

MANAGING AI-BASED SYSTEMS



Session 8: Management and governance of AI

Managing AI-based Systems

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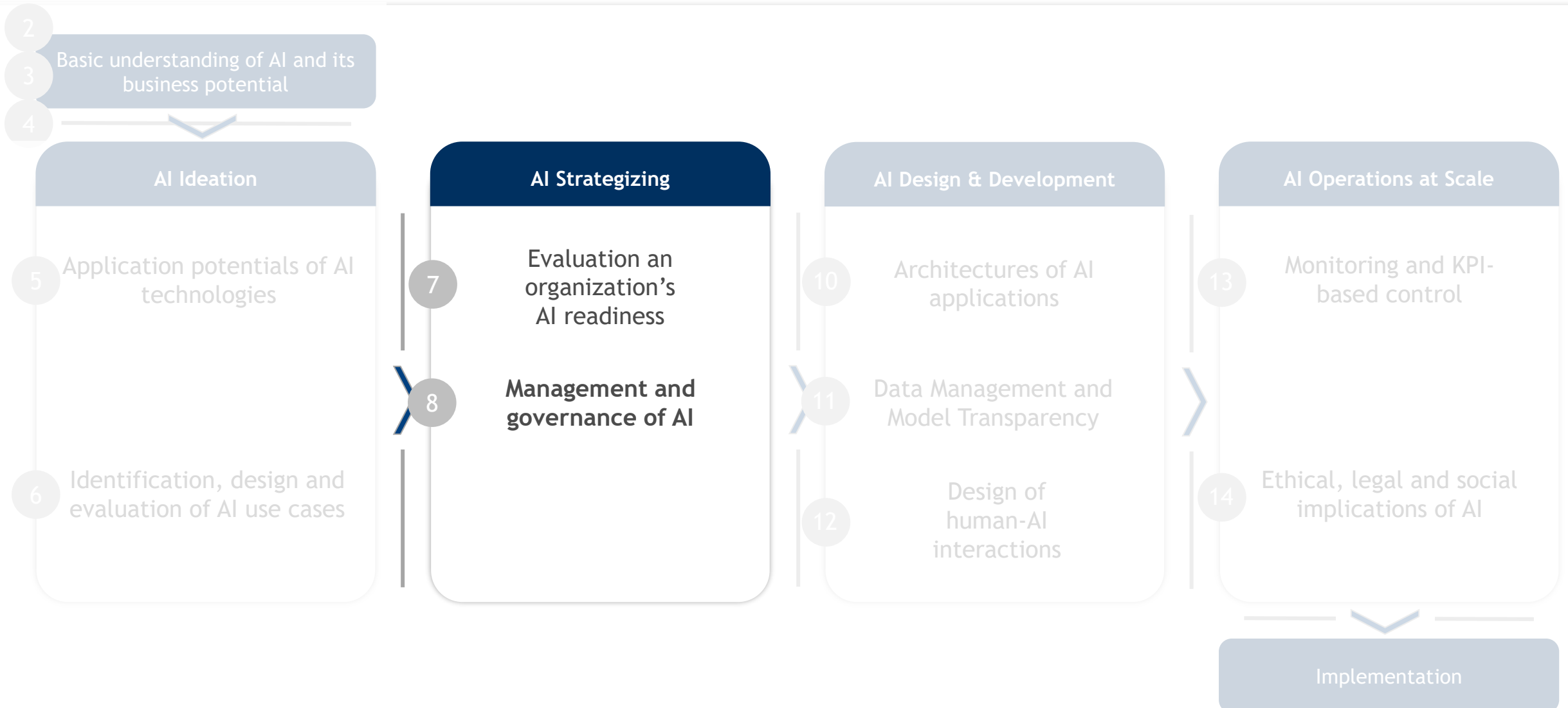
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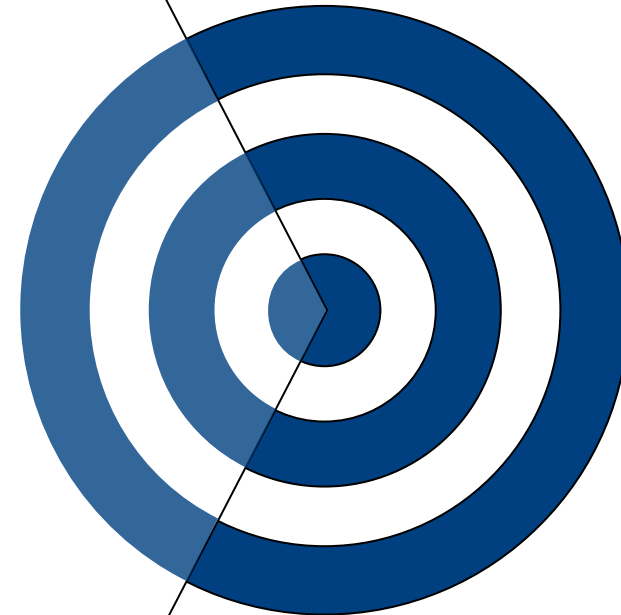
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Course navigator



Objectives of today's lecture

1. Understand how information exchange can be improved for effective AI management
2. Explore how to build suitable team structures for the management of AI
3. Obtain an overview of DevOps and MLOps



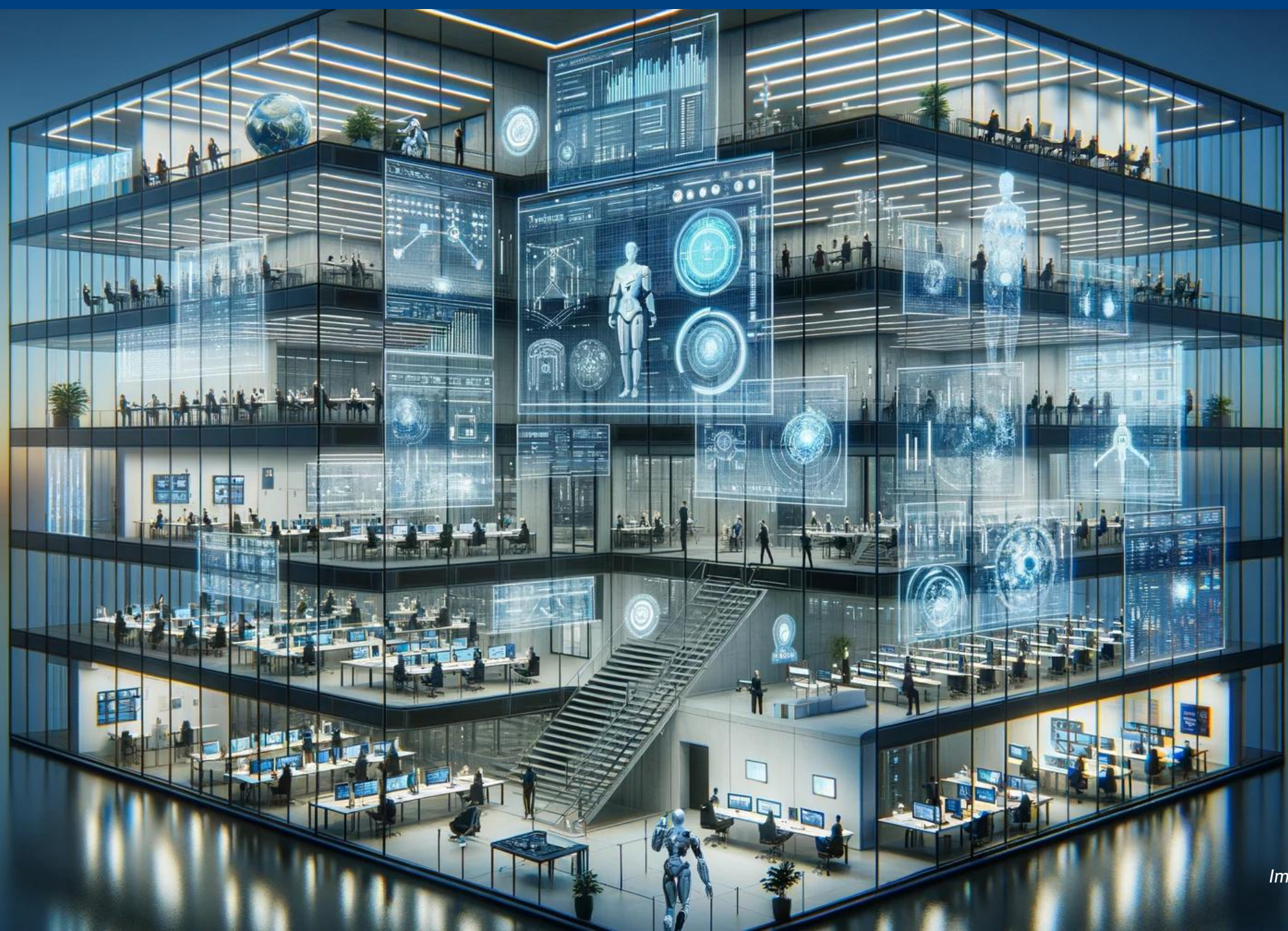
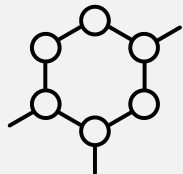
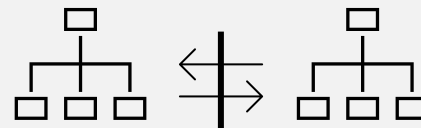


Image: DALLE 3

Why do AI applications require different organizational structures?



Compared to other information systems, the **high autonomy** and **opacity** of AI applications require **new forms of management** in terms of control and monitoring



Information exchange often hampers due to prevailing **competence heterogeneity** and **siloed organizational structures**



Managing AI applications faces an **organizational information processing problem**



How should organizations promote information processing among stakeholders to improve the management of AI applications?

