Conceptual Aspects to Support the Implementation of Digital Transformation in Higher Education Governance

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Abstract

This research focusses on digital transformation and university governance, thus the strategic changes which underly a transformation in university management. It explores the impact of digitalization on the challenges in designing change within university structures. The research builds upon existing research on university governance models. It is based on studies related on the German Excellence Initiative and the Higher Education Pact 2020, which have significantly influenced governance structures and innovation processes in German universities (Alshaer et al., 2017). The study employs a case study methodology, utilizing an expert panel (n = 18) at the Conference of the National Society of Public Administration Informatics. This approach allows in-depth analysis of real-world scenarios and expert insights into the challenges and opportunities presented by digitalization in university governance. The research reveals that data governance and digitalization of management offer significant advantages to university governance. However, these advancements also necessitate adapted governance approaches to fully leverage their potential. For academics and administrators, the study highlights the need for flexible governance models that can adapt to the rapidly changing digital landscape. Policymakers should consider the interplay between funding criteria and governance structures when designing higher education initiatives. This paper provides a perspective on the intersection of comprehensive analysis of how digitalization jointly influences governance structures and innovation processes in German universities.

Keywords: university governance, digital transformation, innovation processes

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Introduction

In today's era of digital revolution, the integration of technology plays an increasingly important role in academia. It has a strong influence on research, teaching, and university administration (Clark, 2018). In the field of research, digitization enables efficient research data management as well as improved collaboration opportunities and communication between research teams at different locations. According to Pritchard et al. (2020), researchers in many countries use advanced digital technologies such as big data, AI, and cloud technologies to efficiently analyze and manage large-scale research data. In the context of teaching, digitization increases in importance. Colleges offer online courses and digital learning resources to enable learning regardless of time and location (Selwyn, 2016). The COVID-19 pandemic has exacerbated the importance of digital learning and forced universities to quickly switch from traditional face-to-face teaching to online teaching (Crawford et al., 2020), even though the pandemic cannot be seen as a driver of digitization at universities in principle, as the expansion of data centers and IT structures had already been planned and initiated beforehand (Lübcke et al., 2022, p. 88). The university administration also benefits from digitization through efficient administrative processes. Some universities now use modern management information systems, online application portals and electronic document management systems (Öztemel & Gürsev, 2020). University governance should therefore be considered in conjunction with data governance, digital sovereignty, and networking in the sense of cross-university cooperation.

Higher Education Funding as an Influencing Factor

The distribution of funds for universities in Germany is a controversial topic that affects both political and academic circles. Several aspects contribute to this discussion. While some federal states are relatively well equipped in terms of higher education funding, others have to deal with smaller budgets. Accordingly, the financing models and structures of the universities vary considerably, depending on the federal state.

In accordance with Article 20 of the German Constitution, higher education funding in Germany is provided by the federal states, especially with regard to the financing of research and teaching. They make up the majority of the university budget and finance both university operations (buildings, staff, etc.) and research. However, the German government also intervenes in funding through certain channels, such as the Excellence Initiative or the Higher Education Pact. The distribution of funds within the framework of the Higher Education Pact in the federal states of Germany can be summarised as follows:

The Higher Education Pact 2020 was adopted by the federal and state governments to accommodate the increasing number of first-year students and to enable them to study at a high quality. Billions of euros were made available for this purpose, with which the states were able to create the necessary training capacities at the universities.

The federal states set various priorities in the implementation of the Higher Education Pact:

- Expansion of study capacities across all types of higher education institutions in order to be able to accommodate the increasing number of first-year students
- Improvement of study orientation and counselling to support prospective students in their choice of study programmes
- Increasing the permeability between academic and vocational education and training, e.g. through the recognition of skills and part-time courses of study

The Higher Education Pact contributed to the fact that the universities were able to accept a significantly higher number of first-year students. At the same time, the number of academic staff at the universities was increased in order to be able to teach the additional students. Overall, it can be seen that the federal states have used the funds of the Higher Education Pact to expand study capacities in line with demand and to ensure the quality of higher education.

