of machines	
• Material procurement	• Electronic control station monitors material supply and order stock levels • eProcurement when order stocks are reached

Fig. 35: Production Application System - Tasks at Organizational Levels

5.3.3 Application Systems for Sales

In the areas of Sales and Marketing, sales support systems are used among others. Sales Support Systems support the following tasks at the different organizational levels:

• Monitoring sales developments	• Visualization of short-term turnover developments through traffic light systems in MIS • Long-term sales development through visualization of maturity curves of products
• Analyzing new sales markets	• Simulation systems for estimating sales volumes based on market key figures (e.g. potential buyers, points of sale, competitiors)
• Planning new products and services	
• Analysis of the competitive situation	• Market observation through web-scraping and data mining
• Market research	
• Advertising activities	• CRM-Mailings • Placing of AdWords campaigns in the search engine
• Price determination	• Spreadsheet calculation by calculating discounts • Spreadsheet for sales aggregations over periods, regions and employees
• Analyse of sales data	
• Performance evaluation of sales force	
• Finding and contacting potential customers	
• Editing orders	• Order processing with inventory control of ordered products via warehouse management system • Credit assessment of customers through internet connection to credit bureau
• Tracking sales	
• Providing customer service	• Complaint handling via Web Site • Complaint processing via trouble-ticket system

Fig. 36: Sales Application System - Tasks on Organizational Levels

5.3.4 Application Systems for Accounting

Accounting and Reporting Systems are used in the accounting department. Accounting and reporting systems support the following tasks, among others, at the different organizational levels:

• Long-term corporate financing	• IPO-support (Initial Public Offering) • Equity/debt analysis • ERP Systems
• Annual or consolidated financial statements	• Financial Accounting • ERP Systems
• Monitoring and controlling of financial resources	• Liquidity planning via banking service interface • API-Banking
• Cost and performance accounting	• Financial accounting systems • Operating statistics database • ERP Systems for the calculation of marginal return, full costs and investments
• Tracking the use of financial resources	
• Payroll accounting	• Calculation using operating data and transfers via payroll accounting
• Making payments to suppliers	• Accounts payable accounting with managements of payment terms and automatic direct debits
• Creating reports on receivables, liabilities, income, expenses and depreciation	

Fig. 37: Accounting Application Systems - Tasks on Organizational Levels

5.3.5 Application Systems for Human Resources Management

Human Resources is responsible for recruiting employees for a company, managing employees and dismissing employees. These activities are carried out with the help of Human Resources Management Systems (HRMS), amongst others. HRMS support the following tasks, among others, at the various organizational levels:

• Leadership concepts	• Intranet documentation of leadership concepts • Communication of leadership concepts to employees
• Job / requirement profiles	• Intranet documentation of job/requirement profiles • Communication of job/requirement profiles to the public
• Visions and missions	
• Planning of recruitment measures	• Extranet cooperations with public and private job markets and media • Evaluation of assessment events
• Planning of the payment system	• Mapping of tariff systems in HRMS • Management of bonus systems in HRMS
• Further training concepts	
• Acquisition of employees	• HRMS integration for placing ads on online job boards • HRMS for planning and implementation of assessment events
• Development of employees	
• Evaluation of employees	• Management of development plans for employees in HRMS • Booking and payment of further education events for employees

Fig. 38: Application Software HR Management - Tasks on Organizational Levels

5.4   Integration of Application Systems

5.4.1 What Does Integration Mean?

Sebastian Itudium: We now know how to classify application systems. But, what do application systems have to do with "integration" and "business processes"?

Mr. Itudium: The Latin term "integration" can be translated as "incorporation into a larger whole". In business, however, the term takes on a broader dimension. In this context, integration refers to sub-processes that merge into a larger unit, such as a business process. Especially in business informatics the connection of people, task and technology is implied. Functions, processes and departments are supposed to be connected with each other.

5.4.3 Problem: Isolated Systems

Prof. Dr. Etilien: In the past, application systems were predominantly function-oriented, i.e., each functional area had its own application system. However, this led to the fact that the various application systems were operated as unconnected island systems in the various functional areas. In addition, the individual application systems each had individual data sets, which led to additional data islands.

5.4.4 A Solution: Data Integration

Prof. Dr. Etilien: We now know that island systems can also produce individual data sets. A first step towards solving this problem is to enable all application systems to access the same database in order to work on it. In this case, all functional areas would, for example, work with the same customer data, warehouse data, sales and production data. At least, the unconnected data islands would then disappear.
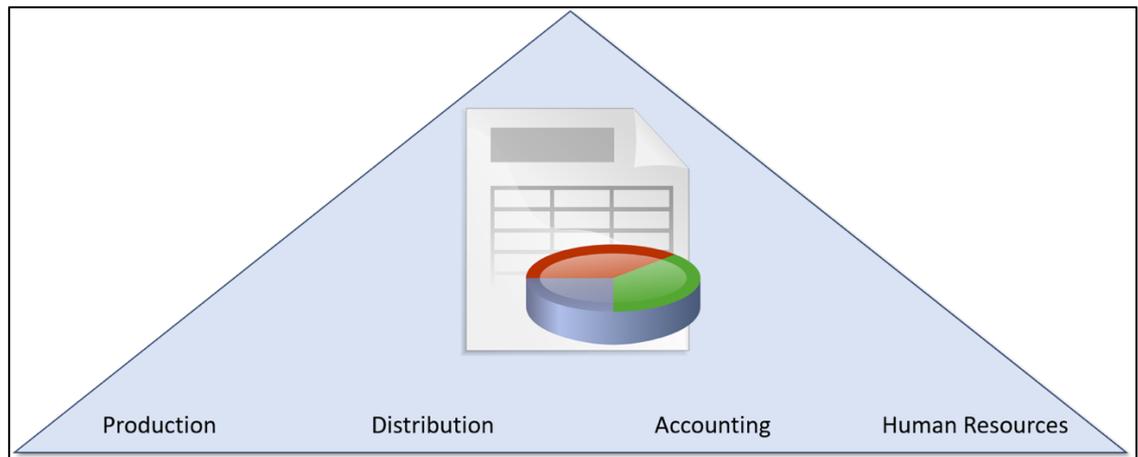
Fig. 39: Data Integration

5.4.5 Business Processes

Prof. Dr. Etilien: A business process is a structured sequence of work steps. Business processes are cross-functional, so that interfaces require to be overcome. Employees from different functional areas form a team to process the work steps. An effective coordination of business processes is only possible with powerful application systems that combine information from the different functional areas.
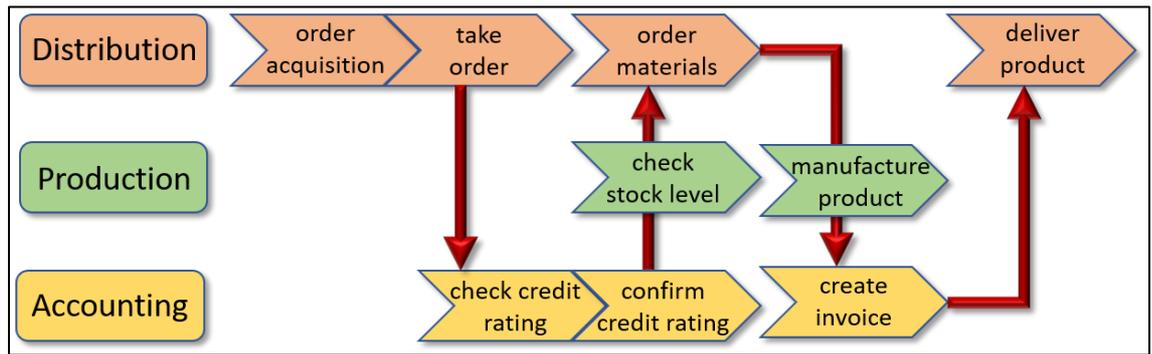
Fig. 40: Business Processes

5.4.6   What is Integrated?

Prof. Dr. Etilien: Dear student, the connection between application systems and business processes should be clear now. When integrating application systems, the following aspects are of particular importance:

- Data integration describes the joint and standardized use of data. This means that a company-wide database to which all application systems are connected can be used by company-wide functional areas. The goal of data integration is the redundancy-free storage of data and the elimination of data inconsistencies.

- Functional integration: We have already seen what functional integration means in the integration of individual functions into business processes. We have learned that functional sequences can also extend beyond departmental boundaries. The application systems involved in the individual functional areas must be functionally linked to each other in order to support this work sequence.

5.4.7   Vertical Integration

Prof. Dr. Etilien: The direction of integration describes the integration within and between the different hierarchical levels of a company. A distinction is made between vertical and horizontal integration. Vertical integration means supplying the application systems of the higher management levels with data from the transaction processing systems. The aim of vertical integration is to provide decision-relevant data for medium and long-term planning at management and strategic level. At the operational level, finely detailed data on daily business transactions is obtained, which is further aggregated at the management and strategic level.

Example: Suppose you work for a company that sells products in all federal states. In such a company, it is common practice to add up (aggregate) the sales figures of each state. A further aggregation is usually done by aggregating the sales figures of the eastern and western federal states. Of course such a company will add up (aggregate) the sales figures nationwide and per state on a monthly and quarterly basis.

5.4.8 Horizontal Integration

<u>Prof. Dr. Etilien</u>: In addition to supplying the application systems of higher organizational levels with data from transaction processing systems, application systems must also be integrated horizontally across all functional areas. Horizontal integration means that the application systems in the functional areas support the work sequence of the business processes. Horizontal integration is thus based largely on the data and function integration described above.

5.5   Final Test

No.	Question	True	False
1	When a company purchases a standardized software product, it is also responsible for the further development of the software.		
2	What are characteristics of functional orientation?		
	Interfaces between the functional departments		
	Integration of the individual functions into business processes		
	Are the following statements true or false?		
3	Decision support systems obtain their data exclusively from within the company.		
4	The vertical integration of application systems refers to the data exchange between the different management levels.		
5	When purchasing standard software, a company bears all development costs of the software alone.		
6	Data integration describes the joint and standardized use of data across several functional areas in a company-wide database to which all application systems are connected.		
7	Finance and accounting systems support employees primarily in payroll accounting, monitoring financial resources and planning training opportunities for employees.		

Tab. 5: Questions WBT 5 - Application Systems: Classification and Integration

6   Application Systems in a Company: Example MS Dynamics NAV

6.1   Welcome to the Practice

<u>Mr. Itudium</u>: Good morning, Sebastian! You will spend today with the IT manager Mr. Sappro. Yesterday, I was visiting our customer Cronus AG to introduce an ERP system to them. You should also be interested in the presentation for Cronus AG. This will help you understand how an ERP system works and how it is used.

<u>Mr. Sappro</u>: Good morning Mr. Itudium and Sebastian! I hope you had a good night's sleep, because there's a lot to do. Please let me know as soon as you're ready to start.

<u>Sebastian Itudium</u>: All right, father. Good morning Mr. Sappro! I am already looking forward to learning more about business processes, their integration and finally the technical implementation in an application system. Finally, I get to know the everyday practice of our company.

6.2   The Business Process of Cronus AG

<u>Mr. Sappro</u>: Let's start with the familiar business process. This is a typical business process, from sales order to delivery of the product to the customer. Based on this business process, we will now get to know the ERP system MS Dynamics NAV. As an example, we will look at sub-processes from this business process to illustrate the role an ERP system plays in a company.
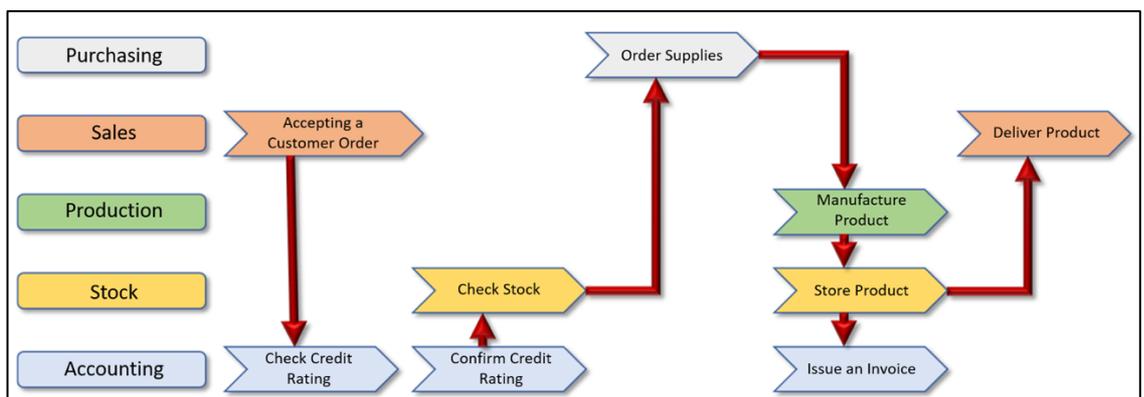
Fig. 41: The Business Process of Cronus AG

6.4   Porter and the Cash Flows

Mr. Sappro: The business process shown above only represents its flow chart. Another common representation of business process is the value chain according to Porter. The value chain according to Porter shows the departments of a company that are involved in the business process. In addition, we can map the flows of information, goods and payments using the arrows on the value creation chain. In this way, we illustrate how a company functions.
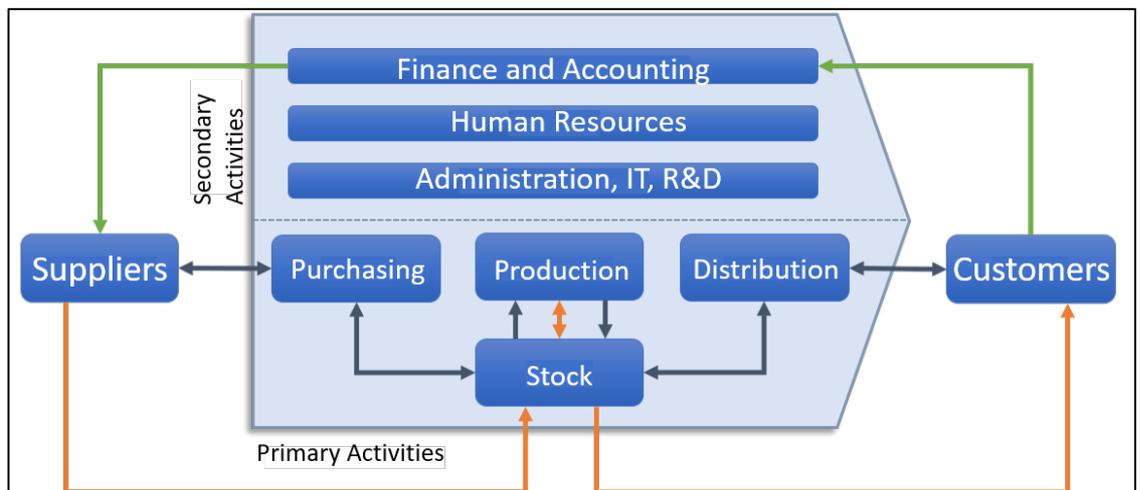
Fig. 42: Cash Flows based on Porter's Model

- Information Flow: The information flow of a business process takes place within a company, but also extends beyond its borders to customers and suppliers. An information flow between companies and suppliers could be, for example, material orders with all the important information about quantity, quality and delivery date. On the customer side, such a flow of information could be a sales order to sales and distribution. Within a company, information flows can consist of statements, orders and bookings.

