UNIVERSITÄT BIELEFELD



INFORMATICS EUROPE

Digital Twin of Universities: a Human- and Data-centric Digital Transformation Approach for Future-oriented Universities

Gregor Engels

Bielefeld University

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Leiden University
1991 – 1997
Professor
Software Engineering
and Information Systems

Paderborn University
1997 – 2023
Professor
Information Systems

Bielefeld University
now
Senior Professor

Academia + Industry Strategic Advisor

Capgemini Germany
2005 – 2015
Scientific Director
Research

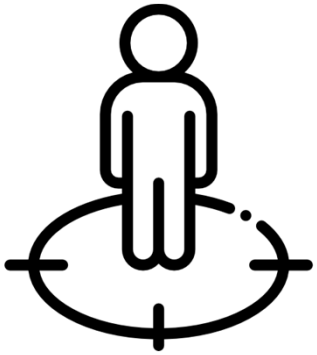
Software Innovation Campus Paderborn (SICP)
2010 – 2023
Founder and Chair

Kehrbusch Management Consulting
since 2020
Partner

my experiences

my positions

my message of today



- Digitalisation begins in the analogue world
- Digitalisation, and particularly digital transformation, is a step-by-step process
- A holistic approach (“mindset”) and comprehensive governance models (“governance”) are essential
- The digital twin is an important conceptual model for digital transformation.
- The modelling limitations of socio-technical systems remain.

Current challenges facing universities in Europe



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- Government cuts to **core funding**
- Lower **external funding** due to cuts in government funding for research and teaching
- The transfer of scientific research to **industry**
- High expectations regarding teaching and research topics in the face of rapid **technological** development
- Increased **competition** between universities
- Declining appeal in an **international** comparison

Digital Transformation as a support strategy: current action topics



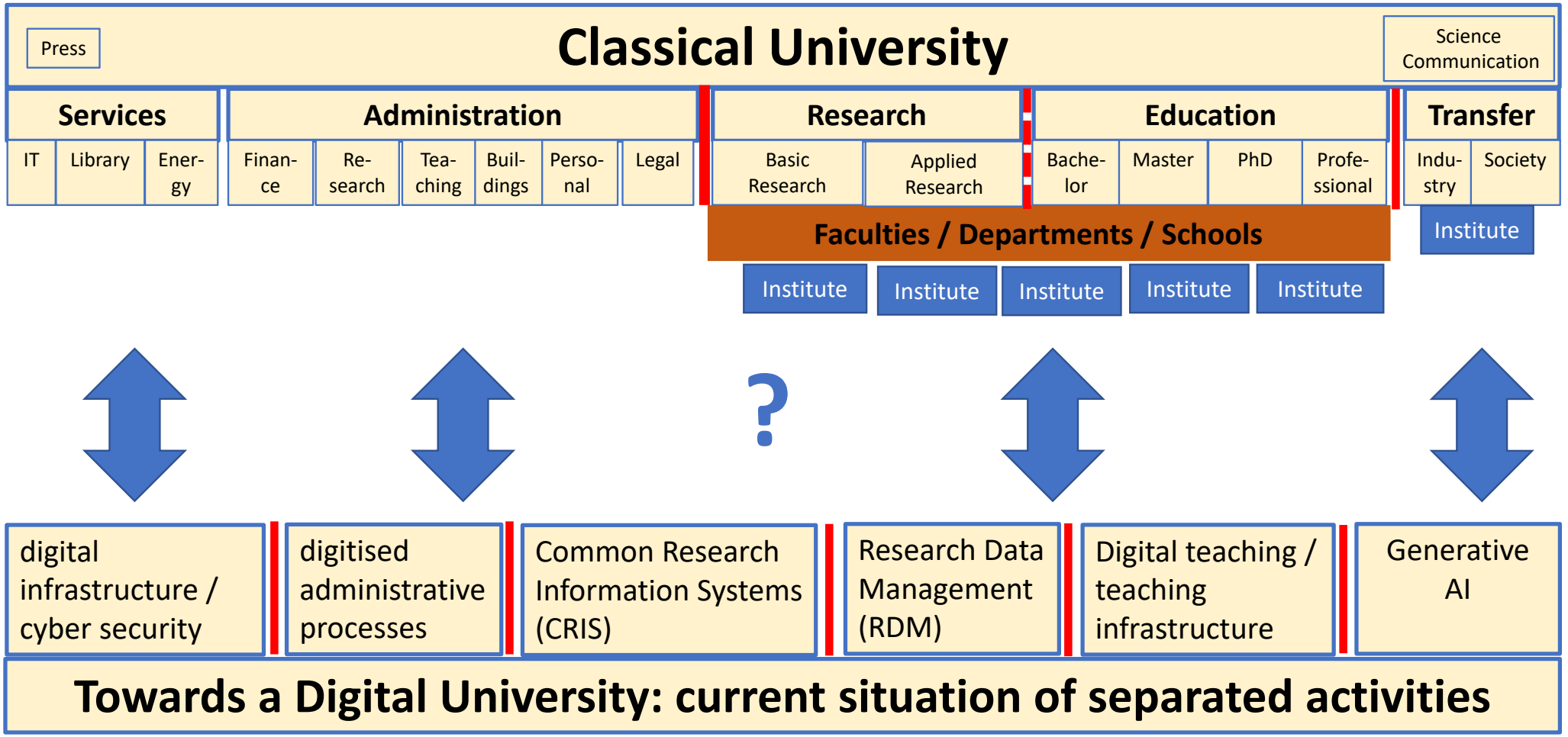
- Digital Management of Research Data (EOSC: European Open Science Cloud, NFDI)
- Digital teaching
- Digitalisation of administrative processes
- Support for transfer processes (prototyping, CRM, etc.)
- The use of AI-based tools in research and teaching (particularly GenAI)
- Science Communication / Online Marketing

