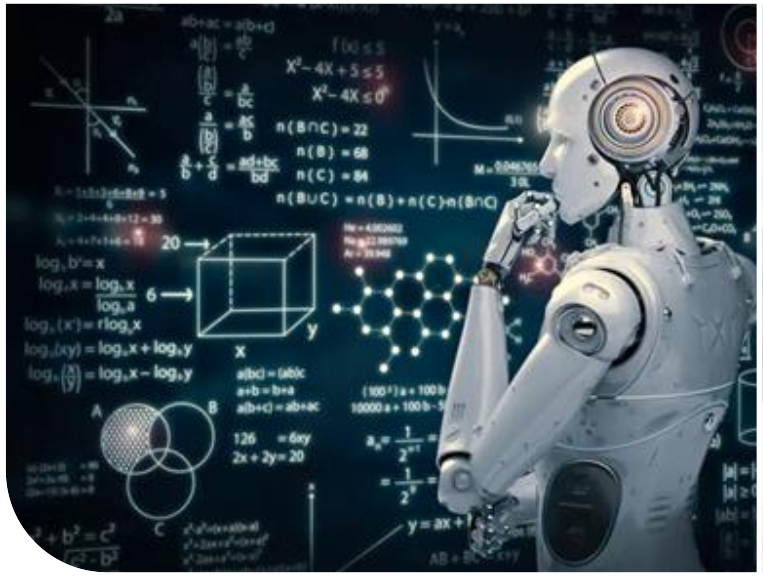
UNIVERSITY OF PASSAU

AI-Based Business Information Systems

Design & Management of AI-Based Business Information Systems



Prof. Dr. Ulrich Gnewuch

Course Organization

Lecture

AI-Enabled Business Capabilities

- AI-Enabled Innovation
- AI-Enabled Insights & Decisions
- AI-Enabled Engagement
- AI-Enabled Automation

AI Technologies & Trends

- AI Ethics & Responsible AI
- Generative AI
- Explainable AI
- Conversational AI

Foundations

- Introduction to AI in Business & Information Systems
- Design & Management of AI-Based Information Systems

Exercise

- **Exercise 4:** Generative AI & Innovation
- **Exercise 3:** Explainable AI Techniques
- **Exercise 2:** Human-Centered Chatbot Design
- **Exercise 1:** Robotic Process Automation Case Study

Industry Talk
ZF Group

Mentimeter

RECAP FROM LAST LECTURE:

- What are typical elements of an AI-based business information system?
- What are key differences between AI-based and traditional business information systems?
- Please name an example of an AI-based information systems that enables at least two business capabilities.

Learning Goals

- Describe the basic design process of AI-based business information systems and explain key differences to traditional design approaches
- Describe key principles and guidelines for the design of AI-based business information systems
- Explain how and why managing AI is different from managing more traditional business information systems
- Identify challenges at the level of strategic, tactical, and operational AI management and develop strategies for addressing them

Guide to Designing AI Systems: Start with the User Experience

Artificial intelligence and design: Questions of ethics

Artificial Intelligence and the Role of Designers in the Future.

Design Principles for Generative AI Applications

Will AI Take Over the Role of a Software Developer?

Conflicting values: a challenge in the design of AI systems

What Do We Mean by "Design"?

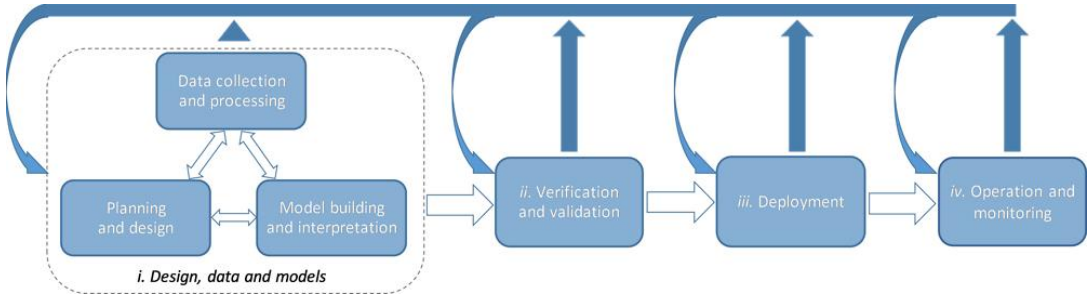
- "Design" can be understood as both a *process* and a *product*:

Design, used as a **verb**, refers to the act of planning or creating something for a specific purpose

→ "design **process**"

Design, used as a **noun**, refers to the outcome of the design process

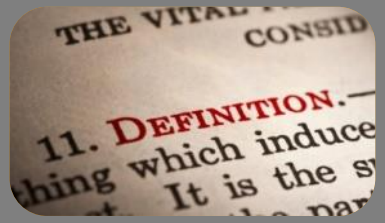
→ "design **product**"



Baskerville et al. 2015

Design as a *Process*

Design as a Process



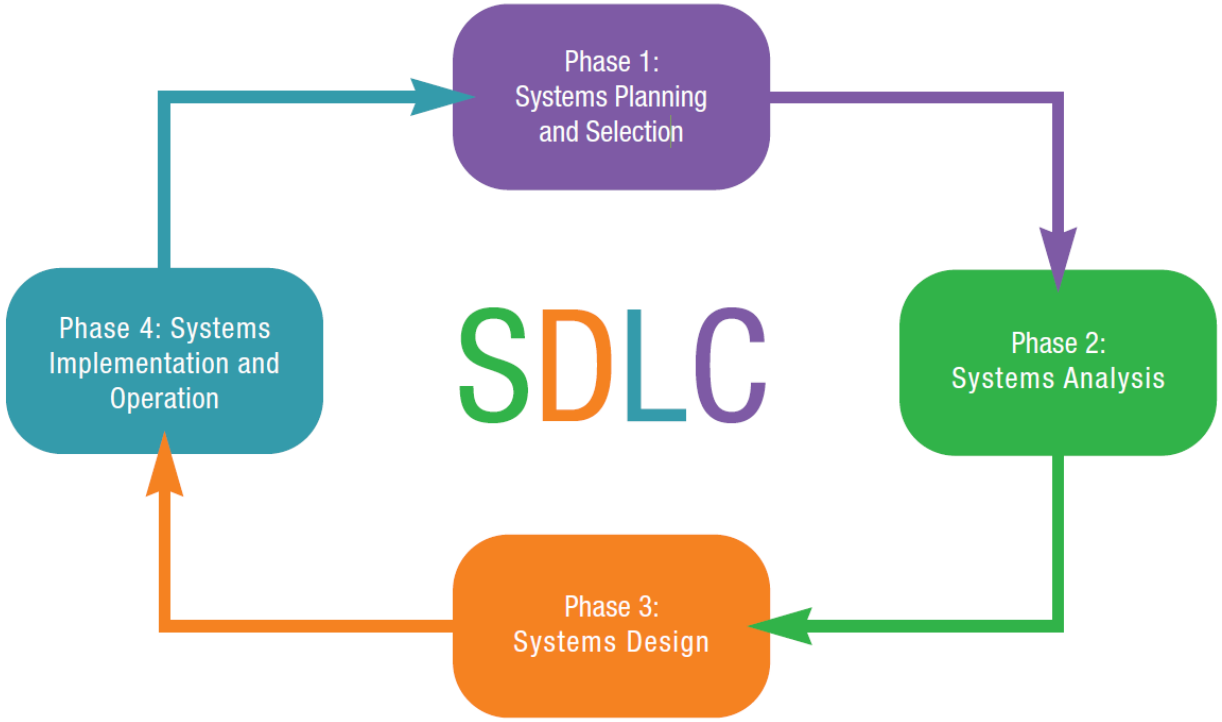
Design, used as a verb, refers to the *act of planning or creating something for a specific purpose* (“process”).

