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RESEARCH ARTICLE

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Digital Desire Paths: Exploring the Role of Computer Workarounds in Emergent Information Systems Design

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ABSTRACT

The information systems literature generally conceptualises information system (IS) workarounds as negative disturbances that need to be avoided. IS design literature has emphasised the need to incorporate user behaviour in emergent IS design. Surprisingly, information systems research has kept the literatures on workarounds and IS design separate and remains silent on how workaround behaviour can inform information system design. In this research, we explore six workarounds in two case organisations and analyse the connections between them. We develop the concept of digital desire paths to describe the process how information system designers improve the system design by observing how users use and work around the system. Digital desire paths offer a novel interpretation of workarounds as input for information systems design and thereby serve as instance of the principle of guided emergence in action design research.

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Workaround; digital desire paths; is design; case study; emergent IS design; guided emergence; action design research

1. Introduction

Information systems (IS) workarounds occur when users use the information system in a way that is not consistent with the designed use and official organisational processes or rules (Alter, 2014; Azad & King, 2008). Users work around IS for various reasons, e.g., when users believe that working around an information system allows them to complete work routines quicker or more effectively or to better attain individual or organisational goals (Azad & King, 2012; Kobayashi et al., 2005). Literature distinguishes two different types of workarounds: An ill-designed information system or a conflict between underlying organisational logics (Azad & King, 2012; Berente & Yoo, 2012; Debono et al., 2013; Ferneley & Sobreperez, 2006). While ill-designed systems workarounds can be resolved by eliminating system irregularities, in situations with conflicting organisational logics, users engage in decoupling or loosely coupling to cope with the underlying organisational logics conflict, which leads to manifested workaround as part of routine information system use (Azad & King, 2012; Kobayashi et al., 2005).

For instance, research on workarounds in ERP systems has found deviant user behaviour causing severe consequences, including loss of control and ineffective information systems (Berente & Yoo, 2012; Ignatiadis & Nandhakumar, 2009; Malaurent & Karanasios, 2019). In a different literature stream on information system design, similar concepts developed around the notion of emergent design, where research argues that user behaviour needs to be incorporated in IS design (Mullarkey et al., 2019; Venable et al., 2016). Action design research, for example, suggests a principle of *guided emergence*, where artefact building, organisational intervention, and evaluation are strongly integrated (Sein et al., 2011). Surprisingly, information systems research has kept these literatures separate and remains silent on how workaround behaviour can inform information system design.

In this research, we seek to close this research gap by understanding how workarounds inform information system design. We use a qualitative research design based on 28 interviews and observations in two cases. We examine different workarounds in each case and analyse the connection between them. In our analysis, the core category *digital desire paths* emerged to describe the process of information system designers improving the system design by observing how users use and work around the system. The category is inspired by the concept of desire paths in urban planning, architecture, and social science literature. Digital desire paths offer a novel interpretation of workarounds as input for information systems design. It thereby serves as instance of the principle of guided emergence in action design research and extends this concept beyond system functionality to organisational processes (Sein et al., 2011).

The remainder of this study unfolds as follows. First, we develop a theoretical framework that draws

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from the literature on workarounds and IS design. Second, we describe our methodological approach. Third, we analyse our two cases. Fourth, we discuss implications for literature and outline limitations.

2. Theoretical development

We describe the theoretical background for this study in two steps. First, we review the literature on emergent IS design to highlight the important role of emergent user behaviour in the design process. Second, we review the workaround literature to understand how users respond to IS design (Orlikowski, 2004). This literature focuses on the user, who is supposed to enact a prescribed information system design. Users work around the system, i.e., use the information system in a way that is not consistent with the designed use and official organisational processes or rules (Alter, 2014; Ejnefjäll & Ågerfalk, 2019). Building on those two literature streams, we outline the research gap of understanding the connection of workaround behaviour and emergent information systems design.

2.1. Emergent information systems design

Understanding what makes an effective information systems design is a central pillar of IS research. Such research has predominantly taken an engineering-oriented view focusing on designing and building innovative artefacts (Hevner & Chatterjee, 2010; Peffers et al., 2007). Design science research offers opportunities for IS research to go beyond description and explanation towards problem-solving and generating design knowledge for practitioners. It, however, does not recognise the socio-technical context in which design and artefact are shaped to its fullest potential (Aanestad, 2012; Markus & Keil, 1994). This gap is illustrated by the explicit or implicit separation of the building and evaluation phases, which focuses on comparing performance of the novel artefact to existing solutions rather than actual user behaviour (Hevner & Chatterjee, 2010; Iivari, 2003; March & Smith, 1995; Wiedemann et al., 2020). While recent research has suggested excellent tools to improve evaluation (Mullarkey et al., 2019; Venable et al., 2016), design science research is still said to keep these phases separate (Sein et al., 2011).

Other research streams have taken a broader perspective on information system design as socio-technical issue that accounts for the emergent nature of IS design (Table 1). Research following a phenomenological tradition has conceptualised design as emergent rather than ex-ante planned (Ciborra, 1997). The soft design science method, for example, emphasises the need to understand user requirements in the ideation phase as input for the building phase, the method also includes initial guidance on understanding user needs and evaluation of the artefact as well (Baskerville et al., 2009). This approach focuses on domain knowledge as ex-ante input for design (Pries-Heje et al., 2014).

Other research highlighted the evolution of artefacts over time and in use (Iivari, 2003). Social constructivist research suggests that successful IS design requires tailoring the system to the individual use context (Holeman & Barrett, 2017; Orlikowski, 2004). Using individual, contextualised technological frames of technologies help users make sense of the IS design (Orlikowski & Gash, 1994). As different users may have different theoretical frames, congruence or incongruence may emerge. Incongruence will lead to resistance, where users do not use the information systems. Therefore, IS designers need to engage with users to incorporate their views in the emergent design (Orlikowski, 2004).

Participatory design as an approach to user-centred design has been developed to better involve users in systems development to improve systems design (Iivari et al., 2010). The approach equalises power relations between designers and users, allows to develop local solutions by providing situation-based actions, and fosters mutual learning between designers and users (Bannon & Ehn, 2012). It thereby offers organisational and technical approaches to better involve users in the development process.

Action design research takes these thoughts even further and offers an approach to bridge the previously separated build and evaluation phases (Sein et al.,

Table 1. The importance of emergent user behaviour in information systems design.

