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# Attitude as a Measure for Acceptance: Monitoring IS Implementation in a Hospital Setting

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## ABSTRACT

The aim of this study was to assess whether Attitude Toward Technology (ATT) is a better measure of technology acceptance than Behavioral Intention (BI) in a mandatory medical setting. A questionnaire was taken in two hospitals, one university (Setting 1) and one private (Setting 2). The technology studied was PACS (Picture Archiving and Communication System). The questionnaire was taken on several occasions: pre-implementation (T1, both Settings); three months post-implementation (T2, S2); and one year after the transition was completed (T3, S1; S2 is underway). Four models were assessed: (1a) original TAM with ATT, (1b) TAM with BI replacing ATT, (2a) UTAUT, and (2b) UTAUT with ATT replacing BI. Our preliminary results indicate that ATT is indeed a better measure for acceptance than BI. Variance explained in ATT ranged from .47 to .72, in BI from .12 to .45. BI was the best predictor of USE.

### Keywords

technology acceptance, medical setting, attitude, TAM, UTAUT, PACS.

## INTRODUCTION

In this study, physicians' acceptance of PACS is measured in two hospitals on different times during the implementation process. To achieve this, we will assess two technology acceptance models, the Technology Acceptance Model (TAM, Davis 1986) and the Unified Theory of Acceptance and Use of Technology (UTAUT, Venkatesh et al. 2003). This study differs in some aspects from previous studies. First, our study is performed in a mandatory setting. With some exceptions (Brown et al. 2002; Venkatesh et al. 2003), Information Systems (IS) acceptance is studied in voluntary settings and most acceptance models are specifically tailored to be used in a voluntary setting. Brown et al. (2002) showed that in a mandatory setting a different pattern of relationships arose depending on the dependent variable, ATT or BI. Second, in this study, the old and new systems coexist until the users and the hospital are ready to make the switch. Moreover, the users feel no need to make the transition as the old system functions well. In Brown et al. (2002), the company made the switch during the weekend, so that the users were still using the old system on Friday and the new on Monday.

So the aim of the study is to evaluate whether ATT is a better measure of technology acceptance than BI in a mandatory medical setting.

## THEORY

### The transition to PACS

The medical field of radiology is evolving from an analog environment into a digital workspace. Previously radiological images were developed or printed onto film. But now with the advent of PACS, radiological images are digitally stored in the PACS and visualized through a PACS web viewer. This transition from analog to digital has been done in a large number of hospitals worldwide. Baumann and Gell (2000) performed a large-scale survey on the presence of PACSs. They identified 177 PACSs on a total of 363 returned surveys, while another 58 sites indicated that they would install one in the subsequent two years. Most of the systems they identified were situated in North America. Recently, Sutton (2007) reported that 64% of the NHS hospitals in England were using PACS; and the positive attitude toward the introduction of PACS was confirmed in studies of Frund et al. (2007) and Bauman and Gell (2000), who found that over 90% of the users would recommend PACS to others. These findings come as no surprise as the benefits of PACS are tangible on different levels throughout the hospital (see Table 1). Although PACS implementation failures are very rare – in a follow-up study only 5.5% of the respondents had abandoned their PACS or decreased its use (Bauman and Gell 2000) – some pitfalls have to be overcome in order for PACS to be accepted and fully used. Johnson and Dye (1995) identified ten steps to improve PACS implementation success. The most important for this study are: (1) not overselling PACS; (2) addressing physical needs; (3) identification of a project champion to lead the project; and (4) the commitment of the upper management. It is also obvious that training

should be provided to the users in order for PACS to be used and the investment to pay off (Law and Zhou 2003). However as the physicians are very busy and learning to work with PACS will not be deemed a priority, continuous support should be provided to the users, especially in the early days of PACS use (Pilling 1999). PACS implementers should also bear in mind that different users hold different views regarding PACS success (Pare et al. 2005).

| | |
|---|---|
| Management | Cost reduction (Reddy et al. 2006) |
| Radiology department (implementers) | Reduction of report turnaround time (Hayt and Alexander 2001)<br>Increased productivity (Lepanto et al. 2006)<br>Higher job satisfaction (Harisinghani et al. 2004) |
| Physicians (end-users) | Increased reliability of image delivery; no more lost films and a faster availability of the images (Frund et al. 2007)<br>Decreased time for image searching (Bryan et al. 1999)<br>Availability of images 24/7 |

**Table 1. Benefits of PACS throughout the hospital**

### IS acceptance literature

A number of measures are used to assess IS implementation success or IS acceptance. Delone and Mclean (2003) identified six categories of IS implementation success, including Use and User satisfaction. In IS literature it is common to define IS acceptance or implementation success as BI or use of the system, depending on the framework used.

