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Understanding adoption of new technologies:

Technology readiness and technology acceptance as an integrated concept

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Abstract

Discovering the antecedents of technology use is of major importance in the field of technology adoption. This study investigates the relationship between the personality dimensions of TRI (Technology Readiness Index) and the system specific dimensions of TAM (Technology Acceptance Model). Data was collected from 186 employees in various Norwegian organisations. Structural equation modelling was used to test the relationship between dimensions of TRI and TAM. The results show that optimism and innovativeness significantly influences perceived usefulness and perceived ease of use. Further, perceived usefulness has a significant positive influence on actual usage. The results imply that both personality dimensions and system specific dimensions are of major importance when adopting new technology. This should be considered when organisations develop implementation strategies.

Keywords: technology readiness, technology acceptance, adoption, implementation

Introduction

Organisations adopt new technologies to improve the efficiency and effectiveness of various work processes. Unfortunately, many technology-based products and services never reach their full potential, and some are simply rejected (Burton-Jones & Hubona, 2006). Failed investments in technology may not only cause financial losses, but also lead to dissatisfaction among employees (Venkatesh, 2000). Hence, explaining and predicting user adoption of new technology is important.

Much research in the Information Systems field has focused on identifying determinants of technology use, and over the past decades, various theories and approaches have been put forward to address this topic (King & He 2006).

According to Porter and Donthu (2006), two research paradigms have emerged to explain technology adoption and acceptance. One paradigm is system specific, and focuses on how a technology's attributes affect an individual's perception of a technology. This in turn affects the usage of the specific technology. The technology acceptance model (TAM) has come to be one of the most widely used models within this paradigm (King & He, 2006; Porter & Donthu, 2006). The two primary predictors in TAM that affect technology usage are *perceived usefulness* and *perceived ease of use* (Davis, Bagozzi, & Warshaw, 1989).

The other paradigm focuses on latent personality dimensions to explain the use and acceptance of new technologies (Porter & Donthu, 2006). In other words, an individual's personality influences the potential acceptance of technology in general. The technology readiness index (TRI) (Parasuraman, 2000) follows this approach. Technology readiness can be viewed as a gestalt resulting from four personality dimensions: optimism, innovativeness, discomfort, and insecurity. According to Parasuraman (2000) these personality dimensions affect people's tendency to embrace and use new technologies. In this respect, optimism and innovativeness function as mental enablers, while discomfort and insecurity function as mental inhibitors to accepting new technologies.

In the last decade, research has emerged combining the two paradigms by integrating the TRI and TAM into one model. Lin, Shih, Sher, and Wang (2005) and Lin, Shih, and Sher (2007) included technology readiness as an antecedent of perceived usefulness and perceived ease of use in TAM. Walczuch, Lemmink, and Streukens (2007) took a somewhat different approach by investigating how each dimension of technological readiness affects the predictors in TAM. We follow this last stream of research. Our goal is to identify aspects that explain and predict user adoption of new technologies. An integrated model will be sensitive to the general attitudes towards new technology (TRI), as well as to the perceived attributes of the system (TAM).

Theory

Technology Acceptance Model

The technology acceptance model (TAM) was designed specifically to explain computer usage behaviour. It is an adaptation of Fishbein and Azjen's (1975) theory of reasoned action (TRA), which has been successful in predicting and explaining behaviour in general (Malhotra & Galletta, 1999; Yi & Hwang, 2003).

There are two central determinants in TAM: *Perceived usefulness*, which refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320); and *perceived ease of use*, which refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320).

Following the theoretical basis of TRA, these perceived characteristics are expected to influence intensions to use a system, which in turn influence actual system usage (Davis et al., 1989). Furthermore, perceived ease of use is hypothesized to influence perceived usefulness. This hypothesis follows from the logic that improvements in ease of use of a system contribute to increased usefulness due to saved effort (Davis et al., 1989).

The TAM has received considerable support over the years. It has been validated over a wide range of systems, and perceived usefulness and perceived ease of use have proven to be reliable and valid cognitive dimensions (Burton-Jones & Hubona, 2006; King & He, 2006). Generally, the model explains between 30% and 40% of system usage (Burton-Jones & Hubona, 2006; Legris, Ingham, & Collerette, 2003). In addition, perceived usefulness is often found to be the strongest determinant in the model (Burton-Jones & Hubona, 2006; King & He, 2006; Legris et al., 2003; McFarland & Hamilton, 2006).

