WHY DO THEY RESIST?
EXAMINING THE SALIENT FACTORS OF PHYSICIANS’ IT ADOPTION BEHAVIOUR

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Abstract

The IT landscape in German hospitals is characterized by great heterogeneity. While IT-systems directly supporting medical diagnosis generally show high adoption rates, acceptance of process supporting systems, such as systems supporting the documentation processes, is often not as originally envisioned when the system was implemented.

This research analyzes physicians’ perceptions towards adopting a digital archive system, which is currently not used as originally intended by the IT-department.

Based on the Unified Theory of Acceptance and Use of Technology (UTAUT) extended with findings of an extensive review of the literature a research model is develop and tested with an in-depth case study at a large teaching hospital in Germany.

The findings identify effort-related outcome expectations amongst the most relevant factors for physicians’ IT adoption behaviour. This contrasts prior research where -if at all- weak impact of effort expectancy on physicians’ behavioural intention has been identified. Further findings show that, although physicians report high computer self-efficacy, training is absolutely crucial to facilitate system usage, as study objects were frequently unaware of the systems’ capabilities.

Keywords: Health IT, Technology Adoption, Unified Theory of Acceptance and Use of Technology (UTAUT), Digital Archive System.
1 INTRODUCTION

More than 10% of Germany’s gross domestic product is spent on health related services every year. The spent increased annually from $2,280 (purchasing power parity per resident) in 1995 to $4,340 in 2010 (DESTATIS, 2012). Around the globe national healthcare systems are threatened by trends like rising costs and increasing demand but also by uneven quality and misaligned incentives.

Facing these challenges, health information technology (HIT) is assumed to be an indispensable enabler in resolving major healthcare issues for its capability to increase efficiency and effectiveness of health care delivery. HIT is expected to reduce healthcare costs by increasing productivity amongst physicians and freeing up scarce healthcare professionals from administrative tasks (MacDonald, 2008; Hillstad et al., 2005; Erstad, 2003; Chaudry et al., 2006). In addition, HIT is expected to improve quality of care (Chaudry et al., 2006; Zheng et al., 2005), enhance patient safety and thus improving health and well-being for the population (Devaraj und Kohli, 2000). Hence, the adoption and diffusion of HIT applications such as the electronic medical record (EMR) becomes vitally important.

Given the distinct advantages it is surprising that HIT diffusion in German hospitals is relatively slow. For instance, delivering patient care, the key process of a hospital, is still supported by traditional paper files in the vast majority of German hospitals. To be specific, only 17.1% of German hospitals have fully-functional electronic medical record systems implemented (Hübner et al., 2010) even though the technical barriers are widely resolved (William, 2003). Therefore, it seems likely that the willingness of healthcare personnel to use the new technology becomes more and more essential for drawing value from IT investment. This correlation has been indicated by several studies (DeLone and MacLean, 1992; Doll and Torkzadeh, 1998). Building on these insights Devaraj and Kohli (2003) identified proper IT usage as the missing link between investment into IT and performance effects.

Following these arguments, the expected value contribution of HIT can only be realized when HIT systems are used effectively (Holden and Karsh, 2009). This implies that, even if the right systems are implemented, a non-satisfactory degree of usage has a negative impact on the value added through the system. In addition, it can be expected that using HIT systems not as intended –consciously or unconsciously– will lead to wasted resources and inefficiencies. Furthermore, inconsistent and/or incomplete data due to a suboptimal degree of usage can lead to fatal results in patient treatment. HIT therefore only adds sustainable value if healthcare personnel adopts the HIT-systems and uses them as intended. This aligns with Angst et al. (2010) and Bhattachjee and Hikmet (2007) who identified resistance towards HIT systems as an important barrier for HIT diffusion in health care.

IT managers in German hospitals are well aware of these effects and are looking for ways to increase systems usage. In a survey of 2,030 German hospitals, 47% ranked users’ resistance towards IT systems as second highest barrier for successful IT projects (VHitG, 2011). Furthermore, a survey conducted by VHitG (2012) shows that only 52 % of the responding physicians are satisfied with the HIT systems deployed in their hospitals even though they are expected to be the major beneficiaries (Bhattachjee and Hikmet, 2007; Pare et al., 2011).

Existing literature does not provide sufficient answers to the question why physicians resist using the HIT systems deployed in their hospitals (Lapointe and Rivard, 2005; 2006). Deeper insight into these matters would enable software firms to provide better systems, hospitals to operate more efficiently, and hospital CIOs to generate higher user satisfaction. Consequently, understanding these factors would lead to significantly more efficient health care delivery processes (Agarwal and Prasad, 1999). As such, the purpose of this study is to enhance knowledge and understanding in the field of healthcare information technology adoption research.

According to these objectives, the following research question is put forward: What are the salient factors influencing physicians’ HIT adoption behaviour? To examine the salient factors, a case study in a major German teaching hospital was conducted. Opposing the majority of the research available
which frequently focuses on HIT implementation projects, this case study observes physicians’ adoption behaviour using an HIT system which is already in operation.

This paper is structured as follows: In the following section the applicable literature is reviewed for insights on the salient factors influencing physicians’ adoption behaviour. Based on the body of knowledge in HIT-adoption research and the barriers to physicians’ technology acceptance, the resulting research model is presented. Subsequently, research approach and results are explicated and findings discussed. The paper closes with limitations, further research and the conclusion.