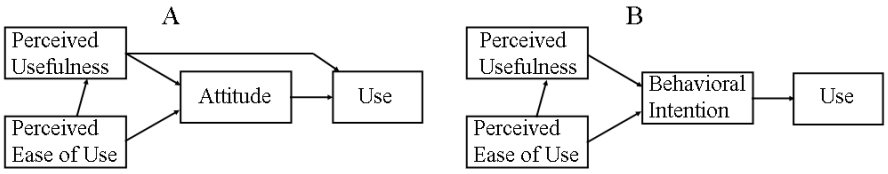


Figure 1. TAM. Part A shows the original TAM as devised by Davis (1986); Part B shows the final version of TAM (Davis et al. 1989).

TAM was an adaptation of the Theory of Reasoned Action (Fishbein and Ajzen 1975), but specifically tailored for modeling user acceptance of IS (Davis 1989) in voluntary settings (Davis 1986). Previous research showed that TAM is a very powerful and parsimonious way to represent the antecedents of system usage (Taylor and Todd 1995; Venkatesh et al. 2003). According to the original version of TAM, two beliefs – perceived usefulness (PU) and perceived ease of use (EOU) – influence people's ATT toward the technology. The use of the technology is then predicted by ATT and PU. BI is omitted in this version of TAM.

BI was then put between ATT and USE and in the final version of TAM, ATT was removed, as in Figure 1b, because it was judged as redundant in a voluntary setting. However, as Brown et al. (2002) showed that the relationships between the constructs differed depending on the setting (mandatory vs. voluntary use), we will assess both versions of TAM. In an extended version of TAM – TAM2 – subjective norm was added as a predictor of behavioral intention (Venkatesh and Morris 2000), which makes it very similar to UTAUT (Venkatesh et al. 2003) displayed in Figure 2. TAM has been used in a range of settings, including medical settings, to study different technologies (Brown et al. 2002; Chau and Hu 2001; Davis et al. 1989; Taylor and Todd, 1995).

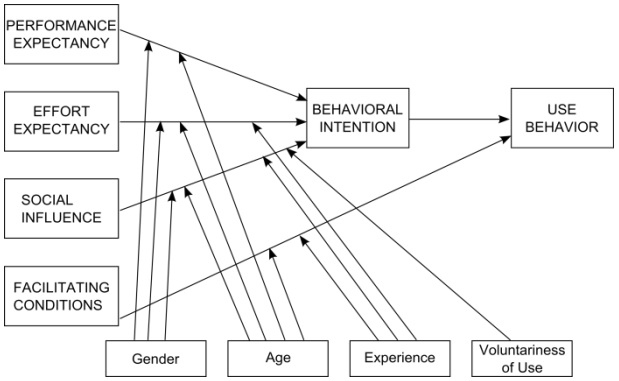


Figure 2. UTAUT (Venkatesh et al. 2003)

UTAUT was designed based on eight prominent (technology) acceptance models (Venkatesh et al. 2003). But, while TAM gives a very parsimonious view on the acceptance of a new technology, UTAUT incorporates more antecedents of BI and system use: Performance Expectancy (PE), a construct closely related to PU in TAM; Effort Expectancy (EE), a construct that is similar to EOU in TAM; Social Influence (SI); and Facilitating Conditions (FC). Moreover, four moderating variables are included: gender, age, setting and experience. Venkatesh et al. (2003) found that UTAUT explained up to 70% of the variance in BI when data were pooled over three measurements and 46 to 48% when only one measurement was taken into account. We will use a reduced version of UTAUT without the moderating variables and compare our results with the reference material in Venkatesh et al. (2003, table 21).

