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Psychosocial factors affecting the adoption of technology in an institution of higher education

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This study investigated the psychological and social factors pertinent to the adoption of information and communication technology within a tertiary education institution. A conceptual model grouped the independent variables as individual characteristics, the individual's perception of group characteristics and the individual's perception of organisation characteristics. The dependent variable, the adoption of new technology, was indicated by the actual usage of telematic educational technologies by postgraduate teaching staff. In this study the results showed that attitudes towards new technology and management support were among the most important determinants of technology adoption. Certain implications for tertiary institutions were pointed out.

Psigososiale faktore van belang vir die aanvaarding van tegnologie aan 'n hoëronderwysinstelling

Die studie het die sielkundige en sosiale faktore ondersoek wat belangrik is vir die aanvaarding van inligting- en kommunikasietegnologie aan 'n tersiêre onderwysinstelling. Aan die hand van 'n konseptuele model is die onafhanklike veranderlikes gegroepeer in individuele eienskappe, die individu se persepsie van groepseienskappe en die individu se persepsie van organisasie-eienskappe. Die aanvaarding van tegnologie, as die afhanklike veranderlike, was aangedui deur die mate van werklike gebruik van telematiese tegnologie deur nagraadse dosente. Die resultate in hierdie studie het aangedui dat houdings teenoor nuwe tegnologie en bestuursondersteuning van die belangrikste voorspellers is vir die aanvaarding van tegnologie. Sekere implikasies vir tersiêre onderwysinstellings word aangedui.

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The rate of technological development is forever increasing, resulting in an accelerated need to change and adapt to the dynamic context in which we find ourselves. Organisations are faced with the challenge of the diffusion and adoption of these new technologies by staff. According to Karahanna & Straub (1999), the rate of technological change does not necessarily imply a similar rate of adoption, as adoption and technology usage are dependent on the psychology of user acceptance.

Technological innovations, with specific reference to information and communication technologies, have become a crucial part of everyday functioning. Duderstadt (1998) indicates that the main difference between the challenges of the eighties and the late nineties to higher education institutions is the rapid advancement of technology — a technological revolution which will continue to challenge higher education institutions in the foreseeable future. He further indicates that the rapid advancement in information technology has already had a substantial impact on campus activities.

Universities are now competing in the international arena and it is becoming essential for staff to adapt to change and embrace technological developments. The adoption of various technologies, such as telematic educational technologies, will assist universities to increase their market, to diversify in terms of educational strategies, and to achieve international competitiveness. Given the increasing rate of technological change, the strategic role of technology, and the importance of staff acceptance and adoption of technology, it is necessary to determine the social and psychological variables that contribute to the process of technology adoption. An understanding of both individual characteristics and the social system in which adoption occurs is essential. Armed with knowledge as to why people adopt or do not adopt technology, and of what motivates them to do so, will facilitate the management of information technology diffusion and adoption as well as ensuring the support expected from the implementation of the new technologies.

The significance of this research is to broaden the knowledge base and the understanding of the adoption of technology by focusing on the social and psychological factors of teaching staff within the higher educational context. The research study attempted to highlight the

social and psychological factors related to the individual level of technology adoption and provide an empirical basis for understanding the adoption of telematic educational technologies.

Such technologies may be incorporated within contact-based tuition programmes, continuing education programmes or distance education programmes. The flexibility of these technologies not only enhances traditional educational models but also offers innovative methods of teaching and learning. A whole new paradigm of education has emerged. The National Working Group's report to the Minister of Education (2001) on *The restructuring of the higher education system in South Africa* indicates that information and communication technologies can play a role in enhancing the quality of teaching. It goes on to say that programmes offered via these technologies could target non-traditional students and, in so doing, increase the participation rate and involvement of students who would otherwise have been denied access to higher education. By incorporating telematic educational technologies within the learning environment, universities will be able to stay abreast of change, enhance their competitiveness and offer students learning environments characterised by quality and flexibility.

1. The complexity of innovation adoption

Innovation adoption does not occur within a vacuum. It is a complex, multi-faceted phenomenon. Over the past few decades voluminous research has accumulated about the variables that influence the adoption of innovations.

An innovation is defined as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers 1995: 11). The rate of adoption is "the relative speed with which an innovation is adopted by members of a social system" (Rogers 1995: 22). Adoption refers to the decision of an individual/organisation to make use of an innovation, whereas diffusion refers to "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers 1995: 5).

The adoption of technology is a social phenomenon influenced by various innate factors and individual psychological characteristics, as

well as by the dynamics of groups and the interaction between individuals within a specific context.