01 | The AI application management model

02 | Building suitable team structures

03 | Governance of AI

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03 | Governance of AI



Image: <https://www.businessworldit.com/ai/the-changing-role-of-artificial-intelligence-in-business-management/>

Typical management challenges of AI applications

AI application		User requirements	Process
Data challenges <ul style="list-style-type: none"> ➤ Data quality ➤ Data quantity ➤ Data accessibility ➤ Data validation 	AI technology challenges <ul style="list-style-type: none"> ➤ Model robustness ➤ Technical debt ➤ Lack of domain consideration 	Socio-ethical challenges <ul style="list-style-type: none"> ➤ Moral conformity/ Fairness ➤ Transparency ➤ Comprehensibility ➤ Interpretability ➤ Trust ➤ Biased expectations 	Process challenges <ul style="list-style-type: none"> ➤ Workflow incompatibility ➤ Workflow disruption ➤ Incorporation of workflow changes ➤ Process safety
Contextual restrictions			
Organizational challenges <ul style="list-style-type: none"> ➤ Strategic conflicts ➤ Unclear responsibilities ➤ Siloed team structures ➤ Lack of AI expertise 	Infrastructure challenges <ul style="list-style-type: none"> ➤ Computational effort ➤ Interoperability ➤ IT fragmentation 	Economic challenges <ul style="list-style-type: none"> ➤ Profitability ➤ Scalability ➤ Lack of real business value 	Regulatory challenges <ul style="list-style-type: none"> ➤ Privacy ➤ Product safety ➤ Accountability



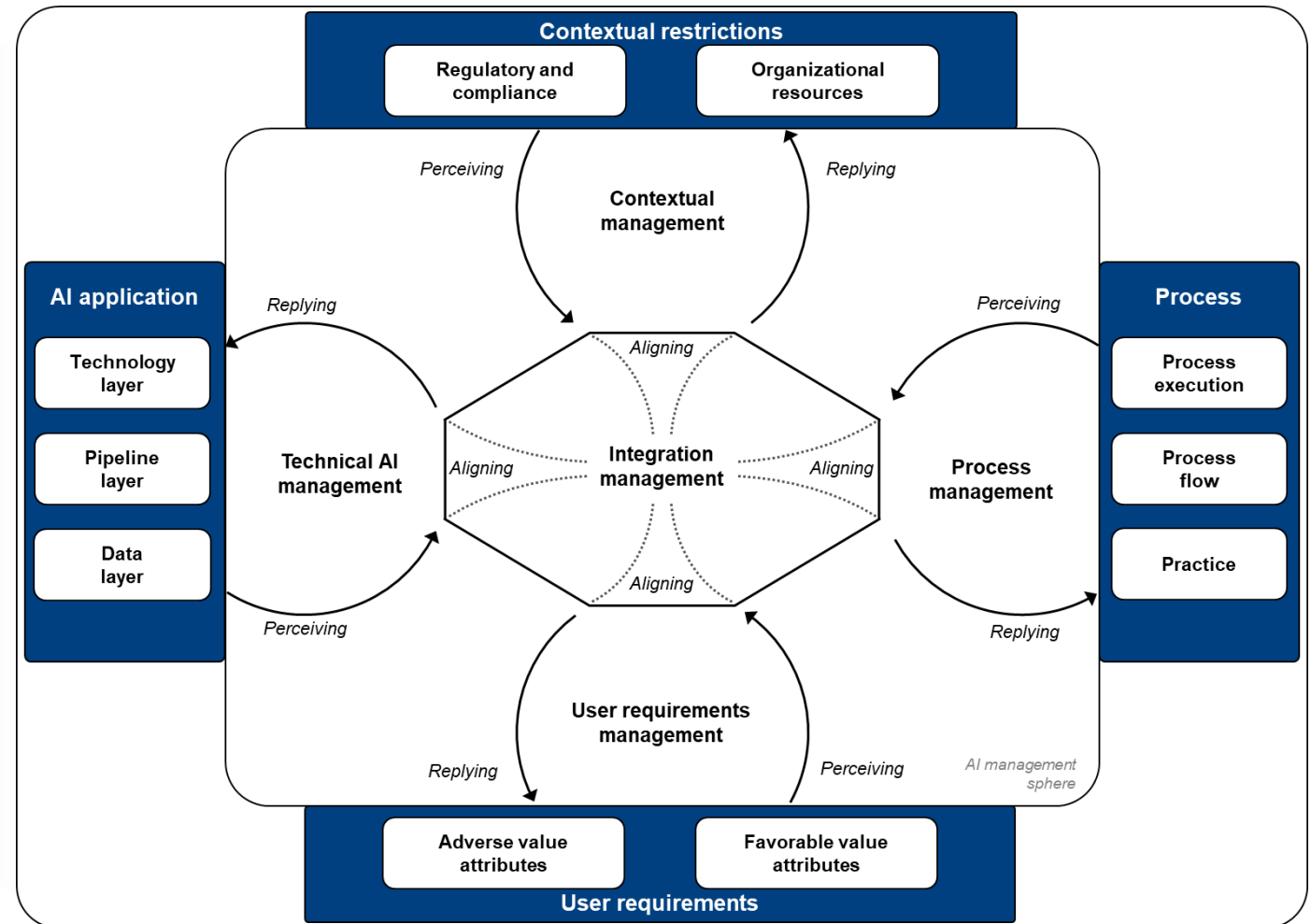
Deployed AI applications can raise several challenges that need to be handled with a suitable organizational structure

Hofmann et al. (2024)

The AI application management (AIAMA) model: Structuring AI management

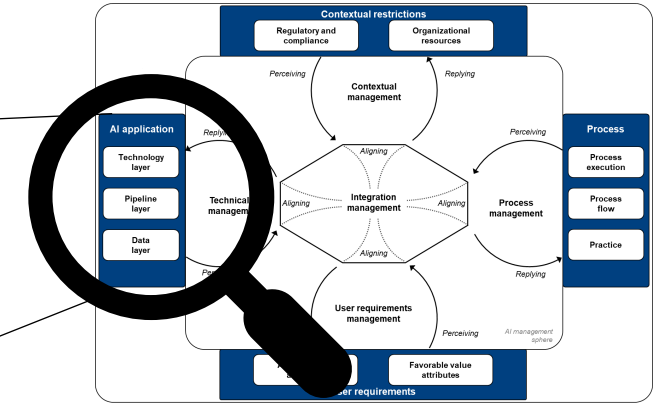
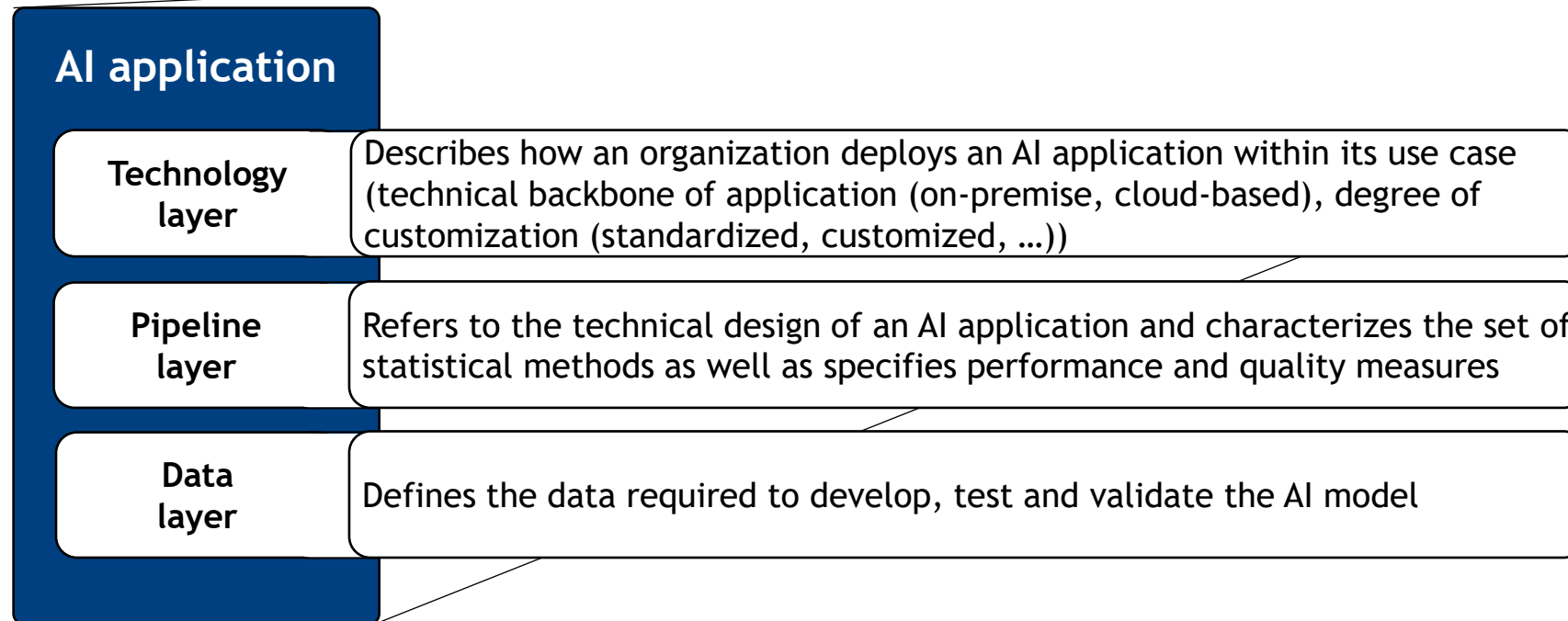
To deal with the named AI application management challenges, the AIAMA model...