2 LITERATURE REVIEW

Several studies in Information Systems Research have been conducted to examine users’ acceptance of technology and the extent of usage of IT systems, however, predominantly not in a healthcare context. Hence, the literature review encompasses a discussion of adoption research in general as well as adoption research in healthcare and a review of studies on physicians’ belief structures as well as on barriers towards using HIT.

2.1 Technology Adoption

Technology adoption theories are based on a variety of theoretical perspectives from different disciplines. Psychology contributed the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980), which Ajzen (1991) extended to the Theory of Planned Behaviour (TPB). As an extension of the TPB, Taylor and Todd (1995) decomposed the belief structures in the TPB and combined them with the Technology Acceptance Model (TAM), which was contributed by information system research as an extension of the TRA (Davis, 1989). Venkatesh et al. contributed the UTAUT model which aggregates eight prominent adoption models.

Each of these theories addresses the cognitive, affective and behavioural reactions of individuals towards a distinctive behaviour, predominantly the acceptance and use of technology. From a bird’s eye view, the models differ in scope and character of the causal relationships among their constructs. First, models like the TAM focus almost exclusively on beliefs about the technology and the results associated with its usage. In contrast, TPB and the Social Cognitive Theory (SCT) (Compeau and Higgins, 1995a, 1995b) encompass other beliefs that might influence behaviour independent of perceived outcomes (Compeau at el., 1999). Second, TAM and TPB conceptualize the causal relationships as unidirectional, with the environment influencing cognitive beliefs. SCT, in contrast, explicitly proposes the existence of a continuous reciprocal causation among the environment in which an individual operates, his/her cognitive perceptions, and his/her behaviour (Compeau at el., 1999; Carillo, 2010). To gain a deeper insight into the different approaches, TAM and SCT are briefly outlined below. A presentation of the Unified Theory of Acceptance and Use of Technology (UTAUT) complements this discussion.

David’s Technology Acceptance Model is likely to be the most cited employed theoretical model in technology acceptance research (Benbasat and Barki, 2007; Lee et al., 2003). As TAM has its origins in TRA, it is based on the premise that human beings behave rationally, that they make systematic use of information available and that they consider the implications of their actions before they decide whether to perform a certain action or not. In this context, intentions are a function of salient beliefs about the likelihood that performing a particular behaviour will lead to a specific outcome. The stronger the intention to engage in a behaviour the more likely its performance will be (Ajzen, 1991). In turn, intention is shaped by the person’s attitude toward the behaviour. Since the TRA calls for the elution of the salient beliefs about one’s attitude toward a particular behaviour, TAM proposes two constructs: perceived usefulness and perceived ease of use. Both are proposed as salient beliefs relevant for computer acceptance behaviour. Perceived usefulness is defined as the “prospective user’s subjective probability that using a specific application system will increase his or her job performance within an organizational context” (Davis et al., 1989). Perceived ease of use is defined as the “degree
to which the prospective user expects the target system to be free of effort” (Davis et al., 1989). Although TAM has consistently outperformed both the TRA and the TPB in terms of technology acceptance research (Davis et al., 1989; Venkatesh et al., 2003), the simplicity of the TAM caused researcher to state that it is unreasonable to expect that such a simple model could universally explain decisions and behaviour across a variety of technologies and adoption contexts.

**Social Cognitive Theory** (Bandura, 1986) has widely been accepted and empirically validated in various fields of research (Carillo, 2010). SCT follows a “triadic reciprocity” approach where personal factors, behaviour, and the environment mutually influence each other (Bandura, 1986). Compeau and Higgins (1995b) and Compeau et al. (1999) applied and extended SCT to the context of computer utilization. They assume three determinants of usage behaviour: outcome expectations, emotional reactions to computers, and self-efficacy. Outcome expectations are distinguished in performance outcome expectations and personal outcome expectations, which both directly influence usage expectations and personal outcome expectations, which both directly influence usage behaviour (Compeau and Higgins, 1995a). Performance outcome expectations deal with job-related outcomes, personal outcome expectations refer to the personal consequences of the behaviour and deal with the individual esteem and sense of accomplishment (Compeau and Higgins, 1995b). Emotional reactions to computers are conceptualized as affect and anxiety. Affect is defined as an individual’s liking for a particular behaviour; anxiety is defined as evoking anxious or emotional reactions when it comes to performing the behaviour in question. SCT theorizes a direct impact of both affect and anxiety on actual usage behaviour (Compeau and Higgins, 1995b). Self-efficacy refers to a judgment to use a technology to accomplish a particular job or task (Compeau and Higgins, 1995b), which directly impacts individual’s performance expectations, the emotional reactions to computers (anxiety) and the degree of their actual computer usage.

Through a review and consolidation of the conceptual and empirical similarities among the eight most prominent technology acceptance and use models, Venkatesh et al. (2003) developed the **Unified Theory of Acceptance and Use of Technology**. UTAUT aims to explain intentions to use an information system and subsequent usage behaviour. By conducting a longitudinal validation and comparison of the eight models, they identified four core constructs playing a significant role as determinants of user acceptance and usage behaviour: performance expectancy, effort expectancy, social influence, and facilitating conditions. While performance expectancy, effort expectancy and social influence asserted to impact behavioural intentions to use technology, facilitating conditions are emphasized to have a direct influence on usage behaviour. Subsequent validation of UTAUT in a longitudinal study found that it accounts for 70% of the variance in usage intention; this is a considerable improvement on previous models which routinely explain just about 40% of acceptance (Venkatesh et al., 2003). However, critics of this model are stating that the UTAUT with its eight independent variables for predicting behaviour represents only a patchwork of many largely not integrated and uncoordinated digests (Bagozzi, 2007).