- Flow of Goods: The flow of goods in a business process occurs within a company, but also extends beyond its borders to customers and suppliers. For example, goods ordered by the company are transported to the company's warehouse and put into storage. Finished products can be shipped from the warehouse to the customer. Within a company, stored raw materials can be transported to the production hall for further production.

- Cash Flows: The cash flows of a business process take place within a company, but also extend beyond its borders to customers and suppliers. To both, customers

and suppliers, account transfers for invoices can be listed here. Within the company, the accounting department usually makes bookings.

6.5   Enterprise Resource Planning

<u>Sebastian Itudium</u>: That's all nice and well, but what does this have to do with an ERP system? I cannot imagine how these arrows are technically implemented.

<u>Mr. Sappro</u>: Planning and deployment of a company's resources are referred to as "Enterprise Resource Planning" (ERP). ERP is supported by certain IT systems. They help the employees of Cronus AG to successfully carry out their activities in the individual departments of Cronus AG.

<u>Sebastian Itudium</u>: Now, I am curious how the individual steps of our business process will be implemented in MS Dynamics NAV?

6.6   Approval of the Sales Order in the Sales Department

<u>Mr. Sappro</u>: The process begins in the sales department, which receives a sales order. The sales department creates offers, manages master data and accepts orders from customers. Let us therefore recall our business process. Order acceptance is therefore a flow of information between sales and the customer. In the business process presentation, a sales representative receives an inquiry from a new customer.
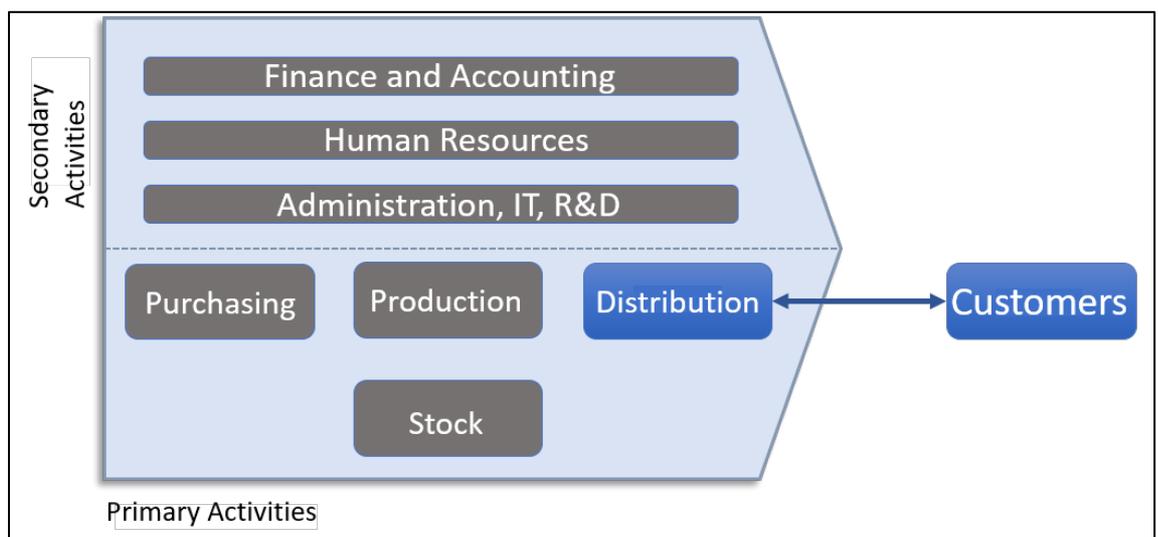
Fig. 43: Porter - Acceptance in Sales

6.7   Credit Check and Stock Inquiry

Sebastian Itudium: If I have understood it correctly so far, we are currently only in one department, the sales department. However, the next step in our business process is the credit check and confirmation, as well as the transmission of the necessary data to the warehouse. So, we have to move to the finance department.

Mr. Sappro: Right. This is where the ERP system really comes into play! It transmits the data automatically and across departments. The credit check and confirmation of credit-worthiness represents a flow of information, just like the stock inquiry. This determines whether the desired product is already in stock. If this is not the case, the product has yet to be manufactured. But, we will take a closer look at this on the following pages. For clarification, I will once again show the value chain according to Porter with the information flow.

6.8   Purchase and Production

Mr. Sappro: Now, it gets a little more complicated, because the flow of goods is added. We will now distinguish between two different cases:

1. We do not have one of the ordered products in stock. To manufacture this product, we have to order materials from our supplier.

2. We have another of the ordered products already in stock ready for shipping.

6.9   Case 1: Product Manufacturing

Mr. Sappro: In the first case, the warehouse communicates that the product is not in stock and has to be manufactured before dispatch. To do this, we have to purchase material from our supplier. Now, the purchasing department must be included. In our business process, the purchasing department represents the interface between suppliers and Cronus AG. It is responsible for purchasing the goods required for the manufacturing of our product. Once the required materials have been added to the warehouse, they can be used in production. The manufactured product can then be sent to the customer from the warehouse.

6.10   Case 2: The Shipping of a Finished Product

Sebastian Itudium: Let's look at the second case now, the ordered product is already in stock. We already know how a product is dispatched in the course of the flow of goods. We will now see how sales and accounting are integrated into the shipping of a product.
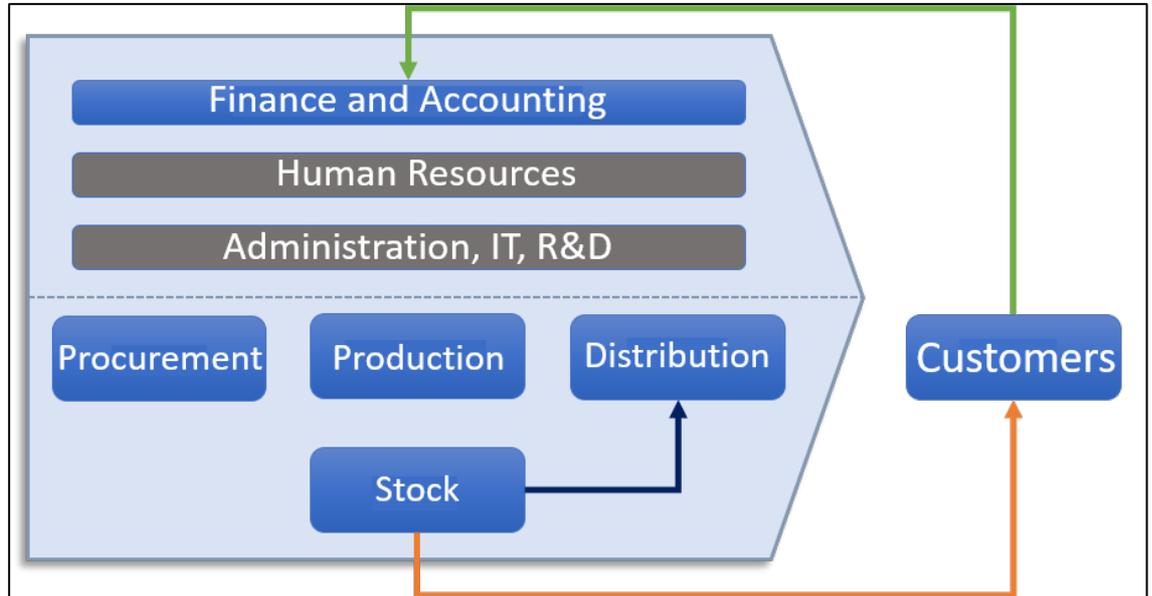
Fig. 44: Porter - Shipping a Finished Product

1.   Step 1: The warehouse prepares the shipping of the goods and transfers the product to the goods dispatch department. At the same time, both, the sales and accounting department, receive information about the goods ready for shipping.

2.   Step 2: The accounting department issues the invoice for the upcoming delivery. This allows the sales representative to send the invoice to the customer, for example, in an e-mail. Finally, the goods are shipped from the warehouse.

3.   Step 3: Finally, the customer only has to pay for the delivery. The responsible employee receives a corresponding message from the ERP system as soon as the customer has paid his invoice. The payment transaction has been successfully completed.

6.11   A Successful Business Process

Sebastian Itudium: The finished product is delivered to the final customer at the end of the business process. This process is completed after successful settlement of unpaid invoices. An ERP system therefore helps to combine work steps from different departments.

6.12   Closing Time

<u>Mr. Itudium</u>: Good evening, Sebastian. I hope you have learned a lot today. We were successful at Cronus AG. They were thrilled by the advantages of an ERP system. Our customer was delighted with the increase in efficiency of their business processes. The suppliers of Cronus AG also use MS Dynamics NAV, which should enable a fast and smooth supply chain.

<u>Sebastian Itudium</u>: That sounds like a successful business deal! Mr. Sappro was able to explain to me how cash flows along a value chain are being carried out. Now, I have a greater understanding of how the processes of the various departments are technically implemented, even across companies. Tomorrow, I will be out with Mr Sappro again. He wanted to show me different data models in Access. I can't wait to see what it's all about!

7   Data Management and Data Modeling in a Company

7.1   Corporate Data Management

7.1.1   Further Training Programmes

Mr. Sappro: Good morning, Sebastian! Today, we will send you to a workshop on data management and data modeling. Our customer, PC Leasing GmbH, needs help with its data management within the company. Tomorrow, we will send you to PC Leasing GmbH with one of our consultants. So take good note of everything you will learn today!

Sebastian Itudium: Good morning, Mr Sappro! I am looking forward to it. This topic was already covered in the university lectures. Now, I am getting a more detailed insight and tomorrow, I will be able to apply the acquired knowledge directly. See you tomorrow Mr. Sappro!

7.1.2   Welcome

Mr. Datamoll: Welcome to our workshop on corporate data management and data modeling. I hope you all got here safely. My name is Mr. Datamoll and I will be your speaker throughout the day. Let's take a look at the agenda for our workshop. The following questions should be answered by the end of the day.

1.   What is data and what is data management?
2.   How is data structured?
3.   What do we use for data management?

7.1.3   What Is Data?

Mr. Datamoll: Let's start with the first question and refresh our basics. What is data? At first, you should understand what data is, before we take a look at data management or data modeling. One can generally distinguish between characters, data, information and knowledge. Therefore, let us define briefly what the terms mean.

- Characters: Characters are individual display elements. This includes, the letters, numbers, figures, musical notes or currency symbols.

- Data: When we syntax characters, the characters become data.

- Information: When we put data with a purpose reference, it becomes information.

- Knowledge: When we network information, knowledge is created.
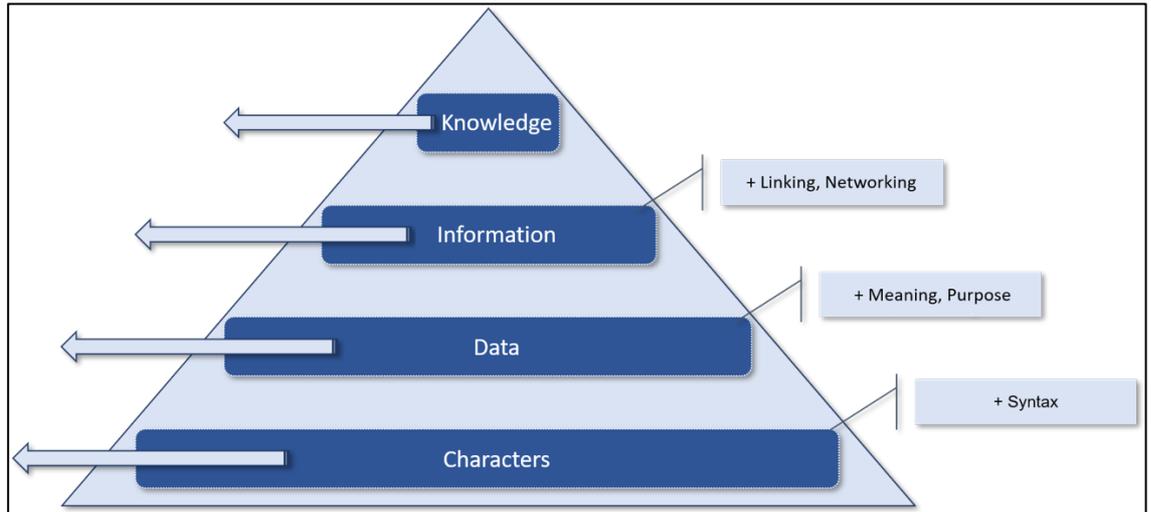
Fig. 45: Data Pyramid

7.1.4 Digression: Information Management

Mr. Datamoll: Now that we know how to distinguish data from information and knowledge, it is time for a little digression. In this lecture, we will deal with data management, which involves a rather technical view. In information management, on the other hand, the focus is on the management process of planning, controlling and monitoring. In doing so, information management pursues the goals of providing information to decision-making processes in a company and optimising the interaction between people, machines and organisation.

