TOWARDS DIGITAL BUSINESS PROCESS MODELS IN HIGHER EDUCATION INSTITUTIONS: A CASE STUDY BASED ON THE ONBOARDING OF STUDENT EMPLOYEES

Research full-length paper

Track 04 - Digital Ecosystems: Trends, Perspectives and Opportunities

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Abstract

Digitalization is one of the major challenges which also affects higher education institutions. However, a lot of organizational business processes in the administration of higher education institution are still analog and paper-based. We conducted an in-depth case study at one of the top-ranked higher education institutions based on the onboarding process of student employees by applying a five-step approach focussing on the first three steps: (i) qualitative analysis of the case itself, (ii) development of a common denominator, and (iii) develop a new digital business process model derived from a concept matrix. The results contribute to theory with a digital business model in higher education institutions. Research can use the results to develop measurements for new digital skills and competencies and implications for other related areas such as participatory user design, artificial intelligence, e.g., contract validation, and outsourcing/offshoring, all business processes involving multiple stakeholders who bring in different resources to the process. Practitioners can apply the digital business model to discuss this topic and enable them to set up appropriate relationships with other organizations. Organizations can apply this concept for value co-creation in their networks.

Keywords: Digital business process models, digitalization, transformation, higher education, case study.

1 Introduction

Digitalization is the innovation engine of the 21st century and one of the major challenges which also affects higher education institutions (Gottlieb and Utesch 2019; Hess et al. 2016). Information technology (IT) drives new challenges in the digital infrastructure of organizational business processes such as the administration (Bughin and Van Zeebroeck 2017; Porter and Heppelmann 2015). However, many business processes in the administration of higher education institutions are still analog and paper-based. The digital change leads to a new way of thinking and expectations the so-called digital mantras (Kreutzer and Land 2013, pp. 43-76). Thus an individual expects personalized services for his individual needs connected to its environment at every time from any place (Kreutzer and Land 2013, pp. 43-76). Our approach addresses the identified research gap in the dimension environment and administration (Gottlieb and Utesch 2019) with a digital business process model in higher education institutions to build the fundament of best practices. In this first step, we focussed on a case analysing a business process to build a foundation for a business model in our future research.

"A *business model* is a conceptual tool containing a set of objects, concepts and their relationships *[…]* to express the business logic of a specific firm" (Osterwalder et al. 2005, p. 3) and goes beyond the products and services from a company (Clinton and Whisnant 2019, p. 465). However, the business processes of higher education institutions in Germany are in a transition from analog to digital. This transformation affects higher education institution in its full use of technology (Hess et al. 2016; Matt et al. 2015). In

Digital technology is a combination of information systems, computing, communication, and connectivity technologies (Bharadwaj et al. 2013). Many firms are integrating digital technology into their business activities to drive their business performance, such as reducing cost, fulfilling customer expectations more comprehensively or innovating their business model (Fitzgerald et al. 2013).

Digital Innovation is an innovation enabled by digital technology that leads to the creation of new forms of processes, products, services or business models in to reshape the underlying value proposition of a firm (Yoo et al. 2010). Consequently, there is an interplay between both concepts of digital innovation and digital technology. In addition, digital innovation can be grounded on the recombination of digital- and physical resources generating novelty (Brynjolfsson and McAfee 2014; Yoo et al. 2010). Digital innovation involves both physical- and digital materiality. Properties of digital materiality are programmability, addressability, sensibility, communicability, memorability, traceability, and associability (Yoo et al. 2010). A research gap is: *which digital material can change both innovation processes and outcomes?* (Nambisan et al. 2017). A broader definition state digital innovation as "process or business model that is perceived as new, requires some significant changes on the part of adopters and is embodied in or enabled by IT" (Fichman et al. 2014). Yoo et al. (2010) stated a combination of materiality and digital innovation, whereby digital innovation itself is periodically and consists of waves of digitalization. There are various definitions of digital innovation in the literature, and in this paper, we understand digital innovation as a novel process, or business model enabled by digital technology, which involves physical materiality and digital materiality.