When an innovation is initially introduced, not everyone adopts it at the same time and some never adopt the innovation (Durrington *et al* 2000). Various research studies have been conducted to determine the variables associated with technology adoption. Variables that focus on individual, organisational, technology and group characteristics have been identified as significant predictors of technology adoption.

Innovations such as e-mail, the internet, the Worldwide Web and telematic educational technologies are currently receiving attention in research studies, and will form the focus of this study.

The model devised by Sultan & Chan (2000) focuses on the organisational, individual, group and technological characteristics that are hypothesised as influencing the adoption of new technology (Figure 1). This model differentiates between adopters and non-adopters of technology in firms. The dependent variable in their study (Y) is the adoption of a new technology. This variable is related to the following independent variables: individual factors (X_1); group factors (X_2); company factors (X_3); and technology factors (X_4). The hypothesised relationships are shown in parenthesis, where (+) indicates that the variable is positively related to the adoption of technology and (-) that it is negatively related. In developing a statistical model, Y can take on specific values, such as $Y=1$ if the individual within an organisation is an adopter of new technology, and $Y=0$ if not. Sultan & Chan's study shows that "individual characteristics, perception of group characteristics, and company characteristics are significantly related" to technology adoption, but that "the individual's perception of the technology is not" (Sultan & Chan 2000: 106).

Based on the model proposed by Sultan & Chan (2000), as well as other research and literature (see below), an adapted model will be presented in the following section (cf Van Niekerk 2002). The independent variables (X_i) were revised, redefined, operationalised and measured. The data was then analysed in order to determine the differences in key variables for adopters and non-adopters of new technology.

Figure 1: Research model for the adoption of technology
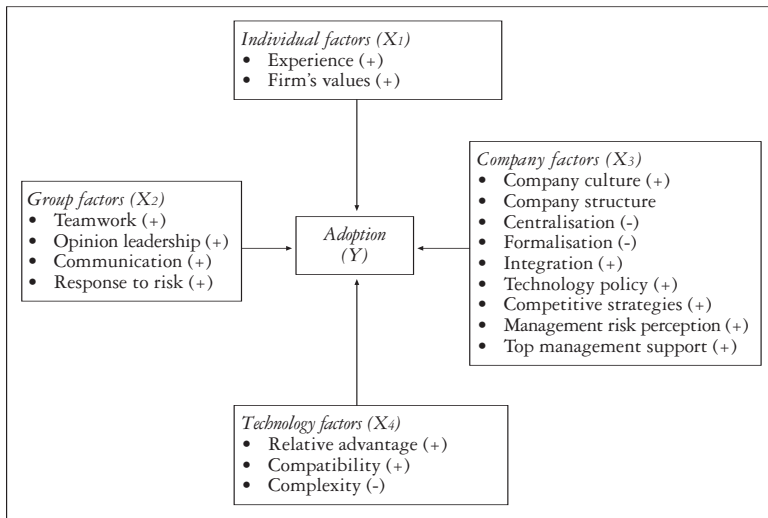
2. A multi-faceted approach to the adoption of innovation: an overview of the relevant variables

Van Niekerk (2002) reviewed current literature and research, from which it became evident that innovation adoption is a complex process affected by a myriad of variables. Individual characteristics as well as perceptions of group and company characteristics were found to be of relevance in Sultan & Chan (2000). The fourth factor, namely the perception of technological characteristics, was not found to be significant in Sultan & Chan's study. Based on Van Niekerk's review as well as Sultan & Chan's findings, the individual, group and company characteristics were adapted for the current study, and uniquely operationalised. Technological characteristics were excluded from this study as this factor was not found to be significant by Sultan & Chan.

2.1 Individual characteristics

The first set of variables to be considered relate to the characteristics of the individual. Those included in this study were: experience, atti-

tudes, self-efficacy, cognitive style, proactive attitude and pro-active coping.

2.1.1 Experience

Experience refers to encounters that people have gone through. In terms of this study, experience refers to how long the person has been a lecturer.

In the literature contradictory positions are held with regard to the influence of experience on technology adoption, which is complex. Sultan & Chan (2000: 109) hypothesised "that the experience of organization members may influence adoption decision-making". The results of their study, however, did not support this hypothesis. Other researchers, such as Bandura (1982), Bateman & Zeithaml (1989), Hill *et al* (1987), and Perkins & Rao (1990) found that experience did enable people to contribute more meaningfully to innovation decisions. Their results indicate that the degree of experience which people possess increases their ability to make innovative decisions. Tabak & Barr (1999: 254) hypothesised that

> … past success in innovation adoption decisions would increase the tendency to interpret new adoption alternatives more positively and functionally.

They found past experience to be a variable significantly related to the adoption of technological innovations.