- There are many process models or frameworks that offer step-by-step guidance on how to design a (business) information system
- These models typically involve a set of activities:
  - Analyzing the status quo and collecting requirements
  - Evaluating (design) alternatives
  - Developing the system (or procuring it)
  - Implementation, operation, and maintenance
  - …
- The design process is not linear but iterative!

Baskerville et al. 2015

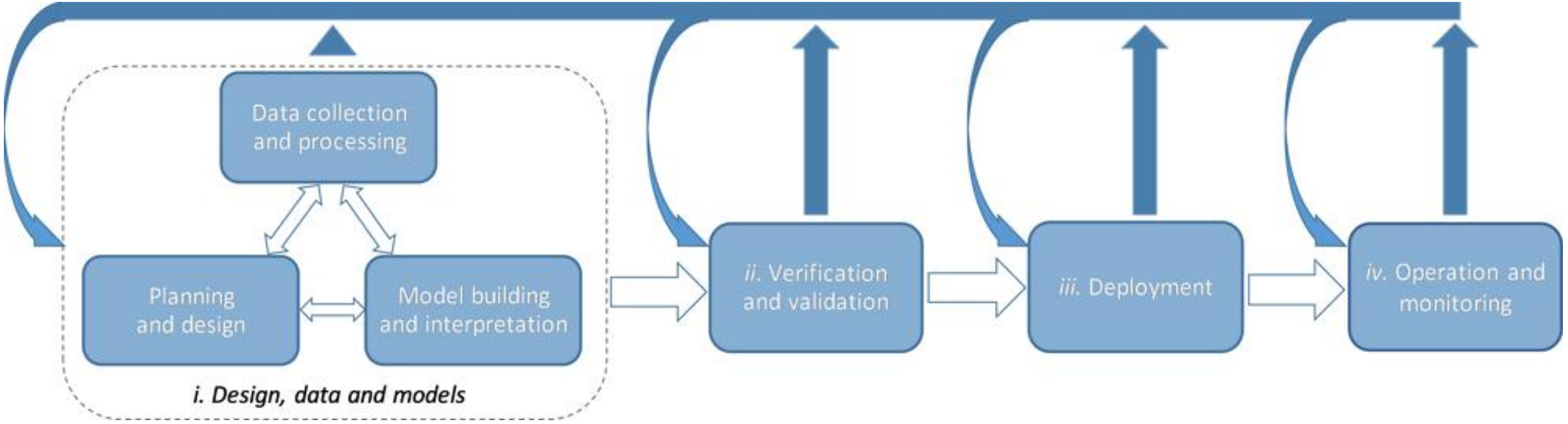
Traditional Approaches to System Design

- The systems development life cycle (SDLC) is one of the most widely applied methods for designing business information systems
- It includes four key steps:
  - Planning and selection
  - Analysis
  - Design
  - Implementation and operation



Valacich et al. 2015

Basic Design Process of AI-Based BIS (1)



Note: Steps with a technical focus (e.g., data collection, model building and verification) are not covered in this course.

OECD's AI Systems Lifecycle (2019)

Basic Design Process of AI-Based BIS (2)

Step	Description
1. Design, data and modelling	• Planning and design involves articulating the system's concept and objectives, underlying assumptions, context and requirements, and potentially building a prototype. • Data collection and processing includes gathering and cleaning data, performing checks for completeness and quality, and documenting the dataset. • Model building and interpretation involves the creation or selection of models or algorithms, their calibration and/or training and interpretation.
2. Verification and validation	… involves executing and tuning models, with tests to assess performance across various dimensions and considerations.
3. Deployment	… involves piloting, checking compatibility with legacy systems, ensuring regulatory compliance, managing organizational change and evaluating user experience.
4. Operation and monitoring	… involves operating the AI system and continuously assessing its recommendations and impacts (both intended and unintended) in light of objectives and ethical considerations.

OECD (2019)

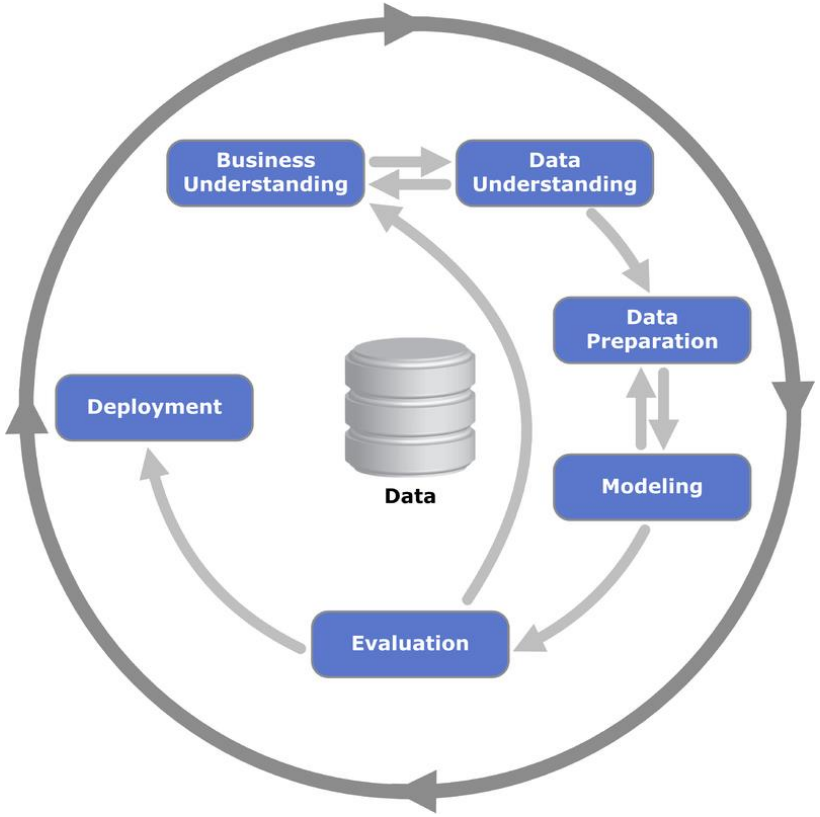
AI-Specific vs. Traditional Design Process

- Similar high-level sequence of process steps:
  - Planning/analysis
  - Design
  - Implementation
  - Operation