Tasks of information management:

- Modeling of information logistics: Mapping of information flows and requirement profiles for applications.

- Interface to corporate controlling: Continuous review of the requirements set by a main user of the information.

- Strategic IT management: Long-term orientation of IT in relation to the business strategy, e.g., through SISP (Strategic Information System Planning).

- Operational IT management: Planning, monitoring and control of IT; e.g., through ITIL (IT Infrastructure Library) or CoBiT (Control Objectives for Information and Related Technology Framework).

7.1.5 Digression: Knowledge Management

<u>Mr. Datamoll</u>: Since we can now differentiate between data, information and knowledge, I would like to say a few words about knowledge management. Knowledge is linked and networked information that we accumulate throughout our lives. Unlike information, knowledge can only be generated and not purchased. Therefore, knowledge management is concerned with how to generate this knowledge. This includes the acquisition, development, transfer, storage and use of knowledge.

<u>Sebastian Itudium</u>: Excuse me Mr. Datamoll, but I think it is important to point out that one should distinguish between explicit (codified) and implicit knowledge. According to my textbooks, explicit knowledge can be systematically conveyed and reproduced, whereas implicit knowledge is not even articulated. Polanyi defined implicit knowledge with the perception "that we know more than we know to say".

<u>Mr. Datamoll</u>: Thank you for this important and correct remark, Mr. Itudium. Now arises the question which goal is related to knowledge management. Knowledge management should serve to find the best possible solution for the various tasks and questions. For organizations, knowledge management therefore assumes an essential position. After all, companies have a wide variety of problems to solve, e.g., in their operative business. Knowledge capital can be derived from this as the fourth decisive production factor.
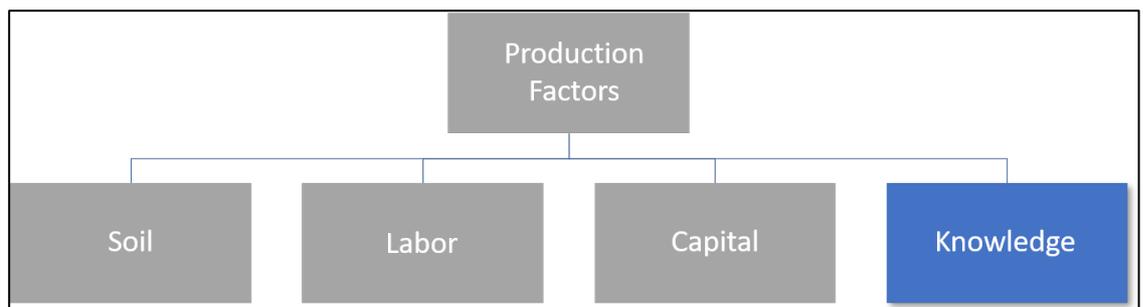
Fig. 46: Production Factors

7.1.6 Why Is Data Management Necessary?

<u>Sebastian Itudium</u>: Excuse me, I have a question on this. According to our understanding of data, data accumulates everywhere. Just think of the customer data of large companies or the data volumes of social media platforms. How do companies manage to generate information and knowledge from these data sets?

<u>Mr. Datamoll</u>: The companies manage this by structuring their data. This data structuring is the main task of data management. Think of a database containing customers and their

addresses in your company. In the past, customers' addresses were still stored on paper in filing cabinets. Their purchases were also recorded on paper and filed in a separate file under the corresponding customer name. Now, imagine how these filing cabinets overflow and burst apart over time. If you now want to have certain information about all customers in Giessen, you need a lot of time. To manage the data, the companies use certain software products, which are commonly called "database systems". Database systems are the digital solution for overflowing filing cabinets.

7.1.7   Data Management

Mr. Datamoll: We have just noticed that database systems help to structure data. To be able to store data in a database, the data must be prepared or arranged and structured. In other words, to use data efficiently, it must be stored and made available in a suitable data or information structure. The term "data management" thus covers the following aspects:

- Gathering data,

- structuring data and

- storing and providing structured data

7.1.8   Database System

Mr. Datamoll: Now, we know what is meant by data management. Database systems (DBS) help us with this data management. A database system consists of a database (DB) and a database management system (DBMS). The process leading to the available data can be described as follows:

1.   Collection on physical data carriers,

2.   structuring of the data according to a model and

3.   MS Access is a DBS that provides us with a structuring option and physical storage facility for collected data.

7.2   Data Modeling in a Company

7.2.1   Managing and Modeling Data

Mr. Datamoll: After we have clarified that data has to be structured, we now ask how this can be done. Can someone tell me how to structure data?

Sebastian Itudium: I seem to remember that you structure data by modeling it so that you can use it with a DBS. This is done in order to be able to better link data later on. As far as I know, it's a step-by-step process.

Mr. Datamoll: You are absolutely right. Data modeling means depicting reality. However, this is very complex and must therefore be presented in a simplified form. Therefore, we also have to decide which data we want to use in general. Let's take a look at the step-by-step procedure in the overview first. I will then explain the individual steps.

Step 1: Finding relevant data

The first step is to define a specific operational task. Only the data required for this specific operational task is relevant in the following. This creates a kind of simplified "mini world".

Step 2: Determining correlations of the data

The content of the relevant data must be described. It is determined which data with which purposes in the delimited mini-world are required as information for the operational task in question.

Step 3: Structuring the content of data

The content structuring of data is called "data modeling". There are special methods for creating data models. One of them is, for example, the ER-model.

Step 4: Preparing the data model

The data models must be converted into a form that a computer can process. For this purpose, the created ER-model is further developed into a relational structure, the logical data schema also called "relational model".

Step 5: Storing and providing data

The prepared data models are physically stored in a DBS in order to use them for operational purposes.
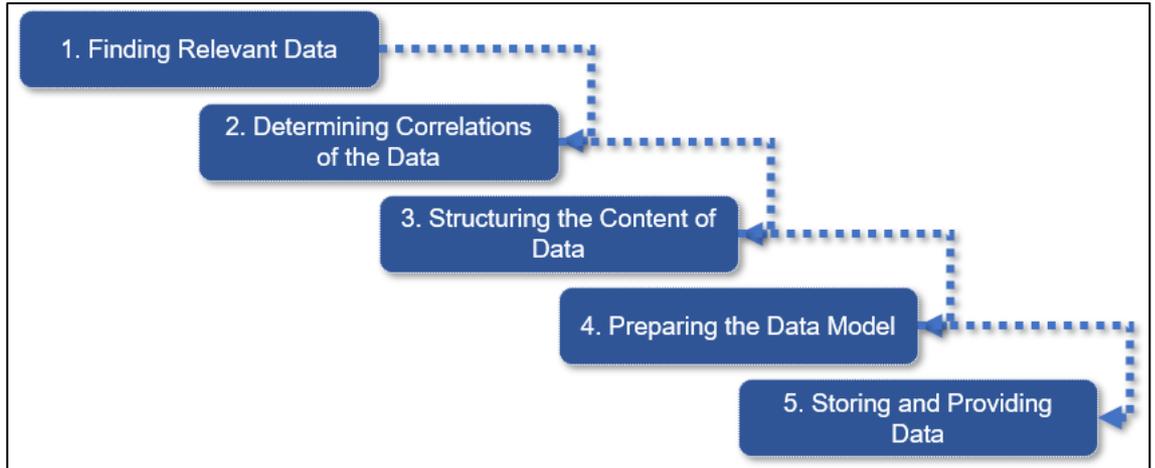
Fig. 47: Steps of Data Modelling

7.2.2   The ER-Model

Mr. Datamoll: The most widely used description language for conceptual data models today is the Entity Relationship Model. Conceptual data models are like a bridge between human understandable environmental description and a machine understandable relational structure.

Sebastian Itudium: From what I understand, ER-models are graphical modeling languages. Are these independent of the database management system used later on?

Mr. Datamoll: Correct! These are exactly the advantages of data modelling with the ER-model. They are graphical and easy to understand due to a clear symbolism. Let's take a look at the next step. Turning now to the core elements of an ER-model. The Entity Relationship Model defines the data elements (entity) with their attributes, which are stored in an information system. Additionally, the relationships between these data elements are defined.
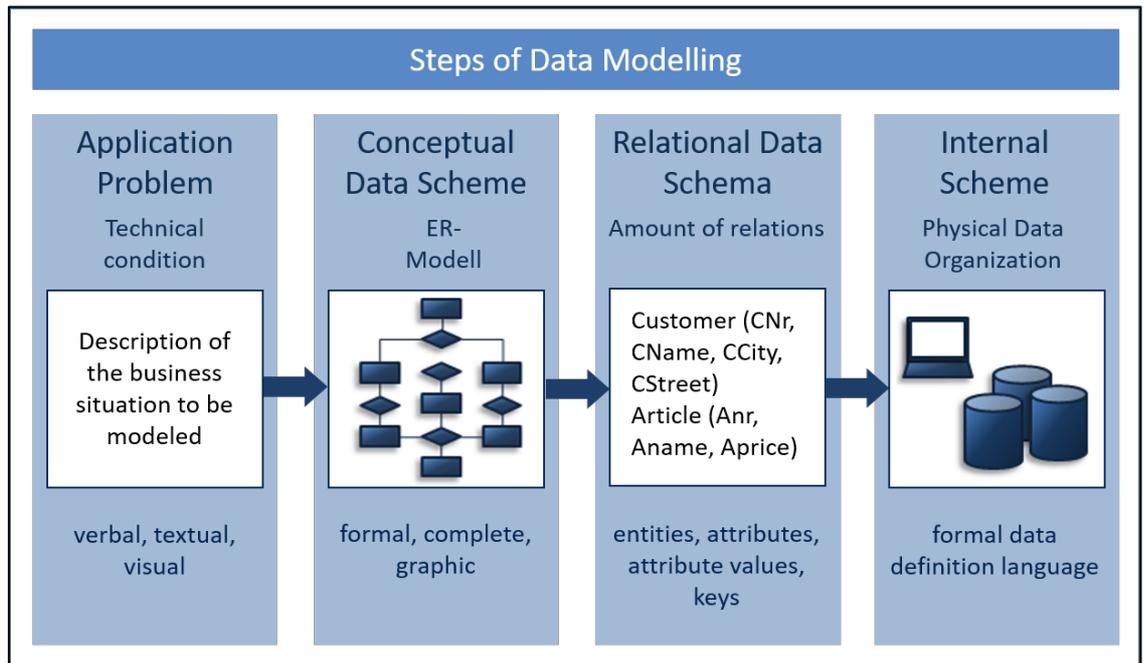
Fig. 48: Steps of Data Modeling and ER-Model

7.2.3 Elements of the ER-Model

<u>Mr. Datamoll</u>: The ER-model consists of its core elements

- <u>The entities</u>: An entity is an object from the real world, such as an employee or customer. Entities can be grouped into entity types such as "person", "book", "automobile" or "order".

- <u>The attributes</u>: Entities can have attributes. Attributes are characteristics of an object. For example, a person may have a name, age or several mobile phone numbers. Unique attributes or combinations of attributes, such as, a pension insurance number or customer number, are called "keys" and are displayed underlined in the ER-model.

- <u>And the relationships</u>: Relationships between two entities are represented by diamonds and are usually described by verbs. Relationships provide the connection between two entities. For example, one employee may use one PC, a department may employ several employees, and one or more employees may be involved in one or more projects. These relationships can be described in even more detail by so-called "cardinalities".
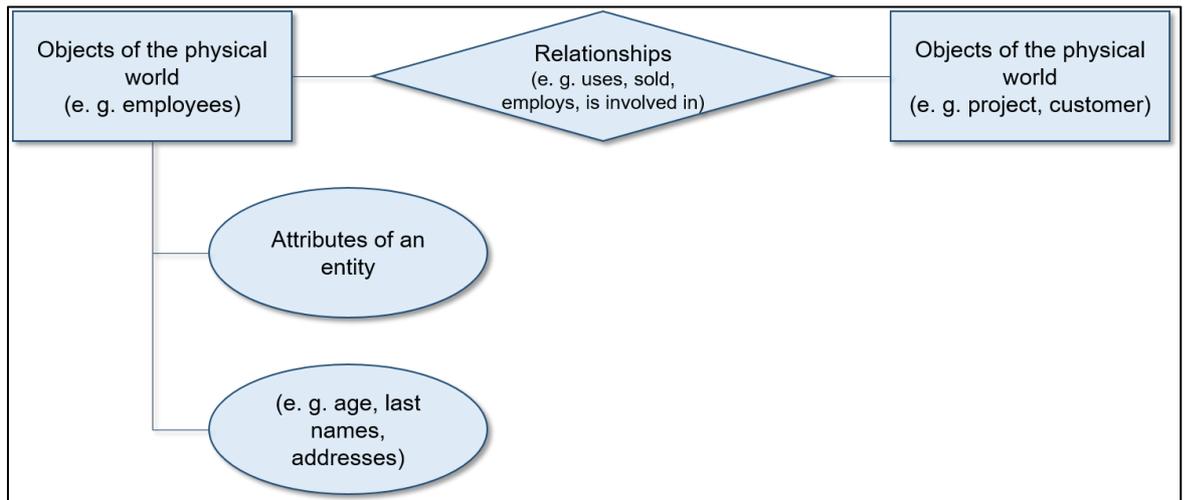
Fig. 49: The ER-Model

7.2.4 Cardinalities

Mr. Datamoll: The cardinality ratio expresses the degree of a relationship and describes its assignment. The following assignments are possible:

- 1:1 relationship: Each entity may have a relationship with a maximum of one other entity.