- theorizes the organizational structures of AI management with respect to information processing among stakeholders when mitigating AI challenges
- depicts relevant management constructs and prescribes management cycles enabling information exchange between the management constructs
- describes which factors affect AI application management and illustrates abstract activities to maintain an AI application's target state



Hofmann et al. (2024)

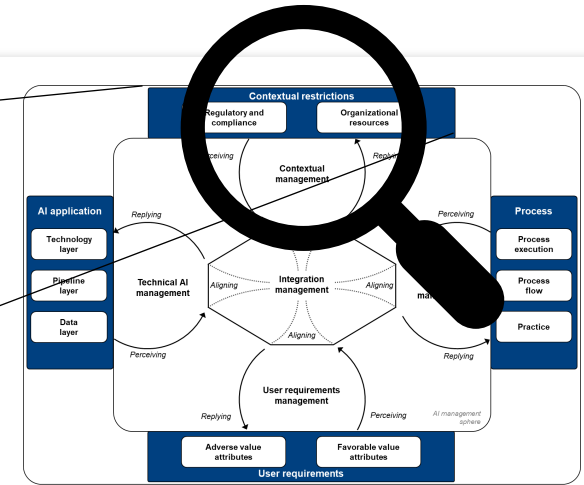
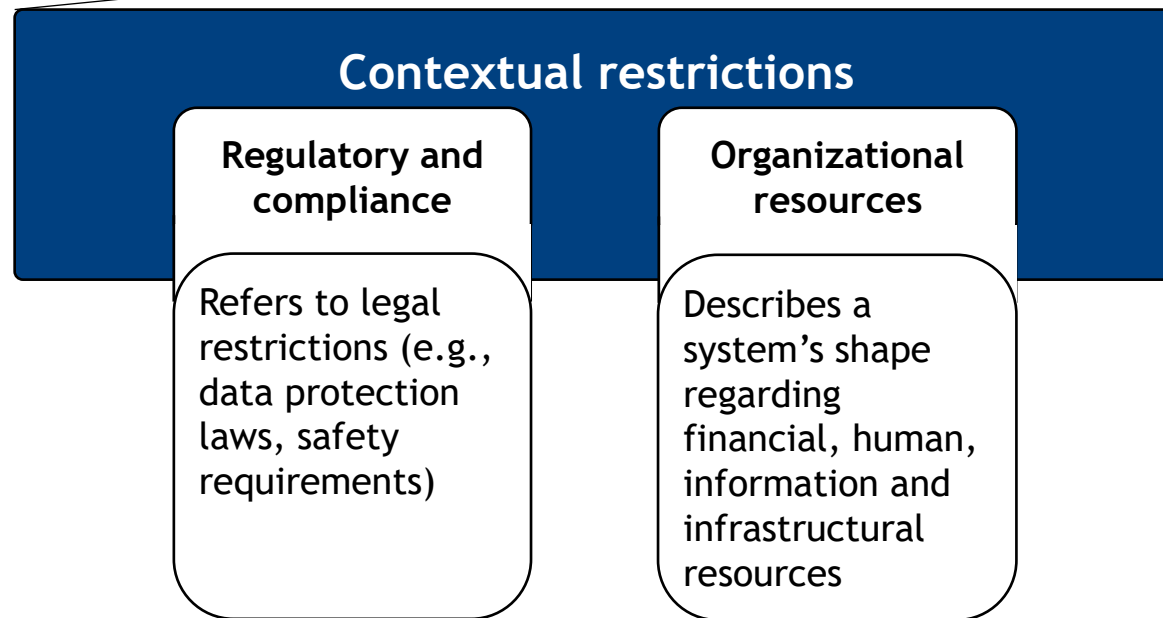
The AIAMA model factors: AI application



The factor AI application defines the deployed AI technology and consists of three dynamic constructs

Hofmann et al. (2024)

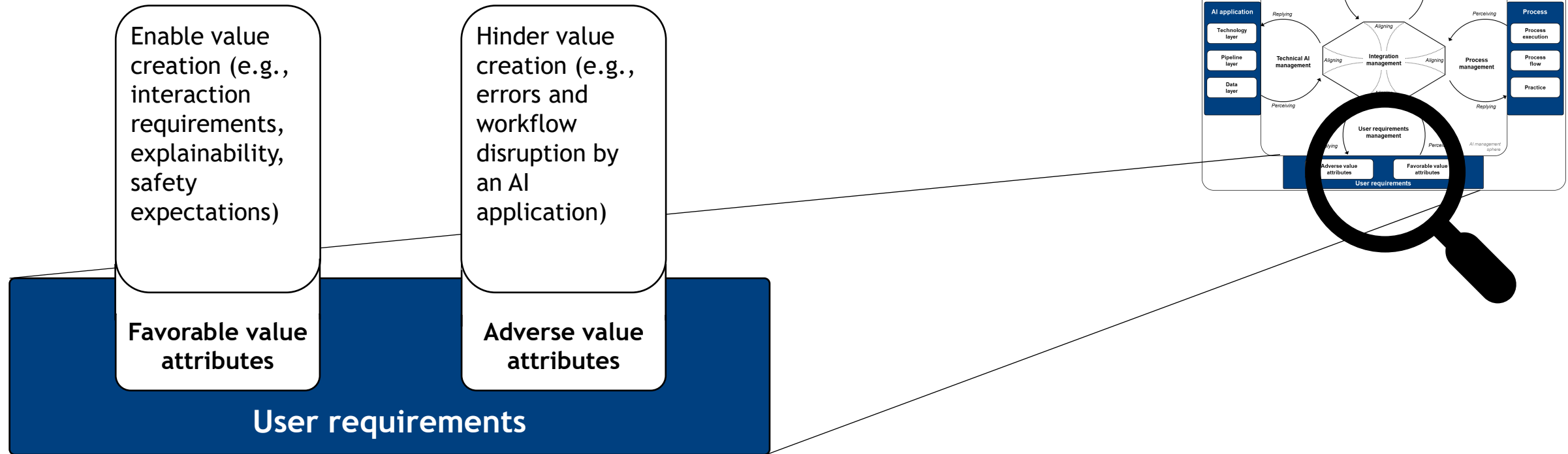
The AIAMA model factors: Contextual restrictions



» The factor contextual restrictions unifies constructs that define the general space of action of the AI application

Hofmann et al. (2024)

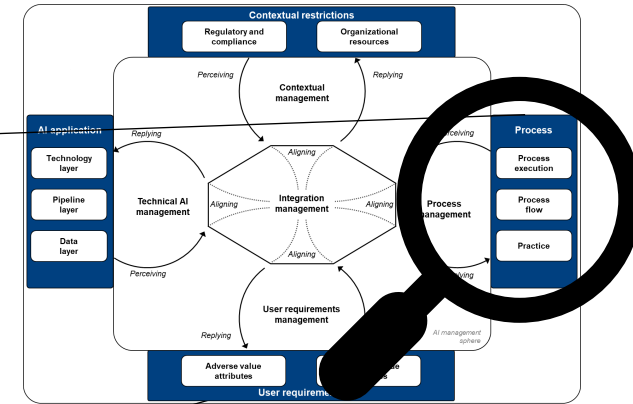
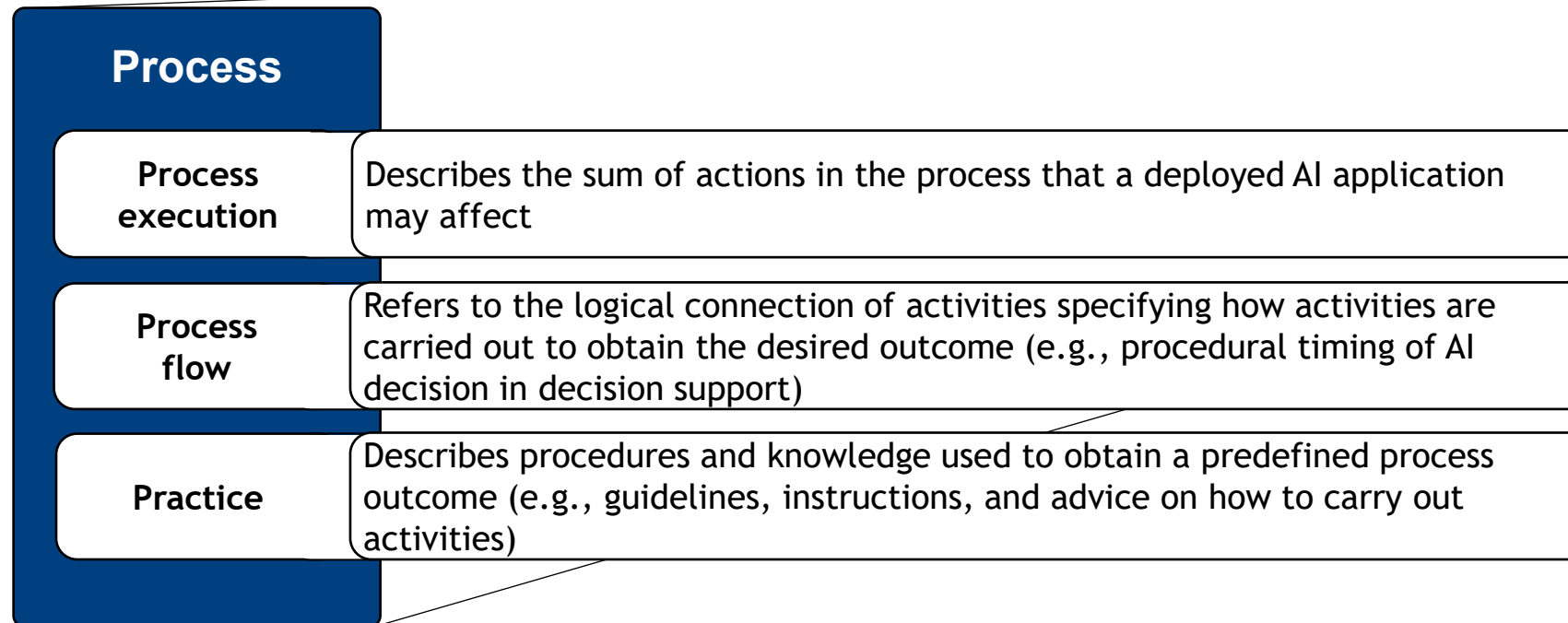
The AIAMA model factors: User requirements



» The factor user requirements define the users' value attributes and requirements towards the AI application

Hofmann et al. (2024)

The AIAMA model factors: Process



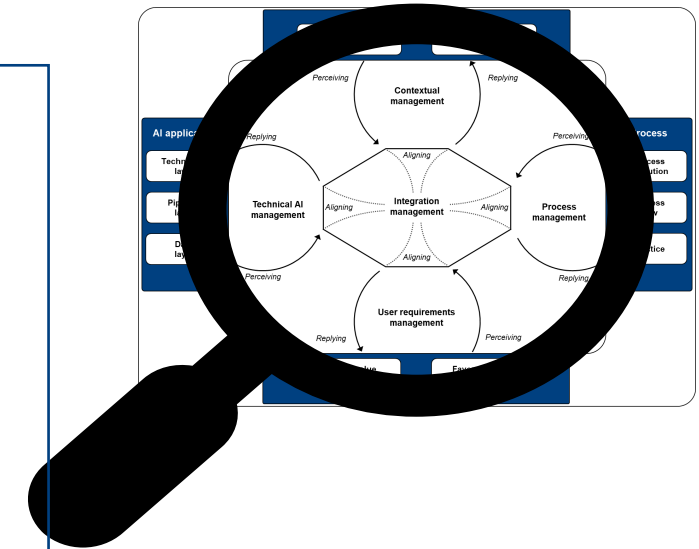
The process factor clarifies process-related considerations and requirements from the AI application's underlying use case

