Brightening Physical University Admission Through Digital Process Virtualization: An Action Case Study in Ghana

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Abstract. The purpose of this study is to understand how digital process virtualization can be used to address problems with physical admission in a developing country university. Bright ICT research calls for solutions to practical problems in society including education. However, related studies in education have focused more on teaching and learning. Therefore, less is known about education management and administration. This study addresses this research gap through an action case study of a digital process virtualization project to address problems with a physical admission system in the University of Ghana. The research findings show that problems such as delays, inconvenience of submitting physical documents, difficulty of accessing lecturers in their offices to serve as referees and untimely feedback can be addressed by inscribing virtual functionalities into digital platforms for affordance actualization by users. However, in situations where personal knowledge is needed for providing academic references, additional functionalities are needed to promote digital interactions between actors.

Keywords: bright ICT, process virtualization, digital platform, higher education, virtual functionality, inscription, affordance, action case study, Ghana.

1 Introduction

IT enabled-capabilities for efficient and effective organisational processes are critical for organisational performance and stakeholder values [1, 2]. Conversely, organisational processes can be problematic in terms of delays, bureaucracy and inconsistencies thereby constraining satisfactory performance and value creation. Business process re-engineering with ICT is considered as an effective approach to address such problems [3, 4, 41]. Moreover, recent advancement in digital technologies such as the Internet and the Web presents opportunities to address problems with traditional, face-to-face and paper-based processes by converting to virtual processes via digital platforms [5]. Doing so however requires that organisations develop the necessary IT-

enabled capabilities [1] such as digital virtual processes that enable remote actors to interact without the need for face-to-face contact in a physical location.

In line with this background, the purpose of this study is to understand how digital process virtualization can be used to address problems with physical, face-to-face and paper-based processes. Digital process virtualization involves the migration of offline face-to-face process in physical locations onto digital platform for online interactions among people in geographically distributed locations [6, 7]. In recent years, several interactions that used to occur in physical locations have undergone virtual digital process transformation, resulting in online innovations such as e-commerce and e-learning [8].

Bright ICT refers to an IS (information systems) research initiative that focuses on solving real problems in society [9]. Within the IS literature, calls for bright ICT research [10] have been made to help address technology-induced and general problems various areas of society including education [11]. However, bright ICT research in education has focused largely on e-learning. Therefore, not much research exists on university administrative areas such as student admission. In line with this research gap, the research question for this study is how digital process virtualization can be used as a bright ICT initiative to address problems with physical admission in a university. To address the research question, this study draws on an action case study (Braa & Vidgen, 1999; Lee, Baskerville, & Pries-Heje, 2015) and actor-network theory concept of inscription [14–16] combined with the theory of affordance [17–19] to investigate a digital virtualization of a physical graduate admission process in the University of Ghana

The rest of this paper is organized as follows. The following section reviews relevant literature on bright ICT and digital process virtualization. The next section presents affordances and inscription as the theoretical lens. The section after describes the research setting and the action case study. The subsequent section reports on the action case study findings. The section after analyses the findings. The discussion follows while the final section serves as the conclusion.

2 Bright ICT and Digital Process Virtualization

Bright ICT: Advancement in ICT has generated benefits for IT-enabled capabilities [1, 2] and business process re-engineering [3, 4] for process efficiency and effectiveness [10]. However, ICT advancement has also induced problems, which have been referred to as dark ICT, such as cybercrime, internet privacy and security breaches [20]. Bright ICT has been proposed as a grand IS research initiative to address dark ICT issues [9] as well as societal problems in healthcare, education, and poverty. Thus education has become a research stream in bright ICT research [10]. This study therefore responds to research calls for bright ICT by focusing on how digital process virtualization can be used to address problems associated with physical admission process in a university.

Digital Process Virtualization: Digital process virtualization involves migrating processes and interactions from offline onto digital platforms [7, 21, 22]. As virtual environments, digital platforms offer functionalities for remote interactions among geographically distributed people without the need for direct and face-to-face contact in a physical location [23, 24]. Process virtualization can be physical such as in the case of distance learning and postal services or digital such as in the case of e-commerce and the internet [25]. As this study concerns digital admission, the focus is on digital process virtualization involving an online admission system rather than a physical process virtualization.