- 1:n relationship: Only the first entity may be related to multiple entities.

- m:n relationship: Each entity may have relationships with several other entities.
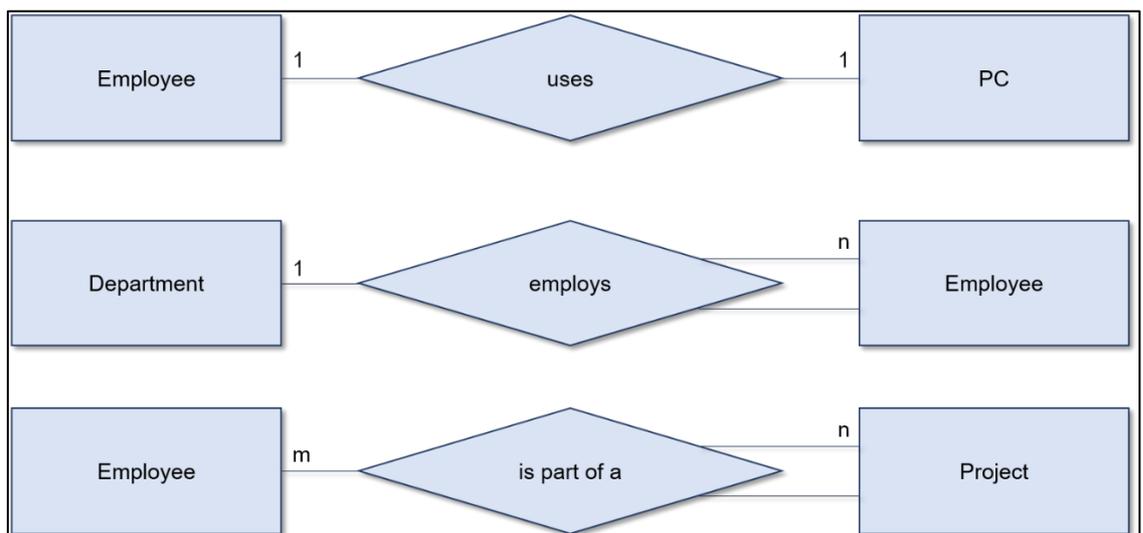
Fig. 50: Cardinalities

7.2.5 Procedure for the ER-Model

Sebastian Itudium: Mr. Datamoll, I have a question regarding the ER-model. I now know the basics and elements of the model. But, how may I proceed with the modeling? Is there another procedure?

Mr. Datamoll: Mr. Itudium, you are asking an important question. There is also an approach to entity relationship modeling. We can again divide this into four steps.
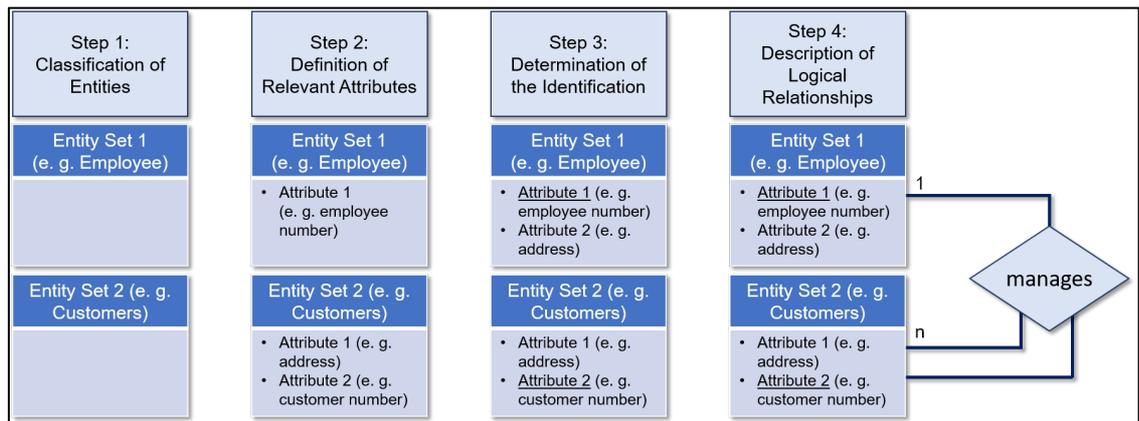
Fig. 51: Procedure for the ER-Model

7.3   Data Management in Practice

7.3.1 Data Practice with Microsoft Access

Mr. Datamoll: So far we have dealt with many things only on a theoretical basis. I therefore suggest that we look at how data is managed in practice. I have already told you about various DBMS. Today, we want to take a look at Microsoft Access as an example of how data is typically managed. You will see, it is much simpler than theory suggests. So here's to some quick wins in Access!

1.   Creation of relationships or logical connections
2.   Creation of queries
3.   Creating reports

7.3.2 End of the Workshop

Mr. Datamoll: Thank you very much for participating in the workshop. I hope you enjoyed your little foray into the real world. You now know what data is and why it is of the greatest relevance to companies. In addition, with the ER-model, you have learned a

method of modeling data. Finally, I was able to show you Microsoft Access, an application system that allows you to manage and model data. I thank you for your attention and hope that you will be able to take some of the information from this workshop back into your company.

8   Networks

8.1   Networks in the 21st Century

8.1.1   Networks in Everyday Work Life

Research: Before networks existed, information and data had to be tediously collected from magazines, books and encyclopaedias. Now, it is possible to find information on specific keywords on the Internet in just a few seconds.

Applications: A lot has also changed in the application process and the search for suitable candidates. New jobs were published in newspapers and new employees were found through extensive research. Today, applicants can be found via social networks and job offers can be published on platforms.

Communication: Finally, the exchange of data between colleagues has become faster and easier. In the past, documents were sent by internal mail and appointments were arranged individually with each employee. This can now be done with a mouse click in a few seconds.

8.1.2   Help from the Professor

Sebastian Itudium: Hello Professor Etlien, I am supposed to help my father to improve the computer network of FamIT to make us more competitive. Unfortunately, I did not have a lecture on this topic in my previous studies, but I thought that you are the right person to talk to regarding this topic!

Prof. Dr. Etlien: Hello, Sebastian, nice to see you again. Of course I can help you in this area. It's best to start with the basics so that you understand what a network is before we apply it to FamIT.

8.1.3   What Are Networks?

Prof. Dr. Etlien: In general, a network can be understood as a set of elements that are connected to each other. I'm pretty sure that you also use the (social) network Facebook to keep in touch with your friends and acquaintances and to keep up with what's going on with them. With this example, you can already guess what the main task of networks is: They should make information accessible to other network members or, in other words, networks should distribute information.

Prof. Dr. Etlien: Next, I would like to explain the basic structure of a network to you: A network consists of nodes and edges. A part of the network is also called "network segment".
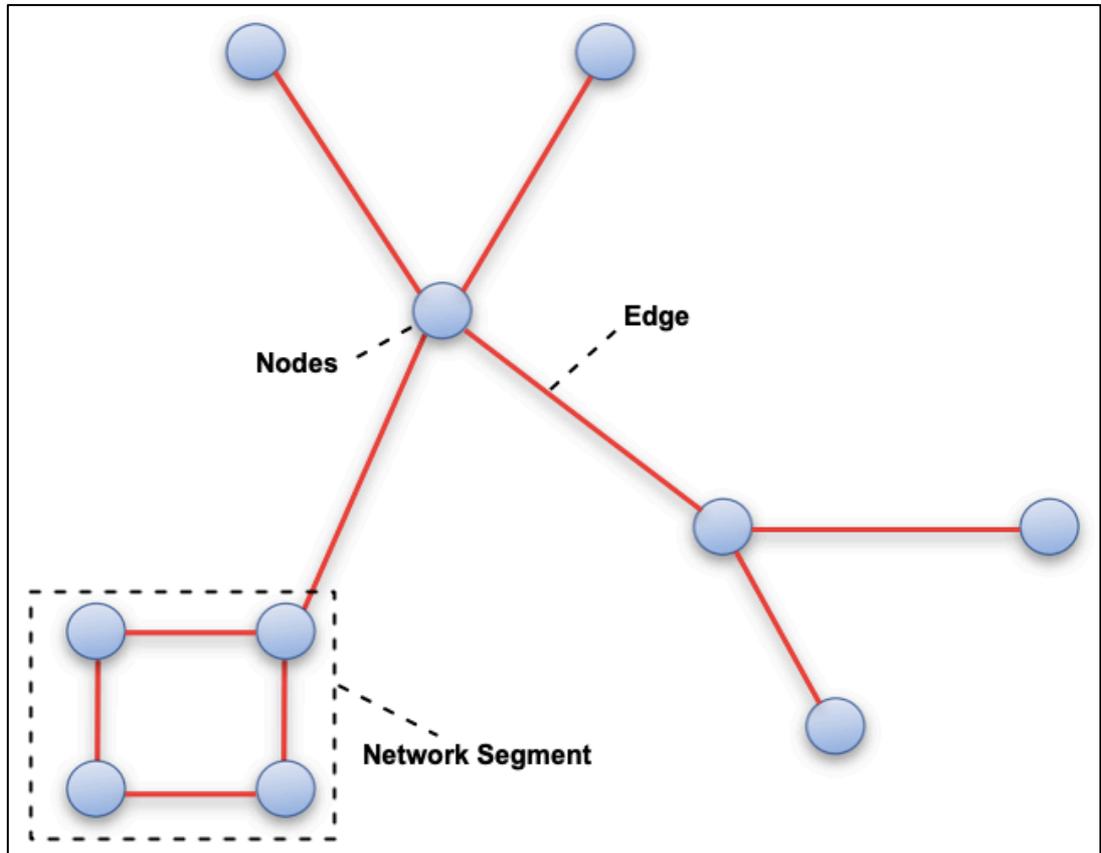
Fig. 52: Network Segment

8.1.4 The Technical Network "Internet"

Prof. Dr. Etlien: Networks are realized through technical elements. The nodes can be represented by computers and the edges by cables. A technical network consists of physical components.

8.1.5 Other Technical Networks

Other examples of technical networks are:

- Power lines

- Water pipes

- Water pipes

Please think about the overall economic significance of such technical networks.

8.2   Network Devices

8.2.1 Introduction

<u>Prof. Dr. Etlien</u>: You have already learned what is generally meant by a "network" and what its structure looks like. Next, we will take a closer look at the network structure within FamIT. A network can be seen as a set of elements that are connected to each other. The main task is the distribution of information.

8.2.2 Network Devices

<u>Prof. Dr. Etlien</u>: As just mentioned, a network consists of nodes, edges and network segments. The nodes represent the active components within a network infrastructure. These active components correspond to various network devices that are deployed on the network. To help you better understand the functions of the individual components, I would like to explain them to you using the FamIT.
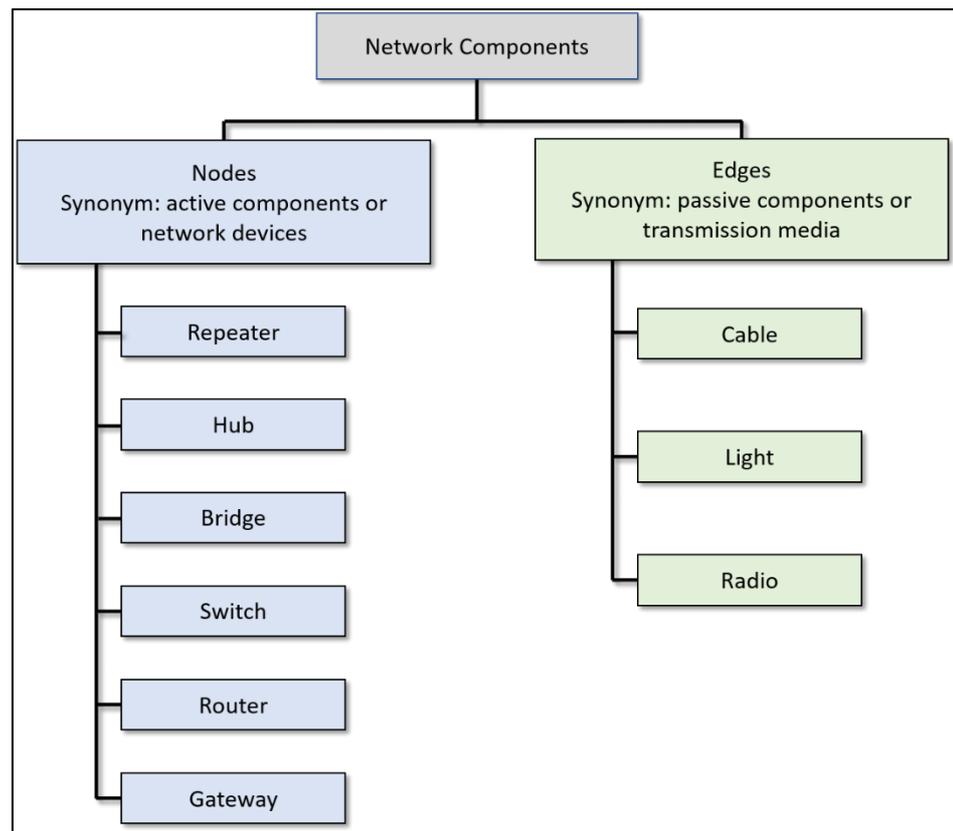
Fig. 53: Network Devices

8.2.3 Network Device: Hub

In the past, so-called "hubs" were frequently used.

