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Adoption of E-Government Requirements to Higher Education Institutions Regarding the Digital Transformation

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Abstract. Higher education institutions' (HEI) administrations in Europe are facing difficulties regarding their digitalization. However, to succeed in digital transformation, digital services' introduction, and optimization, the HEI needs to understand its digitalization requirements. As HEI administration reaches its highest digitalization level when it is in the development stage of e-government, the e-government's needs and requirements can be applied in the context of HEI administration. Therefore, we conducted a four-step approach: (1) a systematic literature review, (2) qualitative longitudinal and latitudinal coding, (3) creation of a concept matrix of the e-government's requirements analysis, and (4) its evaluation on an example of a German HEI. We extend the knowledge base with a requirements matrix for HEI administration to be obeyed. We conclude that e-government's requirements are comparable to HEI's administrative requirements with process-oriented digitalization as the basis. Given the requirements, HEIs digitalize their administrative processes more efficiently.

Keywords: E-Government, Requirement, Higher Education Institution, Administration, Digitalization.

1 Introduction

Higher education institutions' (HEI) administration is currently the HEI area with the lowest digitalization level in Germany [1]. However, the contradiction is that although HEI administration lacks the most on digitalization, its staff is at least ready (47.8 %) to cope with the digital transformation compared to students (81.7 %) and academic staff (68.5 %) [1]. To make progress concerning the HEI administration's digitalization, the administration needs to understand its digital transformation requirements. Similar to HEIs, e-government relies on information and communication technologies (ICTs) in the public sector to transform the relations between public institutions and citizens [2]. Thus, we assume the e-government requirements to be comparable to those of HEI administration. A good understanding of the requirements supports the development and usage of new technologies, such as artificial intelligence and blockchain, and the digital transformation and optimization of existing services. Therefore, European HEI

administrations can apply this understanding to resolve the transformation issues. We answer the research question: *What are the e-government's digitalization requirements evaluated in the context of HEI administration?* We extend the knowledge base by creating an e-government matrix for the HEI administration. Our results yield that HEI requirements are comparable to those of e-government and can improve the efficiency of HEI administrative processes' digitalization.

The remainder of this article is structured as follows. In the section Related Work and Definitions, we dig into the claim of e-government requirements' relevance for the HEI administration to get a common understanding and explain relevant terms. We illustrate our approach in the section Methodology and Framework. In section Results, we describe the e-government's requirements. Afterward, we discuss our findings in the context of HEI administration and shed light on requirements' applicability in HEI administration. We close with the Conclusion and Future Work.

2 Related Work and Definitions

Scientific contributions dealing with e-government's requirements focus on the process. To obtain requirements from citizens [3, 4], they define a model that guides the developer through the e-government's software creation process and evaluates the quality of the requirements [5]. In addition, there are governmental documents, such as the European Union (EU) e-government action plan of 2016-2020 [6], describing the European Commission's plans to improve e-government. The action plan aims for full digitalization but describes goals to be achieved rather than the requirements.

Referring to the applicability of the e-government's requirements in the HEI context, multiple researchers state the HEI administration's digitalization process-es to follow e-governments' requirements, such as regulation approaches [1, 7-9]. E-government's requirements are contained in the German governmental regulations, such as the Bavarian E-Government Regulations (Bayerisches E-Government-Gesetz - BayEGovG) and E-Government Regulations of North Rhine-Westphalia (E-Government-Gesetz Nordrhein-Westfalen - EGovG NRW), which mention the applicability of these approaches to juristic persons under public law, including HEIs [10, 11]. We aim to evaluate e-government's requirements in the context of HEI administration. The relevant key terms are *digitalization*, *requirements*, *e-government*, and *HEI administration*.

2.1 Digitalization

The digitalization process transforms society, relying on ICTs [11]. It refers to technological changes and encompasses organizational and management innovations. Digitalization is the key driver of modifications in the e-government processes. Currently, digitalization supports the achievement of the HEI's strategic goals, which is an emerging trend regarding ICT adoption in HEIs [2].