Hofmann et al. (2024)

The AIAMA model management sphere: Managerial activities consisting of five management cycles

Management Cycles

- The **four factor management cycles** comprise management activities that can mitigate and regulate the management challenges arising in the factors outside the management sphere:
 - **Technical AI management:** Controls the implications on the AI-related architecture and data
 - **Contextual management:** Ensures that an AI applications complies with environmental restrictions
 - **Process management:** Targets the implications on business processes
 - **Requirement management:** Controls the implications on user requirements for the AI applications
- The **integration management cycle** focuses on coordinating and controlling the various management factors and ensuring managerial alignment; it connects the four factor management cycles and guides information processing



Hofmann et al. (2024)

The AIAMA model: Interactions

Interactions between factors and management sphere

Perceiving phase

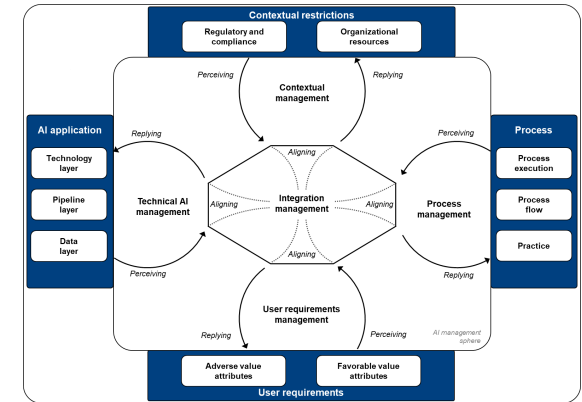
- Taking measures to actively sense the AI's environment
- Trigger-based (relying on predefined criteria for known changes) or individually assessed for extraordinary changes (e.g., data drift incidents)
- Requires clear responsibilities to correctly perceive the ambiguous or abnormal behavior of the AI application

Aligning phase

- Assessing a construct's changes and developing actions to align these to the system's overall goals
- Intersection of the integration management cycle and the other four cycles
- Allows propagating information and triggers actions through the AI application management sphere (e.g., problem analysis, risk assessments, etc.)

Replying phase

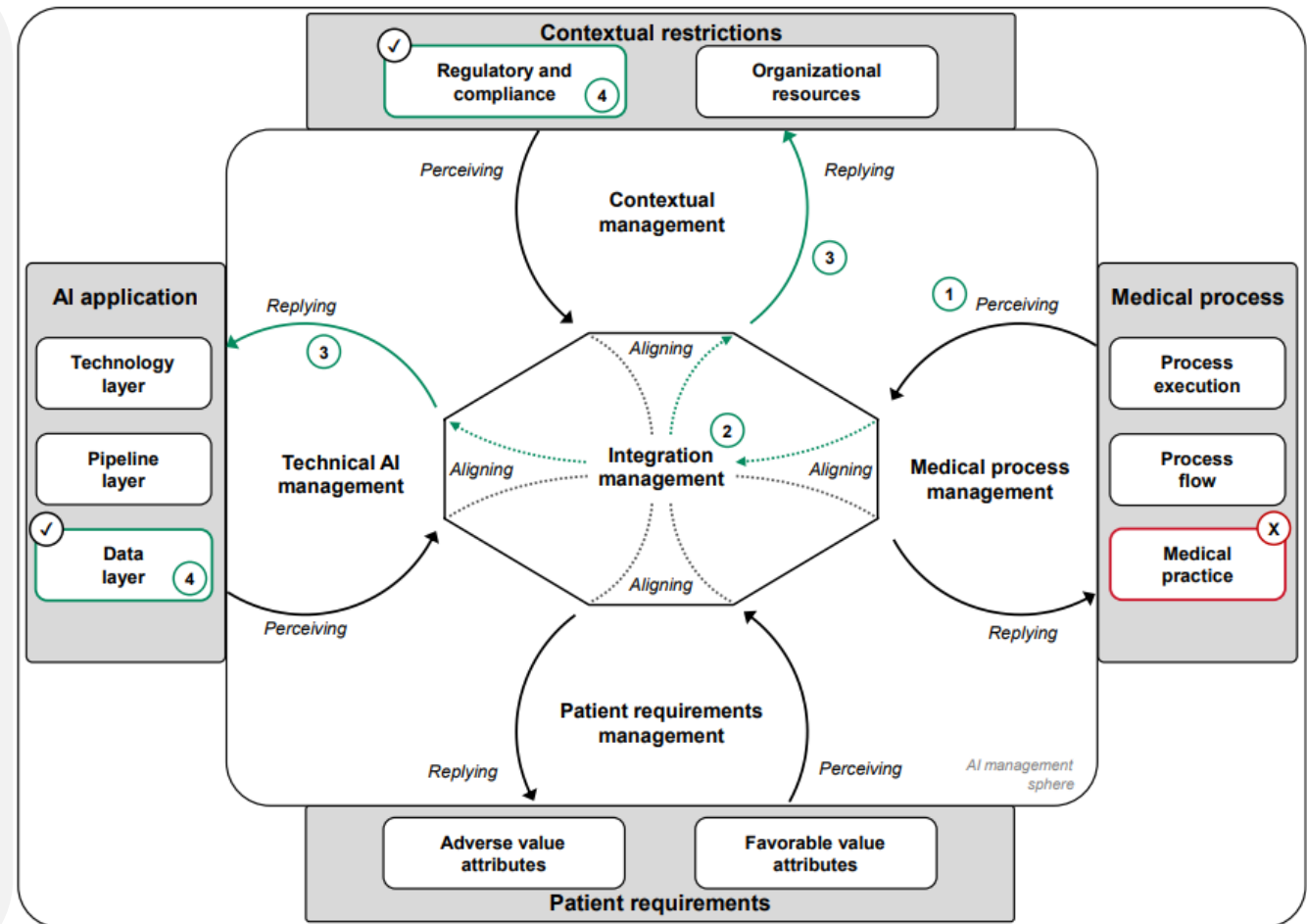
- Managerial activities that change the outer constructs based on decisions made in the previous aligning phase (e.g., data rebalancing, model reconfiguration, process redesign, etc.)



Hofmann et al. (2024)

The AIAMA model applied in healthcare: The challenge of outdated medical practices

- ✗ Updated medical guidelines induce a change of the medical practice
- 1 Potential impact on AI application is perceived by physicians and reported to the integration management
- 2 Integration management seizes the information and assesses the implications
- 3 Integration management develops an approach for the adaption procedure
- 4 Technical AI management retrains the AI application; stakeholders from regulatory and compliance conduct a legal review.
- ✓ The AI application is deployed and complies with updated guidelines