To the best of our knowledge, research in the area of higher education institutions analyzed the development of curricula using IT (Coskun 2015; Fichman et al. 2014; Zafoschnig 2014), explored IT-based learning techniques such as computer-mediated learning, e-learning (Alavi 1994; Eshchanov et al. 2011; Gupta and Bostrom 2009; Piccoli et al. 2001), and identified gamification or game-based learning (Callaghan et al. 2013; Prensky 2003) as one driver in this field. However, an integrative approach from the organizational environment and administration to IT-based learning is missing. Thus, this study explores a case focused on organizational administration in a higher education institution.

From an information systems research perspective the *how is something done* is observed on a general level (Fichman et al. 2014). Research focuses on information technology strategies and how this

developed in the last decades (Bharadwaj et al. 2013). Bharadwaj et al. (2013) combined the information technology strategy with the business strategy to a digital business strategy. Information system research as predestinated research area raises theories on digital transformation strategies and have derived new theories by underlying best practice case studies from firms in Germany (Hess et al. 2016). Enterprises rated their digitalization process as D (starting phase) in 65% (Fitzgerald et al. 2013). 2018 still 45% of Enterprises indicating a beginners level (IDG 2018). Since five years and due to the findings that digitalization is a must-have for CEOs agenda (Fitzgerald et al. 2013), we expected a higher growth rate.

Further, in theory, the followed processes to digitalize the business process has an orchestration (Hess et al. 2016). Nambisan et al. (2017) confirm this finding and suggests an orchestration of the digitalization process. Kreutzer and Land (2013) distinguish three steps of digitalization: (1) data recording, (2) processes, and (3) cross-linking.

In contrast, we analyze a case study based on one of the top-ranked higher education institutions—Technical University of Munich (TUM). Most of the higher education institutions in Germany, especially in the administration, is state-funded. The higher education administration ensures the fulfillment of the tasks of the university in planning, administration, and legal matters. In doing so, it must work towards the economical use of the budget and the economical use of higher education institutions. The administrative affairs of the institutions and committees of the university are also carried out exclusively by the higher education administration.

The purpose of this paper is to explore the business processes of higher education institutions addressing the onboarding of student employees by developing a digital business process model. To develop valuable digital business process models in higher education institutions in the human resources department, we have to consider how to identify process elements while fulfilling the EU General Data Protection Regulation (GDPR), federal, and state data protection regulations. We follow the research question: What is an appropriate digital business process for higher education institutions in the onboarding of student employees.

To answer this question, we structure the paper is as follows. First, highlighting the methodological approach and giving insights to the studied case in the section *Method and Case*. Second, presenting the findings of the analyzed case in section *Results*. Third, *discussing* the findings according to the literature before concluding the results and giving an outlook for future research in the section *Conclusion and Future Work*.

2 Method and Case

The overall method creates an IT artifact for digital business models in higher education institutions, according to (Hevner et al. 2004). This artifact provides a reference model to implicate the business process of higher education institutions addressing the digitalization of the onboarding of student employees. Therefore, we apply a five-step approach as follows and focuses on this study on the first three steps.

First, conducting a qualitative approach which is appropriate for answering the question of how as well as exploring the why underlying the observed phenomena (Yin 2014). In particular, we chose a revelatory case research method. Due to the fact, it allows for theory building regarding new and exciting phenomena through the in-depth analysis of an exemplary, novel, or unique cases (Flyvbjerg 2006; Sarker et al. 2013; Yin 2014). The focused case of a digitized and seamless integrated onboarding of student employee's business processes at TUM is such a case. The unique business process consists of revolutionary new technology and new higher education market strategy. Both conditions in one business process is a radical innovation developing digital credentials. However, it is a strategy from a thriving higher education institution. We code several process documents and a series of expert interviews of several single business units, which are in contact with non-digital

credentials. From the coding, we deduce Aris Event Process Chain (EPC), Aris Business Process Model and Notation (BPMN), and Aris Business Process Landscapes (BPL) to derive a common denominator of attributes from existing forms and process documentation. Besides, this denominator the illustration of the digital business process allows to orchestrate the business process (Nambisan et al. 2017).

Second, developing the common denominator of attributes of the identified documents such as the name of a person. Therefore, we coded the attributes of these documents, and for a more comprehensive view, we look at requirements in these documents. The requirements illustrate the workflow and enable to illustrate the business process.