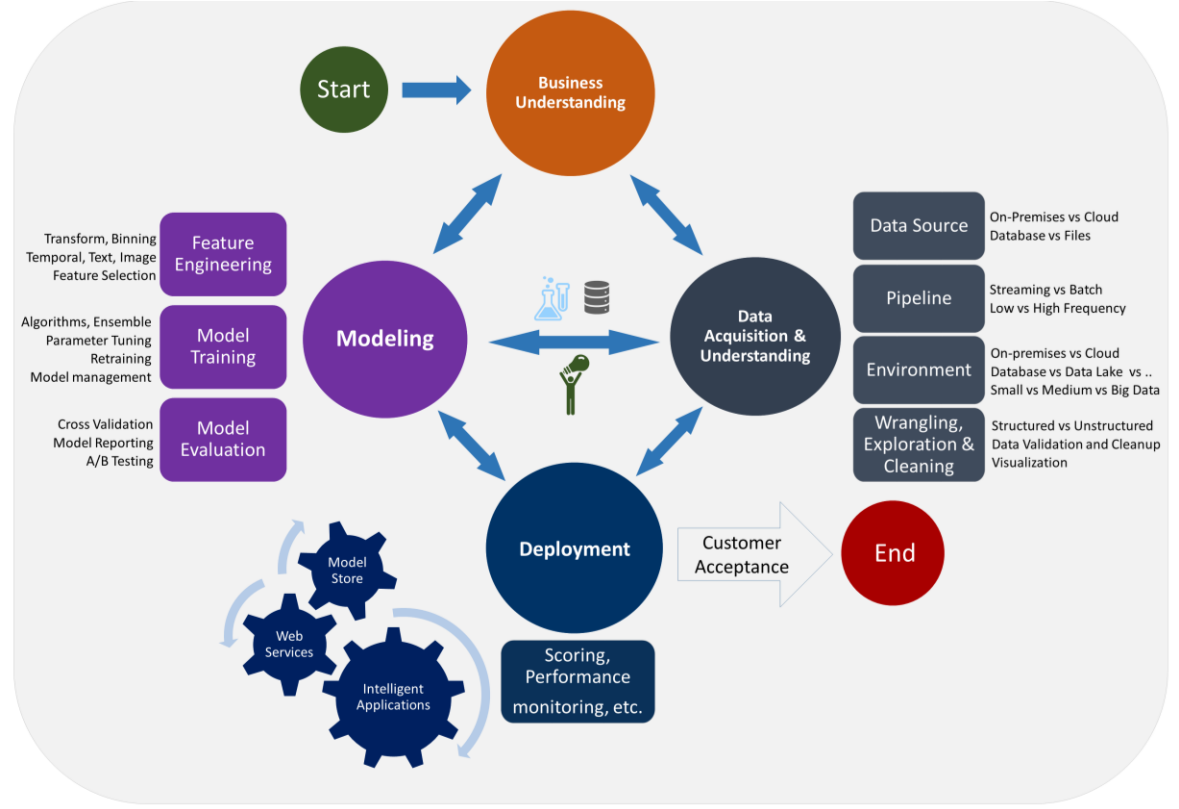
- Key differences:
  - Centrality of data and models that rely on data
  - Focus on experimentation → many iterations at every step
  - Focus on continuous improvement, even after the deployment, due to AI's capacity to optimize and evolve over time

OECD (2019), Dolata & Crowston (2019), Vial et al. (2023)

Examples of More Specific Design Process Models



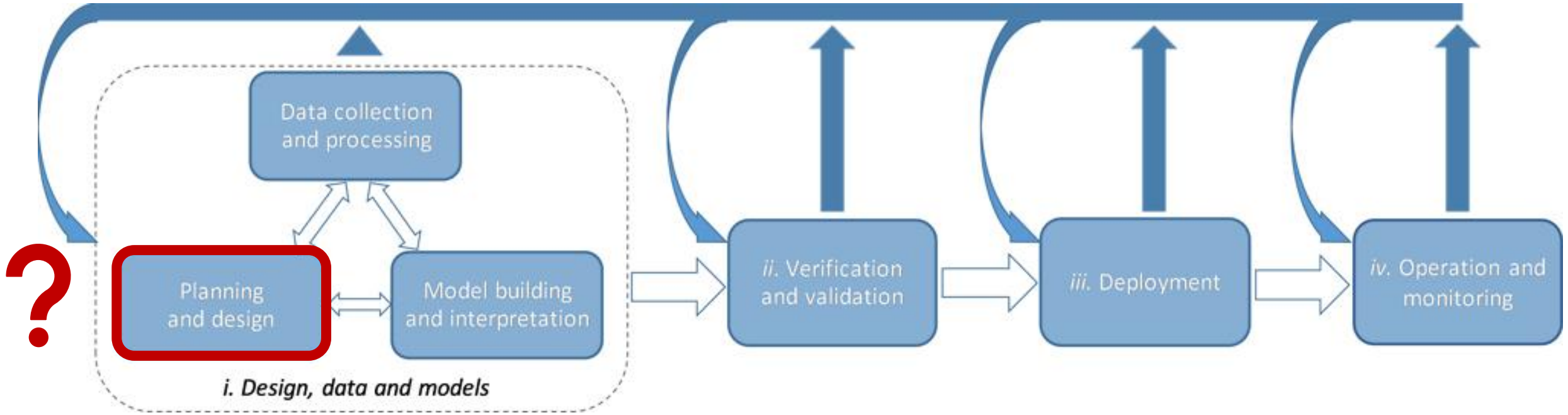
CRISP-DM (Shearer, 2000)



Microsoft's Team Data Science Process (Microsoft, 2022)

OECD (2019)

Human-Centered Design Process (1)



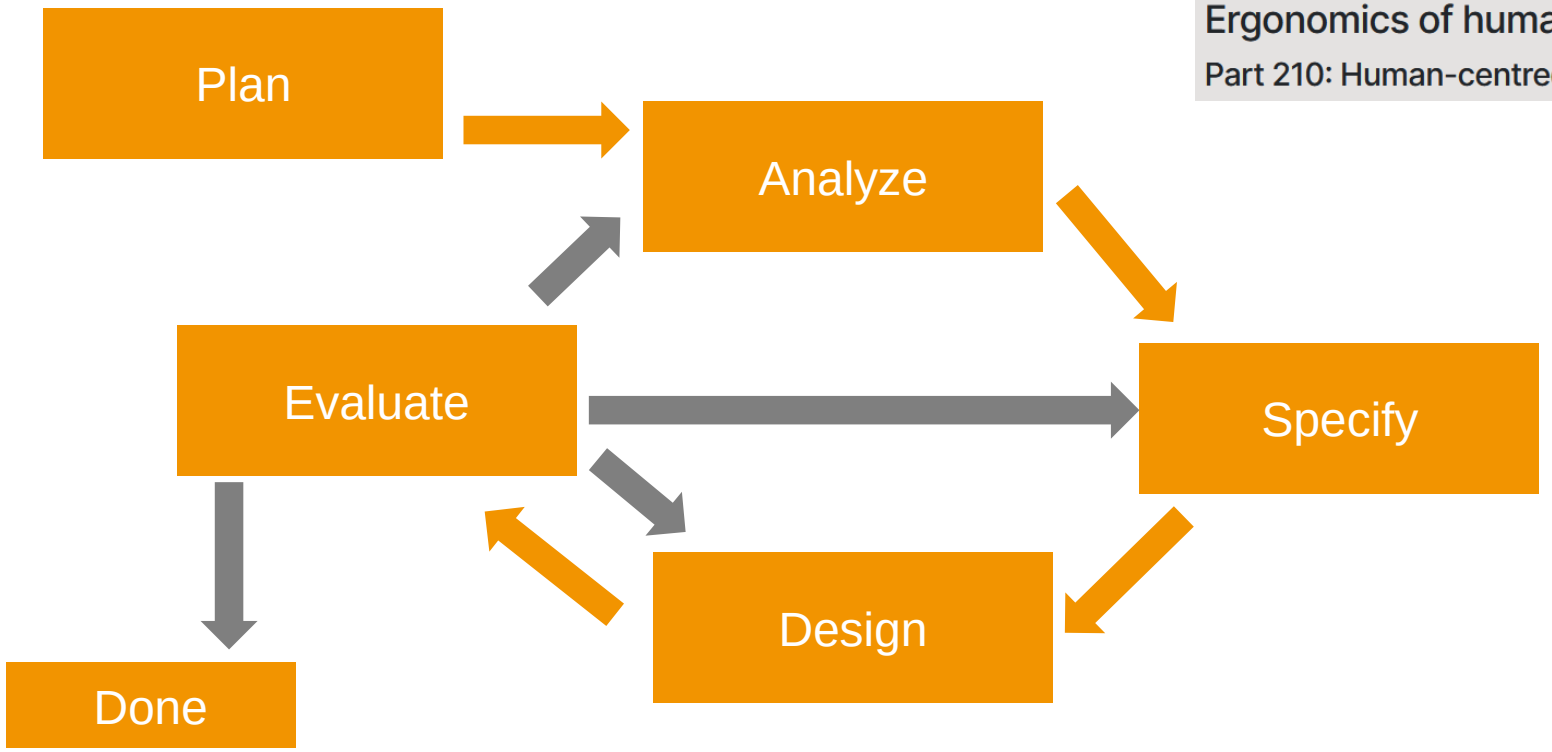
Planning and design involves articulating the system's concept and objectives, underlying assumptions, context and requirements, and potentially building a prototype → How?