### 2.2 Technology Adoption in Healthcare

Although there is a variety of different approaches and models explaining adoption and use of IS, there is little consensus in literature on how to measure IT adoption in healthcare (Battacherjee, 2007). Following TAM’s leading role as a model for investigating user acceptance in general, current empirical research suggests that it has also notable predictive power in examining physicians’ technology acceptance and adoption behaviours (Hu et al., 1999). In several studies focusing the healthcare context with a largely reasonable goodness-of-fit index, support for the general applicability of TAM in a physician population was found. Nevertheless, TAM’s explanatory power is limited compared to studies that examined the TAM among non-professionals (Hu et al., 1999). Hu et al. (1999) as well as Chau and Hu (1999) assume that physicians differ considerably from nonprofessional users in general competence, intellectual and cognitive capacity, as well as work arrangement and nature (Hu et al., 1999). In particular the influence of the ease of use construct is questionable. Almost all reviewed studies showed that ease of use has no significant impact on perceived usefulness and that it is no predictor of intention to use (Chau and Hu, 2001, 2002; Hu et al.
Regarding perceived usefulness, almost all studies reveal a form of medical pragmatism. It seems that a crucial determinant for physicians’ intention to adopt HIT is whether they perceive the technology as useful and relevant and whether they evaluate the output quality as adequate for their daily work. The findings regarding the predictive power of perceived usefulness are consistent across all discussed studies (e.g. Chau and Hu, 2001, 2002; Dansky et al., 1999, Pare et al., 2006). Only Ilie (2009) did not find that usefulness, extended and conceptualized as performance expectancy, is a critical predictor of intention to engage with EMR systems.

Despite the strong predictive power of perceived usefulness, the uncertain significance of ease of use does not totally account for the comparatively weaker explanatory power of the TAM as a whole (Hu et al., 1999). Therefore, the need for a tailored approach which incorporates physician-specific variables into the TAM model is determined (Yarbrough and Smith, 2007). According to Yarbrough and Smith (2007), Hu et al. (1999), Dansky et al. (1999), Pare et al. (2006) as well as Schaper and Pervan (2006), other factors and their influence on individual adoption behaviour should be examined. For instance, Dansky et al. (1999) demonstrated that contextual factors like physicians’ perceptions on organizational support, training and technical infrastructure are strong predictors of perceived usefulness. In addition, Pare et al. (2011) as well as Ash et al. (2003) emphasize the importance of organizational readiness and supportive leadership in a clinical context.

The UTAUT model incorporates additional constructs like social influence and facilitating conditions and it extends the concept of perceived ease of use. Although, UTAUT was successfully tested in other domains, there are only a few relevant studies applying UTAUT in a healthcare context. For instance, in their explorative study, McCulloch et al. (2011) have examined the facilitators and barriers to the adoption of surgical assistance systems based on constructs of UTAUT. It emerged that the major facilitators to adoption were perceived usefulness and facilitating conditions among both users and nonusers. In addition, Chang et al. (2007), Duyck et al. (2008) and lately Pynoo et al. (2012) empirically demonstrated the fitness of UTAUT among physicians. In line with the TAM studies, Chang et al. (2007) and Duyck et al. (2008) identified performance expectancy, as the strongest predictor of intention to use. Whereas Pynoo et al. (2012) show that the effect of performance expectancy evolved over time and that it has no effect on behavioural intention in pre-implementation stages. Nevertheless, these findings confirm the assumption that physicians tend to make their decisions based on highly pragmatic considerations. Regarding the effect of effort expectancy in post-implementation stages, Chang et al. (2007) emphasize a significant effect on behavioural intention. In contrast, Duyck et al. (2008) as well as Pynoo et al. (2012) examined only insignificant influence. Regarding social influence, only Pynoo et al. report a significant impact on physicians’ adoption behaviour, the other two studies examined only a slightly significant impact on behavioural intention.

In addition, the results in regard of the effect of facilitating condition on actual usage are mixed. Only Duyck et al. (2008) found that the construct of facilitating conditions is a salient predictor of the degree of actual system usage. In the most current studies Lin et al. (2012) show the importance of addressing known barriers to adoption already during the implementation phase. Venkatesh et al. (2011) conducted a longitudinal study and underline the critical fact that users frequently not use the systems to the extent provided by the IT department. Their findings are only partially applicable to this study as Venkatesh et al. focus on systems that cross organizational boundaries (in- and outbound).

Reflecting previous technology adoption research in healthcare, it seems as if the ability to explain adoption behaviour in healthcare of most of the existing adoption models is –in contrast to other domains– limited. Nevertheless, UTAUT proved its superiority in other domains and even the findings in healthcare contexts are indicating that most of the constructs covered by UTAUT significantly affect hospital personnel behavioural intention to adopt new IT (Aggelidis and Chatzoglou, 2009; Chang et al., 2007). Examining the questions “how” and “why” physicians adopt or resist HIT in order to identify the salient factors influencing physicians’ HIT adoption behaviour, having a closer look on the UTAUT constructs as a starting point seems reasonable.
3 RESEARCH HYPOTHESES

As laid out before, not much is known about the barriers to technology acceptance and adoption of HIT among physicians (Ilie et al., 2007). Therefore, the constructs and relationships of the UTAUT model as well as findings from prior adoption research guided the formulation of the research hypotheses presented in this section.