Third, deducing a concept matrix from the common denominator of the attributes to receive a reference architecture. Therefore, we follow an iterative approach to theorizing, which combines deductive and inductive elements (Yin 2014). We pursue prior relevantly examples of case study research in the information system community (Dibbern et al. 2008; Kranz et al. 2016). Hence, we derived a preliminary theoretical concept (Dubé and Paré 2003) from the coded interviews and onboarding documents from the administration. We are counting each variable of the onboarding documents such as the name of the student and summarizing the number of occurrences of the variable to measure its frequency. To get rid of redundant variables because of the translation of some documents, we subtracted the doubled counting from the translation to derive a corrected sum. Besides, we counted the frequency of multiple inputs when a variable appeared in multiple documents. Along the way, we adapt existing and integrated new constructs when necessary to improve the concept. In combination with the second step, we optimize the business process to derive a digital business process model from managing the activities in practice as needed. Thereby this study follows the goal of improving agility and operational performance.

Fourth, iteratively developing a demonstrator to realize a proof of concept. Therefore, we proof the usage of the current environment and define additionally necessarily requirements for future system architecture. For the system architecture, we explore adoptable hard- and software solutions as well as the required data and process models, to establish and consolidate the results, norms, and standards need to be revisited and further developed. This system results in a system architecture embedded in the services and process landscapes of all areas of activity in the field of the new digital management and administration. These findings result in a digital service platform.

Fifth, deriving from the digital service platform best practices to provide respective information as a benchmark for further development. Due to the specific case, we found no comparable other higher education institutions.

Figure 1 illustrates the overall research approach and the research focus of this study.

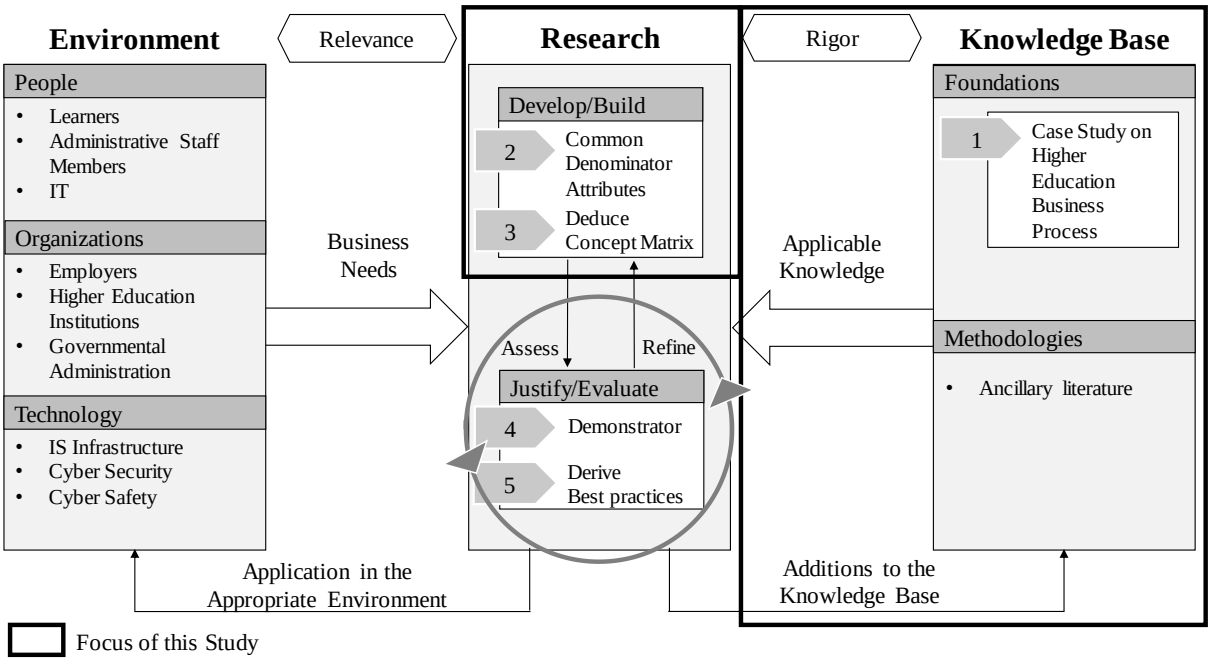

Figure 1. Research Approach. According to Hevner et al. (2004)

We gained access to the case by the senior vice president (Chief Information Officer) from the higher education institution Technical University of Munich (TUM). TUM is a top higher education institution in Germany with 15 faculties educating more than 41,000 students. Around 570 professors and 6,650 academic staff research and teaching. The university has a budget of about EUR 1.5 billion (inclusive the university hospital). In total the institution has about 10,500 staff members split among several campuses in over 400 buildings.