01 | The AI application management model

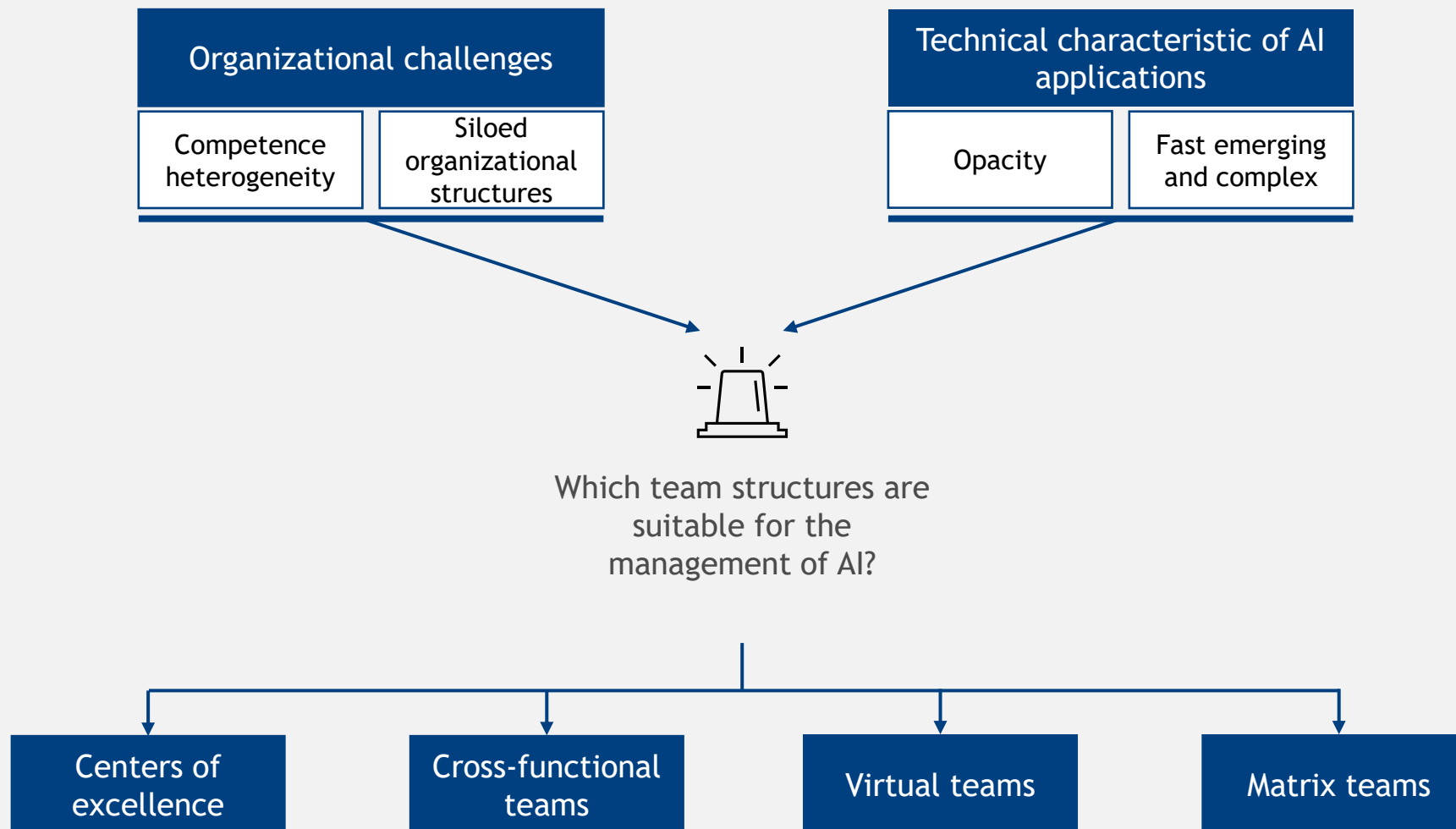
02 | Building suitable team structures

03 | Governance of AI



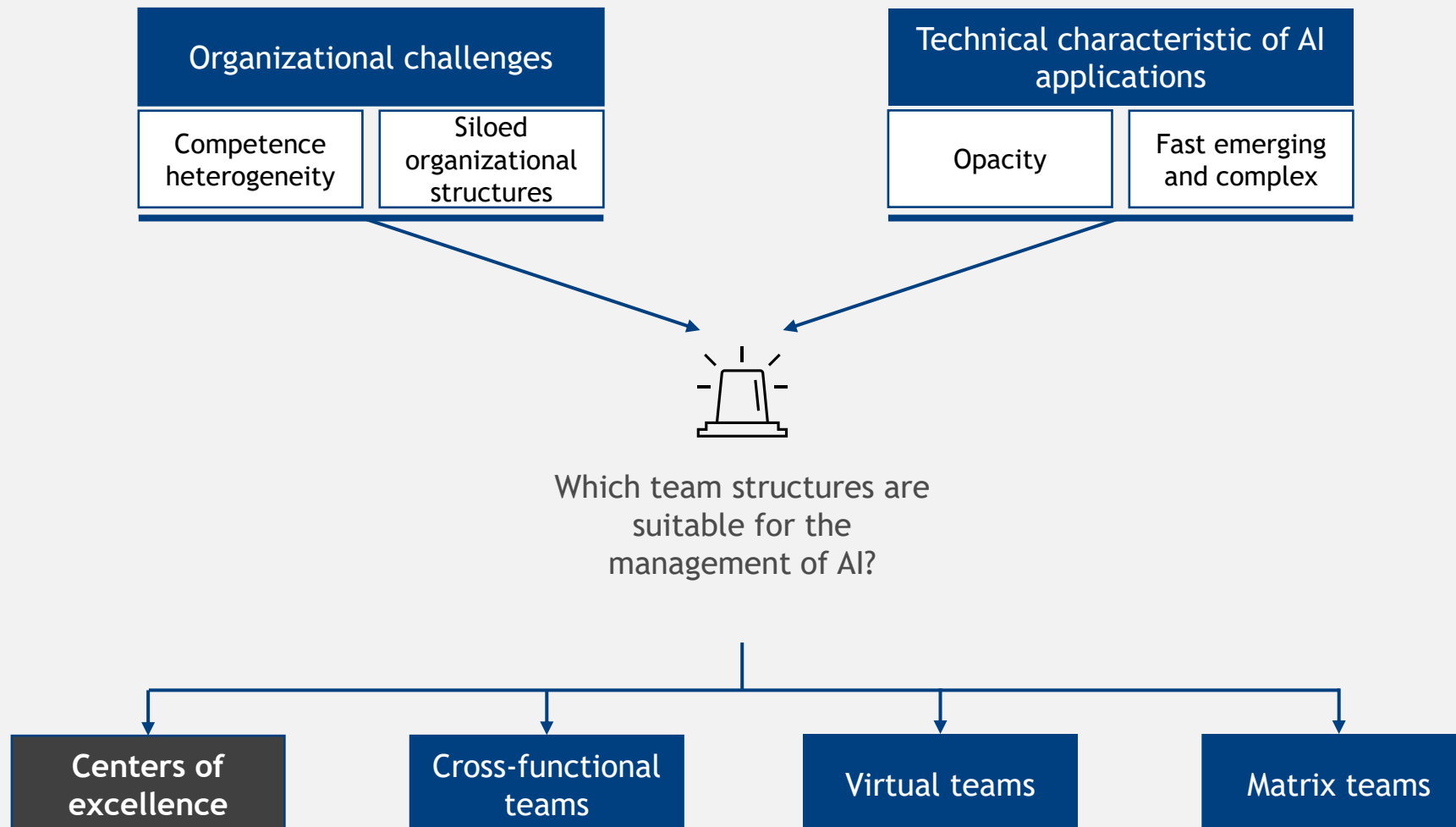
Image: <https://www.experto.de/businessstipps/so-organisieren-sie-teamarbeit-erfolgreich.html>

Building a team structure for the management of AI



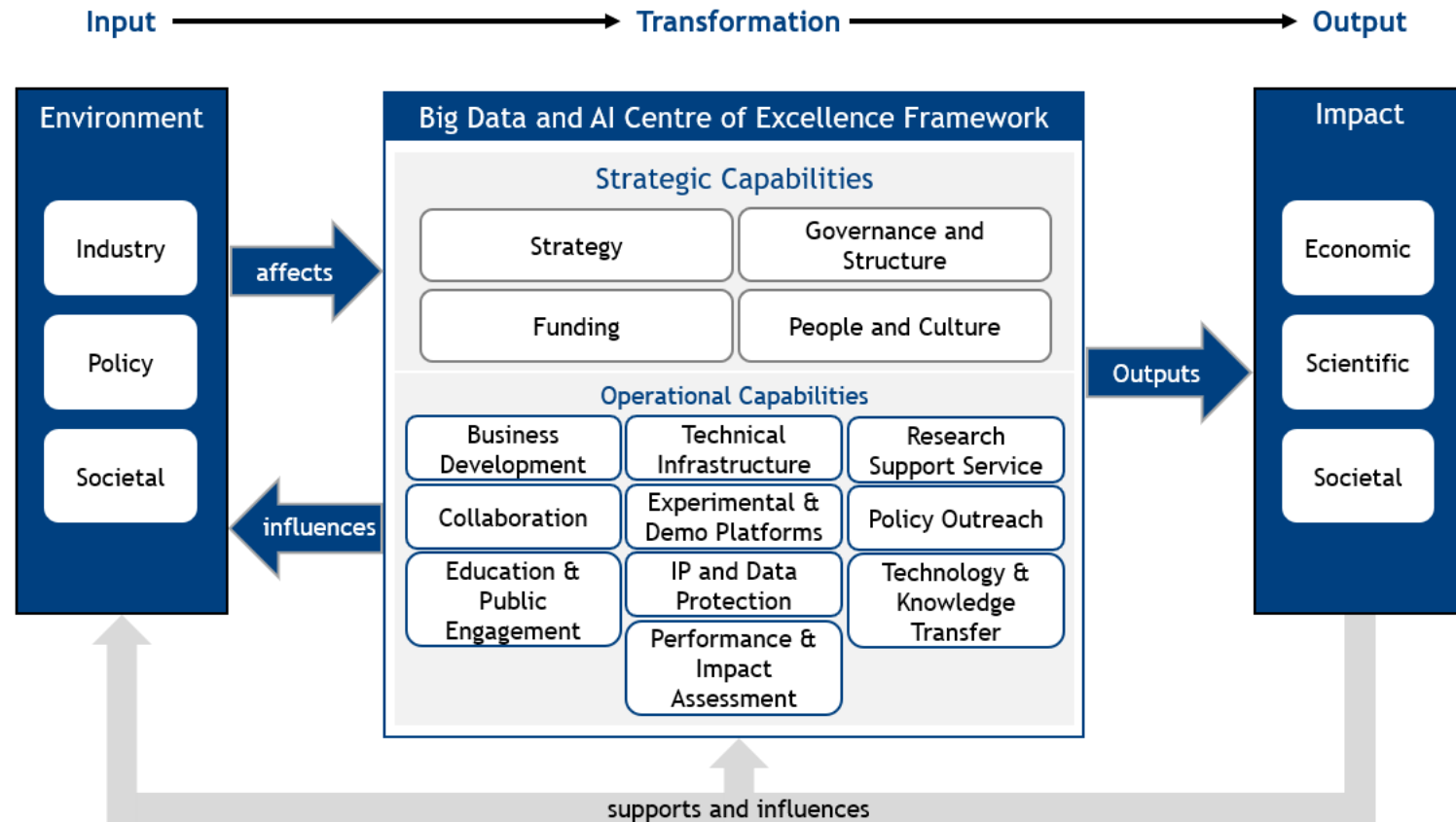
Hofmann et al. (2024), Curry et al. (2021), Cunningham & Chelladurai (2004), Moore & Birkinshaw (1998), Kolodny (1997)

Building a team structure for the management of AI



Hofmann et al. (2024), Curry et al. (2021), Cunningham & Chelladurai (2004), Moore & Birkinshaw (1998), Kolodny (1997)

Team structures: Centers of Excellence (CoE)



The AI Centre of Excellence interacts with the environment to generate economic, scientific and societal impacts by using its strategic and operational capabilities

Curry et al. (2021)

Team structures: Centers of Excellence (CoE)

Definition

- Organization or organizational unit that provides leadership, research, best practices, innovation and training for a specific area of focus or domain
- Aims to drive continuous improvement and enhance an institutions' capacity, capability and continuity in a specific domain

Advantage

- + Convenient structure for change
- + Internal growth of expertise
- + Acquire sustained funding for research projects
- + Facilitate knowledge transfer and knowledge development

Relevance for AI management

- A CoE, with its concentrated expertise, can experiment with cutting-edge AI technologies to drive innovation
- With the AI talent market being highly competitive, a CoE can help upskill existing employees and reduce the dependency on external hires