The hub is a central distributor and signal amplifier for data. The devices connected to the hub send the data to this device.

The big disadvantage is that a hub cannot decide to whom the received data should be forwarded to. Therefore, the hub sends the data to all devices that can be reached by the hub. These are then only accepted by the addressed recipient.

8.2.4   Network Device: Switch

The switch is a signal amplifier and distributor for data. A switch connects several network devices (e.g., printers, computers, routers or other switches) to a network so that they can communicate with each other. A switch receives the data, reviews it and then forwards it only to the network node that is supposed to receive it.

8.2.5   Network Device: Router

The switch only connects components that are on the same network. The router connects components from different networks. The data received from the router is analyzed and forwarded to the target network. The target network then handles the forwarding of the data to the recipient.

8.2.6   Network Device: Firewall

With the help of a firewall, the connections between different networks should be protected. A firewall constantly monitors incoming and outgoing data traffic. Only the permitted data traffic is routed through a firewall. A firewall thus ensures that data is protected from unauthorised access and unauthorised persons cannot read it. This is done on the basis of previously defined rules.

8.2.7   Network Device: Wireless Access Point (WAP)

The Wireless Access Point (WAP) serves as a base station for wireless connections.
The WAP can establish a wireless connection to all WiFi-capable end devices and is itself connected to a permanently installed network via a cable connection. In contrast to the switch, the data is not sent by cable, but by (encrypted) transmission. Often mobile devices (notebooks, mobile phones, etc.) are connected to a WAP. However, the WAP can also be used as an interface to other network devices.

8.2.8   Network Device: Fritz!Box

The functions just presented are combined in a "Fritz!Box". The Fritzbox is simultaneously router, gateway (to the telephone network), WAP, switch and firewall in one. So the FritzBox is a multifunctional device. It saves effort and costs for many individual devices. In many private households these multifunctional devices are used to connect network-compatible devices within the household network via cable or WiFi. The router in the multifunctional device also establishes the connections from the household network to the Internet.

8.3   Transmission Media

<u>Prof. Dr. Etlien</u>: You have now got to know all important network devices (active network components). Now, I will introduce the (passive) network components. Passive network components are transmission media that connect individual devices with each other and thus make data transmission possible. The network edges are realized with the transmission media.

8.3.1   Transmission Medium: Copper Cable

An important medium for data transmission is the copper cable. Electrical signals can be transmitted between devices within the company network using the copper cable.

8.3.2   Transmission Medium: Optical Fibre

In addition to the classic copper cable, optical fibres (glass fibre cable) can also be used. Optical fibre cables are used where particularly high data transmission capacities are required.

8.3.3   Transmission Medium: Radio Links

Radio connections (e. g. mobile radio, WiFi or Bluetooth) transmit data with electromagnetic waves in all directions. For the FamIT, for example, a WiFi signal can be used. A Wireless Access Point (WAP) is used as a transmitter and receiver station.

8.3.4   Transmission Media Ranges

<u>Prof. Dr. Etlien</u>: I have summarized for you the average ranges and transmission rates of copper, light and radio links.

8.4   Topologies and Spatial Extent

8.4.1 Topologies

<u>Prof. Dr. Etlien</u>: Now that you have learned about the active and passive components of a network, I would like to explain what a network topology is. Topology is the arrangement of the elements in a network. There are different types of topologies:

- Ring Topology

- Cell Topology

- Bus Topology

- Star Topology

8.4.2 Topology: Star

The star topology is characterized by the fact that each participant in the network is directly connected to the center. A connection can be made via optical fibre cable, copper cable or radio. The center of the star can be a router, switch or computer.
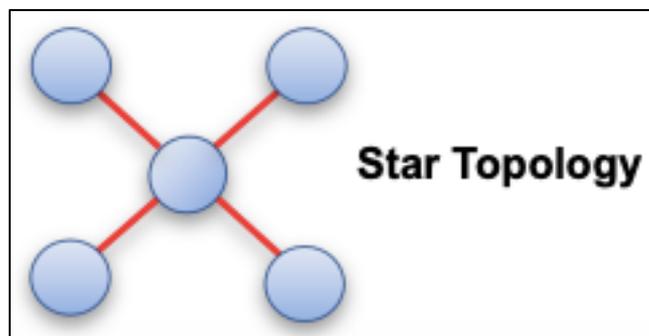
Fig. 54: Star Topology

8.4.3 Topology: Ring

A ring topology is characterized by the fact that each network device is connected to its left and right neighbors, creating a closed ring. Data is passed from member to member until it reaches its destination.
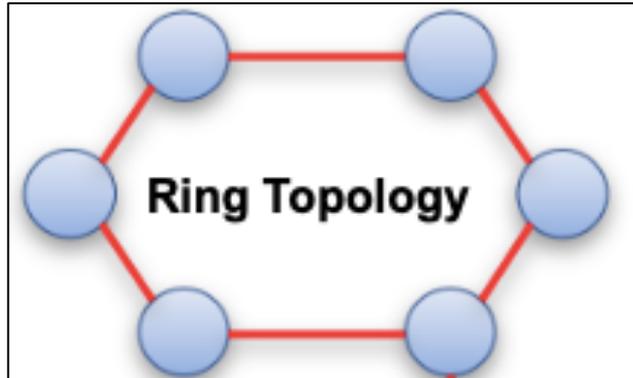
Fig. 55: Ring Topology

8.4.4 Topology: Bus

A bus topology consists of a main line (bus, backbone) to which the network devices are connected. Copper cable is usually used as the transmission medium from the bus to the network devices.

8.4.5 Topology: Cell

The term "cell topology" is used for wireless networks. A "cell" is the area around a base station (e.g., wireless access point). In this area, WAP enables wireless communication with mobile devices.
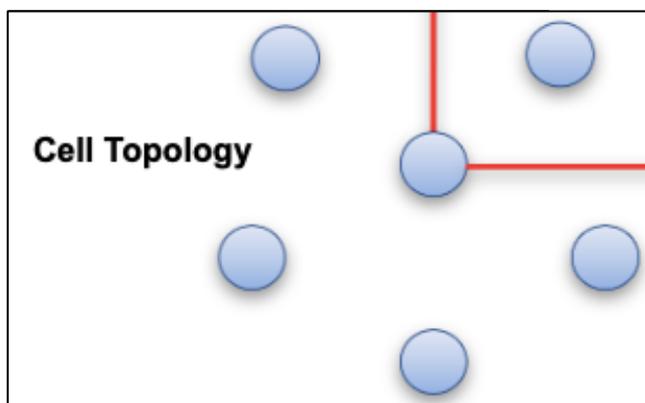
Fig. 56: Cell Topology

8.4.6 Overview: Advantages and Disadvantages

Prof. Dr. Etlien: I have compiled the advantages and disadvantages of the individual topologies for you.

8.4.7 LAN, MAN, WAN, GAN

Prof. Dr. Etlien: Finally, I will show you what is meant by the terms LAN, MAN, WAN, GAN.

- A **Local Area Network** (LAN) is the connection of several network devices within a building or property and is used to share data and peripheral devices. A LAN is limited to a specific property, e.g., company premises.

- A **Metropolitan Area Network** (MAN) connects several Local Area Networks (LANs), so that a communication network can be extended to an entire city or region. A MAN is regionally limited. It can extend over several kilometers.

- A **Wide Area Network** (WAN) is not spatially limited. It connects geographically distant computer systems (in unlimited numbers) with each other.

- A **Global Area Network** (GAN) is a WAN that spans the entire globe. Probably the best known Global Area Network is the Internet.

8.4.8 Closing Time

<u>Prof. Dr. Etlien</u>: That brings us to the end and I have shown you everything that could be important for building a network infrastructure in FamIT. I hope that I could be of help!

<u>Sebastian Itudium</u>: Thank you Prof. Etlien. Now, I can help my father to build a competitive network.

8.5   Final Test

No.	Question	True	False
1	The active network components include:		
	Router		
	Terminator		
	Cable		
	Wireless Access Point		
	Switch		
2	Which is the cell topology?		
3	Cable and light connections belong to the passive network components.		
4	When planning networks, you have to consider...		

	... Which topologies to use.		
	... When the network should be first expanded.		
	...Which network devices and transmission media should be used.		
	...What requirements the network should meet.		
5	Compared to a hub, a switch has the advantage that it only sends data to those stations it is intended for.		
6	Received data packets are forwarded to all participants in a network by a switch.		
7	A network generally consists of nodes and edges, which merge into meshes.		
8	What is not a network topology?		
	Switch topology		
	Star topology		
	Bus topology		
	Ring topology		
9	One advantage when planning networks is that the requirements for the network do not have to be defined user-specific, as the same requirements apply to all networks.		
10	A Local Area Network (LAN) is extended to a large city or region at most.		

Tab. 6:   Questions WBT 8 – Network

9   Worldwide Network: Internet

9.1   Fundamentals of the Internet

9.1.1   The Technical Network: Internet

<u>Prof. Dr. Etlien:</u> We have already learned that networks always consist of nodes and edges. A section of a network is also called a "network segment". These structures are the basis for worldwide networks, such as the Internet.

9.1.2   The Internet

<u>Prof. Dr. Etlien</u>: Let's have a close look at the Internet. The Internet ("interconnected network") is a worldwide network of computers or computer networks. It is the dominant Global Area Network (GAN) and is therefore also called the "the network of networks". Global networking enables close-meshed communication and interaction. It is nowadays completely normal for customers to order goods on the Internet and for companies to communicate with international subsidiaries.

9.1.3   The Structure of the Internet

<u>Prof. Dr. Etlien</u>: In order for the Internet to be usable, various devices and technical requirements are necessary.

- <u>Local/regional networks:</u> Local or regional networks can be networks of a company (intranet), a university (for example the JLU network) or research networks (for example the former DARPA).

- <u>Cable/radio connections:</u> In addition to fiber optic lines, copper lines, radio or satellite connections are still used today to transfer data between different Internet nodes.

- <u>Backbones:</u> A backbone is a connection between different networks. Generally, this refers to the connection of larger networks with each other.

- <u>Router:</u> Routers are used to enable communication between different networks.

9.1.4   The Components of the Internet

<u>Prof. Dr. Etlien:</u> Everything that we just read is once again summarized here as a diagram.
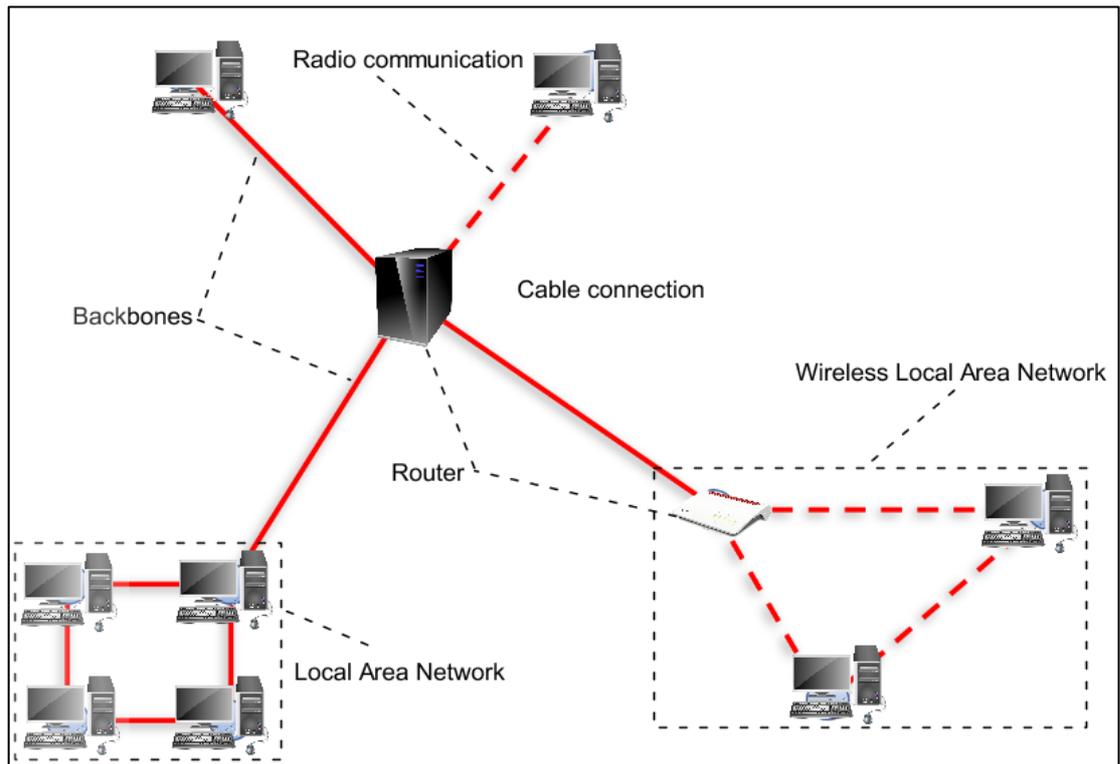
Fig. 57: Components of the Internet

9.1.5 The IP Address

<u>Prof. Dr. Etlien</u>: Just as a house has an address, every node on the Internet has its own digital address. This digital address is the so-called "Internet Protocol address", also known as "IP address". Nowadays, two types of IP addresses are distinguished: IPv4 and IPv6 addresses.