During the academic year, there is a very high velocity in the number of contracts by the scientific student employees caused by the student roles such as tutorials, a short period of student programs, a short period of the semester (contracts only during enrollment per semester), and required knowledge.

After the insights of this in-depth cases study, this paper clarifies the results from the development of the new digital business process model.

3 Case Analysis

We found for the coding 14 documents for the onboarding process for student employees at the university. Five out of these documents are a translation into English. We numbered the documents with a three-digit number. We started with the enumeration of the tens. An English document is marked at the unit place with one. We used a prefix "DOC_" for future processes. In total, we determine 350 variables. However, 125 variables have multiple inputs. Multiple inputs is a marking for a variable that occurs more than once in a document. From these multiple input variables, the students had to fill in 85 redundant data information such as name or postal address. Besides these redundant variables, we identified another 66 variables from checkboxes. We have consolidated them to 33 variables. In total, a digital system reduces the number of variables to 231 unique variables. The variables of the form *DOC_050/DOC_051* are included in the document *DOC_090*. The business process costs are not only the redundant recording from the student but also the inspection of all these variables and documents for each contract.

Further, the results from analyzing documentary indicate a non-common basis of understanding. We identified four stakeholders: the candidate, the organizational unit, the human resources unit, and the information technology service center. The *candidate* is the applying person. She/he holds personal information such as personal belonging, name, birthdate, birthplace, and previous jobs. *The organizational unit* holds information about the job, such as position, fond, and cost center. In some cases, the organizational unit consists of three main acting persons the *head of the organizational unit*, the *staff position*, and the *staff member*. Besides these persons, there can be further staff member involved. The *human resources unit* holds information about the necessary documents and tools. The acting persons are a staff member for controlling the documents, and a person with authority to sign. The *information technology service center* provides software infrastructure such as SAP ERP.

The onboarding process can be divided into six phases: (i) initialization, (ii) initial agreement, (iii) identification, (iv) validation, (v) creation, and (vi) agreement. The onboarding process starts with the *initialization phase*. In the initialization phase, the possible student employee and the organizational unit reach an agreement such as working hours and salary. In the *initial agreement phase*, the organizational unit prepares the agreement data such as the name of the student, working hours, and the location of the employee in the unit. The *identification phase* serves to acquire the student personal data in detail such as birthdate, place of birth, previous activities, and to hand in corresponding certifications. The *validation phase* has as a goal to proof the agreement preparations from phase (ii) and the personal student data as well as the certifications from phase (iii). In the *creation phase*, the human resources unit prepare and print the contract. In the *agreement phase*, both parties sign the contract documents (one example for the employee and one for the human resources unit). Figure 2 represents the sequence of the phases of the current onboarding process of student employees.

Figure 2. Sequence of Phases of the Current Onboarding Process of Student Employees

4 Results

The current design of the onboarding process has a lot of forth and back between the student and the organizational unit and between the organizational unit and the human resources unit. Figure 2a presents the current process. It seems to be comparable to a waterfall model. This construction of the business process leads to high overhead when a mistake occurs at the end of the process. Since the validation of the documents is at the end of the business process—the human resources unit—all steps in between have to be rerun through all involved persons. A more in-depth look during an interview in the organizational unit illustrates mistakes because of different naming in the forms as well as a different understanding of naming. Also, mistakes from the future student employee in filling out the form, mistakes in writing, unclean writing, unreadable writing. Additional long durations caused by sending the documents from one unit to another by internal mail forth and back.

The new invented digital process redesigns the process in methods and its application and lead necessarily to concrete variables. The redesign of the onboarding process shifts the responsibility to the candidate (see Figure 4b, top lane). The background methods are changing. This change can be observed in more system interactions between the lanes, especially the top lane—student employee, and the bottom lane—information technology service center. We have a cross-linking to the SAP system and the student data system. The digital business process also enables validity checks in between the process. The organization unit has almost the same processes, and the responsibility has not changed (see Figure 4b, the second lane from the top). The processes from the organizational unit

differ in the method of recording the data. At the end of the process, the human resources unit signs the contract (see Figure 4b, the third lane from the top).