Disadvantage

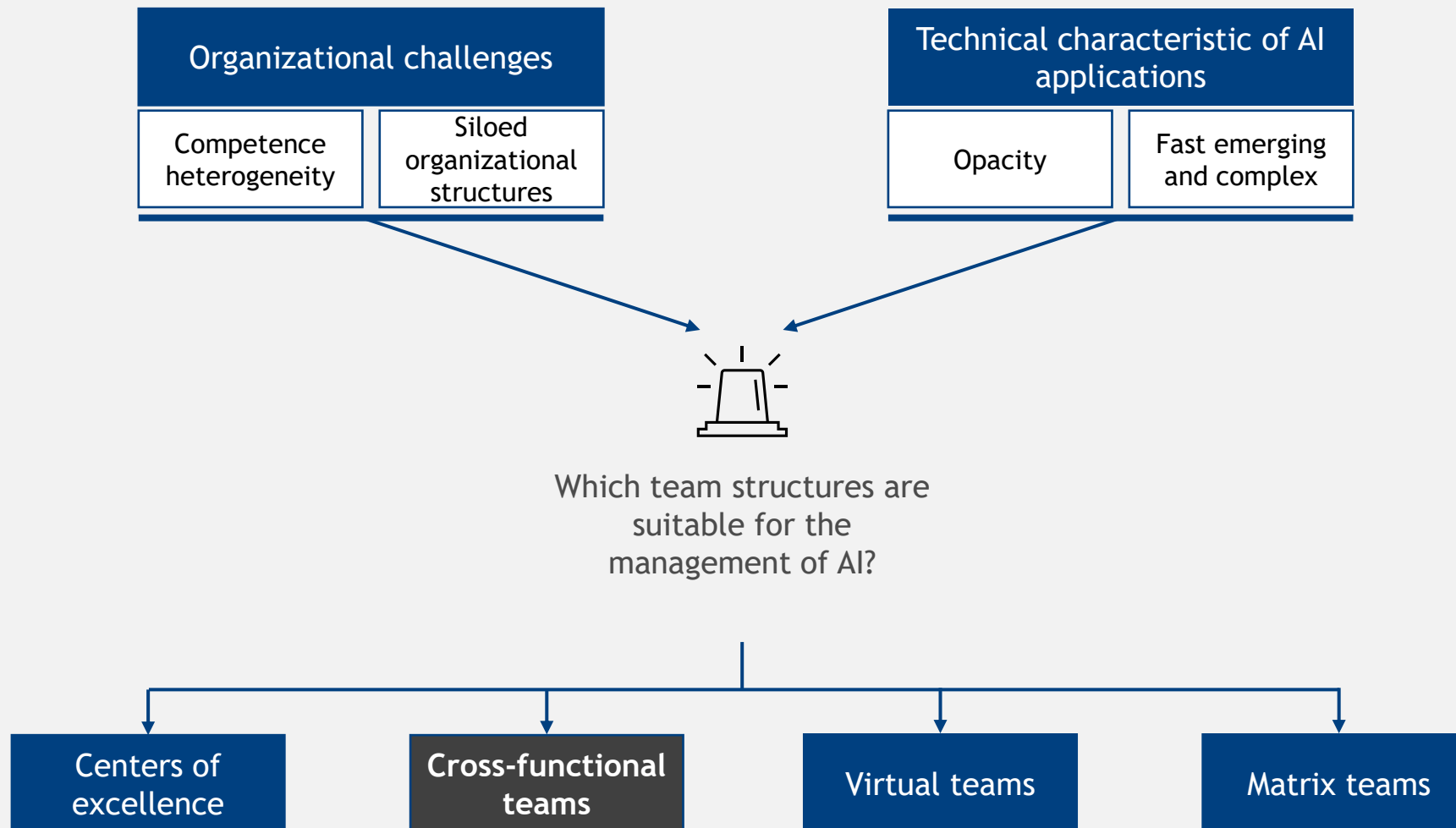
- Strong dependency of the organization on the CoE
- Siloed structure is possible if CoE separates too much
- High effort and cost for implementation

Centers of Excellence



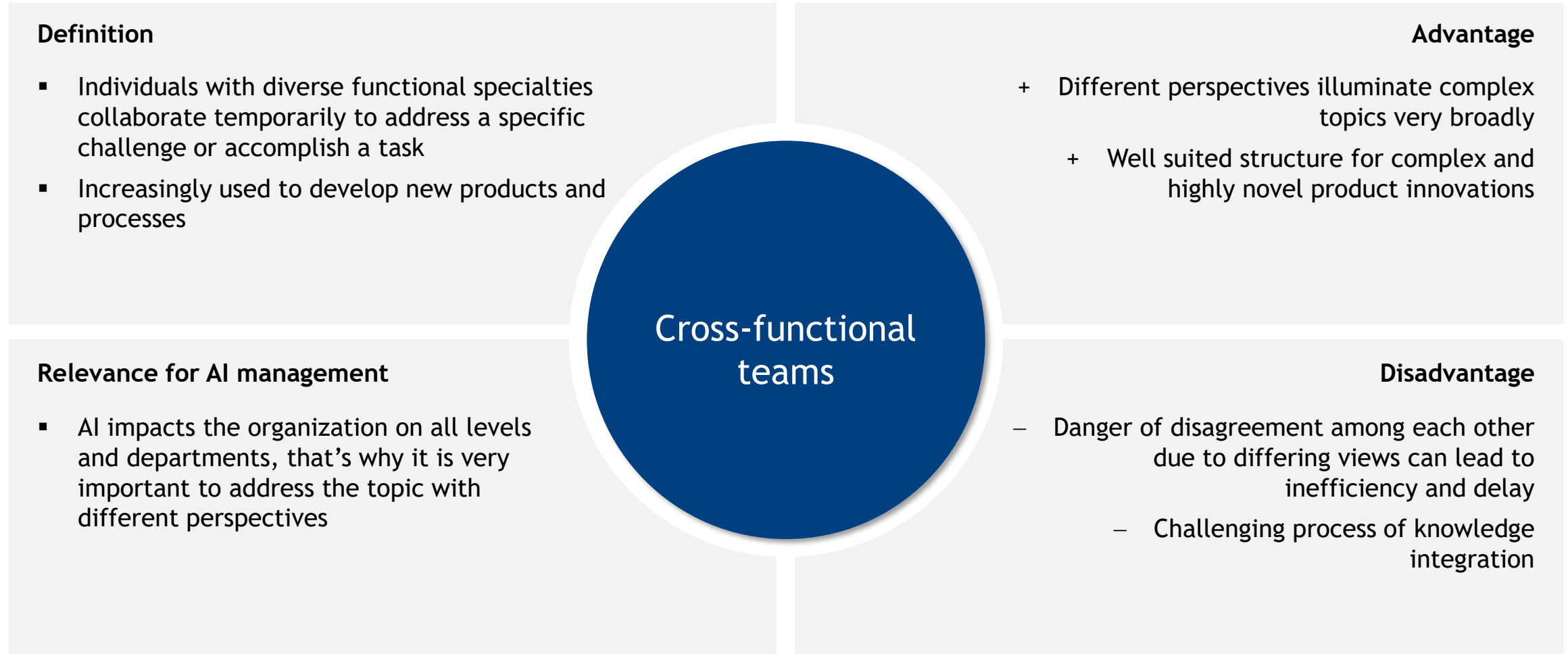
Curry et al. (2021), Nasution et al. (2019), Amar et al. (2011), Moore & Birkinshaw (1998)

Building a team structure for the management of AI



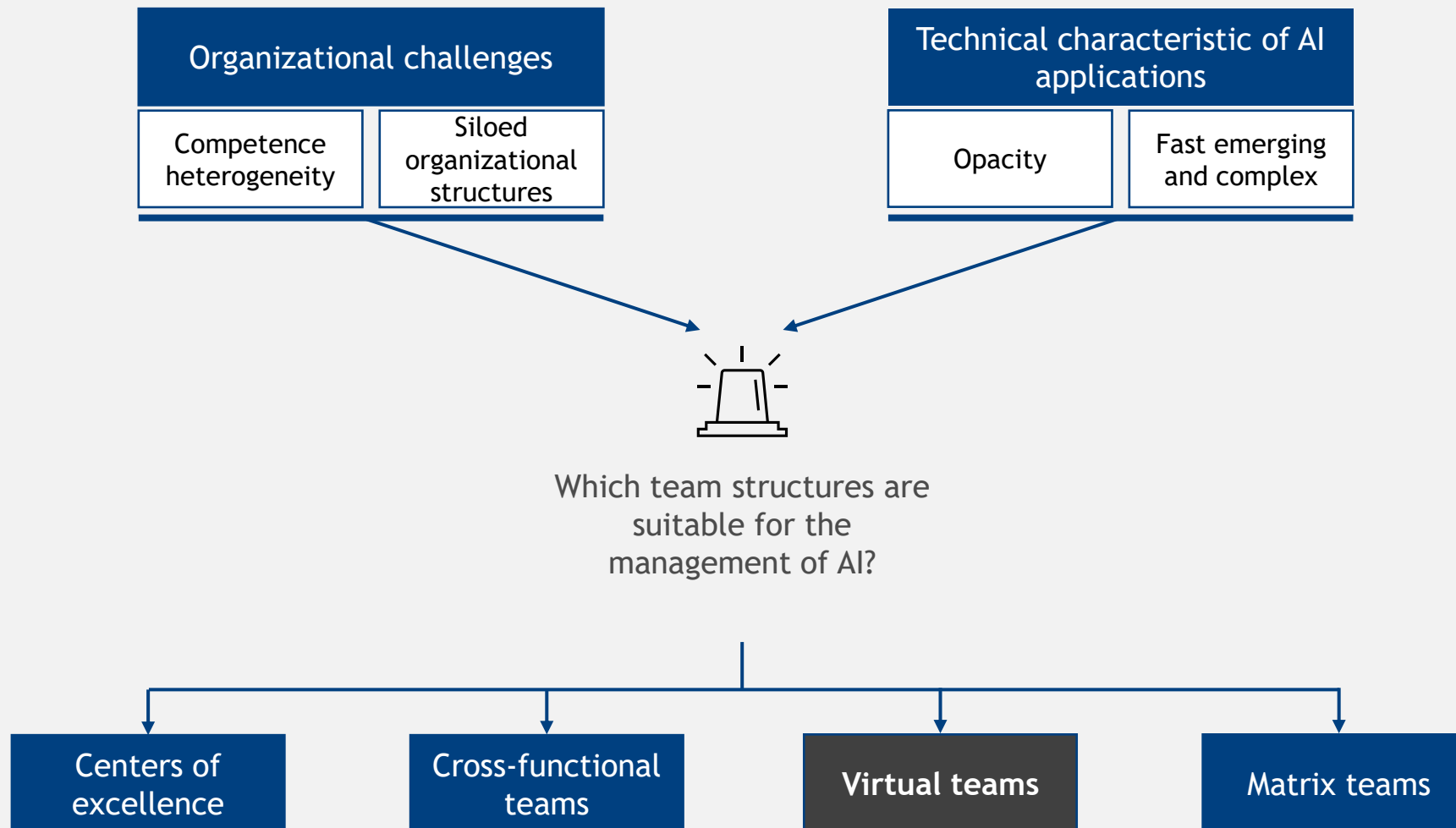
Hofmann et al. (2024), Curry et al. (2021), Cunningham & Chelladurai (2004), Moore & Birkinshaw (1998), Kolodny (1997)