Since the original TAM was introduced, the model has undergone numerous adjustments. Some versions of TAM simply include perceived usefulness, perceived ease of use, and actual use of a particular system (e.g., Adams, Nelson, & Todd, 1992; Burton-Jones & Hubona, 2006; Davis, 1989). These adjustments have been adopted in this study.

Technology Readiness Index

Technology readiness (TR) refers to "people's propensity to embrace and use new technologies to accomplish goals in home life and at work" (Parasuraman, 2000, p. 308). It is a combination of positive and negative technology-related beliefs. These beliefs are assumed to vary among individuals. Collectively, these coexisting beliefs determine a person's predisposition to interact with new technology (Parasuraman & Colby 2001). Furthermore, findings show that these beliefs can be categorized into four dimensions: optimism, innovativeness, discomfort, and insecurity (Parasuraman, 2000).

- *Optimism* is defined as "a positive view of technology and a belief that it [technology] offers people increased control, flexibility, and efficiency in their lives" (Parasuraman & Colby, 2001, p. 34). It generally captures positive feelings about technology.

- *Innovativeness* is defined as "a tendency to be a technology pioneer and thought leader" (Parasuraman & Colby 2001, p. 36). This dimension generally measures to what degree individuals perceive themselves as being at the forefront of technology adoption.

- *Discomfort* is defined as "a perceived lack of control over technology and a feeling of being overwhelmed by it" (Parasuraman & Colby 2001, p. 41). This dimension generally measures the fear and concerns people experience when confronted with technology.

- *Insecurity* is defined as a "distrust of technology and scepticism about its ability to work properly" (Parasuraman & Colby, 2001, p. 44). This dimension focuses on concerns people may have in face of technology-based transactions.

Optimism and innovativeness are drivers of technology readiness. A high score on these dimensions will increase overall technology readiness. Discomfort and insecurity, on the other hand, are inhibitors of technology readiness. Thus, a high score on these dimensions will reduce overall technology readiness (Parasuraman, 2000). Results show that the four dimensions are fairly independent, each of them making a unique contribution to an individual's technology readiness (Parasuraman & Colby, 2001).

TRI emerged through an extensive multiphase research program in the United States. In the final 36-item scale the four dimensions demonstrated, for purposes of group analysis, a sound reliability with Cronbach's alpha ranging from .74 to .81. Further, Parasuraman (2000) found a positive relationship between TR scores and technology-related behaviours (i.e., ownership of new technology, use, and desirability to use in the future). A replication in Great Britain has further strengthened the soundness of the TRI. Tsikriktsis (2004) extracted the same four-factor structure with Cronbach's alpha ranging from .74 to .88. Both studies obtained large national cross sectional samples by conducting random based telephone interviews: A total of 1000 adults (over 18 years) participated in the United States, and 400 adults (over 16 years) participated in Great Britain (Parasuraman, 2000; Tsikriktsis, 2004).

An Integrated Model: Technology Readiness and Acceptance Model

The technology readiness and acceptance model (TRAM) is, as the name implies, an integration of the two models. First presented by Lin et al. (2005), TRAM represents the latest contribution to merge general personality dimensions of TRI with system specific dimensions of TAM. Thus, explaining how personality dimensions can influence the way people interact with, experience, and use new technology.

In the first attempt to integrate these two tests, technology readiness was used as a predictor of TAM (Lin et al., 2005). However, in a more recent study, factors comprising technology readiness have been linked directly to the dimensions of TAM (perceived usefulness and perceived ease of use), resulting in a more specific model (Walczuch et al., 2007). Optimism and innovativeness are thought to lead to higher perceived usefulness and ease of use of a given technology, whereas insecurity and discomfort are suggested to inhibit these dimensions of TAM.

Linkages between perceived usefulness, perceived ease of use, and actual use of technology are well established (Davis, 1989; Venkatesh & Davis, 2000; Schepers & Wetzels, 2007). However, an inclusion of actual use in the integrated model has not yet been proposed. By including actual use, interrelationships between factors can be displayed in a more comprehensive picture. Following the model proposed by Walczuch et al. (2007), we view the personality dimensions of TRI as antecedents to the cognitive dimensions of TAM. The inclusion of actual use would constitute a valuable extension of previously conducted research. The direct effects of TRI dimensions on actual use have previously been accounted for (Parasuraman & Colby, 2001). These direct effects are, however, not included in our proposed research model. There are two reasons for this. First, inclusion of external variables mediated through perceived usefulness and perceived ease of use is in accordance with the original model of TAM (Davies, 1989). Second, we attempted to provide a clear and at the same time simple representation of relationships among different variables within the model.