Tradition	Understanding	Illustrative reference
Phenomenology	The concept of *cultivation* serves as metaphor to describe information systems being grown and nurtured rather than fully engineering or planned. Successfully designing information systems requires care (German "Sorge"), the goal to avoid deviance and conflict.	(Beverungen, 2014; Ciborra, 1997; Dahlbom et al., 2000)
Social constructivism	The concept of *enactment* describes the designer's engagement with users who will be left with the artifact and interact with it regularly. These users use technological frames to make sense of the system.	(Holeman & Barrett, 2017; Orlikowski, 2004; Orlikowski & Gash, 1994)
User-centered design	The concept of *participatory design* seeks to involve users in system development by giving them design choices of the system they will be using.	(Bannon & Ehn, 2012; Iivari et al., 2010)
Action research	The concept of *emergent design* builds on the observation that many information system design features are not a priori designed, but emerge from user behavior. The action design principle of *guided emergence* suggests that the designed artifact is continuously shaped by organizational use, perspectives, and participants.	(Baskerville et al., 2009; Iivari, 2003; Pries-Heje et al., 2014; Sein et al., 2011)

2011). The authors build on the concept of emergence of design artefacts at the intersection of IT and organisation and stress the inseparability of the building, intervention and evaluation steps when designing information systems (Sein et al., 2011). Information systems designer create preliminary artefacts which then are shaped by organisational users. Thereby, various forms of organisational context are inscribed into the artefact during building, intervention and evaluation (Sein et al., 2011).

Overall, these different research streams stress the close relationship between designing systems and using systems. They underline the importance to understanding the interplay between design and use, where the former does not only guide the latter, but the latter informs the former as well.

2.2. Workarounds as reaction to information systems design

Workaround behaviour is caused by two different situational conditions: (1) When the system is inappropriately designed so users are not able to accomplish their goals, which we refer to in the following as ill-designed system workarounds (IDSWA) (Azad & King, 2008; Debono et al., 2013; Ferneley & Sobreperez, 2006; Röder et al., 2016). The other situational condition (2) is when the system embodies an organisational rule that is in conflict with another organisational rule related to the business process, which we refer to as conflicting-logic workarounds (CLWA) (Azad & King, 2012; Berente & Yoo, 2012; Röder et al., 2016).

Studies of IDSWA conceptualise workarounds as reaction to ill-designed information systems and thus imply that the workaround can be resolved by improving the information system design. Examples include a global enterprise system that is worked around in culturally different subsidiaries with differing local process, norms and values (Malaurent & Karanasios, 2019). Similarly, studies in health care settings describe ill-designed information systems due to flexibility requirements of the health care domain (Beerepoot & van de Weerd, 2018; Debono et al., 2013; Kobayashi et al., 2005; Yang et al., 2012). Such workarounds can be resolved by improving system design (Kobayashi et al., 2005; Malaurent & Karanasios, 2019).

Studies of CLWA draw a more complex picture of the root-cause of the IS workaround and the implications for IS system design (Ejnefjäll & Ågerfalk, 2019). They assume that the information system implements an organisational rule that is in conflict with another rule related to this business process. Studies report on conflicting organisational logics between formal transparency and informal discretion in taxation or approval of medication and thrust to patient safety in a hospital environment (Azad & King, 2012). Similarly, conflicting organisational rules exist in enterprise social network adoption (Choudrie & Zamani, 2016) and enterprise information system implementation (Berente & Yoo, 2012). CLWA studies suggest that the workaround manifests in the information system, because the system embeds two conflicting organisational logics (Berente & Yoo, 2012).

Consequently, CLWA studies focus on the consequences of workaround behaviour, relaxing the implicit assumption that workarounds will be resolved after system re-design. Building on institutional theory, these studies suggest that actual systems use is decoupled or loosely coupled from the intended system design (Azad & King, 2012; Berente & Yoo, 2012). They provide accounts of how users react to information systems that embed underlying organisational rule conflicts (Fries et al., 2016; Röder, Wiesche, Schermann, & Krcmar, 2014). However, their description of loose coupled and decoupled systems remains silent on the designers' reaction towards this workaround behaviour.

Other CLWA literature suggests that workaround mitigation measures may only be effective for a limited period of time as users will find other ways to circumvent information systems, which leaves us with speculation on the process how the workaround is emerging as an interaction of designer and user around the system (Miller & Wedell-Wedellsborg, 2013; Patterson et al., 2002). Especially in situations, where the underlying rule conflict was not resolved, it is likely that the user seeks alternative ways to circumvent the improved information system (Azad & King, 2012).

Taken together, the two literatures on IS design and workarounds suggest a complex interplay between building information systems and using information systems to attain individual or organisational goals. On the one hand, workarounds may serve as useful source of emergent information systems design (Iivari, 2003; Orlikowski, 2004; Röder, Wiesche, & Schermann, 2014; Sein et al., 2011). On the other hand, understanding emergence and potentially conflicting logics in information systems design may shed light on conflicting empirical evidence on success and failure in resolving workarounds (Alter, 2014; Ejnefjäll & Ågerfalk, 2019; Ferneley & Sobreperez, 2006; Malaurent & Karanasios, 2019; Röder, Wiesche, Schermann, & Krcmar, 2014). It is this connection of workaround behaviour and emergent information systems design that we investigate in this study.

3. Method

We followed a qualitative research approach to investigate how workarounds inform information system

design (Miles & Huberman, 1994). Specifically, we examined six workarounds in two cases and their interplay. This research design is particularly suited to explore complex and rich empirical phenomena (Gioia et al., 2013). We find it particularly helpful in exploring workarounds, which are highly sensitive when discussed with management or from a regulatory context.

3.1. Case selection and data collection

We engaged with different organisations to identify a broad set of workarounds to study. We selected our cases based on three characteristics: 1) type of workaround, 2) similarities in workaround context, and 3) differences in organisational context. We chose conflicting-logic workarounds as type of workarounds as we sought to explore the implications of workarounds on IS design. We selected case organisations from different industries, both known for their occurrence of workaround, but differing in organisational characteristics such as organisational logics. Finally, we sampled IT security workarounds in both organisations to ensure comparability of the cases.

This research uses data obtained via two case studies; one in the health care domain, the other in an industrial research and development setting (See Table 2 for an overview). The first case study at ALPHA, a medium-sized hospital, presents a particularly suitable starting-point for our investigation, as the health care domain is predominantly studied in research on IS-mediated conflicting-logic workarounds (Azad & King, 2008). In ALPHA, medical professionals were violating data privacy policies to transfer electronic health records to private computing equipment and to share patient information with other medical professionals. The second case study at BETA, an automotive manufacturer, allows us to investigate workarounds in an industrial research and development setting. In BETA, the engineers frequently violated access control procedures put in place by BETA to safeguard intellectual property. The authors had repeated interactions with both ALPHA and BETA which ensured sufficient levels of trust to observe and discuss workaround behaviour.

We conducted interviews and audio-recorded and transcribed these. Field notes of observations and presentations of work routines were documented in memos and shared within the research team. In total, we conducted 28 interviews across both cases. We adapted a snowballing approach to identify interview partners. In the interviews, we focused on understanding patient privacy at ALPHA and IT-supported innovation processes at BETA. In both cases, the workarounds were not at the centre of our questions asked in the interviews as we see workarounds as sensitive topics. With the broad topics of privacy and IT-supported innovation at the core of the interviews, we could ask about information systems and workarounds as a side product. We asked broad questions about company rules, guidelines, and procedures related to information system usage and difficulties and adaptations in the past (see Appendix A for the initial list of questions asked to users). Nonetheless, we focused our analysis around individuals that experienced or practiced similar workaroundsfor example, we interviewed the IT security representative at ALPHA and the people responsible for hardware support at BETA. Initially, we developed a broad understanding of a variety of information systems that were circumvented, but identified three workarounds that shared similar characteristics for each case (see Figure 2,3).