Team structures: Cross-functional teams



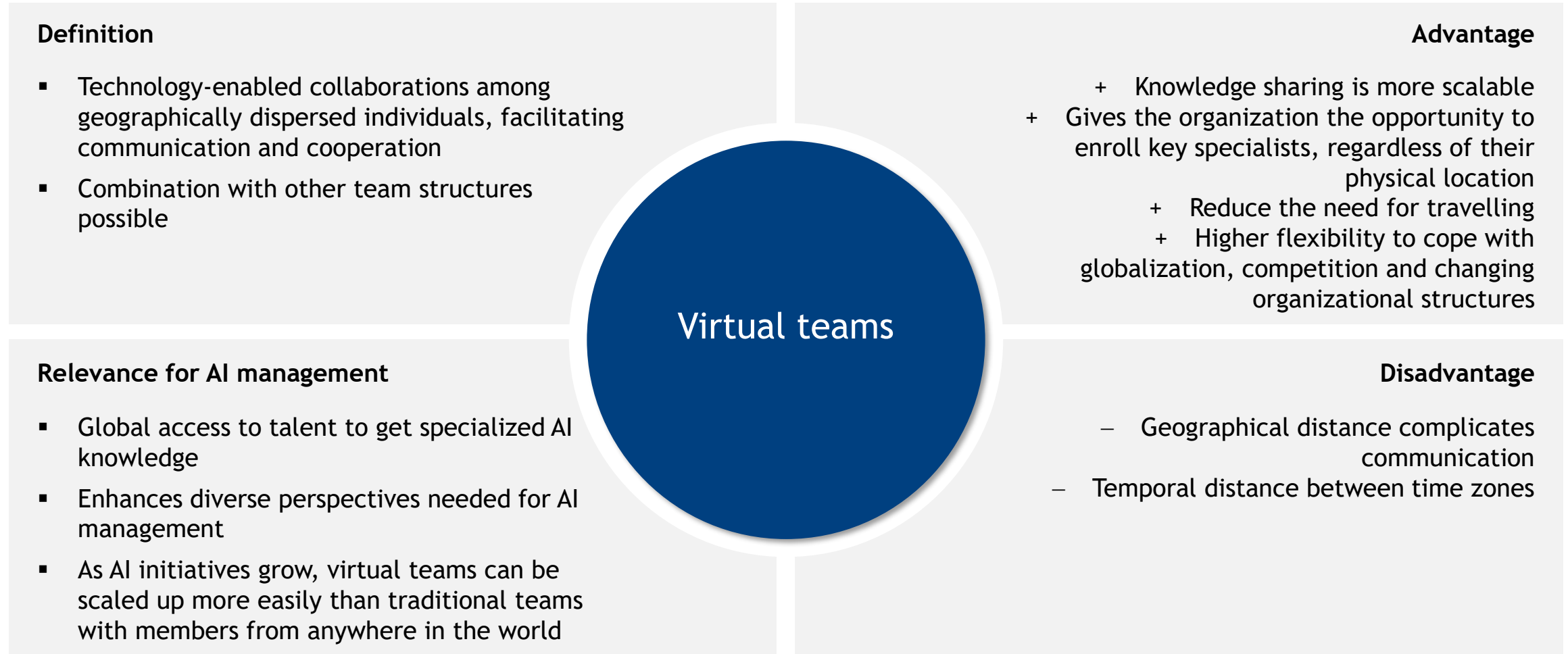
Cunningham & Chelladurai (2004), Webber (2002), Majchrzak & Faraj (2012), Edmondson & Nembhard (2009), McDonough III (2000)

Building a team structure for the management of AI



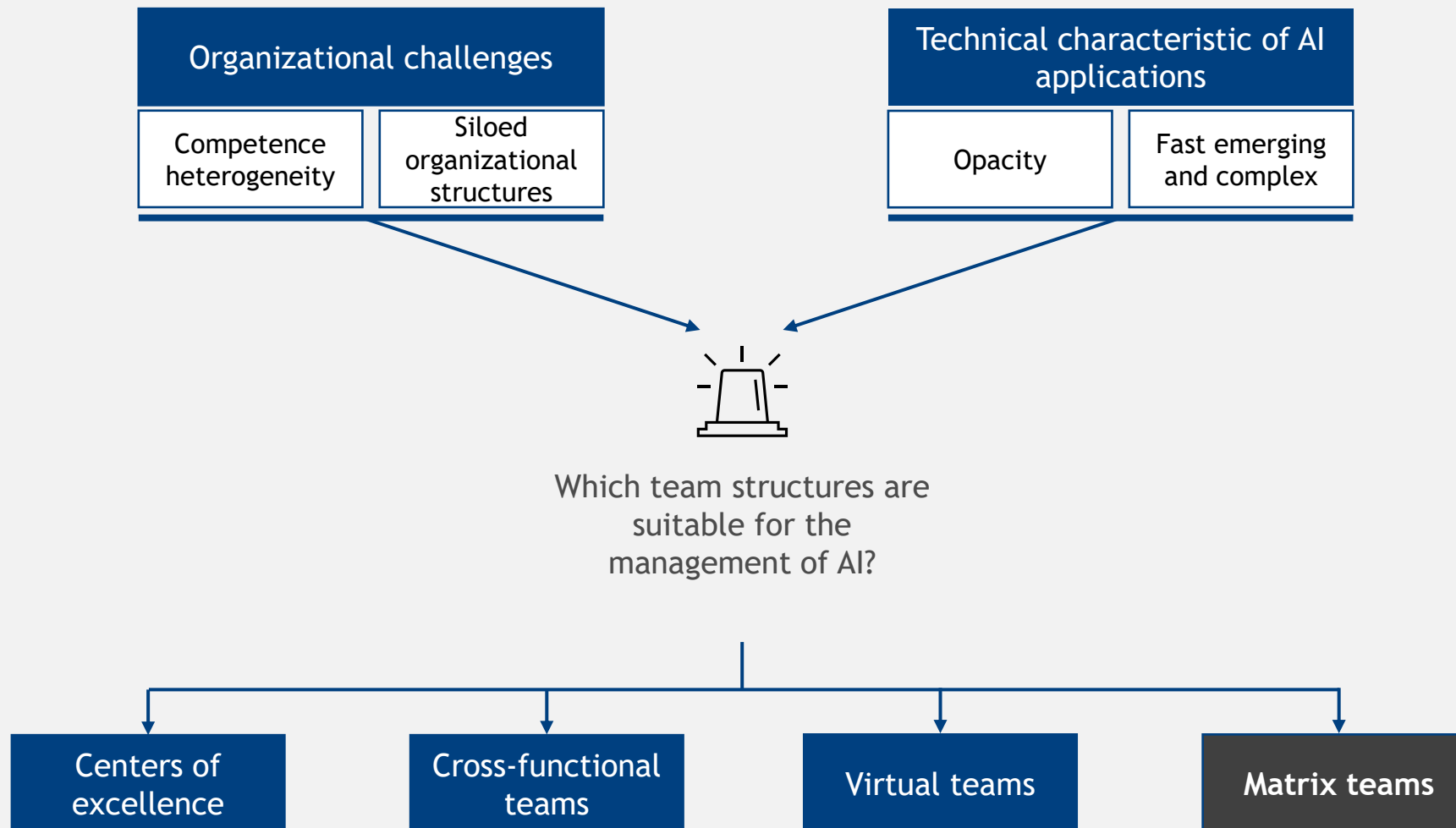
Hofmann et al. (2024), Curry et al. (2021), Cunningham & Chelladurai (2004), Moore & Birkinshaw (1998), Kolodny (1997)

Team structures: Virtual teams



Moore & Birkinshaw (1998), Morrison-Smith & Ruiz (2020), Hinds & Kiesler (2002), Orlikowski (2002), Allen (1984)

Building a team structure for the management of AI



Hofmann et al. (2024), Curry et al. (2021), Cunningham & Chelladurai (2004), Moore & Birkinshaw (1998), Kolodny (1997)

Team structures: Matrix teams

Definition

- Collaborative structure that encourage coordinated, multidisciplinary efforts across functional areas
- Objective is to merge the efficiency of functional design with the adaptability and responsiveness of a multi-divisional organization

Advantage

- + High flexibility and adaptability
 - + Resource sharing
- + Interpersonal skill development
- + Quick decision making through communication effectiveness

Matrix teams

Relevance for AI management

- Flexibility and agility to changing project requirements
- Matrix teams allow for the dynamic allocation of resources based on the AI project's current phase and requirements
- Cross-learning opportunities through the collaboration of diverse perspectives

Disadvantage

- Dual lines of reporting lead to overlay
 - High potential level of conflicts
 - Unclear roles and responsibilities
 - More coordination effort
- High need of management personnel

Kolodny (1979), Hatch (2012), Burns & Wholey (1993), Goś (2015), Schnetler et al. (2015)

01 | The AI application management model

02 | Building suitable team structures

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Why do AI applications require governance mechanisms?