Human-Centered Design Process (2)

ISO 9241-210:2019

Ergonomics of human-system interaction

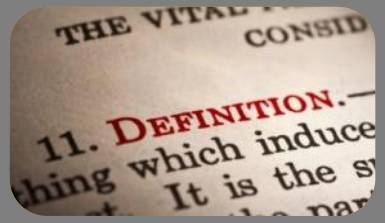
Part 210: Human-centred design for interactive systems



DIN EN ISO 9241-210

Design as a *Product*

Design as a Product



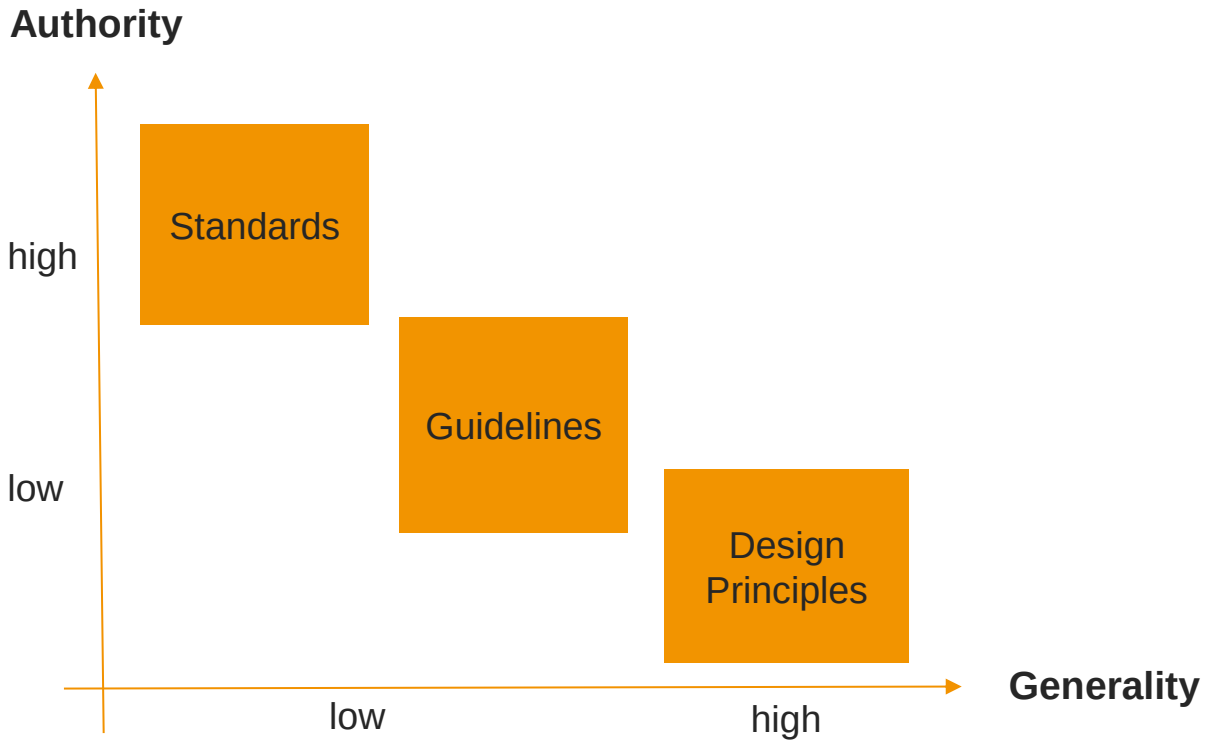
Design, used as a noun, refers to the *outcome of the design process* (“product”).

- There is a large body of knowledge about a “good” or “ideal” design of (business) information systems
- This design knowledge is captured in different forms:
  - Standards
  - Guidelines
  - Design principles
- AI-specific design knowledge exists, but it is important to not forget about general design knowledge that applies to all (business) information systems

Baskerville et al. 2015

Different Forms of Design Knowledge

- **Standards**: specific design rules with lower generality, but high authority
- **Guidelines**: specific design rules with high generality and limited authority
- **Design principles**: abstract design rules, with very high generality and low authority



Standards

- Standards are usually set by national or international bodies to ensure compliance with a set of design rules by a large community
- Various standards exist for hardware and software (see ISO 13.180 Ergonomics https://www.iso.org/ics/13.180/x/)
- Examples:
  - ISO 9241: Ergonomics of human-system interaction
  - ISO 6385:2016: Ergonomics principles in the design of work systems

AI Standardization is Still in Progress

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GERMAN STANDARDIZATION ROADMAP
ON ARTIFICIAL INTELLIGENCE
2ND EDITION

With the second edition of the German Standardization Roadmap Artificial Intelligence, today we are able to present an expanded and updated analysis of the current status and need for international standards and specifications for this key technology. In doing so, we wish to build on the great success of the Roadmap published in November 2020, the results of which received a great amount of international attention not only in specialist circles but also among political bodies and by the press following the presentation of the Roadmap at the German government's Digital Summit.

Standardization is also seen by the new German federal government as part of its AI Strategy and as a topic of very great importance. Following a kick-off event organized by DIN and

Title	Contents	Status
ISO/IEC 22989:2022, Artificial intelligence – Concepts and terminology [16]	Concepts and terminology for artificial intelligence	Published
ISO/IEC 23053:2022, Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML) [24]	Terminological framework for machine learning	Published

On the topic of AI systems management, the following works are to be mentioned:

Title	Contents	Status
ISO/IEC 23894:2022, Information Technology – Artificial Intelligence – Guidance on risk management [25]	Guidelines for the risk management of the development and use of AI systems. This standard is also being developed under the direction of a German editor.	In development, publication due end 2022
ISO/IEC 38507:2022, Information technology – Governance of IT – Governance implications of the use of artificial intelligence by organizations [26]	Organizational governance in connection with AI	Published
ISO/IEC 42001, Information Technology – Artificial Intelligence – Management System [27]	Certifiable management standard for AI that contains requirements and organizations for the responsible development and use of AI systems.	In development, publication due mid 2023

www.din.de/go/roadmap-ai

Guidelines

- Often created by (software) companies
- Examples of AI guidelines:

Company	Guideline	Link
SAP	SAP's Guiding Principles for Artificial Intelligence	https://www.sap.com/documents/2018/09/940c6047-1c7d-0010-87a3-c30de2ffd8ff.html
Microsoft	Responsible bots: 10 guidelines for developers of conversational AI	https://www.microsoft.com/en-us/research/publication/responsible-bots/
Google	Google AI Principles	https://ai.google/responsibility/principles/
Deutsche Telekom	Guidelines for Artificial Intelligence	https://www.telekom.com/en/company/digital-responsibility/details/artificial-intelligence-ai-guideline-524366
Bayerischer Rundfunk	Ten guidelines for our day-to-day use of AI and automation	https://www.br.de/extra/ai-automation-lab-english/ai-ethics100.html

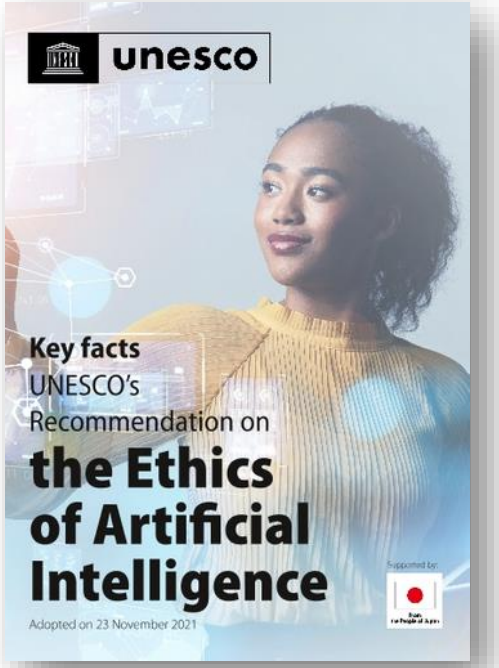
General Design Principles: Examples

Norman's Six Principles	Shneiderman's Eight Golden Rules of Interface Design	Usability Body of Knowledge
• Affordance • Visibility • Feedback • Constraints • Mapping • Consistency	• Strive for consistency • Seek universal usability • Offer informative feedback • Design dialogs to yield closure • Prevent errors • Permit easy reversal of actions • Keep users in control • Reduce short-term memory load	• Usefulness • Consistency • Simplicity • Communication • Error Prevention and Handling • Efficiency • Workload Reduction • Usability Judgment

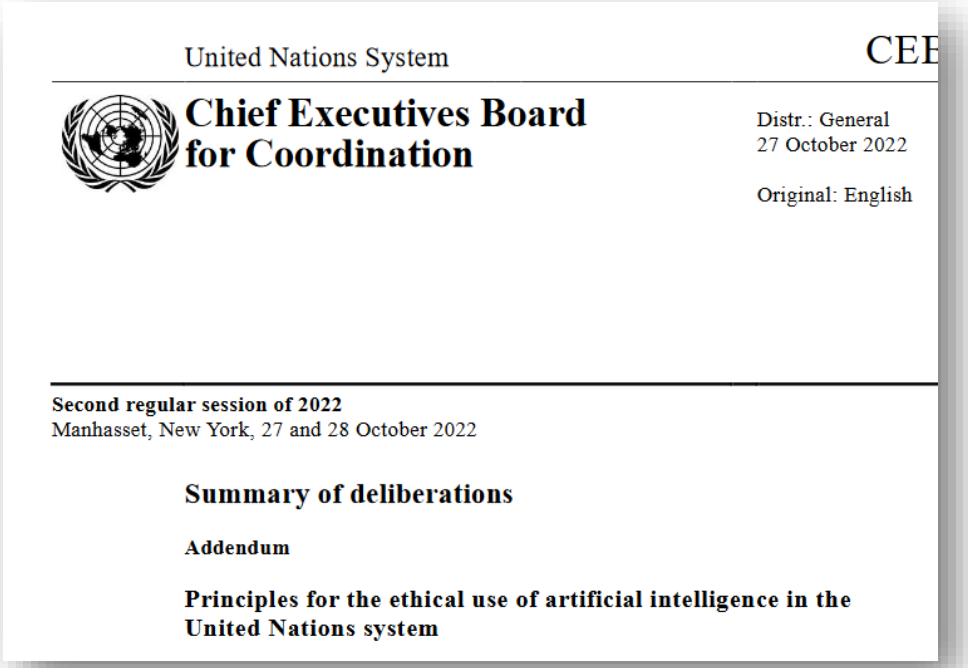
Norman 2013; Shneiderman et al. 2016; UsabilityBoK.org

Design Principles for Ethical AI

https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai



https://www.unesco.org/en/artificial-intelligence/recommendation-ethics


United Nations System

CEB

Chief Executives Board for Coordination

Distr.: General
27 October 2022

Original: English

Second regular session of 2022
Manhasset, New York, 27 and 28 October 2022

Summary of deliberations

Addendum

Principles for the ethical use of artificial intelligence in the United Nations system

https://unsceb.org/principles-ethical-use-artificial-intelligence-united-nations-system

...

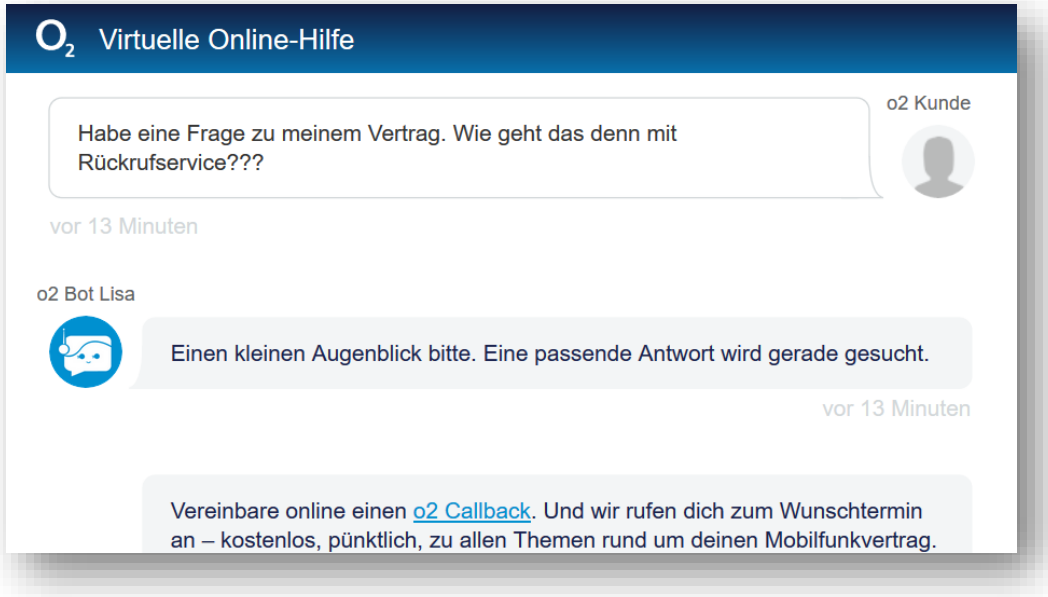
Design Principles for Ethical AI

Principle	Example Definition
Transparency	*AI actors "should provide meaningful information, appropriate to the context [...] to foster a general understanding of AI systems, to make stakeholders aware of their interactions with AI systems [...] to enable those affected by an AI system to understand the outcome, and, to enable those adversely affected by an AI system to challenge its outcome [...]" (OECD)*
Justice and fairness	*The development, deployment and use of AI systems must be fair. […] fairness has both a substantive and a procedural dimension. The substantive dimension implies a commitment to: ensuring equal and just distribution of both benefits and costs, and ensuring that individuals and groups are free from unfair bias, discrimination and stigmatization. […] The procedural dimension of fairness entails the ability to contest and seek effective redress against decisions made by AI systems and by the humans operating them. […] (EU)*
Non-maleficence	*AI systems should not be used in ways that cause or exacerbate harm, whether individual or collective, and including harm to social, cultural, economic, natural, and political environments. (United Nations)*
Responsibility	*Designers and builders of advanced AI systems are stakeholders in the moral implications of their use, misuse, and actions, with a responsibility and opportunity to shape those implications. (Future of Life Institute)*
Privacy	*Artificial intelligence should not be used to diminish the data rights or privacy of individuals, families, or communities. (UK Parliament)*