At BETA, we realised that interviewees were not comfortable to speak about workarounds “on the record”. When the audio recorder was turned off, users reported rich stories of workaround behaviour. Thus, we complemented the interviews with observations and presentations of work routines at BETA, which is common in workaround research (Alter, 2014; Safadi & Faraj, 2010). Subsequently, field notes became central in documenting workarounds (Miles & Huberman, 1994).

3.2. Data analysis

We coded the data to systematically understand the interplay between workaround and information

Table 2. Case overview.

Case	ALPHA	BETA
Domain	Healthcare	Research and Development
Work routines	Administration of electronic patient records	Requirement engineering and design of automotive services
Information system	Hospital information system	Engineering workstations
Manifestation of workarounds	Medical professionals transfer patient records to private computing equipment.	Engineers share credentials as a means of sharing access to documents.
Interviews	10	18
Sample	Users: Junior (5) and senior (3) physicians Designers: security specialist (1), IT director (1)	Users: Engineer (5), sales and marketing (4) Designers: process owner (8), IT architect (1)

system design. First, we applied open coding techniques and focused on descriptive coding and process coding (Miles & Huberman, 1994). In descriptive coding, we summarised the workarounds we identified: "transfer EHR to USB", "send EHR via E-mail", "use VIP flag to mark sensitive EHR" for case ALPHA (see table A2 in Appendix B) and "do not log out of work station", "claim new ID card to stay logged in", and "break ID card to stay logged in" in case BETA (see table 3 in Appendix B). We used process coding to identify "conceptual action in the data" (Miles & Huberman, 1994), i.e., how workarounds occurred and how they influenced information systems design. It was in this phase of the analysis that a connection between the individual workarounds emerged, which ultimately led to the digital desire paths concept.

In the second coding cycle, we focused on developing patterns in the codes (Miles & Huberman, 1994). We purposefully focused to identify similarities and differences among the many codes we identified (Gioia et al., 2013). Similarities included shared causes of different workarounds and differences included designers' reactions to workarounds, i.e., accommodation in ALPHA and rejection in BETA. From this difference in reaction, *digital desire paths* emerged as core category to describe how workarounds affect emergent system design. We found that information systems designers used workaround information to adapt the system design.

We applied axial coding by focusing on those codes that relate to our core concept, the concept of digital desire paths (Glaser, 1978). We substantiated the emergent categories by developing a full understanding of each of the six workarounds (summarised in tables A2 and 3 in Appendix B). Here, we used the 6 C coding paradigm recommended by Glaser (1978) as it is particularly suitable to study actions intertwined with the dynamics of time. We coded details on context, cause, contingencies, conditions and consequences, which helped us structure our understanding of how digital desire paths develop as back and forth between users working around and the designer changing the system.

While this description suggests a linear process, we adhere to the grounded theory practice of an highly iterative approach (Gioia et al., 2013; Glaser, 1978; Wiesche et al., 2017). The first and second-level concepts we developed are documented in the data structure in Figure 1 (Gioia et al., 2013).

4. Results

We present the results in two steps. First, we document the digital desire paths observed at ALPHA and BETA, a concept that describes the connection between individual workarounds and corresponding information system design reaction. In each case, we focus on three workarounds, which in the case of ALPHA led to a workaround-incorporated design that yielded a stable information system with no further workarounds. In the case of BETA, information systems designers

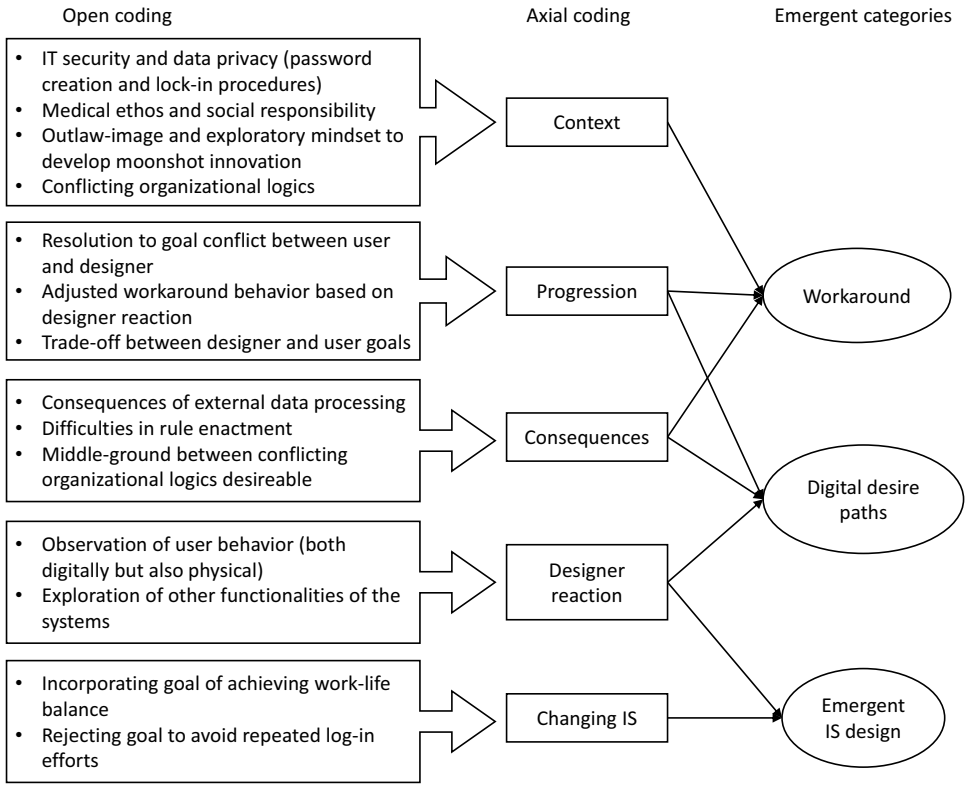

Figure 1. Data structure.