Research Model

People who are optimistic and innovative with reference to technology in general are thought to hold positive attitudes toward new technology and technology use. Therefore, we hypothesized that optimism and innovativeness are enablers that have positive effects on how people perceive and relate to new technology (Parasuraman & Colby, 2001; Tsikriktsis, 2004). Thus, we hypothesize:

H1. Optimism is positively related to perceived usefulness.

H2. Optimism is positively related to perceived ease of use.

H3. Innovativeness is positively related to perceived usefulness.

H4. Innovativeness is positively related to perceived ease of use.

Feelings of insecurity related to technology are on the other hand associated with ambiguity and low usage (Parasuraman & Colby, 2001; Tsikriktsis, 2004). In accordance with prior research we therefore assume that insecurity predicts lower levels of perceived usefulness and perceived ease of use. Thus, we hypothesize:

H5. Insecurity is negatively related to perceived usefulness.

H6. Insecurity is negatively related to perceived ease of use.

Discomfort, on the other hand, is not expected to have a negative impact on perceived usefulness. One would expect people to see the main value of a system, regardless of how they handle it. Still, discomfort is expected to affect perceived ease of use. A system that is not manageable is more likely to be a non user-friendly system. Thus, we hypothesize:

H7. Discomfort is not significantly related to perceived usefulness.

H8. Discomfort is negatively related to perceived ease of use.

It is widely acknowledged that perceived ease of use contributes to perceived usefulness (King & He, 2006; Lin et al., 2005; McFarland & Hamilton, 2004; Schepers & Wetzels, 2007; Venkatesh, 2000; Yang & Yoo, 2004). This assumption is based on the theoretical argument that some user-friendly applications could be perceived as useful, but not all useful applications are user-friendly. Thus, we hypothesize:

H9. Perceived ease of use is positively related to perceived usefulness.

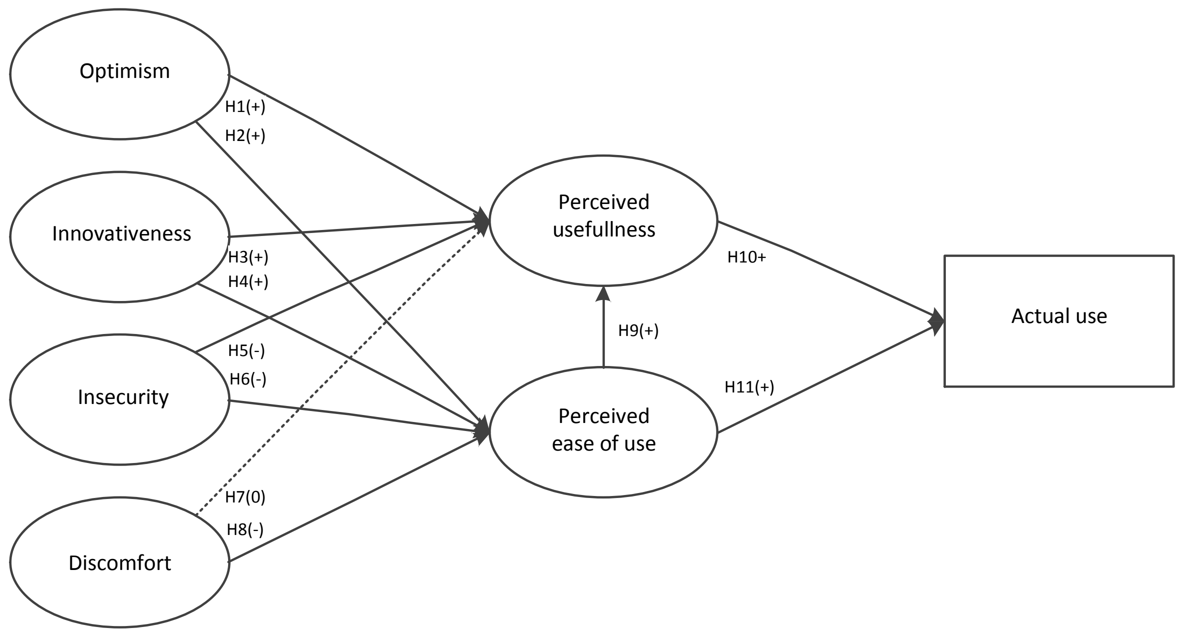

Figure 1. The integrated model (TRAM) with hypothesized relations among study variables.