2.2 Requirements

The requirement is a “[...] quality or qualification that you must have in order to be allowed to do something or to be suitable for something” [12]. Applied to e-government, a requirement is a quality or qualification that this institution needs for its successful digitalization and digital services provision. We assume this interpretation also to be valid for the HEI administration.

2.3 E-Government

The e-government (also electronic government, digital government) relies on ICTs for relations’ transformation in the public sector [3]. This paper focuses on e-administration, referring to the administration’s management processes and interactions between citizens and businesses with the administration [3, 13]. E-administration is responsible for implementing the policy framework and its maintenance, service management, such as providing subventions, facility management, financial, economic, and social issues. The other is e-democracy, including e-participation and corruption prevention, which supports citizens’ opinions and decision-making processes regarding political problems with the help of electronic media [3, 13].

The e-government’s communication matrix consists of: (1) Government to Government (G2G), (2) Government to Business (G2B), and (3) Government to Citizen (G2C) (see Fig. 1) [13]. G2G refers to the horizontal integration of three state powers and vertical integration of the state levels [1]. G2B deals with integrating state and private business actors who demand and provide services [1]. G2C is the integration of the state and citizens requesting public services [1]. Opposite directions also exist.

Although the term’s core understanding is similar across different countries, the development states of e-government variate [12, 13]. European countries, such as Denmark and Finland, and the USA, show similarities regarding their basic e-government principles, such as one-stop services, service access, and data sharing [12].

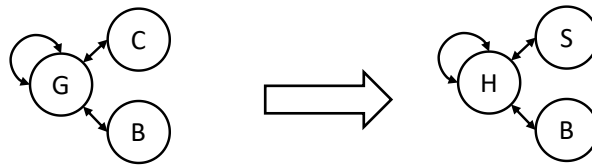


Fig. 1. E-Government Matrix (left) vs. HEI Matrix (right), based on [13].

2.4 Higher Education Institution

Multiple factors led to the HEIs’ evolution: The Bologna Process initiated the structural transformation of HEIs in Europe, with numerous actors coordinating the transfer from HEIs to increase competence and scarce financial resources [14, 15]. Optimization and modernization became essential for administrations to improve the HEIs’ services efficiency and quality [16]. HEIs now transform into process-oriented institutions where a

process and its continuous adaptation to the organization's requirements are considered central aspects of the HEI implementation [14, 17].

E-government is process-oriented, and process optimization belongs to its prioritized targets [18]. Moreover, the HEI administration reaches the highest level of digitalization when it is in the development stage of the e-government [2]. Therefore, we can think of the HEI administration's matrix similar to the e-government's (see Fig. 1). (1) HEI to HEI (H2H) may refer to ICT usage within the HEI or interactions between different HEIs on the national or international levels. (2) HEI to Business (H2B) refers to the connections between a HEI and its external partners, including the student union, sponsors, and start-ups. (3) HEI to Student (H2S) is about services and applications offered to students, such as Student Information Systems (SISs) and Learning Management Systems (LMSs). Reverse directions, B2H and S2H, are also possible.

The Technical University of Munich (TUM) can be considered as representative German HEI (~600 professors, ~45,000 students, budget ~1.6 billion in 2019 (including the university hospital)) [19]. The HEI is highly process-oriented, referring to business processes, such as validating and submitting documents [20]. Due to its high overall digitalization level, established partners from the industry, and information systems targeted at the students' support, TUM has a matrix similar to the e-government's.

3 Methodology and Framework

In this paper, we carried out a literature review according to the four-step approach of Brocke et al. [21]. We addressed the first two steps in previous sections. We conducted the *AIS eLibrary* and followed Webster and Watson [22] by looking for contributions in leading journals and conference proceedings for literature search. We looked at eight journals from the Association for Information Systems (AIS) Senior Scholars' basket and the five recommended by the AIS Special Interest Group (SIG) Electronic Government. We also included four leading Information Systems (IS) conferences. To keep track of current developments, we considered only literature published in the last five years (2015-2020) and used the keywords *digital government*, *e-government*, and spelling variations. The literature search resulted in 433 hits. We read the titles and abstracts of the papers to identify relevant literature. Papers without any reference to e-government and those only focusing on its e-democracy component as well as articles discussing concrete technologies' applications in the e-government context, such as gamification, were excluded. We kept articles with a general focus and those discussing and (or) testing their findings' validity in European and American contexts. We found 16 relevant articles after screening the full texts.