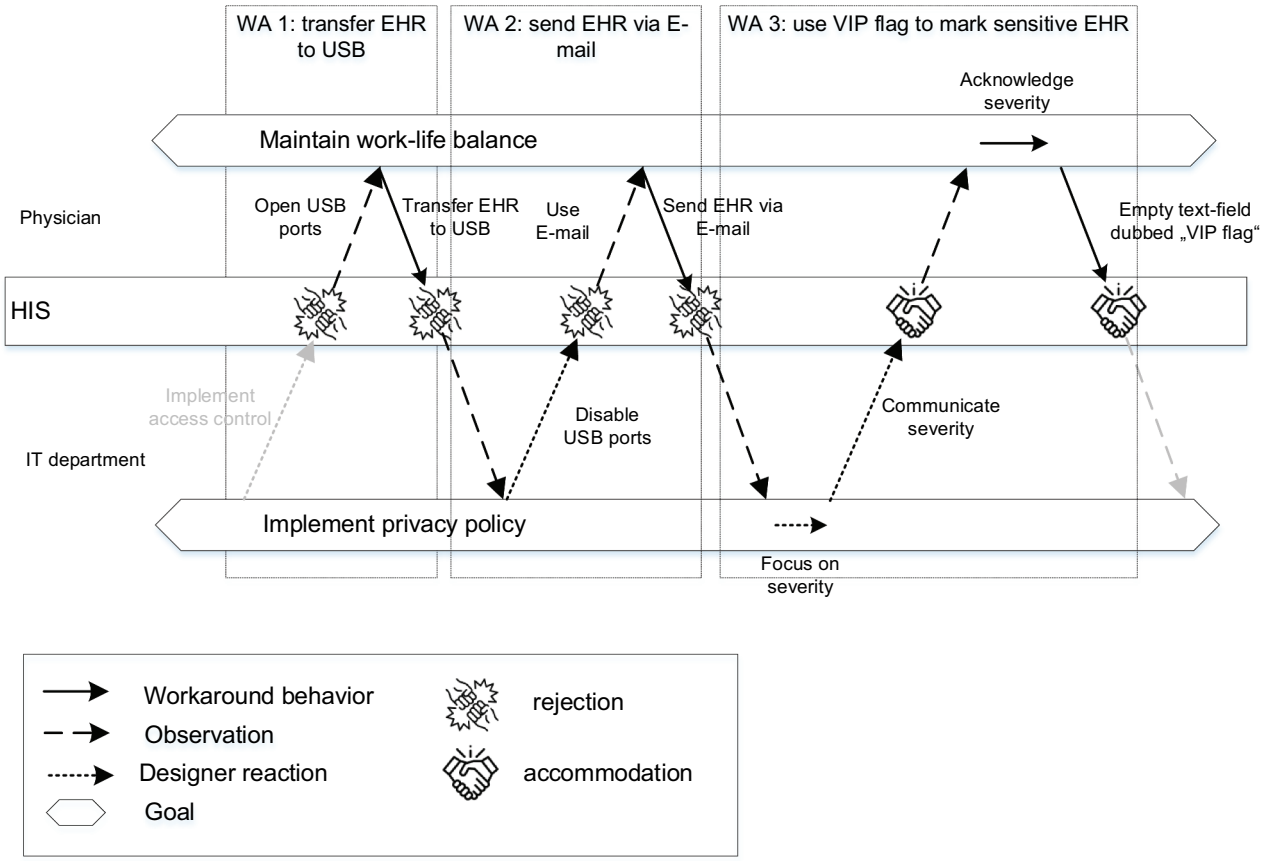

Figure 2. Digital desire path in the health care case ALPHA.

rejected information system improvements suggested by user workarounds, leading to an instable information system with workarounds persisting. In a second step, we describe the results of our cross-case analysis that revealed differences between both digital desire paths. In the case of ALPHA, a pluralistic context led to information systems designers incorporating workarounds in the emergent system design. In the case of BETA, a hierarchical context led to information systems designers rejecting workarounds in the emergent system design.

The core category of this research are *digital desire paths*, which conceptualise workarounds as evolutionary part of information system design. Information system designers observe how users use and work around an information system to alter system design. Similar to architects observing physical tracks in grassy spaces (Helbing et al., 1997; Nichols, 2014), information systems designers observe users' IS workaround behaviour to understand potential rule conflicts that crop out in working around the information system that implements this rule. Depending on the organisational context, information systems either incorporate or reject workarounds in the emergent information system design.

4.1. ALPHA: incorporating digital desire paths into information system design

The case of ALPHA illustrates a digital desire path with three information system designs that resulted in workaround behaviour and a fourth design that did not yield further workaround behaviour. We found that information system designers respond to workaround behaviour by incorporation parts of the workarounds in the emergent system design (Figure 2).

All workarounds manifest trough the interactions between physicians and the hospital information system (HIS). Physicians should use the HIS to create, update, and process patient's electronic health records (EHR) on the medical status of patients. The hospital has privacy policies that explicitly prohibit the extraction of EHR from the HIS. In fact, the HIS is the only information system designated to store and process EHR. However, despite being aware of such policies, we observed that physicians share EHR with colleagues outside of ALPHA and copy EHR from the HIS to private devices. ALPHA's IT organisation as the designer are aware of these workarounds and have adapted the HIS several times to eliminate the undesired behaviour of data sharing. One designer described:

„I think it is common knowledge and actual practice that you find ways of taking your patient's files home to work while being with your family".

We find physicians to work around the privacy policy to adjust their work–life balance. Physicians copy EHR to personal USB devices to take the data home and work on it from their personal computers. During the day, they feel that they do not have the time to document their interactions with patients. Thus, they complete the documentation after hours at home. On the next work day, they copy the EHR back to the HIS. Physicians reported that this workaround allows them to be with their families and thus allows them to maintain a work-life-balance:

„these hospital workstations force me to document diagnosis here on site. So I don't see my family at all anymore".

Naturally, ALPHA's IT organisation highlights the risk of loss of confidentiality and system integrity. The IT organisation has no means to ensure adequate levels of security on physicians' personal computers. Furthermore, USB devices can be misplaced, overwritten, or even lost.

With the goal of maintaining work-life-balance, physicians realised that the HIS allows them to download EHR on private USB devices. Although the physicians are aware that actually downloading EHR would violate the intended user behaviour, the ubiquitous availability and ease-of-use of USB devices enables them to institutionalise the workaround.

The IT organisation at ALPHA was aware of this behaviour and in an attempt to eliminate the workaround, disabled the USB ports on HIS workstations and implemented a formal process of re-opening them. Taken in isolation, this adaptation to the information system design effectively constrained the behaviour of physicians, but is also substantially affected the physicians' goal of maintaining work-life-balance. One official described:

> *When somebody wants their USB port to be opened, they have to sign a form with [the IT department] that they take the risk [. . . of] data breaches, data loss and other security at ALPHA on their own.*

Thus, the physicians established another workaround. Instead of USB devices, they began to use E-mail to transfer EHR to personal computers. This way, they could work on EHR from home again. While the physicians were aware of the increased risk of using E-mail to copy EHR, they felt that working on the EHR from home would reconcile the goal of providing excellent patient service and maintaining a work–life balance. Interestingly, this workaround posed a significant challenge to the IT organisation. E-mail was critical to internal and external communication channels, so simply blocking E-mail similar to disabling USB ports, would not be an option. Furthermore, physicians typically use their individual E-mail accounts for research purposes. Thus, filtering E-mails was also not an option.