According to Davis (1989) the main contributor to actual use of a new technology is its perceived usefulness. Hence, people primarily adopt new technologies based on their functions, rather than based on how easy it is to perform the functions. Users are, for instance, willing to adopt a difficult system if it captures a critical function. However, in practical terms, about 90% of research done on TAM also shows direct effects of perceived ease of use on actual use (Schepers & Wetzels, 2007). Thus, we hypothesize:

H10. Perceived usefulness is positively related to actual use.

H11. Perceived ease of use is positively related to actual use.

Figure 1 illustrates our research model including the hypothesised relationships between the dimensions of TRI, TAM, and actual use of technology.

Method

Sample

Our sample consisted of 186 employees from a variety of Norwegian private and government organisations. The sample can be further divided into two subgroups based on the respective technology of interest. 123 respondents used electronic health record (EHR) related to hospital work on a daily basis, and were all employed at the same health trust in the Central Norway Regional Health Authority. The EHR gives hospital employees the opportunity to produce, record, share, change, and connect patient data. The subgroup consisted of 89.4% women and 10.6% men. Age was reported in four categories as summarized in Table 1.

The other subgroup consisted of 63 respondents who used an external and internal instant messaging (IM) system. This subgroup consisted of respondents from numerous independent companies spread all over Norway. The IM system is meant to improve customer service by giving customers an additional communication channel suitable for answering less complex questions. The IM respondent sample consisted of 58.7% men and 41.3% women. Age was reported in categories as summarized in Table 1.

Surveys of the IM subgroup were administered to the different companies by mail, while surveys of the EHR subgroup were administered through contact persons within the health trust. Participation in the surveys was anonymous.

Questionnaire

The study questionnaire included the TRI developed by Parasuraman (2000) and the technology acceptance model (TAM) as introduced by Davis (1989) (see Appendix A and B for a complete list of the items in the TRI and TAM). The TRI is a multi-item scale comprising 36 technology belief statements, both positive and negative, related to one of the four TR dimensions. Each item was rated on a 5-point Likert scale (from 1 = strongly disagree to 5 = strongly agree).

Table 1

Distribution of sample age in categories

Age category	EHR group	IM group
21-30 years	25.2%	17.5%
31-40 years	23.6%	52.4%
41-50 years	26.8%	20.6%
>50 years	24.4%	9.5%

Note. Perceived usefulness and perceived ease of use were measured as distinct dimensions in the technology acceptance model. Each dimension comprises six items rated on a 7-point Likert scale (from 1 = extremely unlikely to 7 = extremely likely).

Both TRI and TAM items were first translated into Norwegian, and then back translated by a third independent person. Formulation of TAM items was modified in accordance with the technology used by respondents. *Actual use* was self-reported on a 7-point Likert scale (from 1 = not at all to 7 = several times a day).

Procedure

The research model was tested using structural equation (SEM) modelling which allows researchers to perform path analytic modelling with latent variables (Bollen, 1989). In our research design the latent variables representing TRI were *optimism, innovativeness, insecurity and discomfort.* TAM consisted of the two cognitive dimensions *perceived usefulness* and *perceived ease of use.* Items associated with each latent dimension were included in the structural equation model in Amos 6.0. Figure 1 displays interrelationships among the main study variables as hypothesized above.

Results

Preliminary Analyses

Before testing our hypotheses, we assessed the reliability and validity of the translated TRI and TAM scales. Confirmatory factor analysis (CFA) using structural equation modelling (SEM) was conducted in Amos 6.0 to examine to what degree each item corresponded to its respective latent dimension. Our limit for low factor loadings was set to .30, as recommended by Ulleberg and Nordvik (2001). Further, we assessed the Cronbach's alpha to test the internal consistency as a measure of reliability for each sub-scale. According to Nunnally (1978) alphas above .70 are acceptable for group analyses.

CFA of TRI scales revealed four items with low factor loadings (listed as INS6, INS7, INS8, and DIS9 in Appendix A). They were excluded from subsequent analyses. With these items excluded, Cronbach's alpha for TRI dimensions ranged from .68 to .84. The alpha values are presented in Table 2 along with the alphas obtained by Parasuraman (2000) in the United States and Tsikriktsis (2004) in Great Britain. Three of the four dimensions show acceptable reliability for group analysis. Cronbach's alpha for discomfort is just below the acceptance criteria as suggested by Nunnally (1978).