BI or use are good measures for technology acceptance in voluntary settings. However, in a mandatory setting, ATT is a better measure for technology acceptance, as the users

have no choice of using the new technology in order to perform their job. In a study in the financial sector, Brown et al. (2002) found that the relations between the constructs in TAM differed in mandatory settings and that ATT in a mandatory setting acted as BI in a voluntary setting. Moreover, no correlation was found between ATT and BI (Brown et al. 2002). Thus, if there is no need to use the IS, a user might accept but never use the system. The notion of ATT as an indication for the performance of a behavior is not new. Ajzen and Fishbein (1980) state that the relationship between ATT and behavior is only strong and predictive if they correspond. So "attitude toward using PACS" should be a far better predictor of "PACS use" than "attitude toward PACS".

## METHOD

### Questionnaire

A questionnaire was created with six scales of Venkatesh et al. (2003) to assess UTAUT and TAM: PE/PU, EE/EOU, SI, FC, ATT and BI. The items of these scales had to be rated on a 7-point Likert scale ranging from 1 (complete disagreement) to 7 (complete agreement) with four as a neutral point. The questionnaires taken post-implementation included an extra item measuring the self-reported frequency of PACS usage in the previous months. At T2-T3, one item of the BI scale was removed, as "I plan …" and "I intend …" in future tense, are the same in Dutch. Some additional items were included in the questionnaires to capture the demographic information of the respondents and their use of PACS tools. The questionnaire contained no measure of perceived voluntariness of technology use as we estimated, in line with Brown et al. (2002), that use of PACS was mandatory as soon as the physicians had to use PACS in order to see radiological images.

### Timing of the questionnaires

The questionnaire was taken on four occasions in two different settings. A fifth questionnaire is now collected in Setting 2. A timeframe of the timing of the questionnaires is presented in Figure 3. This questionnaire was not taken at T2 in Setting 1. There, a short, changed questionnaire was taken, which could not be used for this study.

### Study 1

#### *Setting*

The first study was conducted in a university hospital with about 4800 employees for 1169 beds. The medical staff consists of 600 physicians and about 1700 nurses. The radiology department is dispersed over 7 locations around the campus and it handles an ever-increasing number of requests. PACS go-live in the radiology department was in the course of March 2005 and hospital-wide in July 2005. The radiology department stopped printing film on February 14th 2006, so a dual "analog film printing / digital PACS delivery" situation existed for several months. At the start, the physicians were informed that the hospital would make the complete transition to PACS as soon as possible, but no date was set. Prior to the implementation of PACS, the hospital informatics department upgraded all computers so that they met the minimum requirements for the PACS web viewer.

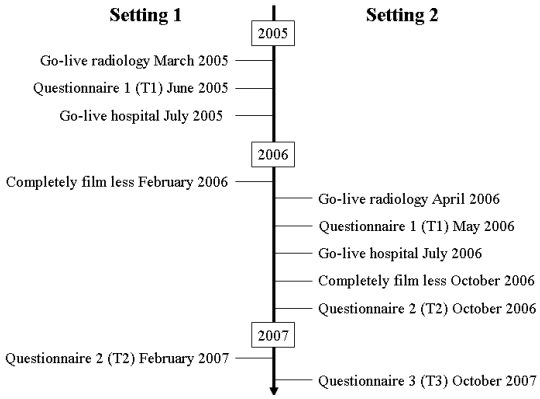


Figure 3. Timeframe of PACS project per Setting

#### *Training issues*

Prior to the implementation of PACS, the radiology department PACS project cell considered several training options and they finally opted for the installation of a digital learning environment building on the vendor-supplied help system. This e-learning system was developed during radiologists' training and ready for use prior to the introduction of PACS to the physicians. PACS was first introduced to the physicians in a plenary session. During this session, the advantages of and the need for PACS were highlighted, together with an overview of the possibilities of PACS. The members of the project cell visited each service (45 in total) on three different occasions, during staff meetings, to solve user-problems.

#### *Response rate*

At T1 (no experience), 570 questionnaires were sent through the internal mail and 184 usable questionnaires returned, while at T3 (extensive experience) only 147 usable questionnaires returned out of 585.