> *So they changed the system so data cannot be stored on a USB drive anymore [. . .] I could – theoretically speaking – of course send the data via E-mail. Easily.*
>
> *I just open the E-mail client, copy the patient data into this E-mail and send them somewhere. And on the way back, I copy the new text into the EHR on the work station.*

The IT organisation realised that closing every communication channel would result in an essentially unusable HIS. Furthermore, physicians justified their workarounds as essential to meet the two seemingly opposing goals of the goal of providing excellent patient service and maintaining a work–life balance. Instead, the IT organisation implicitly accepted the appropriation of a checkbox in the HIS to help physicians to assess the risks of sharing EHR. The checkbox was dubbed "VIP flag" and signified if the EHR contains particularly sensitive information or was about a patient of public interest. Physicians would refrain from copying EHR marked with a VIP flag, which significantly reduced the risk of the user behaviour:

> *See, here, you can mark a patient as "VIP" that means, you don't see who it is. And these files stay here in the hospital. That is a quasi-agreement amongst doctors.*

By acknowledging the VIP flag, information system designers incorporated workarounds into the emergent system design to improve the overall situation. Rather than implementing a system that was worked around by users, they found a way to meet the underlying goal behind the physician's work around behaviour: By marking the VIP flag, physicians informed their colleagues that this patient record contains sensitive information and should be prioritised and processed in the HIS. EHR that were not marked could still be processed at home. While the IT organisation continued stressing the risks and downturns of privacy breaches, the new system design reduced this risk significantly. Hence, compared with the previous workarounds, this was considered acceptable from both users and designers alike.

4.4. BETA: information systems designers rejecting digital desire paths

In the case of BETA, the digital desire path included three different information system designs that each led to different workarounds. We found that information system designers rejected design recommendations suggested by the workarounds, which led to persisting workarounds (Figure 3).

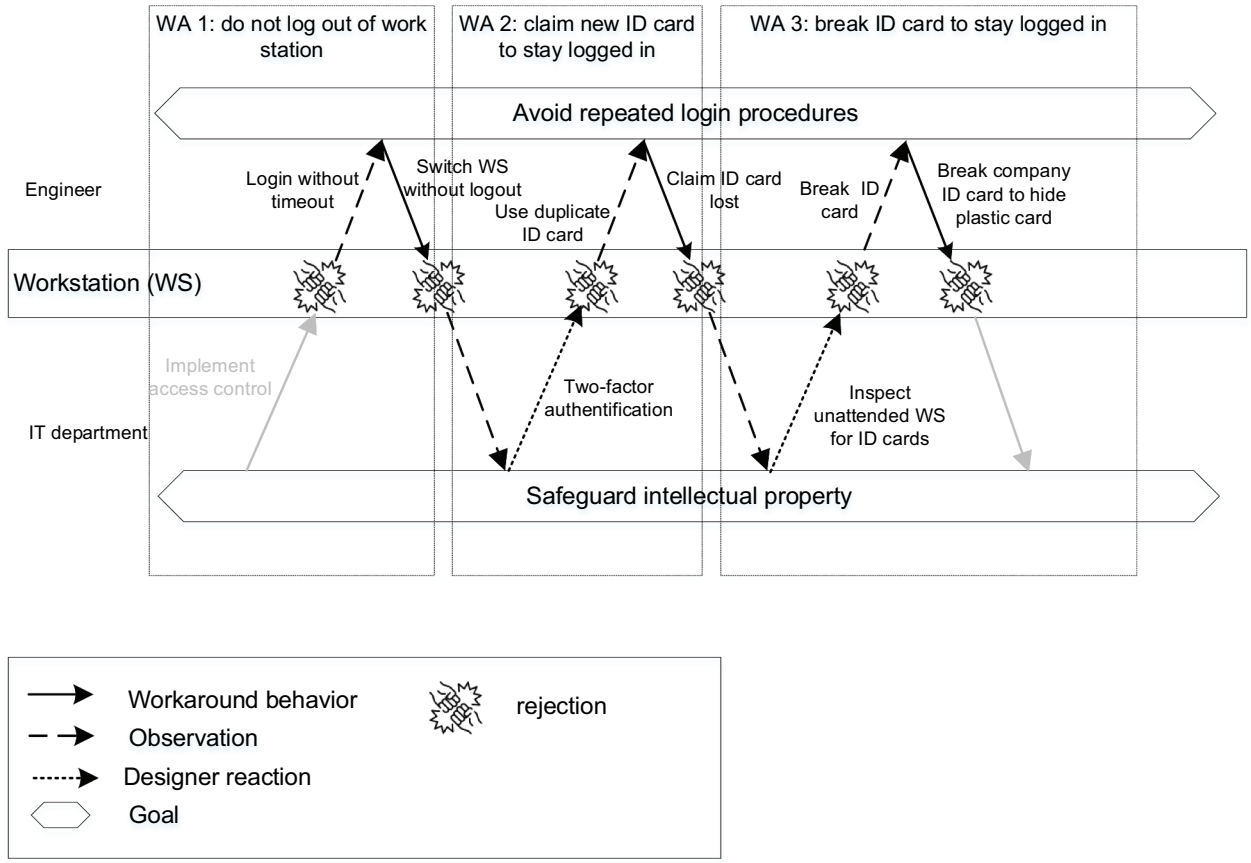

Figure 3. Digital desire path in the engineering case BETA.

The engineers at BETA were tasked with simultaneously developing novel and potentially groundbreaking products and services, providing maintenance support, and implementing minor improvements to existing products and services. Different activities required different workstations, which were secured to safeguard intellectual property. This resulted in frequent login and logout sequences, which were perceived as cumbersome by the engineers. Over time, the engineers at BETA implemented three workarounds (See Appendix B).

The first workaround we identified was that engineers left their workstations unlocked while they were in meetings, had a quick conversation with a colleague, or went on breaks. Providing user-name and passwords based on company-guidelines several times a day was considered cumbersome and unnecessary. Thus, they simply logged in in the morning and logged out at the end of the day. The IT organisation became aware of this behaviour. Potentially critical intellectual property was unsecured, open to unrestricted access or manipulation.

In our field notes we documented a situation during our visits to BETA, when an engineer was confronted with security issues by a member of the IT department. As response to this admonishment, the engineer promised adhering to security guidelines in the future. In an informal discussion afterwards, the engineer described the colleague as nagging and cumbersome.

As this was a company-wide phenomenon, the IT organisation implemented a two-factor authentication process to ensure that engineers have to logout when they leave a workstation. In addition to the password, engineers had to insert a company ID card into the workstation. This company ID card was used for other purposes such as printing, buying meals in the cafeteria, and for physical access control. Thus, the IT organisation at BETA assumed that this would enforce the intended behaviour.

Quickly, the engineers realised that a company ID card that was claimed lost or broken, would still work for an extended timeframe as the second factor during the authentication process. Because the company ID card was a multi-use card, the IT organisation faced substantial challenges to manage the deactivation of the card in the various subsystems. Thus, obtaining a replacement card would allow them to circumvent the two-factor authentication process. The engineers would claim a card as lost and leave it in the workstation.

As an intermediate solution, employees of the IT organisation would inspect the various departments and confiscate company ID cards that were left in unattended workstations. The engineers noted on the confiscated cards were summoned by the IT

organisation and the engineers had to explain their behaviour. Although this was an effective deterrent for the majority of engineers, some of them, in particular, engineers who had to frequently switch workstations because they have roles in different department, were still circumventing the two-factor authentication process.