Regarding the CFA of TAM, all items showed high factor loadings (above .70). Hence, there was no need to exclude items from these scales. Both dimensions exhibited high levels of Cronbach's alpha (above .90) indicating very good reliability.

Table 2

Cronbach's alpha of TRI dimensions in Norway, United States, and Great Britain

Country	Optimism	Innovativeness	Discomfort	Insecurity
Norway	.84	.83	.68	.75
United States	.81	.80	.75	.74
Great Britain	.83	.85	.74	.88

Table 3

Results from structural equation modelling

Exogenous variable	Endogenous variable	β	*B*	*SE*
Optimism	Perceived usefulness	.30**	0.76	0.17
Innovativeness	Perceived usefulness	-.24**	-0.52	0.13
Insecurity	Perceived usefulness	-.08	-0.25	0.19
Discomfort	Perceived usefulness	.01	0.02	0.21
Optimism	Perceived ease of use	.46**	0.70	0.13
Innovativeness	Perceived ease of use	.18*	0.23	0.10
Insecurity	Perceived ease of use	-.06	-0.12	0.16
Discomfort	Perceived ease of use	-.13	-0.28	0.18
Perceived ease of use	Perceived usefulness	.59**	0.97	0.12
Perceived ease of use	Frequency use	.13	0.22	0.18
Perceived usefulness	Frequency use	.33**	0.36	0.11

Note. $^{*}p < .05$. $^{**}p < .01$.

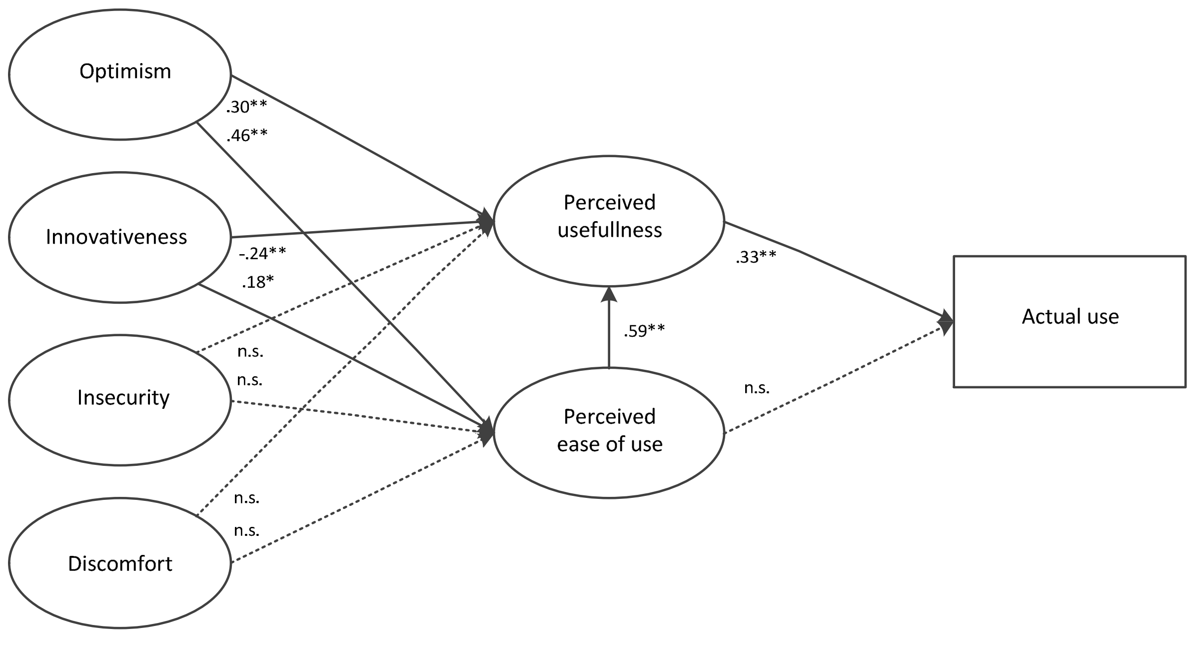

Figure 2. The integrated model (TRAM) with standardized estimates from path analysis. $^{*}p < .05$. $^{**}p < .01$.