Characteristics of IPv4 addresses:

- It consist of four number blocks.

- The number blocks are separated by dots.

- Each block consists of numbers from 0 to 255.

Characteristics of IPv6 addresses:

- It consists of eight information blocks.

- Colons separate the blocks of information.

- All numbers from 0 to 9 and all letters from a to z without special characters and umlauts are permitted.

9.1.6 Structure of IP Addresses

IP addresses are structured similar to postal addresses. For exact address identification, the components of the IP addresses are interpreted accordingly. The addresses of the IPv4 version can be divided into.

- A network part

- A host part

The addresses of the IPv6 version can be distinguished into

- A prefix

- An interface identifier

9.1.7 Domain Name System

<u>Prof. Dr. Etlien</u>: The Domain Name System (DNS) was developed to find out the IP address of the recipient within a network. The DNS translates an IP address into a descriptive character string, the so-called "web address". With this web address, the user can access a specific web page from the Internet. For this reason, the Domain Name System is also known as the phonebook of the Internet.
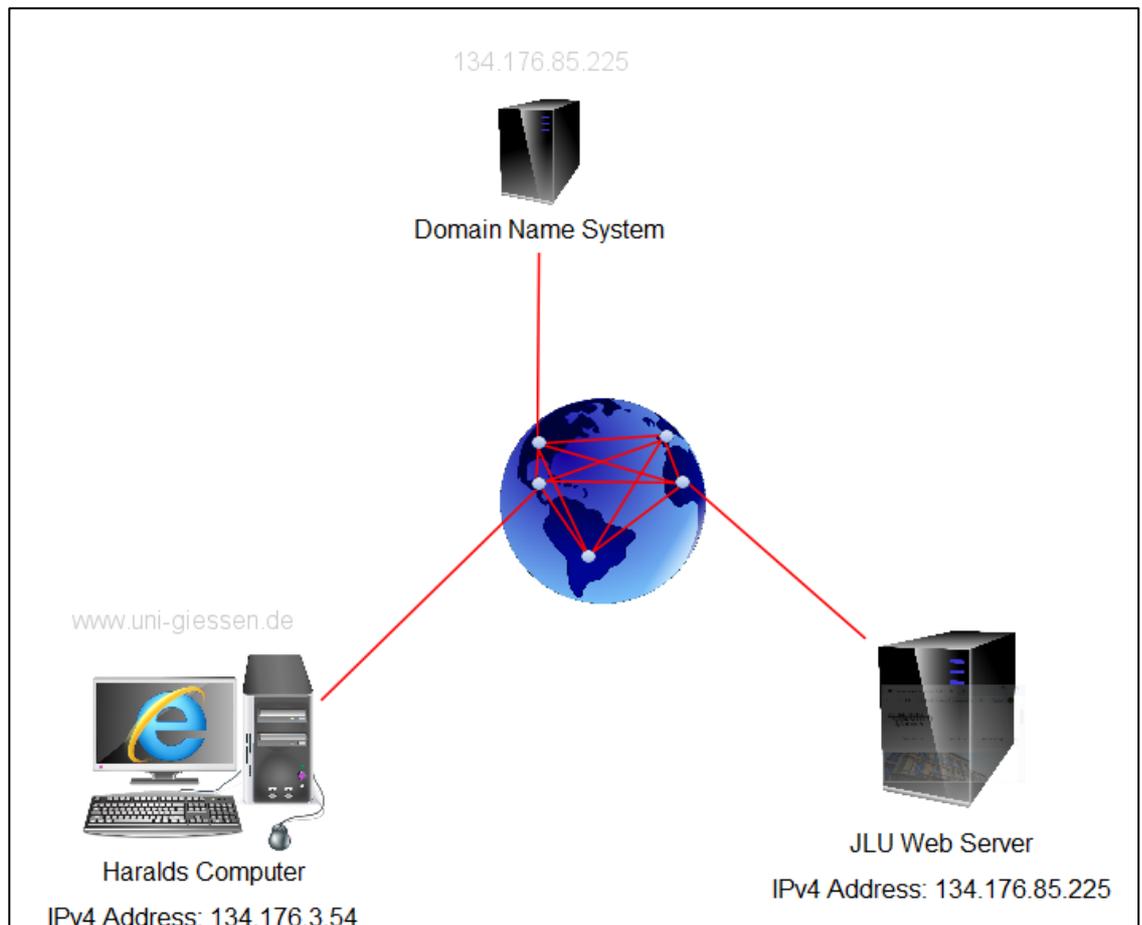
Fig. 58: Domain Name System

In order for Harald to access the JLU website, he enters the following address into his web browser: www.uni-giessen.de. The web browser sends this address to the DNS. The DNS looks up the IP address that matches the web address. Then it sends the IP address back to Harald's web browser. The web page is delivered to Harald and displayed in his web browser.

9.2   Services on the Internet

9.2.1   Internet Services

Prof. Dr. Etlien: When we are on the Internet, we always use certain Internet services. Here are a few examples of typical services on the Internet.

- World Wide Web (WWW): The World Wide Web is used to transmit web pages. A web browser is required to display web pages (e.g. Internet Explorer, Google Chrome, Firefox).

- E-mail: An email is the electronic form of a letter.

- Streaming: Streaming services allow audio and video files to be accessed for entertainment purposes.

- Instant Messaging: Instant messaging allows users to exchange written messages and images in real time.

9.2.2   Disassembling an E-mail for Data Transport

Prof. Dr. Etlien: After writing an e-mail and then pressing the send button, the e-mail will be split into data packets (e.g. 100 packets). Each packet has the same size, e.g. 256 bytes. This way your e-mail becomes a larger amount of data packets. Each data packet contains your sender IP and the IP address of the recipient. In addition, the number of the data packet (e.g. 24 out of 100) is on the data packet. Then, all data packets are sent.
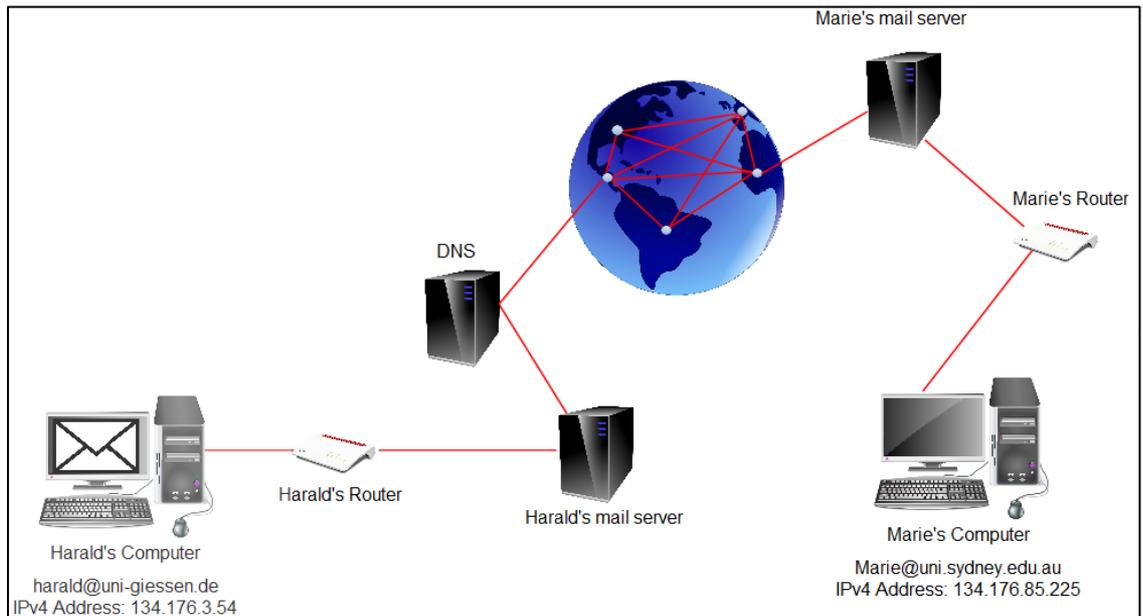
Fig. 59: Disassembling an E-Mail for Data Transport

9.2.3 Sending an E-mail

Harald wants to send an e-mail to Marie. After he has written the e-mail, Harald clicks on "Send". Harald's e-mail program then dispatches the message. The message is first routed via Harald's router to his mail server. Using Marie's e-mail address, the DNS can determine to which IP address the e-mail should be sent to.

9.2.4 Finding the Way on the Internet

Not all data packets take the same route through the Internet. In order to find the right route, the individual numerical blocks of the IP address are analyzed by Harald's router. It checks whether it knows Marie's router. If it knows her router, it sends the data packets to this router. If not, it sends the data packets to a router that is closer to Marie's router. This procedure is repeated until the data packets have reached the destination router. The e-mail is delivered to Marie. Sometimes individual data packets take a different route to avoid busy or overloaded connections.

9.2.5 Accessing a Web Page

Accessing a web page works similar to sending an e-mail. First, Harald enters the URL into his web browser. This URL is translated by the DNS into an IP address. The IP address is used to connect to the server of the web page. The HTML documents for the web page are on the web server. These are broken down into data packets and sent back

to Harald's computer. There, the data packets are reassembled into an HTML document and then displayed in the web browser.

9.2.6 Instant Messaging

While sending and reading an e-mail is basically asynchronous, instant messaging (IM) enables immediate transmission and readiness for reading. IM therefore works quasi-synchronously. The reason for this is that both sender and recipient access the same server.

9.2.7 Peer-to-Peer

<u>Prof. Dr. Etlien:</u> We have seen that different server nodes are needed to bring sender and receiver together. With Peer-to-Peer (P2P) such central servers are not required. In P2P networking, each sender computer (peer) and each receiver computer (peer) performs server functions. Each participant can exchange data with each peer.

9.2.8 File Sharing

File sharing has become popular through services like Napster. With such a P2P network, Harald can for example watch movies that are stored on Marie's computer. Harald and Marie, as well as every other participant in the network, have to be "online" all the time and reserve space on their hard drive where the films are stored. All other peers can access these films. Only those who offer films in the network can themselves request films from other peers. No servers are required for file sharing.

9.3   Final Test

9.3.1 Accessing a Web Site (Test)

No.	Question	True	False
1	Put the elements in the correct order for accessing a Web site.		
	HTML documents are sent.		
	DNS finds IP address to the URL.		
	Entering the URL in the Internet browser.		
	Website is displayed on PC.		
2	What versions of IP addresses do exist?		
	IPv3		
	IPv4		
	IPv5		
	IPv6		
3	Which of the following attributes are part of an IPv6 address?		
	Interface Identifier		
	Prefix		
	Network part		
	Host part		
4	The abbreviation DNS stands for		
5	For instant messaging, both the sender and recipient use different servers.		
6	What are conventional Internet services?		
	World Wide Web		
	E-mail		

	Instant Messaging		
	Streaming		
7	The Domain Name System converts a URL into an IP address and vice versa.		
8	What type of connection is established between two computers during file sharing?		
	Peer-to-Peer		
	Computer-to-Computer		
	Network-to-Network		
	Location-to-Location		

Tab. 7:   Questions WBT 9 – Worldwide Network: Intern

10   E-Business

10.1   Increased Efficiency through E-Business

10.1.1 What Is E-Business?

An exact and uniform definition of "e-business" is difficult to find. Due to the two essential meanings of the English noun "business", two meanings can also be derived for the term "e-business". Firstly, it refers to trade, the process of buying and selling goods. In the context, e-business refers to market transactions. On the other hand, e-business refers to the entirety of all business processes. In this context, e-business refers to the information technology networking of companies with all economic actors along the entire value chain from supplier to customer. This WBT begins by looking at trade via the Internet.

10.1.2 Markets and Transactions

Before we can talk about trading and the benefits of e-commerce, we need to clarify where trading takes place. Trading takes place both, traditionally and electronically, in markets. Markets are neutral "places" where supply and demand meet. Markets are where economic transactions are carried out, i.e., where goods and services are exchanged. But; why should a company operate on an electronic market? The transaction cost theory can be used to answer this question. The transaction cost theory deals with the analysis of the costs associated with the transaction and the comparison of these costs with different forms of coordination. The transaction cost theory divides a transaction into four phases:

- Information phase: For potential transaction partners and conditions

- Agreement phase: Formulation of contracts and agreement between supplier and buyer

- Processing phase: Processing, shipping and payment of the goods

- Post-contract phase: Monitoring of agreements on deadlines, quality, quantity and price and, if necessary, adjustment of the agreement

10.1.3 Transaction Costs

According to the transaction cost theory, different costs arise in each individual phase. These costs are incurred by the transaction itself and are not related to the production of a traded product (e.g., a car) or a traded service (e.g., consulting). The cause of costs is

the initiation and processing of the (goods) exchange. For more information on the individual costs, please move your cursor over the individual phase sections.

- Search costs / initiation costs arise from the procurement of information about potential business partners or prices. In traditional markets, offers are obtained by telephone, print media or a personal visit. However, the primary cause of costs is the time required for this.