Jobin et al. 2019

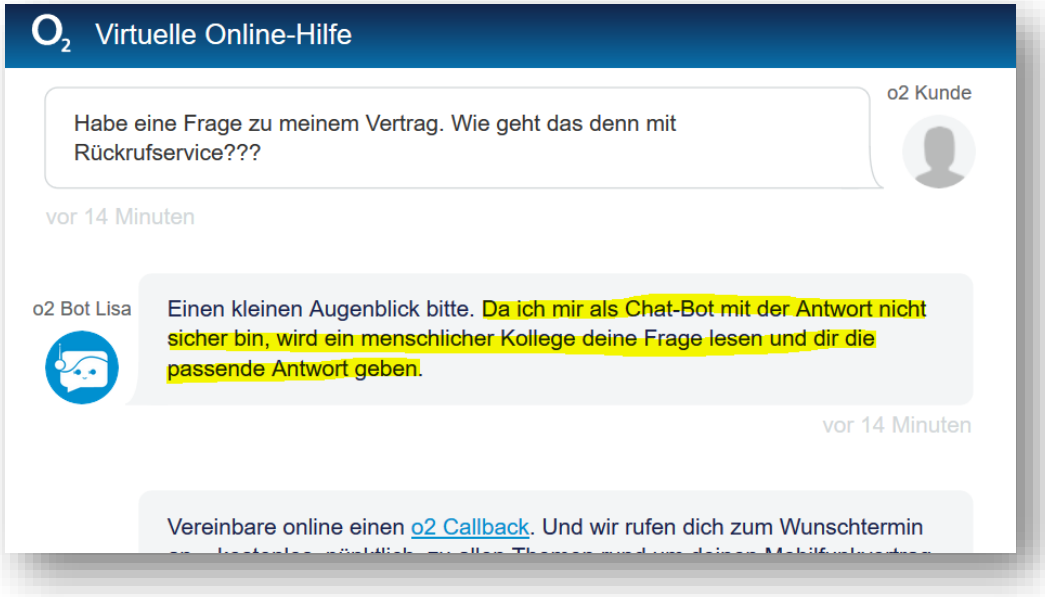
Research Example: Transparency in AI-Based Customer Service

Human involvement not disclosed



vs.

Human involvement disclosed



Should companies that use hybrid service agents (chatbot + human employees working behind the scenes) be transparent about human involvement?

- The disclosure of human involvement changed customer communication behavior
- This ultimately increased employee workload because fewer customer requests could be handled automatically by the chatbot and had to delegated to a human

Gnewuch et al. (2023): https://pubsonline.informs.org/doi/10.1287/isre.2022.0152

Transparency in AI-Based Customer Service

Please imagine that you are responsible for designing a hybrid service agent (chatbot + human employees). Given that disclosing human involvement can lead to increased effort from employees (and potentially raise your operational costs), would you still choose to be transparent with your customers? Why?

→ Discuss these questions with a partner for **~5 minutes** and be ready to share your opinions

Management of AI-Based Business Information Systems

How Artificial Intelligence Will Redefine Management

Your boss will be replaced by AI before you are

How artificial intelligence is redefining the role of manager

It's Managers, Not Workers, Who Are Losing Jobs To AI And Robots, Study Shows

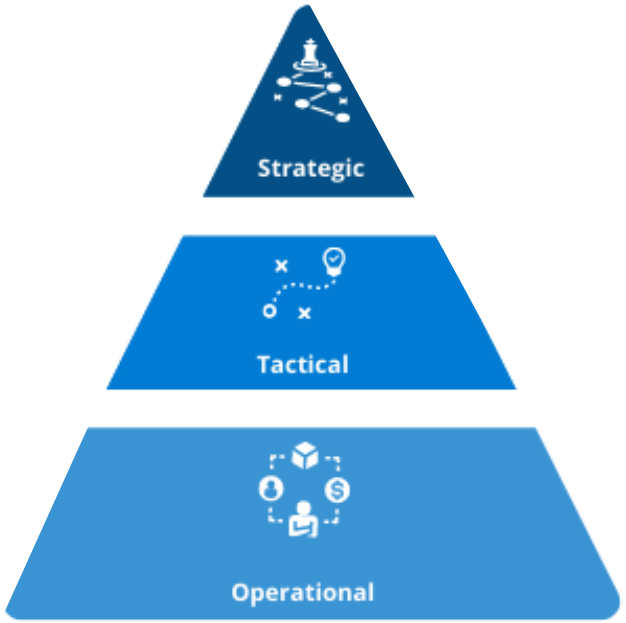
How Will AI Help Good Managers Be Great?

Why are Machine Learning Projects so Hard to Manage?

Definition: Management

Management involves communicating, leading, coordinating and controlling the tasks of others in an organization, and decision making is a key activity of managers.

- There are three levels of management:
  - Strategic / Executive
  - Tactical
  - Operational / front-line
- Each level of management has its own responsibility and specific functions
- Managing AI presents challenges to organizations at every level



Drucker 2008

Managing AI

What do you think are common challenges associated with the management of AI?

Challenges When Managing AI

Challenge	Expectations / Assumptions / Demands	Reality
Inflated expectations	• Expectation that AI technology can revolutionize everything overnight • Tendency to throw AI at every problem	• Unrealistic expectations can easily lead to disappointments about the return-on-investment of AI initiatives • AI comes with errors and limitations, like any other IT
Managing AI projects like IT projects	• Assumption that ML models are just computer programs that are easy to create and modify • Expectation that a continuous delivery of results is possible	• AI applications are learning agents, not deterministically programmed systems • Even established software development approaches cannot fully account for the exploratory and collaborative nature of AI projects
The question of why	• Decision makers demand explanations and prescriptions in high-stakes and uncertain situations • Legal and ethical requirements demand interpretability	• ML models are black boxes and based on correlations only, but they are typically more accurate than traditional methods of prediction
Dynamic environments	• Traditional software, once put into production, runs over years	• Predictive accuracy of ML models degrades over time • Frequent updates and retraining of models is necessary

Hopf et al. 2023

Key Questions at the Strategic Level

What is the potential impact of AI on our business model, culture, strategy, and industry?

How can we prepare our workforce for AI? How and where can we find and hire top AI talent?

Do we need an AI / data strategy? Who can help us develop one?

Which AI technology and AI providers should we choose?

How can we use AI to reduce costs? How can AI help us automate processes?

Should we replace our employees with AI (now or in the future)?

Automation vs. Augmentation

- IT has always been used to automate work, but the growing capabilities of AI may allow automation on a much larger scale
- Still, not all tasks can be (fully) automated
- Key strategic decision between *automation* and *augmentation*:

Automation: Humans hand over a task to AI with little or no further involvement.

→ Reduce costs and free up staff for more value-added work

Augmentation: Humans collaborate closely with AI to perform a task.