In our field notes we documented a situation when returning to BETA and working with the above mentioned engineer again. We observed that there was no ID card in the workstation. When asked whether this issue was resolved, the engineer smiled and closely pointed toward the ID card slot. He explained that together with some colleagues, they found a way to resolve the ID card issue for good and for all.

The engineers would simply break or cut the card so that it would be hardly visible during an inspection. Members of the IT organisation would glance at a workstation and visually check whether a company ID card was still inserted. Breaking the card made it almost impossible for members of the IT organisation to detect unlocked workstations. As such, the engineers increased the effort required to detect unlocked workstations and thus reduce the risk of getting caught.

In the case of BETA, the emergent information system design rejected the system improvement as suggested by the workarounds. In the digital desire path, information system designers continued implementing authentication mechanisms that required high authentication time for users. As a consequence, the authentication workarounds became persistent.

4.5. Cross-Case Analysis: the concept of digital desire paths

Our cross-case analysis revealed similarities and differences between the digital desire paths at ALPHA and BETA. In both cases, conflicting designer and user goals embedded in the information system design caused the workaround behaviour. Both cases are related to IT security and data protection, a part of organisational design that is known for hampering individual user' productivity (D'Arcy & Herath, 2011). Information systems designers in both cases observed users' workaround behaviour to alter the emergent information system design. Thereby, workarounds become integral part of the information systems design. Designers put out information systems for users to evaluate the solution in real-world settings. By passively observing workarounds, designers can both observe conflict with the underlying rule as well as specific practices on how the systems are worked around. They can either use the workaround processes as templates in the system design or learn from workarounds to develop new processes and system features that meet users' goals.

The two cases differ in the type of digital desire path that occurred. In the case of ALPHA, the digital desire path was successful, as consensus about the information system design emerged when information system designers either started incorporating workarounds in the emergent system design or supplanted the workarounds. The example of ALPHA shows that designers can embrace user needs in the system by carefully analysing workaround behaviour and the digital desire paths may eventually end in accommodation: Designers use the workaround information to design a system that can be seen as consensus on effective user behaviour.

In the digital desire path, physicians imbricated the goal of maintaining work-life balancing and began downloading EHR to private USB devices. One physician explained the underlying reason:

> *You should be allowed to take work home. So many colleagues exceed their working hours, just to write patients reports or other details for further treatment.*

As a response, the IT organisation as the designer adapts the information system by disabling the USB ports. While this response eliminates the ability to download patient data, physicians identified the possibility to circumvent the EHR using E-mail. As such, the elimination of the possibility to download EHR data increased the likelihood of other forms of working around the system. Furthermore, this also restricted the ability of the designer to respond. Sending E-mails is relevant for other tasks beyond entering patient data in the EHR, most of which are part of the intended user behaviour. Adapting the design to forbid E-mail communication would have significant detrimental impact on the intended user behaviour. One designer described why they sought to implement the users' preference in the emergent design:

„So I ask them, "was that you, copying files from your computer last Friday at 10:30pm?" Of course, I can file an official report, but I kind of understand their motives. So we sit back at [the IT department] and try to think of a solution that is working both for them and for us".

Instead of suppressing the workaround again, the designer did not intervene when the physician adapted a field in the system, the VIP flag, to communicate varying degrees of sensitivity associated with EHR. The result was accommodation, i.e., a compromise that satisfies both underlying goals. On the one hand, the physicians were still able to take EHR home, which was still a violation to privacy policy. On the other hand, the risk of significant consequences was reduced because physicians opted to work on sensitive EHR in the hospital and refrained from taking them home.

In the case of BETA, information system designers failed to include the workaround into the emergent

information system design, which led to persistence of workarounds. The example of BETA illustrates that information system designers do not embrace workarounds in the system design but suppress workaround behaviour. Here, the digital desire path ends in users continuing to reject the system. Users continued to attain their goals and find creative ways to work around the system.

In the digital desire path at BETA, information system designers respond to engineers' behaviour to leave workstations unlocked during the day by implementing two-factor authentication. Engineers work around this new design by reporting company ID cards as broken or lost. As the designer is not able to deactivate these cards, she opts to inspect the offices and collects duplicate company ID cards used to keep workstations unlocked. Although the requirement to explain oneself to the IT organisations had a deterrent effect, some engineers started breaking cards, so they could not be seen when sticking in an unattended workstation. This behaviour significantly increased the effort during inspection.

The digital desire path at BETA ends in a different final state as at ALPHA, rejection. BETA's designers changed the information systems several times to eliminate the original workaround, only to realise that the users rejected the emergent design and found a new workaround around the system. For instance, the fact that the company ID card was still operational when reported lost or broken was because of a heterogeneous use of this card. Furthermore, eliminating the possibility to break the card would have required the designer to switch the type of two-factor authentication.

Understanding why designers in ALPHA succeeded in the digital desire path by understanding the underlying needs that cause the workaround and negotiate a middle ground and designers at BETA failed to do so points to different antecedent conditions in both cases. While on the system level, the digital desire paths are similar as workarounds occur when implementing IT security and data protection measures in workstations for daily use, the two cases differ on the process level. In the case of ALPHA, information system designers understand the conflicting logics embedded in the system and design a possible middle ground. In the case of BETA, designers fail to respond to the workarounds' underlying motivation in the emergent system design, which led to persistent workaround behaviour.

Both cases differ in the organisational context. ALPHA, a hospital, is considered a pluralistic context where multiple, potentially conflicting organisational logics, high levels of individual autonomy, and diffuse power structures exist (Denis et al., 2007). We find that in such situations, information system designers are sensitive to different goals, caused by conflicting organisational logics. This sensitivity lead to successful digital desire path, when information systems designers implemented a middle-ground in the emergent information system design to address the underlying goals that caused the workaround behaviour. On the contrary, BETA is a hierarchical context that follows a coercive, bureaucratic logic (Adler & Borys, 1996). Here, formalisation such as written rules and procedure are used to ensure compliance and reduce variance. We find that in such situations, information system designers use workaround information in digital desire paths to refine process controls. BETA implemented three different authentication mechanisms without accounting for the users' constant need to change work stations. Here, the emergent information system design did not include workaround elements and led to persistent workarounds.

5. Discussion

This research examined two cases of digital desire paths. In one case, designers started to incorporate the workarounds in the emergent design and designer and user accommodated each other. In the other case, the designer supplanted the workarounds leading to a rejection of the emergent design. This research offers a novel lens on workarounds, as input for information systems design. Our concept of digital desire paths contribute to information systems design literature, action design research, and architecture literature on desire paths.

5.1. Workarounds as vehicle to improve information system design

The concept of digital desire paths offers a novel perspective on the purpose of workarounds. Our results show that workaround can help in developing more usable information systems. First, information system designers can observe system user behaviour to better understand the underlying reasons why users work around a system as in the case of BETA, where the ongoing discussion around access control explains users breaking ID cards. Second, observing workarounds can yield potential solutions as well (Nichols, 2014). In the case of ALPHA, the accommodation of using the VIP flag was developed by users. By exploring workarounds for redesigning information systems, information system designers can design systems that are better aligned with organisational context and usage behaviour (Ferneley & Sobreperez, 2006). In addition to mitigating (Azad & King, 2012; Ignatiadis & Nandhakumar, 2009) and accepting workaround behaviour (Berente & Yoo, 2012; Debono et al., 2013), digital desire paths show a third purpose of workarounds: improving emergent information system design.