The distribution of public higher education funding can vary greatly depending on the federal state. According to the quarterly publication "Finances and Taxes" of the Federal Statistical Office (Destatis), Baden-Württemberg, for example, is on top with an expenditure rate of 106 euros per capita, while Saxony-Anhalt ranks last. On average, the federal states spent around 87 euros per capita on higher education institutions in 2017 (Federal Statistical Office, 2018).

In this debate, there is also a demand for more intensive federal-state cooperation in terms of higher education funding. The German Council of Science and Humanities calls for greater participation by the federal government in the financing of colleges and universities (German Council of Science and Humanities, 2018). This would imply a comprehensive reform of German higher education funding and could potentially lead to a reduction in the current disparities between the federal states.

The financing of a university has a significant influence on its governance structure and processes. For example, the distribution of funds, budget decisions, and external funding sources can influence the autonomy and decision-making of university management. Conversely, the governance structure of a university can also have an impact on funding, as transparent and efficient governance practices, for example, can influence the allocation of resources. After all, both funding and governance are critical to a university's successful development and performance.

Transformation Approach Through Digitalization

Based on the 2018 focus study "Digitization of Universities", the level of digitization in terms of research was 34.4%, in teaching and learning 29.3% and in higher education administration 23.3% (Gilch et al., 2019, p. 3). In 74.0% of the universities surveyed in the study, digitization was anchored in the higher education strategy, in 83.0% this also included the digitization of teaching and learning, and in 79.0% of the respondents, the digitization of administration. For 42.9%, digitization was part of the university's target agreement with the state government (Gilch et al., 2019, p. 4). The 2019 report of the Higher Education Forum on Digitalisation also emphasises the importance of digitalisation in higher education and the need to promote digital skills. It shows that universities in Germany are making progress in digitization, but that there are still challenges here. Topics such as e-learning, digital teaching and learning formats and the role of Open Educational Resources will be discussed. In addition, the importance of data protection and IT security in the context of digitization is emphasized, and the need to promote digital innovation and the creation of a digital infrastructure is cited. Overall, it is depicted that the digitization of universities is a continuous process.

Digitization is often found as a profile feature in the mission statement of a university, especially as a focus in the mission statement of teaching. Digitization should also be mentioned in a digitization strategy, in the university development plan or in a future concept, which are designed for the long term, as well as in study and examination regulations (Lübcke et al., 2022, pp. 88-90) and in relation to university administration. In this context, a look at different management approaches of universities will be taken in order to shed light on the

causes of the lower degree of digitization in higher education administration at the time of the survey compared to the aspect. Finally, the study by Weisflog and Böckel (2020) comes to the conclusion that students also consider the digitization of almost all organizational processes to be important, especially processes that recur frequently (Weisflog & Böckel, 2020, pp. 31–32).

Hybrid Governance Models to Create Connectivity to Digitalization

Generally speaking, university leaders are responsible for the strategic direction and effective administration of a university or college. Higher education governance refers to the oversight and management of higher education institutions, universities, and higher education systems. It defines the management of responsibilities, duties, and relationships between the various actors such as university management, faculty, students, regulators, and society (Kehm, 2020). Higher education governance is therefore a continuum of tensions and trade-offs between different goals, values, expectations, and challenges. It requires a deep understanding of the specific contexts, cultural characteristics and institutional dynamics of each university or higher education institution.