3 Theoretical Foundation: Affordances and Inscription

The theoretical foundation for this study is the combined lens of actor-network theory (ANT) concept of inscription [14, 15] and the theory of affordance [17, 18, 26]. *Inscription* is the act of embedding functionalities into technological artefacts [27, 28] such as software. The outcomes of the inscription process are functionalities that enable or constrain users. In relation to IS, inscription refers to embedded prescriptions in components such as software, hardware, manuals, standards, processes and procedures. For this study, inscription concerns the embedding of virtual functionalities digital platforms during at the development phase.

Affordance refers to action possibilities or constrains that objects present to people as actors [29, 30]. In relation to IS, objects are technologies that present possibility or inhibition to users. As a theoretical principle, an affordance is neither a property of the object nor a property of the actor [31]. Rather, an affordance is an emergent property of interactions between actors and objects [32, 33]. Affordances emerge an actor's perception and become actualized when the actor practically engages with the object [34] for intended goals [35].

Inscription was used to analyse virtual functionalities that got embedded in the digital admission platform while affordance was used to explain the enabling or constraining mechanisms of such functionalities

4 Research Setting and Methodology

Research Setting: The research setting is the University of Ghana, the oldest and the biggest higher education institution in the country. Over the years, the university has been dealing with increasing number of graduate applications. Yet, its graduate admission system was largely paper-based and fraught with problems such as delays, document misclassification and losses as well as untimely feedback. To address the problems, the author initiated an action case study for digital process virtualization with web developers from the university's ICT unit. The project occurred over a five-year period from 2014 to 2018.

Methodology: Action case study [12, 36] is a qualitative research methodology that combines action research and interpretive case study [12, 13, 37]. It is a form of participatory approach to bring positive changes to real-life problem situation while seeking research understanding to contribute to knowledge at the same time [13].

Qualitative data was gathered from multiple sources, namely participant observation, project documents, project meetings, focus group discussions as well as interviews with applicants, students, administrators and faculty. Initial analysis of the data occurred alongside data gathering and project activities. Detailed theoretical analysis was based on concepts from ANT inscription and affordance theory. Emerging findings were evaluated through member checking [38–40] with the research participants.

5 Case Description

Up to 2009, the University of Ghana's graduate admission system was offline. In 2010, the physical application form was migrated online at the university's website. However, graduate applicants had to physically submit or post supporting documents to the university. In 2012, the action case team, led by the author, analysed the existing system and identified several problems.

Problems with the existing system: First-year graduate students, who had used the system to apply, complained of delays in completing and submitting the online forms due to slow internet connectivity and frequent downtimes. Some of them also questioned why their supporting documents could not be uploaded alongside the online form. Others also complained about the difficulty of getting three former lecturers to complete their academic reference forms. According to them, the process required physically chasing the lecturers in their offices to get them to complete the forms.

Among the students were past students of the university who complained about why they had to pay for and submit their transcripts to the same university. They wondered why the university could not use their academic records for the admission process. The administrators also complained about limited staff and the tedious process as follows,

> *we even have to print the online forms and together with the supporting documents sort and arrange them per applicant, per programme and per department. Sometimes due to work overload, we mismatch and lose some documents.*

There were instances when documents were wrongly dispatched to various departments. Selection committee members in the departments also complained about delays in getting application documents from the admission office and the excessive paperwork. Another problem with the existing system was the need for the admission office to write, sign and post individual offer letters to successful applicants. Given the huge numbers, the office found it a daunting task and wished that the process could be automated.

Developing the Digital Platform: After the problem diagnosis, the project team developed functional requirements for the digital platform, using PHP and MYSQL. The functionalities inscribed into the virtual application include a document upload service to enable applicants to complete the online forms and upload all supporting documents. Another functionality was past student records retrieval service to avoid the need for past students of the university to submit transcripts and certificates when applying.