Expectations regarding the added value of digital transformation

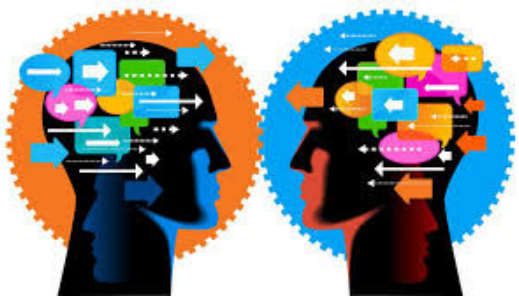


- Higher standards in research and teaching
- Improved efficiency in university processes
- Greater transparency (finances, research results, study situation)
- Greater planning certainty
- Improved target-group-oriented communication (e.g., science communication)

Digital Transformation Map



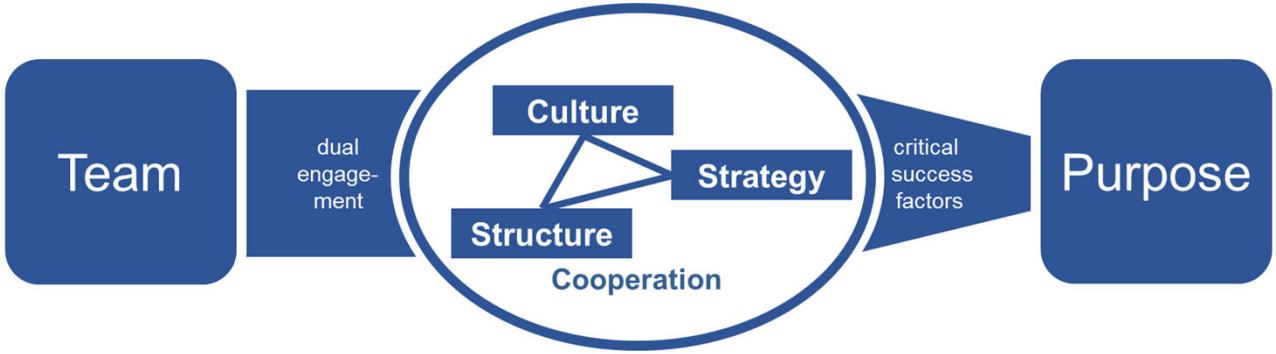
A critical analysis of the current state of digital transformation in universities