The **complexity** of AI applications and **numerous failure scenarios** when using AI increases the **uncertainty** for companies on how to use AI applications effectively and efficiently to generate business value



Risks arise at various levels that can negatively impact the potential of AI applications



Appropriate **rules** and **structures** in the sense of holistic **governance** are essential



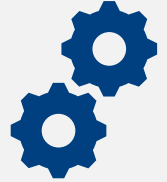
As a framework, governance defines **decision-making rights** and **responsibilities** in the corporate field through the targeted and coordinated use of **governance control mechanisms**



AI governance, as the link between the desired corporate goals and the operational decisions related to AI applications, plays a key role in the successful and targeted use of AI applications

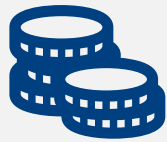
Technical risks

- Uncertain origin of data and models in complex technical infrastructures
- Bias due to poor data quality
- Complex traceability of error sources
- New cyber attack targets



Economic risks

- High investment costs for the development and operation of AI applications
- No added value due to lack of acceptance of AI applications
- Loss of value due to AI malfunction



Regulatory risks

- Data protection implications for privacy and security
- Lack of standards and certifications
- Ambiguity about the interpretation of new AI regulation by the legislature



Ethical risks

- Limited mapping of demographic diversity in training data
- Passing on bias through AI applications
- Contribution of bias by AI developers
- Lack of transferability of value systems



Social risks

- Trust and acceptance problems from employees
- Disagreement on the normative consent for the scope of action of AI applications
- Dissimilar knowledge about potentials and challenges of AI applications



Schneider et al. (2022), Wirtz et al. (2022), Reddy et al. (2020)

AI governance: benefits

Build AI at scale, with a centralized, comprehensive view of all activities

Facilitate communication and collaboration among data scientists, AI engineers, developers, and other stakeholders shaping the AI lifecycle

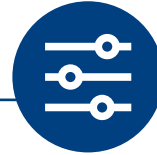
Specify enterprise policies to be enforced during the AI development and deployment lifecycle

Capture AI lifecycle facts, enabling greater transparency and automated documentation

Perform analysis of these facts to improve business outcomes, increase overall efficiency and learn best practices



The objective of AI governance is to deliver transparent and ethical AI to establish accountability, responsibility and oversight



When setting up governance mechanisms for AI applications, the appropriate balance must be found between **minimizing risk and promoting innovation**. Depending on the industry, application, and type of AI, such mechanisms can become important at different levels:

Structural level

Procedural level

Relational level

Schneider et al. (2022), Wirtz et al. (2022), Reddy et al. (2020)

Key points 10



Structural mechanisms

Mechanisms that establish roles, reporting paths, and responsibilities to ensure effective decision-making and accountability



Procedural mechanisms

Mechanisms to establishing consistent processes at all stages of AI deployment to ensure that an AI application works in the intended way



Relational mechanisms

Mechanisms to support the decision making and the communication between stakeholders who are involved in the lifecycle of AI applications

Presentation Agenda 7



01

Structural mechanisms

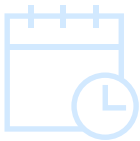
Organizational frameworks that establish roles, reporting paths, and responsibilities to ensure effective decision-making and accountability



02

Lorem ipsum

dolor sit amet, consectetur adipiscing elit. Sed non risus. Suspendisse lectus tortor,



03

Lorem ipsum

dolor sit amet, consectetur adipiscing elit. Sed non risus. Suspendisse lectus

AI governance: structural mechanisms

Structural mechanisms refer to the **organizational frameworks** that establish roles, reporting paths, and responsibilities to ensure effective decision-making and accountability concerning AI or other systems



For companies it is essential to **define the resources they need** - both horizontally along the AI lifecycle and vertically across organizational levels

Examples

- **Along the AI lifecycle:** Assign clear responsibilities for data management to enhance accountability and efficiency
- **Across organizational levels:** Responsibilities and decision-making authorities should always be clearly communicated



An effective and efficient management of AI requires clear roles, reporting lines and responsibilities along the AI lifecycle and across all organizational levels

AI governance: procedural mechanisms

Procedural mechanisms involve establishing **consistent processes** at all stages of AI deployment to ensure that an AI application works in the intended way (e.g., meeting a desired performance level or legal requirements)



For companies, it is helpful **to set standards** that ensure that consistent AI applications and architectures can be established across the company

Examples

- **During AI application development:** Define processes to help identify use cases that are meaningful to the business; procedures to optimize data sources rather than the data cleansing process
- **During the operational use of the AI application:** It is essential for companies to have backup applications available to be able to quickly replace unforeseen negative effects of a current algorithm



Due to the probabilistic behavior of AI applications, companies must continuously identify emerging malpractices of AI applications and derive appropriate countermeasures

Schneider et al. (2022), Wirtz et al. (2022), Reddy et al. (2020)

Relational mechanisms **support the decision making and the communication** between stakeholders who are involved in the lifecycle of AI applications



For companies, it is helpful to set up **interdisciplinary teams** and further provide **collaborative platforms** to make the best possible use of AI applications

Examples

- The AI application operator should be in exchange with the data scientists to get a better understanding of what the AI application can and cannot perform for productive operations
- Appropriate onboarding processes can promote the efficient development of AI applications



Explainability and traceability of an AI application's decisions should be intentionally embedded in communication structures where the need arises

Schneider et al. (2022), Wirtz et al. (2022), Reddy et al. (2020)

Examples of existing AI governance guidelines

USA

Name: SR-11-7

Users: US bank officials

Purpose: To provide guidance for the application of company-wide model risk management initiatives and the maintenance of an inventory of models implemented for use, under development, or recently retired

Goal: Model development and validation must enable anyone unfamiliar with a model to understand the model's operations, limitations and key assumptions

Canada

Name: Directive on Automated Decision-Making

Users: Organizations creating AI solutions

Purpose: To assess and regulate the deployment of AI tools by implementing a scoring system that evaluates the level of human intervention, peer review, monitoring, and contingency planning required for the AI solution

Goal: Seeks to create a framework that enhances the accountability, transparency, and reliability of AI systems, especially those intended to serve citizens

Board of Governors of the Federal Reserve System Washington, D.C. (2011); Digital (2019)

Examples of existing AI governance guidelines

Europe

Name: AIGA „AI governance and auditing“

Users: Organizations and decision-makers involved in AI development and deployment

Purpose: Addressing global standards, regulatory requirements, and ethical considerations to ensure that AI technologies are developed and deployed in a transparent, accountable, and ethical manner

Goal: Facilitate responsible AI implementation by offering a structured approach to AI governance throughout the entire AI system lifecycle, aligning with global standards and aiding compliance with the European AI regulation (AI Act)



The abundance of AI governance guidelines highlights the increasing recognition for responsible and ethical AI development and deployment

futurium.ec.europa.eu (2020)

What are the consequences of not implementing AI governance?



Lack of efficiency

Data scientists or validators can't be sure of the lineage of a model's data or how the model was built

If model is trained using wrong or incomplete data, months of work could be destroyed

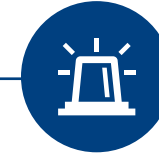


Significant penalties

Ensuring AI application compliance with various

- regulations
- contractual agreements
- standards

not possible without targeted governance and monitoring mechanisms



Brand reputation at risk

More likely malfunction of AI application without good governance due to, e.g., manipulated input data

Clearview fined again in France for failing to comply with privacy orders

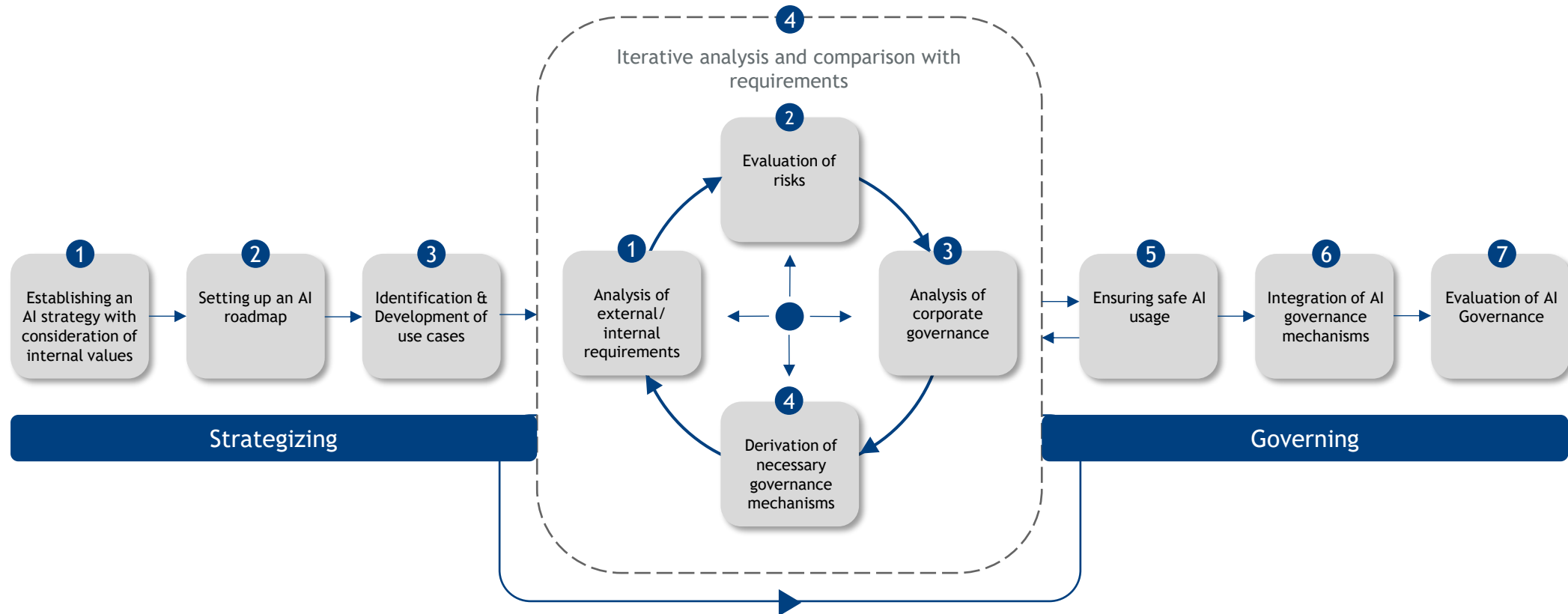
Clearview AI, the U.S. startup that's attracted notoriety in recent years for a massive privacy violation after it scraped selfies off the internet and used people's data to build a facial recognition tool it pitched to law enforcement and others, has been hit with a fine in France over non-cooperation with the data protection regulator (over €25 million)



<https://www.forbes.com/sites/emmawoollacott/2023/01/18/gdpr-fines-reach-record-level/?sh=11865c9f652d>

Techcrunch.com (2023)

A method for transforming existing governance mechanisms in companies to AI governance



Today's lecture at a glance



We discussed the AIAMA model which helps estimating the affected stakeholders of an AI management challenge and developing effective information paths to mitigate them

We explored different team structures and clarified their relevance, advantages and disadvantages for the management of AI

We discussed the need for governance as well as relevant factors and frameworks

Questions, comments, observations



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