Structural Equation Modelling

Estimation results from the SEM-analysis are summarized in Table 3. Inspection of individual coefficients for the hypothesized relations among study variables revealed that only optimism and innovativeness had a significant influence on perceived usefulness and perceived ease of use. Moreover, optimism was the strongest predictor of both perceived usefulness ($\beta = .30$, $t(180) = 4.41$, $p < .01$) and perceived ease of use ($\beta = .46$, $t(180) = 5.38$, $p < .01$).

We detected a significant positive relationship between the following study variables: optimism and perceived usefulness, optimism and perceived ease of use, as well as innovativeness and perceived ease of use. These results supported hypotheses H1, H2, and H4. Contrary to hypothesis H3, the significant relationship between innovativeness and perceived usefulness was negative. The relationships between the remaining TR personality dimensions (insecurity and discomfort) and the cognitive dimensions of TAM (perceived usefulness and perceived ease of use) were not significant. Hence, hypotheses H5, H6, and H8 were rejected. Note that the relationship between discomfort and perceived usefulness was expected to be not significant. Hence, hypothesis H7 was supported.

In accordance with hypothesis H9, we obtained a significant positive relationship between perceived usefulness and perceived ease of use ($\beta = .59$, $t(180) = 8.08$, $p < .01$). Further, the analysis revealed positive relationships between the cognitive dimensions of TAM and actual use. However, only perceived usefulness showed a significant influence. Accordingly, hypothesis H10 was supported while hypothesis H11 was rejected. Perceived ease of use does, however, affect actual use indirectly (through perceived usefulness). In sum, six of eleven hypotheses were supported. The hypothesized relationships and respective results are depicted in Figure 2 including standardized estimates for significant results. The overall model was found to have an acceptable fit at best ($\chi^2 = 1764.2$, df = 935, $\chi^2(935) = 1.89$, RMSEA = .07, CFI = .82, TLI = .81). χ^2 /df ratio and RMSEA are acceptable, but CFI and TLI are below general cut-off criteria (.95) for acceptable fit as proposed by Schreiber, Nora, Stage, Barlow, and King (2006).

Discussion

This study has investigated the relationships between personality dimensions as proposed in TRI and main elements of TAM (i.e., perceived usefulness, perceived ease of use, and actual use).

Our findings reveal that some, but not all, personality dimensions of TRI influence technology acceptance and usage. Optimism and innovativeness were the only personality dimensions that significantly affected perceived usefulness and perceived ease of use. The positive relationship between optimism and the cognitive dimensions of TAM can be interpreted as follows: An individual that is optimistic about technology in general, will find a specific system more useful, and easier to use, than someone less optimistic.

The effect of innovativeness was more intriguing. As expected, we obtained a positive relationship between innovativeness and perceived ease of use. This result implies that innovative people find it easier to use a system. Unexpectedly, however, the relationship between innovativeness and perceived usefulness was negative. Thus, highly innovative people find systems less useful than less innovative people.

This is somewhat contradictory to previous findings, where innovativeness was found to have a positive effect on the adoption level of technology (Jong, Ruyter, & Lemmink, 2003; Ward, Chitty, & Graham, 2007). Then again, Walczuch et al. (2007) found the exact same negative relationship between innovativeness and perceived usefulness as the present study. They concluded "that innovative people are more critical towards technology since they are aware of the newest developments and possibilities, and expect all technology to fulfil highest demands" (p. 212).

Based on our results, the question that arises is how innovativeness can be positively related to technology adoption, and at the same time negatively related to perceived usefulness? One possible explanation is that highly innovative people are more willing to adopt and try new technologies as compared to people characterized by low levels of innovativeness. However, innovative people would easily cease to use a system due to their high standards for new technological development.

Insecurity and discomfort had no significant effect on the cognitive dimensions of TAM. Except for the relationship between discomfort and perceived usefulness, this result had not been expected. However, the beta coefficients were in the predicted direction, and a larger sample size may have led to significant results. Yet, even with a larger sample size and significant relationships, the effects would be small due to the low standardized beta coefficients.

Further, our analyses revealed that actual use was directly affected by perceived usefulness, but not by perceived ease of use. However, the positive relationship between perceived ease of use and perceived usefulness indicated an indirect influence of perceived ease of use on actual use. To summarise, the perceived characteristics of the systems, influence actual usage, and perceived usefulness were found to provide the main contribution to system usage. These findings are in accordance with the majority of previous research on TAM (e.g., King & He, 2006; Legris et al., 2003; Schepers & Wetzels, 2007).