2.1.2 Attitudes

Attitudes shape both our social world and our social behaviour. They involve associations between attitude objects and evaluations of those objects (Baron & Byrne 1994). Attitudes include the disposition to evaluate certain objects consistently as positive or negative and to behave towards these objects in a manner congruent with these evaluations. Attitudes include an element of "for" and "against" (Allport 1961).

Research conducted has shown that attitudes play a significant role in the adoption of technology:

> Attitudes and behavior, it appears, are often closely linked. This is not always the case, and the relationship between them is far more complex than common sense would suggest. In general, though, at-

> titudes do predict many forms of social behavior across a wide range
> of contexts (Baron & Byrne 1994: 137).

Rogers's (1983) innovation theory explains that before a decision to adopt an innovation is made, a favourable or unfavourable attitude towards it has already been formed. According to the Theory of Reasoned Action (TRA) "one's actual usage of IT will be a function of one's attitude towards its use" (Moore & Benbasat 1996: 132). Moore & Benbasat (1996: 132) found that "both one's own attitude and the expectations of others influenced the degree to which one used IT after adoption".

It is thus important to assess the contribution of attitude since it appears to play an important role in the adoption of technology.

2.1.3 Self-efficacy

According to Bandura (1977a: 185), "self-efficacy is the component of the self-concept that deals with one's perceived abilities and competencies to deal with a given task". Bandura (1977b) goes on to say that self-efficacy is the expectancy that one's efforts will lead to successful accomplishment, a point well illustrated by Baron & Byrne's (1994: 186) comment that self-efficacy predicts the academic success of professors:

> Faculty members who are high in self-efficacy and job involvement tend to set goals and engage in many projects simultaneously. These behaviors lead to their work being published [...] in turn lead [ing] to academic success.

Self-efficacy is almost always beneficial, and increases in self-efficacy lead to improved performance (Bandura 1989).

According to Bandura (1989), people with high self-efficacy are more active in their beliefs and abilities, manage situations proactively and solve problems creatively. Rogers (1995) describes early adopters as less fatalistic than late adopters. Since fatalism is the extent to which one perceives oneself to have no control over goals or the future, the opposite tendency, or the extent to which one feels that one has control and is actually efficacious will increase the probability of one's adopting new technology (Rogers 1995). In a similar vein Tabak & Barr (1999) found that self-efficacy had a significant positive rela-

tionship with the intention to adopt potential innovations. Gist & Mitchell (1992) have shown that self-efficacy influences decision-making.

One can thus hypothesise that someone with high self-efficacy in terms of technology usage will have a greater potential to adopt new technology.

2.1.4 Cognitive style

Researchers are aware of the importance of cognitive processes and realise that these must be taken into account in any attempt to understand behaviour. Cognitive processes such as memory, reasoning and inference are "processes that underlie our thoughts, beliefs, ideas and judgments" (Baron & Byrne 1994: 9). They are influenced by biological inheritance as well as by environmental influences. The concept of cognitive ability, which can be described as intelligence and refers to the ability to integrate and interpret large amounts of information (Kirkpatrick & Locke 1991), is related, as is cognitive style, which is one's general method or style of dealing with the environment, and develops as one matures (Morris 1988).

According to Rogers (1995), early adopters are less dogmatic: they welcome new ideas and have a greater ability to deal with abstractions; they are able to adopt an innovation on the basis of rather abstract stimuli, and they are more rational and intelligent than later adopters. All these aspects define a certain cognitive style that appears to be necessary for the adoption of innovations.

2.1.5 Pro-active attitude

Pro-active attitude, as defined by Schwarzer *et al* (1999a), is

> ... a belief in the rich potential of changes that can be made to improve oneself and one's environment. This includes various facets such as resourcefulness, responsibility, values and vision.

According to Schwarzer *et al* (1999a), the pro-active individual believes that s/he has sufficient internal or external resources to attain goals. S/he takes responsibility for his/her own development and focuses on solutions as opposed to problems. The pro-active person is driven by values and has vision, creating meaning in life by striving for am-

bitious goals. Values are also influenced by external factors during socialisation

Researchers such as Corfman *et al* (1991), Janis (1982), O'Reilly & Chatman (1986), Peters & Waterman (1982), and Sultan & Chan (2000) have found that values and vision — components of pro-active attitude — are significant variables in the adoption of technology. The reason is probably that when people in an organisation share values, they have common ground, which is strengthened if it is further shared with the company as a whole.

2.1.6   Pro-active coping

While pro-active attitude deals with internal orientation, pro-active coping focuses on setting and achieving goals:

> [P]roactive coping is autonomous and self-determined goal setting and realisation of goals; it deals with self-regulatory goal attainment processes and explains what motivates people to strive for ambitious goals and to commit themselves to personal quality management (Schwarzer *et al* 1999b).