- Agreement costs: In traditional markets, contract negotiations take place either on location or over the phone, resulting in trasportation or telephone costs.

- Settlement costs: In addition to the purchase price, there are also shipping and insurance costs for the transport of the goods.

- Control costs / Adjustment costs: Even after the conclusion of the transaction, costs may still be incurred if the contractual agreements are not fulfilled. In the event of a complaint, for example, the customer must invest time and money in communication and transport, while the seller faces costs for restoring the contractually agreed condition.

10.1.4 Cost Reduction due to E-Business

The transaction cost analysis is suitable to show the transaction costs in different market forms.

We compare transaction costs in a traditional market and an electronic market and illustrate different efficiency effects.

- Information phase: The constant availability of information about products (test portals and customer reviews) and their prices (price comparisons) on the WWW increases market transparency and reduces the costs of obtaining information. Increased market transparency thus leads to an increased transaction speed.

- Agreement phase: The increased market transparency provides a good basis for negotiating price agreements. Thus, price agreements can be made for online purchases or online auctions such as eBay, which are based on fair market prices. This means that the risk of transactions at exorbitant prices can be reduced. In addition, many web shops cover the shipping costs from a minimum order value.

- Processing phase: In the processing phase it is an advantage to be able to pay quickly, conveniently and securely via so-called "e-payment providers", such as

PayPal. Another advantage results from the purchase of electronic transferable products, such as software available for download after the purchase. There are no costs for packaging, insurance and shipping.

- Post-contract phase: Electronic customer service (e.g. via email or instant messaging) and electronic updates for hardware and software also offer opportunities to reduce costs and increase the speed of a transaction in the post-contract phase.

- Conclusion: Compared to traditional markets, e-commerce will lead to lower transaction costs in the information and possibly also in the agreement phase. However, there may be costly problems of security, credibility and legal enforceability in the settlement and post-contract phases.

10.1.5 Further Effects of Electronic Markets

The high number of Internet users will attract numerous providers, increasing the intensity of competition in existing markets and enabling competition in niche markets.

Increased market transparency (based on customer evaluations and price comparisons) increases the power of the customers and generates a great deal of cost and quality pressure on the providers.

10.1.6 E-Business Sectors

As mentioned in the beginning, e-business is not limited to transactions between enterprises and end customers. In addition to contacting customers via the Internet as a distribution channel (business-to-consumer, B2C), e-business also uses information and communication technology to establish open and networked organisational structures within a company (business-to-self, B2S) or between companies that are linked in business (business-to-business, B2B).

Intra-organizational networking is carried out via the intranet and inter-organizational networking via the extranet. The following user groups can be used to differentiate between these interfaces:

- End customers (B2C)

- Business partner (B2B)

- Own company (B2S)

We start with the business-to-consumer relationship.
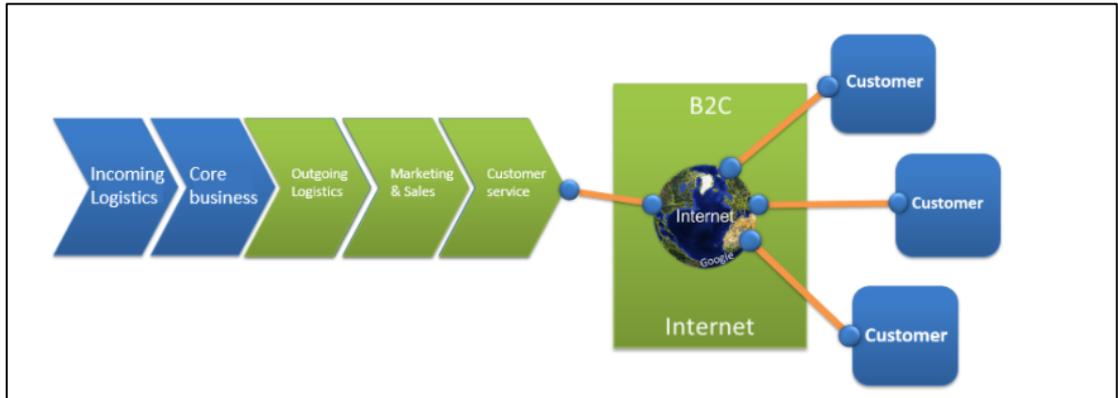
Fig. 60: Business-to-Consumer Relationship

10.2   Business-to-Consumer

10.2.1 E-Commerce

The B2C relationship involves the e-commerce activities of a company and is aimed at the end customer. These activities take place on the Internet and are therefore accessible to everyone. Today, the terms "e-business" and "e-commerce" are often used interchangeably. However, this is not correct. For the purpose of differentiation, e-commerce will now be explained.

E-commerce is the process of computerized buying and selling of goods and services electronically over the Internet, which also covers the first part of the e-business perspective presented at the beginning. It includes marketing, delivery and customer service.

10.2.2 Advantages of Internet Trading

As already known, e-commerce is conducted in particular on the Internet. In the previous WBT, you have learned what the Internet is and what services it offers. Now, we will go a step further and look at the Internet from an economic or business point of view. This means that we will clarify what business purposes the Internet (intranet, extranet) can serve.

As a marketplace, the Internet offers several advantages over a traditional marketplace:

- Ubiquity: Internet / web technology is available everywhere anytime.

- Global reach: Content is available worldwide and there are hardly any practical restrictions.

- Abundant communication: Video, audio and text messages are possible.

- Interactivity: The Internet enables "two-way communication", which enables the creation of interactive web pages.

- Higher information density: Information and communication costs decrease, information punctuality and accuracy increase.

- Individualization: E-commerce enables strong customization.

10.2.3 Customer Relationship Management

As mentioned in the beginning, the B2C relationship focuses on the end customer. Therefore, it is of utmost importance for companies to build long-term and stable relationships with their customers. This is done within Customer Relationship Management (CRM). CRM combines all activities of a company whose goal it is to maintain and improve customer relationships. The focus is on the needs of the customer by tailoring the offer to the customer's wishes and providing the customer with the opportunity to communicate with the company in different ways. By improving customer satisfaction and customer loyalty, sales are increased and costs are reduced at the same time.
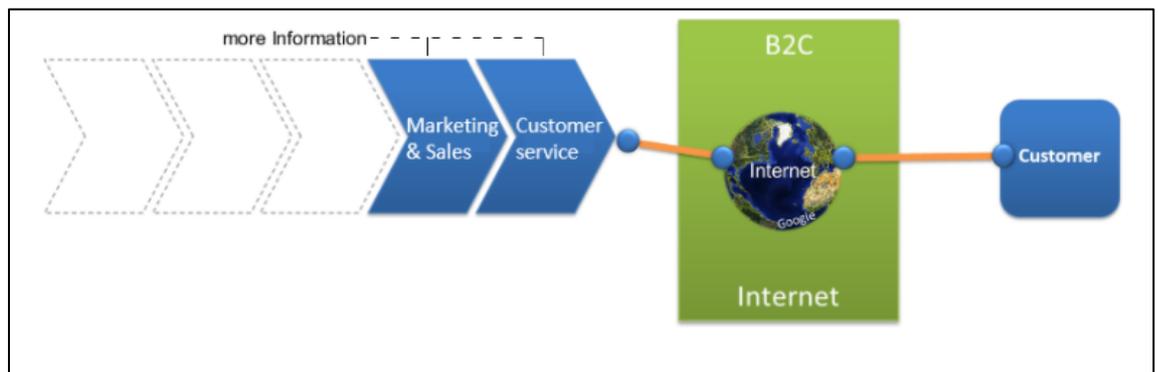
Fig. 61: Customer Relationship Management

- Marketing and Sales: CRM in marketing means effective and efficient business: Instead of costly and time-consuming customer telephone calls and letters, customers can be addressed extensively and yet individually by electronic means. In addition to personalized (and interactive) mass advertising on the Internet or email marketing, customers can also be reached conveniently and efficiently via social networks

- Customer Service: In customer service, instead of a telephone hotline, contact can be established via email or a service website with Frequently Asked Questions

(FAQ) can be set up. In addition, CRM offers electronic product updates, driver downloads or personalized information on upgrade or add-on possibilities as after-sales service.

10.3   Business-to-Business

10.3.1 Transactions between Business Partners

In addition to business with the end customer, the processing of transactions between business partners is of interest in e-business. B2B describes the cooperation and communication between partner companies and takes place via the extranet.

The use of this serves the purchasing and supply as well as the sales and the maintenance of relations with cooperating companies. The extranet is a closed network based on Internet technology that connects companies via the Internet. While the Internet is accessible to everyone, an extranet is protected (e.g., by firewalls) against unauthorized access and only allows selected users (partner companies) to access it.
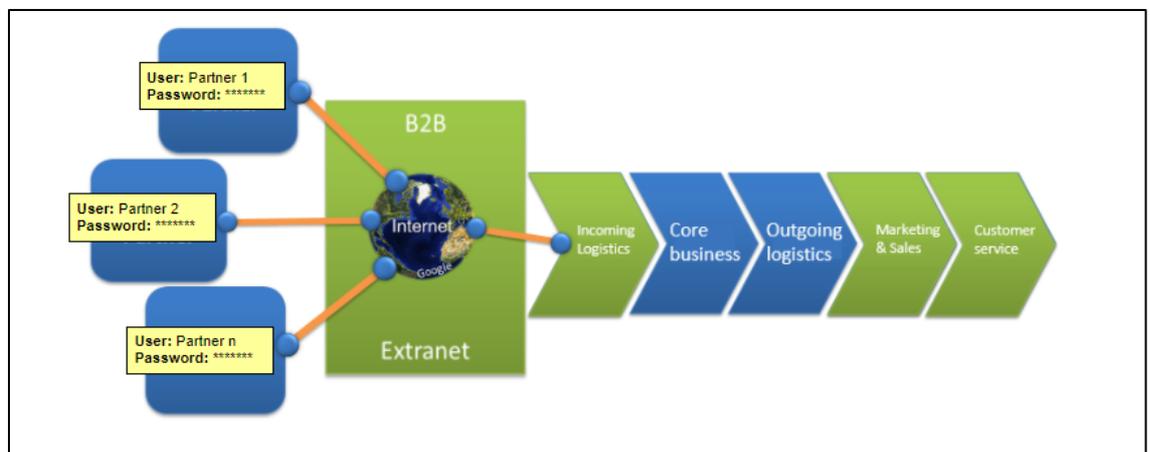
Fig. 62: Transactions between Business Partners

10.3.2 E-Integration

"Electronic Integration" (E-Integration) refers to the electronic integration of business partners into internal company IT systems via the extranet so that partner companies merge into a (fictitious) unified company. As a result, internal company boundaries are overcome, data can be exchanged more efficiently (reduction of data entry errors and data inconsistencies) and business processes are optimized (process speed is increased by eliminating waiting times). According to this, communication and business processing is

greatly facilitated by the integration of business partners. E-integration covers the areas of procurement, logistics, but also sales and relationship management (CRM).

10.3.3 E-Procurement

A frequently used sub-area of e-integration is e-procurement. "E-procurement" refers to electronically supported procurement using Internet technologies (extranet) and Internet services. The aim of e-procurement is to make procurement time and cost efficient in order to enable the focus to be placed on strategic tasks with a higher value-added share. A typical example of e-integration is the integration of suppliers. Thus amazon.com has also integrated many of its suppliers electronically in order to make the procurement process more efficient. This also includes the supplier of the iBoard.

Example: The stock of iBoard is at 80 % of the maximum capacity, but due to high sales, the stock is rapidly decreasing to 20 %. A connection to the supplier is established. The iBoard supplier automatically receives the critical stock level of con amazon.com and thus automatically receives the order to deliver new iBoards. amazon.com will receive the iBoards in time, without any delivery shortage. An inventory update is passed on to the supplier.

10.4   Business-to-Self

10.4.1 E-Workflow

E-business not only includes the relationships of a company with its partners or end customers, but also all business processes along the value chain within a company. The individual company departments are connected to each other via intranet, so that all information is directly available to the entire company and does not have to be exchanged between the individual departments on paper. Authorized employees can therefore access the centrally stored data from their workstations, which improves both the supply of information and cooperation between the various departments. This electronic support of the individual units in their activities is called "Electronic Workflow" (E-Workflow).