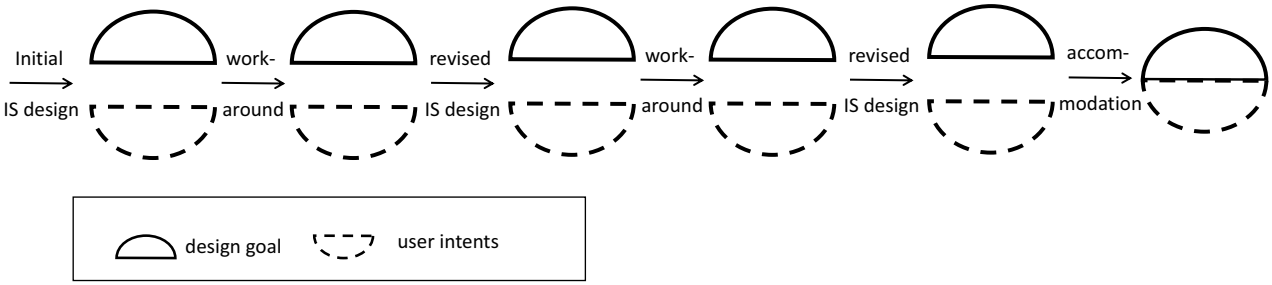

Figure 4. Concept of digital desire paths.

Digital desire paths provide an explanation of why using workaround behaviour as input for information system design increases information systems acceptance and usage (Figure 4). After putting out an initial information systems design, designers can observe usage behaviour including workarounds. Iteratively observing workarounds and revising the IS design as part of digital desire paths helps designers understand and resolve the underlying goal conflict. Thereby, information system designers take the position that finding a middle-ground in information systems design outweighs coercing compliance. A middle-ground design leads to loosely coupled processes whereas coercion will lead to more workarounds and ultimately decoupled processes (Azad & King, 2012; Berente & Yoo, 2012). Thus, workarounds can be seen as stepping stones towards usable system design.

Our data reveal two different strategies for designers to respond to workarounds in their emergent system design. In hierarchical contexts, designers seek to suppress workarounds by enforcing the underlying organisational rule. If designers do not have high degrees of control for the process, this will result in instable information systems designs with persistent workarounds. Various examples in literature and our cases illustrate users' creativity and resourcefulness in their attempts to circumvent the system again (Kohlstedt, 2016; Nichols, 2014; Rogers, 2019). In pluralistic organisations, designers accommodate users' preferences with incorporating workaround behaviour in the emergent information system design. When designers understand the underlying reason of users working around the system, they can change the design to better meet user needs. Our data illustrates that users will be willing to make concessions until a loosely coupled truce emerges (Azad & King, 2008).

Our findings offer a novel way to handle conflicting-logic workarounds. Extant research has shown that altering the system design resolves workarounds that are caused by ill-designed systems (Boudreau & Robey, 2005; Ferneley & Sobreperez, 2006; Yang et al., 2012). For conflicting-logic workarounds, however, the system is only the embodiment of the conflicting organisational logics and thus changing the system will not automatically resolve the underlying rule conflict (Azad & King, 2012; Berente & Yoo, 2012). In our digital desire paths, the designer carefully observe the user's behaviour to identify the underlying goal conflict and then change the information system design to account for this knowledge. Our concept of digital desire paths describes this complex process that can involve several rounds of system design and workaround behaviour.

5.2. Action design research via emergence of computer workarounds

The concept of digital desire paths contributes to the literatures on action design research and design science research (Peffers et al., 2007; Sein et al., 2011). Incorporating workarounds in information systems design can be seen as an instance of guided emergence (Sein et al., 2011). It thereby offers a new entry point in information systems design processes (Ågerfalk, 2019; Mullarkey et al., 2019). As designers "should (a) consciously guide the design of the artifact, and at the same time, (b) allow the artifact to emerge via influences from the organizational participants" (Holeman & Barrett, 2017), digital desire paths offer them a tool to observe and incorporate workarounds as part of the emergent design. The case of ALPHA illustrates that workarounds can be an integral part of guided system emergent design.

The functionality view in the literature on emergent system design captures user behaviour caused by ill-designed systems (Hevner & Chatterjee, 2010; Iivari, 2003). More recent work has suggested continuous evaluation at different stages of the development process to better capture ill-designed system elements (Mullarkey et al., 2019; Venable et al., 2016). Similarly, agile methodologies ground in the assumption that user input is a critical source of knowledge for the initial development of information systems. Features and components are being developed in tight interaction with users in an attempt to overcome ill-designed systems (Cao et al., 2009; Fitzgerald et al., 2006; Przybilla et al., 2018). However, users of systems

that embed conflicting organisational goals do raise issues for improvement for system designers (Berente & Yoo, 2012).

Existing research on emergent system design explicitly or implicitly focus on functionality, usability and meeting defined requirements (Baskerville et al., 2009; Holeman & Barrett, 2017). But, as illustrated in our two cases, users might also work around systems because of a conflict with the underlying rule. Rather than using user feedback tools to improve system functionality (Mullarkey et al., 2019; Venable et al., 2016), designers need to learn about the underlying goal conflict and experiment with potential improvements. Following the digital desire path may serve as a useful tool to observe user behaviour and derive emergent system improvements.

Our cross-case analysis revealed contextual conditions, under which workarounds can be successfully integrated in emergent information system design. In more pluralistic organisations, digital desire paths are more likely to succeed in designing systems that are accepted and followed by users (Denis et al., 2007). In rather hierarchical context, workarounds are rejected in the emergent information system design and will lead to persistent workarounds (Adler & Borys, 1996). Rejecting workarounds in emergent system design might result in a workaround culture, where workarounds are seen as legitimate and the only way to get work done (Debono et al., 2013).

Seeing digital desire paths as steppingstones for emergent information system design broadens the view on design research in the information systems discipline. This idea aligns well with the close integrating of artefact building, organisational intervention, and evaluation as proposed by action design research (Sein et al., 2011). Observations of unanticipated workaround behaviour serve as signals for the information system designer to adapt the system design as well as the accompanying organisational processes.

5.3. Digital desire paths to observe user behavior

Our concept of digital desire paths was inspired by the concept of desire paths in urban planning, architecture, and social science literature (Helbing et al., 1997; Nichols, 2014). For architects, desire paths convey helpful information determining the usability of a design and can even point to necessary improvements in future designs (Coutts et al., 2019). Desire paths document human creative reactions to designs that do not meet their needs. Architects embrace desire path in the system design by understanding the underlying user needs and altering the design accordingly (Kohlstedt, 2016; Ungvarai & Kisgyoergy, 2016).