4 Results

We found the top discussed concepts to be *stakeholder collaboration* (13 articles), *cost reduction* (nine articles), *interest diversity* (eight articles), and *legal regulations* (eight articles). Our findings revealed *complexity decomposition* and *reliability* as the concepts with a little discussion. We derived four requirement categories: three (G2G,

G2B, G2C) from the communication matrix and one (Services) from the literature. Table 1 shows the inductively created concept matrix based on our findings.

1. **G2G** stands for the requirements of a single e-government and its interaction with other e-governments.
2. **G2B** consists of concepts describing stakeholder collaboration and their interest diversity.
3. **G2C** represents governmental needs when interacting with the citizens.
4. **Services** refer to the enabling services representing qualities of ICTs.

Table 1. E-Government Concept Matrix (N.a. = not applicable).

Requirement	Description	Source/ Discussed	Applica- tion to HEI Ad- ministra- tion
G2G			
Ambi- dextrous Organiza- tion	The e-government adopts conflicting values: ef- ficiencies and innovations. Efficiencies are ser- vice improvements, whereas innovations stand for new technologies.	[23, 24]	Yes
Adaptability	The e-government adapts to innovations and technological changes.	[23-29]	Yes
Stability	The e-government maintains its fixed organiza- tional structure. It is risk-averse to prevent the <i>failure trap</i> , i.e., taking too many risk-intensive actions.	[23, 24, 30, 31]	Yes
Balanced Power	The e-government aims for balanced power dis- tribution within the organization.	[23-25, 29, 30]	Yes
Complexity Decomposi- tion	The e-government decomposes complex prob- lems, such as software projects, into smaller parts.	[23, 26]	Yes
Flexibility	The e-government has a flexible infrastructure. The decision-making life cycle times are short and final decisions are done as late as possible.	[23, 31, 32]	Yes
Accountabi- lity	The e-government keeps its staff accountable with rules and regulations.	[23, 24, 27, 30, 31, 33, 34]	Partially
Staff Educa- tion	The e-government is responsible for educating its staff by providing it with the necessary ICT competencies to increase its openness to change.	[23, 25, 26, 29, 32]	Yes
Cost Reduc- tion	Technologies applied in social services decrease expenses. However, governments only focusing on cost savings are at risk of failure.	[25-27, 29, 31-35]	Yes
Legal Regu- lations	Regulations for digitizing have to be adapted. E- legislation's identification should happen as early as possible in a project.	[23, 25, 27, 29-31, 33, 35]	Partially
G2B			

Interest Diversity	The e-government has central role in digital projects and manages other parties. It should know its internal and external stakeholders, their capabilities, and interests.	[23, 25-27, 30, 34, 36, 37]	Yes
Stakeholder Collaboration	The e-government collaboration with its internal and external stakeholders allows the parties to create joint value propositions.	[23, 25, 26, 29, 30, 32-39]	Yes
G2C			
Citizen Centricity	The e-government focuses on its citizens and aims to satisfy their needs.	[27, 29, 31, 34, 39]	Yes
Digital Identity	The e-government allows its citizens to identify themselves with a digital ID or other means.	[29, 38]	Yes
Privacy	The e-government guarantees citizens' privacy.	[27, 29, 33]	Yes
"No-Stop Shop"	The e-government proactively provides services to the citizens, i.e., when a life event occurs.	[29, 38]	Unclear
Trust	The e-government builds and maintains a high level of trust of the citizens.	[29, 31, 33-35, 39]	Yes
Engagement	The e-government motivates the citizens to engage with digital services, e.g., by informing them about the existing services.	[25, 27, 31-33, 37, 38]	Yes
Services			
Quality	The service data is of high quality. The digital services are of high quality.	[25-27, 29, 30, 32-34]	N.a.
Efficiency	The service is efficient.	[23, 24, 34, 37, 38]	N.a.
Innovation	The e-government develops and introduces new technologies. It avoids the <i>failure trap</i> .	[23, 24, 26, 27, 34]	Yes
Transparency	The service is transparent, e.g., the citizen is able to track his service requests.	[27, 29, 31, 33, 34]	N.a.
Accessibility	The service is accessible via various channels. The data is accessible across organizations.	[29, 32-34, 38]	N.a.
Usability	The service is easy to use.	[32, 34]	N.a.
Reliability	The service is reliable. It uses reliable data.	[23, 25, 29, 30]	N.a.
Data Management	The data necessary for the service is maintained, reused, and cleared up regularly.	[25, 27, 29, 33]	N.a.
Interoperability/Integration	The services are interoperable within the organization and between the internal and external services.	[27, 29, 32-34]	N.a.
Standardization	The e-government establishes data and technical standards.	[25, 27, 29]	Partially
Security	The e-government is security conscious. The services are secure.	[23, 25, 27, 29, 30, 33]	Yes/N.a.