- Lack of a **strategy** for integrating silo-like individual initiatives
- Lack of a strategic approach to the digital transformation of **all areas** of a university
- A lack of understanding of a comprehensive governance model covering **end-to-end** processes, **data** sets and areas of **responsibility**
- A lack of a **university-wide mindset** for a comprehensive and end-to-end digital transformation

Solution Approach: A human- and data-centric approach for a future-oriented university





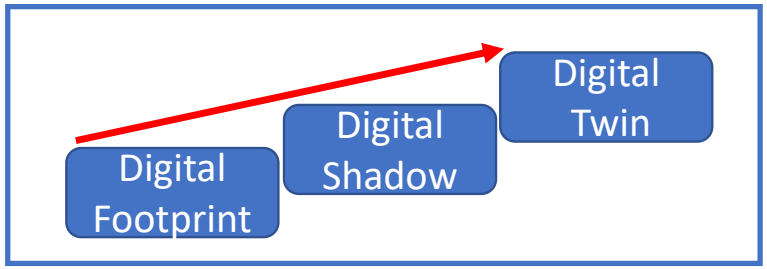
The human-centric perspective views a university as an instrument for the entire university community, working together as a team to achieve a common purpose: **“We are the university!”**

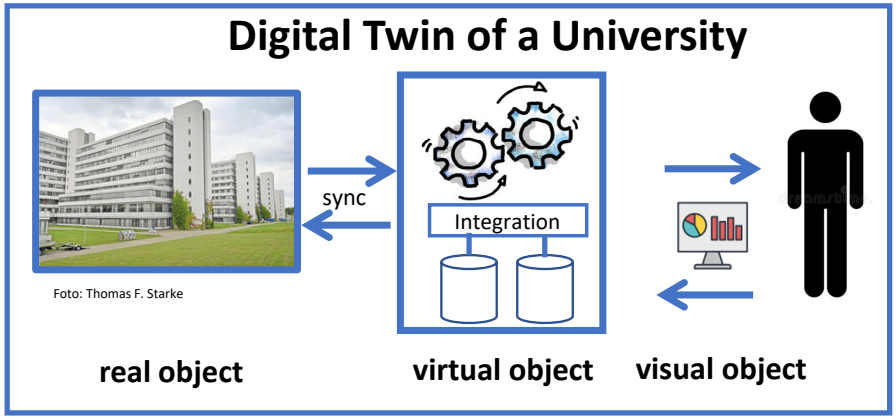
Jointly agreed guidelines for the triad of culture, strategy and structure define the cooperation in a holistic manner: **“We follow guidelines and rules!”**

The team is committed to two things: carrying out operational tasks AND further developing its working methods: **“We operate and take care of the future!”**

The data-centric perspective: Data sets with clearly defined responsibilities are used for monitoring, planning and managing the university: **“We know our data!”**

Solution Concept: Digital Twin





Stakeholder:
- Rectorate
- Administration
- Faculties / Deans
- Professors
- Students
- IT / Library
- …

Added value of a Digital Twin
- Transparency
- Efficiency
- Effectiveness
- Real-time control
- Trend analyses
- Simulations

Non-technical Aspects
- Societal Impact / Ethics
- Sustainability
- (Data) Sovereignty
- Digital Awareness
- Digital Responsibility



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Prof. Dr. –Ing. Ulrich Rückert
Vice-rector for Digitisation and Data Infrastructure

Technical support for a university's management model

International Rankings:
Usage Scenario for a Digital Twin of Universities

We should participate in an International Ranking! To increase reputation and visibility!

- Too much work
- No time to collect the data
- Nobody looks at it

Did you think about using a Digital Twin of our university?

Not yet, but I'm open to explore! Let's start!



THE (Times Higher Education) key performance indicators (KPI)
Where are the data in our university? Who is responsible?