The disciplines of urban planning and architecture characterise physical desire paths as phenomena where pedestrians choose to deviate from the intended paths imposed by architectural design and designers embrace such deviations in future architectural design (Helbing et al., 1997; Nichols, 2014). Examples are beaten down paths in the grass in parks, unpaved shortcuts to paved walkways, or tramped down paths in the snow on sidewalks (Kohlstedt, 2016; Rogers, 2019). Similar analogies, social desire paths, have been used in social sciences to describe collective social change work such as when parents move their children one-by-one out of their neighbourhood public school (Nichols, 2014).

Digital desire paths are instances of social desire paths where digital artefacts play an important role as cause and information medium (Nichols, 2014). Digital desire paths have their root cause in frictions with an information system, where users work around an implemented system. First, the system enforces their behaviour and it can also be used as creative means to circumvent the design goal. The information system is also the information medium, where process details, workaround behaviour, and digital desire paths become evident. Rather than observing traces on grass or snow, digital traces need to be observed, documented in enterprise system databases (Berente & Yoo, 2012; Ignatiadis & Nandhakumar, 2009; Malaurent & Karanasios, 2019). While designers may be able to observe user behaviour for social and digital desire paths, users in the digital context may not be as explicitly aware of others' behaviour as in other social desire paths. They might not be able to observe trace data as in the physical world and need to turn to other social structures to learn about others' user behaviour.

Desire paths in the digital world can help trace individual user behaviour and thus, develop user categories. This helps in better understanding workaround motivations and develop individualised solutions. Similarly, rather than only observing the results of the unintended behaviour in form of the physical desire path, digital desire paths document each usage step including the time stamp when this activity occurred. This offers additional helpful information for analysing desire paths as designers can understand sequence of steps taken.

5.4. Contribution to practice

Our study also has practical implications. First, eliminating workarounds may result in unintended results with more pronounced consequences. However, designers have the opportunity to adapt the information system design to influence workaround behaviour. Second, through the observation of actual workaround behaviour, designers may obtain important insight into how to improve the information system design and realign goals espoused by the

designer and the users. Designers should equip users with substantial degrees of freedom and then carefully observe emerging patterns of user. The actual user behaviour reveals the goals espoused by the users. Hence, this knowledge can be used to institutionalise desired user behaviour or to effectively devise systems that discourage undesired user behaviour. Third, digital desire paths suggest that post-adoptive user behaviour is characterised as an agile, iterative interaction for effective user behaviour. Thus, designers should set aside sufficient resources to accommodate this interaction.

5.5. Limitations

Our study is subject to limitations. First, our study uses grounded theory methodology to gather and interpret data. This may introduce subjective biases. Although we have followed recommended guidelines, we cannot rule out the possibility of such a bias in our data. However, the individual workarounds identified in our data have also been identified in other studies on workarounds. Thus, we are confident that our results are not significantly biased. Second, our empirical data only reveals a certain timeframe on the interaction between designers and users. Thus, we may have missed critical junctions in the interaction between designers and users. Future research needs to address this limitation. The concept of digital desire paths offers, however, an amendable model for the general interaction between designers and users. Third, although we develop the concept of digital desire paths, our cases only provide initial evidence on antecedents, consequences, and the role of interventions in digital desire paths. Hence, initiating further research on digital desire paths is the primary purpose of this study.

6. Conclusion

In closing, this study introduces the concept of digital desire paths to describe how workaround behaviour can inform information system design. After deploying an information system to users, information system designers can observe users' workaround behaviour to improve future designs. In light of the discussion on the importance of control through information systems, digital desire paths are important for implementing effective enterprise system that embed organisational rules (Berente & Yoo, 2012; Boudreau & Robey, 2005; Strong & Volkoff, 2010). Using the lens of digital desire paths helps identify signals of needs for refinement in emergent system design (Markus & Keil, 1994; Sein et al., 2011). Learning from architects and urban planners in their openness to change their designs after it is built, workarounds are responses to conflicting organisational logics embedded in information systems design, which are then employed to redesign the system. Thereby, workarounds serve as stepping stones towards effective information system design.

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Appendix A: Interview Questions Asked to Users

- Can you please describe your role within ALPHA? What are your tasks and responsibilities?
- Which information systems do you know within ALPHA? Which information systems do you interact with? Can you please describe the system and how you and others use it?
- What is your experience (broad) with the information system $X_{1\text{-}n}$? Can you please give an example?
- Could you please elaborate on challenges you experience or experienced when using information system $X_{1\text{-}n}$?
- Can you please tell me something about the purpose and processes of information system $X_{1\text{-}n}$?
- What is the history of the information system $X_{1\text{-}n}$? Can you please elaborate on what you know about purpose, involved stakeholders, introduction, and adaptation of $X_{1\text{-}n}$?
- When you think about deviations from the intended systems use, which cases can you imagine? Have you had experience with such behaviour (yourself or others)? Can you please explain what happened? What where consequences for the involved individuals, but also for the processes? How do your colleagues use the information system $X_{1\text{-}n}$?
- What is your opinion of the underlying rule $Y_{1\text{-}n}$? Why does this rule exists (e.g., regulation, efficiency, hierarchical reporting)? Do you think there were other options to implement the rule $Y_{1\text{-}n}$? Which consequences do you think happen (individual and organisational level) if you or others circumvent rule $Y_{1\text{-}n}$?
- When you think of yourself or others circumventing information system $X_{1\text{-}n}$, under which conditions did that happen? What triggered the decision to circumvent the system?
- Are there any questions that you expected that we did not ask? Can you please refer me to a colleague who can share more experience on this topic?

Appendix B: Overview Workarounds per Case

Table 3: Workarounds at ALPHA

		Conflicting logic				
WA	Context	Designer goal	User goal	Contingency	Condition	Consequence
1	Standard HIS workstations	Implement privacy policy	Maintain work-life balance	Open USB ports	Able to transfer EHR to USB devices	Work on EHR at home
2	HIS with open USB ports	Eliminate ability to transfer EHR	Work on EHR at home	Disable USB ports	Abfle to send EHR via E-Mail	Work on EHR at home
3	HIS with disabled USB ports but E-Mail	1) Reduce risk from EHR handling 2) Maintain E-mail functionality	Communicate sensitivity of EHR	Empty text-field dubbed "VIP flag"	Able to communicate sensitivity of EHR to colleagues	Work on sensitive EHR in the hospital

Table 4: Workarounds at BETA

		Conflicting logic				
WA	*Context*	Designer goal	User goal	*Contingency*	*Condition*	*Consequence*
1	Workstations with standard login and password	Safeguard intellectual property	Avoid repeated login procedures	Login without timeout	Ability to stay logged in	Switching workstations without login procedures
2	Unattended workstations with users logged in	Eliminate ability to stay logged in in unattended workstations	Switching workstations without login procedures	Two-factor authentication with multi-purpose company ID card	Claim company ID card as lost or broken	Leave duplicate company ID card in workstation
3	Unattended workstations with company ID cards	Deter engineers from using duplicate company ID cards	Avoid detection of duplicate company ID cards	Plastic company ID card	Ability to break company ID card	Broken company ID card hardly detectable