In contrast to the current process, the validity check in the redesigned process is done by the system at the beginning and in between of the onboarding process. This shift changes the tasks of the IT service center in total from a data storage service to a new business process such as scripting, validating, document recognition as well as storage not only for personal data but also for documents. Hence, this shift needs a document management service. Figure 3 illustrates the shift in the sequence of the phases of the redesigned onboarding process of student employees.

Figure 3. Sequence of Phases of the Redesigned Onboarding Process of Student Employees

The structure of the process seems to be similar to the well-known software development process V-Model XT (Informationstechnikzentrum Bund 2019). The V-Model XT has a testing phase which occurs at nearly every single step in the digital process the validation phase is due to the shift similar. The central manual and prone to error work of validation switched to an automated business process located in the center. Figure 4 highlights the differences between the current (paper-based, non-digital) and the redesigned (digital) onboarding process of student employees as well as the validation and responsibility shift.

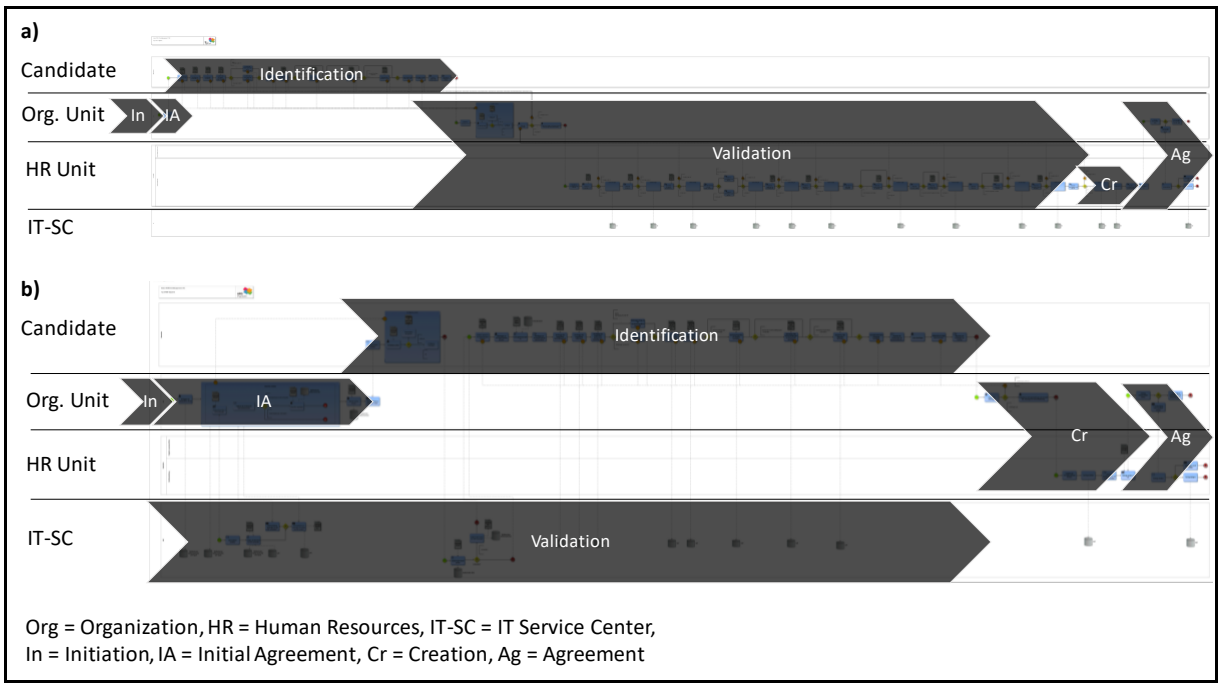

Figure 4. Onboarding Process: a) Current Design, and b) Redesigned.

The longitudinal and latitudinal coding of the documents results in a concept matrix. Four stakeholders deliver the knowledge of the record for the contract. We group this knowledge into three file destinations: *contract data record, additional data record,* and *master record.* The *contract data record (CD)* consists of are necessary data for each contract with the staff member to generate the contract, whereas the *additional data record* includes further information such as social or retirement data. The *master record* consists of the *main data of the employee (MD),* known by the organizational unit at the beginning before the contract process starts and the *additional data of the employee (AD)* known by the employee itself. The master record is always the same for each contract. The assignment stems from the forms. Within the forms the naming of the allocation is inconsistent. Table 1 highlights a part of the concept matrix of the onboarding process.