Bagozzi *et al* (1992) introduced the idea of goal pursuit as a significant variable in the adoption of technology. When one perceives certain behaviour as a problem, one perceives it as a goal or an end state. Their research findings show that the psychological processes associated with the formation and pursuit of goals are important considerations in the adoption of computer technologies (Bagozzi *et al* 1992).

2.2 The individual's perceptions of group characteristics

The second set of variables to be considered in this study relate to an individual's perceptions of the characteristics of the group. Based on the literature and research conducted in this field, as well as Sultan & Chan's findings, two variables will be addressed here: teamwork and communication.

2.2.1   Teamwork: collective teacher self-efficacy

According to Schwarzer *et al* (1999) collective self-efficacy refers to a group's belief that they are competent as a group, that they are able to deal with obstacles and goals. It is similar to individual self-efficacy but at the level of the group. It involves teamwork, which can

be defined as two or more individuals working together where the group effort amounts to more than the sum of the parts. Sultan & Chan (2000: 109) define teamwork as "several individuals performing work that subordinates personal prominence to the efficiency of the whole".

Investigations on the importance of teamwork, co-operation and unity (cohesiveness) have been conducted by Barclay (1991), Baron & Byrne (1994), Coopey (1987), Janis (1982), Sultan & Chan (2000), and Zaccaro & McCoy (1988), among others. According to Rogers (1995), early adopters are more socially participative, have greater exposure to interpersonal communications and are more highly interconnected through interpersonal networks than late adopters. If a group is cohesive and its goals correspond to those of the organization, then group behaviour will probably be conducive to organisational goals (cf Ivancevich & Matterson 1996). If the organization's goals involve technology adoption, one can hypothesise that this will also be among the goals of a cohesive team, and "more teamwork among group members will positively drive technology adoption" (Sultan & Chan 2000: 110). The findings of these researchers also indicate that adopters of technology are more inclined than non-adopters to perceive teamwork within the group as important.

2.2.2   Communication

Communication is defined as the transition of information and understanding through the use of common symbols, which may be verbal or non-verbal (Ivancevich & Matterson 1996). Rogers (1995: 335) defines communication as

> ... a process in which participants create and share information with one another in order to reach a mutual understanding [...] the contact between a change agent and clients.

Rogers goes on to say that most people will evaluate a new technology not on the scientific information provided by the experts, but rather from the subjective evaluations of colleagues who have adopted it. Communication between individuals plays a vital role in the dissemination of technological information and the adoption of technology.

Research by Carter *et al* (2001), Durrington *et al* (2000), Frambach & Schillewaert (2002), Friestad & Wright (1994), Rogers (1995), Sultan & Chan (2000) and Tang (2000), among others, has shown that the influence on communication on the adoption of technology is crucial. According to Sultan & Chan (2000: 110),

> … the literature suggests that increased communication between members of an adopting unit promotes adoption and communication network links are crucial for technology adoption.

In addition, their research findings indicate that adopters communicate more than non-adopters. This finding is similar to that of Rogers, in that early adopters have greater exposure to interpersonal communication and are more highly interconnected through interpersonal networks than late adopters.

In addition to the importance of informal communication and interpersonal networks, Carter *et al* (2001: 285) found that the use of formal communication networks also contributes to technology adoption.

2.3 The individual's perception of organisational characteristics

The third and last set of variables to be considered relates to the individual's perceptions of the characteristics of the organisation. Based on the literature review and on research conducted in the field, as well as Sultan & Chan's (2000) findings, three variables will be addressed: culture, structure and management support.

2.3.1 Culture

Culture can be defined as "a unique system of values, beliefs and norms that members of an organization share [and] an important cause of effectiveness" (Gibson *et al* 1988: 45). Sultan & Chan (2000) define culture as "an integration of human behaviour that includes thought, speech, and action of an organization". A positive culture within an organisation may sustain a competitive advantage, as cultures are not easily imitated (Barney 1986).

Sultan & Chan (2000) found that adopting subjects perceived their companies as supportive and nurturing. They concluded that a

supportive company culture is therefore positively related to the adoption of technology. Organisations that are flexible and consensual, promoting the empowerment of staff, are more likely to innovate (Burns & Stalker 1961). West (1990) asserts that greater participation in decision-making decreases resistance to change, which makes the adoption of new technology more likely. Lai & Guynes (1997) concur that organisational openness will positively influence adoption. The research suggests that the more collaborative and participative decision-making is within an organisation, the greater the likelihood that new technology will be adopted (Sultan & Chan 2000).