### Study 2

#### *Setting*

The second study was performed in a private hospital, a merger of four separate hospitals. About 2300 persons are employed in this hospital for 1094 beds. The medical staff consists of 200 physicians and 910 nurses. The radiology department is dispersed over the four hospitals. PACS go-live in the radiology department was in April 2006 and the radiology department introduced PACS to the physicians in introductory meetings in the course of May 2006. The physicians gained access to PACS after these meetings. The radiology department stopped printing film in October 2006, however with a few exceptions. Analog

images are still printed for physicians without computers and on special request. So, up to now, there still exists some sort of a dual "analog film printing / digital PACS delivery" situation. So in line with the definition of Brown et al. (2002), use of PACS in this setting is not yet mandatory.

*Training issues*

The physicians were introduced to the features and possibilities of PACS in an introductory meeting. During this meeting, a demonstration was given on the use of PACS. After the implementation of PACS, several follow-up sessions and refresher courses were given to clarify user-problems. No further specific training was provided, as a newer version of the PACS web viewer was installed in this setting. This web viewer had an extended help system, which was in fact quite similar to the digital learning environment developed in setting 1.

*Response rate*

The first questionnaire (T1, no experience) was handed out and collected during the introductory sessions to PACS. This way 50 physicians were reached. At T2 (moderate experience) the questionnaires were delivered and collected through the internal mail of the hospital, 59 (out of 148) usable questionnaires were returned.

## RESULTS

Table 2 gives an overview of the descriptive statistics. Overall, the expectations at T1 were higher in Setting 2 than in Setting 1. However it seems that these expectations haven't been met as the ratings on all scales evolved in a negative manner at T2, but this could be due to the lack of extensive experience with PACS. The results at T3 will clarify this issue. However, it is remarkable that the ratings on the BI and ATT scales decreased. In Setting 1, where the physicians gained extensive experience with PACS at T3, a positive trend was observed. It seems that the implementation of PACS has succeeded. A comparison with the results of Setting 2 on T3 will be very interesting.

Table 3 presents an overview of the regression analyses. Four models were tested: (1) **Model 1a**: TAM as presented in Figure 1A; (2) **Model 1b**: TAM as presented in Figure 1B; (3) **Model 2a**: UTAUT as in Figure 2, without the moderating variables; (4) **Model 2b**: UTAUT with BI replaced by ATT. Over all settings and measurements, variance explained in ATT was higher than in BI. Variance explained in use was very low at T3 (S1), but higher at T2 (S2) where use of PACS was not yet mandatory. BI was a better predictor of USE than ATT except in model 2b (S1).

In Setting 1, the key predictor of ATT was PE/PU at both times, with EE/EOU as a good secondary predictor on T1. A different picture emerged in Setting 2. There EE/EOU was the best predictor of ATT at T1, while PE/PU was the best predictor at T2, with SI as a strong secondary predictor of ATT. It is striking that in Setting 2 a negative connection is found between PE/PU and BI on T1 and between EE and BI on T2, while this is not the case when ATT is the dependent variable.

## DISCUSSION

In this study, the acceptance of a medical IS by physicians was measured in two hospitals on several times, using questionnaires devised to assess TAM and UTAUT. The aim was to find out which variable, ATT or BI, is the best measure for technology acceptance in a mandatory setting. Our results indicate that, in a mandatory setting, ATT is a better measure for acceptance than BI: while the regressions on ATT were all very clear and straightforward, the regressions on BI revealed some strange patterns (e.g. negative regression coefficients for

| | Setting 1 | | Setting 2 | |
|---|---|---|---|---|
| | T1 | T3 | T1 | T2 |
| PE | $5.14^{a}$ | $5.73^{a}$ | $4.94^{b}$ | $3.90^{b}$ |
| EE | $4.42^{a,c}$ | $5.27^{a}$ | $5.34^{b,c}$ | $4.65^{b}$ |
| SI | $3.39^{a,c}$ | $4.17^{a}$ | $4.65^{b,c}$ | $5.38^{b}$ |
| FC | $4.39^{a,c}$ | $5.31^{a}$ | $5.19^{b,c}$ | $4.54^{b}$ |
| ATT | $5.04^{a,c}$ | $5.42^{a}$ | $5.78^{b,c}$ | $\mathbf{5.11}^{b}$ |
| BI | $5.66^{a,c}$ | $6.60^{a}$ | $6.27^{c,b\dagger}$ | $\mathbf{5.80}^{b\dagger}$ |
| USE | --- | 6.12 | --- | 5.68 |