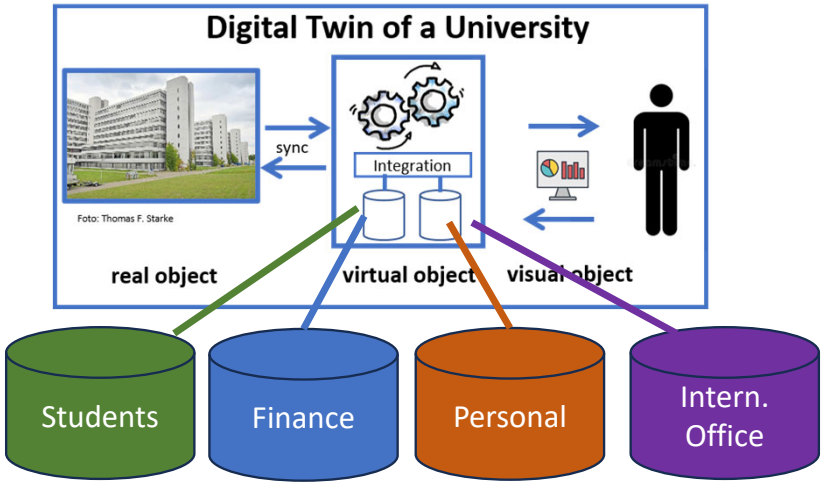
Personal
Students
Finance
Finance
Students
Personal
Intern. Office
Finance

Pillar	Metric	% weighting
1. Teaching	Reputation survey	15.00
	Academic staff-to-student ratio	4.50
	Doctorates awarded-to-bachelor's degrees awarded ratio	2.25
	Doctorates awarded-to-academic staff ratio	6.00
	Institutional income	2.25
2. Research	Reputation survey	18.00
	Research income	6.00
	Research productivity	6.00
3. Citations	Citations	30.00
4. International outlook	Proportion of international students	2.50
	Proportion of international staff	2.50
	International collaboration	2.50
5. Industry income	Industry income	2.50
		100

37% Input Bielefeld University

30% Input Citations

33% Input Survey



Benefits of using a Digital Twin:
What can we learn from the data in the virtual object?
Can we improve the real object, the university?

Objective

- **Higher** Doctorates Awarded-to-Academic Staff Ratio

KPIs:

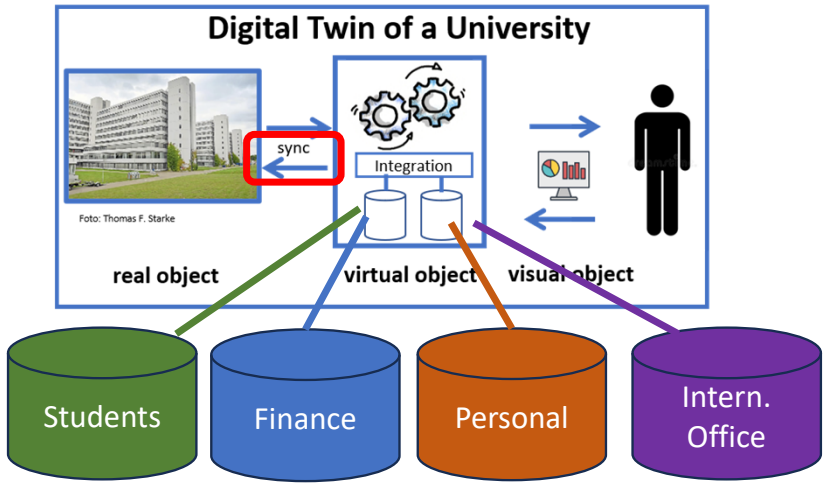
- Number of finished PhD
- Number of Academic Staff

Data Governance:

- Who is the owner of the data?
  - Students Department / Personal Department
- Who is responsible for the data (values)?