2.3.2 Structure

Another aspect impacting on culture is the structure of the organisation. According to Tung *et al* (2000: 371) "culture refers to the structure, style and shared values of an organization". Structure is defined as the "degree of complexity, formalization, and centralization in the organization" (Robbins 1991: 460). Complexity refers to vertical, horizontal and spatial differentiation within an organisation; formalisation to the degree to which jobs in an organisation are standardised, and centralisation to whether decision-making is centralised at a single point.

Previous research indicates that the structure of an organisation impacts on technology adoption (Sultan & Chan 2000). Coopey (1987) found a negative correlation between centralisation and adoption. Sultan & Chan (2000: 111) assert that in most studies, including their own,

> ... the results show that organizations that allow more participative decision-making or [are] less centralized and less formalized in sharing of ideas and information across functional work groups would be more innovative. Individuals within such organizations would therefore be more likely to adopt new technology.

2.3.3 Management support

Management support is "the continual active and enthusiastic approval of senior executives for a proposed innovation" (Sultan & Chan 2000: 111). A management commitment provides a positive environment for the adoption of technology. Management support is provided through

open communication, a nurturing climate, commitment and the availability of resources for the adoption of new technology.

Research has shown that management support is positively related to the adoption of technology. Sultan & Chan (2000) found that adopters have a higher degree of management support. Eder & Igbaria (2001), Moore & Benbasat (1996), Premkumar & Roberts (1999), and Tang (2000) found that as management support increases, so does successful technology adoption. Management support appears to be an important determining factor. Many of the factors mentioned above involve congruence between the organisation's values and goals and those of the individual and the group. If management facilitates and supports certain goals in an organisation, such as technology adoption, then success is more likely, especially in combination with other factors that are deeper and less ingrained in the organisation (such as values and cohesiveness or teamwork).

To summarise the discussion above and indicate the relevant variables used in this study an adapted conceptual model (Figure 2) is shown below. This model aimed at differentiating between adopters and non-adopters of technology in organisations. The dependent variable (Y) in this study is the adoption of a new technology. This variable is related to the following independent variables: individual factors (X_1); an individual's perception of group factors (X_2), and an individual's perception of organisational factors (X_3). The hypothesised relationships are shown in parenthesis, where (+) indicates that the variable is positively related to the adoption of technology and (-) negatively. $Y=1$ if an individual within an organisation is an adopter of new technology, and $Y=0$ if not.

3. Method

3.1 Participants and procedure

This research study was conducted within the Faculty of Engineering, Built Environment and Information Technology of the University of Pretoria. By its very nature, *ie* the engineering and information technology fields, the faculty selected allows for the incorporation of advanced technologies within the curricula and was thus an appropriate

Figure 2: Heuristic model
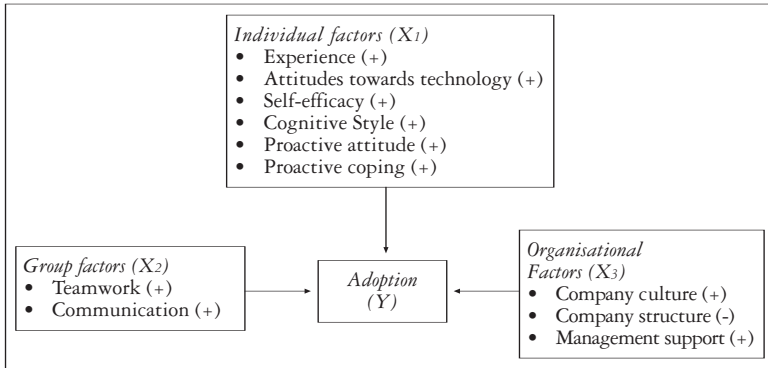
and relevant faculty in which to conduct the study. The population (N=122) consisted of academic staff members teaching postgraduate students. The reason for this delineation was that the research focused on telematic education technologies. Approximately 80% of telematic education programmes offered at the University of Pretoria are at the postgraduate level, as opposed to only 20% undergraduate (including diplomas and certificates). All the telematic education programmes currently offered within the Faculty of Engineering, Built Environment and Information Technology are at the postgraduate level. The entire population, *ie* all lecturers and professors teaching postgraduates, was targeted in the study, a selection method which eliminated selection bias, as recommended in terms of the limitations identified by Sultan & Chan (2000). The target group consisted of all postgraduate lecturers or professors.