Online referencing service was included to automatically request references from academic referees. The e-mail request included a link to an online reference form which the referees could complete and submit electronically. The system was also designed to ensure that admission committee members in various departments could access submitted application documents and related records of applications anytime anywhere, without the need for the admission office to dispatch paper documents to them. To address the problem of manual generation and physical posting of offer letters to applicants, the team embedded a functionality to e-mail successful candidates to download their offer letters.

Subsequently, the project team demonstrated the digital platform to deans of schools, heads of department and various user groups. Comments and feedback from the demonstration sessions were used to address potential challenges. The team also organized training sessions during which users' feedback on errors and inconsistencies were used to address inherent challenges. The newly developed application was launched on the university's web platform in January 2013.

Positive and negative feedbacks have been used to improve the system. The following positive feedback came from a student:

> *It was very exciting to do everything online and I did not need to go to campus to queue and submit documents or go to the post office to post photocopies.* However, the following negative feedback on getting academic references came from an admission officer: "*With the previous system, we always received reference reports together with the supporting documents. However, with the new system so many referees fail to send their reference reports.*

In relation to referencing, some academics complained of not knowing the students for whom they were to write references after receiving the automatic e-mail request.

6 Case Analysis

framework This section presents the analysis of the action case findings based on the ANT concept of inscription for functionalities embedded in the digital platform, affordance for their actualization and the relationship between the two theoretical concepts.

Functionality Inscription: The findings reveal document upload, online referencing, online selection and online admission as the virtual functionalities that the action case team got inscribed into the platform. Table 1 shows the functionalities, their target user groups and the intended solutions.

Table 1: Inscribed Functionalities

Functionalities	**Target Users**	**Solutions**
Document upload	• Applicants	• Enable applicants to upload supporting documents • Avoid printing and submission of physical documents
Online access to past students' records	• Past student applicants • Digital platform • Selection committee	• Enable past students to enter their previous ID numbers • Enable digital platform to use ID numbers to retrieve past student records • Enable selection committee access past student records online
Online referencing	• Applicants • Referees	• Get applicants to enter referees' e-mail addresses on the online application form • Get virtual admission platform to e-mail reference request to referees • Get referees to complete and submit online referencing form.
Online selection	• Selection committee • Admissions officer	• provide electronic access to the selection committee. • virtualize selection and admission of qualified applicants • enable applicants to receive SMS feedback to download admission letters
Online admission	• Admissions office • Application	• Enable admissions office to digitally review selected qualified applications • Enable admissions office to decide on admit or reject.

Each of the inscribed virtual functionalities was an intended solution to problems with the existing system.

Affordance Actualization: The use phase of the virtual admission platform revealed how the inscribed functionalities were converted into actual affordances or not. The upload functionality was actualized as an affordance for electronically attaching and submitting supporting documents with the completed online application form. This affordance was consistent with the intention for inscribing the functionality to enable applicants to avoid the need for posting or submitting physical documents.
Similarly, the functionality for past student ID entry was also actualized as an affordance for past students to supply their previous IDs to avoid the need to submit physical copies of their certificates and transcripts as before. However, the intention behind this affordance could not be realized without the digital platform playing the role of electronically retrieving the academic records from the students' database. Thus the affordance actualization for the Student ID entry could only serve as a trigger for records retrieval.

Conversely, actualizing the online referencing functionality as an affordance for virtual referencing was not straight forward. The applicants generally perceived the affordance and supplied the e-mail addresses. However, in some cases, the use of wrong e-mail addresses rendered the affordance unsuccessful. Even in situations where the e-mail addresses were correct, some referees did not actualize the affordance for online referencing due to difficulties in remembering some of the applicants, especially those who failed to contact the referees directly to agree.
The online admission functionality was actualized between the selection committees and the admission office. The committees actualized the online selection as an affordance to review and recommend applications for acceptance or rejection by the admission office without the need for paper documents. The functionality also afforded an opportunity for committee members to do the selection without the need for physical meetings in collocated offices as before. Similarly, the admissions office actualized the online admission functionality as an affordance for vetting and admitting or rejecting applications online without the need for physical documents.