Over the years, various governance models have developed to better distribute responsibilities and power structures and introduce control mechanisms. These models can be broadly divided into two main categories, collegial and managerial governance models. The collegial model follows the approach in which decision-making and leadership are broadly distributed across subject matter experts within the organization (Bircher, 2016). The managerial model, on the other hand, is characterized by stronger central management and a clear distribution of roles. The collegial model can contribute to greater participation and a sense of community, but it can also slow down decision-making processes and lead to disagreements. The managerial model, on the other hand, can be more efficient and responsive, but there is a risk that academically less qualified people will be at the helm of a higher education institution and make decisions that may be more focused on business interests. It is also possible to combine elements of both models to create a hybrid model that takes advantage of both approaches (Morley, 2013). In practice, most university administrations are a mixture of both models. They have a management that sets strategic goals and manages the administration, but also a management committee that makes decisions and advises.

Higher education governance is undergoing significant changes. These are often due to the influence of various forces, including financial pressures, societal change, and technological innovation (Stensaker & Vabø, 2013). Most recently, the management of a global pandemic, climate disasters, global and political uncertainties, increasingly economic downward trends in addition to digitalization, demographic change and decarbonization. Accordingly, universities are also forced to redefine and adapt their leadership and management structures. With linking university governance and data governance concepts, universities and colleges can promote the digitization process and optimize their performance in teaching, research and administration.

Importance of Big Data, Interoperability, Digital Sovereignty and Cooperation

Data governance refers to the formulation and enforcement of formal policies, processes, and standards around data governance (Weber et al., 2009) and refers to the use of big data to improve decision-making and management in higher education institutions. The use of data drives the strategic direction of the institution of higher education, improves efficiency and productivity, and supports quality assurance and accreditation. In addition to these benefits, data-driven governance also comes with risks and challenges. For example, the use of data

increases the risk of data breaches. There is a risk of misinterpretation and thus of making wrong decisions. Data literacy as orientation knowledge thus becomes almost a compulsory course for university staff (Hense et al., 2023, p. 45).

In addition to the targeted handling of data, digital sovereignty is another meta-topic when it comes to the digital transformation of universities. Digital sovereignty in the context of higher education governance refers specifically to how universities and colleges manage their data-driven services and processes and ensure that they can make their own decisions about their digital infrastructure and data policy (Karcanias et al., 2020). This means, for example, reducing dependencies on individual software providers and database management systems (e.g., Microsoft Access, Oracle, SAP MaxDB). One advantage of digital sovereignty in higher education administration is improved data security (Zuiderwijk et al., 2020). When a higher education institution controls and manages its own data, it can take better security measures to prevent data breaches and loss. Digital sovereignty also enables greater autonomy over one's own digital processes. Universities can design their own systems and platforms that are specifically tailored to the needs of their administration, their students and their staff (Weissinger, 2018). However, maintaining and updating their own digital infrastructures and systems can be expensive and labour-intensive for higher education administrations, especially when specialized expertise and skills are required. It is therefore crucial that institutions take a clear and strategic approach to developing their digital sovereignty in order to maximise potential benefits and minimise negative impacts (Schulz, 2019).

When operating your own digital infrastructure and services, it is important that these systems can function smoothly with each other; whether for the exchange of information between different departments within the university or for cooperation with external partners and systems. Interoperability refers to the ability to interact for mutual benefit and in the interest of common goals (Berger et al., 2023, p. 3). It is also considered one of the pillars of the development of effective information management with regard to higher education institutions (Smith, 2018). By connecting different applications, individual work processes can be streamlined, for example by eliminating duplicate data entry during student registration or updating employee information (Johnson, 2020). In addition, interoperability provides a centralized information base that provides quick access to up-to-date and consistent data (Roberts & Fisher, 2017). In addition, interoperability opens up the possibility of creating integrated analytics and reports, enabling higher education administrators to identify trends and make better strategic decisions (Smith, 2018). Interoperability also requires a digital agenda so that strategic implementation in administration, research and teaching can be supported in a structured way to promote an overarching strategic vision (Willcox et al., 2016).