Data was elicited directly from the target group. An introductory letter explaining the research study was compiled and electronically distributed to the target group together with two questionnaires and a consent form. Follow-up e-mails were sent as reminders in order to facilitate data collection. After two weeks hard copies of the questionnaires were sent to each prospective respondent via internal mail, since it was hoped that some of those who had not completed the questionnaires electronically would complete a hard copy, as was in-

deed the case. Anonymity was ensured. Of the 122 prospective respondents, 50 completed the questionnaires and returned them either electronically or as hard copy via internal mail.

Based on the criteria set out above, 14 of the 50 respondents adhered to all three criteria. Therefore, 14 respondents were classified as adopters in this study and 36 as non-adopters. Adopters represented only 28% of the sample group, and non-adopters 72%. It thus appears that the implementation of telematic educational technologies is in the initial stages of adoption.

3.2 Measuring instruments

The measuring instruments comprised two questionnaires, which were the primary method of data collection. The first questionnaire was biographical, while the second employed Likert-type questions utilising a 5-point scale in order to collect information on various psychological factors that might influence the adoption of information technology.

3.2.1 Reliability and validity of questionnaire scales

Questionnaire 2 consisted of seven scales in a five-point Likert-type format. It contained statements relating to various social and psychological factors that may influence the adoption of information technology. Respondents were asked to express their opinion on these statements, ranging from "strongly disagree" to "strongly agree".

3.2.2 Determining Cronbach's Alpha for the seven scales

Cronbach's Alpha was used to determine the reliability of the adapted scales used in this study. Item-scale correlations and scale intercorrelations were calculated. Based on the results of the item-scale correlations, six items were removed. Several scales were amalgamated as they showed high intercorrelations.

The item analysis and scale intercorrelations were re-calculated after the changes and adjustments had been made. Cronbach's Alpha was re-calculated for each scale. The Alpha coefficients were all above 0,836, ensuring good reliability and homogeneity of items in the scales. The item-scale correlations were satisfactory.

3.3 Operationalisation of variables

As has been indicated, the variables proposed in the conceptual model were measured mainly on five-point Likert-type scales ranging from "strongly disagree" to "strongly agree". Seven scales were used in the measuring instrument, which aimed to capture the underlying theoretical domain of the construct. Single-item questions were used to determine respondents' demographic information and technology usage as well as for measurement of the remaining variables.

3.3.1 Dependent variable

The dependent variable in the amended conceptual model (see Figure 2) was the propensity to adopt technology. The technologies in this study included e-mail, internet, the www and telematic educational technologies.

In order to classify respondents either as adopters or non-adopters of technology the frequency of usage of the various technologies was taken as the determinant, while criteria were set for each type of technology. The technologies were separated into three main categories: e-mail, www/internet and telematic educational technologies. Although e-mail and the www/internet actually form part of telematic educational technologies, it was decided to separate them as it was assumed that most postgraduate lecturers have adopted e-mail and the www/internet. Telematic educational technologies involve far more then just e-mail and the www/internet usage. In order to prevent respondents from indicating that they made use of telematic educational technologies just because they used e-mail and the www/internet, the three categories were created. Once the frequency of usage for each category had been determined for all respondents, they were classified as adopters or non-adopters.

If the respondent met all three of the criteria, s/he was classified as an adopter:

• using e-mail on a daily basis;
• using the www/internet at least once or twice a week;
• using telematic educational technologies at least once a fortnight.

These criteria demonstrate that an adopter makes use of or has adopted e-mail, the internet, the www and telematic educational

technologies. In today's technologically driven society, e-mail is crucial to communication. The assumption was made that a respondent should use it on a daily basis in order to be considered an adopter. The www and the internet are also important technologies that assist individuals in performing their daily activities in a working environment. The assumption was made that respondents should use them at least once a week in order to be classified as an adopter. As for telematic educational technologies, due to their "novelty", respondents had to make use of them at least every fortnight in order to be considered to have adopted them.

3.3.2 Independent variables

These include all the variables in the amended model (Figure 2):

- Individual characteristics — experience ($X_{1.1}$), attitude ($X_{1.2}$), self-efficacy ($X_{1.3}$), cognitive style ($X_{1.4}$), pro-active attitude ($X_{1.5}$) and pro-active coping ($X_{1.6}$);
- An individual's perception of group characteristics — teamwork ($X_{2.1}$) and communication ($X_{2.2}$);
- An individual's perception of organisational characteristics — culture ($X_{3.1}$), structure ($X_{3.2}$) and management support ($X_{3.3}$).

The variables were scored by adding the scores of items loading on each variable. Variables $X_{1.5}$ and $X_{1.6}$ (pro-active attitude and coping) were treated as a single variable in the analysis ($X_{1.5\&6}$). The reason for this was that these scales showed high intercorrelations. The higher the score on each variable, the more positive a respondent's assessment of it.