3.1 Performance expectancy

Performance expectancy is shaped by the degree to which a user believes that using the system will help him/her to attain gains in job performance. Venkatesh et al. (2003) showed that performance expectancy is the strongest predictor determinant of behavioural intention. This finding is consistent with previous conducted studies in healthcare context.

Perceived gains in performance can derive from several sources. Frequently cited reasons include supporting the information-flow throughout the hospital, better availability of data including simultaneous access, as well as clinical reminders, medication interaction checks and allergy alerts (Aarts and Koppel, 2009). Nevertheless, physicians’ beliefs of HIT systems’ capability to improve quality of care are mixed. On the one hand, Holden (2010) found support for this, in particular, the availability and readability of information, more precise data, and earlier awareness of patient status were considered as real advantages and thought to improve clinical decision making and reduce medical errors (Gans et al., 2005). On the other hand, Kemper et al. (2006) report that more than half of the physicians interviewed perceive a lack of improvement in patient care and a worsening of performance. In addition, many physicians perceive HIT to make their work more difficult and complex (Holden, 2010). Regarding EMR systems, the perceptions also differ whether physicians actually use these systems or not. It was shown that non-adopters were much less likely convinced that system usage will improve quality of care (Hennington and Janz, 2007). Nevertheless, as physicians are ultimately responsible for their patients, it is theorized that perceptions of the effects of EMRs on improving quality of care and patient safety shape their performance expectancies.

Issues regarding productivity outline the second big theme related to physicians’ performance expectancy using HIT systems. In hospital settings, increased productivity associated with the use of HIT is mainly connected with timesaving in physician’s administrative tasks. For instance, enablers for increased productivity are simple access to patient records without physical searching, no need for deciphering handwriting and automatic data processing (curves etc.). Holden (2010) showed that 70% of the interviewed physicians believe using HIT can speed up the care process. Considering the enormous administrative burden of physicians, the possibilities of HIT speeding up work processes are proposed as important performance expectancies.

In summary, it is hypothesized that physicians who believe that their work goals can be better reached through the usage of HIT will have high intentions to use such systems.

3.2 Effort expectancy

Effort expectancy is shaped by a user’s perceptions of the degree of ease associated with the system under investigation. Some studies showed that effort expectancy is a significant determinant of users’ intention to use IT (Aggelidis and Chatzoglou, 2009). Current research as well as anecdotal evidence suggests that physicians do not perceive HIT systems, in particular EMR systems, as easy to use. For example, Loomis et al. (2002) found significant concerns about the ease of data entry. Only 55% of adopters and 13.4 % of non-adopters believed that data entry is easy. In previous interviews with hospital staff (Weeger et al., 2011), it was mentioned that the interfaces of HIT are rarely well designed; that the logical structure of the input forms is often not based on job-related routines; and that the data-entry via keyboard is often too complicated for physicians. In addition, recent studies have identified system speed to be the primary determinant of clinical users (Rose et al., 2005). Due to
the mixed findings, physicians’ effort expectancies and their impact on their adoption behaviour have to be further examined. As such no hypothesis is formulated at this time. The data will be analysed post-hoc to guide the applicable argument.

3.3 Social influence

Social influence is defined as the degree to which an individual perceives that important others believe he/she should use a new technology (Venkatesh and Davis, 2000). Previous research has shown that an individual’s intention to use a new technology can be influenced by the opinions and perceptions of people in his or her immediate environment (Venkatesh and Davis, 2000). “Individuals are more likely to comply with others’ expectations when those referent others have the ability to reward or punish non-behaviour” (Venkatesh et al., 2003, p. 452).

The direct effect of social influence in context other than healthcare conflicts with the findings of Chau and Hu (2002), which studied physicians’ decision-making process to use internet-based health services. Although their research was conducted in a hospital setting, organizational environment and social influences may differ between Germany and Hong Kong. For instance, looking at the strict hierarchical structure amongst physicians in German hospitals and the substantial influence of supervisors (Vogd, 2004) it is excepted that there is a significant impact of social influence on behaviour. Physicians may feel uncomfortable if disagreeing with their supervisor. Hence, a supervisor’s negative attitude towards EMR-systems could have a negative impact on the subordinate’s behavioural intention to use the EMR. In addition, Kim and Kankanhalli (2009) also considered colleague opinions as a salient social influence in work-environment. Forming the largest user group of healthcare IT (Deese and Stein, 2004) nurses are another important work-related source of reference for physicians. Nursery staffs’ role involves direct nursing care at the patient’s bedside as well as a focus on collaboration among other healthcare groups (Apker et al. 2003). Amongst other things, HIT systems are focused on increasing efficiency due to improved collaboration within and between the healthcare groups. In addition, nurses are responsible for writing large parts of the longitudinal patient story. Hence, to take advantage of HIT, physicians’ are dependent on the meaningful use of HIT by nurses. In summary, it is hypothesized that opinions and perceptions of peers influence physicians’ intention to use HIT systems.