Limitations and Perspectives for Future Research

There are several limitations to be mentioned with regard to this study. First, by testing the model on two different technologies simultaneously, the total outcome may have been biased. There may be problems with the comparability between IM and EHR in terms of importance, usefulness, and necessity. For instance, in Norwegian health trusts, the use of EHR is mandatory. This may have caused little variation in the dependent variable (actual use). An investigation of how mandatory use affects adoption of technology as compared to voluntary use would be of major interest for the field.

Second, the subgroups within our sample display demographic differences. The EHR group consists mainly of women (89.4%), while age is evenly distributed. The IM group is evenly distributed with regard to gender, but the majority of participants belong to the same age group (52.4% of participants are between 31-40 years). These different kinds of homogeneity in gender or age may have biased our results. Future research should attempt to eliminate possible confounding effects of age and gender. It is also advisable to assess age in a more specific metric manner.

Third, deleting items from the TRI scales may cause a validity problem. However, only four out of 36 items were deleted. Removing three items from the insecurity dimension, and one item from the discomfort dimension led to higher reliability of the two dimensions, and a better overall model fit, hence improving internal consistency. It is recommended by Ulleberg and Nordvik (2001) to exclude low factor loadings. As long as the majority of items of each TRI dimension are still included into subsequent analyses, it is viable to assume that the reduced item subsets still measure the constructs in question. One reason for partly lower factor loadings may be the translation of original items into Norwegian. Further, it is possible that some of the TRI items are outdated. Some of the statements in the test may therefore begin to lose a sense of what they once were meant to capture. For example, the statement "The human touch is very important when doing business with a company" could be related to stronger participant feelings when evaluated ten years ago than it does nowadays. Hence, updating items and subsequent scale revision and validation may be a viable direction for future research.

Fourth, the Cronbach's alpha for discomfort is below Nunnally's (1978) suggested cut-off value (.70). It is also low, compared to the values obtained in the United States and Great Britain, as presented in Table 2. The reasons for low scale reliability in the Norwegian sample may be again related to poor translations of some items. However, according to Sekaran (2000) Cronbach's alpha with values between .60 and .70 is acceptable for studies with between-group analysis designs.

Fifth, when translating the TRI and TAM items, further assessment of reliability should have been undertaken. It is argued above that we obtained acceptable results for the internal consistency of each dimension. There is, however, no guarantee for this consistency over time. Assessment of test-retest reliability could have dealt with this limitation, and strengthened study results.

Sixth, the TRAM represents a fairly complex model, and the complexity could easily expand further with additional paths and variables. From a theoretical point of view, there is no limit to the complexity of a model. However, a thin line persists between model complexity and comprehensiveness. Research that examines TRAM connections beyond those that have been presented in this study, will add to the understanding of implementation of new technologies in general. It would be interesting to see to what degree TRI dimensions correspond to actual use directly. If insecurity and discomfort are not mediated through TAM, the dimensions may have direct effects on actual use. It is also possible that the effects of these dimensions are mediated through other variables not included in this study, such as social norms, for example. Further, this study has focused on technology related beliefs and perceptions. How this corresponds to more generic personality traits has to our knowledge not been investigated thus far. We encourage future research looking into these aspects.

Finally, generalizing these results to other technologies should be done with caution. IM and EHR can be categorized as interactive technology as they both simplify communication and sharing of information via computer networks. They were also fairly novel technologies in the organisational settings in which we tested them. It is viable to transfer our results to other novel technologies, especially in organisational contexts. In contrast, adopting our results to well-established technologies is more problematic as the TRI is less applicable to such systems. We believe that the link between technological readiness and technological acceptance is worth further consideration by testing the TRAM model on different new technologies in different settings (e.g., organisational, educational and private). Only thorough research in this area can determine to what degree the relationships between model dimensions depend upon technology and context.

Conclusion

The results from this study replicate and extend earlier findings from Walczuch et al. (2007) to a large extent. The personality dimensions of TRI influence cognitive dimensions of TAM, and subsequently, technology usage. The integrated model expands prior models due to its focus on both individual and system specific characteristics.

On one hand, when introducing new technology, considerable emphasis should be placed on users and their general attitudes toward technology, especially in settings where it may be impractical to test the system before it is adopted. When general knowledge about users has been obtained, necessary steps could be taken to initiate successful implementations.