4. Data analysis

In order to compare the results for the two groups (adopters and non-adopters), the Mann-Whitney test was performed for the following variables: experience ($X_{1.1}$); attitudes ($X_{1.2}$); self-efficacy ($X_{1.3}$); cognitive style ($X_{1.4}$); pro-active attitude and coping ($X_{1.5\&6}$), and teamwork ($X_{2.1}$). The Mann-Whitney test is one of the most common and best-known non-parametric tests for two independent samples and is equivalent to the parametric t-test (Howell 1989). The Mann-Whitney test results are shown in Table 1 and discussed below.

Table 1: Mann-Whitney results for adopters and non-adopters

Scales	Adopters (n=14)		Non-adopters (n=36)		Mann-Whitney
	Mean	Std Dev	Mean	Std Dev	p-value
Experience	9.0	9.60	10.25	8.84	0.44
Attitudes	131.57	15.71	118.33	20.50	0.02*
Self-efficacy	74.28	4.32	75.16	6.26	0.54
Cognitive style	43.71	3.33	44.44	7.72	0.28
Proactive attitude and coping	87.5	9.22	85.49	14.63	0.96
Teamwork	38.28	4.56	34.41	8.46	0.15

*Significant at the 5% level

In a situation where people adopt technology one would expect greater work experience. The same goes for attitude: the more positive a person's attitude toward the technology, the greater the likelihood of technology adoption. Similarly, the higher the self-efficacy of an individual, the greater the likelihood of adoption. Cognitive style also appears to affect technology adoption: the better an individual's ability to deal with complexity, abstraction and novelty, the more the potential for adoption. The higher the pro-active attitude and proactive coping of an individual, the more likely technology adoption becomes. In a context of significant teamwork among group members, adoption is also more likely.

With regard to the variables discussed above, the expectation in terms of a null hypothesis is that the adopter group will not differ on these dimensions from the non-adopter group. If the groups do differ, the expectation is that the adopter group will obtain higher scores than the non-adopters. According to Table 1 there were no significant differences between groups on any of the dimensions except attitude ($p<0.05$).

A *chi*-square test was performed for the following variables: communication ($X_{2.2}$); culture ($X_{3.1}$); structure ($X_{3.2}$), and management support ($X_{3.3}$), for adopters and non-adopters. Dichotomous responses were formed for each variable by categorising the Likert responses

into dichotomous negative and positive responses (poor or good com-
munication, a supportive or non-supportive culture, bureaucratic or
democratic structures, and management support or lack thereof). The
chi-square results are displayed in Table 2 and discussed below.

As was the case above, in a situation where persons adopt techno-
logy one would expect communication among group members to be
positively related to such adoption. The same goes for culture: the
more supportive and participative people perceive the organisational
culture to be, the higher the potential for the adoption of technology.
Similarly, the structure of an organisation exerts an influence: the less
centralised and formalised people perceive the organisational structure
to be, the higher the potential for adoption. The greater the percep-
tion of management support for a technology, the greater the likeli-
hood of its being adopted. Within the context of this study, manage-
ment support refers to the perception held by an employee that a
supervisor/manager has adopted the technology.

With regard to the variables discussed above, the expectation in
terms of a null hypothesis is that the adopter group will not differ on
these dimensions from the non-adopter group. If the groups do differ,
the expectation is that the adopter group will endorse positive res-
ponses and the non-adopter group negative responses. According to
Table 2 there were no significant differences between groups on any
of the dimensions except for management support ($p<0.01$). Most
adopters (79 %) saw management as supporting technology adoption
while 63 % of non-adopters stated that management did not support
technology adoption.

In summary, nine of the abovementioned variables were not sup-
ported in this research study. However, attitudes and management sup-
port proved to be significantly related to the adoption of technology.

5. Discussion

South Africa, a country starved for education, desperately needs edu-
cation initiatives that can take knowledge to the people in a cost-
effective manner. Telematic education technologies facilitate the pro-
vision of innovative delivery mechanisms, thereby moving away from

5.1 Findings

The results showed that two variables, attitudes towards technology and management support, were able to distinguish between adopters and non-adopters. These two variables may be crucial and need to be addressed before technology implementation and adoption are attempted.