3.4 Facilitating conditions

Venkatesh’s (2003) definition of organizational facilitating conditions includes the individuals’ beliefs regarding the existence of a satisfactorily technical infrastructure, as well as management and other internal support that would encourage the use of the system. Unlike social influence, organizational facilitating conditions are found to not influence behavioural intention significantly. Nevertheless, empirical evidence shows a significant relationship between facilitating conditions and the actual degree of usage. Regarding the healthcare context, literature highlights three major technical and organizational factors working as enablers or barriers: organizational support, sufficient IT infrastructure and technical support.

According to Pare et al. (2011), organizational readiness for change is a key factor for hospital personnel’s support implementing a clinical information system. Although organizational support is a major factor associated with successful implementation of HIT its importance is largely overlooked (Boonstra and Brockhuis, 2010). Nevertheless, several studies reported the identification of a “system champion” amongst the physicians as critical to the effective implementation of HIT (Pare et al. 1997; Studer, 2005). System champions are frequently characterized as well-respected, knowledgeable leaders, committed to the system’s success. Serving as an advocate, they are willing to support the change (Miller and Sim, 2004). This effect is specifically significant in large organizations like hospitals (Studer, 2005). In view of these arguments, it is hypothesized that organizational support facilitates physicians HIT usage.
**IT infrastructure** encompasses computer hardware, software, and network technologies, which is necessary to implement IT solutions throughout an organization. In addition to the existence of a sufficient IT infrastructure, high reliability and availability are essential prerequisites for physician’s adoption behaviour. This proposition is based on physicians concerns about not being able to access vital information in case of system failure (Boonstra and Brockhuis, 2010). As reliability of an HIT depends on the technological capabilities of a hospital’s IT department physician's perceptions regarding these capabilities are likely to be a predictive factor of their intention towards HIT. In line with Bhattacherjee and Hikmet (2008) who confirmed the critical role of infrastructure support on HIT usage, it is hypothesized that the capabilities of a hospital’s **IT infrastructure facilitates physicians’ HIT usage**.

Many physicians complain about a general lack of training and **technical support** when problems associated with using HIT arise. Therefore they are reluctant to use such systems (Boonstra and Brockhuis, 2010). Consequently, the availability of specialized personnel/help desk which are able to provide instructional and/or hand-on-support, is important. Support for this proposition is provided by empirical evidence showing that the level of technical support is crucial for the success of system usage (Bhattacherjee and Hikmet, 2008; Aggelidis and Chatzoglou, 2009). As a consequence it is hypothesized that the capabilities of a hospital’s **technical support facilitates physicians’ HIT usage**.

Facilitating conditions also include **compatibility** which is defined as the degree to which a system is perceived as being consistent with the existing practices, values, needs and experiences of the user (Moore and Benbasat, 1991; Taylor and Todd, 1995). On the one hand, most of the physicians have developed individual and sometimes highly efficient processes and working styles (Boonstra and Brockhuis, 2010). Therefore it is comprehensible that the compatibility of HIT with existing processes is a frequent cited key motivation for HIT usage. On the other hand, misalignment leads to frustration and slowdowns in workflows and leads physicians to develop resistance toward such technologies (Lapointe and Rivard, 2005; Walter and Lopez, 2008). Subsequently it is hypothesized that healthcare professionals’ compatibility-assessments influences their behavioural intention to adopt a HIT system (Chau and Hu, 2002; Wu et al. 2005).

Incorporating the arguments given above, the resulting research model looks as follows:

![Research Model](image)

**Figure 1. Research Model**

### 4 RESEARCH DESIGN

When the investigation of a contemporary phenomenon in depth within its natural setting is the aim and the research question is of exploratory nature, a case study approach is the method of choice (Yin, 2009).

As discussed in the literature review and the discussion of the research hypotheses, physicians’ adoption behaviour seems to depend on underlying conditions such as the medical self-esteem, physicians’ pragmatic decision-making behaviour and their perceptions of the organizational readiness
for additional HIT. Understanding adoption behaviour requires a deep understanding of the respective contextual conditions. As there is relatively little a priori knowledge of what salient factors influencing physicians’ HIT adoption behaviour in German hospitals and as the ability of quantitative research methods is limited for investigating a phenomenon in its natural setting, we build a positivist case research methodology similar to Lee (1989) focusing the investigation of the relevance of the a priori constructs derived from literature.

In the reminder of this section the research site, the unit of analysis (physicians’ adoption behaviour regarding a digital archive system) as well as the process of data collection and data analysis are presented.

4.1 Research Site

The research site selected for this study is a large teaching hospital (LTH) in Germany with approx. 1,500 beds, more than 60,000 in-patient and more than 300,000 out-patients per year. LTH focuses on secondary and tertiary care. Approx. 8,500 employees in 17 specialized clinics with 39 departments and approx. 20 institutes and medical centers are dedicated to patient care.

Data for this study was conducted in one of LTH’s focal clinics. The work in this department is characterized by interaction of clinical care and research. We have narrowed the scope on the outpatient care of this department, where each year about 7,000 patient contacts are recorded. LTH provides an HIT based on standard software, which is supplemented by various sub-specialty areas (such as laboratory information system, a documentation system for intensive care etc.). The degree of usage of HIT systems in daily work is partially low. Especially a lately launched digital archive system (DAS) struggles with low usage rates, although this system was meant to enhance the hospital-wide information exchange processes. Consequently this system has been selected to investigate our research question.