Measures

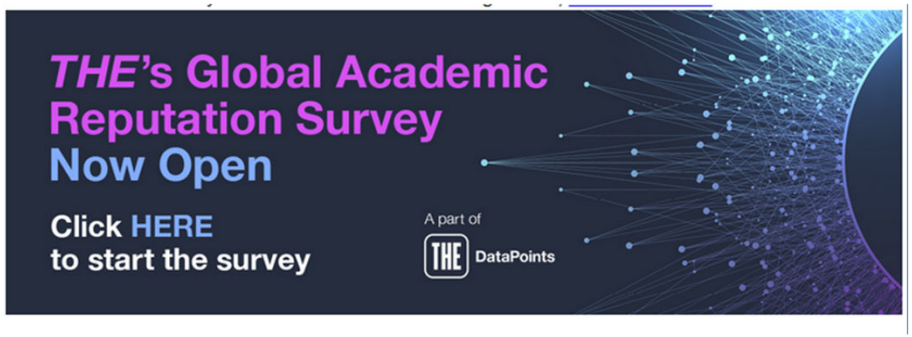
- Professors: increase the number of research projects
  - graduate schools, collaborative research projects, industrial projects
- Rectorate: provide incentives
- Dean: personal communication with colleagues



THE (Times Higher Education) Reputation Survey. Topic: International Visibility and Reputation

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33% Input Reputation Survey



? **Which universities in the world are the best in research?**

? **Which universities in the world are the best in teaching?**

THE (Times Higher Education) Reputation Survey. Topic: International Visibility and Reputation

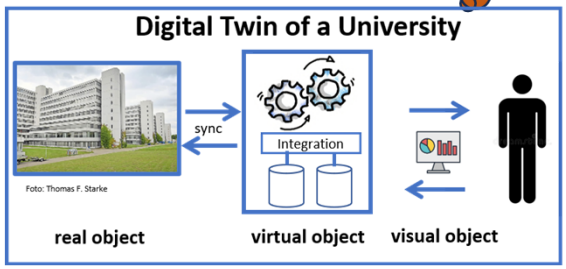
Objective
- Higher International Visibility and Reputation

KPIs:
- **What are the right KPIs?**

Data Governance:
- **Which data is needed?**
- **Who owns the data?**
- **Who is responsible for the data (values)?**

Measures
- **What are appropriate measures to improve these KPIs for international visibility?**

Is the Digital Twin also usable for improving the survey?



? **Which universities in the world are the best in research?**

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THE (Times Higher Education) Reputation Survey. Topic: International Visibility and Reputation

Objective
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KPIs:
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Measures:
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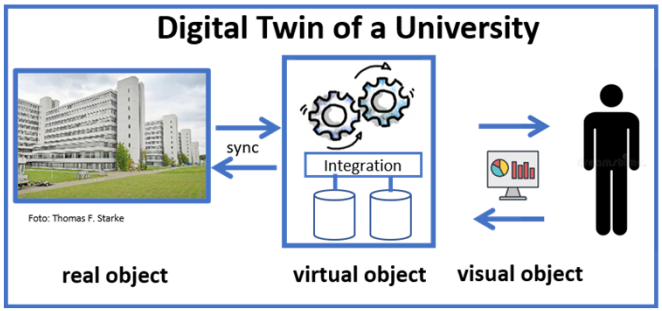
Objective
- Higher International Visibility and Reputation

KPIs:
- **# international guests**

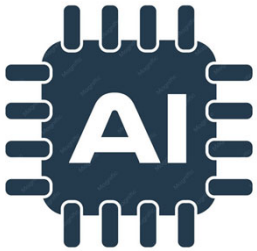
Data Governance:
- **???**

Measures:
- **Invited talks**
- **Organization of an international conference**

Possible Scenarios for using a Digital Twin



Digital Twin =
integrated data + AI-based algorithms



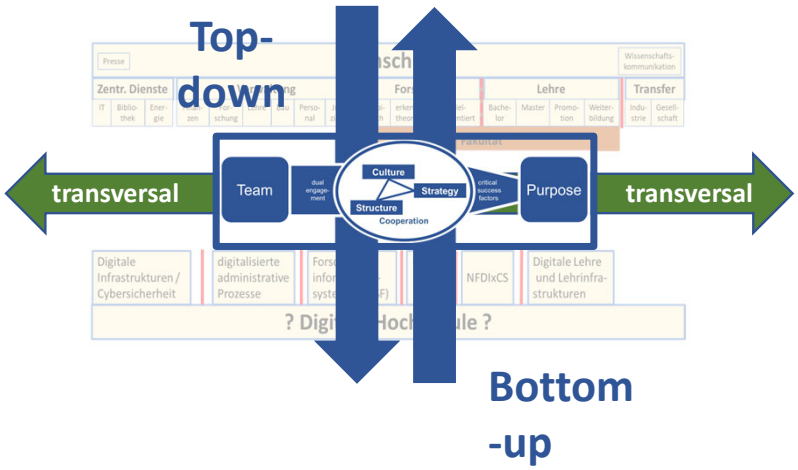
Introduce a new study programme
- Identify industrial or societal needs
- Define curriculum, compute needed resources, check availability
- Check (inter-)national competitiveness