→ Leverage complementary strengths and enable mutual learning

Raisch & Krakowski 2021; Rai et al. 2019

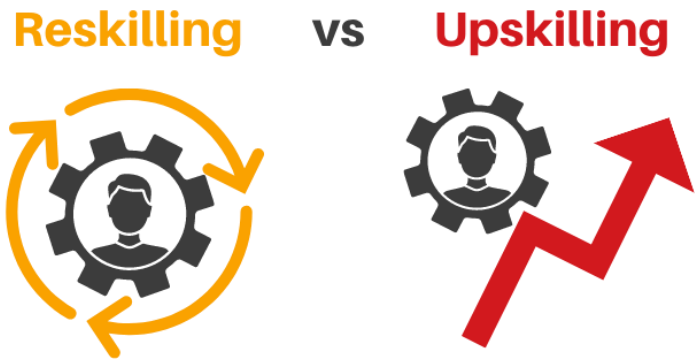
But: Augmentation Can Lead to Automation

- The relationship between automation and augmentation is not a trade-off decision
- Augmentation can also be a driver of automation
- Example of candidate assessment process at JP Morgan Chase:
  - Initial augmentation stage: A team of experienced HR managers worked closely with an AI-based system to identify reliable, firm-specific predictors of candidates' future job performance.
  - After a year of intensive interaction between the human experts and the AI-based system, JP Morgan Chase decided to automate the candidate assessment process because the system was now reliable enough

Riley 2018; Raisch & Krakowski 2021

Upskilling and Reskilling

- While some organizations immediately release human employees, many try to avoid layoffs
- Upskilling and reskilling are two strategies that can help organizations adapt to the changes caused by AI automation
  - Upskilling is about learning new skills to be better at the current job role
  - Reskilling is about learning new skills to move into a different job role
- These strategies also allow organizations to develop talent that is not readily available in the market and fill existing skill gaps



Tamayo et al. 2023

Key Questions at the Tactical Level

What does our new AI initiative mean for the future of my department or business unit?

How will my department or my teams react when they hear about the new AI system?

How can I manage the change and disruption associated with our new AI initiative?

How can I use AI myself to manage my department or teams?

How to communicate our new AI initiative without causing fear and uncertainty among employees?

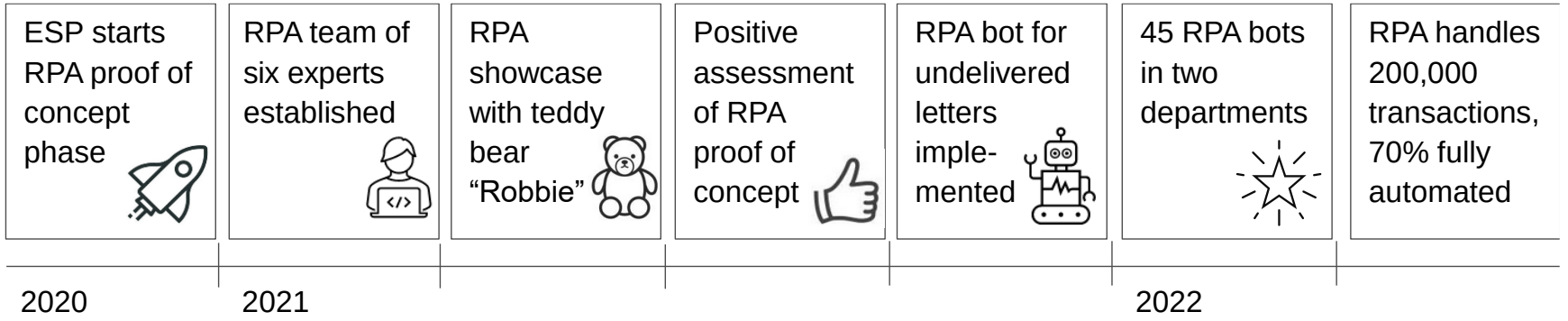
How can I implement our new AI system in a responsible way?

Research Example: Large-Scale RPA Implementation

- Case study at a German-based energy service provider
- In 2019, the CEO decided to implement robotic process automation (RPA) to automate back-office processes (e.g., in customer service, billing)
- Over a period of two and a half years, 45 RPA bots were implemented to enable the automated processing of more than 200,000 back-office transactions per year → equivalent to 5 full-time employees
- Employees were concerned about RPA's impact on their jobs

Schulte-Derne & Gnewuch 2024

Research Example: Large-Scale RPA Implementation



1. RPA implementation at ESP started with a small agile team consisting of a process manager, a "key user" with a customer service background and external consultants
2. Collaborative approach in the initial exploration of possible RPA use cases by involving all stakeholders, including back-office employees, leaders, and members of the IT department
3. After analyzing the potential time savings of each use case, a first proof of concept was developed. Insights from the proof of concept formed the basis for the design, development, introduction and evaluation of each RPA bot

Schulte-Derne & Gnewuch 2024

Key Questions at the Operational Level

What does the new AI system mean for my professional future?

Which of my tasks can I delegate to AI? Which tasks does AI delegate to me?

How does my job change because of our new AI system?

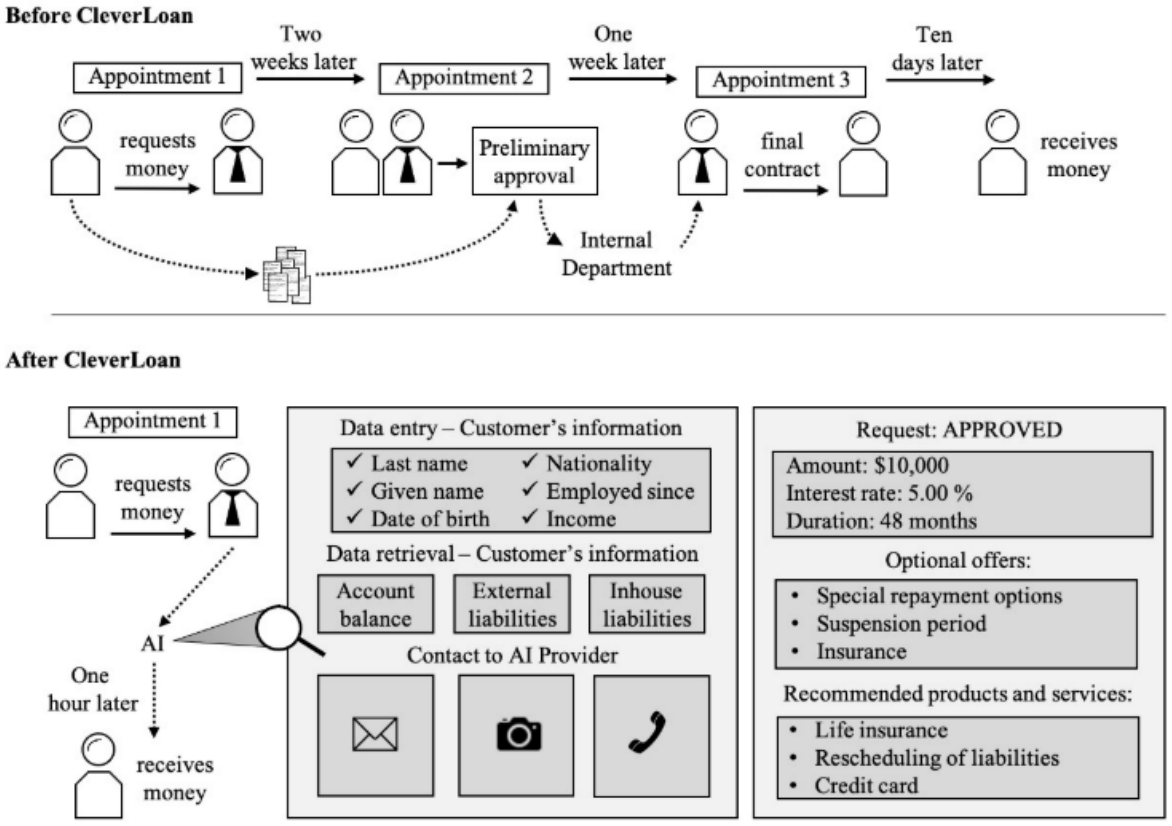
Will I still be needed, or will I be replaced? What happens to my colleagues?