Assignment	**Field Description**	**DOC_010**	**DOC_020**	**DOC_021**	**DOC_030**	**DOC_031**	**DOC_040**	**DOC_041**	**DOC_050**	**DOC_051**	**DOC_060**	**DOC_061**	**DOC_070**	**DOC_080**	**DOC_090**	**sum**	**sum_correction**	**Multiple input**	**Who**	**File Destination**
OE	Employment Agency	1													1	2	**2**	2	OE	CD
OE	Contact Person for Queries	1														1	**1**	0	OE	CD
OE	Phone No.	1														1	**1**	0	OE	CD
OE	Mail from OE	1														1	**1**	0	OE	CD
EM	Name								1	1						2	**1**	0	HR	CD
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
PE	Mail from PE										1	1			1	3	**2**	2	ME	MD
PD	Street	1									1	1	1		1	5	**4**	4	ME	MD
PD	Street No.	1									1	1	1		1	5	**4**	4	ME	MD
PD	ZIP Code	1									1	1	1		1	5	**4**	4	ME	MD
PD	City	1									1	1	1		1	5	**4**	4	ME	MD
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
PE	IBAN												1			1	**1**	0	ME	AD
PE	BIC												1			1	**1**	0	ME	AD
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Sum																	**350**	**125**	**4**	**3**

Table 1. Concept Matrix of the Onboarding Process (exemplarily in excerpts). OE = Organizational Unit, EM = Employer, HR = Human Resources, PE = Person, PD = Personal Data, ME = Member, CD = Contract Data, MD = Main Data, AD = Additional Data.

Thereby, data quality changes from handwritten to a systematically recorded dataset. Thus the dimensions of data quality are fulfilled (Loshin 2011). This quality enables data analytics and qualified monitoring of the dataset in a shorter period. Besides, the digitalization of the process enables validity checks at the beginning of the process and thereby reduce forth and back questions as well as getting rid of this prone to errors working way.

5 Discussion

The developed business process model represents the three digitalization steps. The data recording is now the first step of the new digital business process. However, the data collection has a cross-linking to several systems. This cross-linking supports the business process with already recorded additional data. Hence this data need no longer to be acquired by every contract again. Besides the reduction of recording redundant data within the process, the validation of the data proceeds during the acquiring process at realtime. Thus we can confirm with the digital business process model the steps of digitalization (Kreutzer and Land 2013). Also, the properties of digital materiality are programmability, addressability, senseability, communicability, memorability, traceability, and associability (Yoo et al. 2010). All seven properties are part of the developed digital business process model. In combination with the cross-linking, digital innovation enables business process audit and business analytics (Brynjolfsson and McAfee 2014; Yoo et al. 2010).

Since the implementation of digital systems needs a common understanding, we searched for structures solving this issue. A solution is a knowledge base. However, there are different implementations of this database, e.g., a glossary or a wiki. We decided to apply a glossary as knowledge base because it is a simple shared table among the project partners without logins and verification. In addition, the experts are familiar with it.

Figure 4a let assume a process similar to the waterfall model from software development. The waterfall model is a linear process and divided into clear phases. We also have identified clear phases in the onboarding process. The phases are linear and have similar disadvantages such as the forth and back; unflexible do to the linear workflow, late validation, agreement like a ‘big bang’ implementation. Therefore, we assume comparability to a waterfall model.

The shift in the validation process let assume a surprising similarity to the V-Model XT (Informationstechnikzentrum Bund 2019). The V-Model XT adaptation to the digital business process shifts the process structure and enables more flexibility, faster recognition of mistakes, and to focus on the service task of the contract itself in the human resources unit. However, the validation phase moves in the center of the process. Thus ICT becomes a critical role in the process.