An intranet is an internal company network that provides access to data throughout the company. Existing Internet technology can be used for this purpose. Users can use both networks with the same interface (e.g., a web browser). However, an intranet is protected against public access by firewalls. Access is only granted to authorized persons (usually employees) via an user ID, so that even remote locations can be connected to the intranet.
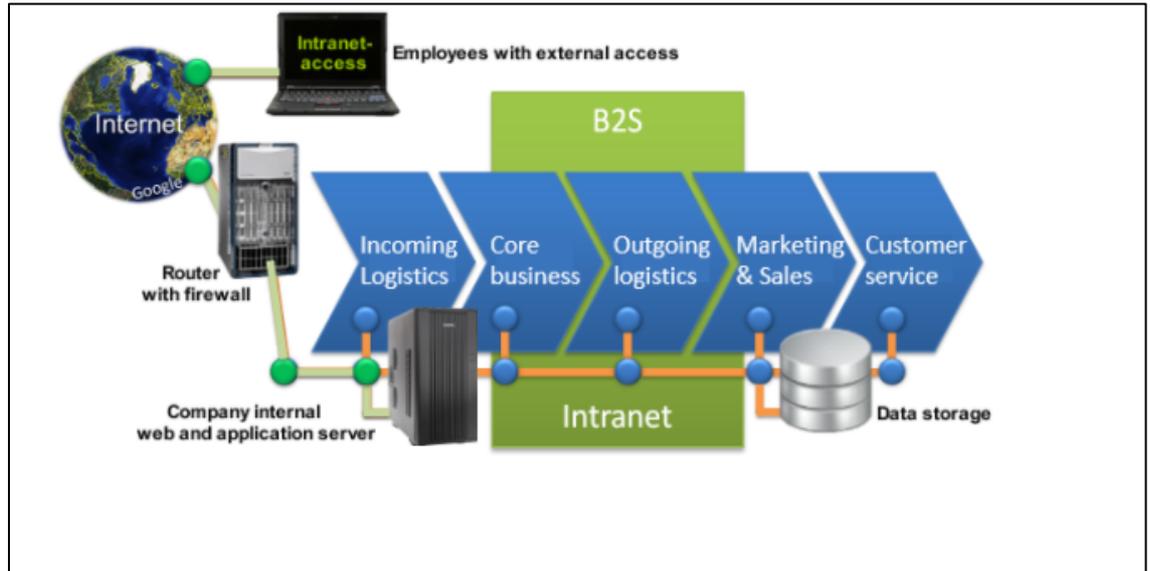
Fig. 63: E-Workflow

10.4.2 Harald's iBoard

At first, Harald informed himself about the iBoard thanks to his social network and the Internet. He then saw that it was still in stock at amazon.com and ordered it from there. He now has his iBoard, but what remained hidden to us until now is what was going on behind the "scenes": the internal company processes or the e-workflow at amazon.com. We will now take a look at this in an exemplary (and simplified) way.

Let's go!

- What Harald started at amazon.com, is an electronic ordering process. The ordering processes are stored in the internal data memory in his customer file, allowing every relevant department to access Harald's customer file via the intranet.

- Since Harald's creditworthiness is okay (he is a regular customer) the order can be processed immediately.

- The warehouse automatically receives a notification to send an iBoard to the shipping logistics department so that they can prepare the iBoard for shipping. Since the outgoing logistics also has access to the intranet, they already know the delivery address and can ship the iBoard immediately.

- After dispatch, the accounting department will invoice Harald for the products and check the payment status.

- In addition, customer service receives a notification that Harald has ordered an iBoard. In the future, amazon.com will be able to send him customized offers (e.g., a bag for his iBoard) by newsletter (CRM).

10.5   Final Test

No.	Question	True	False
1	The internal networking within a company is called "Self-to-Business relationship".		
2	The goal of CRM is to build long-term and stable customer relationships.		
3	The search for potential transaction partners and their conditions is done in the agreement phase.		
4	In the information phase mainly agreement costs arise.		
5	E-business reduces the intensity of competition, resulting in suppliers charging higher prices.		
6	The terms "e-business" and "e-commerce" are often mistakenly used synonymously, even though e-business is actually a subcategory of e-commerce.		
7	Business partners communicate via:		
	Internet		
	Intranet		
	Extranet		
8	During the settlement phase, the customer pays for his goods and receives them.		
9	What phases is the transaction cost theory divided into?		
	Processing phase		
	Post-contract phase		
	Exchange phase		
	Payment phase		
	Agreement phase		

	Information phase		
10	E-commerce activities are mainly carried out via the Intranet.		
11	E-commerce is the process of computer-assisted buying and selling of goods and services electronically over the Internet.		
12	E-commerce includes the following areas:		
	Customer Service		
	Procurement		
	Delivery		
	Human Resources		
	Marketing		
13	What are the costs in the post-contract phase?		
	Agreement costs		
	Search costs		
	Control costs		
	Adjustment costs		
	Initiation costs		
14	After payment of the purchase price by the customer, no further transaction costs can arise.		
15	E-procurement ensures a more efficient information supply and collaboration within a company.		

Tab. 8:   Questions WBT 10 – E-Business

Annex

Answers to the exercise questions in WBT 1

No.	Question	True	False
1	An IT system is:		
	A hardware / software system to support a task in a company.	X	
	A system for rationalizing or increasing the efficiency of the tasks to be performed.	X	
	A single system that is ideally integrated with the various other IT systems of a company (IT system network).	X	
	A single system, which must necessarily be integrated with the various other IT systems of the company (IT system network).		
	Please answer the following questions with true or false .		
2	ERP systems follow the approach of combining all types of application systems and all business-related functional areas in a central application system.	X	
3	So-called "information management" is an intersection of business administration, computer science and technology.		X
4	The tasks of business informatics are the conception, development, implementation, maintenance and use of computer-aided information processing systems.	X	
5	Production planning and control systems are personnel planning systems which are used in the HR department of a company.		X
6	Isolated IT systems have the advantage that the information flow is uninterrupted.		X
7	Integrated IT systems (IT system network) are characterized by the fact that information flows through the company without media disruption.	X	

8	Business Informatics is an interdisciplinary, now largely equal discipline between business administration and computer science with a broad range of interfaces to technology.	X	
9	Business informatics deals exclusively with the functional areas of a company.		X
10	CRM systems (Cash Return Management Systems) are used in the finance department of a company.		X
11	The main task of business informatics is considered to be the occupation with information management. This is understood as the task of providing all positions (and thus levels) in a company with the required information in an up-to-date and appropriate form.	X	
12	The integration of the cross-company value-added chain in the field of business informatics opens up opportunities for joint value creation. However, a process and system integration of the interfaces is not necessary.		X
13	Management information systems process exclusively internal company information.		X

Tab. 9:   Answers to the Exercise Questions in WBT 1

Answers to the exercise questions in WBT 2

No.	Question	True	False
1	The level concept follows the approach:		
	"Technology extinguishes organisation"		
	"Technology follows organisation"	X	
	"Technology enables organisation"		
2	There are various concepts for networking the hardware infrastructure. These are:		
	The Multi-Level Concept	X	
	The Client/Server Concept	X	
	The ITC Concept		
	The Central Computer Concept	X	
3	RAM and ROM are components...		
	Of the periphery		
	Of the main memory	X	
	Of input and output		
4	The circuit concept of the von Neumann Architecture contains the following components:		
	ALUs - calculator	X	
	Memory - storage device	X	
	Central processing unit	X	
	I/O Unit - Input/Output Unit	X	

		X	
	Bus - connection system	X	
5	Number Cruncher …		
	Can be found at almost every university		
	Can also be run privately		
	Can perform simulation calculations.	X	
	Please answer the following questions with true or false.		
6	One goal of IT systems is that access to data and programs must be possible from different locations.	X	
7	The networking of IT systems should enable rapid data exchange between all components.	X	
8	The central computer concept was mainly pursued until the early 1990s.		X
9	With the level concept, the primary task of the technological use of "rationalization" was supplemented by planning and control tasks.	X	
10	The computing power of a desktop PC is greater than that of a minicomputer.		X
11	Due to their complexity, supercomputers are less common than microcomputers.	X	
12	The main task of mainframes is mass data processing.	X	
13	Minicomputers are often used as "link computers" with a pre-processing function between micro- and mainframe computers.	X	
14	The "Central Processing Unit" belongs to the von Neumann Architecture.	X	
15	Only computers up to about 1990 are based on von Neumann Architecture.		X

Tab. 10:   Answers to the Exercise Questions in WBT 2

Answers to the exercise questions in WBT 3

No.	Question	True	False
1	The monitor resolution...		
	Is measured in width x height.	X	
	Is measured in width x depth.		
	Is measured in depth x height.		
2	Select all image input devices.		
	Scanner	X	
	Keyboard		
	Webcam	X	
	Graphics tablet	X	
	Touchpad		
3	The chip card is a...		
	Direct access memory	X	
	Magnetic memory		
	Optical memory		
	Semiconductor memory	X	
	Sequential memory		
	Are the following statements true or false?		
4	The advantage of sequential storage compared to direct access storage is the shorter access time.		X

5	With sequential storage, the storage medium is divided into so-called memory blocks.	X	
6	The von Neumann architecture describes solely the peripherals of a PC.		X
7	The mouse is an input device that follows three-dimensional movements with a position marker on the screen.		X
8	Sequential memory means that data is stored sequentially and can only be read in this order.	X	
9	A smart card can only be used as an alternative payment method.		X
10	The advantage of a USB flash drive is the standard interface	X	

Tab. 11:   Answers to the Exercise Questions in WBT 3

Answers to the exercise questions in WBT 4

No.	Question	True	False
1	Software is differentiated into ...		
	... Application software	X	
	... System software	X	
	... And hardware		
2	The main tasks of the operating system are:		
	Device control, user administration and file system management.		
	Device control, user administration and data formatting.		
	User administration, file system management and programming language development.	X	
	Are the following statements true or false?		
3	Apple's hardware standards are not compatible with Intel.		X
4	Unix is a Linux distribution.		X
5	The hardware of a computer is controlled by the device control.	X	
6	Operating system commands can be executed via the console, user interfaces and application programs.	X	
7	Software are programs for operating computers.	X	
8	Linux can also be an operating system for a phone.	X	
9	Linux is an open source software.	X	

Tab. 12:   Answers to the Exercise Questions in WBT 4

Answers to the exercise questions in WBT 5

No.	Question	True	False
1	When a company purchases a standardized software product, it is also responsible for the further development of the software.		X
2	What are characteristics of functional orientation?		
	Interfaces between the functional departments.	X	
	Integration of the individual functions into business processes.		X
	Are the following statements true or false?		
3	Decision support systems obtain their data exclusively from within the company.		X
4	The vertical integration of application systems refers to the data exchange between the different management levels.	X	
5	When purchasing standard software, a company bears all development costs of the software alone.		X
6	Data integration describes the joint and standardized use of data across several functional areas in a company-wide database to which all application systems are connected.	X	
7	Finance and accounting systems support employees primarily in payroll accounting, monitoring financial resources and planning training opportunities for employees.	X	

Tab. 13:   Answers to the Exercise Questions in WBT 5

Answers to WBT 8

No.	Question	True	False
1	The active network components include:		
	Router	X	
	Terminator		
	Cable		
	Wireless Access Point	X	
	Switch	X	
2	Which is the cell topology?		
3	Cable and light connections belong to the passive network components.	X	
4	When planning networks, you have to consider...		
	... Which topologies to use.	X	
	... When the network should be first expanded.		
	... Which network devices and transmission media should be used.	X	
	...What requirements the network should meet.	X	
5	Compared to a hub, a switch has the advantage that it only sends data to those stations it is intended for.	X	
6	Received data packets are forwarded to all participants in a network by a switch.		X
7	A network generally consists of nodes and edges, which merge into meshes.		X
8	What is not a network topology?		
	Switch topology		X
	Star topology		
	Bus topology		
	Ring topology		

| 9 | One advantage when planning networks is that the requirements for the network do not have to be defined user-specific, as the same requirements apply to all networks. | | X |
| 10 | A Local Area Network (LAN) is extended to a large city or region at most. | | X |

Tab. 14:   Answers to the Exercise Questions in WBT 8

Answers to the exercise questions in WBT 9

No.	Question	True	False
1	Put the elements in the correct order for accessing a web site.		
	HTML documents are sent	4	
	DNS finds IP address to the URL	2	
	Entering the URL in the Internet browser	1	
	Website is displayed on PC	4	
2	What versions of IP addresses exist?		
	IPv3		
	IPv4	X	
	IPv5		
	IPv6	X	
3	Which of the following attributes are part of an IPv6 address?		
	Interface identifier	X	
	Prefix	X	
	Network part		X
	Host part		X
4	The abbreviation DNS stands for	Domain Name System	
5	For instant messaging, both, the sender and recipient, use different servers.		X
6	What are conventional Internet services?		
	World Wide Web	X	
	E-mail	X	

	Instant messaging	X	
	Streaming	X	
7	The Domain Name System converts a URL into an IP address and vice versa	X	
8	What type of connection is established between two computers during file sharing?		
	Peer-to-Peer	X	
	Computer-to-Computer		
	Network-to-Network		
	Location-to-Location		

Tab. 15:   Answers to the Exercise Questions in WBT 9

Answers to the exercise questions in WBT 10

No.	Question	True	False
1	The internal networking within a company is called "Self-to-Business relationship".		X
2	The goal of CRM is to build long-term and stable customer relationships.	X	
3	The search for potential transaction partners and their conditions is done in the agreement phase.		X
4	In the information phase mainly agreement costs arise.		X
5	E-business reduces the intensity of competition, resulting in suppliers charging higher prices.		X
6	The terms "e-business" and "e-commerce" are often mistakenly used synonymously, even though e-business is actually a subcategory of e-commerce.		X
7	Business partners communicate via:		
	Internet		
	Intranet		
	Extranet	X	
8	During the settlement phase, the customer pays for his goods and receives them.	X	
9	What phases is the transaction cost theory divided into?		
	Processing phase	X	
	Post-contract phase	X	
	Exchange phase		
	Payment phase		
	Agreement phase	X	
	Information phase	X	
10	E-commerce activities are mainly carried out via the Intranet.		X

11	E-commerce is the process of computer-assisted buying and selling of goods and services electronically over the Internet.	X	
12	E-commerce includes the following areas:		
	Customer Service	X	
	Procurement		
	Delivery	X	
	Human Resources		
	Marketing	X	
13	What are the costs in the post-contract phase?		
	Agreement costs		
	Search costs		
	Control costs	X	
	Adjustment costs	X	
	Initiation costs		
14	After payment of the purchase price by the customer, no further transaction costs can arise.		X
15	E-procurement ensures a more efficient information supply and collaboration within a company.		X

Tab. 16:   Answers to the Exercise Questions in WBT 10

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