Affordance Actualisation and Re-Inscription: In areas where the inscribed functionalities failed to become actualized affordances, the action case team initiated a re-inscription process to modify such functionalities to meet the needs of the various user groups. The two cases involving the re-inscription were online referencing and online admission communication. For the online referencing, it was realised that just getting applicants to enter e-mail addresses of referees for the system to send them links to complete the form was not enough. The functionality was therefore re-inscribed with a requirement for applicants to indicate that they had contacted the referees and had their consent before nominating them. In addition, additional data fields were added for applicants to provide their pictures and contact details to help referees remember the applicants and also contact them when necessary.

The second issue concerned the lack of tracking functionality for applicants to monitor the status and outcome of their applications. The virtual platform was subsequently re-inscribed with a tracking functionality for applicants to check the status of their application. Some applicants actualized the functionality as the affordance to

monitor referees' responses. Following the re-inscription, applicants had the opportunity to change referees. The tracking functionality also afforded the applicants the opportunity to have feedback on the outcome of their application. Successful applicants were therefore able to know about their admission and login to download their offer letters.

7 Discussion

In line with the research question, the findings for this study are discussed based on the problems with the previous physical admission system and the solutions from the new virtual system. Based on this, the discussion is centred around the virtualization of documents and person-to-person contact, reliability of internet connectivity, and mutual relationship between virtual functionality inscription and affordance actualization.

The findings show that an admission system virtualization in a university can afford opportunities to address problems of delays and errors that result from document misclassification and losses associated with physical admission processes. From the case, the shift from physical document environment to a digital platform with digital forms and electronic document exchange helped to reduce the errors, delays and misclassification associated with the existing physical system. Within the IS literature, reported benefits of digital virtualization include the removal of space and time constraints for geographically dispersed people [27], anytime anywhere access and flexible working arrangements [21, 42-43]. From this study, the new findings on the benefits of digital process virtualization are reduction in delays, misclassification errors and losses associated with physical document processes.

However, additional findings show that in situations where people need to know or remember others in order to perform an online action such as in the case of academic referencing, virtualization is not enough. Such situations require personal interactions to avoid mistrust, suspicion and false entity, which constitute key limitations in virtual interactions [21, 27]. Complementing virtual interaction with intermittent face to face contacts has been proposed as a solution to such situations [7-8]. The findings from this case show that virtual interaction reduces the willingness of people to provide references for others without additional functionality to remember or interact with them. This finding shows the need for digital platform developers to inscribe functionalities for online interaction in such situations.

Another finding from this study is that where people expect to know the status of activities, online tracking becomes an essential functionality for user affordance. From the case analysis, once the direct contact between applicants, referees and admission officers was removed, applicants needed a functionality to track the status of their application and references. Before the digital virtualization, physical contact between applicants, faculty, admission officers, and paper documents served that

purpose. However, with virtual submission and referencing, it became necessary to include online tracking functionalities for status monitoring.

On the relationship between virtual functionality inscription and affordance actualization, the findings reveal a mutual shaping between the two. As shown from the case, the inscribed functionalities served as the basis for affordance actualization while the affordance actualization served as the evaluation framework for feedback for the functionality re-inscription. The combined theoretical lens of inscription and affordances was found useful for explaining the emerging and changing nature of digital virtual functionalities.

8 Conclusion

This study began with the aim of understanding how digital process virtualization can be used to address problems with a physical admission system. The research findings show that the key problems applicants faced under the physical admission process were delays, frustrations in physical document submission, difficulty in getting physical access to lecturers to serve as referees and not getting feedback on time. The action case study approach used as the methodology shows that problems associated with physical processes can be addressed through an interactive process between virtual digital functionality inscription and affordance actualization. However, the findings also demonstrate the need for interpersonal communication functionalities and affordances where personal knowledge is needed such as in the case of providing references for people.

Based on the findings, the study contributes to bright ICT research in IS by focusing on how digital process virtualization can be used to address problems with physical processes in the under-researched area of higher education admission. For practice, the findings show that functionality inscription and affordance virtualization can be used as an evaluation framework for achieving intended goals of digital process virtualization. Future research can focus on the relationships between inscribed virtual functionalities, unintended affordances and socio-cultural dimensions of digital processes virtualization as bright ICT research in a developing country context.

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