4.2 Digital Archive System (DAS)

Secure and long-term (10 to 30 years depending on the type of documentation) archiving of all documents of patient care is a regulatory requirement in Germany. Despite these legal requirements on documentation, significant information gaps are reported: 50 percent of the physicians and 37 percent of the nurses stated a lack of relevant patient information (Hübner et al., 2010). As physicians rely on these documents for patient care, this issue is a serious one. Physicians’ decision-making heavily depends on these documents and are legally obliged to document the course of treatment of diseases in order to make their decisions understandable, to increase transparency and to ensure a long-term treatment (Bundesärztekammer 2011) Therefore, a hospital has to ensure that the course of treatment, all medical decisions and all care instructions are adequately documented and later archived. Fulfilling these requirements, the DAS allows healthcare personnel to access and archive all documents regarding patient care and all administrative documents through a single interface. Using the DAS, improvements concerning hospital-wide information sharing to minimize information gaps, enhanced access control, reduced storage space for archives and cost savings due to fewer printouts are expected. In addition, DAS enables time and location independent access to all documents as well as improved search functions across all document types.

LTH has employed a standardized DAS since 2008. The system is provided by an external supplier and provides interfaces to the existing hospital information system. DAS allows user-specific access to digitized patient records in form of PDF documents. The DAS is embedded in a portal which serves as the Standard Clinical Workplace (SCW) enabling access to all clinical documents (reports, laboratory results, progress documentation, discharge summaries) as well as to administrative documents (patient admission documents, consent forms, etc.). The documents are organized in a multi-tab pattern, encompassing categories like medical history, course of treatment, laboratory, nursing documentation, other, and administrative documents.
After patients’ discharge, the paper-based patient record is sent to an external service provider in order to scan all documents and to file them in the DAS. The time between patients’ discharge to the availability of all documents in the DAS can take up to 12 months.

4.3 Data Collection and Analysis

The clinic employs 14 physicians (part- and full-time) 10 nurses and administrative staff. To gain qualitative data, interviews with thirteen employees (6 physicians and 7 nurses) have been conducted, covering around 2/3 of the personnel working with the DAS. The interviews lasted approx. 60 minutes each and have been guided by a structured questionnaire. The questionnaire was developed similar to Pynoo et al. (2012) in their study on physicians’ attitudes towards PACS systems. In addition to the initial hypotheses the questionnaire also focused on interviewees’ perceptions regarding their satisfaction, their expectations regarding DAS and suggestions for improvements. Questions regarding the initial propositions included questions with scaled answers (Likert; 1-5) as well as open questions, placed at the end of the interviews. All interviews have been recorded. To enrich data and understanding, the usage of the DAS was observed in its natural settings. Data collection took place in during two months in mid 2013.

Collected data consisting of the recorded interviews, additional notes from the interviews and notes from the observation as well as some qualitative data gathered through the questions based on Likert-scales was linked to theory by using a mixed-approach consisting of the pattern-matching technique and the explanation building method (Glaser, 1965; Yin, 2009). Drawing and verifying conclusions was grounded on the tactics proposed by Miles and Huberman (1994). Using clustering-methods, data was aggregated, attributed and compared based on the a priori propositions and themes emerged beyond (e.g. with a case-by-attribute-matrix). To avoid hasty conclusions, the data had been examined carefully to determine whether any disconfirming evidence appeared. After conducting cross-checks of internal plausibility, deductive conclusions based on the initial propositions were made.

5 FINDINGS

Data analysis was driven by two objectives: (a) examine the validity of the proposed constructs and (b) discover salient factors beyond these propositions. Following these objectives some initial propositions were supported and some were found to be not as relevant as expected.

First of all, it was found that physicians, nurses and other staff are indeed using the DAS as part of their daily work. Nine out of 13 interviewees are using the DAS daily. Isolating the physicians, four out of six physicians are using the DAS on a daily base; two out of six at least once a month as their daily work do normally not require them to use the DAS. A deeper investigation of physicians’ use of the DAS indicated that all of the interviewees are using the DAS parallel to the traditional paper-based record.

The concept of DA Systems assumes that physicians view the documents online to reduce the handling of paper-based documents and enable collaboration. Contrary to this expectation, almost all of the physicians are frequently printing previously digitalized records. The reasons are multiple: documents are printed to add them to the paper-based record to obtain the most complete collection of documents, to add handwritten notes, to deliver the documents to the patients, and for communication with other physicians.

In some cases, such as delivering documents to the patients, printouts are necessary. Other motives substantially jeopardize the benefits of the DAS. For instance, printing documents that are available in the DAS in order to add them to the paper based record contradicts the advantages of the DAS: additional notes on the paper are not available for physicians also dealing with the patient and having (temporarily) no access to the paper-based record for any reason. In addition, printing documents instead of viewing them on the screen causes additional costs for printing and archiving (the document
has to be re-scanned and added to the archive once the patient is discharged). It also has a detrimental effect on ease of use of the DAS record due to redundant documentation.

The statements of the non-medical staff emphasize the questionable use of the DAS by physicians. Asked for the reasons why they are printing documents out of the DAS, the majority responded with arguments that can be attributed to physicians’ requests.

Although physicians report a high degree of usage, their use of the DAS is frequently not as intended by the IT department and hence does not facilitate the realization of the advantages expected due to the usage of HIT.