How can I effectively collaborate with AI to improve my job performance?

Do I need additional training to be prepared for the future of work with AI?

Research Example: Use of AI in Loan Decision-Making

- Case study of a German bank (“Main Finance”)
- Main Finance implemented an AI-based system (“CleverLoan”) to substitute for human decision making in the loan consultation process
- Before the introduction of CleverLoan, the bank’s loan consultants were responsible for advising customers and deciding whether to grant a loans
- Afterwards, CleverLoan autonomously decided whether to approve a loan and provided the consultant with a final and irreversible decision



Mayer et al. 2020; Strich et al. 2021

Research Example: Use of AI in Loan Decision-Making

- The introduction of CleverLoan resulting in positive and negative changes to employees' role identity:

And for the [AID-C] the job is totally clear, because suddenly he is able to do loan consulting, while before, he was only at the service counter and somehow led people from one consultant to the next, and at most would fill out a transfer form. (HR, AI Provider; Former Consultant, *Main Finance*)

→ Some employees were happy because they could now perform a more valuable and interesting task

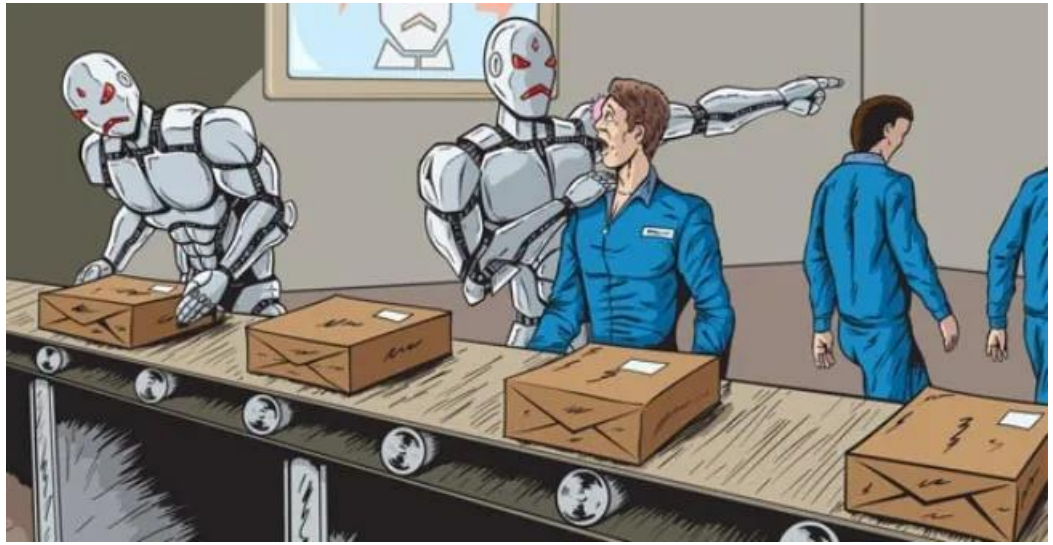
"[The role can now be done by] anyone who can push the buttons. Regarding the ability to take decisions, … I am just more and more restricted [by these tools]. So, I don't really have any competence of my own anymore. I am only a worker who just punches in the data." Loan Consultant, Main Finance

→ Other employees felt their professional identity threatened

Mayer et al. 2020; Strich et al. 2021

Change of Perspective: From Threat to Opportunity

- Rather than perceiving AI as a threat, employees may shift their mindset and view it as an opportunity for growth
- Key individual tactics include:
  - Adding or removing tasks
  - Increase mastery in existing ones
  - Learning new skills that AI cannot (yet) take over
- Can result in job expansion or job reduction

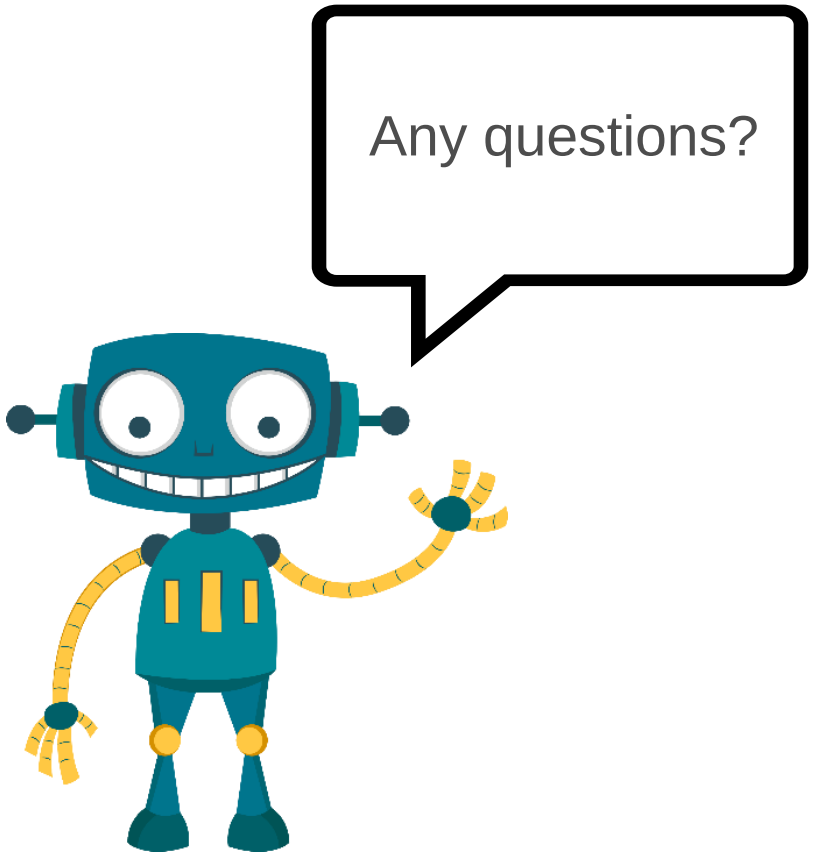


Afiouni & Pinsonneault 2022

Key Takeaways From This Lecture

- Designing and managing AI is different from designing and managing more traditional business information systems
- Many process models exist that offer guidance on how to design AI-based business information systems (e.g., OECD's AI system lifecycle, CRISP-DM)
- There are many design principles and guidelines for (AI-based) information systems, some of which specifically address AI-related design challenges (e.g., ethical concerns)
- The management of AI presents challenges to organizations at every level:
  - Strategic level (e.g., impact of AI on business strategy and workforce)
  - Tactical level (e.g., introduction of new AI-based systems)
  - Operational level (e.g., employees' perception of and interaction with a newly introduced AI-based system)
- There are common strategies and tactics for addressing these challenges (e.g., upskilling and reskilling programs)

Thank you for your attention!



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