With regard to both adaptable and data-driven university governance, which pursues and enables extensive autonomy with regard to digital services and processes, requires corresponding systems in this regard, and against the background of advancing knowledge and technology, one of the most practical ways not to be left behind is to build cooperation and networks with other universities. Although universities are often perceived as self-contained organisations, they are part of a larger education system and can also benefit from greater interaction with this system (Burt, 2001). Conferences, workshops and other events aimed at promoting cooperation between universities in the field of digitalisation can also be helpful. These platforms enable exchanges and relationships between universities (Bentley-Goode et al., 2017). Here, either the university management or the level of the faculties and institutes can take an initiating role, working groups can be set up to promote digitization, existing networks and structures can be used, or external partners such as technology companies,

consulting firms, etc. can be involved in order to use resources and knowledge to accelerate digitization. In order to successfully establish networks and cooperations to promote digitization at universities, a combination of these different approaches is certainly necessary.

In addition to guidelines for digitalisation, as summarised in a digital agenda, and supporting measures, the measurement of the impact of digital measures is important. This is because measurement helps organizations understand and optimize the success of their activities and also enables the data-driven decision-making already mentioned several times.

Methods

The following survey is intended to establish the relationship between administrative digitization and requirements from the target group of administrative employees. The interplay between practical requirements and scientific knowledge interests is intended to open up the service of administrative digitization as a field of design. In this respect, qualitative statements about administration and research in this field had to be collected.

Conducting and Evaluating Expert Interviews

For the present study, guideline-based, qualitative expert interviews were conducted with various actors from administration, science and business (N = 18). The survey period lasted from September 2024 with a workshop at the Conference of the National Society of Public Administration Informatics to the integration and writing in February 2025. The interviews were recorded, transcribed, and then evaluated by means of content-structuring content analysis (according to Mayring). The aim was to identify central topics, challenges and solutions in the context of smart cities, digitalisation and administrative practice with regard to synergies with the control logics of knowledge companies. Two interviews could not be used due to irreconcilable conclusions about the person.

The statements of the experts were anonymized and summarized in the form of table statements. The sample was determined with the minimum criteria of a minimum three-year-old member of the status group as well as corresponding disciplinary responsibility in the field. The assignment was made according to the main focus of content. The evaluation was carried out deductively along predefined categories (e.g., challenges, funding structures, reuse, cooperation, sustainability) and was supplemented by inductive category formation when new topics arose.

The following table summarizes the central statements of the experts surveyed, differentiated according to content-related topics. The assignment was made in functional clusters. Anonymization is carried out by generic actor designations with the first letters of first and last names.

Table 1

Table Statements of the Expert Interviews

Actor (anonymized)	Central message	Context/Description	Interpretation	Implication
NT (Science)	“Smart city projects are increasingly benefiting from neural networks, especially in the area of	use of AI technologies in urban development, e.g. pattern recognition in traffic flow	AI is seen as a key technology for data-based optimization (cf. Kitchin, 2014).	Investments in AI skills and data infrastructure are necessary.