5.1 Facilitating conditions

Three themes were hypothesized: organizational support, sufficient IT infrastructure and technical support. Surprisingly, only technical support was pointed out by the physicians. Although, two physicians assumed shortfalls in the quality and quantity of the IT infrastructure as a result of further inquiries, IT infrastructure and organizational support seem not to be essential issues in LTH. Therefore case study data does not allow for deeper investigation of these facilitating conditions on physicians’ adoption behaviour.

As laid out above, case study data suggest that the relatively high adoption rate of the DAS is grounded in the mandatory nature of usage. Nevertheless, almost all of the physicians are indicating that they are proficient in dealing with the digital archive: only one out of six physicians’ reports a lack of self-efficacy using the system. Adding nurses and administrative staff, 62% of the users stated that they feel confident in dealing with the DAS. In comparison with other users, Pynoo et al. (2012) pointed out that physicians are more likely to adopt new systems due to their general competence and intellectual capability. Analyzing the self-assessments of the physicians in this case study and their actual degree of usage, this assumption was confirmed. However, the self-efficacy perceptions may also be an Achilles' heel. It seems as the physicians are using the systems to meet their needs to the degree they can integrate the system in their existing workflows. On closer examination, their highly perceived self-efficacy seems to lead to inefficient usage. A reason for the gap between self-assessments and the observed usage-behaviour, laid out above, could simply be due to the fact that none of the physicians have been introduced and trained on the DAS. It seems as if their know-how regarding the functions of the DAS originates from their learning-by-doing experiences rather than from the features the system offers and the opportunities that arise from using the DAS as intended. Support for this assumption is provided by the following observation: physicians’ indicating a low intensity of use also assessed their skills using IS weaker than the others and explicitly claimed a need for training-sessions. And that’s even though they specified to be using information systems more than eight hours a day. It seems as if they have got a notion that they could use the system more efficiently. Like the physicians, nurses and administrative staff is also poorly trained on the system: only two out of seven have received training lessons.

Although physicians show relative high self-efficacy perceptions and do not strongly call for training sessions their actual behaviour indicates a need for formal training programs. This is in line with propositions from prior research stating that either structured training programs or alternative methods of knowledge transfer (e.g. peer-training) are necessary to achieve added value through usage of non-trivial applications (McCulloch et al., 2011). Case study data and in particular the comparison of physicians’ statements with their usage behaviour observed supports this propositions: It indicates that technical support will, on the one hand, facilitate the degree of HIT-usage and, on the other hand support proper usage of HIT systems.

5.2 Performance expectancy

Analyzing physicians’ statements regarding their performance expectations shows that physicians’ believes on how the DAS can help them to enhance job performance are rather weak. Without further
inquiry by the interviewer, none of the physicians expected enhancements regarding quality of care and patient safety due to DAS usage. Hence the following analysis is mainly based on physicians’ statements regarding potential impacts on their productivity due to DAS usage.

The majority of physicians stated that required documents are not available via the DAS or that the DAS does not enable them to find required documents within reasonable time. In addition, almost all physicians rejected the statement that the DAS enhances document retrieval compared to the traditional paper-based records and archives. Hence it is not surprising that the physicians do not believe that the DAS is a suitable replacement for the paper-based patient-record. Their intention to refrain from paper-based documentation methods based on prior experience is relatively low. In contrast, the performance expectations of none-medical staff are significantly higher. Even though they also demand substantial improvements of the existing DAS, they are much more open towards digital-only documentation processes and the subsequent usage of systems like the DAS.

Data analysis shows that performance expectations contribute significantly to the physicians’ adoption decision-making process in particular on physicians’ intention to use HIT. Although the usage is mandatory, physicians’ performance expectations have an impact on the degree of their DAS usage. Physicians’ low performance expectations and their attitude towards a replacement of the paper-based record, provides unequivocal support for this hypothesis. This finding is consistent with previous conducted studies in healthcare context, where performance expectancy also appears to be the most significant determinant of physicians’ intention to use HIT (Chau and Hu, 2002, 2002a, Hu et al., 1999).

Analyzing the reasons of physicians’ low performance expectancy, a causal relationship between training efforts and physicians’ performance expectations was found. Nearly all physicians have expressed complaints about missing functions of the DAS. For instance, physicians brought up missing functions like text recognition, copy to clipboard, export functions enhancing the creation of the discharge documents or simply printout-functions. Consulting the IT specialists, however, has shown that the DAS offers most of these functions. Therefore, a relationship between the degree to which physicians believe that using the system will enhance their job performance and their knowledge on systems’ capabilities and how to use them exists.

5.3 Effort expectancy

Case study evidence shows that the degree of ease associated with the use of the system, does impact the degree of DAS usage. First, almost all physicians stated that ease of use is a crucial factor for evaluating HIT. Second, physicians were found to estimate the effort associated with the use of the paper-based patient record as significantly lower compared to the usage of the DAS. Only two physicians agreed that the DAS is easy to use. Frequently mentioned effort drivers regarding DAS usage are unstructured and complex filing of documents (mentioned 5 times), weak response times (3), no copy-and-paste functionalities (2), long click paths (1). In contrast, physicians perceive significantly lower efforts using the paper-based record. The effort-benefits mentioned are for instance faster access to documents (3), a better overview (3), less effort dictating the doctor’s letter (2). Additionally, effort-drivers outweigh physicians’ expectations regarding effort reductions using the DAS. Hence, case study evidence provides support for the proposition that physicians’ effort expectancy impacts their intention to use the DAS and is therefore an important predictor of their actual usage behaviour. This finding contrasts prior research where, if at all, a weak impact of effort expectancy on physicians’ behavioural intention has been identified. The possibility using the paper-based documentation in parallel could be an explanation for this phenomenon.