5 Discussion and Implications

In the following, we outline the applicability of the e-governments' requirements in the HEI administration context on the example of European HEIs, such as TUM.

5.1 H2H

The H2H category is related to the G2G category of e-government. The first requirement is the government's need to be *ambidextrous*. Ambidexterity stands for the digital government that continuously innovates and improves existing services. We discuss this concept using the organization of teaching processes in HEIs as an example. 95% of German representatives of higher education administrations think that online media support traditional face-to-face teaching, and 40% assume that completely online teaching is possible [40]. Therefore, most of the representatives are convinced of the proficiency of conflicting values simultaneously existing in the HEI context. However, HEI administrators should not be considered fully ambidextrous, as they tend to be digital-averse and in favor of *stability* [1]. Nevertheless, we see the degree of digitalization in student lifecycle actions at TUM as extraordinarily high compared to other HEIs.

Since the introduction of the Chief Information Officer (CIO) position in HEIs, universities actively participate in digital transformation and tailor to their needs digital systems, such as SISs [16], which demonstrates *adaptability*. Setting up innovation labs to work on innovative projects without disrupting existing processes can support ambidexterity [40]. At TUM, the *Big Data Innovation Lab* allows for developing and evaluating innovations on a research platform in different industry sectors. Such innovations often allow for cost reduction due to process automation.

Balanced power relations in e-government enable a clear assignment of roles and responsibilities of the parties involved. At TUM, the Extended Board of Management is responsible for the university's development plan, structural reorganization, and budget [41]. The roles are assigned, e.g., the President represents the university internally and externally, the Board of Management makes decisions on the university's key attributes: scientific, international, and entrepreneurial [41].

Complexity decomposition and *flexibility* are the next requirements to be discussed. An agile HEI can address both aspects [45]. An exemplary agile method is Design Thinking [43]. Given the customers' needs, this method allows the HEI to create a Minimum Viable Product (MVP) satisfying minimal users' requests. After being approved by the users, the product's adjustments are possible [43]. Thus, agile administration enables flexible solutions and product development in smaller pieces. The concept of smaller academic qualification units can become part of future academic study programs [44]. In general, the transformation of a HEI is complicated, as a bureaucratized rigid structure characterizes it, and public financing may envelope its digitalization. Therefore, its flexibility is not mainly determined by the market developments but by the legal regulations and academic culture [45]. The Bologna Process enhances, inter alia, the introduction of a system of comparable Bachelor and Master degrees, and promotes mobility of students and academic staff [46]. The Standing Conference of the Ministers of Education and Cultural Affairs responsible for coordinating and developing education in Germany is another example.

Art. 2 para. 1 sentence 7 of the Bavarian Higher Education Act (BayHSchG) obliges HEIs to promote the continuing *education* of their employees [47]. The employees can gain ICT capabilities, e.g., at the *TUM Institute for LifeLong Learning* that focuses on

providing knowledge in the area of digitalization. The need for staff training is essential, as a lack of motivation is currently one of the main obstacles to digitizing HEIs.