With regard to attitudes it is worth noting that three components make up an attitude: beliefs about the object (facts, opinions and general knowledge); feelings about the object (like, dislike, hate, or love) and behavioural tendencies towards the object (inclinations to act towards the object, *ie* to approach it or to avoid it) (Morris 1988). For example, an attitude towards a new kind of technology includes beliefs about the technology (the specifications of the technology), expectations of what the technology can do and the advantages of the technology. Beliefs are based on perceptions and experiences and may be rational or irrational. Feelings also form part of an attitude — liking or disliking the technology, anxiousness and apprehension about using the technology, and so on. Feelings are also based on perceptions created in the user's mind, emphasising the intricacy of attitude formation. Lastly, behavioural tendencies towards a technology include an inclination to behave in a certain way, for example, to avoid it, to use it, or to teach oneself to use it. The three components of attitude impact significantly on each other and may even provide contradictory information. In certain instances one component may weigh more heavily than the others. Generally speaking, though, the three aspects are often consistent with one another (Morris 1988). In short, if one has positive feelings about a new technology, one will tend to have positive beliefs about it and behave positively towards it. However, although attitudes and behaviour seem to be linked, the relationship is multifaceted and complex — one should not assume that attitude change will lead to behavioural change (Baron & Byrne 1994).

5.2 Implications

This research study can provide management with an understanding of the adoption of technology within tertiary education institutions. Individuals who have adopted telematic educational technologies have

a more positive attitude towards the technology than non-adopters. A practical implication is that managers and telematic educational implementators need to assess and evaluate the attitudes of employees before and after the adoption of technology. Assuming that there is a link between attitude, feelings and behaviour, as discussed above, managers need to ensure that attitudes towards the technology are positive in order to ensure that users "buy in to" its benefits thereby encouraging technology adoption. Strategies need to be identified and put in place to ensure a smooth adoption process.

A few broad recommendations will be presented in the hope of facilitating positive attitude formation, behavioural change and ultimately technology adoption among staff.

5.2.1 Attitudes and management support

The following aspects relate to effecting attitude change. Management involvement in the adoption of technology can be assumed to assist in forming the attitudes of personnel. Management adoption must thus be seen as implied in the suggestions below.

- A faculty's readiness to accept technology needs to be determined. Attitude surveys can be helpful in determining staff perceptions before, during and after technology implementation.

- The advantages of the innovation need to be highlighted and spelt out for all role-players, — lecturers, students, managers and the university as a whole.

- The more involved the faculty/lecturers are during decision-making and planning, the greater their commitment to the adoption process will be.

- Communication is of the utmost importance in fostering positive attitudes, as it enables information and knowledge to be channeled through to all involved. Uncertainty and lack of information inhibit the adoption of new technology and create negative attitudes. Most people are psychologically averse to uncertainty as it creates misunderstandings and misconceptions about the technology.

- Success stories should be communicated to all role-players. If people are able to see and experience the value of a new technology, their attitudes may begin to change and become more positive.

5.2.2   General aspects

- A work group needs to be established to facilitate the implementation of technology adoption throughout the University.
- Collaboration between role-players is essential and they should work closely together. One way to ensure this close co-operation is to have regular meetings with representatives from each department/faculty.
- Realistic time schedules should be implemented during the roll-out of a new technology. Lecturers have to cope with the demands of their normal duties in addition to learning about and creating telematic programmes.
- Facilitators need to be trained and should provide assistance and first-line support to all faculty/lecturers embarking on technology adoption.
- A help-line function (both telephonically and electronically) needs to be established to answer questions. Frequently asked questions and answers should also be displayed on a web page on the intranet.
- New staff should attend an orientation/training programme introducing them to telematic educational technologies as well as providing basic training.
- Existing staff should also attend this training.

This study has found that adopters are more likely to perceive themselves to have senior management support than non-adopters. Another major practical implication is that management must be co-operative and supportive, playing an active role in adopting new technology. Management needs to show its commitment towards a technology before implementation and adoption can occur. One way for senior managers to show commitment is for them to make use of the technologies themselves. This study found that adopter's managers make use of technology, and that adopters are aware of this. Setting an active example is most effective. Previous results have shown that managers, both by their own example in actively using technology

and by showing others what tasks constitute acceptable use, can facilitate adoption in organisations (Fulk *et al* 1990). In addition, management needs to be made aware of the benefits of technology within their own departments and faculties. Management needs to cultivate and foster an environment that embraces technology and facilitates its adoption.

6. Conclusion

This study has investigated the psychosocial factors that appear to be significant in the adoption of innovation. The success of an initiative providing alternative learning technologies depends on ensuring that their implementation and adoption are dealt with efficiently and effectively. A number of factors impacting on technology adoption were investigated. Although previous research abounds with factors that contribute to adoption, a heuristic model was developed to guide the investigation into the psychosocial factors affecting technology adoption. Aspects such as the small sample size and the fact that only one institution was investigated could have influenced the results. However, the study showed that participants' attitudes towards technology and their perception of having management support for its adoption, played a significant role in their willingness to adopt it.

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