Regarding their perceptions on the ease of use of the DAS, physicians and none-medical staff do agree: none-medical staff does also not perceive the DAS as easy to use. Nevertheless, summarizing and counting the statements of none-medical staff regarding the effort using paper-based documentation, none-medical staff does not expect that using paper-based record causes much less effort than using the DAS. This finding contrasts with physicians’ effort perceptions using the paper-
based record. In addition, non-medical staff’s intention to use DASs and other HIT systems replacing traditional documentation methods was found to be significantly higher than physician's. This finding also indicates that performance expectancy has an impact on behavioural intention in a healthcare setting, even though the strength of the effect could not be determined in this case study.

5.4 Social influence

The physicians’ statements of colleagues’ opinions regarding DAS usage indicate that peers only slightly motivate/demotivate the use of the IT system. A majority neglected that they have been encouraged by other colleagues to take advantage of the DAS. It seems as if physicians’ usage behaviour is not dependent on the opinions of others. Following our observations and physicians’ statements, perceived and actual behavioural control is relative weak, at least in this department. This finding is also supported by physicians’ responses to the question if their superiors promote usage of the DAS, which was largely negated. Comparing these findings with physicians’ intention and usage behaviour, the initial proposition regarding social influence could not be confirmed. Case study data indicates that weak behavioural control does neither foster, nor inhibit DAS usage. Hence, the weak social influences, do not impact behavioural intention. Effects of strong social influences could not be observed. For instance, case study data does not provide indications of how physicians are influenced by supervisors with a positive attitude towards HIT systems. Hence, the initial proposition is not refuted. Turning a sharper focus onto social influences, especially in regard of the substantial influence of supervisors over the careers of their subordinates could be a valid recommendation for further research.

5.5 Compatibility

A main inhibitor to the widespread adoption of the DAS is the need for parallel use of the traditional paper-based record arising through poor integration of existing systems and workflows. For instance, as many but not all documents are available in the DAS physicians are forced to change their working routines without gaining productivity (just to work with the DAS). In this regard Schaper and Pervan (2006) stated that a technology which is perceived to be incompatible with existing work processes will lead to resistance. This proposition is fully supported by our findings: As long as not all patient-centered documents are comprehensively available in the DAS, physicians’ system usage will remain limited to the print-function in order to stick to their established work-practices. Our case study data clearly shows that systems’ compatibility with existing workflows has a strong impact on physicians’ usage behaviour.

6 LIMITATIONS AND FURTHER RESEARCH

The findings stated above are limited due to the exploratory nature of this research. Although research sites have been selected carefully, the setting in the department under observation and the physicians interviewed cannot be regarded as representative. Nevertheless, the subject group provided a suitable sample regarding age, gender and position. As it was the aim to pave the way for further studies elaborating on this topic, the qualitative approach was reasonable. Therefore, we would welcome additional rigorous and possibly quantitative studies, specifically confirming the actual influence of the factors proposed to influence physicians’ adoption behaviour and to test the proposed extension of the UTAUT model. Also, it needs to be taken into account that the findings apply only to hospital settings. General practitioners’ or self-employed physicians’ adoption behaviour may be differing. Also, the specific cultural background of the research objects limits generalization into a context wider than German hospitals.

Adoption research has uncovered many of the salient factors influencing physicians’ adoption behaviour. As adoption research focuses on cognitive, affective and behavioural reactions of individuals to technology and innovation, it likely does not cover all factors leading to unintended and
inefficient HIT usage. During the case study it became obvious that the degree of usage is not only determined by individuals’ adoption behaviour. Furthermore, HIT software -like the DAS- is often commercial-of the-shelf-software and therefore not designed to meet the specific needs of a specific organization. The proposed compatibility construct tries to cover some of these issues. Nevertheless, observations indicated that there are misfits between the system and the organization beyond compatibility with existing processes. In addition, UTAUT focuses on the perceptions and beliefs of individuals and is therefore not suitable to examine misfits between a system and the organization as a whole. It seems to be a promising approach for further research to undertake a detailed investigation of these misfits. Further research could be based on the work of Strong et al. (2009) on organization-enterprise system fit which may be suitable for the healthcare context.

7 CONCLUSION

This study revealed insights into the salient factors for physicians’ adoption of an HIT system. Performance- and effort-related outcome expectations, as well as facilitating conditions have been identified as the most relevant factors. Identifying physicians’ performance expectancy as the probably most salient determinant of usage behaviour is in line with findings of prior research. It was found that physicians are only willing to adopt an HIT system if they perceive that the system under investigation outweigh the efforts using it and is superior to established systems and methods. Case study data confirms the assumption, that the medical profession is rather pragmatic. In addition, the need for adequate training and technical support was highlighted. Although physicians have shown high self-efficacy perceptions, training sessions are necessary to increase their actual degree of system usage, since study object have frequently been unaware of systems’ capabilities.

This paper can serve as basis for further research based on the UTAUT in this particular field. The findings highlight the effect of physician’s compatibility perceptions, which should be examined further.

HIT implementation will only be successful when effort is undertaken to change physician perception and adoption behaviour.
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