The use of technology changes the whole business process, as well as the focus of the business unit back to their root activities. These results correlate with the literature and confirm the findings from Hess et al. (2016) in the usage of the technology. Splitting the data sets into a master record and a contract data record can avoid redundant data. The methodological change of the digital business process (Yoo et al. 2010) is mainly the locus of filling the documents. In contrast to the non-digital process forms no longer need to be filled handwritten. Consequently, the person from the human resources unit has no longer to deal with the task of typing out the documents to the SAP system. This change in the method of the business process implies fewer mistakes at the end of the process.

The approach by interviewing the stakeholders such as employed students, staff members from the human resources unit, and the organizational unit illustrates different perspectives into the business process model resulting in an innovative solution referring to the digitized artifacts (Nambisan et al. 2017). The digital business process is more user-oriented than the current paper-based process. On the one hand, the *new* student employee has less redundant variables and fewer sources of errors. The human resources unit has less forth and back communication due to the prior validation of the documents and the information technology support.

On the other hand, new complexity and side options appear in the process, e.g., a service platform which integrates the onboarding process (Nambisan et al. 2017). This platform means an integrated approach from the application of the student employee over the selection process to the onboarding process and the alumni process. In addition, this service platform can provide human resource management during the employment relationship.

Further, we skipped design options due to several reasons which we outline in the following. First, applying an upgrade to human resources software system with an onboarding workflow causes high

costs of licenses of professional accounts and a redundant administration of users. In contradiction, the service platform enables us to adopt and adapt current information systems such as the onboarding system of students (not student employees), SAP. Second, the service platform enables us to present software as a service solution instead of standardized desktop solutions. Third, we can add future services to this service platform whereby a self-service portal is conceivable. Fourth, we can present the involved stakeholders with the point of contact in an already known system.

The result—a digital business model—confirms the theory (Fichman et al. 2014) and has not only a significant change in the part of adopters but also in the embodied IT. Additionally, IT enables further analytics and monitoring of the digital process of onboarding student employees.

Our findings from the case do not discover the waves of digitalization (Yoo et al. 2010). To observe the waves of digitalization, a general perspective over the integration of several processes might be a fruitful approach. However, the investigated specific, unique business process changed the validation moment to data input time. Information data coming from the responsible user, in this study, the student employee, drives this change. The digital material of the study is information in an almost digital business process. Only the contract itself needs to be signed handwritten due to law restrictions. The newly developed business process model (Kreutzer and Land 2013) has both physical- and digital materiality. The credentials we have as input in the process have to fulfill the properties of digital materiality (Yoo et al. 2010). Additionally, the credentials have to be revision-proof. It follows that we could find a digital material that changes the process but not the outcome. To change the outcome, we need a contract as a digital credential. This credential has to be global, accepted, and to fulfill law restriction.

6 Conclusion and Future Work

This study is investigating a digitalization process in one of the top-ranked higher education institution. We address the theoretical gaps in the information systems and engineering education literature in a systematical case study. Specifically, the in-depth case study has identified the differences in the non-digital and digital processes in the onboarding process of student employees. This study is to the best of our knowledge the first that attempts to look into the digitalization phenomenon in some depth, offering a more penetrative understanding of the concept. Besides, the study goes a step further than past studies that have dealt with antecedents and consequences of digitalization by identifying stakeholders and a fruitful fundament.

Moreover, the case study emphasizes the importance of IT in the digitalization process: first, by studying the current non-digital process within the context of onboarding of student employees; and second, by highlighting the different, IT-related enablers that influence the business process. According to the best of our knowledge, explicit consideration of IT-related issues has been minimal in prior studies.

We plan to discuss the findings of this study with the community at MCIS 2019 to strengthen the research outcome for a possible generalization in higher education institutions. We will implement the result of this study in a demonstrator to illustrate its applicability and to evaluate user satisfaction and user design. Additionally, on the long-term, this application should fit in a customer-friendly and smoothly integrated ICT infrastructure for research, teaching, and administration in the university.

Future studies can use the findings to expand the theory and to develop measurements for new digital skills and competencies. We believe that our study's results have important implications for other related areas such as participatory user design, artificial intelligence, e.g., contract validation, and outsourcing/offshoring, all business processes involving multiple stakeholders who bring in different resources to the process. Besides, digital credentials in a global solution according to law restrictions might close the research gap for digital material.

We provide managers with the conceptual clarity to discuss this topic and enable them to set up appropriate relationships with other organizations. Organizations can apply this concept for value co-creation in their networks.

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