Actor (anonymized)	Central message	Context/Description	Interpretation	Implication
	traffic and energy management."			
MW (Science)	"Smart cities and eGovernment can benefit from each other, but short-term subsidies make little sense because funding opportunities are too bureaucratic."	funding structures, synergies between Smart City and eGov	criticism of short-term, project-related subsidies; Need for long-term, flexible programs (cf. Bogumil & Holtkamp, 2022).	Reform of funding practice, reduction of bureaucracy.
MR (Municipal representation)	"Bad investments and cost-intensive reuse are major risks in digital projects."	cost-effectiveness, lifecycle of digital solutions	Subsequent use and sustainability are criticized as insufficiently planned (cf. Schuppan, 2020).	Development of exit strategies and reuse concepts.
MS (Science)	"Digital conferences facilitate collaboration, save resources and enable broader participation."	digitization of communication, home office	Digital tools are perceived as drivers of efficiency (cf. Mergel et al., 2019).	Expansion of digital infrastructure and skills.
TK (Administration/Science)	"Municipal umbrella associations should work more closely together in order to exploit synergies and pool resources."	cooperation, advocacy	Fragmentation is seen as an obstacle; Networking as a solution (cf. Kuhlmann & Wollmann, 2019).	Promotion of network structures and exchange platforms.
HR (Science)	"The workload for digitization is initially high, but merging municipal data centers can help to share resources."	Resource Management, IT Infrastructure	Initial expenditure as an investment, shared services as an efficiency Strategy (cf. Lenk, 2017).	Promotion of joint IT structures.
DF (Science)	"Sustainability must be a central goal of digital projects, both ecologically and socially."	sustainability, longevity	Sustainability as a leitmotif, not just technical progress (cf. Hilty & Aebischer, 2015).	Integration of sustainability criteria in project evaluation.
JV (Science)	"We are experiencing digital turning points, but the state is not acting professionally enough to leverage potential."	digitalization, administrative culture	Lack of willingness to innovate and professionalism (cf. Mergel, 2016).	Professionalization and change management in administration.
KG (Administration)	"Digitization creates more time for substantive work if processes are consistently automated."	process digitalization, efficiency	Automation as a means of relief (cf. Schuppan, 2020).	Focus on process optimization and automation.

Actor (anonymized)	Central message	Context/Description	Interpretation	Implication
HH (Administration)	"Conferences must make economic, social and technical sense in order to find acceptance."	event formats, hybrid events	Holistic demand on digital formats (cf. Bryson et al., 2020).	Development of integrated event strategies.
HK (Economy)	"Many contacts with municipalities, state supports, fire brigade receives operational data in real time, but federalism makes reuse difficult."	data management, federal structures	Real-time data as progress, but fragmented responsibilities as an obstacle (cf. Kuhlmann & Wollmann, 2019).	Harmonization of standards and interfaces.
HA (Science)	"Environmental databases and collaborations with Helmholtz and coastal research have existed for 25 years and form a valuable knowledge base."	Scientific Cooperation, Data Management	Long-term cooperation as a success factor (cf. Hilty & Aebischer, 2015).	Strengthening research networks and data infrastructures.
VS (Science)	"Science takes over, administration is unattractive, modernization is necessary to attract talent."	attractiveness of the administration, shortage of skilled workers	Administration as an unattractive employer, modernization as a solution (cf. Mergel, 2016).	Employer branding and modernization of working conditions.
WI (Administration)	"We see ourselves as a bridge builder between research and administrative practice in order to transfer innovations."	knowledge and innovation transfer	importance of interface actors (cf. Bryson et al., 2020).	Funding for transfer offices and real-world laboratories.
VK (Economy)	"There are career changers from the business world and technical networking, but clear regulation and service management concepts are needed."	Personal, Governance	Need for governance structures and service orientation (cf. Lenk, 2017).	Development of service management and regulation.
MR (Administration/Science)	"Federalism and digitization do not go together, nationwide structures would be better for scalability."	structural debate, digitalisation	Criticism of federal structures, call for centralization (cf. Kuhlmann & Wollmann, 2019).	Discussion about centralization and standardization.

Evaluation and Interpretation Logic of the Results

The evaluation of the guidline interviews was based on the qualitative content analysis according to Mayring (2015). Both deductive categories (pre-defined, e.g., "funding

structures", "sustainability", "governance") and inductive categories (developed during the analysis, e.g., "employer branding", "shared services") were used. The transcripts were read several times, relevant text passages were coded and then condensed using text analysis (Mayring, 2015).