NOTES: VALUES WITH SAME SUFFIXES DIFFER ON P<.05 (OR $^{\dagger}$P<.10) (2-SIDED T-TEST): $^{A}$S1: T1⇔T3; $^{B}$S2: T1⇔T2; $^{C}$S1-T1⇔S2-T1

**Table 2. Mean Scale Ratings (Likert scale from 1 to 7)**

| | Setting 1-T1 | | Setting 1-T3 | | Setting 2-T1 | | Setting 2-T2 | |
|---|---|---|---|---|---|---|---|---|
| Model | 1a(.57) | 1b(.34) | 1a(.47) | 1b(.21) | 1a(.47) | 1b(**.12**) | 1a(**.65**) | 1b(.24) |
| PU | $\mathbf{.49}^{***}$ | $.43^{***}$ | $\mathbf{.54}^{***}$ | $.34^{***}$ | $.21^{\dagger}$ | **-.07** | $\mathbf{.50}^{***}$ | $\mathbf{.43}^{**}$ |
| EOU | $\mathbf{.36}^{***}$ | $.22^{**}$ | $.21^{**}$ | $.18^{*}$ | $\mathbf{.61}^{***}$ | $.42^{**}$ | $.40^{***}$ | .12 |
| Model | 2a(.35) | 2b(.58) | 2a(.31) | 2b(.52) | 2a(**.14**) | 2b(.50) | 2a(.45) | 2b(**.72**) |
| PE | $.41^{***}$ | $\mathbf{.48}^{***}$ | $.29^{**}$ | $\mathbf{.49}^{***}$ | **-.07** | $\mathbf{.23}^{*}$ | $.52^{***}$ | $.57^{***}$ |
| EE | $.16^{*}$ | $\mathbf{.34}^{***}$ | .00 | $.15^{\dagger}$ | $.39^{*}$ | $.54^{***}$ | **-.22** | $\mathbf{.20}^{\dagger}$ |
| SI | .09 | $.13^{**}$ | $.12^{\dagger}$ | $.21^{**}$ | .12 | -.02 | $\mathbf{.41}^{***}$ | $\mathbf{.27}^{**}$ |
| FC | $.13^{*}$ | .01 | $.34^{***}$ | .10 | .16 | $.24^{*}$ | $.34^{**}$ | $.15^{\dagger}$ |
| Dep: USE | 1a(.05) | 1b(.02) | 2a(.03) | 2b(.05) | 1a(.20) | 1b(.20) | 2a(.22) | 2b(.20) |
| BI / ATT | .08 | $.17^{*}$ | .10 | $\mathbf{.17}^{\dagger}$ | .25 | $.46^{***}$ | $.36^{*}$ | $.33^{*}$ |
| PU FC | $.20^{\dagger}$ | N/A | .14 | .12 | .26 | N/A | .21 | .21 |

**Table 3. Results of regression analysis per model. Adj. $R^2$ between brackets. Lower part: regression on USE on T3 and T2. The values reported are β-regression coefficients. (Sig.level$^{***}$p<.001; $^{**}$p<.01; $^{*}$p<.05; $^{\dagger}$p<.10.)**

PE and EE). Two key factors were identified, PE/PU and EE/EOU. The usefulness of the technology (PE/PU) is important during all steps in the implementation process, and ease of use (EE/EOU) is especially important in the early stages, when the users are still learning to work with the technology. Our results also indicate, contrary to previous findings (Chau and Hu 2001) that pressure from the top management could have a positive influence on the acceptance of an IS. Finally, compared to the findings of Venkatesh et al. (2003), variance explained in USE was low (T2: .20 to .22) to very low (T3: .02 to .05), indicating that USE is not a good measure for technology acceptance in a mandatory setting.

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