On the other hand, the model explains why some systems are rejected even in organisations where people are highly optimistic toward technology in general. If specific characteristics (i.e., perceived usefulness and perceived ease of use) are too low, a system will be rejected regardless of people's general technology readiness. Hence, measures of perceived usefulness and perceived ease of use provide valuable additional information for those who design and implement new technology.

In sum, a combination of the two models in TRAM comprises a holistic view. It indicates that adoption of new technologies involves individual as well as system specific factors. In our view, a fundamental aspect of research is that it should be applicable. In this respect, an integration of psychometric constructs and system-related experiences is future-oriented, innovative, and useful.

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Appendix A

Table 1

Technology readiness index (TRI) items

Optimism	
OPT1	Technology gives people more control over their daily lives
OPT2	Products and services that use the newest technologies are much more convenient to use
OPT3	You like the idea of doing business via computers because you are not limited to regular business hours
OPT4	You prefer to use the most advanced technology available
OPT5	You like computer programs that allow you to tailor things to fit your own needs
OPT6	Technology makes you more efficient in your occupation
OPT7	You find new technologies to be mentally stimulating
OPT8	Technology gives you more freedom of mobility
OPT9	Learning about technology can be as rewarding as the technology itself
OPT10	You feel confident that machines will follow through with what you instructed them to do
Innovativeness	
INN1	Other people come to you for advice on new technologies
INN2	It seems your friends are learning more about the newest technologies than you are [reverse scored]
INN3	In general, you are among the first in your circle of friends to acquire new technology when it appears
INN4	You can usually figure out new high-tech products and services without help from others
INN5	You keep up with the latest technological developments in your areas of interest
INN6	You enjoy the challenge of figuring out high-tech gadgets
INN7	You find you have fewer problems than other people in making technology work for you
Discomfort	
DIS1	Technical support lines are not helpful because they do not explain things in terms you understand
DIS2	Sometimes, you think that technology systems are not designed for use by ordinary people

Technology readiness index (TRI) items *(continued)*	
DIS3	There is no such thing as a manual for a high-tech product or service that is written in plain language
DIS4	When you get technical support from a provider of a high-tech product or service, you sometimes feel as if you are being taken advantage of by someone who knows more than you do
DIS5	If you buy a high-tech product or service, you prefer to have the basic model over one with a lot of extra features
DIS6	It is embarrassing when you have trouble with a high-tech gadget while people are watching
DIS7	There should be caution in replacing important people-tasks with technology because new technology can breakdown or get disconnected
DIS8	Many new technologies have health or safety risks that are not discovered until after people have used them
DIS9	New technology makes it too easy for governments and companies to spy on people
DIS10	Technology always seems to fail at the worst possible time
Insecurity	
INS1	You do not consider it safe giving out a credit card number over a computer
INS2	You do not consider it safe to do any kind of financial business online
INS3	You worry that information you send over the Internet will be seen by other people
INS4	You do not feel confident doing business with a place that can only be reached online
INS5	Any business transaction you do electronically should be confirmed later with something in writing
INS6	Whenever something gets automated, you need to check carefully that the machine or computer is not making mistakes
INS7	The human touch is very important when doing business with a company
INS8	When you call a business, you prefer to talk to a person rather than a machine
INS9	If you provide information to a machine or over the Internet, you can never be sure it really gets to right place

Note. The questionnaire compromising the TRI, is copyrighted by A. Parasuraman and Rockbridge Associates, Inc., 1999, and is adapted with written permission. TRI items from Parasuraman (2000) were translated into Norwegian.

Appendix B

Table 1

Technology acceptance model (TAM) items

Perceived usefulness	
USE1	(. . .) enables me to accomplish tasks more quickly
USE2	Using (. . .) improves my job performance
USE3	Using (. . .) increases my productivity
USE4	Using (. . .) enhances my effectiveness on the job
USE5	Using (. . .) makes it easier to do my job
USE6	Overall, I find (. . .) useful in my job
Perceived ease of use	
EASE1	Learning to operate the (. . .) is easy for me
EASE2	I find it easy to get the (. . .) to do what I want it to do
EASE3	Usage of the (. . .) is clear and understandable
EASE4	I find it cumbersome to use the (. . .)
EASE5	It is easy for me to remember how to perform tasks using (. . .)
EASE6	Overall, I find the (. . .) easy to use

Note. TAM items from Davies (1989) were translated into Norwegian.