The statements were assigned to the following main categories:

- innovation and technology transfer (e.g., AI, neural networks, databases)
- funding structures and resources (e.g., funding practice, bureaucracy, shared services)
- governance and organization (e.g., federalism, cooperation, regulation)
- sustainability and reuse (e.g., ecological, social and economic aspects)
- Attractiveness and modernization of the administration (e.g., employer branding, professionalization)
- Process optimization and efficiency (e.g., automation, digital conferences)
- Transfer and interface management (e.g., bridge builders, real-world labs)

According to this categorization, the objects of interpretation can be aggregated into the following statements:

Innovation and Technology Transfer

The integration of new technologies such as AI and neural networks is seen as central to the development of smart cities. Scientific cooperation and long-term databases are emphasized as success factors (Hilty & Aebischer, 2015; Kitchin, 2014). The administration must build up competencies and infrastructures in order to exploit this potential.

Funding Structures and Resources

Short-term, bureaucratic funding programmes that make sustainable development more difficult are criticised (Bogumil & Holtkamp, 2022). Instead, long-term, flexible and less bureaucratic funding structures are demanded. Shared services and the merger of municipal data centres are mentioned as solutions for pooling resources (Lenk, 2017).

Governance and Organization

Federal structures are seen ambivalently: on the one hand, they enable local adaptations, on the other hand, they make standardization and reuse more difficult (Kuhlmann & Wollmann, 2019). The need for clear governance structures and service management concepts is emphasized.

Sustainability and Reuse

The sustainability of digital projects is highlighted as a central goal, both in an ecological and social sense (Hilty & Aebischer, 2015). Bad investments and lack of subsequent use are mentioned as risks. There is a need for life cycle management and reuse concepts (Schuppan, 2020).

Attractiveness and Modernization of the Administration

The administration is perceived as unattractive for skilled workers. Modernization, employer branding, and the improvement of working conditions are cited as central levers for attracting talent (Mergel, 2016).

Process Optimization and Efficiency

Digitization and automation are seen as a means of increasing efficiency and relieving the burden on employees (Schuppan, 2020). Digital conferences and tools are rated as resource and time savers.

Transfer and Interface Management

The role of bridge-builders between research and administration is emphasized as essential for innovation transfer (Bryson et al., 2020). Transfer points and real-world laboratories are identified as suitable formats.

Merging, Synthesis and Limitations

The analysis shows that successful digitization in municipalities and administrations requires an interplay of various factors: technical willingness to innovate, sustainable funding structures, effective governance, attractive working conditions, and functioning interfaces between science and practice. The challenges lie particularly in overcoming bureaucratic hurdles, harmonizing federal structures, and developing sustainable reuse concepts.

Qualitative content analysis enables a systematic condensation of expert statements, but is dependent on the subjective interpretation of the researchers (Mayring, 2015). The selection of experts and the focus on certain topics can limit generalizability. Nevertheless, the insights gained provide valuable impetus for the further development of smart city and digitization strategies.

Conclusion

In summary, digitalization can support the management of higher education institutions in many ways and help address governance requirements due to budgetary constraints. Some of them are:

- Increased efficiency: With automating processes and routine tasks, costs can be reduced and efficiency increased. More efficient management can help meet governance requirements even with limited resources.
- Improved information management: Digital platforms make it possible to manage information more effectively, which can be essential for compliance with governance regulations. With the help of digital systems, relevant information can be collected, stored and retrieved more easily.
- Transparency and accountability: Digital technologies can promote greater transparency and accountability, which also contributes to governance compliance. This can be achieved by tracking goals and achievements on digital platforms.
- Strategic decision-making: Digital data analytics tools can help management make strategic decisions by providing valuable insights into trends and patterns. This helps university managers make informed decisions and use resources efficiently.

In addition, it is important that university governance takes into account aspects such as data-driven governance, digital sovereignty and interoperability, as well as cooperation and networking. Finally, improved digital competence in management can better meet the requirements of governance by harnessing the full potential of digitalization. Implementing a

solid digital strategy can help address the multiple challenges of governance tasks in times of limited budgets.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

Generative AI and AI-assisted technologies were used in the writing process to improve the language and readability of this paper. The use of the technology was carried out under human supervision and control and all work was carefully checked and post-processed.

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