Moreover, the e-government and, thus, the HEI should keep its employees *accountable*. Although the HEI administration can add internal control mechanisms, it cannot influence the Law on Academic Staff in Higher Education Institutions (Bayerisches Hochschulpersonalgesetz - BayHSchPG). As *legal regulations*, such as the BayE-GovG, cannot be adjusted by the HEI administration directly according to its digitalization needs, their unchangeable nature may restrict the digital strategy. However, the Online Access Act (Onlinezugangsgesetz - OZG) may be the key digitalization enabler. There are already positive examples in higher education, and the Online Access Act will push even more activities in the context of online access via university web portals, authentication, and authorization, e.g., via Shibboleth, and data exchange via systems, such as LMS [48].

5.2 H2B

The H2B category is comparable to G2B and refers to various internal stakeholders being active in a HEI: students, teaching and scientific staff, personnel involved in the management and support processes. Libraries, data centers, and student unions can be considered external actors. [14] Therefore, the HEI's stakeholders' landscape is heterogeneous. This heterogeneity and the HEIs' process-oriented nature imply the need to consider *diverse interests* and collaborate with other stakeholders. In this collaboration, the HEI administration acts as an intermediary between the parties, including students, researchers, and business actors. Referring to the second requirement, *stakeholder collaboration*, only an intense interconnection and constant collaboration via online platforms can address the high digital transformation speed needed to maintain high teaching, research, and overall HEI's levels [45].

5.3 H2S

The H2S is similar to the G2C category regarding *citizen centrality* comparable to the HEIs' student centrality and student life cycle [14]. Moreover, a HEI student usually has a *digital identity*, and the EU General Data Protection Regulation guarantees student's *privacy*. However, this set of regulations may restrict the administration's actions regarding digitalization. New solutions, such as the self-sovereign identity (SSI) allowing students to control their private data, already exist [49]. With SSI, HEIs benefit from verifying, validating, and authenticating student data.

Currently, most HEI processes are realized as a one-stop-shop. However, *no-stop-shop* services arise at highly digitalized process-oriented HEIs, e.g., at TUM, the study progress monitoring is fully automated. The students' *trust* is necessary to prevent their resistance to using digital services. However, student concerns as digital natives are less complex than citizen clients of e-government, so encouraging their *engagement* and providing them with necessary information is easier to handle.

5.4 Services

We focus on the commonly discussed aspects of innovation, standardization, and security and refrain from discussing technology-specific requirements. HEIs already recognized the importance of *innovation* implementation [50]. The university is unlikely to experience the *failure trap* with the administrative staff being rather digital-averse.

Like the e-government, the HEIs collaboratively define standards and create interfaces, e.g., for the students' data transfer among institutions. *Standardization* is one of the operational challenges when introducing an IS at a HEI [16].

The *security* requirement encompasses cybersecurity and the HEI being aware of it. Events on security help to increase the awareness of the HEI's staff and students of this topic. At TUM, the *IT Security and Data Protection Days* take place regularly. Moreover, security control and innovations are part of the CIO's responsibilities.

6 Conclusion and Future Work

In this paper, we obtained the requirements of the e-government regarding its digitalization. Then, we evaluated these needs in the context of European HEIs, such as TUM, to assess their applicability to the HEI administration. We found most e-government's needs contained in Table 1 to apply to the administration fully. A HEI can only partially address some requirements which may represent boundary conditions, e.g., legal regulations may restrict its digitalization. Some H2H requirements are adaptability, flexibility, cost reduction, stakeholders' needs, collaboration, and interest diversity; H2C – privacy and student centrality; and service-specific – security, and standardization. During digital transformation, the administration can refer to the requirements matrix to obtain which of its needs may be covered or supported by an innovation and determine the technology's potentials.

Future research can determine additional requirements, including interdisciplinary contributions from research areas outside the IS leading journals and conferences. We considered papers dealing with the e-governments in Europe and the USA, whereby the contributions discussed institutions situated in different countries. These cross-country settings represent a limitation and may make the findings' comparability and transferability problematic [51]. Moreover, future research can focus on measurements and the coding of concepts that we did not address in our contribution. Therefore, researchers can extend the paper on generalizability to improve the external validity. In addition, future research can assess the requirements matrix with more HEIs and technological innovations.

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