Define the research profile of your university
- Identify clusters of researchers, research topics
- Check (inter-)national competitiveness

Improve the transfer with industry
- Find matching of research topics with industry portfolios
- Define strategic roadmap to improve transfer activities

Automate end-to-end processes in your university
- Workflow automation with Agentic AI

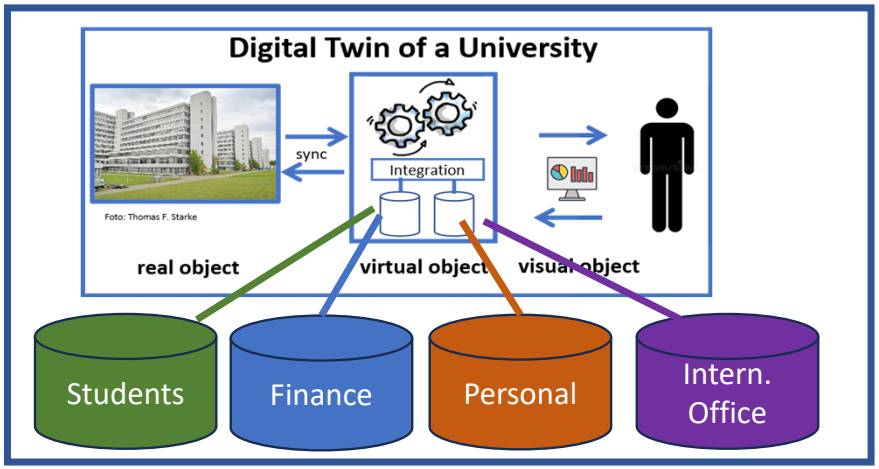
Recommendations for action for a future-oriented university

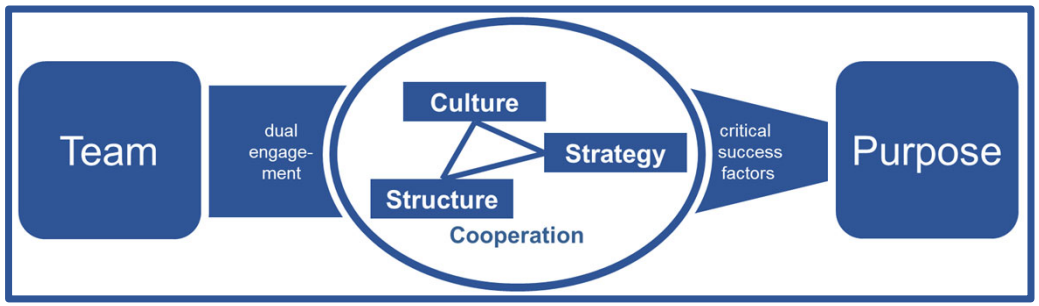


- Work together to develop and define the university's **purpose**
- Formulate **strategic objectives** across all areas (research, teaching, knowledge transfer, IT, administration, …)
- Select **scenarios** and define the associated end-to-end processes, KPIs and data
- Define and implement a **digital twin** (data management, responsibilities, software)
- Establish a human- and data-centric **governance model** and **mindset** across the whole university
- Define clear **responsibilities** for **change processes** and actively support them

Wrap up - Summary

Digital Twin of Universities: a Human- and Data-centric Digital Transformation Approach for Future-oriented Universities





Digital Twin of a University

Conceptual and technical support for a university's management and governance model